Working Paper
ENGLISH ONLY

UNITED NATIONS
ECONOMIC COMMISSION FOR EUROPE

CONFERENCE OF EUROPEAN STATISTICIANS

Work Session on Statistical Data Editing
(Paris, France, 28-30 April 2014)

Topic (i): Selective editing / macro editing

Experiences from Selective Editing at Statistics Sweden

Prepared by Anders Norberg, Karin Lindgren and Can Tongur, Statistics Sweden

I. Introduction

1. The main purpose of selective editing (SE) is to reduce costs for the manual work at the national statistical institute (NSI) without losing substantially in precision in estimates. A related aspect is to reduce the response burden for enterprises. Focus lies on detecting errors that have large impact on the output statistics.

2. To implement the idea of SE using the score function in surveys, Statistics Sweden (SCB) started developing methods in detail and a generic IT-tool in 2007. A score function considering both suspicion and potential impact was successfully in use for for the foreign trade statistics, Jäder and Norberg (2005). The first version of the generic editing tool SELEKT was implemented in the *Wage and Salary Structures in the Private Sector* survey in 2008. This survey is complex in several aspects and it was a target to have an editing tool with capacity to fully cover the needs of such a complex survey.

3. This paper presents experiences from the implementation of SE at SCB. SE and the SELEKT tool are described in section II. Section III includes a description of the implementations of SELEKT. Experience using SE is discussed in Section IV.

II. Selective Editing with SELEKT

4. A method for the search for "significant" errors, proven successful by experience, was presented early by Hidiroglou-Berthelot (1986). The HB-method consists of a test that considers both a measure of size and the relative change from a previous occasion for a survey variable. Robustness is achieved by the use of the median and quartiles of similar units.

5. The SELEKT system, developed at SCB, can be seen as the HB-method generalised in various aspects. SELEKT can

(a) handle multiple sets of domains, not only a population total;
(b) handle multiple variables;
(c) apply to multi-stage designs with primary sampling units and cluster elements;
(d) combine traditional edit rules and the SELEKT-type edits which produce suspicion depending on how far out from some common dispersion an observed test variable is located;
(e) use priority weights for variables and domains in the aggregation of local scores to global scores;
(f) aggregate local scores to either the sum of local scores, the sum of squared local scores or the maximum of local scores;
(g) use a threshold at every step of aggregation of local scores so that only the part that exceeds the threshold is aggregated.

6. SELEKT comprises of a well-structured set of open-coded SAS™ macros and programmes. SELEKT is an infrastructure with options. SELEKT is only one part of a complete editing system. Due to all the differences between surveys, several bespoke "adapters" must be programmed for each survey.
SELEKT requires the following tables:

(a) A survey output matrix with domains as rows, estimates of sums and ratios thereof as columns and estimated standard errors.
(b) An edited "cold deck" data set from previous survey rounds is used to compute anticipated values and intervals of variation according to time series and cross-section analysis

7. When SELEKT has produced working tables, after analysis of cold deck data, the user can modify single or sets of values in these tables. Examples: Anticipated values produced by a method not provided by SELEKT can replace the standard values. Importance factors for combinations of domains and variables of no interest should be set to zero. Importance factors for combinations of domains and variables of especially high interest should be set to a high value.

8. Lindgren (2012) demonstrates that the cut-off threshold values for scores are set by using cold deck data that have not been selectively edited, but rather notoriously edited. It is important to have both raw (unedited) data and final (edited) data for at least one previous survey round to set up a simulation of the selective editing. The key indicator when deciding on the proportion of records being manually followed-up is the RPB (relative pseudo bias).

$$\left|RPB_{d,j,\underline{Q}}\right| = \frac{\left|\hat{T}_{d,j,Q} - \hat{T}_{d,j,Q=100}\right|}{SE\left(\hat{T}_{d,j,Q=100}\right)}$$

where *d* is domain, *j* variable and *Q* the proportion of records investigated. $\hat{T}_{d,j,Q=100}$ and $SE(\hat{T}_{d,j,Q=100})$ are estimated from a notoriously edited data set and $\hat{T}_{d,j,Q}$ is the estimate using the same data set but replacing raw data with edited data only for the Q percent units with the highest global score. The goal is to get a RPB below 0.2 in most essential combinations of domains and variables.

