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Current Methodological Issues at Statistics Sweden

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Abstract: The article provides an overview of the organization and contents of Statistics Sweden's research and development work. Section 1 describes the processes for research, planning and quality work as well as various means for maintaining the methodologists' continuing training and education. Section 2 provides examples of current research projects. Section 3 discusses some proposed changes of Sweden's statistical system and their implications on research and development work conducted at our agency.

Key words: Organization; training; monitoring; development work.

1. Organization of Statistics Sweden's Methodological Work

In Sweden, most official statistics are produced by Statistics Sweden's four main branches: areal statistics, enterprise statistics, labour force statistics, and statistics on individuals and households (demographic surveys). There is also a research and development department and a department for statistical services. The total number of statistical products produced during one year is about 200. According to a report on data collection, in 1988, 86 surveys used mail questionnaires, 18 used interviews, and some "other method" was used in the remaining cases. A number of the mail surveys are censuses, and "other method" reflects, to a great degree, information that is collected in public sector activities and is delivered as raw data to Statistics Sweden for processing and publication. Statistics Sweden is divided geographically between two locations, Stockholm, where top management resides, and Örebro. All of the departments are represented in both locations. The number of employees is today about 1200 which contrasts with the 2000 employees at the end of the 1970s. At present, about 45% of all employees are in Stockholm and the remainder are in Örebro. In addition, there is a corps of interviewers who are spread over the entire country, but whose central leadership is in Örebro, and there are three regional offices with a few employees each.

For the most part, the reduction in personnel has occurred through efficiency gains due to computerization without any significant reduction in statistical production. This year there will be a major reorganization of Statistics Sweden resulting in many changes. How these changes will affect the research and development work is discussed in Section 3.

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1.1. *The placement of methods expertise throughout the organization*

Approximately 60 statisticians work with development issues or application of statistical methods as their main assignments; about one quarter of these are actually placed at the Research and Development Department. Approximately 20 of the 60 statisticians have graduate degrees. Five of those at the Research and Development Department have professorial appointments. The general development work conducted at the Research and Development Department is financed through a particular budget from the government.

The R & D Department works with general development work in the area of survey methodology and statistical coordination and standards; R & D is responsible for the national and international contact network; and performs special studies for the Office of the Director General. The four main branches have their own methods groups that are responsible for developmental work relevant to their own statistical production. In addition, there are methodologists who work exclusively on methodological problems in certain large surveys, for example, in the consumer price index, the labour force survey, environmental statistics, and the survey of living conditions. This work is ordered and financed by the survey itself.

The organization of computer science activities have changed a great deal during the past year. The responsibility for the mainframe computer and its maintenance has been transferred to a private company, DAFA, which will also sell computer consulting service to Statistics Sweden. Through a particular agreement, Statistics Sweden is assured that the protection of privacy and confidentiality will be maintained. Statistics Sweden's own computer science unit, which earlier belonged to the R & D Department, has been re-organized to assume complete responsibility for its own economy. The new computer science unit has its own leadership and in the future, the unit will not have an autonomous work agenda, but will "take orders" from other departments. The exact details of this new arrangement are not yet fully determined.

The main part of the staff of Statistics Sweden now work at their own PCs connected via a network with the mainframe. A few of the most used standard network programs are: Microsoft Word, SAS, Excel, and Charisma. Other software can be installed on a PC's harddisk, but without the support of the computer science unit. The network also has electronic mail and an electronic bulletin board. The electronic administrative functions are developing rapidly and for example by first quarter 1993, all time reporting is performed electronically. Even the regional offices are a part of the network and the interviewers can retrieve information from an electronic mail box. This network is very efficient. For instance, it is much easier now to put together working-groups where some members work in Örebro and others in Stockholm.

1.2. *Planning*

The planning of the general developmental work is documented in both a three-year plan and a more detailed one-year plan. While the three-year plan is more of an outline, the one-year plan is highly detailed and is followed up every six months. An important part of the planning is a number of discussions with the other departments. During the last few years, the plans have been discussed in the Quality Council, an agency-wide group with the Director General as chairman. The finalized three-year plans are a part of the agency's budget

request to the Department of Finance. The developmental work conducted at the different branches is planned by the department's methods group in cooperation with the head of the department and those responsible for individual programs and projects.

