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SAS programs for variance estimation of the measures
required for Intermediate Quality Report

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1. Introduction

This document lists the SAS program for variance estimation of the measures specified in the EU-SILC regulations and technical guidelines for the Intermediate Quality Report to be produced by countries.

The earlier report, SILC.02 (27 March 2009): “SAS programs for variance estimation of the measures required for Final Quality Report”, described the set of programs for the standardised computation of sampling errors for the indicators required for the Final Quality Report. Apart from listing the program code, that report provided essential information on the methodology and interpretation of the results. That information is essential also for the set of programs listed in this report, and is repeated here with the essential adaptations for convenient reference and completeness.

As specified in the existing guidelines, the measures for which sampling errors are required for the Intermediate Quality Report are all cross-sectional.

The variance estimation method employed in the programs is the Jackknife Repeated Replication (JRR). This is the method adopted by Eurostat for the computation of sampling errors. A brief outline of the approach is provided below in Annex III: “Technical note on JRR procedure for estimating variance and design effect”.

Section 2 describes the general framework for variance estimation programs developed for application by countries if they chose to use the JRR approach.

The various programs will be divided into sets for the purpose of their development and presentation. This set deals with the variables list for sampling error computation in the Intermediate Quality Report guidelines. Section 3 describes the scope of the programs included in the set covered in this report.

The central part of this report is formed by Section 4 and 5 which describes the fundamental SAS macros which the program code is divided into and all the indicators computed, along with a listing of the actual SAS coded in Annex I. The first group of macro contains 13 macros for the poverty measures required. The second set “Macro perc_bound” calculates any kind of weighted percentile of a distribution. The third set “Macro JRR” implements the Jackknife Repeated Replications (JRR) methodology. The fourth set “Macro Kish” calculates the quantity ‘Kish_Jrr’ described in Annex III as the part of the design effect (‘deft’) which arises from variation in sample weights. Section 5 identifies all the indicators computed with all the required breakdowns.

The SAS code, along with the illustrative data set and results, which accompany this report are being provided separately.

Section 6 provides a step-by-step description of the program, and Section 7 quick guide for the user. Finally, Section 8 provides an illustrative example, and the output for this illustration is listed in Annex II. More detailed results with commentary, meant for inclusion the quality reports, will be provided in subsequent documents.

Related reports

Report SILC.01 (18 March 2009):
“Required tables on sampling errors in EU-SILC Final Quality Report (FQR)”

Report SILC.02 (27 March 2009):
“SAS programs for variance estimation of the measures required for Final Quality Report”

Report SILC.03(1) (30 March 2009)
“Standard errors for the statistics included in Final Quality Report Illustrations for Austria, Denmark, Iceland and Sweden. Full cross-sectional sample for 2006”

Report SILC.03(2) (2 April 2009)

“Standard errors for the statistics included in Final Quality Report Illustrations for Austria, Denmark, Iceland and Sweden. Longitudinal sample 2004-2006, panels of 2 and 3 year duration.”

2 General framework for variance estimation programs

As noted, the method adopted by Eurostat for the computation of sampling errors is Jackknife Repeated Replication (JRR).

Where applicable, the JRR approach is quite straightforward technically. Apart from specifying the sample structure and defining appropriate ‘computational units’ for the purpose, the method merely involves repeated computation of the estimates (for which sampling errors are required) over different (often numerous) sample replications; variance of any statistic is estimated simply from variability in the estimate itself across the replications. The form of the final variance estimation formula does not depend on the particular statistic involved or on details of the sample design.

Eurostat has been developing SAS routines and macros for the computation of sampling errors and design effects using the JRR approach for all the indicators as specified for the EU-SILC Intermediate and Final Quality Reports to be produced by countries, and to the extent possible also for other measures of income sources and distribution, poverty, inequality etc. which may be of interest in analysis and reporting of the survey results. The objective of programs is to encourage and facilitate routine computation of sampling errors for these statistics by countries.

There are two main tasks involved in the computation of sampling error.

(1) The first task is the development of efficient and accurate computer programs (in our case SAS routines) for the computation of each statistic for which sampling errors are required. This computation does not depend on the structure of the sample, apart from the sample base (i.e., the analysis units to be included in the computation) and the sample weight of each unit. While these routines are specific to each statistic of interest, they apply unchanged for any national survey, independent of its sample structure. The variance computational task involves repeated estimation of the statistic over a large number of full-scale ‘replications’ of the sample, the construction these replications being the objective of the second task.

