Quality Guidelines
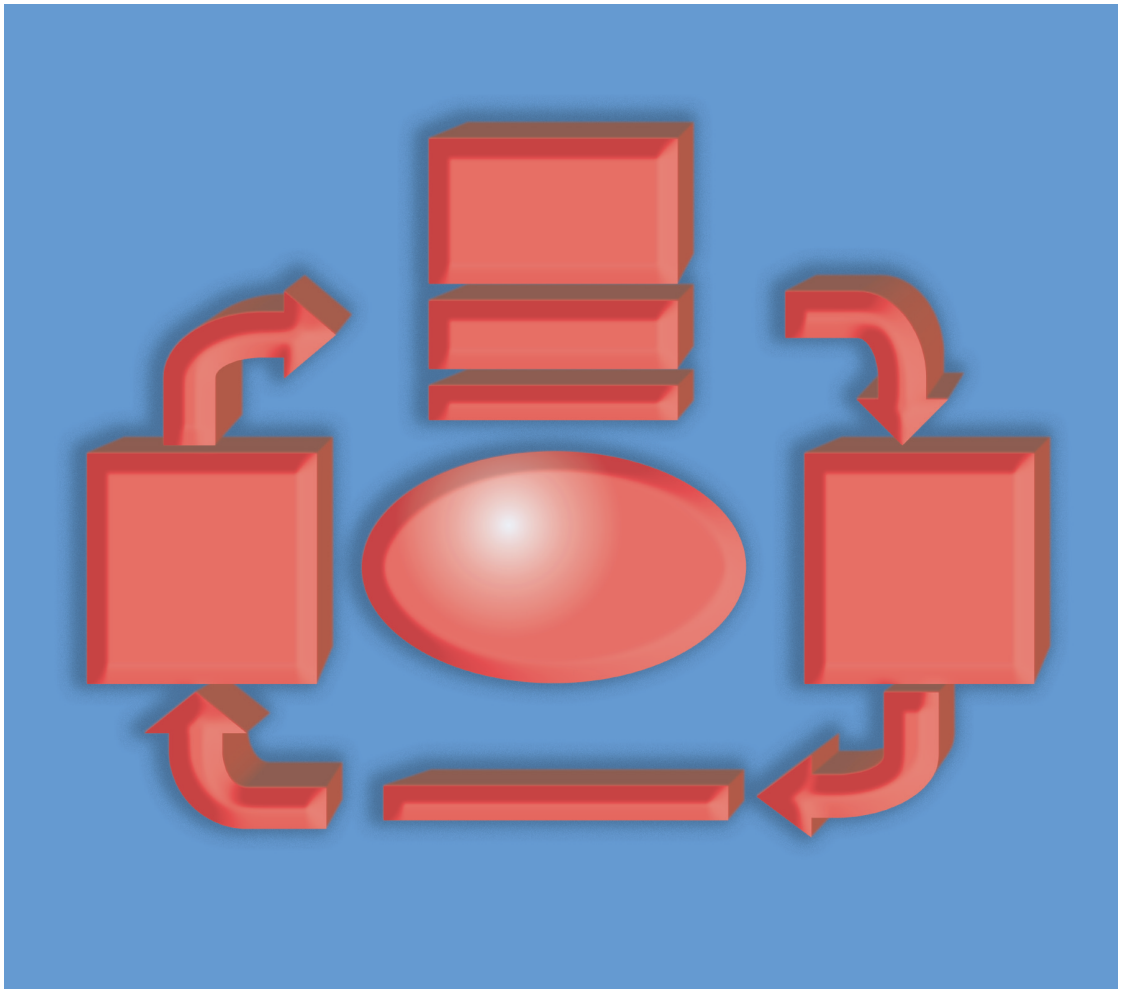# for Official Statistics
2nd Revised Edition

Quality Guidelines
for Official Statistics
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Foreword

Statistical information is the end product of a complex process comprising many stages. The production of statistics is based on a statistical system methodology, which is a collection of theoretical and practical procedures. From these procedures the statistical expert must make appropriate selections and applications. Moreover, the expert must be able to describe the used methodologies clearly and comprehensibly to stakeholders. This Handbook of Quality Guidelines for Official Statistics aims to support the development of statistics production and interaction with stakeholders. Much like its predecessor, this edition of the Handbook will again also be utilised in customer and personnel training.

The statistical production process constitutes the core of our activity. Statistics Finland abounds with skills and knowledge connected with this production process, and with the design and implementation of statistical systems. The central purpose of Statistics Finland's Quality Guidelines for Official Statistics is to gather existing knowledge and current best methods into the organisation's common competence capital. Shared utilisation of this capital and harmonisation of production processes within the whole organisation form the underpinnings for raising productivity and for continuous improvement of the quality of statistics.

This Handbook comprises chapters on four main subjects. The opening chapter examines the operating framework within which statistics are produced, the norms that regulate official statistics, and universal quality requirements. The second chapter focuses on statistical production and survey processes, and their different stages in a functional sequence from the collection and processing of data to the compiling of statistics, parameters and indicators. The objective is to expose the process in its entirety and, at the same time, illustrate the way in which its stages interrelate to complement each other. To emphasise the importance of documenting statistical surveys, the entire third chapter is dedicated to this subject. Documentation must be an integral element of the working approach of every statistical expert, and every work stage. The fourth chapter explores the publication and dissemination of statistical information and the services provided to customers using statistical data. The chapter stresses the importance of customer orientation and continuous development of customer services in official statistics. The usability of this Handbook is further enhanced by the alphabetical index at the end.

This volume is the second revised edition of the Handbook in English, intended for all our international partners and clients who are interested in the statistical systems and operational framework in Finland. A quality handbook needs constant revising, and this electronic version will be updated and developed, taking into account the continuously changing operating environment of the field of statistics and today's growing information needs.

Almost all the material in this Handbook was compiled in small working groups headed by named responsible persons. This new edition of the Handbook is based on its earlier, first edition. Altogether 22 authors and 15 commentators contributed to this revised version of the Handbook. In addition, numerous employees of Statistics Finland supplied valuable source material for it and

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1   General Operating Framework

1.1   Norms of Official Statistics

1.1.1   Legislation

The Finnish Statistics Act (280/2004) is a general act of state applying to all official statistics. Its purpose is to create preconditions for the production of efficient and unified official statistics, which take into account both national and international data needs. The Statistics Act defines a clear, confidence generating operating policy that applies to the suppliers and users of data. It contains regulations concerning the different stages of statistics compilation and focuses especially on the rationalisation of data collections, data supplier relations, implementation of statistical ethics and data protection.

The Statistics Act states that statistics must be compiled by primary exploitation of data collected in other contexts, such as those in administrative registers. Data suppliers may only be directly requested to supply such data that cannot be obtained by other means. The statutory obligation to supply data specified in law concerns state authorities, public service producers, practitioners of a trade, commercial undertaking or profession, municipal or state corporations, municipalities and joint municipal boards and non-profit institutions. Representatives of those obliged to supply data must be consulted well in advance about a new or revised round of data collection and (with the exception of state authorities) must also be provided with feedback in the form of statistics.

The Statistics Act also requires that good statistical practices, the international recommendations and generally applied methods be followed. These regulations refer to compliance with the principles of statistical ethics.

The Statistics Act contains a section on the quality of statistics, according to which statistics must be as reliable as possible and depict conditions in society and their development correctly. Statistics must be published as soon as possible upon their completion. To ensure comparability of the resulting statistical data, harmonised concepts, definitions and classifications should be used in their compilation wherever possible.

Council Regulation (EC) No. 322/97 on European community statistics must be applied to statistics that are compiled in accordance with the Statistical Programme of the European Union. The central principles of the Finnish Statistics Act and those of the Council Regulation on community statistics are in line with each other.

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http://www.stat.fi/meta/lait/lait_statisticsact04.pdf

1.1.2 Professional Ethics

Scope and purpose

The professional ethics of the field of statistics constitute the cornerstone on which statistical authorities base their activities. They form the foundation for statistical legislation and its application, and also influence the operating principles and lines of action adopted by statistical authorities.

The principles of the professional ethics in the field of statistics have been gathered into a Declaration on Professional Ethics, adopted by the International Statistical Institute (ISI) in 1985. This declaration forms the basis of Statistics Finland´s own Guidelines on Professional Ethics. The Council of Europe has also approved a Council Recommendation No. R (97) 18, concerning the protection of individual data in the field of statistics, which is based not only on data protection legislation but also on the above principles of professional ethics. In addition, the European Commission adopted a Recommendation on the independence, integrity and accountability of the national and Community statistical authorities (COM217, 2005). The key part of the recommendation is the Code of Practice (see section 1.13).

Principles

The objective of a statistical professional is to give an impartial, diversified and reliable picture of society while respecting the privacy of those whom the data concern. The continuously and rapidly changing operating environment creates new kinds of ethical problems and brings old ones back to surface. The purpose of the guidelines on professional ethics (Statistics Finland, 2006) is to facilitate the solving of these ethical problems.

Guidelines

According to the Guidelines on Professional Ethics, Statistics Finland and its employees shall abide by the following ethical principles:

- Impartiality, meaning an objective and independent manner of producing statistics, free from any pressure from political or other interest groups, particularly as regards the selection of techniques, definitions and methodologies best suited to the attainment of the objectives as set out. It implies the availability of statistics, with a minimum delay, to all users;

- Reliability, meaning the characteristic of statistics to reflect as faithfully as possible the reality which they are designed to represent. It implies that scientific criteria are used for the selection of sources, methods and procedures. Any information on the coverage, methodology, procedures and sources will also improve data reliability;

- Relevance, meaning that the production of statistics is a function of clearly defined requirements determined by the objectives. These requirements determine the fields, timeliness and scale of statistics, which should keep abreast of new demographic, economic, social and environmental developments at all times. Data collection should be limited to what is necessary for attaining the desired results. The production of statistics which has ceased to be of interest for objectives should be abandoned;

- Cost-effectiveness, meaning the optimum use of all available resources and the minimization of the burden on respondents. The amount of work and the costs which the production of statistics requires should be in proportion to the importance of the results/benefits sought;

- Statistical confidentiality, meaning the protection of data related to single statistical units which are obtained directly for statistical purposes or indirectly from administrative or other sources against any breach of the right to confidentiality. It implies the prevention of non-statistical utilization of the data obtained and unlawful disclosure;

- Transparency, meaning the right of respondents to have information on the legal basis, the purposes for which the data are required and the protective measures adopted. The authorities responsible for collecting statistics shall take every step to supply such information.

The Council Recommendation No. R (97) 18 of the European Community also contains corresponding principles that are binding on the national statistical institutes of all its Member States.

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1.1.3 Code of Practice

Scope and purpose

Objectivity and comparability in evaluating the quality of statistics requires broad co-operation and mutually approved and applied quality criteria. The statistics produced and disseminated by statistical authorities within the European Statistical System (ESS) must meet strict criteria on quality and reliability at both national and Community levels. For this reason the Commission has issued for the European statistics Code of Practice which directs the development of the System to enable it to serve better the needs of the information society. The aim of the European Statistical System is to function efficiently and fulfil the requirements set on independence, integrity and accountability.

The Code of Practise is a self-regulatory instrument, for it has been prepared and endorsed by the principal producers of European statistics. The Code of Practice comprises 15 principles that must be observed in the production of Community statistics. The Code of Practice has the dual purpose of:

(i) Improving trust and confidence in the independence, integrity and accountability of both the National Statistical Authorities and Eurostat, and credibility and quality of the statistics they produce and disseminate.
(ii) Promoting application of best international principles, methods and practices by all producers of European Statistics to enhance their quality.
(Commission of the European Communities, 2005).

The Code of Practice builds upon the ESS Quality Declaration (Statistical Programme Committee, 2001):

The mission of the European Statistical System

"We provide the European Union and the world with high quality information on the economy and society at the European, national and regional levels and make the information available to everyone for decision-making purposes, research and debate."

The vision of the European Statistical System

"The ESS will be a world leader in statistical information services and the most important information provider for the European Union and its member states. Based on scientific principles and methods, the ESS will offer and continuously improve a programme of harmonised European statistics that constitutes an essential basis for democratic processes and progress in society."

The ESS Quality Declaration provides guidance within the European Statistical System towards developing Total Quality Management approach in line with the EFQM model (EFQM, 2003). Adopting the EFQM model has also been supported by the recommendations given by the Leadership Group (LEG) on Quality (LEG on Quality, 2000). Guidance for implementation the LEG rec-

ommendations are provided by the LEG Implementation Working Group (European Communities, 2002).

Principles

The Code of Practice guides the producers of statistics in meeting the European quality standards and in serving both national needs and those of European institutions, governments, research institutions, business concerns and the public generally. The quality of statistics is determined by their relevance, accuracy and reliability, timeliness, coherence, and comparability between regions and countries. In addition, easy accessibility is essential when the quality of statistics is being evaluated. High-quality statistics must meet the needs of all users according to these criteria.

The principles of the Code of Practice have been grouped into three main sections which cover the institutional environment, statistical processes and statistical output (COM217, 2005):

I. Institutional Environment

Principle 1: *Professional Independence* – The professional independence of statistical authorities from other policy, regulatory or administrative departments and bodies, as well as from private sector operators, ensures the credibility of European Statistics.

Principle 2: *Mandate for Data Collection* – Statistical authorities must have a clear legal mandate to collect information for European statistical purposes. Administrations, enterprises and households, and the public at large may be compelled by law to allow access to or deliver data for European statistical purposes at the request of statistical authorities.

Principle 3: *Adequacy of Resources* – The resources available to statistical authorities must be sufficient to meet European Statistics requirements.

Principle 4: *Quality Commitment* – All ESS members commit themselves to work and co-operate according to the principles fixed in the Quality Declaration of the European Statistical System.

Principle 5: *Statistical Confidentiality* – The privacy of data providers (households, enterprises, administrations and other respondents), the confidentiality of the information they provide and its use only for statistical purposes must be absolutely guaranteed.

Principle 6: *Impartiality and Objectivity* – Statistical authorities must produce and disseminate European Statistics respecting scientific independence and in an objective, professional and transparent manner in which all users are treated equitably.

II. Statistical Processes

Principle 7: *Sound Methodology* – Sound methodology must underpin quality statistics. This requires adequate tools, procedures and expertise.

Principle 8: *Appropriate Statistical Procedures* – Appropriate statistical procedures, implemented from data collection to data validation, must underpin quality statistics.

Principle 9: *Non-Excessive Burden on Respondents* – The reporting burden should be proportionate to the needs of the users and should not be excessive for respondents. The statistical authority monitors the response burden and sets targets for its reduction over time.

Principle 10: *Cost Effectiveness* – Resources must be effectively used.

III. Statistical Output

Principle 11: *Relevance* – European Statistics must meet the needs of users.

Principle 12: *Accuracy and Reliability* – European Statistics must accurately and reliably portray reality.

Principle 13: *Timeliness and Punctuality* – European Statistics must be disseminated in a timely and punctual manner.

Principle 14: *Coherence and Comparability* – European Statistics should be consistent internally, over time and comparable between regions and countries; it should be possible to combine and make joint use of related data from different sources.

Principle 15: *Accessibility and Clarity* – European Statistics should be presented in a clear and understandable form, disseminated in a suitable and convenient manner, available and accessible on an impartial basis with supporting metadata and guidance.

Guidelines

To ensure high-quality statistics output, the producers of statistics must monitor regularly the realisation of their activities and targets in compliance with the Code of Practice. To sustain high quality of statistics, their production must be developed continuously to meet the ever more demanding and complex information needs of the users.

The Code of Practice defines indicators for each of its principles. Statistical authorities should adhere to them and contribute to the development of their operating environments according to them.

To meet the statistical quality criteria the producers of statistics must take into consideration the following indicators defined in the Code of Practice (COM217, 2005):

1. *Relevance:*
   - Processes are in place to consult users, monitor the relevance and practical utility of existing statistics on meeting their needs, and advice on their emerging needs and priorities.
   - Priority needs are being met and reflected in work programme.
   - User satisfaction surveys are undertaken periodically.

2. *Accuracy and reliability:*
   - Source data, intermediate results and statistical outputs are assessed and validated.

- Sampling errors and non -sampling errors are measured and systematically documented according to the framework of the ESS quality components.
- Studies and analyses of revisions are carried out routinely and used internally to inform statistical processes.

3. *Timeliness and punctuality:*
   - Timeliness meets the highest European and international dissemination standards.
   - A standard daily time is set for the release of European Statistics.
   - Periodicity of European Statistics takes into account user requirements as much as possible.
   - Any divergence from the dissemination time schedule is publicised in advance, explained and a new release date set.
   - Preliminary results of acceptable aggregate quality can be disseminated when considered useful.
   -

4. *Coherence and comparability:*
   - Statistics are internally coherent and consistent (e.g. arithmetic and accounting identities observed).
   - Statistics are coherent or reconcilable over a reasonable period of time.
   - Statistics are compiled on the basis of common standards with respect to scope, definitions, units and classifications in the different surveys and sources.
   - Statistics from the different surveys and sources are compared and reconciled.
   - Cross -national comparability of the data is ensured through periodical exchanges between the European Statistical System and other statistical systems; methodological studies are carried out in close co-operation between the Member States and Eurostat.

5. *Accessibility and clarity:*
   - Statistics are presented in a form that facilitates proper interpretation and meaningful comparisons.
   - Dissemination services use modern information and communication technology and, if appropriate, traditional hard copy.
   - Custom-designed analyses are provided when feasible and are made public.
   - Access to micro data can be allowed for research purposes. This access is subject to strict protocols.
   - Metadata are documented according to standardised metadata systems.
   - Users are kept informed on the methodology of statistical processes and the quality of statistical outputs with respect to the ESS quality criteria.

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1.1.4   Official Statistics

Scope and purpose

Official statistics is a statistical system comprised of essential and high-quality social statistics that are produced regularly or at sufficiently frequent intervals, and are nationally representative. The available statistics must in practice reflect the users' needs and priorities, and adhere to international standards and recommendations on the compilation of statistics. In many countries official statistics are generally defined as having to serve different user groups: ordinary citizens, public administration, the economy and research.

In most cases official statistics are defined through the central topics and subject areas of society. The division into topics can be based on the UN's main division of statistical series: population and social statistics, economic statistics and other statistics, under which statistics are divided into sub-series, or grouped alphabetically or according to some other established routine. The series groupings are designed so as to remain relatively stable even if the statistics produced within them undergo extensive revisions.

Principles

A reliable body is needed to produce official statistics. In general, the compilation of official statistics is entrusted to a public authority specifically established for this purpose, or else the task may be decentralised between authorities in different administrative sectors. In most cases, official statistics are published by central government authorities with a national statistical office as the central, co-ordinating organisation.

The principles applied in the compilation of official statistics are the Fundamental Principles of Official Statistics adopted by the United Nations Statistical Commission in 1994:

1. Official statistics provide an indispensable element in the information system of a democratic society, serving the government, the economy and the public with data about the economic, demographic, social and environmental situation. To this end, official statistics that meet the test of practical utility are to be compiled and made available on an impartial basis by official statistical agencies to honour citizens' entitlement to public information.

2. To retain trust in official statistics, the statistical agencies need to decide according to strictly professional considerations, including scientific principles and professional ethics, on the methods and procedures for the collection, processing, storage and presentation of statistical data.

3. To facilitate a correct interpretation of the data, the statistical agencies are to present information according to scientific standards on the sources, methods and procedures of the statistics.

4. The statistical agencies are entitled to comment on erroneous interpretation and misuse of statistics.

5. Data for statistical purposes may be drawn from all types of sources, be they statistical surveys or administrative records. Statistical agencies are to choose the source with regard to quality, timeliness, costs and the burden on respondents.

6. Individual data collected by statistical agencies for statistical compilation, whether they refer to natural or legal persons, are to be strictly confidential and used exclusively for statistical purposes.

7. The laws, regulations and measures under which the statistical systems operate are to be made public.

8. Co-ordination among statistical agencies within countries is essential to achieve consistency and efficiency in the statistical system.

9. The use by statistical agencies in each country of international concepts, classifications and methods promotes the consistency and efficiency of statistical systems at all official levels.

10. Bilateral and multilateral co-operation in statistics contributes to the improvement of systems of official statistics in all countries.

The Code of Practice of the Commission of the European Communities contains as a self-regulatory instrument standards for the independence of national and Community statistical authorities. The Code takes the principle of independence further by introducing the concept of professional independence, which refers specifically also to the dissemination and availability of statistics. The principle of professional independence is described as follows:

The indicators to monitor the application of this principle include:

> *"The professional independence of statistical authorities from other policy, regulatory or administrative departments and bodies, as well as from private sector operators, ensures the credibility of European statistics."*

(i)   the specification in law of the elements of independence,
(ii) the status and the functional responsibilities of the heads of statistical authorities, including the decisions on statistical methods, standards and procedures,
(iii) the decisions on the content and timing of statistical releases,
(iv) the publication of statistical work programmes.

Official statistics describe social and economic conditions and changes in different sectors of society. Costly and far-reaching decisions are often made on the basis of statistics. It is therefore essential that the statistics can be trusted. This trust is dependent on the quality and objectivity of statistics.

Guidelines

Signs of commitment to quality include quality improvement measures, use of generally approved quality standards and tools, quality analyses, systematic quality evaluations, sufficient documentation of official statistics and openness and transparency to users. For the users, these are also signs of professional competence, on which the confidence of the users in organisations producing official statistics and in their services largely depends.

- Official statistics must meet certain quality criteria, and their producers must be credible so that customers can rely on the information.
- Besides for the production of reliable statistics, the compilers of statistics are also responsible for their efficient dissemination, as well as for their quality evaluation and reporting.
- The quality reporting must be done in compliance with generally approved quality indicators. The quality components for statistics of the European Statistical System include: i) relevance, ii) accuracy and reliability, iii) timeliness and punctuality, iv) coherence and comparability, v) accessibility and clarity.
- To gain the trust of the users the compilers of official statistics and their leaders must demonstrate solid commitment to quality in their internal operating culture.

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1.2   Quality of Statistics

1.2.1   Total quality management

Scope and purpose

At Statistics Finland, quality has traditionally meant the quality of statistics, in other words, product quality. Statistics Finland's strategic total quality management (TQM) has been defined to complement this product quality outlook. The objective of TQM is achievement of the organisation's performance excellence, and one of its central goals is attainment of a quality that meets quality award standards. At the same time the quality award framework is also a modern definition for total quality management.

In TQM the focus is broadened from an individual statistical product and its production to the entire system of statistics production and to other core processes, and from there on to the entire management system, personnel, partnerships and resources. By systematic management of these aspects one can create an operating system that emphasises quality and thereby also improves the quality of end products.

Good performance capacity is built on the following characteristics (EFQM, 2003):

Results orientation:
* Excellence is dependent upon balancing and satisfying the needs of all: employees, customers, data suppliers and society in general.

Customer focus:
* A clear focus on the needs of current and potential customers when planning products, services and lines of action.

Leadership and constancy of purpose:
* The behaviour of an organisation's leaders creates a clarity and unity of purpose within the organisation and an environment in which the organisation and its people can excel.

Management by processes and facts:
* Organisations perform more effectively when all inter-related activities are understood and systematically managed and decisions concerning current operations and planned improvements are made using reliable information.

Personnel development and involvement:
- Shared values and a culture of trust and empowerment encourages everyone and merges the organisation's goals with the interests of the personnel.

Continuous learning, innovation and improvement:
- The management and sharing of knowledge within a culture of continuous learning, innovation and improvement enables an organisation to develop to the utmost and to become distinguished from others.

Development of partnerships:
- An organisation works more effectively when it has mutually beneficial relationships with its partners, built on trust knowledge and integration.

Public responsibility:
- Exemplary enterprise citizenship.

According to the ISO 9000 definition, quality is a composite of all the characteristics, including performance, of an item, product or service that bear on its ability to satisfy stated or implied needs. Quality management refers to all the measures an organisation takes to assure quality. The production and supply of high-quality products and services is composed of three elements:

- *Quality planning:* Defining customer needs, their translation into the best methodological solutions, and their introduction by the creation of appropriate structures and systems to ensure cost-effective data collection, processing and dissemination at the specified level of accuracy.
- *Quality assurance / verification:* Monitoring of a product and production by analysing the quality of end products against customer needs and plans. Assurance entails studying the individual processes, activities and tasks within the production process to ensure that these are appropriately implemented.
- *Quality improvement:* Activity aimed at the elimination of observed quality problems. It may entail total renewal or redesigning of systems (corrective or continuous improvement activity).

Quality evaluations are mostly related to set goals or quality standards. They can be self-evaluations, conducted internally, or the evaluating can be fully or partially assigned to an outside party. Evaluations can either be based on qualitative or quantitative measures or combinations of these.

Evaluation is usually carried out against a written description of the procedure that is to be evaluated, which is used to establish whether the activities agree with plans, are implemented efficiently and are appropriate from the point of the stated objectives. Evaluations also examine the state of improvement measures. They may also involve assessments of how good the employed procedures are relative to best practices.

Quality can also be examined by investigating different sources of error in statistical data. Identification of the seriousness of risks and their probability is yet another approach. The information gained can be utilised by compilers of

statistics to improve quality and by users of statistical data for making appropriate interpretations.

Principles

Quality management system

A quality management system is a jointly agreed frame of reference for the activities of an organisation. It outlines the organisation's external and internal operating environments and the role of the organisation. The aim of a quality management system is to create a systematic method for seeking, transferring, maintaining and developing the best practices in order to protect the interests of customers. It also endeavours to lend transparency to the desired operating models and bring them to the knowledge of the entire organisation.

A quality management system attempts to systemise the modes of action that guide people's collaboration, so as to benefit everybody and to promote the improvement of the organisation's modes of action relative to the customer and interest group. It encourages communication between experts, which is essential from the point of view of the organisation itself, the customers and the other main interest groups.

A quality management system creates the preconditions for an organisation to build and consolidate methodological approaches, current best methods, monitoring systems and continuous improvement. It alleviates the so-called gap syndrome in an organisation, that is, breaks between functions in its hierarchy and in the horizontal customer direction, improves discourse links and distribution of tacit knowledge within the organisation.

A good quality management system helps to identify the things that have to be done, gives ideas, redefined by experience, as to how they should be done and produces valuable feedback knowledge that can be utilised to enhance the performance capacity even further.

Quality management systems and quality in general can be examined from the point of view of the organisation, the core processes or the individual process as follows:

Organisation level

Expansive, strategic improvement projects affecting the whole organisation should be sought and implemented at the organisation level. The basis for quality management at the organisation level is the quality award model and self-evaluation for detecting strengths and improvement areas. The balanced scorecard (BSC) is an instrument for producing strategic plans and for implementing them, as well as a communication tool. The TQM system describes a combination of these (Chart 1.1)

Chart 1.1   Total quality management system
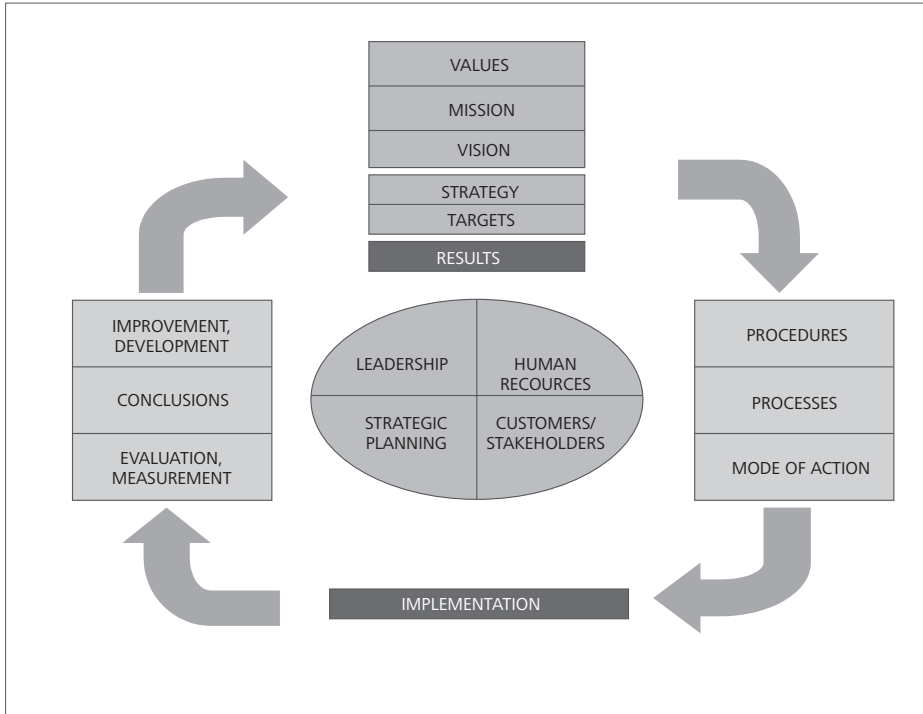
Core production process level

Consistent, cost-effective and fluent production processes and related logistics should be developed and maintained as one core process at the core production process level. Essential elements in this are process identification, definition, modelling, documentation, evaluation, metering, quality assurance and improvement. As operational elements, core processes are influenced by statistical methods, tools, data, software programs, metadata and handbooks.

Statistical process level

Statistical surveys are sub-processes of core production processes. Examinations at the statistical process level try to ascertain whether the production process of an individual statistical survey functions optimally. However, becoming a top organisation requires development of all the above mentioned processes rather than improving only some individual statistical processes.

Guidelines

• The cornerstone in the application of TQM is avoidance of the evolution of one´s own separate quality world. The aim is the creation of an integrated management system of activity (quality) in which good quality principles are incorporated into statistical production systems.