The results of the developmental work are followed up at the end of each period. A particularly extensive follow-up was conducted in connection with the 1992 planning. The Finance Department requested a particular examination of the benefits of the developmental work that has been conducted during the most recent five-year period.

Particular efforts are made to produce summary reports on the agency's activities so that the development work can be directed towards those areas where it is most needed. In 1988, a data collection study was conducted which examined the resources devoted to data collection and data processing and described how the various statistical products were distributed over the different collection methods. In 1991, a study was conducted of the connection between the different statistical products as foundation for evaluating how the best possible information content in official statistics can be reached through coordination of variables and definitions, production coordination, and how respondent burden can be minimized (see Eklöf, 1991). To assist the planning and better be able to evaluate the utility of different development projects, the R & D Department is establishing a technique and methods data base so that it can be clearly seen how the agency's statistical production uses different types of data collection methods, and the degree of computer support used in the production process. With time, the data base can also be an effective aid which illuminates, describes and analyzes changes in production activities.

1.3. Continuing education and maintaining competence

To maintain a high level of competence in Statistics Sweden's personnel, a number of measures have been taken. Among other things, new employees can participate in an extensive training in survey methodology. There is even an extensive in-house seminar series that encompasses both statistical methods and computer science. Seminars range from general to those that are relevant to specific types of surveys, for example, demographic, enterprise, etc. The results of the methods work are disseminated through different internal publications, which are summarized in ABSTRACTS, which comes out three or four times a year. An important part of competence development is that every year a number of leading researchers from other statistical agencies or universities are invited to Statistics Sweden to hold seminars on their own research work. Previous topics have included variance calculation, measurement errors, nonresponse problems, exploratory data analysis, design of experiments and computer assisted data collection.

The continuing education is under the direction of The Statistics Sweden School of Continuing Studies (U/SKOL), which is financed partly by agency funds for certain basic training and partly from tuition. The courses are open to participants from outside of Statistics Sweden, and some courses are even designed for non-Statistics Sweden participants. U/SKOL has a flexible organization with a small core staff. Most of the teachers are on loan from other parts of Statistics Sweden. In this way, the entire continuing education program is an integrated part of the statistical work conducted at Statistics Sweden and the program is an important vehicle for the dissemination of the results of our own development work.

Statistics Sweden's professors play an important role in maintaining quality, not only in the development work but even in general education and seminars.

Statistics Sweden has a Scientific Council consisting of university professors in statistics, economics, medicine, and the social sciences. The council meets four times a year and discusses projects of greater methodological interest. Otherwise, contact with the Swedish academic world is for the most part informal. No university in Sweden offers a degree in survey research but a number of university lecturers are keenly interested in sampling issues. Every other or every third year, Statistics Sweden arranges a research conference on a particular theme, for example, areal statistics, enterprise statistics, nonresponse issues, or measurement errors, with participants invited from universities and other agencies. Usually, statisticians from the other Nordic countries participate.

Statistics Sweden collaborates with survey specialists worldwide. We publish the Journal of Official Statistics, a quarterly specializing in survey methods and applications. Occasionally, we participate in organizing international conferences, most recently, the 1987 Telephone Survey Methodology Conference in Charlotte, NC, U.S.A., and the 1990 Survey Measurement Error Conference in Tucson, AZ, U.S.A. Currently we participate in organizing the 1993 Establishment Survey Conference in Buffalo, NY, U.S.A. and the agency is a regular member of the Data Editing Joint Group. We have also organized international conferences at Statistics Sweden. The most recent examples are the conferences on nonresponse, diary survey methodology, and use of auxiliary information in surveys. We believe that it is important to keep a high profile internationally. National offices around the world have, for the most part, the same methodological problems and agencies benefit, across the board, from sharing both research work and research results.

1.4. The agency-wide program for monitoring and improving quality

The overall monitoring of quality in the agency's products and steering of the development work is performed by Statistics Sweden's Quality Council under the chairmanship of the Director General. Particular studies are conducted by a work group which consists of members from both the Research and Development Department and the subject-matter departments.