III. Implementation of SELEKT at Statistics Sweden

9. SCB has implemented SE in eleven surveys that had large spending on micro editing. The experience from implementing SE with SELEKT shows that pre-work such as learning about the survey, staging tables from the production database, production of performance indicators of the existing traditional edit rules, multivariate analysis aiming at finding homogenous groups and good anticipated values and finally to find threshold values for local and global scores, are resource demanding processes.

10. Triton is a general production system for the collection and editing of micro data, under construction at SCB. Triton is intended to facilitate the data capture, the efficiency of statistical production, especially the editing and to ensure the quality of data. Triton attempts to provide functionality that can be used in most of SCB's surveys, thereby replacing the existing product specific production systems. Fewer systems aim at lower maintenance costs and make it easier for the production staff to work with several statistical products. A strong demand to improve data editing to cut costs and to decrease response burden meant that SELEKT had to be implemented before the Triton. SELEKT has been implemented in the existing survey specific IT-systems of various kinds and standards. The implementation of Triton has started with the simplest surveys – opposite to the implementation of SELEKT which started with the surveys with the most costly editing, the most complex ones.

A. Foreign Trade with Goods within the European Union (Intrastat)

11. In order to reduce costs, management decided to decrease the number of scrutinized observations in the *Intrastat* survey from around 2 400 to 1 500. Micro editing with a score function computed as a weighted geometric mean of a measure of suspicion and a measure of potential impact was successfully implemented in Intrastat in 2004. Jäder and Norberg (2005) noted that the overall hit rate, the proportion of error flagged units which generate a change of data in the follow-up process, increased from about 40 per

cent to 65 per cent, which might be explained by the decrease of flagged records. However, the impact on the published variable *Invoiced value* has increased with the introduction of the new method. This editing method can be considered as the predecessor of SELEKT at SCB.

12. Suspicion is based on the logarithm of price per *quantity* and importance on *invoiced value* of transaction. Importance of errors on six different aggregation levels of commodity groups, constructed by important 8-digit CN codes, 6-digit CN codes, 3- and 2-digit SITC codes and totals, all for arrivals and dispatches, are accounted for. Relevant and accurate medians and quartiles for unit prices and invoiced values in homogenous groups are needed.

13. Records are not aggregated to enterprise; hence this is not altogether SE in the sense that the total number of re-contacts with respondents is not minimized. The gain from reducing the number of respondents re-contacts while increasing the number of edited transactions for the fewer contacted respondents is not considered as important in this survey. 1 500 observations were flagged and followed-up each month, which also provided excellent conditions for planning the editing workload on the staff. This has now been abandoned for a fixed cut-off threshold value, i.e. a fix quality, yielding on average around 1 000 observations for follow-up. The editing program is run once a month, when most data have been collected. It would facilitate and spread the work load over a longer period if it could be done more frequently. The new editing method has been a positive experience for the staff at Intrastat and at the time of implementation, the staff was trained on what SE is about and how it works.

B. Commodity Flow Survey

14. This survey is run only once every fifth year. It is conducted as a sample survey of local units of enterprises within the sectors “mines and quarrying”, “manufacturing” and “wholesale”. In 2009, the survey had a sample of about 10 000 Swedish local units in a number of industries, which responded to questions about net mass, value, type of goods, transport mode and destination of individual transports.

15. Unedited and edited data from previous surveys was not available. Due to the nature of data (with large measurement problems) and a large amount of data records, it was not possible to edit the survey with through some high quality editing process. Under these bad conditions the new generic tool SELEKT was seen as a means to prioritize records for editing. Anticipated values and normal variation of value per quantity for different goods were taken from the foreign trade survey for similar commodity groupings.

C. International Trade in Services

16. *International Trade in Services* is a quarterly survey with results important to the balance of payment statistics. The survey is based on an annual sample of 5 000 enterprises and organisations. Before implementing SELEKT the macro editing was very time-consuming. An analysis was made per service type (there are around hundred), per in/out-flow and per country of trading partner (again hundreds).

17. Data structure of the survey is row oriented and with three levels of in-data; enterprise, service type and country of trading partner. An alternative would be to set up variables (columns) for each service type in/outflow and country of trading partner, which would yield several thousands of variables. To implement SELEKT, several adaptations were necessary for data processing because the edit rules compared data within and between the three levels and with previous quarter and the same quarter previous year.