(2) The second task is the specification of the replications to be used in the estimation of sampling errors. These are defined in terms of structure of the sample, specifically the strata and the primary sampling units in the sample. This task is essentially independent of the particular statistic involved, thus being the same for any statistic. However, it has to be performed separately for each country, taking into account the specific sample structure.

(3) The above two aspects are linked through one or more datasets of specified content and structure. The datasets specify the sample of units on which the computations are performed, and for each unit all the substantive variables involved and also a small set of variables defining the sample structure. The sample structure variables are the output of task (2), and at a minimum include the following:

- Computational stratum
- Computational PSU
- Sample weight of the unit
‘Computational’ stratum and PSU are defined from the type of units actually involved in the sample (at the time the unit was first selected into the sample), but possibly after some redefinition based on statistical considerations.

(4) A source of variation in programs (1) can arise from differences in the type of statistic involved. The following are some examples.

(i) Mostly, cross-sectional and normal longitudinal variables (such as persistent poverty rates) can be treated in exactly the same way. However, estimating sampling errors of measures of net change and averages has some special features making the programs in set (1) a little different from those for normal cross-sectional and longitudinal measures.

(ii) Two types of measures for subpopulations need to be distinguished.

- Computations for ordinary means or proportions for subclasses are no different from those for the full sample: the only difference being in the dataset (3) involved. Units not belonging to the subpopulation of interest can be simply disregarded in the computations.

- However, some measures for subpopulations are more complex in the sense that the total sample is also involved in their construction. An example is the poverty rate for children (subpopulation), but with the poverty line defined on the basis of income distribution of the whole population. Such measures involve some differences in the structure of the programs under (1).

(iii) At least in principle, the JRR procedure can be used to incorporate or to identify separately the effect on sampling error of various data adjustment and estimation steps, such as imputation, calibration or smoothing etc. Essentially, this involves reapplying the step concerned before computing the estimate in each replication. This again requires adjustments to the structure of the variance estimation programs under (1).

(2) Specification of sample structure (country-specific)

(0) Original data files (UDB files H, R, P, …)

(3) Standardised datasets (files H, R, P, …)

(1) JRR variance estimation programs (variable-specific)

(4) Variations in structure of the program for special types of statistics, e.g.:

(i) measures of net changes and averages
(ii) special subpopulation statistics
(iii) incorporating effect of imputation, calibration, etc.
3. Scope of the programs included in this set

The program described in this set concerns (1), namely *variance estimation programs for the specified set of variables required for in the Intermediate Quality Report*, but also part of (4), estimate done for required subpopulations. These variables are all of a cross-sectional type.

The program assumes as input a standardised individual dataset, with the sample structure variables (computational stratum, computational PSU, and sample weight of each unit).

This standard program applies for all countries. In each case two runs using different datasets may be involved as follows.

- The computations may be repeated by replacing two actual sample structure variables (computational stratum and PSU) by those constructed by randomising the order of units in the sample (as explained in the Annex). This provides estimates of design effects.

A numerical illustrations is included with this report. It has been done for cross-sectional 2007 data for Austria which in fact used simple random sample (apart from the presence of unequal sample weights), for which the sample structure is therefore know to us. Similar computations will be performed shortly for the other three simple random samples countries (DK, IS, SE), as it has been done in previous Report SILC.02, SILC.03(1) and SILC.03(2).

In these random samples of elements, design effect arises simply from the variation in sample weights.

4. Description of Macros

In this section a brief description of the main macros that user can find at the very beginning of the program is provided. These macros can be divided in four classes: macros for the calculation of the indicators required in the Intermediate Quality Report, one macro for the calculation of a percentile of a distribution, one macro for the estimation of the variances of these measures with the Jackknife Repeated Replication methodology and one macro for the estimation of the Kish factor.

4.1 Macros for the calculation of the indicators required in the Intermediate Quality Report

- **Macro stat1**: at-risk-of-poverty-rate after social transfers;
- **Macro stat2**: at-risk-of-poverty-rate before social transfers (including pensions);
- **Macro stat3**: at-risk-of-poverty-rate before social transfers (excluding pensions);
- **Macro stat4**: median of the equivalised disposable income;
- **Macro stat5**: at-risk-of-poverty threshold;
- **Macro stat6**: inequality of income distribution S80/S20 income quantile share ratio;
- **Macro stat7**: relative median at-risk-of-poverty gap;
- **Macro stat8**: median income below the at-risk-of-poverty threshold;
- **Macro stat9**: at-risk-of-poverty-rate, (50% of the median);
- **Macro stat10**: at-risk-of-poverty-rate, (70% of the median);
- **Macro stat11**: at-risk-of-poverty-rate, (40% of the median);
- **Macro stat12**: Gini coefficient;
- **Macro stat13**: mean equivalised disposable income.
4.2 Macro perc_bound

This macro allows to calculate any kind of weighted percentile of a distribution. The value that it calculates is the linear interpolation of the percentile. This means that if any real value of the distribution lies in this percentile, a value between the two nearest values - above and below the percentile is interpolated. It needs information from individual datasets (PID).