In 1979, Statistics Sweden introduced guidelines for quality declarations of its surveys. Additional policy came in 1983 which defined recommendations for user-oriented statistical quality declarations. The guiding principle of the policy is that the producer has to inform the users of factors which are important for the correct interpretation of the statistics. The information should be accessible and easily understood for the users, and in all respects formulated to meet user needs. The quality declaration should include information on definitions, methodology and comparability both over time and with other data. These guidelines governed quality presentation emphasizing the need for estimates of precision and estimates of the magnitude of the nonsampling error components. The treatment of other quality factors, like relevance and timeliness was then more superficial. As a result of these guidelines and policies, Statistics Sweden has seen the quality declarations of its surveys gradually improve during the last decade. However, further discussions of the meaning of survey quality and the components that should be included in the quality concept were intense. To improve the analysis of Statistics Sweden's total output,

top management decided in 1989 that a new definition of the quality concept should be used. The newer definition describes quality as a vector of 22 indicators grouped into three broad equally important categories: relevance, precision, and accessibility.

The yearly Survey of Quality is the main tool for monitoring the level of quality and changes in the agency's statistical products (see Eklöf and Nilsson, 1992). This survey was initiated in 1989 and the measurement process has improved with each successive year. Each year a questionnaire is sent to all heads of statistical products. The heads are asked to express how they believe the users judge the quality improvements in Statistics Sweden's statistical products. The questions concern changes during the current year. The findings are collected in a quality report and an overall evaluation is performed. In 1992, (fiscal year 1991/92) quality was judged to be unchanged in 80% of our statistical products for all three main categories. Quality improvements were cited about twice as frequently as deteriorations in quality. The most common improvements were increased timeliness and improved relevance. To find out the users' own opinions, a users' questionnaire is planned for spring 1993. As a complement to the quality report, continued tracking of nonrespondents and other special studies are conducted. Three years ago, statistical reports published during a certain period were evaluated in accordance with the quality vector. This will be repeated in 1993 to determine the extent to which improvements have been realized.

Under the leadership of the Quality Council, a program has started to examine all of the statistical products. The examination is, however, a rather limited effort. It will be performed by someone who is not tied to the product and is meant to describe the current situation and provide suggestions for solutions and improvements. At present, only a limited number of products have been examined, for example, the Survey of Household Income, Survey of Higher Education, Consumer Price Index, etc. On the other hand, our experience is that without fail, potential improvements in quality or efficiency have emerged from these examinations. In a number of cases, the examinations have quickly led to remedial measures.

Another program is what we call the quality funds. Top management has set aside supplementary funds for quality studies and projects that rationalize work, routines, etc. The point is to broaden quality work by supporting projects that would not otherwise be funded and encourage a broad spectrum of personnel to get involved in quality work. Studies of the quality of data collection, editing, and coding are given priority. The projects that promised to result in savings were also given high priority. Studies of the quality of data collected from administrative records have been encouraged. The amount of available money has been trice outstripped by the amount requested.

2. Examples of Development Work

2.1. A sample of projects

Sections 2.2 through 2.8 discuss the contents of a number of newly completed, in progress, or planned development projects which mainly concern survey techniques and methodological issues. Our list is far from complete. A few examples of important and expensive projects that will not be discussed here are (1) an extensive revision of the Swedish classification of industry, (2) a highly prioritized project to increase the accessibility of the statistics for the users and (3) the introduction of a geographic information system which was developed at the Department of Areal Statistics, and

which will be used throughout the entire agency.

2.2. *New technology for data collection*

To expedite, make less costly, and raise the quality of data collection, a battery of new techniques and technologies are being introduced and evaluated (see Blom et al., 1991). Most data entry uses a software called RODE-PC which was developed for Statistics Sweden. This program allows various degrees of integration with other phases of the work. Optical Character Recognition has been used since 1987 for data capture from mail questionnaires and registration cards. Both cases have meant great strides in efficiency with all of the corresponding benefits. Bar codes are used only to register the arrival of questionnaires. Data collection on disk is already used in a few surveys.