18. By using SELEKT the number of flagged units decreased from 10 to 9 per cent. Other changes were implemented at the same time. The editing staff now produces the error list themselves, several times per production round. This spreads the workload over a longer period, compared to the old system when the product manager had to create an error list when most of data was collected. The editing staff now has time to go through the entire error list. On average, hit rates increased over all edits from 53 to 64 per cent. However, the largest improvement was that SELEKT helped structuring the micro editing, moving re-contacts closer to the time of data delivery by substantially reducing late macro editing.

D. The Wage and Salary Structures in the Private Sector

19. *Wage and Salary Structures in the Private Sector* is an annual survey. The sample design is one-stage cluster sample of enterprises and employees. An important part of data collection is made by employer organisations that provide edited data for larger enterprises. This part covers about 65 per cent of all employees in the survey, and SCB collects data for the remaining 35 per cent of employees.

20. Within the categories “blue-collar” and “white-collar” workers, the most demanded output tables are created by cross tabulations of the variables “Gender and Industry” and “Gender and Occupation.” Altogether, there are around 1 400 output domains considered.

21. Fatal edit rules checking for valid social security number (SSN) and valid occupation codes are included. Traditional query edit rules relate for example comparing wages to previous survey rounds and to average wages for the specific occupation. All edit rules are applied through SELEKT. All fatal errors are “transported” by SELEKT to the error list. Regression tree analysis was used to set up a limited number of homogenous groups for the purpose of calculating anticipated values, as recommended by Norberg (2012).

22. Adofsson & Gidlund (2009) present process data. The fraction of employees that is manually reviewed decreased from 37 per cent based on traditional editing (before 2008), to 17 per cent with SE, excluding the editing of occupation code and SSN, This corresponds to a decrease of 54 per cent. The number of flagged enterprises decreased from 79 to 69 per cent. If there had been no errors in Occupation codes and SSN, only 11 per cent of the employees would have been flagged for manual review. Expressed in time, total cost-saving in 2008 was 1 100 hours which corresponds to one fourth of the total costs for collecting and production editing. About 1 000 hours were spent “adapting” the existing production system and developing the SELEKT- prototype but other requirements on the existing survey production system have been raised. This type of cost is mainly expected to occur in the nearest survey rounds.

23. One indication of quality is given by the size of the standard errors of the most important estimates. The number of main publication cells that were not published in 2008 due to large sampling variance was, more or less, equal compared to earlier survey rounds. However, the number of imputed values was substantially increased now that imputation in some cases is a substitute for manual review when using SE.

24. A positive aspect of SE is that the editing staff finds their work more meaningful than before. Their experiences are summarized by the following words from one member of the editing staff: “Now we know that the manual review is important and that our work really matters”. Staff involved in the implementation thinks that the work was burdensome at times, but summing up the experience of the implementation everyone thinks that the positive effects outweigh the negative ones.

E. Short Term Statistics, Wages and Salaries, Private Sector

25. Wages and salaries in the private sector are reported monthly, for industry groups. The sample covers 5 500 enterprises. For a long time it has been well known that there are measurement problems in this survey. Certain variables in particular, ex. “supplements including overtime pay”, are prone to errors. The editing staff used a “mechanical correction” when errors were flagged in the error list instead of re-contacts with respondents. SE was not expected to flag these errors that must be considered to be inliers.

26. SELEKT implementation work was very comprehensive. There are several questionnaire variables collected and the total salary per enterprise is derived. The editing system has over 100 edit rules. Instead of re-writing the edit rules in SAS-code the implemented SELEKT system fetches the error codes in real time from the SQL-database and transforms them to the SELEKT format. Hit rates for the edit rules are used as measures of suspicion in the local scores. Evaluation of SE on old data was made under the condition that the “mechanical correction” for the inliers was applied for flagged units.

27. Leaving errors with small impact on output behind with SE yields lower quality in the anticipated values in coming months. This is the only implementation where this problem was evaluated. Twelve months of data was used in search for the global threshold value for score, considering this fact.