The SAS program doesn’t calculate this value in such a manner. In fact if any real value of the distribution lies in this percentile, the SAS takes the nearest real value above the percentile.

We highly recommend this procedure for the estimation of percentiles.

4.3 Macro jrr

This macro implements the Jackknife Repeated Replications (JRR) methodology. It implements the so called JRR variable (see annex for details). In order to estimate the standard errors, the measures are estimated inside the replications. In fact, inside this macro there is the computation of the “\%stat&k”.

Inside the replications we also reallocate the weights. Once a PSU is deleted, its weights are assigned to the other PSUs in the same stratum of the PSU deleted, so that the total sum of the weights doesn’t change (see formula [4] in annex for details).

4.4 Macro Kish

This macro calculates the quantity Kish_Jrr described in Annex III as the correlation between the weights and the statistic implemented.

5. List of the all the measures and the relative subpopulations present in the program:

Here we present the list of the indicators and their relative subpopulations considered in the present program.

There is also an indicator $I_i$ for each that corresponds to the indicator of the index and subpopulation in the program.

The at-risk-of-poverty-rate, known also as Head Count Ratio, is abbreviated as HCR.

Hh stays for household
P.L. stays for poverty line.

I1 = 'HCR, after social transfers: Age 0-15';
I2 = 'HCR, after social transfers: Age 16-24';
I3 = 'HCR, after social transfers: Age 25-49';
I4 = 'HCR, after social transfers: Age 50-64';
I5 = 'HCR, after social transfers: Age more then 64';
I6 = 'HCR, after social transfers: Male';
I7 = 'HCR, after social transfers: Female';
I8 = 'HCR, after social transfers: Male Age 0-15';
I9 = 'HCR, after social transfers: Male Age 16-24';
I10 = 'HCR, after social transfers: Male Age 25-49';
I11 = 'HCR, after social transfers: Male Age 50-64';
I12 = 'HCR, after social transfers: Male Age more then 64';
I13 = 'HCR, after social transfers: Female Age 0-15';
I14 = 'HCR, after social transfers: Female Age 16-24';
I15 = 'HCR, after social transfers: Female Age 25-49'
I16 = 'HCR, after social transfers: Female Age 50-64'
I17 = 'HCR, after social transfers: Female Age more than 64'
I18 = 'HCR, after social transfers: Male Age more than 16'
I19 = 'HCR, after social transfers: Female Age more than 16'
I20 = 'HCR, after social transfers: Male Age 16-64'
I21 = 'HCR, after social transfers: Female Age 16-64'
I22 = 'HCR, after social transfers: Male Age 0-64'
I23 = 'HCR, after social transfers: Female Age 0-64'
I24 = 'HCR, after social transfers: One person hh under 65 years'
I25 = 'HCR, after social transfers: One person hh 65 years and over'
I26 = 'HCR, after social transfers: One person hh male'
I27 = 'HCR, after social transfers: One person hh female'
I28 = 'HCR, after social transfers: One person hh total'
I29 = 'HCR, after social transfers: 2 adults, no dependant children, both adults under 65 years'
I30 = 'HCR, after social transfers: 2 adults, no dependant children, at least one adult 65 years or more'
I31 = 'HCR, after social transfers: Other hh without dependant children'
I32 = 'HCR, after social transfers: Single parent hh, one or more dependant children'
I33 = 'HCR, after social transfers: 2 adults, one dependant child'
I34 = 'HCR, after social transfers: 2 adults, two dependant children'
I35 = 'HCR, after social transfers: 2 adults, three or more dependant children'
I36 = 'HCR, after social transfers: Other hh with dependant children'
I37 = 'HCR, after social transfers: Hh without dependant children'
I38 = 'HCR, after social transfers: Hh with dependant children'
I39 = 'HCR, after social transfers: Accommodation tenure status: Owner or rent free'
I40 = 'HCR, after social transfers: Accommodation tenure status: Tenant'
I41 = 'HCR, after social transfers: Main activity status: Employed'
I42 = 'HCR, after social transfers: Main activity status: Unemployed'