In the 1990 census, data communication technology was introduced for decentralized, on-line data processing. Registration of incoming forms could be done at local (municipal) data processing stations rather than centrally at Statistics Sweden. Both the data registration (bar code registration of incoming forms) and data capture were performed on-line with Statistics Sweden's mainframe. The PCs have been IBM PS/2 models 50 and 30. An IBM 3745 controlled communication. This technology has meant a gain in timeliness of up to one year for several variables. The actual savings, calculated to approximately 50 million SEK, were to the advantage of the municipalities.

Experiments are now planned to test data collection and data capture with scanners, computer to computer communication, and touchtone data entry (TDE). Equipment and appropriate software have been studied. Suitable products to test the techniques have been identified and the principles for evaluation are being finalized. Before these techniques can be put into production, profitability evaluations must be decided upon, and these can be critical for the application of TDE. The savings reported by the U.S. Bureau of Labor Statistics in its use of TDE for employment data from private companies may not be applicable to Statistics Sweden as the number of respondents in Sweden is much smaller.

2.3. *The interviewing unit*

Statistics Sweden's interviewers do both face to face and telephone interviews. The organization has always been able to conduct nationwide interviews. The greater part of the interviewer corps has always been decentralized while only a small telephone group has been in Örebro. The interviewer corps is organized into groups of 10–15 interviewers who are led by a regional supervisor. The supervisor is responsible for the organization of the daily work, and that the final goals are achieved. As a consequence of the decentralized organization, it has been a priority to develop a general and decentralized CADC (Computer Assisted Data Collection) system which can accommodate both telephone interviewing and face to face interviewing.

The CADC system uses a central computer which oversees the entire process and the software is for the most part developed by Statistics Sweden. The CADC system orchestrates all major survey operations including: questionnaire design, data collection, data registration, editing, and coding. The system delivers the results in a record file which is later tabulated and analyzed. As CADC offers much tighter control and follow-up of the data collection process than paper and pencil methods do it is most useful when the interviewer corps is decentralized. Through CADC, the supervisors

receive daily information of the progression of the field work (with a one-day lag). Interviewers in the field use portable computers which communicate with a mainframe in Örebro during the night. The PCs used in the field are Toshiba 1200 with a 9.54 MHZ 80C83 processor, 1Mb RAM, 20 Mb hard disk, and 3.5 floppy A-drive. It weighs 5.5 kg (12 lbs), has an internal 1200 baud modem, and a battery which lasts about two hours.

The most important test of CADC was a production test in Statistics Sweden's Labour Force Survey (LFS) (see Blom, 1990). The test was conducted from August 1989 through January 1990 (with reinterviews conducted in February 1990). The Labour Force Survey (LFS) was divided into two groups, one which was interviewed with CADC and the other with pen and paper. The pen and paper sample consisted of 89,000 individuals while the CADC sample consisted of about 19,000.

With CADC, data arrive at the central data processing unit much faster (20–30%) than with traditional methods. The majority of the interviewers (81%) thought that CADC made a positive contribution to their jobs and 57% thought that CADC was more efficient than paper and pencil methods. There are also clear indications that the CADC interviews require less of the interviewers' time than paper and pencil methods do.

The two methods showed no significant differences for main variables in the LFS, i.e., number employed, unemployed, temporarily absent from work force, etc. There were very small differences in nonresponse levels. On the other hand, this test of CADC in the LFS did not lead us to believe that CADC lends a general higher level of quality than traditional methods. The quality gains are limited to tasks performed by hand which were error prone, for instance, transcription, calculation, etc. The savings from CADC stem from the following factors: no data registration, reduced costs for postage and paper, reduced editing and corrections, and fewer incomplete questionnaires – usually caused by interviewers not correctly following skip patterns.

Based on the results of this test, Statistics Sweden decided to go completely over to computer assisted interviewing in the LFS and other telephone surveys.

Cost pressures have led to a study of the organization of the interviewer corps. This study is moving in the direction of increasing the centralized telephone group while letting a number of the field interviewers become increasingly specialized in face to face interviews. This would entail an increase of the telephone group and some changes in how the work is divided among the telephone interviewers. To maintain nationwide coverage in surveys that use face to face interviews, Statistics Sweden is looking at two-stage sampling in scarcely populated areas and replacing face to face interviews with telephone interviews when travel costs would prove prohibitive. Simultaneously, work is being conducted to develop quality control programs for the interviewers by conducting reinterviews and extensive follow-up of the interviewers' field work.