28. Results from the implementation analysis give a hint of the potential for savings. Around 14 per cent fewer enterprises are flagged by SELEKT compared to traditional micro editing. Automatic imputation has also been implemented, which also had a large impact on the amount of editing. This result is based on the requirement that the global threshold is set to leave pseudo-bias over 10 per cent only in 1 per cent of the output domains, which is a higher demand of precision than we generally require. One of the challenges has been how to consider the very many detailed domains in which the accuracy is important.

F. Short Term Employment, Private Sector

29. The quarterly survey *Short Term Employment, Private Sector* is designed to indicate employment changes on detailed industry levels and to present employment statistics by regions and gender. The sample has 17 000 local units. Variables and presentation tables are given differentiated importance factors in SELEKT and the survey variable, "total number of employees" is considered as the most important variable.

30. Redesign of an edit rule resulted in an improved hit rate for the main variable "total number of employees". The edit rule was split into four sub-edits with varying lengths of acceptance intervals. These four sub-edits had hit rates going from 52 per cent for the tightest interval to 87 per cent for the loosest, catching the most extreme observations. Hit rates were used as measures of suspicion in SELEKT.

31. Using SE, the number of flagged units decreased with 22 - 27 per cent, depending on quarter, In addition to the savings gained by using SE, improvement was made by adjusting the existing traditional edit rules. As a result of more efficient micro editing the previous heavy macro editing was decreased substantially, to around one fifth. This was one goal for this implementation. Hereby the re-contacts with the respondents could be done earlier from data delivery.

G. Business Activity Indicators

32. The *Business Activity Indicators* survey of "New Orders in Industry" and "Deliveries in Industry" is produced monthly, and the related" Industrial Inventories" is quarterly surveyed. Hence, two separate implementations of SE had to be made, setting off the possibility of producing one global score per respondent for all three surveys simultaneously.

33. Around 10 per cent of sampled observations were flagged by at least one traditional edit rule in the old method. The hit rate was unsatisfactory low. Due to irregular monthly orders, deliveries and changes of inventories in many industries it is not possible to produce good anticipated values. The SELEKT system is applied without strict cut-off thresholds for the global scores, which results in a list of flagged observations with the global score to guide the editing staff in prioritizing respondents for re-contacts. When this new editing method was introduced other changes were introduced as well. It is now possible for the editing staff to run SELEKT themselves in order to obtain an error-list, which is done several times a month. This spreads the workload over a longer period, compared to the old editing system which required the product manager at the subject matter unit to run the editing at specific time points.

H. Rents for dwellings

34. The annual *Rent for Dwellings* survey is based on a sample of approximately 12 000 rented dwellings. The survey is carried out as a postal and web survey, addressed to the property owners and rent and quality of their sampled dwellings is surveyed. There are about 2 600 respondents, i.e. real estate owners of the dwellings in the sample. SE is focused on minimising the number of re-contacts with respondents. This is the first survey for which a global score is being computed on a higher level than primary selected units.

35. Levels and changes of rent are analyzed in several dimensions, e.g. size, age and the geographical location. Fourteen different types of presentation tables are considered, six of which are at specific priority. Prior to implementing SELEKT, quality of editing was increased by reviewing the traditional edit rules: redundant edit rules were deleted and acceptance regions were updated based on more recent data. Each year, SELEKT is re-initiated through an update of the edit rules and, when necessary, new edit rules are added.

36. The implementation of SE has led to a 60 per cent decrease in flagged sampling units (dwellings). This corresponds to a decrease in the total number of "flagged respondents" from some 60 to less than 40 per cent. A significant effect of SE is the higher quality obtained. SE makes the flagged errors become clearer in the review work. Errors that are on the error list are graded by the computed score. This way, the editors can get an idea of which errors are most influential.

I. Revenues and Expenditure Survey for Multi-Dwelling Buildings

37. Real estate of multi-dwelling buildings owned by municipal housing companies, private bodies and housing cooperatives are covered by the survey. The statistics are based on a census of municipal housing companies and on a sample survey of real estate belonging to the other two categories of ownership. The main purpose of the survey is to produce statistics on revenues, expenses and net operating income for the owners of these units. Thus there are a lot of variables. Results of the survey are presented in sixteen different outputs; for example by ownership, ownership and region, and by ownership and "value-year" of estate.