I43 = 'HCR, after social transfers: Main activity status: Retired'
I44 = 'HCR, after social transfers: Main activity status: Other inactive'
I45 = 'HCR, after social transfers: Main activity status: Employed, Male'
I46 = 'HCR, after social transfers: Main activity status: Unemployed, Male'
I47 = 'HCR, after social transfers: Main activity status: Retired, Male'
I48 = 'HCR, after social transfers: Main activity status: Other inactive, Male'
I49 = 'HCR, after social transfers: Main activity status: Employed, Female'
I50 = 'HCR, after social transfers: Main activity status: Unemployed, Female'
I51 = 'HCR, after social transfers: Main activity status: Retired, Female'
I52 = 'HCR, after social transfers: Main activity status: Other inactive, Female'
I53 = 'HCR, after social transfers: Work intensity: hh without dependent children, w=0'
I54 = 'HCR, after social transfers: Work intensity: hh without dependent children, 0<w<1'
I55 = 'HCR, after social transfers: Work intensity: hh without dependent children, w=1'
I56 = 'HCR, after social transfers: Work intensity: hh with dependent children, w=0'
I57 = 'HCR, after social transfers: Work intensity: hh with dependent children, 0<w<0.5'
I58 = 'HCR, after social transfers: Work intensity: hh with dependent children, 0.5<=w<1'
I59 = 'HCR, after social transfers: Work intensity: hh with dependent children, w=1'
I60 = 'HCR, before social transfers including pensions: Male Age 0-15'
I61 = 'HCR, before social transfers including pensions: Male Age 16-24'
I62 = 'HCR, before social transfers including pensions: Male Age 25-49'
I63 = 'HCR, before social transfers including pensions: Male Age 50-64'
I64 = 'HCR, before social transfers including pensions: Male Age more than 64'
I65 ='HCR, before social transfers including pensions: Female Age 0-15';
I66 ='HCR, before social transfers including pensions: Female Age 16-24';
I67 ='HCR, before social transfers including pensions: Female Age 25-49';
I68 ='HCR, before social transfers including pensions: Female Age 50-64';
I69 ='HCR, before social transfers including pensions: Female Age more then 64';
I70 ='HCR, before social transfers excluding pensions: Male Age 0-15';
I71 ='HCR, before social transfers excluding pensions: Male Age 16-24';
I72 ='HCR, before social transfers excluding pensions: Male Age 25-49';
I73 ='HCR, before social transfers excluding pensions: Male Age 50-64';
I74 ='HCR, before social transfers excluding pensions: Male Age more then 64';
I75 ='HCR, before social transfers excluding pensions: Female Age 0-15';
I76 ='HCR, before social transfers excluding pensions: Female Age 16-24';
I77 ='HCR, before social transfers excluding pensions: Female Age 25-49';
I78 ='HCR, before social transfers excluding pensions: Female Age 50-64';
I79 ='HCR, before social transfers excluding pensions: Female Age more then 64';
I80 ='Median equivalised disposable income';
I81 ='At-risk-of-poverty threshold, one person hh';
I82 ='At-risk-of-poverty threshold, hh 2 adults 2 dependent children';
I83 ='S80/S20';
I84 ='Relative median at-risk-of-poverty gap: Male Age 0-15';
I85 ='Relative median at-risk-of-poverty gap: Male Age 16-24';
I86 ='Relative median at-risk-of-poverty gap: Male Age 25-49';
I87 ='Relative median at-risk-of-poverty gap: Male Age 50-64';
I88 ='Relative median at-risk-of-poverty gap: Male Age more then 64';
I89 ='Relative median at-risk-of-poverty gap: Female Age 0-15';
I90 ='Relative median at-risk-of-poverty gap: Female Age 16-24';
I91 ='Relative median at-risk-of-poverty gap: Female Age 25-49';
I92 ='Relative median at-risk-of-poverty gap: Female Age 50-64';
I93 ='Relative median at-risk-of-poverty gap: Female Age more then 64';
I94 ='Median income below the at-risk-of-poverty threshold';
I95 ='HCR P.L. as 50% median';
I96 ='HCR P.L. as 70% median';
I97 ='HCR P.L. as 40% median';
I98 ='Gini coefficient';
I99 ='Mean equivalised disposable income'.

6. Step-by-step description of the program

In this section we give a brief description step by step of the program for the estimation of the measures estimates, standard errors and Kish factor.