- Important quality goals that affect the whole organisation are incorporated into strategic goals, whereby they become a part of the planning and monitoring of each activity.
- The BSC is used as the main application and measurement tool in total quality management.
- In practice the ISO 9000:2000 standard series provides a structure for the development of a quality system consistent with the quality award and BSC frameworks.
- In total quality thinking, the organisation's activity is modelled with the help of its core processes and their sub-processes.
- Well motivated and competent personnel understand and agree with the organisation's strategic goals, which essentially improves performance capacity.
- Realisation of change requires direction, solid grounding and tools. Management should decide the direction and assist in the acquisition of suitable (quality) tools.

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1.2.2   Evaluation of the quality of statistics

Scope and purpose

Evaluations of the quality of statistics production are mainly based on international recommendations and obligations concerning the quality and development of official statistics. International organisations, such as the UN, OECD, IMF and Eurostat have set goals for the quality of official statistics and national statistical services.

There are alternative tools for the measurement of quality that can be used to evaluate a statistical organisation, its statistics production or the statistics it produces from various points of view. Quality evaluations can be made at the level of the whole organisation or by focusing on the development of individual statistics or on the customer perspective. Most of the tools can be used by the management and experts of the organisation, but some require the employment of external evaluators.

Quality evaluations are utilised direct to support the management of statistics production, locate needs for development and assess successes. Their points of departure are development of activity, openness and utilisation of uniform procedures. Combined use of several evaluation methods yields a variety of intersecting perspectives on both the organisation and the production of statistics. Comparisons and analyses of outcomes from different evaluations help to assess the reliability and uniformity of the obtained results, as well as similarities or diver-
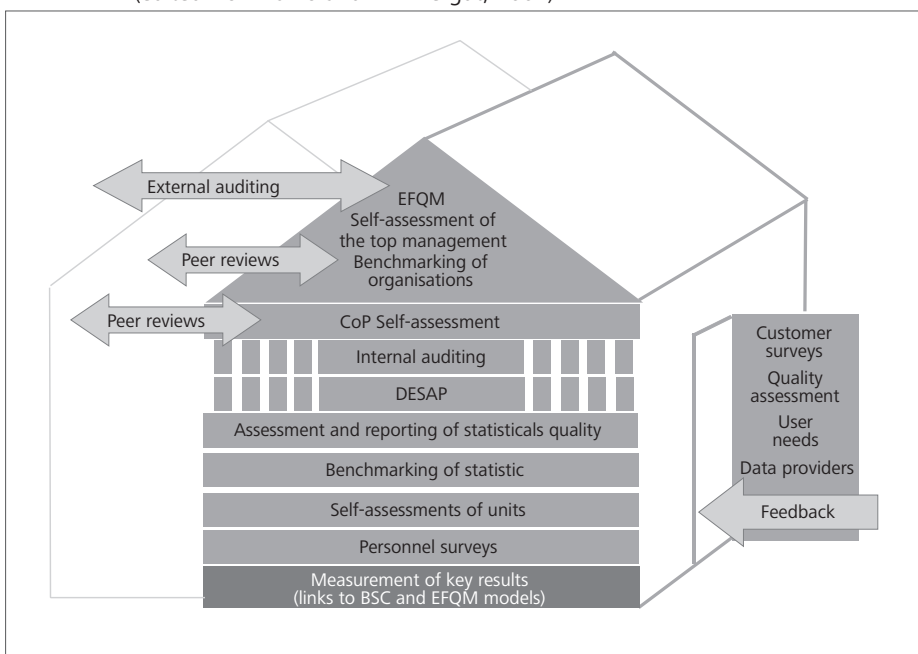
gences between views. The uniformities or dissimilarities of results revealed by comparisons of quality evaluations allow the views of different parties in the organisation to be analysed more thoroughly than would be possible with a single assessment. Combined utilisation of quality tools often produces information that is crucial for comprehensive development of the quality of statistics production.

Principles

Many organisations face the challenge of having to strive continuously for high quality and improvements in their performance. To succeed, the organisations not only need the infrastructure and resources but also an organisational culture that fosters continuous development. This requires highly motivated employees, management of change, transparency, efficient communications and encouragement of employees to improve the work environment and practices. Current and new achievements, development ideas, dialogue and strong motivation will further accelerate the development processes that the organisations seek for. (Laiho and Nimmergut, 2004).

In principle, all development work is based on the quality culture in an organisation. Commitment and courage to present new improvement suggestions is built on trust, respect and openness to new ideas. Self-assessment tools, such

Chart 1.2 Methods for evaluating the quality of official statistics (edited from Laiho and Nimmergut, 2004)

External auditing

EFQM
Self-assessment of the top management
Benchmarking of organisations

Peer reviews

Peer reviews

CoP Self-assessment

Internal auditing

DESAP

Assessment and reporting of statisticals quality

Benchmarking of statistic

Self-assessments of units

Personnel surveys

Measurement of key results
(links to BSC and EFQM models)

Customer surveys
Quality assessment
User needs
Data providers

Feedback

as the DESAP[1] or EFQM[2] self-assessments, and statistical auditing by internal experts aim to provoke and invite these ideas. They also support dialogue within an organisation. (Laiho and Nimmergut, 2004).

Quality evaluations are mostly done relative to a standard, recommendations or objectives. They can be made by the organisation itself, with own or external resources, or by combining the two. Evaluations can be based on both qualitative and quantitative measures and descriptions. Chart 1.2 depicts the quality evaluation methods used by European national statistical institutes and Statistics Finland to support their production of statistics.

A widely used and standardised procedure for evaluating the quality of an organisation's management is known as the EFQM self-assessment, which follows a standardised structure (EFQM, 2003). Its purpose is to pinpoint the organisation's strengths and areas where improvement is required. It also allows informal comparisons between organisations at the management level. The arrangement and areas of focus of such comparisons can be agreed between the compared organisations. In addition, in 2005 European national statistical institutes started CoP (Code of Practice) self-assessments and, in 2006 peer reviews based on it (European Commission, 2005) between national statistical institutes. These are more systematic in nature than the above-mentioned organisational comparisons and follow a clear structure derived from the content of the Code of Practice (see Section 1.1.3).

Quality descriptions that convey information about the quality of statistics to customers are usually looked upon as the quality evaluation tools for statistics production. However, quality evaluation methods that focus on the actual contributors to quality, such as statistical auditing (Eiderbrandt, 2004) and the DESAP self-assessment tailored for statistics production, are more important from the point of total quality (Körner and Nimmergut, 2003).

The principle of auditing is based on total quality management. It concentrates on the production of individual statistics. It acknowledges that the best experts for each set of statistics are to be found in the statistics department concerned, but that other statistical experts can be employed for internal peer reviews. The objective in this activity is to make use of the external perspective to identify the areas of statistics that need development, prioritise them, and implement relevant measures to achieve qualitative improvements in the statistics. The evaluation is based on a written methodological description of the evaluated procedure and on self-assessment. Such evaluations are used to establish whether activities agree with plans, are implemented efficiently and are appropriate from the point of set targets. They examine how good the employed procedures are relative to best practices. Audits also seek to diffuse good practices throughout the organisation.

DESAP self-assessment is also tailored for the needs of statistics production. Unlike statistical auditing in which other experts are used, DESAP is carried out

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1   DESAP (Development of a Self-Assessment Programme)
2   EFQM (European Foundation for Quality Management)

Chart 1.3 Structure of DESAP self-assessment (Körner and Nimmergut, 2003)
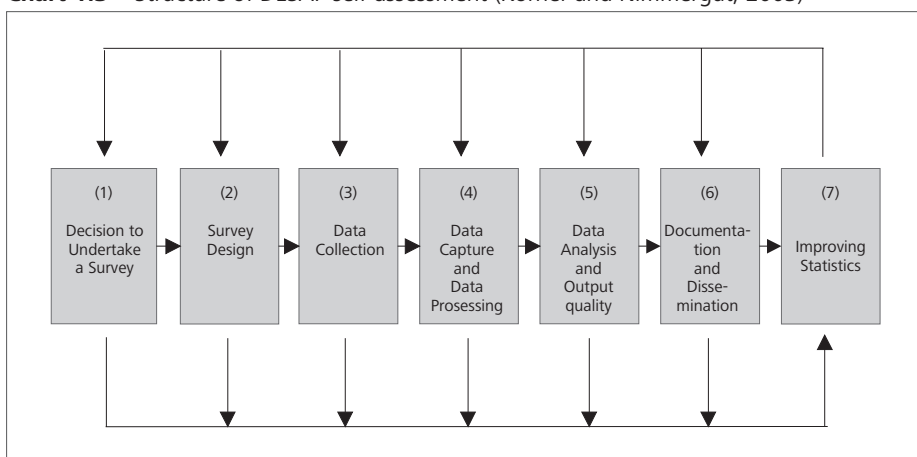
by the persons responsible for a given set of statistics. Thus, it can be implemented without external resources and timed independently to suit the production schedule of the statistics concerned to support the improvement of their quality. DESAP focuses on the production of statistics and was specifically designed for systematic quality evaluation of the statistics within the scope of the European Statistical System (ESS). Thus, it differs from general self-assessments of total quality in organisations. DESAP covers the production factors contributing to the quality of statistics. It complies with the ESS quality requirements and comprises the main aspects relevant to the quality of statistical data. As a checklist it is universal in the sense that it is applicable to all individual statistics for which microdata are collected – irrespective of topic or specific research method. It is intended as a tool for those in charge of research, to help in evaluating the quality of statistics and in the planning of improvement measures. Corresponding self-assessments have been carried out in the past on national initiatives, for example, at Statistics Finland at the turn of the 1980s and 1990s. DESAP was produced as a harmonised tool for the improvement and co-ordination of the entire European Statistical System.

It is imperative that feedback received from data suppliers and customers is given due consideration in the work that is done to improve statistics production. Minimising of data suppliers' response burden, co-ordination of data collections and development of data collection instruments are areas needing continuous improvement in statistics production. Maintenance and nurturing of continuous dialogue with customers is essential to the relevance, understandability and accessibility of statistics. Customers' evaluations and analyses, and active collection of feedback are among the main methods and tools for evaluating and raising quality. Quality descriptions or separate methodological descriptions (Section 1.2.3) are often used to inform users about the quality of statistics. The quality of statistics can also be assessed with comparisons, which allow directing the focus of the evaluation to the coherence and comparability of the compared statistics.

Other methods for evaluating the quality of an organisation are self-assessments of departments (Holma, 2003) and personnel surveys, the results from which should be utilised together with all the procedures described above. Self-assessments need to be supported by other forms of evaluation; other evaluation methods that should be used simultaneously include feedback from different customer groups and parties involved, peer reviews, benchmarking and evaluations performed by independent external parties or customers (Holma, 2003).

Guidelines

- Uniform procedures and tools should be utilised in evaluating the quality of statistics production throughout the organisation. Efficient and coherent exploitation of quality evaluations also requires continuous input into their co-ordination and steering.
- Appropriate timing of quality evaluations of statistics production within the production cycle is critical to ensure that enough benefit is gained from them and the time invested in them does not burden statistics production.
- Obtained results should be utilised in the management and development of statistics production. Information about the principal results and the measures decided upon should be communicated within the organisation.
- Openness is the essential prerequisite in all quality evaluation. The degree of confidentiality and compliance with the openness principle should be specified and communicated clearly in advance in self-assessments.
- Compliance with the openness principle in quality evaluations requires continuous development of the organisational culture.
- Evaluations of the quality of activity should involve internal evaluations as well as systematic collection of information from data suppliers, customers and other stakeholders. Respectively, this feedback should be analysed relative to the results of evaluations within the organisation.

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Additional information

Eurostat. 2006. The Eurostat Quality site. http://ec.europa.eu/eurostat/quality

1.2.3 Official Statistics of Finland and the Quality Criteria

Scope and purpose

Official Statistics of Finland (OSF) aim to draw an exhaustive picture of Finnish society and their task is to serve society by producing the statistical information it needs in its activities. OSF statistics reflect both the needs of the users and general information needs in society. Official Statistics of Finland are grouped into 26 topic areas according to their content.

The Advisory Board of Official Statistics of Finland co-ordinates the system of official statistics and maintains a list of the statistics and publications accepted into OSF. The producers of OSF include Statistics Finland and 19 other public authorities.

Principles

Official Statistics of Finland (OSF) comply with the UN's Fundamental Principles of Official Statistics and the Code of Practice of the Commission of the European Communities (see Section 1.1.3). The Advisory Board of Official Statistics of Finland has specified criteria for the statistics that have been accepted into Official Statistics of Finland.

Statistical series issued in the Official Statistics of Finland must meet the following criteria (Advisory Board of OSF, 2006):

OSF BASIC CRITERIA

OSF basic criterion 1:

The statistics are produced by an agency or institution included in the list of OSF producers maintained by Statistics Finland.

OSF basic criterion 2:

The publishing organisation is responsible for the content of the statistics, and for the correctness of the data, thus guaranteeing continuity in the production of the statistics concerned. OSF statistics cannot be released under any person's name.

OSF basic criterion 3:

OSF statistics contain an up-to-date quality description approved by the Advisory Board of Official Statistics of Finland.

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1. **Relevance:** OSF statistics contain essential and nationally comprehensive data for the needs of society on the topic they represent.

2. **Accuracy and reliability:** OSF statistics describe accurately and reliably the state of, and changes in, the phenomenon they concern. The methods applied in the compiling of the statistics are to be reported clearly and all facts that may have a bearing on the reliability of the statistics are to be analysed and reported on. The measures for correcting errors possibly detected in OSF statistics must comply with the recommendation approved by the Advisory Board of Official Statistics of Finland.

3. **Timeliness and promptness:** The data of OSF statistics must be as up-to-date as possible and their release times must be known in advance and published in a release calendar maintained by their publisher in accordance with the procedures set by the instructions issued by the Advisory Board of Official Statistics of Finland.

4. **Coherence, consistency and comparability:** OSF statistics must be logically consistent with other OSF statistics and as comparable as possible over time and between regional units. OSF statistics shall primarily use general and established international concepts and statistical classifications. The factors affecting the consistency and the comparability of the statistics should be documented and specified in the statistics. Sets of data with deviating definitions should be clarified by using different concepts.

5. **Accessibility and clarity:** OSF statistics are to be presented in a clear, transparent and understandable form and released in an appropriate and convenient manner, and the metadata supporting them as well as instructions for their users must be commonly accessible.

Quality evaluation

The producers of OSF statistics must regularly evaluate the quality of the statistics they produce against the quality criteria specified above. In addition, they must assess and monitor the needs and the satisfaction of their customers, as well as the expediency of their statistics production process.

Quality reports and separate methodological reports of statistics

Each set of OSF statistics must be accompanied by a quality report providing a concise assessment of its quality, reliability and applicability for different purposes. The key purpose of the quality report is to show how the OSF quality criteria are met the statistics concerned.

Furthermore, for each set of OSF statistics it is necessary to consider the internal or external needs for a separate, detailed methodological report and the necessary frequency of such a report. It is especially important to attach a methodological report to statistics in which major revisions have taken place in compilation methodology.

Table 1.1 outlines the structure of the quality report and methodological report and the differences between them. The content and coverage of the methodological report will largely depend on the distinctive features of the set of statistics in question and on the needs of its end users.

Table 1.1 Proposed structure for quality reports and methodological reports

	Quality report		Separate methodological report	
1. Relevance	1.1	Summary of information content and purpose of use of the statistics.	1.1	Precise summary of information content and purpose of use of the statistics. Explanation of the phenomenon the statistics describe and their history.
	1.2	Introduction to key concepts essential for understanding the statistics, and to used classifications, object of study, data collector and informants.	1.2	Introduction to key concepts essential for understanding the statistics, and to used classifications, object of study, data collector and informants.
	1.3	Reference to any acts, decrees and recommendations on which compilation of the statistics is based.	1.3	Reference to any acts, decrees and recommendations on which compilation of the statistics is based.
	1.4	Descriptions of methods for hearing users and for monitoring of the relevance and usefulness of the statistics concerned.	1.4	Detailed descriptions of methods for hearing users and for monitoring of the relevance and usefulness of the statistics concerned.
			1.5	Assessment of how the relevance of the statistics complies with the set requirements and how any changes in the phenomenon are allowed for in the compilation of statistics on it.
2. Methodological description of statistical survey	2.1	Clear report of the method applied, i.e. the population, the basic data, the survey design (census survey or sample survey), (sampling design), data collection method, estimation methods and the use of weighting coefficients in sample surveys.	2.1	More thorough description than in the quality report of the (sampling), data collection, editing, imputation, (weighting) and estimation methods used in producing the final results.
	2.2	Report on effects from sampling errors and non-sampling errors.	2.2	Measurement of sampling errors and non-sampling errors and assessment report on their effects.
			2.3	Evaluation and validation of source data, interim results and the produced statistics.
			2.4	Justification for the methods used and revisions to them (including assessment of their impacts on time series).
			2.5.	Description of used data sources, inclusive of those for additional information.
			2.6	Description of the entire production process for the statistics.

Table 1.1 Cont.

	Quality report	Separate methodological report
3. Accuracy and reliability of data	3.1 Demonstration that the statistics measure the phenomenon they are supposed to measure.	If necessary, more detailed accounts for items 3.1 and 3.2 of the quality report.
	3.2 Account of all facts that may have a bearing on the reliability of the statistics, as well as of key uncertainty factors, i.e. possible sources of error (e.g. non-response or undercoverage).	3.3 Presentation and interpretation of statistical parameters by main classifications for estimates (e.g. standard errors, mean square errors (MSE) allowing for sampling design, and parameters estimating the efficiency of the sampling design (deff).
	3.3 If necessary, tabulation of statistical parameters by the used classifications for estimates (e.g. standard errors allowing for sampling design in sample surveys , mean square errors (MSE), parameters estimating the efficiency of the sampling design (deff).	3.4 Descriptions of key uncertainty factors, i.e. possible sources of error and assessment of their impact on published estimates: – Sampling errors – Non-sampling errors: – Frame – Measurement – Processing – Non-response.
	2.4 Report of non-response or response rates for sampled units in sample surveys.	3.5. Assessment of equivalence between the pursued population and the target population and quality of the used frame.
		3.6 Presentation with quantitative indicators of the impact on the final statistics from non-response, editing and imputation.
4. Timeliness and promptness of released data	4.1 Indication of the point of time or time period the published statistics describe.	4.1 Indication of when data concerning a specific point of time or time period have been published.
	4.2a Indication of whether the data are preliminary or final.	4.2 Analysis of possible deviations between preliminary and final data.
	4.2b If the data may change in future due, e.g. to seasonal adjustment, this should be made clear to the users of the data.	4.3 Examination of whether the production schedule complies with recommendations for OSF statistics. If the statistics are not published within the target schedule recommended for OSF statistics or their publication is delayed, explanation of reasons for the delay in production and publication.
	4.2c If the statistics are first published as preliminary, indication of when the final data will be available.	
		4.4 If necessary, an examination of whether time series data have changed over time (e.g. because of seasonal adjustment).

Table 1.1   Proposed structure for quality reports and methodological reports

		Quality report		Separate methodological report
5.	**Coherence, consistency and comparability of statistics**	5.1	Description of comparability of the statistic over time and with other data.	5.1 More detailed description than in the quality report about comparability of the statistics over time and with other data.
		5.2	Assessment of the consistency and comparability of the statistics with other statistics on the same topic.	5.2 More detailed assessment than in the quality report of the consistency and comparability of the statistics with other statistics on the same topic. In this connection, differences between concepts and the data collection process should be analysed and their impacts assessed.
				5.3 Examination of changes having influenced consistency and comparability of the statistics and their significance to e.g. the used production process, concepts and classifications.
				5.4 Information about lengths of available time series for statistics from whose data comparable time series have been produced.
6.	**Accessibility and clarity of data**	6.1	Introduction of publication channels and provision of contact details for information service.	6.1 Introduction of publication channels (e.g. electronic or printed publication, database and/or on-line service). Additional description of other information service channels.
		6.2	Information to end-users about methods used in statistics production and the quality of the produced data in accordance with the European System of Statistics and the quality criteria of OSF.	6.2 Information to end-users about methods used in statistics production and the quality of the produced data in accordance with the European System of Statistics and the quality criteria of OSF.
		6.3	Descriptions of availability of metadata for the statistical survey and of the data source.	6.3 Description of the metadata of the statistical survey and reference to databases with more detailed metadata.
7.	**Documentation**			7.1 Description of available archived data files.

Guidelines

Publications of Official Statistics of Finland (OSF) must comply with the Publishing Guidelines for Official Statistics of Finland approved by the Advisory Board of Official Statistics of Finland, and contain a reference to a quality description publicly available in the internet conforming with the OSF standard. In addition, they must comply with the Code of Practice on European Statistics issued by the Commission of the European Communities as presented in Section 1.1.3. A quality report must be compiled for each set of statistics.

Internal and external need for a separate, detailed methodological report, its contents and publication frequency must be separately assessed.

The quality of a set of statistics must be primarily evaluated against internationally recommended quality indicators or against quality indicators specified by Eurostat.

Statistical quality is described in quality reports in accordance with the following OSF quality criteria:
1. Relevance
2. Accuracy and reliability
3. Timeliness and promptness
4. Coherence, consistency and comparability
5. Accessibility and clarity

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Additional information
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http://ec.europa.eu/eurostat/quality

2   Statistical Surveys and Production of Statistics

2.1   Definition of a Statistical Survey

Scope and purpose

This chapter examines the general nature of statistics production and the factors that essentially influence the quality of statistics. The objective is to give the reader an overall picture of the connections between statistics production and statistical quality by means of widely used and established definitions. The sub-sections of this chapter therefore reflect the elements that contribute to statistical quality.

The term statistical survey is here restricted to those statistical studies that produce descriptive or analytical information about society for the needs of social or economic decision-making, scientific research or international comparisons. Their aim is to describe the state of the whole population with respect to the subject matter under examination. The population consists of persons, households, enterprises and establishments or other economic and/or social units.

Statistical surveys are conventionally divided according to statistical topics (see Section 1.1.4). When the objective is to plan, maintain, intensify or improve qualitatively the entire statistics production and/or an individual statistical process, it is useful to outline the similarities and characteristics of different statistical survey processes.

These statistical studies are referred to in the literature by the term survey (statistical survey), a broad term which comprises all empirical social statistical research and production. More precisely, a survey applies to the whole target population and the data gathered on it (Marriott, 1990). By definition, the term statistical survey covers the following types of data:

- Total data *(census survey)*, where data collection covers all units of the population,
- Sample data *(sample survey)*, where data are collected from a sample selected from the target population *(usually at random)*,
- Data formed from administrative registers (administrative records),
- Derived statistical data *(derived statistical activity)*, where data have been estimated, modelled or otherwise derived from existing data pools. (Statistics Canada, 1998).

A statistical survey is thus a highly general concept covering all surveys including those based on register data. Each unit of population is sampled for statistical surveys based on total data. In sample-based statistical surveys some of the target population units are selected, aiming at representative results that can be

generalised to the level of the whole target population. Statistical surveys cover direct and indirect data collection from a sample or the whole population and combinations of these approaches, as well as DESAP self-assessment.

Statistical surveys can be divided into repeated or one-off surveys. Repeated statistical surveys are made at certain intervals and on their basis it is also possible to compile time series. Statistical surveys can also be divided into repeated survey series, one-time and secondary surveys. In the first type the survey is repeated several times with the same set of questions. In the case of a one-time statistical survey the total survey process has to be constructed comprehensively from the beginning. Secondary surveys integrate data from other surveys or from administrative registers. It is recommended that Statistics Finland's Survey Laboratory should be used and/or a pilot study made to test the questionnaire (see Section 2.8).

Principles

For planning and the setting of targets, the statistical survey should be regarded as a total process consisting of three main processes: planning, operation and evaluation (see Chart 2.1).

Chart 2.1 Total process of statistical survey (adapted from United Nations, prep. by Sundgren, 1999[1])
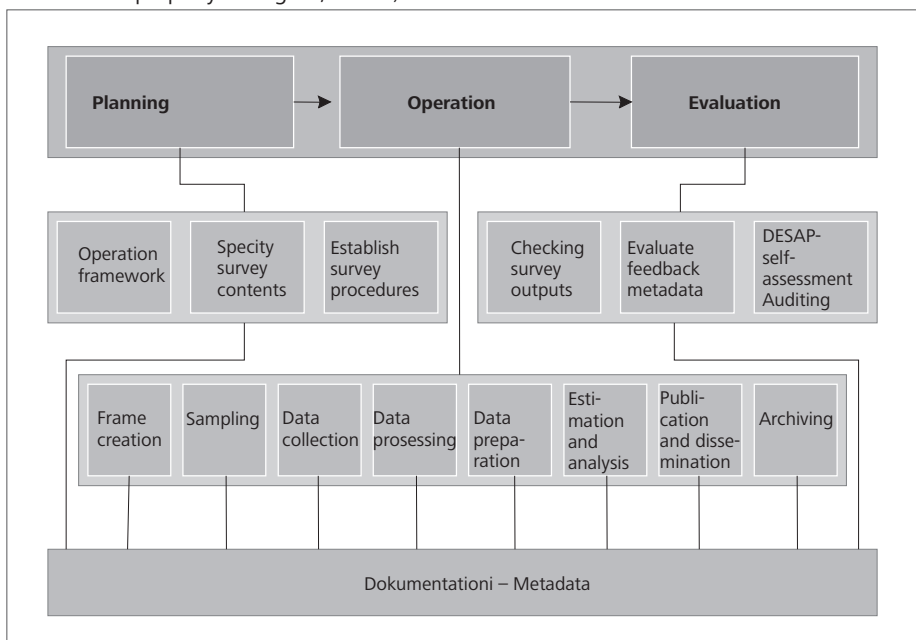
1) Four additions were made to the chart compared to the original one (United Nations, prep. by Sundgren, 1999). "Documentation" and "Accumulation of metadata" were added throughout the statistical research process. "Operating framework" was added to the planning stage and "Auditing" to the evaluation stage.

Planning process

The planning of a statistical survey is often based on the needs of social or economic decision-making or scientific research. The data needs of the customer, researcher or interest group should be identified and specified in the planning stage. The modes of operation, concepts, classifications and standards set by the Finnish Statistics Act (280/2004) determine the operating framework of a statistical survey (see Section 1.1). Chart 2.2 depicts the planning process at Statistics Finland. The purpose of the statistical survey must be realistic and the target population and the content of the survey must be specified in the research plan. The key areas of the planning stage are the definition of the content, the strategic decisions on data collection methods and the planning of data collection. The resources, such as budget, personnel and other equipment, must also be established early on in the planning stage. At the same time the processes, data protection methods and a timetable must be defined for the statistical survey. All efforts should also be made to ensure that the quality criteria set for the statistics can be fulfilled (see Section 1.2).

Chart 2.2   Planning process for a statistical survey
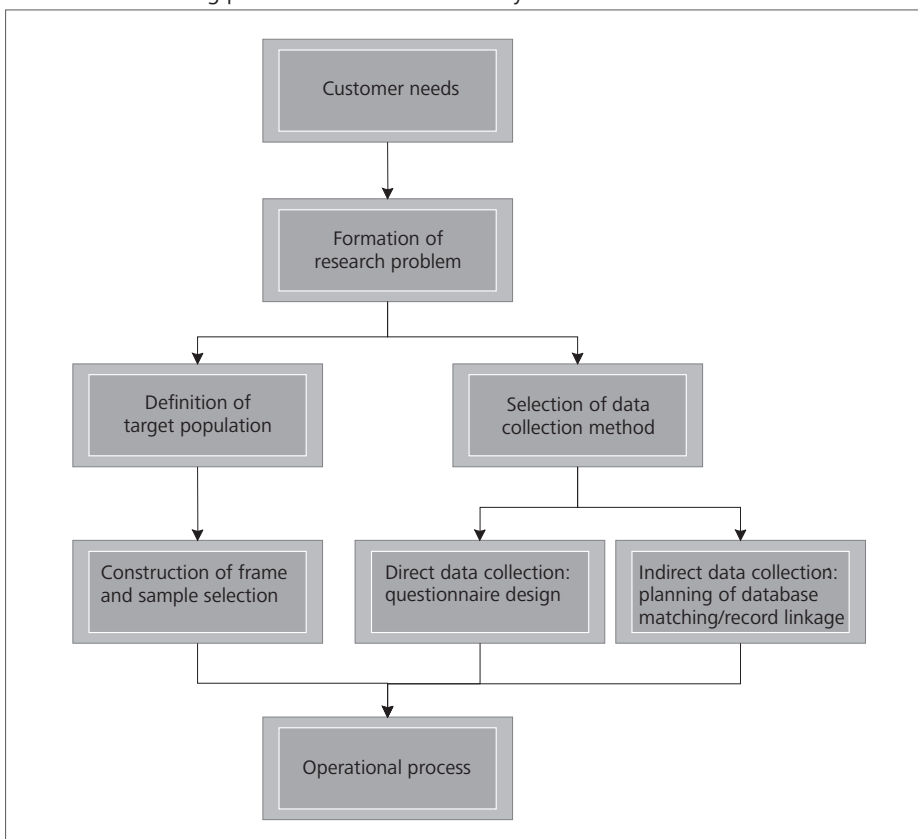
The choice of data collection method is an important strategic decision in the planning of a statistical survey. It is of great significance for the nature of the data collection, the setting of questions and other aspects of questionnaire planning, the duration of the statistical survey and its costs (see Sections 2.7 and 2.6). The data processing methods are also specified in the planning stage, together with the editing and imputation methods needed for the production of a final data set (see Section 2.9). Other important elements of the planning stage are interviewer training and organisation of fieldwork (Statistics Finland, 1999).

In addition, in sample-based surveys the planning stage also entails the planning of sampling to determine the sampling design and estimation methods.