J. Energy Use in Manufacturing Industry

38. *Energy use in manufacturing industry* shows consumption of fuels and electric energy within NACE 05 to 33 in both quantities and monetary values. The consumption is divided into different kinds of energy carriers as well as different kinds of industry branches. As with *International Trade in Services*, data is organised with one row for each type of energy carrier. The drawback is the complexity in constructing edit rules involving more than one kind of energy carrier. There are only three different types of output tables with a total of 1 942 domains.

39. Data are collected for a census of more than 7 000 local units. Equal weighting of all units, small or large, causes impact on produced statistics of individual units to vary much. The potential of SE is thereby promising for reducing editing costs when compared to editing that merely focuses on suspected errors. With traditional editing 50 per cent of the local units used to be flagged for at least one error, with SE only 30 per cent will be flagged. Appendix 1 demonstrates the search for cut-off threshold value.

K. Consumer Price Index (CPI)

40. The Price collectors that work for the *CPI* use handheld computers in data collection at outlets. These handheld computers cannot embed complicated edit rules such as the HB-method. It is however possible to test the noted price for a product offer against a specific acceptance region. The price collector registers both the *price* and a *price signal* which is used in the editing process. Because of the low frequencies of campaign and sales prices, these two types of price signals are joined into one category in the implementation of SE, as follows:

01 = the same product offer, some observed change in price or quantity and regular price
02 = the same product offer, some observed change in price or quantity and campaign/sales price
11 = the same product offer, no observed change in price or quantity and regular price
12 = the same product offer, no observed change in price or quantity and campaign/sales price
21 = a replacement for the previous product offer and regular price
22 = a replacement for the previous product offer and campaign/sales price

41. A hot deck data is constructed as a copy of the previous month´s data. Each record is duplicated in six records, one for each of the six cases described above and the price is retained as previous price and the price signal is retained as previous price signal. Cold deck data is based on nine years of price observations, and modules of SELEKT are run on cold deck in order to find anticipated values and normal variation of price ratios for as similar product offers as possible as the hot deck data. Similarity is defined by product group, price type and same product or replacement. Finally a tailor-made module makes an iterative search for the limits for price change, and consequently price level, which would be flagged, considering both suspicion and impact on the CPI total.

IV. Experience using Selective editing

A. Variations in survey designs

42. One-off surveys and annual surveys contra quarterly and monthly surveys with access to extensive amounts of time series data entail varying access to earlier data for the construction of edit rules and anticipated values. However note that observed units, even in a monthly survey, can be new in an annually updated, rotated sample.

43. In the case of sample surveys, design weights imply that the sampled units have different impacts on the output. The sampling method itself, whether it is stratified SRS or sampling with un-equal probabilities is of little concern for editing. A well-designed sample survey with design weights inversely proportional to measured variables, for example turnover, leave less scope for SE to reduce editing cost than for a census.

44. A significant aspect of survey design is whether one has a one-stage or a multi-stage sample. Efficient editing, focusing on minimising re-contacts with respondents, is more complex for multistage samples, especially when the number of observed secondary units varies between primary selected units, as for *International trade in services surveys* and *Wage and Salary Structures in the Private Sector* surveys.

45. In principle, the type of final sampling unit – individuals, enterprises, products, etc. – has no significance in terms of editing. Nevertheless, it is a fact that business populations generally show a much more skewed distribution on economic and other quantity variables than data about individuals. Surveys with attitudinal questions cannot, for practical reasons, be edited retrospectively by means of re-contact.

46. From an editing perspective, various types of variables must be handled in different ways. Unit identification variables must be correct (at least have valid values), otherwise, there will be technical problems in the matching of data. Classification variables, with a limited set of valid entries, must always be remedied, possibly by imputation, when they are erroneous. A theory and praxis for SE for these errors is missing, it is difficult to assess impact on the statistical output when there is uncertainty about which domain the unit contributes. Examples are errors in product code for international trade surveys and occupation code for the *Wage and Salary Structures in the Private Sector* survey. However, in the case of quantitative variables, SE is straightforward applicable.

47. In some surveys, data are collected on several variables that are not output statistics but rather part of a derived variable. Then, during editing, analysis should be performed of the effects of suspected errors in the derived variable, although suspicion is often calculated for the original variables.