2.4. Measurement techniques

The development and evaluation of measurement instruments is the most decentralized methods work at Statistics Sweden. For many years, measurement issues were handled by a measurement group which belonged to a sub-unit at the Department of Demographic Statistics. This group even maintained a questionnaire and question archive that proved highly useful. At present, the Department of Research and Development has established a Measurement

Laboratory (ML) which, with modest resources, works with methods development, conducts experiments, and provides consultation to Statistics Sweden's surveys. ML has developed routines for cognitive methods such as think aloud protocol, and both laboratory and field experiments. A small number of specially trained interviewers are now associated with the ML and they participate in tests and experiments. Despite its modest resources, the ML has achieved considerable results. Most of ML's activities have consisted of testing survey instruments concentrating on individuals and households surveys like the 1990 census, the Labour Force Survey, and others. At times, research issues have taken a back seat to assisting surveys in their questionnaire design. Recently, cognitive issues as they pertain to business surveys have received increasing attention. One issue that ML has focused on is the changes in measurement technique required as data collection becomes progressively more computer oriented.

To measure variations in responses, a number of reinterviews have been conducted in the Survey of Living Conditions, the Labour Force Survey, and the Survey of Political Party Preferences, among others. Reinterviews are normally conducted three weeks after the original interview and by a different interviewer who is at the same skill level as the original interviewer. As a measure of response variation, the gross difference rate is used, i.e., the number of different answers divided by the entire number of respondents. Reinterviews are done to identify questions that can be problematic during the analysis phase and questions that are candidates for improvement. Different variables generate different response variations. For example, in the Survey of Living Conditions, the percent giving different answers to the question "number of rooms in dwelling" was 2%; "regular dental visits" was 8%; and "participated in a study circle" was 18% (see Wärneryd, 1985). One of the implications of response variation is that results of longitudinal studies become difficult to interpret and compare. Research on how to correct for response variation by using reinterview studies is done by Munck (1991) and others.

In every Swedish census, a number of variables are evaluated using reinterviews and reconciliation. The reinterviews are conducted by asking the census question to a subsample in the Labour Force Survey. Differing responses are reconciled first by internal validation, and when that method fails, through a recontact with the respondent. The first part of the evaluation of household and dwelling data of the 1990 Census was published in April 1992 (see Lindén 1992). This evaluation study showed that the number of households that were properly classified according to number of household members varied between 91% and 96%, dependent on the size of the household. On the other hand, the net error was actually less than 50% of those who were placed in the wrong categories. The variable that proved most error prone was dwelling's type of heating system. The percentage of dwellings correctly classified according to heating system varied between 63% and 96%, dependent on the type of heating system. These results are, nevertheless, an improvement over those in the Swedish 1985 census.

2.5. *Editing*

All editing is now computer supported but we still have expectations for great efficiency gains generated by new editing methods. These changes will be achieved through adjustments in the production routines and the introduction of new technologies. One

goal is the integration of registration, editing, and correction phases. As these changes progressively come into force, the editing phase will function as an important instrument to uncover flaws in the measurement instrument and to detect typical response errors, thus generating suggestions for improvements. Efforts have been directed towards developing methods for macro-editing (see Granquist, 1991). As a part of the introductory work, prototypes for top-down editing and aggregate editing have been developed for SAS to make testing easier for those surveys that are interested in the new editing methods. Evaluation of the effects of editing is assigned a high priority and a handbook for executing and analyzing such studies has been produced. Methodological development has aimed at using analytic and graphical editing to identify certain types of errors.

2.6. Sampling, estimation, and variance calculation

Most of Statistics Sweden's sample surveys are drawn from a small number of permanent registers. These registers are built, for the most part, on administrative material. In the main, these registers must have high coverage and be updated at least once a year. The registers that are most often used as sampling frames are: the business register, property and estate register, the agriculture register, and the register of the total population.