The primary goal of planning is to help to attain as accurate and correct survey results as possible. Possible problems should be anticipated in the planning process. For example, in an interview survey one should be prepared for non-response and for the correction methods required by it. Documenting the planning of the statistical survey will speed up the technical reporting, i.e. the preparation of product descriptions, quality reports and user manuals.

Operational process
The operational stage of the statistical survey comprises the following processes (see Chart 2.3). These processes have an essential bearing on the statistical quality of the final outcome:

- Construction of the sample frame and merging of the required auxiliary information (see Section 2.4) ,
- Selection of the sample (see Section 2.6),
- Compilation/programming of the questionnaire and preparation of work instructions (see Section 2.8),
- Data collection and its co-ordination (see Section 2.7),
- Processing of data (data collection, coding, (logical) checking and editing of data) (see Section 2.10),
- Production of final data (see Sections 2.10, 2.11 and 2.12),
- Estimation and analysis (see Section 2.12),
- Publication of final results and Dissemination of statistical information (see Section 4.2),
- Archiving (see Section 3.2).

Data management and system work are centrally connected to every stage of the statistical survey. Chart 2.3 describes how the documentation of a statistical survey begins and metadata are born already at the planning stage and then continue to accumulate throughout the operational process. Metadata here refer to definitions, classifications, standards, sampling frame, auxiliary information, questionnaire, work instructions, respondent and interviewer comments, editing and variable transformations.

Chart 2.3 Main operational process of statistical survey
(adapted from United Nations, prep. by Sundgren, 1999 [2])
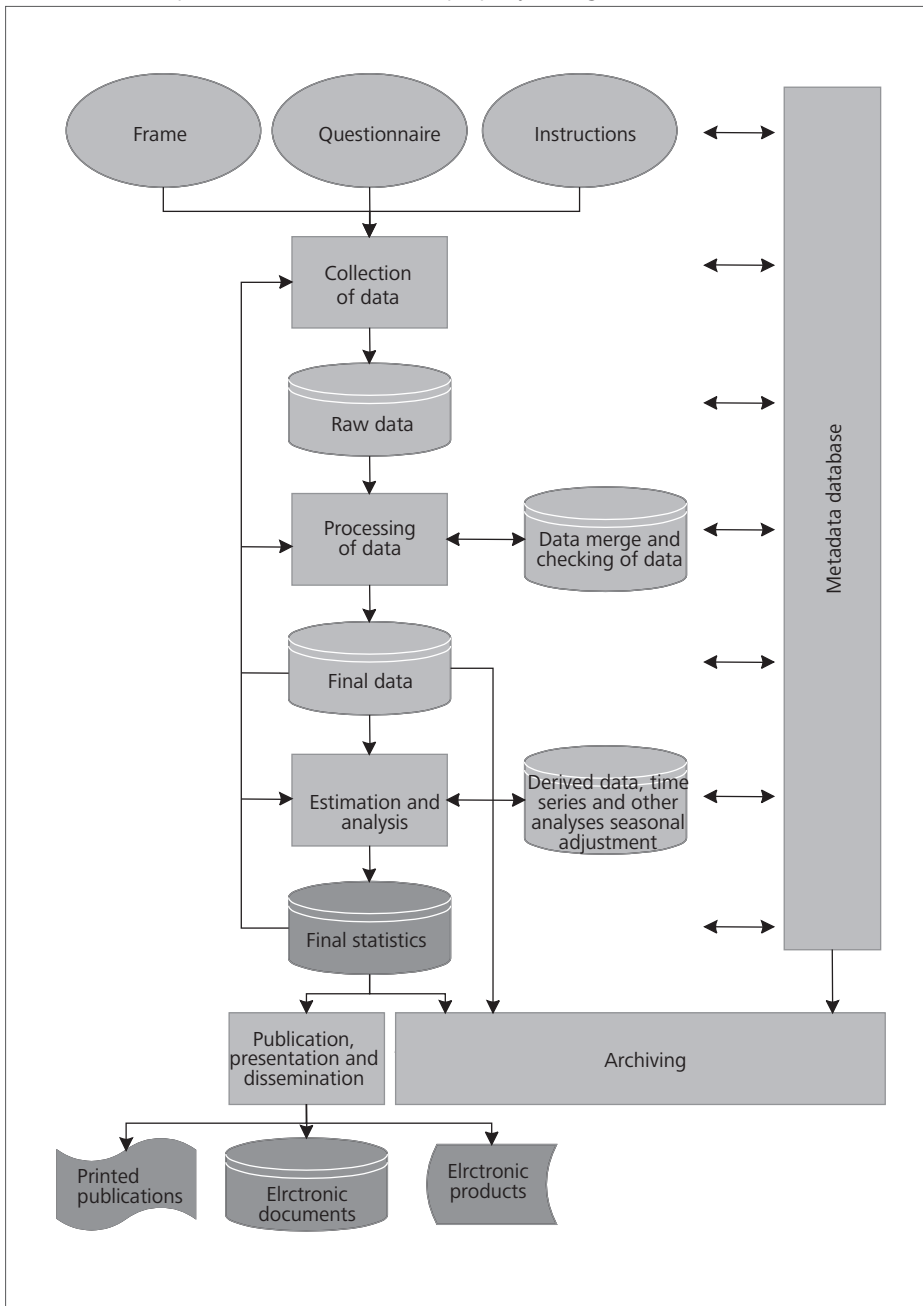
2) The section concerning combination of metadata was changed in the chart (United Nations, prep. by
   Sundgren, 1999) so that metadata are collected and combined throughout the process. In addition,
   "Archiving" of final data, final statistics and metadata was added to the original chart.

Evaluation process

The evaluation stage of the statistical survey examines how the final products defined in the planning stage have been produced and published and how the quality criteria have been attained. In addition, the evaluation process contains the checking and evaluation of the documentation of metadata, the archiving of data, classifications and concepts, and the analysing of customer satisfaction surveys (United Nations, prep. by Sundgren, 1999).

The conducting of the whole statistical survey and the fulfilment of the quality criteria can also be reviewed through DESAP self-assessments of the persons responsible for the statistics, internal audits of statistics production within the organisation, and separate audits in which statistical professionals or independent experts together evaluate the total process of the statistical survey and aim to identify areas for improvement. (see Section 1.2.2).

Guidelines

High quality in a statistical survey can be attained by:
• Resourcing each stage of the statistical survey correctly,
• Investing in the planning stage,
• Careful analysis of customer needs,
• A correctly resourced operational stage, characterised by methodical system work,
• Investing in the interaction of individual operations and the whole,
• Documenting individual work stages so that they can be repeated by another statistical professional (see Section 3.1),
• Approving the statistical survey as completed only when it has been archived (see Section 3.2),
• Evaluating the output of the statistical survey,
• Co-operating with other statistical surveys and sharing good practices and knowledge.

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2.2   Data Protection

Scope and purpose

Data protection refers to the legislation, regulations, methods and their applica-
tion which all aim to safeguard data suppliers' privacy, business or trade secret.
Consideration is given to data protection already at the data collection stage and
when planning it by making sure that no data are collected that are not needed
in statistics production. The data are processed following data protection princi-
ples, which means that confidential data are not disclosed to outsiders at any
stage of the data processing.

Data protection represents a central principle of official statistics. The aim of
data protection principles is to maintain confidential relations with data suppli-
ers. This ensures the availability of exhaustive and reliable data for statistics
compilation. The data protection principles specify which data can be collected,
how the data can be processed and in what form they can be published. Data
protection thus influences the procedures that are employed in the compilation
of statistics and the content of the data that are published.

The data protection statutes concerning official statistics are essentially con-
tained in the Finnish Statistics Act (280/2004) and Council Regulation (EC)
322/97 on European community statistics, but the Finnish Personal Data Act
(523/1999) and the Act and the Decree on the Openness of Government Activ-
ities (621/1999 and 1030/1999) also include provisions relating to data protec-
tion. In addition to legal acts and decrees, guidelines on data protection have
also been issued by the Government Information Security Management Board
(VAHTI). The main VAHTI guidelines concerning official statistics are: Data
protection guidelines for processing data material in public administration (Min-
istry of Finance, 2000) and Sensitive international data material (Ministry of Fi-
nance, 2002).

Statistics Finland naturally has several internal guidelines concerning data
protection, such as guidelines for the application of the Statistics Act and the
Personal Data Act (Statistics Finland, 2005a and 2000a) and those concerning
protection of table format data on enterprises and individuals (Statistics Finland,
2002a and 2000b). General operating principles relating to data protection are
given in the agency's Data protection guidelines (Statistics Finland, 2005b) and

Guidelines on Professional Ethics (Statistics Finland, 2006), based on the principles of statistical ethics approved by the EU, the UN and the International Statistical Institute (ISI). Of these international guidelines, especially the Declaration on Professional Ethics of the ISI (ISI, 1985), the UN's Fundamental Principles of Official Statistics ratified by the United Nations Statistics Division (UN, 1994), and the European Commission's Code of Practice (COM 217, 2005) have been the main points of departure in composing Statistics Finland's Guidelines on Professional Ethics.

Principles

Observation of the data protection stipulations requires careful advance planning of the entire survey process from the collection of data to the publication and dissemination of statistical information. Only data that are necessary to describe the topic concerned may be collected from data suppliers. To reduce the amount of data that need to be collected, sampling and other methods must be used whenever possible. The processing of data must be implemented so that no one's privacy, business or trade secret is endangered. Officials compiling statistics must ensure that data are adequately protected against unlawful processing and exposure. At Statistics Finland, use of microdata from a statistics department other than one's own is also subject to a permission.

As a rule, all data obtained for statistical purposes are confidential. Data describing the activities of central and local government authorities and the production of public services are public. The data contained in the Business Register are also public. Confidential data may only be released for scientific research purposes or statistical studies in a form from which individuals cannot be identified either direct or indirect. As an exception, data on age, gender, education and occupation may be released with identifying data for scientific research or statistical studies. Data can also be released with identifying data to some other statistical authorities defined in the Statistics Act for the purpose of compiling statistics on their field of activity. Release of confidential data for utilisation in administrative decision-making or other similar activity is expressly forbidden. The methods and principles applied to the releasing of data are subject to the guidelines endorsed by the Director General on the granting of user rights to Statistics Finland data files (Statistics Finland, 2005c).

Membership in the European Union means that statistical data must be released to Eurostat, the producer of Community statistics by virtue of Commission Decision (EC, No. 281/1997), where EC regulations concerning specific statistics so require. Council Regulation (EC, No. 322/1997) on Community Statistics contains general principles of the European Statistical System and provisions concerning data protection. In addition, the release of statistical data by Member States to Eurostat is stipulated by the Council Regulation on the transmission of data subject to statistical confidentiality to the Statistical Office of the European Communities (EC, No. 1588/1990). Provisions on the protection of personal data are issued in both a Directive of the European Parliament and of the Council (EC, No. 46/1995) and a Council Recommendation (EC, No. R (97) 18/30 of Sept. 1997) concerning personal data. In addition, the Code of

Practice (COM 217, 2005) gives an absolute recommendation on statistical confidentiality. Commission Regulation (EC, No. 831/2002), implementing Council Regulation (EC) No. 322/97 on Community Statistics, concerning access to confidential data for scientific purposes specifies the situations and measures which, when fulfilled, allows Eurostat to release data in its possession to researchers.

Data may only be published in a format that does not disclose the supplier or confidential information concerning the supplier. Only in exceptional cases may confidential data be published, with the agreement of the supplier concerned. This possibility is mainly applied to data on large corporations. When statistics are released for research purposes or published, the need to protect confidential data should always be verified. The data must be protected by appropriate statistical disclosure control method if there is a risk of exposure of microdata with only minor effort (Hänninen, 1997). Consideration should be given in data protection to the nature and sensitivity of the data and to selecting a method that suits the usage of the data, because disclosure control methods may have an impact on the content of the statistics (Konnu, 2006).

Statistical disclosure control methods

There are diverse disclosure control methods for protecting confidential data. In selecting the appropriate method, consideration should be given to the intended future usage of the data, because the impact from different methods on the protected data can vary considerably. The aim of all disclosure control methods is to put the data into a format that will make the exposure of a record or its attributes impossible. There are different disclosure control methods for tabular data and microdata and these methods need to be discussed separately. The following are examples of the disclosure control methods tested and/or used at Statistics Finland.

I. Disclosure control for tabular data

With regard to tabular data, the sensitivity of variables essentially determines the intensity of the disclosure control methods that must be applied. Assessing the protection needs of tabular data must take into consideration the confidentiality of the variables as well as the number of cases in the table cells, size of the population, number of variables and size of the area the statistics concern, and the degree of detail by which the data are classified. Before a table is published it is a good idea to check the data in it once more. In addition to the actual table being protected, all other tables that are linked to it should also be checked. Publishers of statistics must make sure that confidential data cannot be disclosed by comparing and examining tables.

In considering protection of tabular data, a distinction should be made between frequency tables and tables of magnitudes. Frequency tables give numbers of cases in each table cell, while tables of magnitudes present numerical values such as means or totals of income in a specified currency. More time and other resources are usually needed in protecting tables of magnitudes than frequency tables, which are most often protected by applying a pre-set threshold value below which cell frequencies must be suppressed. Sometimes suppression

can be avoided by combining classification categories so that the cell frequency for the new, combined category will exceed the threshold value.

In protecting tables of magnitudes information is needed not only about the values of the table but also about the values of the records. There are two main criteria for defining the sensitivity of a table or its cell: number of cases in a cell and dominance of cases in a cell. If only one or a few records contribute to the value of a certain cell, the value must be suppressed. In addition to this, it also has to be ascertained that the cell value cannot be calculated by using the marginal sums of the table. If such calculating is possible, other cells besides the original cell contributing to the marginal sums have to be suppressed, in other words, complementary suppression must be used (Duncan et al. 2001). When applying the dominance rule, or the (n,k) rule, information is needed on all records contributing to the cell and on the figures contributing to the cell value. For example, in the case of the dominance rule (2, 80) a cell must be protected if the two biggest records contributing to the cell value account for over 80 per cent of the total cell value.

The aim of more precise disclosure control methods for tables of magnitudes is to prevent the possibility of the records contributing most to the published figures from disclosing each other's values. For example, the second largest company in its field can, if it so desires, assess the turnover of its biggest competitor quite accurately if the company's estimate of the turnover of other companies in the field is correct. Such exposure can be prevented by not publishing exact values for cells but intervals within which they fall. The "p% rule" (Merola, 2005) can be used for detecting cells requiring protection. If one of the units whose data contribute to the value of an examined cell can deduce the value of a variable of another unit contributing to the value of the cell at the accuracy of p%, the p% rule requires the cell in question to be protected. Let us examine protection of the above example in accordance with the 80% rule. In this case the cell containing turnover should be protected if the second biggest company in the field can estimate the turnover of its biggest competitor at 80% accuracy.

There are diverse software programs available for data protection, such as Argus, contained in the SuperCross software, and disclosure control methods for small area statistics.

II. Disclosure control for microdata
Microdata can be protected with non-perturbative or perturbative methods (Crises, 2004a and 2004b). As their name implies, protection in non-perturbative methods is based on removal of confidential information from data. The most efficient way to protect microdata from disclosure is to publish sample data without identifying information instead of total data. Total data can refer to all persons having attained a certain qualification or living in a certain area. All data released for research purposes at Statistics Finland are samples of total data.

Other disclosure control methods Statistics Finland uses for microdata include global recoding, i.e. classifying data by broader categories, top coding i.e. combining of categories with highest values and, correspondingly, bottom coding i.e. combining of categories with lowest values. Recoding helps to protect

rare values without reducing the usability of data. For example, all persons aged over 80 can be grouped into one category in personal data even where the rest of the data are classified by five-year age cohorts.

When the values of variables in data form unique profiles, local suppression of rare values is used. For example, if the data only contain one representative of a certain occupation, the data on the occupation of that person can be expressed as a missing value, which usually removes the risk of identification. A weakness of this method is that an intruder, i.e. a person attempting disclosure can exploit the missing value notation when looking for easily disclosable records. Therefore, suppressed values must not be replaced by a notation that differs from the one used for other missing values but the same notation should be used for all values that are missing, whatever the reason.

When data are protected with non-perturbative methods, there is no risk of analysis results changing in any respect other than the protected values. However, data classified into too broad categories or containing too many missing values can be difficult to use. Perturbative methods should be used if users need particularly exact data. These methods can be further divided into systematic and random perturbative methods. Systematic methods cause an identical change in the data every time they are used, whereas random methods produce different masked data each time.

One of the systematic disclosure control methods is microaggregation (Crises, 2004c), where data records are arranged into groups of similar records and the values of the variables of the records are replaced by the means for the group. There are various options for making the grouping and the group size can be allowed to vary or made constant. A typical example of random perturbative methods is noise adding to the value of a variable (Brand, 2002). This means adding a random value to the value received by the original variable. Noise adding by means of diverse modifications intensifies the protection effect. Another simple example of the perturbative methods is data swapping when some of the values of a specific variable are swapped between two units (Fienberg & McIntyre, 2004),. Data swapping can be applied either at random or by using rank swapping, when the values of the variable are ranked in ascending order before swapping. More advanced random perturbative methods include the PRAM method where protection is based on the changing of variable values according to a pre-selected probability matrix.

As far as microdata are concerned, it is not possible to give exhaustive data protection guidelines that would be applicable in all situations, because the measures required are always dependent on several contributing factors, such as the volume of the data, the number of variables and the degree of classification accuracy. Protection of microdata can also be implemented with software programs, such as the Argus program.

Guidelines

General principles

The Finnish Statistics Act works on the basic principle that all data obtained for statistical purposes are confidential. The following basic guidelines should be observed in the collection, processing and publishing of data:

- Only data necessary for statistics production shall be collected.
- Data already collected for registers shall be exploited as far as possible.
- Identifying information shall be collected and used only when absolutely necessary.
- Variables facilitating indirect identification shall also be removed or aggregated before data are released.
- Data disclosure control methods shall always be documented.

In addition to the general data processing principles, the following detailed guidelines should be taken into consideration when publishing or releasing data. When assessing which data may be released outside the organisation, it is necessary to separate table format data from microdata.

Guidelines concerning tabular data

- Statistics Finland's guidelines on the protection of tabular data on individuals (Statistics Finland, 2002) or Statistics Finland's guidelines on the protection of tabular data on enterprises (Statistics Finland, 2000b) shall be followed when releasing tabular data.
- Statistical tables of data on individuals or enterprises shall be compiled so that their cells do not contain unnecessarily low frequencies. The risk of identification of an individual person, family, dwelling unit or enterprise must always be assessed before data are published or released.
- Tabular data shall be protected by an appropriate method that retains as high usefulness of the table as possible even after the protection.
- Tabular data approach microdata, for example, when a multi-dimensional table is formed using highly detailed classification levels. In such instances, case-by-case consideration shall be given to whether the data should be interpreted as microdata, the releasing of which requires the granting of user rights.

Guidelines concerning microdata

- The guidelines on granting user rights to Statistics Finland's data files (Statistics Finland, 2005c) shall be followed in the releasing of microdata.
- Microdata shall be released only for scientific purposes or for statistical studies.
- Release of microdata shall always be subject to the procedure for granting user rights. A user right is granted for a specifically identified research purpose for a set time period.

- Total data sets shall not be released outside Statistics Finland. Only subsets can be released to outsiders but researchers can have access to total data sets under supervision at Statistics Finland's premises.
- Released microdata shall be in a format from which no records can be identified.
- Disclosure control methods shall be used to prevent indirect identification. With data sets on enterprises it is generally not possible to eliminate the possibility of indirect identification, therefore they can only be released to researchers working under supervision at Statistics Finland's premises.
- Releases of microdata shall always be subject to verification of compliance with data protection principles.

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2.3 Classifications, Concepts, Definitions and Harmonisation

Scope and purpose

Statistics are usually compiled from a large set of individual observations. In order to make conclusions, the empirical observations need to be arranged consistently, e.g. classified by their similarities or differences. Classification is thus an essential part of statistics, and standard classifications are the key instruments of official statistics.

Concepts, definitions and classifications together form the essential operating framework of statistics production. The concepts used are usually based on a theoretical or statistical frame of reference and are used to define the subject, the statistical units to be described and/or the population under study.

The concepts used in statistics are generally standard statistical concepts but they can also be standard language concepts that have to be defined. Use of scientific concepts often causes difficulties in that one concept may refer to several different phenomena, one concept or word may have several meanings, or not all concepts have an empirical equivalent.

At its simplest, a classification consists of named groups and their identifiers (codes). Generally the description of a classification is wider than this and comprises of (i) definitions of groups (names, codes and often also a description of the group, i.e. its text-form definition), and in the case of complicated and broad classifications, (ii) a presentation of the basic concepts, classification principles and criteria.

Classifications can be roughly categorised into:

- Classifications describing the population, persons and their living conditions (demographic classifications),
- Classifications describing economic activity and the national economy,
- Regional classifications and classifications for environment statistics,
- Special classifications, such as the classification of diseases, customs tariff nomenclature and crime nomenclature.

Principles

Classification principles

The observations of the data have to be grouped or classified so that the statistics compiled produce a structured and understandable picture of the real world that corresponds to reality – depicting the structure of society, its current state and the changes in it. The classifications used in statistics have to be relevant for the purpose of key users because statistics have a significant role in social research and decision-making.

The classification must be systematic: it should classify observations consistently using the agreed criteria. The classification is usually also hierarchical, with a main group level (or 1-digit level), which is broken down further on lower classification levels.

Classification groups must be unambiguous, exhaustive and mutually exclusive. Unambiguity means that observations can be clearly classified into a certain group on the basis of the defined classification principles and criteria. Exhaustiveness means that all the cases of the observation data can be classified. Exclusiveness is achieved when the definition of the groups precludes the classification of a case into two or more groups.

Unspecified groups or residual groups such as "not elsewhere classified" should contain relatively few cases compared to the other classification level groups. If the size of the residual group grows considerably, the classification system should be revised.

The concepts and variables related to the classification must be defined. The definitions can be general in nature or consist of operational definitions describing the processing of observations in terms of certain data.

Classification standards

Standard statistical classifications are based almost without exception on international recommendations or agreements. Some of the classifications used by the member countries of the European Community are confirmed as regulations, which oblige EU Member States to use the classifications concerned in official statistics and when delivering information to the Statistical Office of the European Communities, Eurostat. Such classifications confirmed as regulations include e.g. the industrial and product classifications and the basic classifications of the revised System of National Accounts (ESA 95). By contrast, classifications describing the population and its living conditions are based on population census recommendations. In addition, classifications describing income distribution and consumption are founded on the framework of national accounts and on the recommendations regarding income statistics.

Statistics Finland maintains a Classification Database which includes the classification standards used in Official Statistics of Finland. This database is only intended for Statistics Finland's internal use. Statistics Finland's Internet service contains information for external users about the classifications of statistics, at: http://tilastokeskus.fi/luokitukset/index_en.html

Central statistical standards are confirmed as public administration recommendations in Finland. This procedure is aimed at extending use of standard classifications in all sectors of society and particularly in public administration. General statistical standards are used extensively in administrative information systems and increasingly in those of private enterprises and organisations as well. This is very significant for official statistics, since administration, enterprises and corporations are important providers of basic statistical data.

Guidelines

- Standard classifications must be used whenever possible in the OSF, and the classifications and related central concepts must always be presented when publishing statistics.

- When a new classification is introduced, with new definitions and concepts, it has to be ensured that the groups are not given the headings of those already used in national or international standard classifications.
- Users must be informed in the text of the statistical publication or in some other suitable way if it is for some reason not possible to comply fully with the standard concepts and classifications. Deviation from classifications confirmed by EU regulations must be formally approved by the Statistical Office of the European Communities, Eurostat.
- The term "Others" should be avoided as the heading for the residual group, as it functions poorly in a free text search.
- If the size of the observation data makes it impossible to apply a detailed classification level, the classification has to be made on a less detailed level. This can be done by aggregating or combining groups on the same level. The common notation for such an unspecified group is an identifier ending in 0. Correspondingly, an identifier ending in 9 is often given to residual groups.

Comparability, harmonisation
- By using classifications based on international recommendations or agreements it is ensured that statistical information produced in different countries is comparable despite the fact that societies and their structures are different.
- National versions of international classifications are usually produced to allow inclusion of national characteristics and specification of matters relevant to national circumstances.
- A national version is usually prepared by adding a national detail level as the lowest classification level. In this way the structure and the higher classification levels are still in the agreement with the international classification.

Guidelines on individual topics

Country codes

When producing statistics on nationality, country of birth and residence, migration, accommodation, foreign trade, or the country of residence of an enterprise's headquarters, it is possible to use the international standard ISO 3166 on country codes. The code system includes three-digit, two-letter and three-letter codes. The three-digit code, which is issued by the UN Statistics Division, is primarily recommended for use in statistical systems. The two-letter code is meant for general use. The three-letter code can be used to facilitate identification of an area or to increase clarity. The letter codes are mainly based on the English names of countries.

The system contains both independent countries and non-independent areas (countries). Countries have been grouped into six continents and 19 major regions. The division is mainly suitable for use in population statistics. Countries can also be categorised in other ways, e.g. on economic policy grounds or according to state alliances.

Regional classifications and consideration of Cland's special status

The European Union's official NUTS regional classification system is used mainly in statistics (NUTS, Nomenclature des Unités Territoriales Statistiques, which is defined in Regulation (EC) No 1059/2003 of the European Parliament and of the Council). In the Finnish NUTS regional division Mainland Finland and Cland form the NUTS1 regional level, the major regions the NUTS2 level, the regions the NUTS3 level, the sub-regional units the NUTS4 level and municipalities the NUTS5 level.

Regions and statistical groupings of municipalities are the primary regional classifications recommended for statistics. When producing tables on municipal data (NUTS5), municipalities are presented in alphabetical order by area, usually by region. Cland is always presented as the last region. In printed publications showing regional statistical data, the NUTS1 division (Mainland Finland, Cland) is recommended for use as a subheading, with or without corresponding subtotals.

Statistical grouping of municipalities

The degree of urbanisation of municipalities is described with the statistical grouping of municipalities, which classifies municipalities into urban, semi-urban and rural municipalities. The previously used classification of municipalities by type into "towns/rural municipalities" was discontinued in 1997 because it had not functioned well as a synonym to the concepts of town/rural municipality for quite some time, and because the respective division was also removed from legislation. (The law recognises only municipalities that can independently decide whether or not to call their municipality a town.)

Household

The concept household can be used in Finland only in interview surveys and postal inquiries. The concept of dwelling unit is employed in register-based population censuses, annual statistics and other statistics based on administrative records.

Industrial and product classifications

In the Member States of the European Union statistics by industry must be compiled using NACE (NACE, Nomenclature Générale des Activités Economiques dans les Communautés Européennes) or a national classification derived from it. From the statistical year 2003 onwards, an updated version of that classification, NACE 2002 (NACE Rev.1.1), has been used, as well as a national industrial classification based on it, TOL 2002.

The product classification, Classification of Products by Activity (CPA), is used as a reporting classification when providing Eurostat with statistical data related to production, consumption, foreign trade and distribution, for example.

Statistics on industrial production utilise the PRODCOM list covering product headings for the Standard Industrial Classification main groups C, D and E (mining and quarrying, manufacturing, and electricity, gas and water supply). Due to national needs, the PRODCOM list is supplemented with additional headings that are either missing from the PRODCOM list or are subheadings of

the 8-digit PRODCOM headings. These additional national headings have 10 digits.

Documentation

Classifications, concepts and definitions and processing rules must be documented carefully: classifications into the Classification Database and concepts into the Concepts Database. Processing rules and other work instructions connected with statistical surveys are stored in the Archives of Statistics to the extent they have not been described in the unified data file. This way the statistical data and the related classifications, concepts and so on will be available for research later on.

Bibliography

Additional information

Statistics Finland's Classification and Metadata Services unit maintains classifications in the Classification Database, publishes classifications as handbooks and provides information about classifications on the Intranet and Internet. Key classifications are also presented in the Guide to Classifications leaflet that can be handed out at customer training events and in co-ordination meetings, for instance. The Guide to Classifications is available from the classification services.

The Classification Database contains all classification standards and their versions in Finnish, Swedish and English, and in different lengths, with classification metadata, indexes for large classifications (search terms) and conversion keys between classifications from different time periods. The Classification Database is the production environment and service platform for classification products such as handbooks. The Classification Database can be used by all Statistics Finland's employees.

The classification services section has its own Internet site, which presents the main standard classifications used in the official statistics of Finland and the related metadata. The Internet address is: http://stat.fi/luokitukset/index_en.html

The classification standards used by Eurostat and links to several internationally widely used classification standards have been entered into the RAMON Classifications Database. The Internet address is: http://europa.eu.int/comm/eurostat/ramon/

Similarly, the classification standards published by the UN are available from the Internet pages of the UN's Statistics Division (UNSD) at: http://www.un.org/Depts/unsd/class/

2.4   Frames and Coverage

Scope and purpose

The goals of a statistical survey determine the target groups and units of interest. These units form the population. The purpose of almost every statistical survey is to generalise the end results to the whole target population, as statistics are most commonly expressed in the form of distributions, sums, averages, deciles and ratios calculated for the whole target population (Levy and Lemeshow, 1991).

The generalisability, relevance and accuracy of the results of a statistical survey require the use of a correct sampling frame in data collection. In both total

surveys and sample surveys the coverage, completeness, timeliness, information content and accuracy of the frame are critical factors for its suitability. It is also of central importance to evaluate the connection between the frame units and the units measured in the survey, and also their definitional differences and similarities. Practical problems may appear in the identification of household and family structure in registers based on dwelling units. (Kish, 1965).