48. A survey may have few clearly defined users and limited output to a general (public) use, example *CPI*, or extensive statistical reporting, example *Rent for Dwellings*.

B. Variations in productions systems

49. Eight of the eleven surveys mentioned above have tailor-made production systems. System interfaces for the production staff are generally programmed in VB6 or VB.net and data are stored in SQL-databases. This means that the implementation work consists of fetching and joining data from SQL-tables. Three of the surveys; *Revenues and Expenditure Survey for Multi-Dwelling Buildings, Energy Use in Manufacturing Industry* and *Rents for dwellings*, are now using or about to use Triton. So far, we have no experience to report.

C. Macro editing

50. In some of the implemented surveys the macro editing had been rather large scale. By using SE the need for macro editing has decreased substantially. That implies also that follow-ups, including re-contacts with respondents, can be done closer to the data delivery from enterprises. For *Short Term*

Employment, Private Sector survey a reduction of macro editing was a clear goal. As a result of more efficient micro editing the macro editing was decreased to one fifth.

D. Quality

51. Efficient edit rules, as results of reviewing the existing edits, are a basis for good data quality. The implementation work of SE should at an early stage render in an evaluation of the existing traditional edit rules with at least some hit-rate indicator. There is at least one case encountered so far where old edit rules were erroneously programmed. Moving from macro to micro implies that follow-ups closer to the data delivery is beneficent for quality. Since the editing staff now receive shorter error lists with a priority stated for all editing objects mishaps of for instance objects/records slipping through the editing is minimised.

F. Editing staff opinions

52. Generally the editing staffs consider the work through SE as more efficient, more interesting and less stressful as they can concentrate on the important flaggings. Fatal errors have to be handled by follow-up or by imputation. As for the premature version of SELEKT applied at *Intrastat*, the editing staff is very satisfied. There are much fewer objects to follow-up and a more focused editing, even if the task is the same. The hit rate is higher now, which makes the job more meaningful. The staff of *Wage and Salary Structures in the Private Sector* said “Now we know that the manual review is important and that our work really matters”.

G. Respondents' confidence in statistics

53. It happens that respondents to surveys with cluster data, such as the *Intrastat* and *Wage and Salary Structure* surveys wonder why merely some of the cluster elements (products / employees) were flagged as erroneously when the respondent could identify all elements d having the same (systematic) error. This is due to the impact on statistics and the presence of a threshold value for the local scores. In such a case, due to the specific output values in some output cells, the corresponding data values may be more impacting than others with similar errors for the same respondent. This is difficult or perhaps even inappropriate to communicate with respondents. Beside anecdotic information like this, no thorough survey has been done to explore the respondent´s confidence of SE.

H. Resources for implementation

54. Experience show that implementations of SE are relatively costly, hence it is important to choose surveys with good potential for cost savings. Generally we estimate that the total cost for implementation in a complex survey stays in 300 – 600 hours of work. So far at SCB, the implementations have often been made parallel to training of new colleagues.

I. Cost savings

55. SCB has experienced 10 – 60 per cent cost savings for editing. Some of these savings are due to the updated traditional edits. More efficient micro editing has also reduced macro editing, due to the focus on records that impact the output.

J. Maintenance and process data

56. For *Intrastat* the threshold values for score were adjusted in order to flag a smaller number of records when the frame population of enterprises was reduced by a higher cut-off value. For the *Wage and Salary Structures in the Private Sector* survey the new Statistical classification of economic activities (NACE 2007) was necessarily implemented in 2010 and in 2014 the survey requires adoption to the new International standard classification of occupations (ISCO).

57. SCB has not yet applied the discussed method of sampling units below the cut-off threshold for global score to evaluate the relative pseudo-bias. Lewis (2014) demonstrates how this can be done. The

question is if there are resources enough for such evaluations once the management and the budget have accustomed to low editing costs.

58. For years, the need of monitoring and evaluating the editing process has been stressed. A large amount of process indicators can be constructed but their usability should be proven. Indicators can primarily be used to evaluate the editing process itself and secondarily to evaluate the data collection process. Thirdly, quality of the survey, concerning measurement errors, can be indicated. Lindgren and Odencrants (2014) propose a set of process indicators for SCB. So far, very few are in use.