Using combined information from a number of registers is useful for a precise sample allocation or for improved access to auxiliary information during estimation. For example, in the Survey of Household Income, the population register is complemented with auxiliary data on income from agriculture and enterprises to ensure an efficient stratification according to socio-economic groups. In a similar way, the precision has been raised and the nonresponse error reduced for a number of important groups in the Labour Force Survey by complementing the survey data with information from both the national employment office and the tax authorities (see Hörngren, 1992).

The most common sampling method used by Statistics Sweden is stratified sampling with random sampling within each stratum. Cluster sampling and two-stage sampling are less common. This makes variance calculations comparatively simple. Two in-house variance programs are widely used at Statistics Sweden: SMED and CLAN. SMED calculates the precision of level estimates and is used in connection with Statistics Sweden's standard program for compiling tables, TAB68. CLAN is newly developed and is written in SAS; it can be used on both the mainframe and on PCs. CLAN can calculate the precision of double ratios and differences between ratios regardless of the groups that are being compared, i.e., groups from the same survey or from two different surveys, even with partially overlapping samples. The calculations are based on a Taylor linearization and a stepwise application of Woodruff's transformation (see Nordberg and Andersson, 1992).

Recurrent business surveys usually sample populations that change often and rapidly. Objects enter and exit; size and classification change, all of which requires frequent frame updating. Access to auxiliary information offers many opportunities to make the sampling and the estimation more efficient. Often several surveys share the same target population, leading to extensive respondent burden. For these reasons, negative coordination of samples between surveys is necessary, as is a certain amount of rotation within surveys (see Ohlsson, 1992). Because the samples of enterprises are drawn from the

same frame, the Department of Enterprise Statistics has developed a system for sample coordination (the SAMU-system). The coordination is based on a technique which entails the assignment of a permanent random number to every unit in the business register. A sample will consist of those objects that have a random number which falls within a certain interval. The system allows coordination even given different designs, different population definitions, different stratification, and varying selection probabilities. The samples are rotated yearly and the system ensures that the overlap between two sequential samples is not greater than desired. The use of the SAMU-system lends comparability to variable definitions and population definitions.

A modified system for business surveys, called sequential Poisson sampling, has been developed to yield a fixed sample size, whereas the regular Poisson yields a random sample size. The sequential technique also allows stratification according to classifications not included in the registers.

Many surveys use sampling in space and time, like transportation surveys where trucks are selected at random and measurement periods are assigned at random to the selected vehicles. If the population is changing rapidly, as is the case with exit and entry of trucks in transportation surveys, traditional estimators for aggregated values are biased due to coverage problems. In Rosén (1990), a number of adjustment procedures are given for various degrees of nonresponse, repeated measurements, relationship between the number of exits and entries, and the separate exit and entry intensities.

The development of model dependent estimators holds a great deal of interest for Statistics Sweden (see Särndal, Swensson, and Wretman, 1992 and Lundström, 1991). Model based (synthetic) estimation is up to now only used to estimate the number of employed for small areas. The statistics from the synthetic estimates have, however, shown a somewhat different trend for employment than the corresponding numbers from the Labour Force Survey. For this reason, work to calibrate the synthetic estimates with the estimates from LFS has begun. Another application for model based estimation will soon appear as there probably will not be a traditional collection of census data in 1995. Since Sweden does not have a register of rental dwellings, it is not possible to arrive at the exact composition of Swedish households using only register data. Probably, it is possible to describe about 95% of all households correctly. Data on the remainder (mostly cohabitating unmarried couples and families with children older than 18 still living at home) must be produced using model based estimation complemented with information from the population register, previous censuses, and research is currently being devoted to investigate how well the synthetic estimators can work if complemented with auxiliary information from registers. A pilot study has been suggested where the distribution according to size of household and size of dwelling is estimated with SPREE (structure preserving) estimators for different sample sizes.