This Chapter defines the main features of the frames used in statistical surveys for Official Statistics of Finland (OSF) and reviews the role of the frames in relation to the generalisability and quality of the survey results. The nature and special features of the different frames used at Statistics Finland are described in more detail in Section 2.5.

Principles

The target population of a statistical survey should be defined so that the inclusion of each population unit can be determined unambiguously. The next step in the planning of the survey is to evaluate the alternative frames and their suitability. The nature of the statistical survey also has an effect on the suitability of the frame:

- In total surveys the frame and the auxiliary information to be linked to it must correspond to the content requirements of the statistical survey.
- In sample surveys it is essential that the frame contains the auxiliary information needed for the selected sampling method, e.g. the information needed to draw a stratified sample.

The whole target population should be covered by the survey, but in practice it is rare for complete coverage to be attained. Therefore, one has to make a distinction between the concepts of the target population and the frame population. The target population includes all the units of interest, while the frame population contains those units that can be reached. The most commonly used sampling frames are administrative registers.

The information contained in the frame should be up-to-date. When using registers the strata and classifications should be updated according to the latest possible information. When the sampling frame is constructed by combining registers the personal identity codes of selected persons used for linking the register data have to be verified. This applies, for example, to individual and household surveys. The data contained in the registers should be used for directing the sample selection to those population sub-groups that are particularly important for the survey. To this end, it is possible to use stratified sampling, two-stage sampling or sampling with variable probabilities.

When an administrative register is used as a sampling frame it is likely to contain other units as well as those belonging to the target population. Such units belong to overcoverage, and they can usually be identified from the register at the sampling stage. An administrative register can also have undercoverage, that is, units that belong to the target population but are not covered by the register. Overcoverage of the sampling frame can be measured,

but undercoverage is more difficult to estimate (Djerf, 2000). For undercoverage, it is necessary to determine, if possible, how to improve the coverage of the frame.

Chart 2.4   Target population, survey population in statistical research, and undercoverage and overcoverage of frames
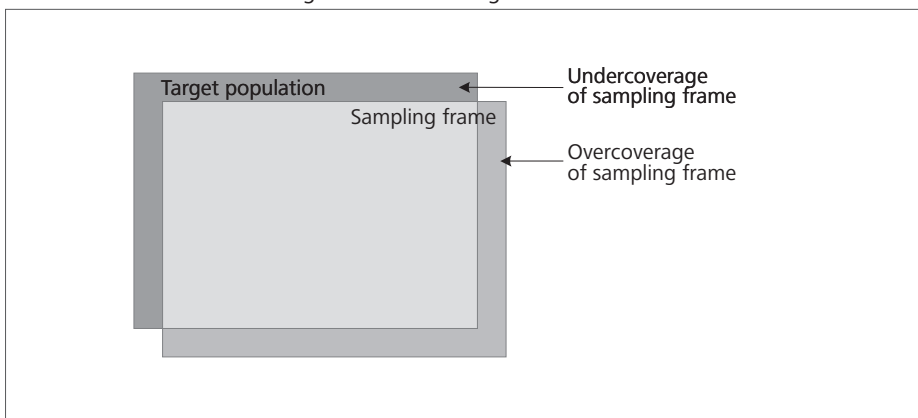
Changes in the population are usually larger in business surveys than in those concerning individuals and households. Particular attention should thus be paid to the timeliness of the sampling frame. In business surveys the enterprise size is usually taken into account when selecting the sample. This can be done by stratification or by selecting enterprises with a probability proportional to their size. The largest enterprises are often placed in a stratum from which all the elements are taken into the sample. This is often referred to as a take-all stratum. The frame should be updated with auxiliary information derived from registers for the estimation stage, and this information has to be used to adjust for undercoverage as well.

When the target population of the survey has been defined, the sampling frame and its possible coverage errors should be examined for accurate definition of the survey population. In some surveys some units are excluded from the population on:

- *Geographical grounds:* For example, Cland Islands and the municipalities in Finland's outer archipelago may be excluded from some household interview surveys.
- *Unit-specific demographic grounds:* A statistical survey may be directed at persons identified by a certain demographic characteristic, such as the adult population. Similarly, a business survey can be centred on enterprises in certain industries, for example.
- *Group-specific grounds:* If the sample unit is of a different type from that of the frame, it must be defined unambiguously. Then the units that are not clearly within the scope of the survey should be excluded from the frame. For example, in some countries persons belonging to the institutional population are

eliminated from the sampling frame of a household survey. (Rossi, Wright and Anderson, 1983).

Guidelines

Guidelines for the choice of sampling frame in OSF:

- Sampling frames should be evaluated to find out which registers are available for creating a sampling frame, their costs of usage and how registers may be merged to form the best possible survey frame.
- Person registers are suitable for selecting samples of individuals, a sample of households should also be drawn from these registers in the following way. The dwelling unit to which the person selected belongs is included in the survey. It is then for the interviewer to form the household structure based on the definition of household and information obtained from the selected person or another member of the household. Dwelling unit information, such as the size of the dwelling unit can, nevertheless, be used as the best estimate for the household before the data collection stage (see Section 2.4).
- The sampling frame used in business surveys is the Register of Enterprises and Establishments or some other data set derived from it. Changes in administrative registers can be regarded as administrative events which are transformed into statistical units when recorded in the Register of Enterprises and Establishments. Legal units are converted into statistical units if necessary.
- The sampling frame used for drawing farm samples is the Farm Register.
- After the sample selection, the auxiliary information totals (or other parameters) should be counted both from the sample and the sampling frame in order to check that the realised sample is consistent with the frame distributions. In the case of large sampling errors the sample selection and the checking might be renewed. It is advisable to attach to the sample as much auxiliary information as possible for later use.
- The quality of the register and the sampling frame should be assessed by means of the collected data. Any overcoverage, errors in the classification variables and undercoverage should be assessed by using other information sources. Feedback obtained from interviewers or elsewhere on the timeliness and completeness of the address information and the correctness of the classification variables should be followed.
- The frame population, sampling frame and its coverage should be reported on in connection with the survey results.

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2.5   Administrative Records and Registers

Scope and purpose

Within the system of Official Statistics of Finland (OSF), administrative records refer to any data collected primarily for some other purpose than official statistics production. In the scope of this definition, bodies other than public authorities can gather and maintain administrative records. This definition draws attention to what is the most important feature of administrative records for official statistics: because the data have been collected for other purposes, using them does not increase the response burden. The costs for producers of statistics are also very low compared to direct collection. These advantages are so significant that they usually weigh more than the disadvantages connected with the use of administrative records. The Statistics Act (280/2004) also lays emphasis on the minimisation of response burden whenever the data needed in statistics production are available from administrative records.

Administrative registers are a sub-group of administrative records. If an administrative record consists of unit-level data, it can be called an administrative register. Within this definition we can talk about registers even if the data are stored into a relation database. Although the data in a relation database may not form a register in the sense of information technology, we can say that the database comprises one or more logical registers.

A statistical register is a register primarily maintained for the needs of statistics production. In the majority of cases it is actually forbidden under the Finnish Statistics Act to use a statistical register for any other purpose than statistics production. The major statistical registers are based on administrative registers. In that case variables relevant to statistics production have been assembled into the statistical register from one or more administrative registers.

A key concept in the use of registers is the code system, which refers to the code by which each data unit can be identified unambiguously. This can be called a general code system if most major register keepers use it. A general code system, such as the personal identity code or the business identity code, makes it possible to combine direct collected data and register data.

Register

An information register is usually a unit-level (total) data record in electronic form, which comprises some group or set in total and is updated regularly.

The majority of registers are administrative, that is, they serve the needs of the authorities. Examples include the Population Information System, the taxation register, registers of employment pensions, of job applicants, of pensioners and of conscripts. Only a small proportion of registers were originally set up for statistical purposes. Examples of these are the Business Register, the related register covering central government agencies and operating units, the register of local government operating units, and the register of enterprise groups. In addition, the Register of Completed Education and Degrees includes post-basic level qualifications attained by the population and the register of students contains students in post-basic level education.

An extremely important register in Finland is the Central Population Register, currently the Population Information System. It was set up in the late 1960s and comprises all those persons who have (or have had) a permanent place of residence in Finland. The Population Information System also includes so-called history information, that is, emigrants and deaths. The Population Information System is updated daily with population change information, that is, births, deaths, immigrants and emigrants, internal migration, marriages, divorces, adoptions and name changes. The Population Information System is a combination of the local registers of the State Local Districts, and it is updated at State Local Offices. In 1980 the Population Information System was extended to cover buildings, dwellings, business premises and free-time residences. Included are all residential buildings and buildings with workplaces. People are linked to dwellings and enterprises to business premises by means of identification data.

Other electronic databases are also often called registers although in practice they are cross-sectional data sets and are not updated with change information. An example of these is the joint selection register, containing applicants and entrants to vocational schools or colleges and upper secondary schools in a given year. The following year this register will consist of an almost completely different set of persons, for which reason it is in fact only an electronic data set. The same holds good for many of Statistics Finland's annual data sets, although they are often called registers.

The taxation register (the present tax database), established at the end of the 1960s, can be thought of as an intermediate form between a register and an electronic data set, although it is formed of persons subject to tax each year and contains information about their income and property that is subject to taxation during that year. The data set is updated by changes in the Population Information System, such as deaths, removals and family information, but the taxation data are collected every year from the income earners themselves, their employers and pension institutions. The previous year's data are thus not updated. Some of the taxation data are maintained in the register/database, however, e.g. property data that are used to determine property tax and profit from sales. These items need not be reported again every year if no changes have occurred.

The most important registers for business statistics are the registers maintained by the tax authorities. The first registers intended for taxation of businesses were developed in the 1970s to include those liable to turnover tax, for example. In the 1980s the taxation authorities revised the information systems of business taxation, converted them into electronic form and introduced the trade registration code (the present business identity code). After these revisions Statistics Finland was able to construct an almost exhaustive Register of Enterprises and Establishments, where information on business start-ups and closures could be maintained almost in real time.

Until the 1990s, utilisation of business taxation registers in official statistics was centred on the Register of Enterprises and Establishments. In the 1990s much progress was made in the exploitation of administrative records in business statistics. First there was a revision of structural statistics in 1995 to 1996, when the business taxation register became the key information source. Production of monthly statistics concerning enterprises' turnover and wage bills was

started in 1998. These are based on the payment control register of the tax authorities, which contains information about value added taxation and wages and salaries paid by registered employers.

Principles

Codes identifying units

Code information is used to identify the units of administrative records and register data. By this means the units in different information systems can be linked to one another: for example, persons to dwellings, dwellings to buildings, buildings to real property and employed persons to enterprises. In person registers the identification tool is the personal identity code, in building and dwelling registers the real estate code, the building code or the dwelling code, in the Register of Enterprises and Establishments the establishment code, the business identity code, and in the vehicle register the registration number of each motor vehicle. The best known of these is the personal identity code containing a control character that ensures it is written correctly. It is virtually unchanging, familiar to users, widely adopted in different registers and completely unambiguous. Absence of codes can be partly compensated with name and/or address information (e.g. when linking so-called pension scheme numbers to business identity codes).

Other information can be also linked to persons by means of the personal identity code, such as the workplace's branch of industry, periods of employment and/or unemployment, periods of illness, pension and study, qualifications completed, income, assets, debts, receipt of income support, possession of a car, ownership of buildings, dwellings and free-time residences, and dwelling unit information.

Main administrative records and registers used in statistics production

Information on population and individual persons:
- The Population Information System, containing information about the population, buildings, dwellings, business premises and free-time residences (maintained by the Population Register Centre)
- People on old age, disability and unemployment pensions, and information on housing allowances and illnesses (maintained by the Social Insurance Institution of Finland)
- The register of income support recipients (maintained by the National Research and Development Centre for Welfare and Health, Stakes)
- The care report register (maintained by Stakes)
- The conscript register (maintained by the Defence Staff of the Finnish Defence Forces)
- Employment data in the employment pension systems (maintained by the Finnish Centre for Pensions, State Treasury, Local Government Pensions Institution and some other small information producers)
- The register of job applicants and labour market training (maintained by the Ministry of Labour)
- Student registers (maintained by Statistics Finland)

- The Register of Completed Education and Degrees (maintained by Statistics Finland)

Information on enterprises:
- The taxation customer register (from the customer database), database on value added taxation (contains monthly data on value added tax and employers' payments), business taxation data, taxation registers, income and property data, annual payment control data on employers
- The Finnish Business Information System, which is an information system jointly maintained by the Tax Administration and the National Board of Patents and Registration of Finland
- The Trade Register (maintained by the National Board of Patents and Registration of Finland)
- The Register of Enterprises and Establishments (incl. State and municipal units) (maintained by Statistics Finland)
- The Farm and Horticultural Enterprise Registers (maintained by the Information Centre of the Ministry of Agriculture and Forestry in Finland)

Other registers:
- The Vehicle Register (maintained by the Finnish Vehicle Administration AKE)

Use of administrative records and registers in statistics production
Usually registers are used in statistics production both in total count statistics and change statistics. For example, population statistics and statistics on population structure are produced from the total count data of the register. Vital statistics (births, deaths, internal migration, emigrants, immigrants, marriages and divorces) are based on the updating data of the register. Similarly, the data obtainable from the register of buildings and dwellings on the stock and production of buildings are based on the maintenance system of the register. Regular maintenance of total count data is also carried out in the Vehicle Register, the Register of Completed Education and Degrees, the Register of Enterprises and Establishments and the register of job applicants, from which total count and change statistics are produced.

Utilisation of administrative records and registers in the compilation of statistics reduces both the costs of statistics production and the response burden on data suppliers, which is one of the main principles decreed in the Finnish Statistics Act (280/2004). For example, the cost of a register-based population census is only a fraction of that of a direct data collection with questionnaires. Some of the census data are inferred with the help of various register data (even if they do not appear direct in any register), such as main activity in the census week, families, household-dwelling units, family's reference person, socio-economic group and distance between place of work and place of residence.

Several statistics produce total count statistics on, for example, population, dwellings, buildings and enterprise stock, as well as information about changes in them. Such information on changes comprises annual data on births, deaths, internal migration, marriages, divorces, emigrants, immigrants, completed

buildings and dwellings, registered vehicles, business start-ups and closures. Once the total count data are entered into a register, only the units where changes have occurred need to be dealt with in order to produce statistics. For instance, only data on new buildings need to be handled in the building register and other buildings left as they are. New information is collected annually for nearly all units for some registers, such as the taxation registers, the Register of Enterprises and Establishments and employment pension registers. Such registers do not differ much from annual data files. Some registers are actually annual files because data on all units and unit attributes in them are recollected every year. Examples of such register data include recipients of housing allowance and student financial aid and the care report register, which is formed of patients in institutional care over the year. Similarly, the student register contains those enrolled at educational institutions each year. The statistics describing change produced from the student register include data on applicants, those selected, and new entrants and graduates.

In general, notifications made by authorities give an exact point of time, whereas the information about change based on the notifications of individual persons is to some degree subjective: for example, people living together may have different views of a cohabiting union, a working student may report him/herself as a student although he/she may meet the criteria of an employed person (engaged in gainful work for at least one hour per week, so according to the labour force concept he/she should report him/herself as an evening cleaner). When register data are used the impact from the respondents' subjective conceptions diminishes. All students with an employment relationship are recorded as employed persons, and the person with the highest income is usually the reference person of the family.

The correctness, absence and logicality of data must also be scrutinised in administrative records and registers. This is a challenge to the compilers of statistics especially if a different organisation maintains the information systems. This is why the available data sources and systematically developed hierarchical inference rules must be efficiently exploited in the checking of the data. For example, business taxation data may miss completely or be erroneous for some enterprises. Correctness of the data should be verified by checking whether the enterprises have closed their accounts. Common error types can then be sought from among invalid accounts, which can be corrected with programmable logicality and inference rules (see Section 2.10). If some of the data concerning business taxation are either missing or cannot be balanced in financial statements, they have to be imputed from data on turnover, because turnover can be derived for all enterprises from the Register of Enterprises and Establishments. The imputation can be improved by highly sophisticated methods that, for instance, take into consideration the industry and the enterprise size class. However, when data on jobs, occupations and income are combined from different registers, it is not always certain that the occupation and branch of industry describe the same employment relationship. This can cause consistency problems.

At their fastest, data from administrative records and registers can become available a few weeks or months after the reference period (the Vehicle Register, the register of job applicants, the Population Information System and the

taxation payment control data), while the completion of the slowest ones takes as long as one year (e.g. the taxation database). Timeliness is affected by the length of time it takes before the event is registered and the frequency at which data are updated in the register. Population information is updated daily, whereas data on income are updated once a year. However, if a person who has moved neglects to notify the authorities about it, the register data are not updated. The completion of a building, i.e. the point of time when it is entered into the building register, is a problematic concept, because the building may have been occupied for a long time before it is declared in the final inspection as having been completed.

Timeliness also has an impact on the exhaustiveness of data. For example, when taxation payment control data are first received by a statistical authority, they cover about 80 per cent of the final turnover of enterprises and 75 per cent of the final wage bill paid by registered employers. It is difficult to know whether the return for an individual enterprise is missing because it is delayed or because the enterprise has ceased to operate. Therefore, data for a given month are requested for official statistics repeatedly for six months until they are exhaustive. This does not eliminate the challenge of timeliness, however. In the case of monthly indicators, the panel method was the first answer to this challenge of timeliness.

Annually produced structural business statistics are compiled by combining data obtained through direct inquiries with data in the business taxation register and the Register of Enterprises and Establishments. Data are only collected direct from a couple of per cent of all enterprises. Monthly turnover and wage sum indicators are compiled by combining data obtained through direct inquiries with data from the register of value added tax (VAT) and employer payments and the Register of Enterprises and Establishments. After this, data are then collected direct from under one per cent of all enterprises. Despite the similarity of the architecture for collecting data for structural statistics and for monthly indicators, the methodological challenges of these two sets of statistics are different. In the structural statistics, imputation plays a major role in the methodology used for correcting deficiencies in the administrative data in order to render them suitable for statistical use. By contrast, panel methods are the main tools for rectifying problems relating to timeliness and undercoverage in monthly indicators. The quality of these statistics has been improved by persevering methodological work.

Guidelines

Preconditions for the exploitation of administrative records and registers

Administrative records and registers must fulfil certain preconditions before they can be used in statistics production. Not all the individual preconditions are absolutely necessary, but they should always be considered from the perspective of other preconditions and alternative collection methods. In general, all administrative records present challenges in quality for compilers of statistics. Experience has shown that these challenges can be met with persistent methodological work as well as cooperation of the data system administrators.

Content and concept preconditions

- *Exhaustiveness:* The register in use should cover the whole intended target population (see Section 1.2.3).
- *Unit specificity:* The basic register data have to be unit-specific. Enterprise mergers and diffusions create another challenge, as their treatment within public administration is not necessarily compatible with the requirements of official statistics.
- *Correspondence with user needs:* Register data have to be relevant for statistical use. The concepts used in register data must be sufficiently uniform with those employed in statistics production (see Section 1.2.3). Often the data in the administrative records have to be regarded as substitution variables, that is, substitutes for variables that would otherwise be difficult to obtain. Therefore, the data have to be converted on the basis of some assumptions (theory) to meet the needs of statistical data.

Reliability

- *Coverage:* The register in use must cover the intended target population as well as possible (see Section 2.4). No absolute coverage percentage can be defined, as no system is completely exhaustive and most systems also have overcoverage, that is, units that would not belong to the target population. The coverage of population censuses varies by country at around 95 to 100 per cent. If the coverage of the registers used for compiling a register-based census is weaker than this, their use is problematic.
- *Reliability of data:* Individual data should be as reliable as possible (see Section 1.2.3). This concerns both code data and attribute data.
- *Correctness of data:* The system of updating the register should also be exhaustive. For example, the population statistics system obtains data on births, deaths, marriages and divorces quite reliably but changes of address are neglected. Similarly, occupational data are updated only in connection with the address updates and significant changes are made to dwellings without building permits. Cohabiting couples considered equivalent to married couples have to be inferred statistically.

Timeliness of register data

- OSF data have to be up-to-date (see Section 1.2.3). Timeliness is affected by the time it takes before the event is registered and how often the data are updated in the register.
- Co-operation between different statistical authorities and methods for controlling shortcomings in timeliness must be improved and developed in statistics production. Because administrative records are by definition not collected for statistical purposes, statistical authorities cannot have a direct influence on problems related to timeliness.

Technical preconditions

- *Documentation:* Sufficiently good and detailed descriptions should be made of administrative records, allowing the user to gain a picture of the operation, structure and information content (see Sections 3.1 and 3.2).

- *Data processing:* The register has to be in electronic form to permit its use for statistics production. Manually processed registers in card-file form, including employee registers of enterprises and membership lists of associations, can seldom be used in statistics.
- *Codes:* It is essential that the register units have commonly used codes.
- *Classifiability:* Attribute data should be coded or in numerical form so that they can be classified. If the data are in character format, such as an occupation, they can be coded by means of automatic coding, for instance. Some character value headings require manual processing (seeSection 2.3).

Administrative preconditions

Keepers of administrative records and/or registers are under obligation to release data to Statistics Finland. The Finnish Statistics Act (280/2004) grants Statistics Finland the right to obtain the data needed for compiling statistics from authorities and several other organisations (see Section 1.1.1).

Costs of register data

According to the Statistics Act (280/2004) "When data are collected for statistical purposes the primary exploited sources shall bedata accumulated in administering the tasks of general government and those produced as a consequence of the normal activities of employers, self-employed persons,corporations and foundations". The costs for the exploitation of registers must not exceed those for any other alternative collection method. Statistics Finland generally compensates register keepers only for any additional costs incurred from the utilisation of data.

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2.6   Sampling Methods

Scope and purpose

For various reasons, sample surveys often substitute censuses in statistical surveys. The costs can be reduced, one can obtain more profound information on the needed phenomenon and the results can be estimated faster since not all population units have to be investigated. They can also be used to obtain additional information to existing data from registers or other administrative sources. A properly designed sample survey will provide the users with accurate parameter estimates for the variables to be studied and at the same time the overall response burden may be reduced.(Kish, 1965; Särndal et al., 1992)

Modern sampling methods are based on randomisation principles and are, thus, called probability sampling methods. Their advantage is that they allow extrapolating the sample results to the whole population and calculating statistics concerning the reliability of these estimates. The choice of a sampling method is dependent on the phenomenon of interest, survey design, population characteristics, sampling frames available, data collection methodology, as well as costs.

Principles

Sampling methods can be classified in many ways. The first one is based on the way data are collected: direct from the elements (ultimate sampling units) or from their combinations called clusters. Another classification is based on the use of auxiliary information for the sampling design from the sampling frame or some other administrative source. Furthermore, the choice may depend on a cost-benefit analysis between the costs and statistical precision.

Element-level sampling methods are often statistically efficient and easily applied, especially when samples are drawn from register frames. Cluster sampling methods are in general not statistically as efficient as element sampling methods but they are often more cost-effective.

The following sampling methods can be applied equally well to element sampling and cluster sampling. After this we will discuss some frame-related topics, such as stratification and clustering.

Simple random sampling

The basic sampling method is simple random sampling (SRS), which is a self-weighting sampling design, meaning that all the elements in a population have an equal probability of being included in the sample.

A convenient way to draw a simple random sample is to assign each population element a (pseudo) random number, sort the data set according to the random numbers, and finally select the required sample size from any sequential part of the population, normally beginning from the first element and continuing until the desired sample size is reached. The selection is based on a random number attached to each population element, thus, no auxiliary information is used in the sampling procedure. (Lohr, 2003). Simple random sampling is commonly used in surveys of individual persons or households. It also serves as a reference sampling method when assessing the statistical efficiency of other sampling designs. (Kish, 1965)

Systematic sampling

Systematic sampling means a process where the population elements are selected using a fixed interval throughout the frame with a random start. The method was developed to select samples conveniently from manual drawer files but it is also useful for today's computer databases.

Systematic sampling applications use auxiliary information from the sorting order of the population. If the elements are in a random order, systematic sampling practically matches simple random sampling. However, the frame can also be arranged according to one or more auxiliary variables. In these cases the method is called implicit stratification and it will yield more accurate results than the random order. If, for example, the focus of interest is a spatially correlated phenomenon among the Finnish population, systematic sampling from the geographically sorted population register (e.g. domicile code in the population database) would produce samples that would be correct.

However, if the population contains some (hidden) order or sequence, systematic sampling may yield a sample that consists of very similar elements that do not reflect the true population variation and thus the sample can lead to erroneous or biased results.

Probabilities proportional to size (PPS) sampling

If a sample is selected from a skewed population with very different unit sizes there is a way to improve accuracy by giving each population element an inclusion probability that is in relation to the size measure. This leads us to the probabilities proportional to size (PPS) sampling method (Särndal et al., 1992; Lehtonen and Pahkinen, 2004).

PPS sampling requires that all population elements have a size measure which is used to calculate the selection probabilities. Sometimes the largest population elements are so dominant that their selection probability becomes one. Such elements are selected with certainty and the selection probabilities of the remaining population elements must be recalculated.

PPS samples are statistically very efficient. However, there is a drawback in that they are often only suitable for analysing variables that are used as a mea-

sure of size or ones that have a high positive correlation with the measure of size.

Division of sampling frame into subpopulations

The sampling frame can be divided into mutually exclusive subgroups with suitable auxiliary information. There are two different reasons for doing this. If the division is made so that each subpopulation is further dealt with as a sampling frame of its own we speak about stratification. On the other hand, the subpopulations may serve as "higher level" combinations of our units of interest and we select a sample of them but ultimately investigate the elements inside each one of them. In this case we speak about cluster sampling.

Cluster sampling

Sometimes it is a good idea to utilise natural combinations of the elements to be measured in the sample selection. Such natural combinations can be e.g. households, establishments, schools or some other units that contain the elements to be measured. If all elements in each selected cluster are investigated we speak about one-stage cluster sampling. Alternatively, the selected cluster may serve as a further set for subsequent sub-sampling. In the latter case we speak about two or even multi-stage cluster sampling. As an example we can consider a study on working conditions: the first-stage sample may consist of enterprises whose employees are the elements to be measured. If all employees in each enterprise are included, our design is a one-stage cluster design, but if we sub-sample some of the employees by occupation, etc., we obtain a two-stage cluster design.

Cluster sampling reduces data collection costs because it obtains data on many elements from each selected unit. However, it has the drawback of increasing sampling variance when compared to simple random sampling. The loss of efficiency is caused by the similarity of the elements in the clusters, known as intra-class correlation. Thus, cluster samples do not necessarily contain as much population variability as those selected with the SRS design.

Stratified sampling

Stratified sampling means that the population elements are divided into homogenous subpopulations called strata with the help of auxiliary variables. With a skewed population stratification (or PPS sampling) it is always desirable to obtain precise information from the largest units.

Stratification basically requires that all population elements have information permitting the construction of the strata. Ultimately, each element can only belong to one stratum. However, sampling designs or sampling rates can vary between different strata. Sometimes all elements in a certain stratum must be investigated, as in a census, while sampling only may be applied to another stratum. In household surveys, fairly basic demographic stratification criteria are used, e.g. geographical area, age or gender.

The sample sizes of various strata must be calculated as an additional step in stratified sample selection, known as allocation. If all strata have the same sample size we speak about equal allocation. Equal allocation is particularly useful

for stratum-wise comparisons. If the sample sizes are proportional to the population shares of all strata we speak about proportional allocation. It is slightly more efficient than the basic SRS design and guarantees that even the smallest strata have their proportional share of elements in the sample. If the population is highly skewed, either optimal or power allocation can be used. Both methods direct the sample to the largest or the otherwise most important units, and are statistically very efficient (Lehtonen and Pahkinen, 2004). In extreme cases the largest units are selected with probability one, known as self-representing strata. The estimation would become unreliable without information from such units.

Complex sampling designs

Complex sampling designs consist of combinations of basic designs. Typically, a complex sampling design is a stratified multi-stage cluster design where the first-stage sampling units are selected with PPS sampling from geographically ordered or otherwise classified clusters. The selection of the ultimate units (elements to be measured) is almost always carried out with SRS or systematic sampling design. Careful combination of stratification and clustering and optimal use of the information from various sampling stages can provide a very cost-effective sampling design.

If the population is in the form of register or other administrative data it may be possible to use a two- or multi-phase sampling design (Särndal et al., 1992). The first-phase sample is often a large sample called master sample where auxiliary information is merged from a survey or other sources. The master sample is further analysed and finally used as the second-phase sampling frame to select the final sample. Multi-phase sampling allows efficient use of auxiliary information for targeting the sample to the desired phenomenon and control of various effects from that information in estimation.

Quota sampling methods

Quota sampling refers to a variety of non-probability sampling methods. They are applied especially in market research with the aim of obtaining a certain number of a predefined type of respondents, i.e. to fill quotas. Quota sampling is prone to selection bias because contacting and the decision to participate may be affected by interest in the topic of the study.

Cut-off sampling is fairly common in business surveys. One has to define a threshold, most often the lower threshold, so that the units smaller than it are removed from the frame and thus cannot be selected. Thus, cut-off sampling is problematic because the estimated results contain undercoverage. In the case of an old sampling frame, population changes may have been substantial and cut-off samples could yield biased results. Therefore, use of cut-off sampling should always be mentioned in an analysis of the coverage and generalisation of the statistic in question as well as the reason given for the choice of the threshold.

Determination of sample size

Sample size is affected by various determinants: the precision at which parameter estimates are required, the way in which small domains and sub-domains are

to be covered (i.e. classification), and population heterogeneity. Naturally, the available resources will also influence the sample size. It can be said that precision, as well as accuracy, will improve when sample size is increased, because the standard errors of the estimates will decrease. However, the improvement is not proportional to the increase in the sample size but occurs more slowly.