K. When is Selective Editing Applicable?

59. As early as possible in the implementation stage it is necessary to address the question "Is SELEKT appropriate for the survey?" For an efficient approach to the question, Statistics Sweden has from gained experience developed a checklist and documentation templates. The checklist contains considerations of the following aspects:

(a) Micro (production) editing must be extensive, there should be a potential for savings
(b) The key variables must be continuous
(c) The main outputs must consist of aggregates of micro data
(d) It must be possible to obtain anticipated values
(e) SELEKT may have to be integrated into the production system.

L. Conclusion

60. We have seen; less micro editing, more efficient edit rules as a result of review of the existing edits rules, pleased editing staff that considers the work as more effective, interesting and less stressful, less late macro editing, difficulties in the integration with current production systems, high implementation costs.

V. References

Adofsson, C. and Gidlund, P. (2009) Evaluation of Selective Editing in SLP 2008, Work Session on Statistical Data Editing in Neuchâtel, Switzerland, 5-7 October 2009, http://www.unece.org/fileadmin/DAM/stats/documents/ece/ces/ge.44/2009/wp.45.e.pdf

Hidiroglou, M. A., and J.-M. Berthelot (1986), Statistical Editing and Imputation for Periodic Business Surveys, *Survey Methodology*, Vol. 12, No.1, June 1986, pp. 73-83.

Jäder, A. and Norberg, A. (2005) A selective editing method considering both Suspicion and Potential impact, developed and applied to the Swedish Foreign Trade statistics Work Session on Statistical Data Editing in Ottawa, Canada, 16-18 May 2005, http://www.unece.org/fileadmin/DAM/stats/documents/2005/05/sde/wp.12.e.pdf

Lewis, D. (2014) Maintenance of Selective Editing in ONS Business Surveys, to be presented at the Work Session on Statistical Data Editing in Paris, France, 28-30 April 2014

Lindgren, K. (2012) The Use of Evaluation Data Sets when Implementing Selective Editing, Work Session on Statistical Data Editing in Oslo, Norway, 24-26 September 2012, http://www.unece.org/fileadmin/DAM/stats/documents/ece/ces/ge.44/2012/07_Sweden.pdf

Lindgren, K. and Odencrants, M. (2014) Applying Process Indicators to Monitor the Editing Process, to be presented at the Work Session on Statistical Data Editing in Paris, France, 28-30 April 2014

Norberg, A. (2012) "Tree Analysis – A Method for Constructing Edit Groups, Work Session on Statistical Data Editing in Oslo, Norway, 24-26 September 2012, http://www.unece.org/fileadmin/DAM/stats/documents/ece/ces/ge.44/2012/05_Sweden.pdf

VI. Appendix 1

Below is demonstrated the results of typical elaborations made to find a cut-off threshold value for the global score. The survey is *Energy Use in Manufacturing Industry*. QP is the proportion of data that shall be selected and Threshold2_Q will be the threshold value. The number of domains (out of 1 942 in total) that get an RPB greater than 20 per cent is demonstrated in column RPB_20. If the demand is that at most one of the 1 942 domains should have an RPB>20 then it would be necessary to flag 30 per cent of the primary selected data. So far, by traditional editing 50 per cent of primary selected units have been flagged by at least on edit, the reduction will be significant for this survey.

Table 1 Cut-off threshold values for global score and number of domains in output statistics with larger relative pseudo-bias than 20, 50 and 100 per cent of estimated total.

QP (%)	RPB_20	RPB_50	RPB_100	RPB_sum	Threshold_Q
1	162	124	98	96437	634.037
2	135	96	72	39750	144.750
3	116	81	52	25070	72.703
4	85	50	29	16149	42.324
5	74	40	22	10647	27.976
6	58	24	7	6280	18.880
7	47	18	7	5621	13.223
8	42	14	4	4939	9.669
9	37	10	4	4268	7.143
10	29	5	2	3223	5.674
11	22	2	0	1075	4.839
12	14	0	0	719	3.823
13	12	0	0	613	3.243
14	11	0	0	560	2.778
15	9	0	0	482	2.405
20	3	0	0	194	1.230
25	2	0	0	90	0.690
30	1	0	0	39	0.355
35	0	0	0	5	0.190
40	0	0	0	0	0.083
50	0	0	0	0	0