2.7. *Nonresponse issues*

By using information in the sampling frame and other registers, it is relatively easy to depict the nonresponse distribution, take certain measures (for example, poststratification), and extract an idea of how important the nonresponse actually is and even evaluate the size of nonresponse errors (see Lindström, 1983). For business statistics, the relevant information is usually a measure of size; for demographic statistics, variables like age, marital status, address, income,

etc., provide useful information. Data which depict and describe the development of nonresponse in all large sample surveys are collected in one yearly report, called the Nonresponse Barometer (see Bergdahl et al., 1992). The first barometer described the development of nonresponse from 1970 to 1985 and included only six surveys of individuals and households. The barometers have successively expanded so that all important surveys are now included and at the same time have become more unified and detailed. Background information on each survey is given in every report. This allows a judgement of how changes in data collection could have affected response rates and makes comparisons possible between different sample surveys. Surveys of individuals and households show an increasing trend in nonresponse. In particular, the not-at-home percentages have greatly increased. In business surveys, there are examples of both increased and decreased nonresponse. One example of the worsening survey climate, despite the increased effort devoted to smooth data collection, is the Swedish 1990 census. In 1990, census nonresponse was 8.5% before and somewhat less than 5% after the first reminder. In the 1970 census, nonresponse was 2.5% before and 0.9% after the first reminder.

LFS is conducted with telephone interviews complemented by face to face interviews for those who do not have a telephone. Studies have shown that unemployment is about three times as high in the group without telephones. Face to face interviews are about ten times more expensive than telephone interviews. Nevertheless, if the face to face interviews were abandoned, the mean squared error would increase in important estimates of unemployment and employment, even if the resources were used to increase the sample size. Nonresponse is tracked month by month. Since the LFS is a continuing survey which seldom experiences any changes in field work and is well-established among respondents, the time series of nonresponse rates of those panels that participate in the survey for the first time are seen as a good measure of the general survey climate.

2.8. *Documentation of products*

To make the use of data easier, to increase data accessibility, and to make the production of statistics less dependent of the individual statisticians who work on the surveys, it is necessary to require the surveys to produce highly detailed survey documentation. Many surveys have produced what is called product handbooks which provide detailed information on data quality, variance, privacy and confidentiality, costs, and development plans. In the DOK-system, each survey has documented its data processing routines. A guide has now been developed which entails a richer level of detail and it is called SCBDOK. SCBDOK integrates the reporting of statistical methods with the reporting of data processing routines. The DOK-system uses the mainframe, while SCBDOK is PC based. SCBDOK can render the product handbooks and the DOK-system obsolete as the contents of SCBDOK will include the same information and, furthermore, be more comprehensive.

2.9. *Presentation and analysis*

Statistics Sweden produces a vast array of different types of statistical products from press releases to in-depth studies based on the analysis of data from many different surveys. We have shifted from a highly controlled publishing environment where most documentation had to be approved by the Director General's office to a more uncon-

trolled do-it-yourself environment. Desktop publishing is easily affordable especially when compared to the costs of typesetting. Diagrams are no longer sent to the draftsmen (see Lyberg and Dean 1991).

The PC environment encourages the use of graphics because the new technologies make graphics highly accessible. Given the high degree of office automation and decentralization, Statistics Sweden produced, in 1989, a statistical graphics handbook as a guide for those who are now producing their own reports with very little outside help. The graphics handbook contains four main sections that deal with (1) the theoretical aspects of visual perception, i.e., color theory, scale, time dimension, perception, and the human brain, (2) various diagrams and the sorts of data for which they are suited, (3) common problems and general solutions, and (4) Statistics Sweden's computing environment and its ability to produce statistical graphics. The various printers and plotters are described in detail with consideration taken to the types of figures and diagrams that they are best suited for.

Because of the increasing use of statistical graphics and the rapid development of graphics software, the handbook is already showing signs of becoming dated. Work on a new handbook is under way and will be ready sometime in 1993.

A number of surveys present their results in time series. Statistics Sweden's quarterly and monthly economic time series have some special characteristics compared to the type of series usually discussed in the time series literature. The Swedish economy is small and dominated by a number of large corporations. As a result, Swedish time series can contain a great deal of noise which complicates interpretation. This often means that the standard programs that, for instance, smooth the seasonal component do not always work well. It is also important to identify nonsampling errors and develop methods to correct for these errors.