Reliability

The reliability of samples is measured with statistical quality indicators. Each probability sampling method has its own formula of sampling variance which primarily describes the variability of point estimates due to the sampling design and sample size. The sampling variance is further used to calculate some commonly used quality measures like standard error, coefficient of variation and confidence interval (or error margin). The quality measures are used in statistical inference as well as when considering the publishing criteria for the results.

In addition to statistical quality indicators one should also pay attention to other error sources in sample surveys. These include e.g. coverage errors in the frames, non-response and possible measurement and processing errors. The presentation of quality indicators is discussed further in the Section describing the quality criteria of Official Statistics of Finland (see Section 1.2.3).

Sample co-ordination

To keep the response burden down, successive samples in regularly repeated surveys should also be co-ordinated. Positive co-ordination means the inclusion of as many of the same units as possible in successive samples. This is typical in panel surveys when there is a need to estimate change as reliably as possible. On the other hand, with negative co-ordination one tries to avoid the selection of same units into successive samples in order to reduce the response burden. The co-ordination should be done so that it causes no bias in the results. If this is impossible, the results should be adjusted by proper statistical methods.

The aim in certain enterprise studies is to investigate changes in the population, and in such cases it is important that a sufficient number of the same units are included in successive samples. To avoid excessive burdening of the same units, the units should be rotated in and out, and various studies should be co-ordinated so that the same units are not included in successive or concurrent inquiries. This co-ordination will ensure that the response burden is distributed as evenly as possible over the entire enterprise population. However, the sample co-ordination cannot be applied to the largest and most dominant units. Those are often selected to all samples to guarantee the coverage of the estimates. (Teikari, 2001).

Recommendations

- One should always apply probability sampling methods. Both simple random sampling and systematic sampling are proper basic methods for multi-purpose surveys when the sample cannot be targeted to certain subpopulations.

- Systematic sampling is a practical method when samples are selected from a register or other administrative data source. In this case the sorting order of the frame can yield samples with correct population distributions.
- Stratified sampling is recommended when there is a need to obtain elements from certain subpopulations in the sample.
- Simple random sampling is not a proper sampling design for business surveys because of the skewness of the business population. The most often used sampling method in business surveys is stratified sampling where the stratification is carried out by industry and size class. In addition, PPS sampling methods are used. The largest elements are often selected as certainty units.
- One has to carefully consider the benefits of complex sampling designs against their drawbacks and technical difficulties. Two and multi-phase sampling designs can be efficient both in terms of costs and statistical accuracy. On the other hand, multi-stage cluster sampling designs can be very inefficient from the statistical point of view.
- When dealing with repeated sample surveys, successive samples must be co-ordinated to reduce response burden, especially in panel and business surveys. There is a practice to relieve respondents of surveys of individual persons and households from similar surveys over a period of time.
- One has to measure, analyse and document sampling variability and other error sources. The most important survey parameter estimates must be reported with their respective standard errors, design effect estimates, response or non-response rates as well as other proper quality indicators.
- Sampling weights must be attached to sample survey data. Weighting procedures are described in Section 2.11, while estimation and statistical analysis methods for survey data are presented in Section 2.12.

Documentation

It is important to report the definition of the target population of a sample survey, the restrictions applied to it and the reasons for them, and an exact description of the sampling frame as well as the sampling method. The quality reports must contain the formulas of the most important estimators, various sources of variability and errors – especially non-response error – and the need for adjustments in weights caused by them. Detailed methodological descriptions in quality and method reports should include the sampling variance formulas based on the correct design as well as an analysis of non-response and other error sources to facilitate as exact calculations as possible of standard errors and other quality indicators.

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2.7 Data Collection Methods

Scope and purpose

This Section examines the properties of different data collection methods and factors that influence the choice of the appropriate method. A data collection method refers to both the selection of sampled units and the way data are collected from them. All data collection projects will be called surveys in this Section. Business surveys and surveys of individuals or households differ from each other primarily due to differences in their target populations. The methodological differences are not extensive, however, so the focus of interest here will mainly be sample surveys of households or individuals rather than censuses or business surveys.

The choice of data collection method is not an isolated decision in survey design, as it has an impact on the whole statistical survey process, like the survey design, the selection of sampled units, non-response rate and the cost of data collection. The data collection method also has a bearing on the timetable of the survey and on the quality of the final results as well as on the design and preparation of the questionnaire. Different data collection methods allow for very different sample sizes. The number of respondents determines the degree of reliability with which the results may be generalised to various population segments (see Section 2.6).

Three factors are usually considered when surveys are classified into different types: the general survey design, the data collection method, and the technology for data acquisition.

Surveys can be divided into longitudinal surveys and cross-sectional surveys. In longitudinal surveys, data are collected more than once from the same sampling units, at more or less regular intervals. In cross-sectional surveys, on the other hand, data are collected only once. In longitudinal surveys, data may be collected in the same way each time, or the data collection method may vary. A panel survey is a special type of longitudinal survey. Statistics Finland's best known personal panel survey is the Labour Force Survey, while the best known business panel survey is the Consumer Prices Index Survey.

It is important to make a distinction between the mode of administration of data collections and the technology applied in data acquisition. In the adminis-

Table 2.1 Survey types by mode of administration and data capture instrument

Mode of administration	Data capture instrument	
	Paper questionnaire	Electronic questionnaire
Self-completion	Self-administered questionnaire, diaries	Internet questionnaire (CAWI), Computer Assisted Self Interview (CASI)
Interview	Interviewer-administered questionnaire	Computer Assisted Personal Interview (CAPI), Computer Assisted Telephone Interview (CATI)

tration modes one distinguishes whether interviewers are used (interviewer-administration) or whether respondents are to answer by themselves (self-administration). On the other hand, the data collection method determines the mode in which the collected data are documented, in other words, whether a paper questionnaire or some kind of electronic data capture instrument is used.

Administration modes can be divided into self-administration, in which respondents themselves read the questions and fill in the questionnaire, and interviewer-administration, in which interviewers read out the questions and mark down the responses. Interviews may be conducted either by telephone or face-to-face. In both administration modes two technologies of data acquisition may be applied: the responses are either marked on paper questionnaires or on electronic media (see Table 2.1).

Principles

The goals of a survey should guide the choice of the mode of administration, and not vice versa. The selection criteria should be the implications of the various modes, which are different. The points of departure in survey design should be based on the needed accuracy of the resulting estimates and on an assessment of the required sample size or the number of respondents in the final sample. In most cases, the reliability of a survey increases as the sample size increases. Another important factor is the quantity and quality of information obtained from each respondent. For example, a long interview should not be conducted by telephone. Similarly, a face-to-face interview is the only option if objects such as visual scales or pictures need to be shown to respondents.

A crucial factor in survey design is often the date when the data should be available for further use. If the final deadline is known, the deadlines for intermediate stages can also be determined. It should also be borne in mind that surveys require co-operation with other parties. Therefore, the planning of the timetable usually calls for agreements and adaptations.

Production schedule

All the stages of a survey have to be taken into account in the planning of the production schedule. The number and the emphases of the required stages vary from survey to survey. For example, the elaboration and testing of an electronic data collection instrument requires more time than does the designing and printing of a paper instrument. On the other hand, the data become available more quickly for further use after a well-designed electronic data collection, be-

cause no further data entry is needed and the data are checked automatically by the rules programmed into the electronic questionnaire.

Schedules of other parties also affect the production schedule of a survey. Especially in interview surveys, the total workload of the field interview unit or the CATI centre has a salient impact on the date and duration of data collection. In addition, it is very important that interviewers have been trained adequately and that their work instructions have been compiled carefully. The availability of other resources, such as those for data editing and data entry, also has an impact on the production schedule.

The duration of data collection depends on the administrative mode as well. As a rule, a survey conducted with CATI is faster than a face-to-face interview surveys or a postal survey. With postal surveys the duration of data collection may be difficult to anticipate. In all eventualities, the duration of the fieldwork depends on the number of reminders that are to be sent to units not responded.

Non-response
The duration of a survey and the response rate are often inversely related. The more time and resources one spends during the fieldwork, the higher the response rate will be. The accepted non-response rate is always a compromise. The often quoted basic thesis is that only two out of the three requirements of low costs, low non-response rate and fast timetable can be achieved in one survey.

Administration mode has an impact on the non-response rate: non-response being highest in postal surveys. Therefore, interviews are more popular in social surveys nowadays. In Internet surveys, non-response and frame undercoverage are major problems.

Many other factors also influence the non-response rate (see also Section 2.9). For example, the duration of the interview and the complexity of the questionnaire as well as conducting a survey during a holiday season usually increase non-response. In addition, the topic of the survey may have an impact on the response rate. For example, surveys concerning health matters tend to produce higher response rates than other surveys.

Quantity and quality of collected data
The total amount of collected data, or the data volume, can be measured by the number of sampling units multiplied by the number of data items collected from one unit. Both factors have an impact on the total duration of the survey. Especially when using a paper questionnaire, the amount of the collected data has a direct impact on the required adjustments and data processing and, in consequence, on the overall duration of the survey.

The data volume limits the possible data collection methods. It is generally held that the duration of a telephone interview should not exceed 30 minutes. A face-to-face interview may take considerably longer. On the other hand, there are also good experiences from much longer telephone interviews when respondents are easy to motivate. In postal surveys non-response increases quickly with the number of questions asked.

In an interview survey, the interviewer fills in the questionnaire for the respondent. In a postal survey the respondent reads the questions and instructions himself or herself and replies to them as he or she understands them. The advantage of the interview mode is that the interviewer knows precisely what is asked and how the responses should be entered and ensures that all the questions receive an acceptable response. In addition, the interviewer is able to move fluently and quickly from one question to the next because of familiarity with the questionnaire. Postal questionnaires generally contain far more errors.

A special advantage of centralised telephone interviewing is that the progress of the survey and its quality can be constantly monitored. Interviewer training, supervision and distribution of supplementary instructions are also much simpler to implement than in a decentralised interview system.

Pros and cons of different data collection methods

Longitudinal surveys are more reliable for describing change – or the dynamics of society – than repeated cross-sectional surveys. Additionally, longitudinal surveys may save resources because the same sample, and at least partly the same data collection instruments can be used. The practical routines become more efficient. A disadvantage in some cases is the panel effect, meaning that respondents become aware of belonging to a panel and change their behaviour or responses. In face-to-face interview surveys, fieldwork and its organisation requires more resources and generates more costs than would be the case with telephone or postal surveys. On the other hand, the presence of an interviewer makes the interview situation controllable because a face-to-face interview makes it possible to clarify both questions and answers. Face-to-face interviewing is the most expensive data collection mode.

Showing pictures or using visual scales to assist the interview is ruled out in telephone interviews, unlike in face-to-face interviews and postal surveys. On the other hand, the influence of the interviewer can be greater in a face-to-face interview than in a telephone interview. In addition, a visit from an interviewer increases the burden on the respondent because it requires more arrangements from him or her than a telephone interview.

One of the advantages of a postal survey is low cost. It is also easier to answer sensitive questions on a paper questionnaire than in a telephone or a face-to-face interview. Choosing from several alternative replies (more than 6) requires visualisation, which is possible only in postal surveys and face-to-face interviews.

Computer assisted data collection offers abundant new possibilities compared to paper questionnaires (computer assisted interviewing methods are listed in Table 2.2). For example, it facilitates the use of diverse question and response combinations. Different question routings for different respondents are easy to implement, and it is possible to attach background information, e.g. from registers, for each sampling unit. The coding of answers, e.g. by occupation, is also possible during the interview. Computer assisted data collection lessens the amount of data entry errors and makes the completion of the collected material faster, because the interviewer or respondent enters the data directly into a computer during the interview, and checks for correctness and logical consistency can be programmed into the questionnaire. Computer assisted

Table 2.2   Taxonomy of Computer Assisted Interviewing methods [1]
(de Leeuw and Nicholls, 1996)

Specific method	Computer assisted form
Face-to-face interview	Computer Assisted Personal Interviewing (CAPI)
Telephone interview	Computer Assisted Telephone Interviewing (CATI)
Self-administrated form	Computer Assisted Self Interviewing (CASI)
Postal survey	Web-interview CAWI, Disk by Mail (DBM), Electronic Mail Survey (EMS)
Panel or diary survey	Computer Assisted Panel Research (CAPAR), Teleinterview, Electronic diaries
Interviewer present	Computer Assisted Self Interviewing with Interviewer present (CASIIP) Question Text on screen: Visual (CASI-V) Text on Screen and on Audio (CASI-A)

NB. Web interview CAWI has been added to the table. It does not appear in the original table.
[1] General name: (Computer Assisted Data Collection), CASIC (Computer Assisted Survey Information Collection), CAI (Computer Assisted Interviewing)

methods are employed in nearly all telephone and face-to-face interviews carried out for Statistics Finland.

Self-administered electronic questionnaires have recently been introduced. This instrument may be either an Internet questionnaire or an electronic questionnaire sent as an email attachment. The main problem of electronic data collection in surveys on individuals or households is coverage and the lack of adequate sampling frame. Not everybody has access to the Internet and there is no complete list of email addresses.

With regard to sensitive questions, a self-administered questionnaire may produce more reliable responses than an interview, and it may also reduce non-response.

Even in a face-to-face interview, the preferred option is sometimes to let the respondents themselves enter the answers to some or all of the questions. The rationale is that interference by an interviewer may influence the responses. However, the influencing mechanism and its effects are usually not fully known.

Electronic self-administered data collection instruments are applicable only to business surveys and even in those circumstances the question of whether all business enterprises have the capacity to respond adequately should be given careful consideration. For surveys on individuals and households, Internet questionnaires can be used as an additional data capture instrument.

Guidelines

- The requirement at Statistics Finland is that the response rates in surveys of individuals or households must be calculated from the actual sample group.
- Usually over 90 per cent of sampling units in surveys conducted by Statistics Finland can be contacted for face-to-face interviews, and with regard to telephone interviews, a telephone number can be found for nearly 90 per cent of respondents. The final response rate usually exceeds 80 per cent in face-to-face interviews, and in telephone interviews it approaches 80 per cent. The rate in postal surveys usually remains well below 70 per cent. Sta-

tistics Sweden has gathered guidelines to minimise non-response (see Japec et al., 2000).

- Statistics Finland has two interviewer organisations, one for field interviews and one for CATI interviews. A schedule for data collection must always be agreed in advance with these organisations.

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2.8 Questionnaire Design and Testing

Scope and purpose

Collected data should be recorded on a standardised instrument. The term instrument is often used because the terms form or questionnaire usually convey the idea of a paper questionnaire, whereas most questionnaires are nowadays electronic. Nevertheless, the term questionnaire will be used in this Section. On the questionnaire, a requested item can be indicated either in the form of a question, e.g. "What is your turnover?", or simply by the name of the data item, e.g. "Turnover".

The following instructions concerning operational principles and questionnaire design have been drawn up mainly for surveys on individuals or households, but they also apply largely to business surveys. Questionnaires intended for establishments, and those intended for households or individuals do not differ much in their design principles. The differences mainly originate from the substance of the survey and from the nature of the respondents and the response process. In business surveys, the questions usually deal with facts and respondents may be expected to be familiar with the concepts used, whereas in surveys of individuals or households questions may concern a great variety of topics, and respondents' familiarity with even the most common concepts cannot be taken for granted. Therefore, one may expect that the respondents' knowledge of the matters in hand will be better in business surveys than in surveys of individuals or households. Therefore, questionnaires with a limited number of instructions can often be used in business surveys.

As to their design, questionnaires, or instruments, may be classified according to two factors: the administration mode (who enters the data), and whether the instrument is an electronic one or a paper version (the technology applied). The resulting four form types set different requirements on their design (see Table 2.1).

In this context the most important distinction is that between self- administered questionnaires and interviewer-administered questionnaires.

Principles

Self-administered questionnaires are designed bearing in mind the respondents, while interviewer-administered questionnaires are designed bearing in mind both the interviewers and the respondents. The central principle in the designing of any question is that the respondent:
- should clearly understand what he or she is being asked,
- can be expected to know the answer to the question,
- understands how the answer should be given.

In order to minimise variation caused by interviewers, a standardised interview method is strongly recommended to ensure that all interviewers present the questions in the same manner. Therefore, presentation standards guiding the interviewers' behaviour and question presentation and probing are employed in

interviews. With long and complicated interviews, interviewers usually have to be trained before the survey, and this may prolong considerably the total duration of the survey.

The researcher is always personally responsible for the functionality of a questionnaire. Advice and help on questionnaire design are available from Statistics Finland's Survey Research Unit and SurveyLaboratory, for instance. Other units also have experience in the designing of data collection instruments.

Research ethics require that respondents must be informed at the beginning of the questionnaire or in a covering letter why the survey is being conducted, who is financing it, and the data source of the sample. The beginning of the questionnaire should also contain a facility for checking that the right person is answering it. In all Statistics Finland's surveys an advance letter should be sent to every respondent telling about the forthcoming contact and about the substance of the survey.

One operational principle of Statistics Finland is that the response burden should be kept as low as possible. The Finnish Statistics Act requires that (see Section 1.1.1):

When data are collected for statistical purposes the primary exploited sources shall be data accumulated in administering the tasks of general government and those produced as a consequence of the normal activities of employers, self-employed persons, corporations and foundations. (Statistics Act, Section 4)

An authority producing statistics shall see to it that respondents are only requested to provide those data that are necessary for the production of statistics. (Statistics Act, Section 5)

The data shall be collected in a manner that is economical and causes the respondents the least amount of inconvenience and cost. (Statistics Act, Section 4)

Guidelines

Questionnaire design

- A number of books have been written about the designing of questions both for postal and interview surveys. Some are listed in the bibliography at the end of the Section. These sources provide essential reading for anyone designing questionnaires.
- Standard definitions of concepts, classifications and questions are applied in the surveys of Statistics Finland. They are explained in the guidelines "Guide to statistical interviewers" and "Designing standards for interview questionnaires".
- It is usually better to try to use questions or question batteries that have been previously tested and found to be good. A prerequisite for the comparability of surveys is use of the same questions.

- Electronic and paper questionnaires differ considerably in their design. For example, an electronic questionnaire must be programmed, and therefore one must name a person responsible for the programming and set a time limit for the task.
- If a survey is conducted using several languages, sufficient time and resources should be allocated for the translation of the questionnaire, working instructions and other material. The translation of an electronic instrument should take place only after the Finnish version is completed and tested.
- The designated respondent has to be indicated unequivocally in a self-administered questionnaire. However, in business surveys the requested information concerns the business. The identity of the responding enterprise is essential, but less so the identity of the person providing the information. Clear filling instructions and a return address must also be provided on the cover page or in the covering letter.
- A paper questionnaire must be easy and convenient to complete. First, it should not be too cramped from the point of view of data entry. Second, it has to be clear, smooth and logical. Data entry is easier if the spaces for responses are placed in one column, e.g. in the right hand margin.
- The name of the survey and the names and direct telephone numbers of contact persons must appear clearly on all covering letters, so that inquiries may be directed immediately to the right person. Copies of the covering letters for active surveys should also be sent to the telephone switchboard.

Questionnaire testing
- A wide range of methods can be used to test and evaluate a questionnaire. The designer may carry out a test interview and evaluate the questionnaire with the help of some of his or her colleagues. The testing of an electronic questionnaire is an especially demanding and time-consuming task because two aspects require attention: the technical aspect and the content aspect.
- Conducting a pilot study can be highly worthwhile whenever possible. A pilot study has the advantage that all stages of the data collection process can be tested.
- It is recommended to consult and use the services of Statistics Finland's SurveyLaboratory in the designing and testing of a new or redesigned questionnaire.
- Focus groups provide advance information on the subject matter of the statistical survey, and they help to establish an overall picture of the concepts and expressions used by respondents. Focus group discussions should be recorded.
- Cognitive one-to-one interviews are used to examine the respondents' thought process when they are being asked survey questions. The aim is to find out whether the respondents understand the questions, can recall the information and are able to provide acceptable answers.
- An expert panel should be engaged to discuss a draft version of the questionnaire in the light of their knowledge of human cognitive processes. A questionnaire coding manual can also be used.

- A split panel test, in which two or more optional questionnaire versions are compared experimentally, can be used to evaluate the impact of wording, question order and data collection method.

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2.9   Survey Response

Scope and purpose

In statistical surveys, the number of valid observations is often reduced at various stages of data collection for different reasons. This loss of data in direct data collection arises from the fact that the requested data are not obtained from some of the selected units. This is also referred to as survey non-response. This is a major problem that typically occurs in voluntary postal and interview surveys, but it cannot be avoided even in surveys to which respondents have a statutory obligation to answer, such as population and enterprise censuses, where the execution of data collection has been optimised. In certain statistical surveys where data can be obtained by an indirect method, from administrative registers or records, missing data is a minor problem whereas diverse problems arise from frame and measurement errors, which can be substantial.

Survey non-response is commonly divided into two main categories: item non-response and unit non-response. (Groves and Couper 1998). Item non-response occurs when some items or parts of an otherwise valid questionnaire form are missing, i.e. the data vector remains incomplete. It may arise for a variety of reasons, such as inability to respond, lack of knowledge, unwillingness to respond, or from inconsistent responses resulting from the failure of some answers to pass the data editing rules, or defective logical checks. In the case of unit non-response data are missing with respect to all the variables.

Non-response influences the survey results. Even if the groups of respondents and non-respondents are similar in respect of both the background variables and the study variables, the effect will be increased sampling variance due to the reduced number of observations. However, in most cases the non-respondents and respondents are not similar, resulting in an additional error source due to non-response. The non-response is then particularly harmful, as it can cause bias in the survey results. It should be pointed out that full censuses are also affected by non-response.

Principles

The most important principle is to produce unbiased statistics of the best possible quality. The response rate should be high and the sampling variance small. These goals can be achieved through careful design of the data collection, careful testing of the measurement instruments, including the questionnaire, and good execution and supervision of the fieldwork and subsequent data processing. Numerous constraints must be respected, such as finance, deadlines and available human resources. Particular consideration must be given to the organisation of the fieldwork, as this constitutes the main interface between the respondents and the data collecting organisation.

The reasons for unit non-response are conventionally divided into three main categories: non-contact, refusal and other reasons. The general principle is to keep the overall response rate high, meaning that all these three categories must remain small. However, a data collecting organisation must bear in mind that

non-contacts and other reasons are categories where one may be able to reduce non-response considerably. In voluntary surveys, refusal is often affected by the topic of the survey. Little can be done to influence the decision of selected individuals, households or businesses, but interviewer skills can, of course, be improved by training interviewers in refusal conversion techniques and on how to motivate people to participate in surveys. In statutory surveys the data collection organisation strives to keep the refusal rate particularly low because the risk of skewed response, and thus of biased survey results, is particularly pronounced.

After the fieldwork it is important to check and edit the data and compare the distributions of both the study and background variables with the population distributions. This facilitates the assessing of the reliability of the results and the adjusting of (some) erroneous results and thus helps to reduce bias. Data users need a careful quality report describing the data collection, the properties of the resulting data and a detailed analysis of the non-response, together with analyses of its presumed effects on the results. The non-response error, including the eventual bias, should always be adjusted for by appropriate statistical methods (see Section 2.11).

Guidelines

- The frame population and the potential sampling frames should be carefully examined and compared with the target population.
- The fieldwork and other survey methods should be appropriate and correctly targeted at the population. Likewise, the timing, advance letters and survey brochure, instructions, data collection methods and tools, and eventual technical devices and other tools should be carefully designed and aimed at reducing the response burden.
- The data collection methods and tools should be carefully tested prior to the actual fieldwork.
- The sampling and estimation methods should be such that unbiased results are obtained as far as possible.
- Persistent efforts should be made to trace non-contacted units, and refusal conversion techniques should be applied. Refusals must be kept to an absolute minimum in statutory surveys.
- When skewed populations are being investigated, e.g. in business surveys, the most influential units should be persuaded to respond.
- The characteristics of the response and non-response groups must be compared, and non response analyses should be conducted. The final data set should be adjusted to correspond to the frame population as well as possible by techniques such as re-weighting or imputation (Section 2.10 and 2.11).
- Non-response should be measured, documented and reported in absolute and structural as well as relative terms using internationally accepted standards. Data users should be informed of its possible effects, such as skewness and other error sources. It is important to monitor non-response rates by category in continuous surveys so that changes in public opinion or fieldwork methods can be taken into consideration.

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2.10 Statistical Editing and Imputation

Scope and purpose

Statistical editing and imputation are used to detect and correct erroneous data. These phases are usually carried out after data collection, but can also be implemented via built-in checks and routines in electronic data collections. The methods and applications used in editing and imputation are still being developed. Currently, miscellaneous terms are used, both in literature and in practice. Standardisation of the terminology is clearly needed to give a common understanding of the terms, so that meaningful and efficient development of the methods can continue. The two concepts discussed here are defined (Eurostat, 2005) as follows:

- *Statistical editing is* the application of checks that identify missing, invalid or inconsistent entries or point to data records that are potentially erroneous.
- *Imputation* is the process used to resolve problems of missing, invalid or inconsistent responses identified during editing. Imputation is performed by replacing some of the responses or missing values on the record being edited to ensure that a plausible, internally coherent record is created.

The United Nations Statistical Commission and the Economic Commission for Europe (UN/ECE, 2000a) have also provided comprehensive documentation for editing and imputation concepts, principles, techniques, and methods. Data editing is thus closely connected with imputation. Data editing methods are

mainly used to identify erroneous or inconsistent data values; and imputation is used to correct these and missing values.

More precisely, *statistical editing* refers to activities by which statistical data are checked with respect to both individual values and mutual compatibility between the values for different variables. The implementation should be started at the lowest level of data, that is, at the micro level, followed by data assessments at more aggregated levels. One must aim for mutual compatibility across levels in the final data. All data must be examined with care in order to avoid significant distortions to survey results and distributions.

Imputation implies that missing or erroneous (e.g. edit failures) values for variables are replaced with imputed values, which have to be as correct as possible in regard to the true but unknown values. Imputation methods vary considerably depending on the type of data set, its scope and the type of missingness of data.

In practice, editing and imputation are carried out in subsequent phases. Editing of a data record is required for checking and identifying whether inappropriate values or logically inconsistent values exist. Imputation is then needed for replacing missing values. Statistical editing is needed at each phase, starting from the planning of a data collection up to the formation of a data file, data processing and analysis. Further editing of data may become necessary even years after the completion of a data collection, e.g. when longitudinal data files are formed.

Principles

The purpose of editing and imputation is threefold: cleaning up of data, producing information about the quality of data and providing a basis for improving the quality of future survey processes. The overall impact and importance of detected errors and defects should be analysed after editing and imputation. Considerable resources should be invested into preventing and analysing major problems, whereas minor defects should be managed with automatic editing and imputation solutions.

Statistical editing

The design of editing rules plays the key role in statistical data editing. The editing rules should not be designed to maximise the number of detected errors, discarding the impact on the multivariate distribution. Quite the contrary, many requirements must be taken into account when specifying sets of edits (UN/ECE, 1997), for example:

- *Completeness of a set of edits:* All possible rules to identify errors must be defined.
- *Correctness of a set of edits:* Every edit must correspond to the knowledge we have of the domain.
- Edits should be declared and documented in a clear and legible manner: Edits must be documented so that they can be traced and their impact assessed.

Data should be edited before being presented as information. This action aims to ensure that the information provided is accurate, complete and consistent. Measuring of the quality effects of editing is based on comparisons between raw data and final data. The editing rate indicates the relative extent of the control work performed. The rate is measured as the proportion of the number of rejected erroneous observations divided by the total number of observations. The editing ratio measures the relative impact of the rejected values on the raw value sum for all observations. The ratio is measured as the proportion of the sum of rejected observation values divided by the sum of all observations.

Editing rate and *ratio* can be used for assessing the efficiency of the processing of data. A small editing ratio may indicate that the suspicious values are an insignificant part of the total sum of all observations (UN/ECE, 2000b). If combined

Figure 2.5 Three examples of using graphical visualisation of data.
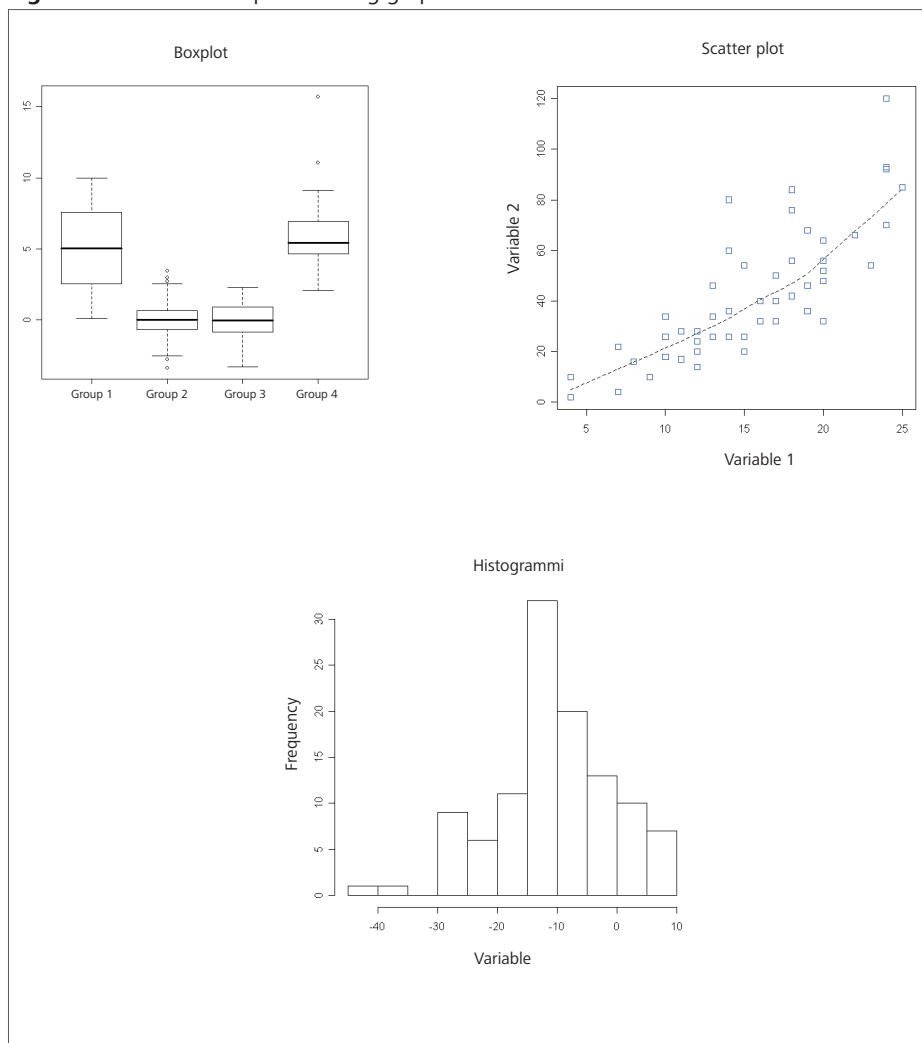
with a high editing rate, a review of the process may conclude that the resources spent on the inspection of rejected values cannot be justified. However, interpretation of the indicators must be examined with caution.

The editing stage should ensure that the bias in survey estimates is minimised, making efficient use of resources without over-editing. There are four commonly defined stages to editing: initial edits, traditional edits, selective edits and macro edits, which have a natural sequence. After each stage of editing, imputation is usually needed to correct the detected erroneous data. The editing stages may overlap due to their varying strengths and capabilities to detect different types of errors (Scarrott, 2006). The method of Fellegi and Holt (1976) is often used in statistical data editing. It is incorporated in many data editing software (e.g. Banff).

Graphical editing

Graphical editing implies the use of the human visual perception ability to identify an anomaly, a pattern or an implied relationship in data that might take much more time and effort to detect by an analytic, non-graphical means. Graphical editing supports more traditional editing methods, which do not always show the impact of a specific data value on estimates (UN/ECE, 1997).

Preliminary exploration of data by graphical means can be a significant help in setting up the bounds for editing and imputation processes. Graphical editing using, for example, boxplots, scatter plots, regression lines and ratios can be used to identify outliers, trends, or other properties of data that may be difficult to find by purely analytical means. Three common types of graphical exploration of data are presented in Figure 2.5:

- **Boxplot** allows the user to explore the distribution of data by categorical groups. Figure 2.5 demonstrates the range of values in each group and identifies the outliers.
- **Scatter plot** reveals relationships or associations between two variables. Values deviating from the regression line in Figure 2.5 must be studied with care to detect outliers.
- **Histogram** shows graphically the shape of the distribution, spread and presence of outliers in data. Figure 2.5 visualises the skewness of the distribution and the outliers.

Imputation

The main role of imputation is to replace missing or erroneous values (e.g. edit failures) in a data set by known acceptable values. Imputation is typically carried out because data systems have been designed to work with complete data sets (Chambers, 2002). Kalton and Kasprzyk (1986) review different kinds of imputation methods, which can be divided into three main groups (Laaksonen, 2000):

- Logical imputation takes place in connection with statistical editing. The imputed values are constructed with the help of an expert or basing on best possible inference arrived at by using strong auxiliary variables or earlier values.

- In the model-donor imputation method, the imputed values are obtained by means of a model fitted to the data.
- In the real-donor imputation method, the imputed values are borrowed from observed values. Thus the values are certain to be ones that would be possible in a real situation.

In these latter two groups the replacements for the missing values are borrowed from entities called donors. The groups are determined by the nature of the donors. It is recommendable that in a real situation several methods should be compared, even where the imputation concerns just one value because the model-donor imputation method might, for example, suit well situations where no real observations can be found with the real-donor imputation method.

Imputation methods can be further classified into deterministic and stochastic ones, the latter containing a random component. In principle, all above groups can include both stochastic and deterministic methods. In addition, imputation methods can be divided into single imputation and multiple imputation methods. In single imputation each missing value is replaced with a single imputed value, and in multiple imputation (Rubin, 1987) two or more values are used. At the moment, multiple imputation methods are not exploited in the statistics production of Statistics Finland.

Imputation produces additional inaccuracy in results, which should be estimated. Multiple imputation is sometimes used for assessing the additional variance (Rubin, 1987; Rubin 1996; Schafer, 1997). Other methods have also been developed for studying the variance arising from imputation (see e.g. Rao and Shao, 1992; Särndal, 1996; Lundström and Särndal, 2001, and Lee, Rancourt and Särndal, 2002).

Indicators, in the form of rates, can be calculated to monitor the imputation process. As in editing, one must pay attention to the interpretation of the indicators. Imputation rate and imputation ratio refer to a single variable. Imputation rate is measured as the proportion of imputed records of the total number of records. Imputation ratio is a measure of the contribution of imputed values to the final estimate and is calculated as the quantity of imputed values divided by the total quantity of all final values (Eurostat, 2005).

Guidelines
- Missing values caused by item non-response should be imputed as necessary in all statistical data.
- Missing values caused by unit non-response shall be corrected in household and personal data by re-weighting (see Section 2.11). In other statistical data, unit non-response may also be corrected by means of imputation.
- Correctness of identifiers is essential if survey data are to be used for weight construction, estimation purposes, or combined with other data (see Sections 2.9 and 2.10). For longitudinal linking of data sets, a specific longitudinal identifying system must be designed, as the identifier suitable for cross-sectional linking may not be sufficient for longitudinal linking.
- One should exploit automated solutions for editing and imputation as far as possible.

- The editing and imputation process must be documented, together with theoretical and practical explanations. In addition, the original raw data and the syntax used for the automatic editing must be documented and archived.
- Quality indicators must be produced and examined. However, their interpretation must be studied with caution. The main indicators for editing are editing rate and editing ratio, while the ones for imputation are imputation rate and imputation ratio (Eurostat, 2005; UN/ECE, 2000b).

Statistical editing
- The range of values must be checked for every variable to see whether it suggests any unacceptable features in the data. This should be done for the whole data set and for suitable subsets. Pre-programmed checking systems must be employed when applying any computer-assisted data collection techniques, such as CAPI or CATI, or self-administered electronic questionnaires (see Section 2.7).
- Outlier detection is applied directly after the value range check. This operation refers to a detailed examination of the distributions of the variables in a data set. All extreme or deviant values identified must be carefully examined for their validity (see Imputation).
- A distinction must be made between the three concepts of missing value, zero value and logically impossible information.
- Different items of data must be compatible, just as individual items must be correct. Cross-checking should be used to examine sub-areas of data, exploiting also external data. Checks based on multivariate analyses must be made by means of a model suitable for the actual research design.

Imputation
- A suitable imputation model must be constructed by trying out and testing several alternatives.
- Imputed values must be flagged with an indicator variable, so that imputations can be distinguished from original values.
- The results from imputation must be examined using both graphs and tables. If the model-donor method is used, the distribution of imputed values should be examined for possible inappropriate or outlying values. If the real-donor method is used, account should be taken of whether donors have been used in adequate numbers.
- An estimate of the additional variance arising from imputation should be computed, if possible.

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2.11 Weight Construction and Adjustment for Non-Response

Scope and purpose

In most sample surveys a weight variable should be included in the data set to be analysed. The principal purpose of weighting is to obtain as accurate parameter estimates as possible with the chosen sampling and estimation procedures. The sampling weight contains information about the sampling design in use and in some cases also about auxiliary information used for improving precision and/or adjusting for non-response (see sub-section "Principles" below).

The basic form of weight is design weight which is defined as the inverse of the inclusion probability of a selected element, i.e. contains information on the sampling design as well as on the sample and population sizes. However, the design weight often needs to be adjusted after sampling and data collection for possible observations of skewness caused by errors in sampling frames, non-response and measurement errors. Moreover, an estimation procedure aiming at improved efficiency may involve further modification of the original weights. This derivation of adjusted or modified sampling weights is called re-weighting.

Principles

Design weight

A design weight is derived direct from the sampling design. For most sampling designs the design weight is the inverse of the inclusion probability. Thus, the inclusion probabilities used in the sampling procedure should be derived for the construction of the weight variable.

Typically, a sampling weight is of an expansion type. An expansion weight is needed for the estimation of population totals and can be interpreted as implying that the value of the weight variable for a given sample element refers to the number of population elements "represented" by that sample element. This is due to the formula of the sampling weight.

In principle, survey data should not be estimated without sampling weights. The weights can be ignored if the sampling design is a self-weighting design (e.g. simple random sampling or systematic sampling applied to population in random order) and the non-response can be judged ignorable which does not need to adjusted. Even then the parameters to be estimated should not be the population totals but e.g. mean, correlation coefficient or ratio of two means. If even one of these conditions is not fulfilled, sampling weights should be used for appropriate estimation.

Sometimes re-scaled weights are used instead of expansion weights. Re-scaled weights are constructed so that the weights sum up to the sample level and the mean of the weights is equal to one. These weights are referred to as analysis weights. Analysis weights are supported by certain traditions in social and other research, the need to estimate the results at the sample level only or the fact that there is no particular version of design-based analysis available. The downgrading of expansion weights to the sample level is normally carried out by dividing the sampling weights of the design in use to the corresponding weights from simple random sampling. In some cases those modified weights are also used for standardised distributions or statistics.

Reweighting

Reweighting refers to widely used methods with the aim of adjusting the original design weights by incorporating auxiliary information in the weighting procedure. The auxiliary data used in reweighting are usually derived from the population or the sample, or both. The simplest reweighting methods are post-stratification and ratio estimation. For example, post-stratification refers to reweighting of the sample units taking into account known population totals

(e.g. population frequencies by gender, age group and region) while ratio estimation implies the use of population totals for continuous variables (e.g. the total turnover of a particular industry). The correct use of ratio estimation requires that there is a linear positive relation between the study variable(s) and the auxiliary information. (Särndal et al., 1992).

More complex reweighting procedures are based on the use of explicit or implicit statistical models, such as linear or logit models. Then the design weights are adjusted by models utilising auxiliary information and the methodology falls under the scope of model-assisted estimation. One of the most often used reweighting methods is the calibration of weights (Deville and Särndal, 1992). In calibration, the original design weights are modified by as small an amount as possible by a statistical model with the condition that the modified weights provide correct population distributions for the auxiliary information in use. The calibration of weights thus tries to maintain the properties of the basic sampling design and at the same time provide consistent estimates with the population distributions.

In most cases reweighting introduces extra variation in sampling weights. Thus, its effect on sampling errors and other quality indicators should be evaluated. The variation of weights may increase substantially if PPS sampling design or heavy stratification was applied in the sample selection. Then it may become necessary to limit the extra variation caused by reweighting.

Adjustment for non-response

Reweighting based on model-assisted estimation is commonly used in adjustment for the possible bias caused by unit non-response. Non-response may be substantial and neglecting it will yield undercoverage in estimates. Furthermore, non-response is hardly ever completely random but often we can assume that there is an association between it and the auxiliary information or study variables. If these assumptions were true the original design weights may yield biased results and lead to incorrect inference.

A simple non-response adjustment is that obtained by replacing the original sample size by the number of respondents, i.e. by inflating the weights correspondingly. However, it is more recommendable to base the re-weighting on any relevant information that relates to the study variables to variables specified in the sampling frame. If a relationship exists and we are able to divide the sample into homogenous sub-populations by the response probabilities, this will reduce the non-response bias. Therefore, the search for, and the use of, powerful auxiliary data for weight construction and non-response adjustment is a part of good statistical practice. Sometimes it may also be useful just to scale the sampling weights to the known population distributions. (Rosenbaum, 1987; Ekholm and Laaksonen, 1991; Särndal and Lundström, 2005).

Calibration of weights

Adjustment for non-response is often carried out with procedures akin to post-stratification where the distributions of auxiliary information are used for dividing both the responding set and the population into sub-populations like strata, and then for the construction of re-weights (Smith 1991; Särndal et al.,

1992; Deville, Särndal and Sautory, 1993). The calibration of weights is based on a more advanced theory where a number of auxiliary information distributions can be used at once for reweighting, most often as marginal distributions (Deville and Särndal, 1992; Lundström, 1997). Quite often the auxiliary information comes from the population or strata, sometimes also sample level information may be used. Software products for calibration include e.g. CALMAR (Sautory, 2003) and CLAN97 (Andersson and Nordberg, 1998).

Recommendations

- A sampling weight is constructed on information on the sampling design, inclusion probabilities, population size, sample size and number of respondents. Those entities are almost always calculated on population sub-groups, such as strata. If the population was grouped, each element must belong to one of the categories and the population level information must be available when the sampling weights are derived.
- If unequal inclusion probabilities are used, these probabilities must be derived for each sample element so that they can be used for calculating weights. When model-assisted estimation is applied, it is often useful to derive provisional estimates in order to find as reliable a weighting scheme as possible. The correctness of weights should be established. Calculate the sum of the weight variable over the sample data set and, in the case of an expansion weight, this sum should coincide with the population size.
- When a stratified sampling design and/or post-stratification are applied, the sum of the weights within each stratum should equal the corresponding stratum size. For calibration weights, the weighted estimates should also exactly equal the marginal distributions, and also the totals for the continuous auxiliary variables at the level at which the information was used (Deville and Särndal, 1992; Särndal and Lundström, 2005).
- The design weights for various sampling designs have been derived with the assumption of no non-response. The first effort to correct for the discrepancy can be a simple adjustment by replacing the original sample size by the number of respondents. We then assume that all elements have an equal empirical response probability.
- The variation in the weights should be examined already at the planning phase of the sampling design if possible. A large variation in weights, and especially a few very large weights among relatively small ones, may have a strong influence on the variance of the estimators.
- If the variation in weights is due to deep stratification, collapsing of strata or increasing the sample size in those strata should be considered. If a large variation in weights is due to post-stratification, extra variance can be reduced by collapsing strata. In a similar manner, marginal distributions can be recalculated using fewer classes when the calibration of weights is applied.

Documentation

Important elements in the reporting of methodology are detailed descriptions of the sampling design and estimation and the re-weighting methods used. The re-

porting should contain explanations of the structures of the most important estimators, an analysis of various sources of bias, especially that of non-response, and a description of the adjustment and re-weighting methods used. Quality and methodological reports should include descriptions of the construction of final weights and the results obtained with them for important estimates (see Section 1.2.3). The methodological description should also clearly report any changes caused by re-weighting to the basic design-based variance estimators, so that appropriate standard errors and other quality indicators can be calculated as correctly as possible.

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2.12 Statistical Estimation and Analysis

Scope and purpose

This Section is devoted to both descriptive and analytical studies. The parameters that are the focus of interest in descriptive statistical surveys are usually totals, averages or proportions at the total population level or relative to parts of it. In surveys where the emphasis is on analysis, the interest falls on connections and interdependences between phenomena. Parameters are connected with statistical models, such as linear models, and are represented by coefficients of correlation or regression, for example. An important stage in both types of survey is the estimation of unknown parameters as reliably as possible. Analytical surveys often include more extensive interpretations of the results than descriptive surveys do. Descriptive surveys, including censuses, are typical in statistical offices. However, the use of statistical models has been extending, e.g. by wider application of estimation techniques employing regression models.

The Section examines estimators and their quality attributes, as well as quality aspects of statistical analysis. Estimation uses the available survey data or register and other administrative data to produce numeric estimates for unknown parameters. Combinations of sample survey data and register data are also increasingly used in this. The calculation method or algorithm needed in the estimation is called the estimator, and its numeric value is called the estimate. Totals are typical examples of descriptive point estimates.

The users of statistics must be provided with essential information on the quality of statistics. The reliability of an estimate is assessed by calculating the standard error or coefficient of variation of the estimator used. The confidence interval (e.g. 95 per cent confidence interval) for a parameter can be calculated using the estimated standard error. For example, the main parameters of interest of the labour force survey are the total numbers of employed and unemployed as well as the unemployment rate. These estimates must be accompanied with their standard errors and confidence intervals.

Statistical analysis refers to a stage in which the survey data are further investigated by appropriate statistical methods. As an example, the labour force survey data may be used to investigate with a statistical model how the duration of being unemployed is related to respondents' age, gender or occupation. Statistical analysis can also be utilised to monitor the internal quality of a survey process. Subsequently, its purpose is to generate improvements through the identification of sources of error, evaluate their influence on the reliability of the data, and propose measures for their adjustment.

The estimation and analysis methods should be chosen carefully so that the properties of empirical data can give support to the method in question. Therefore, the original study or sampling design must be taken into account to obtain reliable results from the study.

Principles

The most important theoretical attributes of the estimators connected with reliability are unbiasedness, consistency, precision and accuracy (Cochran, 1977; Lehtonen & Pahkinen, 2004; Lohr, 1999). An estimator is unbiased when the mean of all possible estimates, corresponding to all possible samples of a given size, is the same as the value of the unknown parameter. In other words, the expected value of the estimator equals the value of the parameter. A weaker, but also more prevalent, attribute is consistency of the estimator. The estimator is consistent if its expected value approaches the value of the parameter as the sample size increases, and matches the value of the parameter when the sample size equals the population size. Precision refers to the fluctuation of estimates around their expected values. The smaller the fluctuation, i.e. the variance, is the greater is the estimator's precision. This property is also called efficiency. An accurate estimator is both unbiased (or at least consistent) and precise. Statistics Finland promotes the use of design-based estimators that are unbiased or consistent, such as those of the Horvitz-Thompson type, generalised regression estimators or calibration estimators (Särndal et al., 1992).

Particularly the efficiency properties of estimators can be improved by incorporating auxiliary information into the sampling or estimation design. Such auxiliary data can be obtained from diverse statistical or register sources. Model-assisted estimation methods, such as regression estimation and ratio estimation, and calibration estimators are examples of inclusion of auxiliary data in the estimation design (Särndal et al., 1992; Lehtonen & Pahkinen, 2004). Improved efficiency can be obtained when the auxiliary data correlate closely with the study variable. This yields a decreasing variance estimate. Efficiency is measured by design effect, which is obtained by calculating the ratio of the variance estimate of the actual sampling and estimation design to the variance estimate based on a simple random sample of corresponding size (see Section 2.6) (Kish, 1965). Efficiency is improved if the design effect is less than one.

Auxiliary information can also be incorporated into an estimation design to adjust bias caused by non-response. The survey data can contain unit non-response, for example, and to adjust the possible non-response bias the data are re-weighted. Then the weight structure of the original estimator, which is usually the Horvitz-Thompson estimator, must be adjusted. Alternatively, an estimator based on post-stratification or calibration must be used (Djerf, 2000). This is particularly important when various sub-populations or domains are investigated. If the sample size of a domain is large the standard estimators (e.g. Horvitz-Thompson or calibration estimators) yield often estimates which are accurate enough (Lehtonen & Djerf, 2001). On the other hand, examining sub-populations with small sample size, basic design-based estimators often fail to perform sufficiently accurately, and special small area estimators must be used (Rao, 2003; Longford, 2005). Especially model-based small area estimators may be biased with respect to the sampling design. Nevertheless, having a small variance, their use can still be justified.

The estimation of change may be improved by applying various forms of panel designs (including rotational panels), or sample co-ordination (Kasprzyk

et al., 1989; Diggle et al., 2002). One can also utilise auxiliary information in the estimation of such parameters, as well as in adjustment for panel attrition (unit non-response in lengthy panels).

In analytical studies, the applied estimators for model parameters are either unbiased or consistent. When the data are collected using a complex sampling design (see Section 2.6) the property of unbiasedness relative to the model is not sufficient, thus one also needs unbiasedness or consistency property with respect to the sampling design (Chambers & Skinner, 2003).

Guidelines

The general advice is to choose estimation and analysis methods that reflect the characteristics of the survey data as far as possible. In order to produce reliable results, an analysis must take into account the original sampling or study design. This can be achieved by using design-based methods that account for the various design complexities, e.g. sampling weights, stratification and clustering.

Sample survey data

- For estimation and analysis, survey data must contain proper information of the original sampling design, i.e. the design weights, analysis weights, as well as the indicators describing stratification and clustering.
- The original sampling design must be retained for later estimation designs. Thus, the original information concerning stratification, clustering, multiple stages and phases, and also information about elements selected with a probability of one, must be kept intact and documented for the subsequent data users. The data must be estimated in compliance with the survey situation without breaking the stratification structure.
- Auxiliary information should be exploited whenever it is reliably available. Auxiliary information can be used, among other things, for re-weighting with different calibration estimators (including those corresponding to post-stratification, ratio estimation and regression estimation). Re-weighting tends to bring sample distributions closer to population distributions. It is recommended to consult a methodology expert about the choice of estimation method.
- The reliability of point estimates should be assessed with the aid of standard errors. Alternatively, the coefficients of variation (relative standard errors) should be examined taking into account the original sampling design and the estimation design as closely as possible. It is advisable to estimate design effects when possible.
- In the case of a complex sampling design and a non-linear estimator (e.g. a regression coefficient), the sample variance of the estimator cannot usually be obtained analytically, and approximations must be resorted to. The commonest approximation method in statistical software programs is linearisation; others include those based on sample re-use, such as the jack-knife, balanced half samples or bootstrap methods (Wolter, 1985; Lohr, 1999; Lehtonen & Pahkinen, 2004). Methodological experts should be consulted when the approximation method is being selected.

- Sample data often contain outlying observations, i.e. values clearly removed from the great mass of the observations. If these observations are proper, they must be left intact. Point estimation can then be performed by robust methods such as trimmed means or quantiles. If the deviation is caused by weighting, measures should be taken to restrict the variation of the weights.
- Estimations should take into account the non-response. Effects of unit non-response are often adjusted by re-weighting methods, such as calibration (see Section 2.11). In the case of item non-response, missing observation values are frequently imputed with the statistical imputation techniques (see Section 2.10). The imputed values must be flagged with indicators. The effects of non-response adjustment operations should be accounted for in variance estimation.
- There are well-established software programs that correctly react to the sampling design complexities. These should be used to calculate point estimates and their sample variances (e.g. SUDAAN software, SAS procedures Surveyreg and Surveylogistic and some Stata procedures). The analysis weights (see Section 2.6) should be incorporated into statistical analysis of survey data.

Register data and time series
- Statistical analysis of data from a total survey (census), registers or other administrative data are dealt with in Section 2.5 (Administrative registers and statistical registers) (see also Wallgren & Wallgren, 2007).
- Estimation and analysis of time-series data are dealt with in Section 2.14 (Time series and seasonal adjustment).

Documentation

Good statistical practice requires that the entire production chain relating to the processing of the data be clearly described. With regard to estimation, this means justifying the choice of the estimators, models, estimation techniques and the software used..

Good statistical practice also requires sufficient reporting of the reliability of statistical estimates to the users. The analysis of reliability of statistics and their results should have proper coverage when documented, especially to facilitate the future needs. Quality and methodology reports provided for data users offer a good means to fill that purpose.

With sample survey data, information must be provided about the point estimates of the main study variables and their statistical reliability in respect of the whole population and the most important population sub-groups. In addition to point estimates, standard errors and confidence intervals reporting of design effects is recommended. With sample survey data, reliability denotes assessments of both the possible bias and the accuracy of the point estimates.

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2.13 Presentation of Statistical Data

Scope and purpose

Presentation, publication and dissemination of statistical data are, together with archiving, the last steps in the process of producing a statistical survey. Presentation is a very significant step because it determines how the outcomes of the previous steps can be made widely and usefully exploitable. The topic of this section is conventional presentation methods of statistical data, which can be applied to both electronic (e.g. Internet) and paper publications. Presentation methods should also be carefully thought over, when dealing with tables of registers, however.

Statistical data – that is, quantitative data – may be portrayed by three different methods: textual presentations, tabular presentations, or chart or graph pre-

sentations. Tables are by far the most frequently used methods of presentation, but statistical charts are becoming more and more popular because a well-composed chart conveys information more illustratively and efficiently than a table or a piece of text, and in many cases a chart provides a more complete portrayal than could be derived from tabular or textual forms of presentation. On the other hand, one must bear in mind that the accuracy of a chart is always limited, whereas accuracy in a table can be increased as required. A chart conveys a message quickly and illustratively, whereas extracting information from a table is slow and a table is unillustrative.

The roles of charts, tables and text overlap slightly because the same matter may be presented by all three methods. Accordingly, the author has to consider their different roles. A chart is suitable for bringing out the central results and those that are the most important to communicate. In addition, the characteristics of some phenomena can only be portrayed graphically. A chart is by far the best method to describe regularities and interdependencies. Text is usually a more subjective presentation than a table or a chart, but it allows for an extensive analysis of the results, which may then also be set in relation to a wider context. On the other hand, mere repetition of the figures already found in a table is not recommended.

The general aim is that both charts and tables should be self-contained so that they convey the essential information as such and can be understood without additional information.

Principles

Principles for tables

Tables come in two basic formats: arrays and tables. An array is usually a small-scale table amidst text and differs from a table by its fairly free format. The statistical table is a relatively strictly formulated presentation, but here, too, different solutions may be chosen to enhance legibility.

The cells of a table may contain different types of information, but most frequently it consists of figures. The items in the cells should be as homogeneous as possible, ideally values of one single variable measured identically. One of the aims of a table is to put data into an easily comparable form. If comparison is not feasible, the purpose of the entire table may be questionable.

Parts of a table

The title of a table is placed outside the table area and should be designed to answer the questions "What?", "Where?", " When?". The title should be illustrative, clear and succinct. If all the items represent the same characteristic, the variable should also be included in the title.

Column titles may be hierarchical so that upper level titles bind the lower level ones together. The variable and the unit of measurement are (often) given in the lowest level column titles if they are the same in all the cells in the column. Sometimes all the column titles together are referred to as the table head.

Row titles may be longer than column titles. Row titles, too, may be hierarchical so that the left-hand titles bind the right ones together. The variable and

the unit of measurement are (often) given in the rightmost title if they apply to all the cells in the row.

In addition, gridlines may be used to facilitate reading the table.

Principles for statistical charts

Unlike a table, the most important function of a statistical chart is to convey information visually. In chart designing there is a risk of unintentional distortion of the truth if the design principles are not fully known. It is the statistician's responsibility to ensure that his or her chart gives an accurate and clear portrayal of the real character of the phenomenon concerned, i.e. that it coveys correct information.

A statistical chart is better than a table for displaying the structural aspects of data, summarising large amounts of data, demonstrating how things are connected, communicating ideas and conclusions and setting up a situation or feeling.

Parts of a chart

- The title of a chart should answer the questions "What?", "Where?", "When?". In some situations a storyline title is an ample solution, while in others (e.g. in research reports) a caption may replace the title. On the other hand, a title and caption do not exclude each other.
- Co-ordinate axes have to be labelled adequately and the variable and unit of measurement have to be indicated.
- Tick marks and labels on co-ordinate axes have to be clear and shown with an adequate font size.

Chart 2.6 Parts and terms of a statistical chart
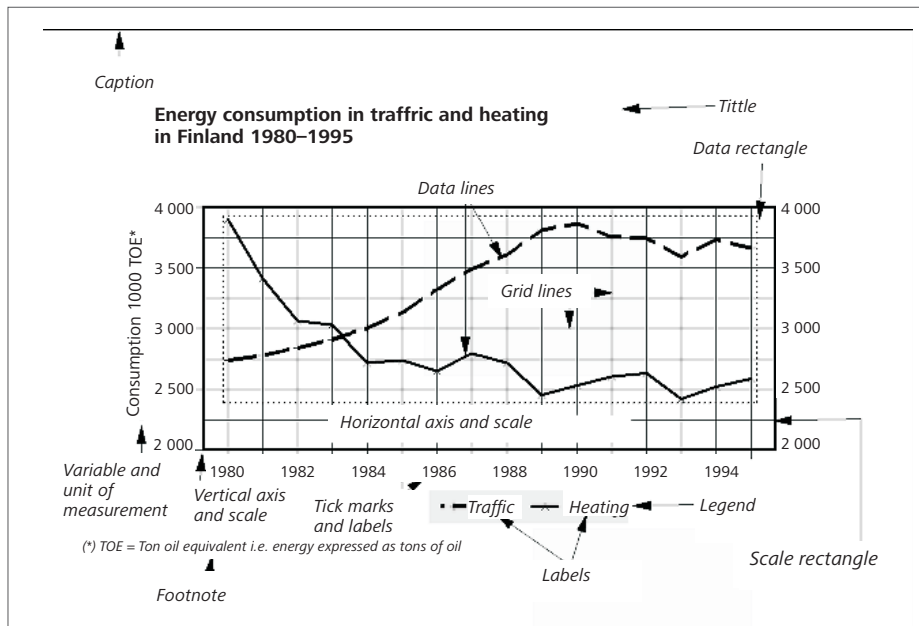
- All chart elements (lines, parts, segments, etc.) have to be labelled.
- Aids that facilitate interpretation and conclusions should be used adequately but not excessively.
- Potential discrepancies have to be pointed out and explained.

The most popular chart types are line charts, column and bar charts, pie charts and thematic maps. Many of these types have several subtypes. In addition, there exist some less used, although highly informative, chart types.

A line chart and a vertical column chart are alternatives. Common to them is that a continuous variable, usually time, is on the horizontal axis, and that they are best suited to presenting time series. A minimum requirement for the variable placed on the horizontal axis is that its scale should be ordinal.

A line chart emphasises variation and trend, whereas a column chart emphasises magnitude and variation in magnitude. Because of this difference a break in the vertical scale, or quantity scale, is of little importance in a line chart, whereas in a column chart, a break in the quantity scale distorts the visual message.