Nonsampling variation can be generated by trading-day, Easter variation, and other holiday effects and by measurement period. A strong, albeit unstable seasonal variation is generated by the Swedish vacation period. The Swedish populous enjoys a five-week vacation during the summer months, but there is some yearly variation as to exactly when the holiday period will fall, thus generating the variation. Transfer function models can aid in the estimation of these effects and are used to adjust the time series. For example, energy consumption is dependent on weather conditions, i.e., a warm or cold winter. It is important to estimate the effects of this factor and calculate a "normal" energy consumption.

To illustrate this work, we present some results from the monthly Labour Force Survey which give a clear indication of the efficiency gains from time series analysis. The number of employed (and present at work) in Sweden is about 3.6 million people and the sampling error is about 19 thousand persons. An ARIMA model of this series shows that the standard error of the noise component is about 84 thousand persons and very large compared to the sampling error. Fortunately, this error can be explained by the fact that the measurement period varies. For practical reasons, the measurement is sometimes done early and sometimes late in the month. A simple model of this variation reduces the noise in the ARIMA model to only 42 thousand persons, i.e., by 50%. Increased sampling efforts can only reduce the standard error from 84 to 82 thousand persons.

Figures 1 and 2 present seasonally adjusted series and estimated trend with X-11 ARIMA for monthly Swedish data from January 1985 to August 1992 for thousands of employed persons who were present at

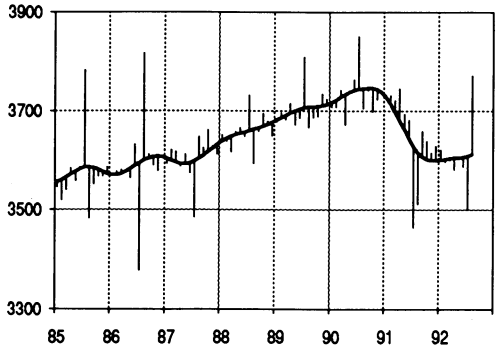

Fig. 1. Data not corrected for measurement period

work. The estimated trend is represented by the line in bold type, while the vertical lines show the seasonally adjusted data. The diagram 2 illustrates the effect of data correction.

The ARIMA model and the X11-ARIMA decomposition tell us that the values for July and August 1992 are outliers.

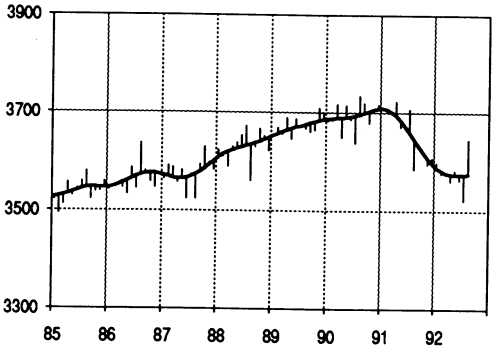

Fig. 2. Data corrected for varying period of measurement

3. The Government's Proposal on the System of Official Statistics and Its Effects on Development Work

During the past year, a governmental study has been conducted of the future organization of official statistics production. A main current of thought in this study has been to investigate the extent to which agencies and organizations outside of Statistics Sweden should control statistics production by funds that previously went directly to Statistics Sweden. These funds would, in the future, go to user organizations which would then use the funds to "order" the statistics from Statistics Sweden or some other statistics producer. A suggestion has emerged from the government that Statistics Sweden will continue to produce "basic" statistics while the funds to produce other types of statistics will go to the agencies which are considered to be the main users. The main users will have the option of using the funds themselves to produce the data, use other producers of statistics, or use Statistics Sweden. The government says that also the main users should benefit from the development work. At the time of this writing, the parliament has not yet made its final decision. It is encouraging to note the clear and strong support for developmental work and international collaboration expressed in the government's proposal.

While waiting for the final decision, Statistics Sweden has initiated discussions of how the agency could best organize itself given a new situation. A great adjustment to market needs will be required of the various branches. The Department of Research and Development could become more concentrated on pure research and coordination of statistics and organizationally answer directly to executive level management. In the future, the agency will have an even greater need to clearly show quality in its statistics and a greater need for certain types of competence in its personnel. Work in this direction has already begun: information about statistical production is being written and standard tender forms are being drafted. Management has ear-marked five million SEK in continuing education funds to strengthen our competence in a number of strategic areas.

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