Horizontal bar charts are well suited for portraying quantities attached to classes and groups. The variable on the vertical axis does not require a continuous scale. A bar chart is not an alternative to a column chart.

A pie chart consists of a circle divided into sectors whose areas carry the quantitative information. This has to be taken into account when pie charts are placed side by side so that their areas are in proportion to the total amounts (the area of the circle increases in proportion to the square of the radius).

A pie chart can only portray a proportional distribution (percentages), and it conveys information much less accurately than a line chart or a column chart does. A pie chart should not be used if data are to be presented accurately, and for the same reason it is justified to give the numerical values of the percentage distributions as well.

Statistical thematic maps are statistical charts placed on a map. They are used to portray spatial distributions. The best known type is probably the choropleth map, on which delimited areal units are shaded in different ways to portray the proportional distribution of one variable.

Embellishment of charts

Charts often seem to generate the need to create an embellished or ornamented presentation. Most typically, an artificial third dimension is added to the chart. Another example is the use of a pictorial chart. Exaggerated use of colours also falls to this category. However, it is hard to find any valid arguments for such embellishment of a statistical publication.

In pictorial symbol charts, symbolic characters, representing people for example, are used instead of columns. They are used in popular presentations because of their appealing and dramatic appearance.

Pictorial symbol charts are so difficult to master that their use should be abandoned altogether. It is almost impossible to construct a symbol chart that complies with the principles of statistical graphics.

Quasi-three-dimensional structures are probably used in charts for the same reason as pictorial symbols - to make impressive presentations of modest topics. The additional third dimension seldom carries any information. Usually such a decorative motif on the chart only impedes its ability to convey information. That is, very often the third dimension is "chart junk".

A three-dimensional structure should only be used in cases where the third dimension truly carries information.

Guidelines

I   Guidelines for tables

- Numbers should not be presented with too many significant digits. Rounding has to be mathematically correct.
- The averages or sums of rows and columns should be presented whenever this is called for and when it facilitates comparison.
- The order of rows and columns has to be logical. Sometimes the best solution may be obtained by using the ascending order of values for both the row and column variable.
- Place those numbers that are meant to be compared in columns, because numbers are easier to read downwards than across.
- The table layout has to be clear.
- Customary notations exist for special situations (e.g. for missing data) and should be followed. Such notations with explanations, are to be found in the Statistical Yearbook of Finland, for example.

II   Guidelines for statistical charts

Chart design
- It is characteristic of the best statistical charts that they
- Communicate visually and function without numerical values attached to them.
- Convey a large amount of information in a small space. The best charts make large data sets coherent. Conversely, making a chart out of a few numbers is not worthwhile.
- Do not distort the message in the data. In a chart, information about magnitude (or proportion) is presented as a visual metaphor, which has to match the numbers. That is, a two times greater magnitude should be represented by a two times higher column. In this case the value of the lie factor is 1.
- Do not graph data out of context. Adequate additional information, such as a title and labels, will link the presentation to reality.
- Reveal data at several levels of detail, from a broad overview to the fine structure. Something can be observed at a glance, further examination gives additional information, and closer scrutiny reveals even more.
- Strive to make the viewer interested in the substance of the chart rather than in the methodology, design or technology of the graphic presentation. It should be borne in mind that the viewer is likely to be more interested in the substance of what is being presented than in the presentation technique.

Line charts
- A variable with a continuous scale of measurement, e.g. time, should be on the horizontal axis.
- The quantity scale on the vertical axis does not need to begin at the origin (zero).
- The relation of the scale on the horizontal axis to that on the vertical axes, the aspect ratio, has a decisive impact on the appearance of the chart. The aspect ratio should be defined so that a line with a 45° slope represents a uniform trend.
- Scales have to be equally spaced on both axis. The logarithmic scale is the only acceptable exception.
- Too many data lines should not be put in a line chart, and each line should be discernible.

Column chart
- A variable with a continuous scale of measurement, e.g. time, should be placed on the horizontal axis.
- The quantity scale on the vertical axis must not be broken. It has to begin at the origin (zero).
- Scales have to be equally spaced on both axis. The logarithmic scale is the only acceptable exception.
- The space between columns should be 25 to 50 per cent of the width of the columns.
- A column group should contain at most three adjacent columns.
- The aspect ratio influences the appearance of the chart.

Bar chart
- The horizontal quantity scale may not be broken. On the other hand, over-long bars may be cut at the ends.
- Bar groups should contain at most three adjacent bars.
- The space between columns should be 25 to 50 per cent of the width of the columns.
- Bars should be arranged in order of size, usually the longest one at the top.

Pie chart
- Six categories at most may be portrayed in one pie chart.
- The categories should be arranged in order of size, from the largest to the smallest.
- The sectors are either placed clockwise starting from 12 or, more often, anticlockwise starting from 3.
- Information may be portrayed by adjacent pie charts of different sizes, but it is very difficult to compare them even if they are of the same size.

Know your audience and media
When designing a chart, consideration should be given to the audience and to differences in its ability to understand presentations. For example, a chart for a newspaper with a wide circulation and a chart for a small circle of experts

should not be designed on the same principles. The presentation medium (television, slide, transparency, newspaper, Internet, etc.) also has to be taken into account, because each medium will reproduce the chart differently. In addition the forum of presentation may have some impact.

Know your capabilities
The worst failures have probably occurred because the designer of the chart has fallen for the belief that anyone can make a statistical chart without knowledge of even the basics of statistical graphics.

Do not confine yourself to what software provides
Special software of varying quality is available for the presentation of statistical graphics. Unfortunately none is perfect. There is a great temptation to confine oneself to what existing software can provide, even if the results are less than good. The other extreme of being carried away with all the possibilities of the software may also result in failure. At least, do not confine yourself to software defaults

The most frequently used charts can be made with software designed for statistical graphics. However, their default settings have mainly been defined for sales purposes. Therefore, confining oneself to defaults usually results in an inferior presentation. Better results are often achieved by trying different alternatives. It should be borne in mind that few software engineers are familiar with statistical graphics, and software is largely developed with a view to its marketability.

Think before using a three-dimensional structure
A three-dimensional structure is only justified if the third dimension carries information that would be difficult to portray by other means.

Balance the roles of text, tables and charts in a presentation
All means of communication have their roles and tasks. Charts are good for portraying the central and most interesting issues and issues that require verification. A table is good for displaying a large amount of data.

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2.14 Time Series and Seasonal Adjustment

Scope and purpose

Economic phenomena are often measured at constant time intervals. The unemployment rate and housing prices are examples of such regularly published statistics. In addition to the absolute value of published statistics, the interest generally lies in a comparison of the change from the previous observations.

A time series is defined as a collection of observations indexed by the point of time of each observation. For example, a time series describing unemployment is created by setting unemployment figures into chronological order. For achieving comparability of the observations on the time-dimension, it is important that unemployment is measured using the same methodology.

The long-term development of unemployment can be observed examining the time series visually. The development over time is referred to as the trend of the series. One can also notice that the unemployment rate varies according to season. The wave-like movement, due to seasonal unemployment, is an example of seasonal variation of a time series.

Seasonal adjustment is applied to reveal the long-term development of a series. In other words, the seasonal component of the time series is removed. Seasonal component refers to the annual periodic fluctuations within a year, which re-occur approximately in the same way (Gomez & Maravall, 1996). Periodic fluctuation is caused by seasons, as well as by other phenomena (e.g. holidays and consumption habits) which are related to the rhythm of the year. Because of this, the seasonal variation has a similar pattern from year to year.

Interpreting the general development of a time series is easier from seasonally adjusted data. Economic cycles are become easier to detect. Seasonal adjustment makes different observations (e.g. months or quarters) comparable with each other (Kokkinen and Alsuhail, 2005; Bell and Hillmer, 1984). Statistics Finland applies seasonal adjustment to, for example, the labour cost index, the indicator of industrial output and the time series of national accounts.

Seasonal adjustment can be performed by several different methods. So-called ad-hoc filters are mainly based on the method of moving averages. X-12 ARIMA is an example of such an ad-hoc filters (Findlay et al. 1998). TRAMO/SEATS is a model-based method (Gomez and Maravall, 1996). Combining the best features of these methods is a topical area of research (Findley, 2005).

Principles

Seasonal adjustment is based on the idea that a time series can be written as a sum of the following components (see Chart 2.7):

1. A trend describing the long-term evolution of the time series.
2. A cycle capturing movement, which is due to economic cycles, for example.

3. Seasonal variation describing periodic fluctuation, re-occurring from one year to the next in approximately the same manner.
4. The irregular component, being the unpredicted part of a series that cannot be attributed to the three aforementioned components. Certain specific outliers, caused for example by strikes, also belong to this component.

Distinguishing the trend and the cycle in a simple and unique way can be difficult. Therefore, they are treated as one component which, for the sake of simplicity, is called the trend (Kokkinen and Alsuhail, 2005; Kaiser and Maravall, 2001). By a seasonally adjusted series we mean a series from which the seasonal component has been removed. That is, a seasonally adjusted series includes only the trend and irregular variation. Both the trend and the seasonally adjusted series are presented in the publications of Statistics Finland.

TRAMO/SEATS, which is a model-based seasonal adjustment method, has been used at Statistics Finland since 2005. Before a series is seasonally adjusted by TRAMO/SEATS, a trading day correction is carried out. In addition, outliers due to strikes or other unexpected events must be detected and corrected. Subsequently, an ARIMA model (Box and Jenkins, 1970; Box, Jenkins and Reinsel, 1994) can be fitted to the data.

By modelling a time series, we mean describing the dependence of the observations on the time dimension with a mathematical formula. This formula is referred to as a time series model. Fitting a time series model implies model selection and parameter estimation. The aim is to describe data in a simple but accurate manner. With a time series model one can examine the periodicity of a series and create forecasts for its future development (Hamilton 1994). Estimations of the trend and the seasonal component are based on these models.

TRAMO/SEATS is based on the assumption that the components of a time series can be extracted from a linear ARIMA model (Box and Jenkins, 1970; Gomez and Maravall, 1996). If the data have non-linear features, the trading-day adjustment and outlier detection may not seem very intuitive. Sometimes one may also note that seasonal adjustment that is visually satisfying may not be optimal according to the diagnostic tests and vice versa (Alsuhail, 2005). In these situations one must assess the main purpose and use of the time series before selecting the final seasonally adjusted time series.

The following graphs in Chart 2.7 describe how an observed time series can be seen as a sum of different components. An observed time series, which is a sum of the trend, seasonal component and residuals, is plotted in the first graph. The trend describes the long-term development of the series whereas the pattern of the seasonal component is nearly identical from one year to the next. The seasonally adjusted series consists of the trend and the residual series which makes it more zigzagged.

Chart 2.7 Time series and their components

OBSERVED SERIES

TREND

SEASONAL COMPONENT

Chart 2.7   Cont.

IRREGULAR COMPONENT

SEASONALLY ADJUSTED SERIES
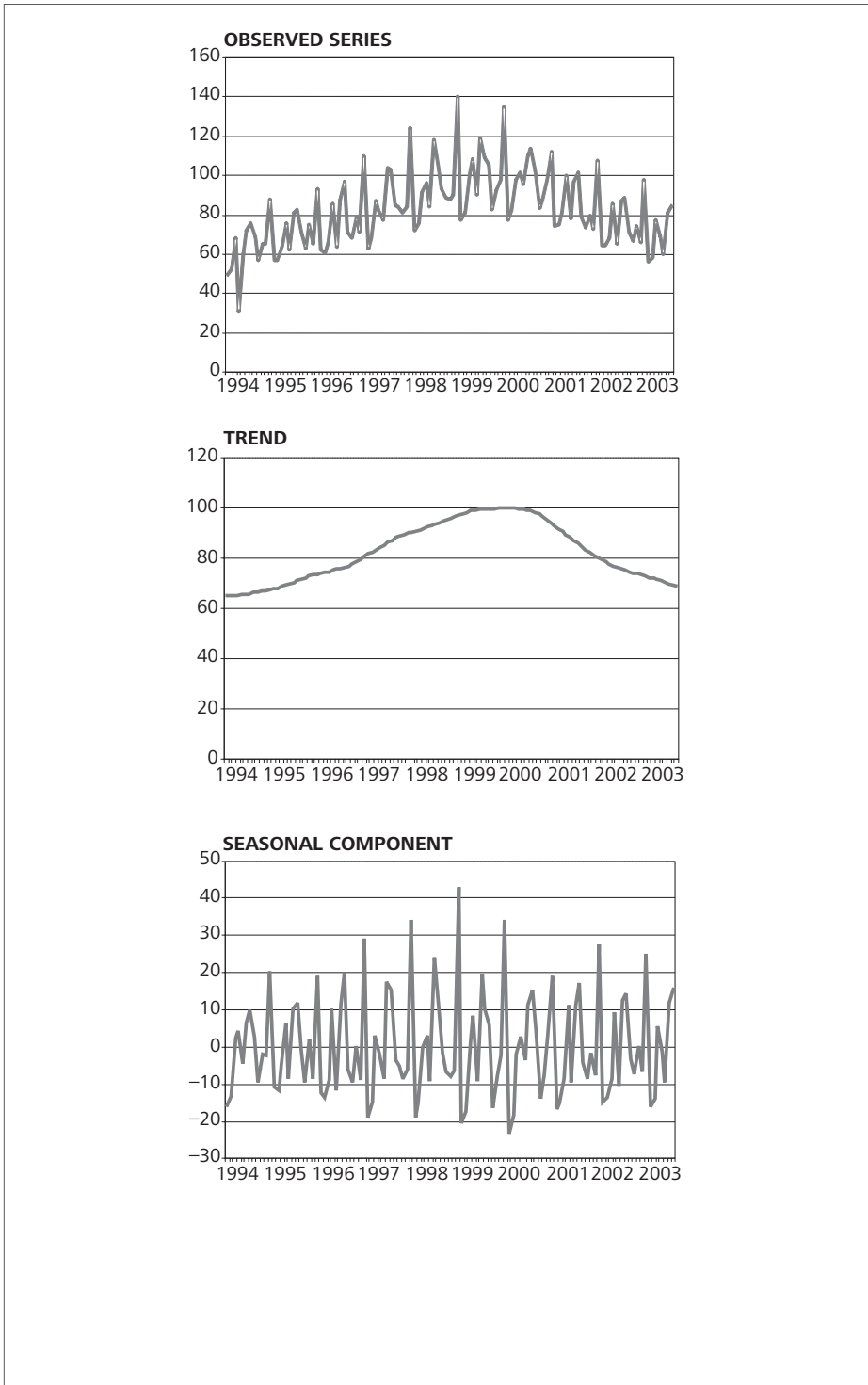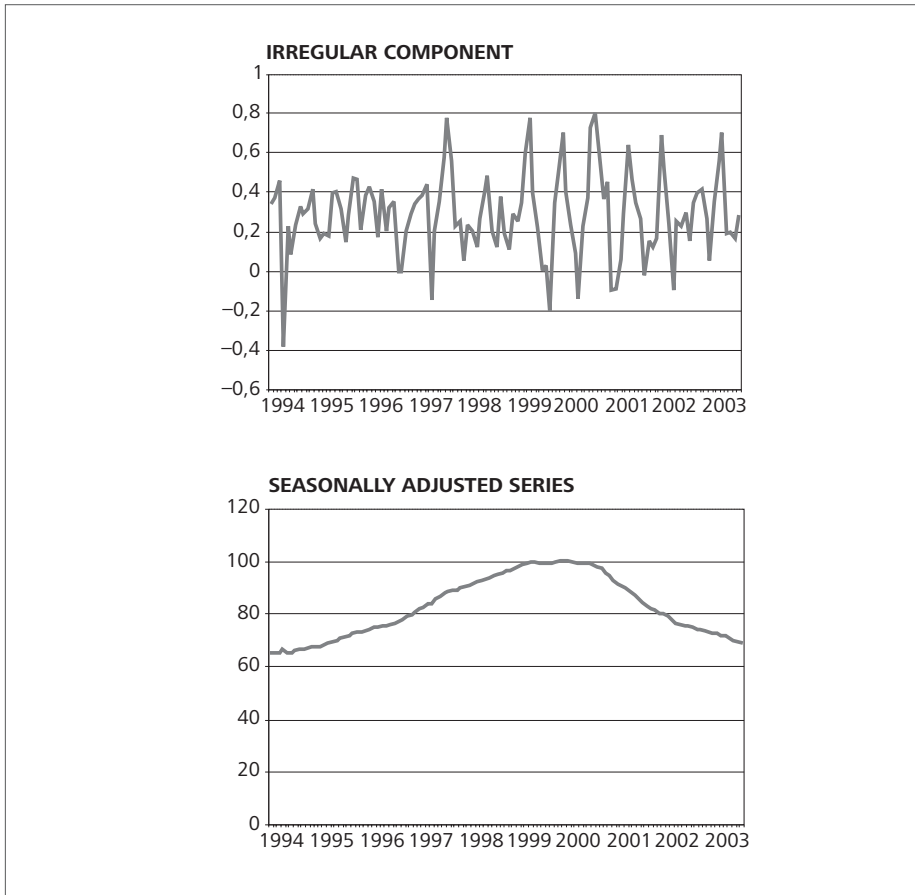
Guidelines

- The TRAMO/SEATS method should be used for seasonal adjustment of time series at Statistics Finland. The Demetra software should be used for this purpose.
- Prior to seasonal adjustment, a trading-day adjustment must be conducted as well as detection and correction of outliers. The trading-day adjustment must be done using a calendar which includes the Finnish holidays.
- When a time series is updated with new observations the most recent values of a trend and a seasonally adjusted time series may become considerably revised, because the most recent values of the trend and the seasonal component are partly based on forecasts. This uncertainty must be pointed out in the publications of Statistics Finland.
- Changes in definitions or methodology limiting the comparability of time series must be clearly stated.
- The success of the seasonal adjustment must be evaluated both visually and by diagnostic tests.

- Statistics Finland should not publish graphs whose values are not included in the tables of the publication.

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2.15 Indicators and Indices

Scope and purpose

Measuring the same phenomenon, e.g. an economic one, over a period of time produces statistical data that are known as a time series. Examples of typical time series are data on prices and quantities of commodities, employees' wages and salaries and numbers of hours worked, or prices and quantities of securities. In simplified terms, a time series is a sequence of figures obtained from precise measurements taken of the same controlled phenomenon over a period of time. Thus, a time series describes the temporal development of the phenomenon concerned (see Section 2.14).

Utilisation of time series is made difficult by the fact that even in well defined and constricted decision situations the topic can be depicted with several different kinds of time series that are not commensurate with each other. "There are simply too many time series to be able to manage the information they contain all at once. There is a need to combine them so that as little information as possible is lost." (Törnqvist, 1974, p. 21). An economic actor is generally not interested in individual time series, but in their statistical generalisations. The method by which the statistical information contained in several time series is compacted into a few parameters is known as aggregation of time series. The simplest example of time series aggregation would be calculation of an arithmetic mean for the observations at given points in time. In the aggregation of prices, these arithmetic means are called unit prices or unit values depending on the case.

The crucial question in the measurement of unit prices or values is the relative proportion and weight with which each time series observation influences the overall total. If the relative weighting changes constantly, aggregated time series will not be temporally comparable. In the aggregation of prices and wages this situation prevails when consumption and labour force structures change over time. The problem can be solved by means of index theory.

Index theory is an area of economics where the focus of interest lies in the aggregation of ratios that are similar in quality and free of measurement units. Index theory solves the aggregation (normalised sums) of price and volume time series of qualitatively different commodities by compacting the information into index series which measure the relative changes (developments) in prices and/or volumes of commodity groups over time.

Changes in consumption structure over time, for example, do not cause qualitative changes in index series because, depending on the index formula used, the consumption structures that are being compared are standardised according to the situation of the base and/or comparison period. The question an index calculation endeavours to answers is: How much more or less has to be paid for the commodities of the base period (comparison period) in the comparison period (base period), allowing for consumer habits in the base and/or comparison period?

Typical indices are generally weighted averages of either price or quantity ratios. The weight structure is determined so as to represent the situation in either the base and/or the comparison period. In price change evaluations this means that even if prices and quantities change simultaneously, the quantitative change is not allowed to interfere with the intended measurement of price change.

In simple terms, the index theory divides into descriptive and analytic (economic-theoretic) research approaches. The analytic research is based on the assumption that economic actors such as consumers and enterprises behave rationally according to a mathematical behaviour model. The problem in the analytic research is that economic actors may change their behaviour over time as a result of changes in, for instance, their socio-economic standing or even personal preferences. Economic realities such as entries and exits of commodities on the consumer market - examples of these include computers, mobile telephones,

typewriters and steam engines - are difficult to assimilate into the behavioural models of economic actors. Indices that are based on an economic theory are bound by it and are often mathematically difficult. The descriptive approach is discussed in Vartia (1976), Samuelson and Swamy (1974), Allen (1975) and Diewert (1974, 1975).

For index calculations the descriptive approach uses the commonest statistical parameters, such as means, geometric means, averages and variances. It does not require specifying of the theoretical frame of reference for the population of economic actors. In simplified terms, the descriptive approach defines an index as an instrument for measuring changes in price and pay levels or average changes in individual prices or wages. The descriptive approach is discussed in Vartia (1976, 1983, 1995), Vartia and Vartia (1984) .

Principles

Indices are indicators of relative change which disclose how much the prices and/or quantities of a given commodity or commodity group (commodity basket) have changed in relative terms from the base period to the comparison period. The points of departure for index calculations are a set of homogeneous commodities and the individual price, quantity and value relations, established by sampling, that apply to these commodities. The price or volume indices of a homogeneous commodity (e.g. Emmenthal cheese) or those of a commodity group composed of homogeneous goods (e.g. cheese) are usually weighted averages calculated from individual price or volume ratios. The weights for the ratios are determined from the price and volume data of the base and/or comparison period.

Unit value index
The unit value index measures the change in average prices over time. For example, it depicts the price ratio for two structurally different commodity baskets between the base and comparison periods. Because the commodity baskets of the base and comparison periods are structurally different, it is impossible to determine what proportion of the change in average prices relates to real price changes and how much of it has been caused by changes in the structure of consumption. The unit value index is only an accurate indicator of price change on condition that the price and/or volume ratios of the base and comparison periods do not correlate with each (Vartia, 1995, p. 6).

The unit value index, which is a comparison of averages, is not a good measure of relative price changes even when the averages of the base and comparison periods have been measured precisely. In other words, even if the standard errors of the averages calculated in the base and comparison periods were zero – meaning that they would equal the average for the population – comparison of averages would not constitute a good index because the commodity baskets of the base and comparison periods would still be structurally different. The error of the unit value index arises from the weaknesses of the implicit volume index it contains. The sum of structurally heterogeneous volumes does not describe volume development correctly. An objective comparison always requires structural uniformity of the commodity baskets.

Laspeyres', Paasche's, Edgeworth's and Fisher's indices

Both prices and volumes typically change simultaneously in the base and comparison periods. In consequence, the commodity baskets that are to be compared are naturally structurally different, so that direct comparison of average prices, for example, does not reveal what proportion of the price change represents real change and what has been caused by structural change. In an index calculation this problem is solved by constructing a hypothetical comparison situation where the commodity baskets are assumed to be structurally identical, like the Laspeyres', Paasche's, Edgeworth's and Fisher's indices. For the Laspeyres' index the consumption structure of the base period is selected as the point of departure and hypothetical consumption expenditure is constructed for the commodities in the basket of the base period at the prices of the comparison period. The index gives the relative price change between the base and comparison periods under the condition that consumption structure is fixed to correspond with that of the base period. Laspeyres index does not allow for the substitution effect caused by the change of prices, so it can either over or underestimate the real price change. The accuracy of an index relative to the real price change depends on how the volume and the prices of consumption have changed in the base period relative to the comparison period. If the prices and the volume change are uncorrelated, the index bias disappears.

In another frequently used index formula, known as Paasche's index, consumption is standardised to its structure in the comparison period. This index tells how much more or less the commodity basket of the comparison period would have cost at the prices of the base period compared to its cost at the prices of the comparison period. The problems of Paasche's price index are analogous with those of Laspeyres' index – it is incapable of allowing for the reallocation of consumption caused by price changes, so it may either over or underestimate the real price change.

The basic problem with Laspeyres' and Paasche's indices is that they take the consumption structure from either the base or the comparison period. Because Fisher's index is calculated as the geometric mean of Laspeyres' and Paasche's indices, it constitutes a more accurate measure of price change than the latter two. It allows for changes in the structure of consumption, thereby eliminating the substitution bias that arises from these changes in the measurement of price change. The problem with Fisher's price index is that it lacks a clear interpretation of the commodity basket.

Yet another index estimated as an average of Laspeyres' and Paasche's indices is Edgeworth's index, in which the index weights are determined as the average of the old and new commodity baskets. Because it allows for changed consumption structure it constitutes a more accurate measure of price change than do Laspeyres' and Paasche's indices.

Further commonly used measures of price and volume change include the Törnqvist, Vartia I and Sato-Vartia indices. In these, prices, volumes and values are specified on a temporally sliding scale, whereby they change continuously so that the indices represent functions of time. These indices allow for changes in consumer habits, which means that they are more accurate than those based on fixed weights (Laspeyres' and Paasche's).

Quality change and index calculation

In the consumer price index, quality change in commodities can be evaluated through sampling. This means that the measurement of price change between the base and comparison periods is only performed on commodities of equal quality. In the case of housing corporation shares, housing plots, detached house prices or wages and salaries, for example, the index calculation problem arising from quality change cannot be solved through the sampling method alone. Calculation of the index will be complicated by at least the following:

1. The statistical units, e.g. dwellings or employees, may change partly or entirely between the base and comparison periods.
2. Structural changes may take place in the targets of measurement between the base and comparison periods.
3. Valuations of the characteristics of the statistical units may change between the base and comparison periods.

If the statistical units do not remain unchanged between the base and comparison periods, it is possible that those included in the comparison group in the base and comparison periods will differ in terms of their quality characteristics. Estimations of price change cannot verify for certain what proportion of the price change is real, that is, price change adjusted for quality, and what is due to quality change.

The second item in the above list is connected with temporal change in the structure of classified statistical data, e.g. when examined in relative terms. For example, the labour force classified by occupation, gender and level of education may change in relation to its proportional work inputs between the base and comparison periods. Correspondingly, the relative focus of the housing market may change geographically between the base and comparison periods.

Hedonic index methods may be used to solve the above three index calculation problems. The methods aim to eliminate the influence of quality changes on the measurement of price change. The procedure leads to a situation where the real price change, measured by log change, is broken down into its components as follows: Real price change = price change adjusted for quality + price change arising from changed quality characteristics.

Methodologically, the breakdown of the real price change into its components can be implemented by two roughly classified hedonic quality standardisation methods: Griliches type of hedonic method (Griliches, 1971) or hedonic imputation (Koev, 1997). The Griliches type of hedonic method concentrates on the elimination of the index calculation problems presented in items one and two above. Typical indices produced with the Griliches method are the index of housing corporation share prices and the index of second hand car prices. Hedonic imputation solves index problems in two stages: in the first stage, estimated prices standardised for quality are calculated for the statistical units, e.g. sold properties or employees in an occupational group, and in the second stage these price estimates are used to construct price ratios adjusted for quality much in the same way as in a typical index calculation. Hedonic imputation has been used in the measurement of wage and salary changes in the metal industry, in

monitoring the prices of detached houses and housing plots, in the labour cost index standardised for quality and in the estimation of pay differentials between sectors such as central government, local government and the church.

Modelling of price determination is typical of both these hedonic methods. Prices are assumed to be determined as conditional expected values, the characters of the statistical units being the condition. In a Griliches type of method the effects of the characteristics on price are standard during the estimation period, so that it makes no allowance for possible changes in personal preferences, i.e. changes in the market valuations of characteristics over time. The price models are typically of the (standard coefficient) covariance analysis type, where the estimation periods are separated from each other by time indicator variables. The estimated coefficients of the time indicator variables disclose directly the relative change in prices compared to the base period. The method solves simultaneously the problems of quality change and index calculation. The estimated price changes are proportional between two points in time for all statistical units.

In hedonic imputation, standardising for quality and index calculation are implemented in two methodological stages. In the first stage, the price models of the base and comparison periods are specified as identical relative to a functional specification. The price models of the base and comparison periods are estimated independently of each other, so that the coefficients of the character variables are not restricted during the estimations.

After this, standardisation for quality is performed as follows. The price models of the base and comparison periods are used to estimate how much the commodities of the base period with their characteristics and structure (e.g. regional, commodity or work input classifications) would have cost in the comparison period with the market valuations of the characteristics and structural factors of the comparison period. The characteristics of the commodities compared and the structural factors arising from their classification comply with the situation of the base period, so that the commodities of the base and comparison periods are qualitatively identical. The change between the prices of the base period and the prices standardised for quality in the comparison period can then be calculated using the typical Laspeyres' formula, for example.

A corresponding procedure can be used to estimate how much the commodities of the comparison period with their characteristics and structure (e.g. regional classifications) would have cost in the base period with the market valuations of the characteristics and structural factors of the base period. The characteristics of the commodities compared and the structural factors arising from their classification then comply with the situation of the comparison period, so that given the volume data of the comparison period, price change can be calculated using Paasche's formula, for example. Hedonic imputation does not restrict the choice of index formula – all typical index formulae can be employed.

The aspect that applies to an index standardised for quality, as to any index, is that they are conditional statistics, the factors controlled in index calculation being the condition. Characteristically, the index values standardised for quality change if the explanatory variables of the price model are changed. Consideration must therefore be given to which explanatory factors of price formation

are relevant, the selection of which can generally be tested by approved statistical methods. If the factors influencing prices in reality are not allowed for in index calculation, the construction and comparability of an index series become questionable.

Guidelines

Guidelines for index construction strategy (Vartia, 1976):

1. The purpose for using the index should be decided by specifying:
- the general nature of the commodities that are to be compared,
- the economic actors from whose perspective relative change will be measured,
- the lengths of the time periods over which relative change will be estimated.

2. Technical problems of index calculation should be solved by specifying:
- the classification that should be applied to the commodities that will be compared,
- the method by which price data on these commodities will be collected,
- the appropriate weight structure.

3. Index calculation methods should be decided by specifying:
- the index formula,
- the strategy for constructing the index series.

Indices can be constructed as either base or chain indices. In base indices the base period is kept constant while the comparison period moves flexibly in time. In chain indices, the base and comparison periods may be successive time periods, for example, or corresponding quarters or months of successive years, and they move flexibly in time.

The fourth problem area of index construction strategy relates to quality changes in commodities, and new and disappearing commodities in the index calculation.

The crucial decision when solving the problem of new and disappearing commodities concerns the time span that should be allowed between the base and comparison periods. The longer the time span, the more certain it is that old commodities will be replaced by new ones. This naturally means that an index series will not be temporally comparable. The problem of new and disappearing commodities is more of a dilemma with base indices than with chain indices. With base indices, the problem can be alleviated by shortening the time span between the base and comparison periods.

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3 Documentation and Archiving

3.1 Documentation of Statistical Survey

Scope and purpose

Documentation refers to the description of statistical activity including the concepts, definitions and methods used, and the statistical production process itself with its information systems and work instructions. In addition, a summary of the results and descriptions of the quality and comparability of the information have to be provided. Statistical documentation can be divided into documentation intended for users and that intended for the producers of the statistics.

By means of documentation users of statistics should be able to:
• Find out what statistics and statistical data (files) there are,
• Find the statistics and data they need,
• Interpret and analyse statistics,
• Process the data.

Documentation intended for the producers of statistics helps them to:
• Produce statistics reliably and efficiently,
• Improve the quality of their statistics,
• Maintain and develop working methods, production processes and information systems,
• Collect information for other similar processes,
  Instruct and train new employees.

Documentation can be divided into documentation of statistical processes and statistical products. Process-oriented documentation describes how the product is produced, while a user of statistics needs a product description of the statistics and their quality.

Chart 3.1   Connection of documentation of a statistical survey with total quality
(Sundgren 2001)
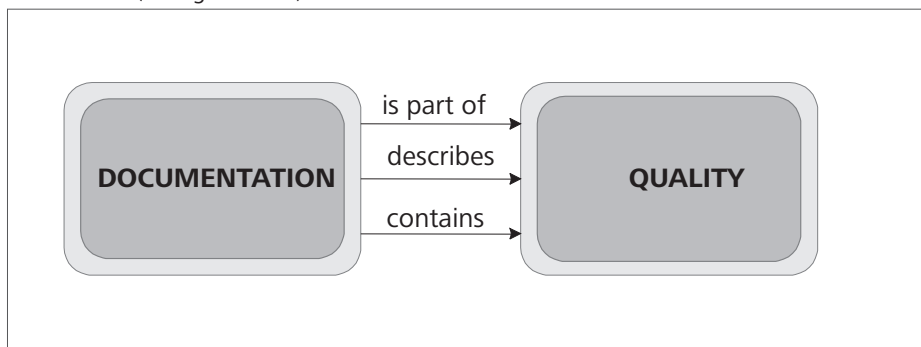
Principles

Documentation should aim to be comprehensive, unambiguous, suitable for multiple uses and, at least within Statistics Finland, it should represent public descriptions of statistics and their production. These descriptions must be up-to-date, well organised, easily accessible, concise and precise. New personnel should be able use them to familiarise themselves with the steps of the production process. A good rule-of-the-thumb for documentation is that anything that would cause considerable problems if left undocumented should be documented.

Statistics Finland's joint metadatabases are utilised in documentation: the Unified file, Concepts and Classification databases, System Register and Archive Formation Plan (AMS). The user interfaces of metadatabases are designed so that they support documentation, having a structure that guides users to record metadata. In addition, instructions and description models have been prepared for user support. Documents can be produced from metadatabases for different purposes, such as distribution databases, archives and other electronic means and paper publications.

Besides documenting these metadata, common practices should be developed for the documentation of process descriptions and work instructions, for example. An explicit description of statistical survey supports the continuity and development of statistics production. The scope and accuracy of the documentation available depends on the needs of the producer and maintainer of the statistics and of the customer.

Guidelines

The documentation should always fulfil all the requirements the customer has set for the statistics concerned. The statistics and the general description of their production process should comply with the following checklist structured in accordance with the quality criteria of the Official Statistics of Finland (see section 1.2.3):

1. Relevance of statistical data

Purpose of use:
* Purpose for which the statistics were produced,
* History.

Definitions:
* Research subject,
* Collector and provider of data,
* Concepts and their definitions,
* Classifications used.

2. Accuracy and reliability

Methods:
- Data collection method,
- Sampling and estimation methods.

Statistical quality of data:
- Correspondence between the target population and the survey population,
- Non-response of sample surveys and methods for correcting non-response error,
- Measurement, processing and sampling errors.

3. Timeliness and punctuality

- Data collection period,
- Publication time,
- Promptness, or observance of the agreed time.

4. Coherence and comparability

Comparability
- With other national and international statistics on the same subject,
- With statistics and time series collected earlier,
- With recommendations and standards.

Coherence
- Uniformity/consistency with other statistics on the same subject,
- Differences in the concepts and collection process.

5. Accessibility and clarity

Data dissemination:
- Data dissemination channels,
- Physical availability of data,
- Exhaustiveness of the forms needed by users,
- Descriptions of available data.

Interpretability of data:
- Availability of descriptions of the concepts and methods used,
- Level of analysis of the results.

6. Documentation

Information system:
- Architecture, information model, operation and version management,
- Source code and testing,
- Rules for processing and checking,
- Management of errors and changes.

Production process:
- Different work stages in the process (see Chart 2.3), organization and responsibilities.

Data warehouse:
- Technical and general description of the data warehouse,
- Technical and general description of the data,
- Inference rules.

Metadata related to data administration:
- Name of statistics,
- Statistical topic,
- Person in charge,
- Obligation to supply data,
- Availability,
- Confidentiality rules and use restrictions,
- Storage, archiving and version management,
- EU regulations,
- Resources used,
- Other information sources and auxiliary information.

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3.2 Archiving

Scope and purpose

The objective of archiving is to guarantee the maintenance of data and their re-use for future data collections, for compiling longitudinal data and time series, and for the purpose of different areas of research and information services.

The operating principle of Statistics Finland states that it shall act as the nation's memory. The purpose of archiving statistical data is to accumulate this knowledge capital. It is important for utilisation and correct use of the data that the descriptions of the archived data are of high quality.

The purpose of archives management is to safeguard the preservation of data in such a form that allows their re-use and enhances the administration of the data pool following the principles of good records management and uniform information management.

The Archives Act (831/1994) states that the central functions of archives management are to make decisions on the preservation times and modes of documents and to maintain an archive formation plan. The duties in accordance with the Archives Act include:

- value assessment and appraisal of data,
- preservation of valuable data,
- organisation and cataloguing of preserved data,
- loan and release for research purposes,
- information services concerning archived data,
- disposal of unnecessary data, and
- protection of data against unusual conditions.

The Archive Formation Plan acts as the accumulation instruction for Statistics Finland's statistical data. It defines the data to be preserved permanently or, by Statistics Finland's decision, for a fixed term. The National Archives approves the Archive Formation Plan with respect to the data to be retained permanently.

All Statistics Finland's electronic data must be archived in standardised form, i.e. as unified data files. This ensures that the data can be recovered in future according to users' needs, even if the original data input programs and equipment become outdated.

Principles

The most important archiving tool at Statistics Finland is the Unified File System, which covers the file and field descriptions, or the metadata of the data to be archived. The Unified File System also comprises Statistics Finland's other metadata systems: the Classification Database and the Concepts Database, which are further utilised in the field descriptions of unified data files, the System Register and the Archive Formation Plan. The two latter are used in the file descriptions.

In principle, the archived description is always stored in one location only. If a classification already described in the Classification Database is used in the data to be archived, this is not described separately but linked by a classification link to the field description of the unified data file. A concept link is similarly made. The Archive Formation Plan link indicates to which archiving item the unified data file belongs and the system code indicates to which system it is linked.

The use of Statistics Finland's meta systems is recommended in archiving, because it expedites and simplifies the description work. The Archiving ABC guide (Taivainen, 2005b) gives instructions on archiving and required applications, their use and support, information about user IDs and installation of applications.

The main steps of an archiving event are as follows:

Step 1. Check the information on the archiving item in the Archive Formation Plan description. Small changes can be made by updating the description. In the case of essential changes (e.g. a change from total data into sample data), a new archiving item should be made.

Step 2. Describe the unified data files in the Unified File System according to the Archive Formation Plan description. The names of unified data files are not listed in the Archive Formation Plan description, but only the data to be archived. The archiving item may include several unified data files. When naming the unified data files, the system code defined in the Archive Formation Plan must be used so that the files can be found in future as well.

Step 3. Archive the unified data files in the Unix. When the archiving has been completed, the files in the Unified File System will have the entry Archived in the field of Storage.

Step 4. In the Archive Formation Plan application, fill in the Release form attaching to it the names of the unified data files concerned and other release information. Then send the Release form with any other paper material to the Archives of Statistics. If the archiving item includes several unified data files that are to be completed at different times, fill in the Release form only when all the unified data files have been archived.

Guidelines

- When using the Unified File System for archiving, the description of the unified data file must always be made with care in order to ensure the usability and correct future use of the data. For further use of the data it is essential that the metadata (description) are of good quality.
- The description of the data must correspond to the data file being described. Before making the archiving description, all the information about the data file to be archived must be clarified (what it is called, which version is to be archived, where it is located, who has rights to it, what variables it has, whether the classifications and concepts used are described in the Classification Database and the Concepts Database, respectively). In addition, attention should also be paid to the archiving guidelines (Taivainen, 2005a, 2005b, 2005c).

- Making the description is always a result of co-operation: a good description includes an understanding of both the production process and the key decisions made in order to produce these data. This understanding should be passed on to further users as well.
- The file description should be made immediately when the information content is complete. The timing of this depends on the nature of the production process. When the description is made early enough, the same description can be used for other needs prior to archiving, for example, for the metadescriptions of the PX-Web or Stat-Fin online service database.
- When the description has been completed, the person in charge of the unified data file will check the description and register it as approved. Only an approved description can be archived.

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4 Promotion of the Use of Statistics, Publishing and Customer Service

4.1 Promotion of the Use of Statistics

Scope and purpose

The scope of promotion of the use of statistics extends to improvement of the usability of statistical information and the product and service selection based on it, and widening of public knowledge about them, as well as elevation of skills in statistical literacy and in the use of statistics.

The aim in promoting the use of statistics is to ensure wide and efficient exploitation of statistics in society. To attain this, statistics must be easily available and usable. The availability of statistics is improved by general and product-specific or statistics-specific communication and marketing and by making products and services easy to find and access. The usability of statistics is enhanced by making statistical products and services clear, illustrative and suitable for user needs. The use of statistics is also fostered by the provision of guidance and training in their use and reading.

The goals and principles defined in Statistics Finland's communication strategy (2003) shall be followed in promoting the use of statistics, as well as in their publishing and in customer service. According to the communication strategy, the following principles should be observed in communication and in customer service:

- *Reliability:* All information released shall be accurate and its level of reliability indicated.
- *Impartiality:* In its communication Statistics Finland shall emphasise the objectivity, independence and equality of data production and comply with the principles of statistical ethics.
- *Openness and equality:* Data shall be released in a fair manner so that the times of their release are notified in advance and everyone interested is given the opportunity to receive them simultaneously at the time of their release. Statistics Finland's staff shall be active experts in their fields and provide information about statistics and services within and outside the organisation.
- *Understandability and clarity:* In all communication Statistics Finland shall aim at understandability and clarity by avoiding excessive professional terminology and by analysing the depictions given by statistics. Presented information shall be so complete that its users will have the possibility for their own interpretations and conclusions.

Statistics Finland's customer service principles are formulated into service commitments (see Section 4.3).

Principles

Public knowledge and availability of products and services are promoted by increasing awareness about the general supply of statistics and by helping end-users to find the information they need. End-users are notified about new information, products and services by means of brochures, press releases, the customer magazine, news and featured items on the Internet service, and at diverse events, occasions and fairs. Press releases are made of new statistical data and research results, methodological changes in statistics and topical issues relating to current public debate, news or other relevant matters. A printed catalogue is compiled annually of Statistics Finland's products and services.

Information and lists describing the general supply of statistics are issued on Statistics Finland's Internet service. Information about statistics and their availability can be found in the list of statistics and in descriptions of statistics, in the list of publications in the Official Statistics of Finland series, in the release calendar of statistics and in Statistics Finland's weekly calendar. Lists and catalogues published online also support information search through links to electronically released statistical information. The Internet service also contains descriptions of statistical products and services.

The TILDA catalogue database of the Library of Statistics contains details of the material available in the Library and the WebStat service provides information about the most reliable international statistical data on the Internet. The publication exchange practices, the library systems and the interlibrary loan network of the Library of Statistics ensure that statistical publications are also available at other libraries.

The usability of statistics is improved through methodological and product development. Feedback collected systematically from end-users is vitally important for product development. Usability tests are also exploited in the product development of web services. The usability of publications is enhanced by improving tables and statistical graphics, and the readability and structure of texts. This requires provision of systematic guidance and training for the compilers of publications.

Statistics Finland supplies the statistics and statistical data it produces to international organisations according to international agreements and regulations. Inquiries from international organisations are channelled through Statistics Finland's Registrar Office, which will retain information on the data supplied.

To promote statistical literacy and user skills, Statistics Finland collaborates with other statistics producers and end-users, such as educational institutions and the media. Statistics Finland organises customer training in which course topics include the compilation, interpretation and use of statistics, and products and services based on statistics. Tailored training can also be arranged for customers. Statistics Finland also offers an eCourse in Statistics, which provides introductory lessons in the interpretation and use of statistics, information search, statistical thinking and the fundamentals of key statistics.

Recommendations

- Public awareness of the supply of statistics shall be promoted by communication and marketing.
- The availability of statistics shall be improved by developing Internet services and by supporting the visibility of statistics in the library network.
- The usability of statistical products and services shall be improved.
- Those in need of information shall be given guidance in how to find the relevant sources of information.
- Customer needs shall be established and statistical products and services shall be developed basing on them.
- Statistical literacy and user skills shall be advanced in co-operation with other statistics producers and end-users, such as educational institutions and the media.
- Statistics Finland shall comply with the public service quality strategy (the Association of Finnish Local and Regional Authorities, 1998) and aim to increase the circulation of the statistical information it produces.

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4.2   Publishing

Scope and purpose

The ethical principles of statistics underline the social responsibility of statistical authorities. Reliable and sufficiently exhaustive statistics are the foundation for efficient management of matters in a democratic society. Citizens need statistical information in order to obtain a realistic picture of their living conditions and society, look after their interests and take part in decision-making. Public administration, the EU, business life and research activities also require reliable and impartial statistical information.

Statistics Finland is planning and developing products and services for both national information needs and for the requirements of the European Statistical System. Statistics Finland's main output, general statistics about society, is freely available to all on the Internet. Statistics Finland supplies the statistical information required by agreements and EU legislation to the EU and to international organisations free of charge. Statistics Finland also serves the users of statistical data with its versatile information services, some of which are supplied for a fee to customers' orders. The goal of publishing is to make the statistical information produced by Statistics Finland available to users without delay.

Principles

Publishing means distribution of statistical information for general use in, for instance, printed and electronic publications and statistical databases. The goals and principles of Statistics Finland's publishing are in line with Statistics Finland's operating strategy (Statistics Finland, 2003a), development lines of web services (Statistics Finland 2003b), and communication principles (see Section 4.1). The publishing principles are:

- *Reliability:* All information released shall be accurate and its level of reliability indicated.
- *Impartiality:* The information shall be released on schedule and shall be available simultaneously to everybody.
- *Immediacy:* All information shall be released as soon as possible after the reference period they describe.
- *Clarity:* All information shall be presented clearly, taking into account the needs of end-users. Users of information shall be given every opportunity to draw their own conclusions.
- *Neutrality:* It is important to exercise caution and restraint in the treatment of contentious social issues.
- *Interpretation:* All information shall be interpreted and analysed by describing the scale and proportions of different phenomena and by explaining the causes and consequences of changes and phenomena. Where possible, the information contained within a given statistical product shall be compared to other statistical data related to the same phenomenon and to any other relevant information.
- *Timeliness:* All information released shall be tied to current social debate and issues. Statistics Finland shall take the initiative in producing statistical information.
- *Openness:* Reliable statistical information shall not be concealed.
- *Guidance:* End-users shall be supported in their acquisition and search for information.

Releasing refers to the publishing of statistical information that makes public for the first time key data from some statistics describing a certain time period. In accordance with the principles of the Statistics Act, completed statistical data are released without delay and are made simultaneously available to all users of information (Statistics Finland, 2004a).

New statistical information is made public as statistical releases on the homepages of each statistical topic. In accordance with the Language Act, information is released to all users at the same time in both Finnish and Swedish (Statistics Finland, 2004b). Statistical releases are issued in English on internationally important statistics (e.g. short-term economic statistics, national accounts and population development; Statistics Finland, 2006a and 2006b). Data releasing and the related informing of data users is part of Statistics Finland's general obligation to communicate as imposed upon all state authorities in Finland.

Releasing is systematic. Extensive information about coming releases is provided in advance in the annual release calendar and in more detail in the weekly newsletter, or the weekly news calendar (Statistics Finland, 2006c). Release calendars serve the purpose of improved predictability in agency operations, making it easier for end-users to plan ahead according to the release dates of new information. Release calendars contribute to improved processes and customer operations, not only in information services but also in marketing and communications. Releasing of statistics according to release plans is monitored regularly.

Statistics Finland produces and releases data from about 200 different sets of statistics covering diverse fields of society. Most of the statistics come under Official Statistics of Finland (OSF). Around 700 releases are made every year from the regularly produced statistics of Statistics Finland.

Confidentiality of data and disclosure before release

The statistical information that is due for making public must be kept undisclosed until their scheduled time of release (Statistics Finland, 2008). Particularly statistics that have a bearing on the capital and financial markets should be kept secret. Examples of confidential statistics include the Monthly Indicator of Total Output, Quarterly National Accounts and Consumer Survey. No advance information must be given about the results of other statistics, but they must be made simultaneously public to all.

On the basis of legislation or special agreements, information can in special cases be provided in advance to, e.g., other producers of official statistics or Eurostat for compilation of their own publications. In these cases, the embargo principle shall always be clearly stated: the receiver must not hand the information over to any other third party before the agreed release time.

Printed publications

Statistics Finland issues printed publications both as series and as separate volumes. The main series of printed publications from the statistics within the scope of official statistics of Finland is called **Official Statistics of Finland** (OSF). It also includes publications of other producers of official statistics than Statistics Finland. Each publication specifies the statistical topic it concerns. The Advisory Committee of Official Statistics of Finland has issued release guidelines for the OFS series (2005) and maintains a catalogue of the publications included in the series.

In addition to OFS publications, Statistics Finland issues publications in series entitled Studies, Reviews, Handbooks and Gender Equality. **Studies** is a series of publications of scientific studies of high standard. The publications of the series are peer reviewed before release. The **Reviews** series contains statistical and research reports that are not suited for publishing in the aforementioned series. The **Handbooks** series comprises the main statistical handbooks, classifications and guidelines. The **Gender Equality** series includes statistical and research reports relating to gender equality.

Besides the series of publications Statistics Finland issues separate volumes, or monographs, and other publications (regional reviews, pocket statistics and periodicals). The separate volumes are individual, high-quality statistical or research reports. Regional reviews contain statistical information by municipality in an illustrative form. Both the general publication *Finland in Figures* and topic-specific publications are issued as pocket-sized statistics. Statistics Finland's periodicals provide information about statistics by means of descriptive articles.

Electronic publications

All the 200 or so regularly produced sets of statistics of Statistics Finland have their own permanent homepages in Statistics Finland's web service. General social statistics and the statistical data contained in them, which are available to all on the Internet, are published and stored on the homepages of individual statistics (Archive of statistical releases http://tilastokeskus.fi/til/arkisto/index_en.html). Statistical information published in databases can also be found through the homepages. In addition to actual published statistical data, the homepages also contain in-depth and background information on the statistics concerned, such as descriptions, quality and methodological descriptions, used concepts and definitions, and classifications.

To facilitate information search, all statistics are grouped according to the division of topics of Official Statistics of Finland (see Section 1.1.4). Grouping, indexing and extensive background data on statistics help end-users to analyse thematic entities and learn more about the topic in question.

Procedures for correcting detected errors

Errors detected in released statistical data must be corrected immediately in accordance with the recommendations of the Advisory Committee of Official Statistics of Finland (Advisory Committee of Official Statistics of Finland, 2005) and internal guidelines of Statistics Finland (Statistics Finland, 2007). The guidelines provide guidance on how errors should be corrected in different dissemination channels of statistical data. Prompt correction of any errors found in publications or web services is crucial to the retention of confidence.

The correction procedure does not concern information issued as preliminary data, in which the possibility for changes is indicated upon release. However, any obvious errors in preliminary data must be corrected appropriately.

Recommendations

• The guidelines of Official Statistics of Finland and Statistics Finland concerning uniform modes of presentation and notation, correction procedures for detected errors, and use and content of release calendars shall be followed in the publishing and releasing of statistics (Statistics Finland 2003b; 2004a; 2004b; 2006c, 2007, and 2008; Advisory Committee of Official Statistics of Finland, 2005).

- Only those Statistics Finland employees who are involved in the compilation of the statistics in question or need the data from them for their work before publication shall handle the data of the statistics and receive information about them prior to their release (Statistics Finland, 2008).
- To evaluate the reliability of statistics, the compilation methods shall be public and generally acceptable. The objective of publications and the guidelines issued to end-users is to promote the correct use and interpretation of statistics. To this aim statistical publications shall include a quality description, from which the reliability of the data and any possible risks of inaccuracy can be concluded (Advisory Committee of Official Statistics of Finland, 2006).

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4.3   Quality in Customer Service

Scope and purpose

One of Statistics Finland's basic duties is to disseminate information as widely as possible. The objective is that the key statistical information from the general social statistics produced by Statistics Finland can be used by customers as a free self-service on the Internet. In addition, the services of the Library of Statistics are available to all users. Survey and interview services are offered as charged services. Statistical information is also supplied as charged assignments to customers' orders.

It is important that customer service is based on a consistent set of principles and practices so that customers get the information and services they need regardless of the department they contact. For this reason, and in order to create uniform and good practices for its customer service, Statistics Finland defined its customer service principles in 2004.

Principles

Customer service principles

The quality of customer service has a major bearing on Statistics Finland's corporate image. The information supplied to customers must be reliable, timely, readily understandable, easy to use, appropriately priced, and in compliance with data security regulations. Customers' information needs must be given due attention and the information supplied in a format that will allow customers to make good, cost-effective use of that information in their own operation. Collecting and responding to customer feedback is important for the maintenance of high quality standards and improvement of service.

All staff members at Statistics Finland shall be familiar with the customer service principles, according to which:

- We are easy to approach
- We serve our customers flexibly and efficiently
- We attend carefully to the needs of our customers
- We operate fast and with precision
- We keep our customers up-to-date
- We learn continuously from our customers
  (Statistics Finland, 2004).

Guidance and information service

In order to make sure end-users gain access to the information they need and know how to interpret it correctly, it is important that information, advice and guidance is provided on Statistics Finland's products and services. A catalogue is compiled annually of Statistics Finland's products and services and their prices.

In addition, Statistics Finland's Internet service contains information about the available products and services, and the related metadata and classifications, data collections, quality descriptions and availability of statistical information.

Customer service at Statistics Finland is a collaborative effort that cuts across department boundaries. Customer calls must not be needlessly diverted from one person to another. Instead, when the agency is contacted by phone, the first point of contact should take note of the customer's contact information and information needs and find the contact within the organisation that can deal effectively with the inquiry. The customer will then be contacted as soon as the information has been retrieved. Customer inquiries and feedback shall be responded to preferably at once but no later than within two working days.

Customer assignments must be handled confidentially. In addition, all necessary steps shall be taken to make sure that the legislative and data protection requirements pertaining to Statistics Finland's information service are adhered to (see Sections 1.1.1 and 2.2). For materials requiring a licence, customers will need to file an application in order to gain access to the material (Statistics Finland, 2005).

The key statistical information is available to end-users as a free self-service on the Statistics pages of Statistics Finland's Internet service. Short guidance and information – usually requiring less than 15 minutes' working time – is provided free of charge. Otherwise separate costs will be charged by the hour.

Customer service outlets are open during normal office hours. Orders for publications can also be placed around-the-clock through the online StatMarket service. The Library of Statistics, its facilities, equipment and collections are available for use by customers during office hours. Statistics Finland has regional service offices in Turku, Tampere, Seinäjoki and Oulu.

Recommendations

- All customers shall be treated with full respect, the aim being to provide a friendly and professional service.
- Customers shall always receive the requested information on time. If any delay arises, customers shall be immediately informed.
- A fee is charged for products and services delivered in response to customer inquiries. Service charges are based on current price lists, which in turn are based on the act and decree on the pricing criteria for state services(159/1992, and 211/1992, respectively) and the Decree of the Ministry of Finance concerning fees charged for Statistics Finland services (1208/2006).
- Quality descriptions shall be attached to Statistics Finland products and services. Otherwise customers shall receive information on the methods used in compiling the statistics and on the applicable concepts and definitions. In fee-based assignments, the texts of the contracts and terms of delivery shall be made available to the customer.

- The aim is to provide customers with products and services that are error-free. The information and products supplied shall always be checked before they are sent to the customer.
- Customer feedback shall be collected via a continuous anonymous feedback channel on Statistics Finland's homepage. Staff members shall also keep a record of received feedback. The response to any claims and complaints shall be friendly and prompt.
- Customer needs and satisfaction shall be evaluated and monitored. Statistics Finland shall conduct a customer satisfaction survey each year. In addition, end-user surveys can be carried out for specific products and services.
- Statistics Finland employees shall undertake to adhere to Statistics Finland's customer service principles.
- The realisation of the customer service principles shall be followed by surveys and other feedback methods.
- Documentation
- Assignment or information service contracts shall be prepared for all information service assignments (Statistics Finland, 2002).
- All phases of assignments in progress shall be recorded and entered into the customer management system.
- Information relating to any exchange with a customer, such as quotations submitted or contracts signed, shall be saved in the customer management system.

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List of Abbreviations

AMS, Archive Formation Plan

ARGUS, Software for statistical confidentiality

ARIMA, Autoregression integrated moving average

BSC, Balanced scorecard

CALMAR, Calibration program (calibration on margins)

CAPI, Computer Assisted Personal Interview

CASI, Computer Assisted Self Interview

CASI-A, Text on Screen and on Audio

CASIC, Computer Assisted Survey Information Collection

CASIIP, Computer Assisted Self Interviewing with Interviewer Present

CASI-V, Question Text on Screen

CATI, Computer Assisted Telephone Interview

CAWI, Computer Assisted Web Interview

CLAN, Software for computation of point and standard error estimates in sample surveys

CoP, (European statistics) Code of Practise

CPA, Classification of Products by Activity

DBM, Disk by Mail

Deff, design effect

DESAP, Development of Self-Assessment Program

EC, European Community

ECE, Economic Commission for Europe

EFQM, European Foundation for Quality Management

ESA, European system of accounts

EU, European Union

Eurostat, (ESTAT) Statistical Office of the European Communities

ISI, International Statistical Institute

ISO, International Organization for Standardization

MSE, Mean square error

NACE, Nomenclature Générale des Activités Economiques dans les Communautés Européennes
(Statistical classification of economic activities in the European Community)

NSI, National Statistical Institute

NUTS, Nomenclature des Unités Territoriales Statistiques (Nomenclature of territorial units for statistics)

OSF, Official Statistics of Finland

PPS, Probabilities Proportional to Size

PRODCOM, List of products of the European Community

RAMON, Classifications Database of Eurostat

SAS, A large intelligence and analysis software package

SRS, Simple random sampling

Stakes, National Research and Development Centre for Welfare and Health

SUDAAN, Software for analysis of complex survey data

SYS, Systematic sampling

TQM, Total quality management

TRAMO/SEATS, Software for seasonal adjustment

UN, United Nations

UNSD, United Nations' Statistical Department

Documentation page

Abstract

The statistical production process forms the core of Statistics Finland's activity. The aim of the *Quality Guidelines Handbook* is to improve the usability of the skills and competence required in the designing and implementing of statistical systems by gathering the existing principles into common knowledge capital.

The *Quality Guidelines Handbook* is intended for all who are interested in the functioning of statistical systems, as well as for the users and producers of statistics. The Handbook outlines the framework within which the field of statistics operates in Finland and describes the relevant legislation, as well as current best methods and recommendations.

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TILASTOKESKUS
STATISTIKCENTRALEN
STATISTICS FINLAND

KÄSIKIRJOJA
HANDBÖCKER
HANDBOOKS

Statistics Finland

– Combining data and expertise into statistics and information services

    varied, reliable data on the society and its development
    broad and active co/operation networks in Finland and abroad
    statistics production built on the work of 1,000 experts in different fields
    head office in Helsinki, regional service offices in Turku, Tampere,
    Seinäjoki and Oulu

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