A. The program start with the preparation of the dataset to be used with all the necessary variables. It is an individual dataset (from R file) with all the variables required in order to estimates the measures and all the variables about the sample structure. Then are created all the indicators Ii for each measure.

Note: a new variable for the work intensity status (HX020) is constructed. The one in the dataset assumes values from 1 to 4, while in the EU-SILC 065.doc it is required with value from 1 to 7. Crossing HX020 with HX060 (household type), we have constructed a new HX020_2 that ranges from 1 to 7.
B. Then there is the macro “%macro sub_ciclo” in which the user should specify the number of PSUs of the dataset and two numbers corresponding to the statistic number with which the program should start and end. Presently, all or a valid range (only consecutive measures) or a single measure can be chosen. In order to have estimates for measures from I1 to I10, one should choose 1 as first measure to estimate and 10 as the last one. For a single measure one should mention the number of the measure as both first and last index. The latter case means the macro will be run once for the measure, whereas in former case (a range of measures) the macro will run sequentially from the beginning of the range to end, once for each measure. Only consecutive measures can be chosen. Details about the place where these numbers have to be inserted are in next section.

C. For each measure required in B, variables that are necessary in order to rescale the weights are added to the dataset. Then it is done: the estimation of the measure, of the standard error and the Kish factor.

Finally a name is assigned to each measure.

D. The program put the results for all the measures selected all together in an output dataset.

7. Quick Guide

➢ For the running of the program, user should create a directory with the files to be used in the program. Then from SAS should be created a library called “sile07” that refers to the previous directory where the dataset is present.

➢ First of all you have to prepare an individual data set (R file) for a given country, which should contain the following variables:

The structure of the data for the data set:

• stratum = the stratum where the observation is located;
• psu = the primary selection unit (PSU) where the observation is located;
• ah = number of PSUs per stratum.
• HID = (household identification number);
• PID = (personal identification number);
• From the Register File (R file):
  o RB050 (personal cross sectional weight).
  o RX020 (Age of the individual);
  o RB090 (Sex of the individual);
  o RB210 (main activity status);
• From the Household File (H file):
  o HX060 (Household Type);
  o HH020 (Tenure Status);
  o HX020 (Work intensity);
  o HX090 equivalised disposable income;
Then the user need to insert into the program the following:

1. Change the name of the dataset with the one appropriate. Here you find “silc07.at”.
2. Insert, at the end of the program inside %sub_ciclo all necessaries information.

%sub_ciclo (a, b, c);
where
a = first measure chosen;
b = last measure chosen;
c = number of PSU in the dataset;
(a and b can range from 1 to 99; a should be always chosen smaller than b (or equal to) ; e.g. a=10 and b=20 will run measures from 10th to 20th).

8. Example
At the end of this document, we provide as example of the output of the program, results obtained using data of EU-SILC cross-sectional dataset for year 2007 for Austria. As structure of the dataset for this country, that is a simple random sample, we have constructed a structure with 100 PSUs and 1 Stratum.

Below we report the Sas code of the program, adapted for this analysis and the output achieved.
ANNEX I: SAS codes

******************************************1. HCR P.L.as 60% median;
%macro stat1;
data input_bound;set working;wj=w0;run;
%perc_bound(50);
data working1;merge working output_bound;by country;line=0.60*y_perc;wj=ws;
if eqinc gt line then z=0;if eqinc le line then z=1;run;
proc univariate data=working1 noprint;output out=est mean=est;var z;weight wj;by
country;run;
data jrr;merge working1 est;by country;y=z-est;subpop_i=1;run;
title 'stat1';
%mend;

******************************************2. HCR P.L.as 60% median before social transfer
including pensions;
%macro stat2;
data input_bound;set working (drop=eqinc);wj=w0; eqinc=eqhy022; run;
data working1;merge working output_bound;by country;line=0.60*y_perc;wj=ws;
if eqhy022 gt line then z=0;if eqhy022 le line then z=1;run;
proc univariate data=working1 noprint;output out=est mean=est;var z;weight wj;by
country;run;
data jrr;merge working1 est;by country;y=z-est;subpop_i=1;run;
title 'stat2';
%mend;

******************************************3. HCR P.L.as 60% median before social transfer
excluding pensions;
%macro stat3;
data input_bound;set working (drop=eqinc);wj=w0; eqinc=eqhy023; run;
data working1;merge working output_bound;by country;line=0.60*y_perc;wj=ws;
if eqhy023 gt line then z=0;if eqhy023 le line then z=1;run;
proc univariate data=working1 noprint;output out=est mean=est;var z;weight wj;by
country;run;
data jrr;merge working1 est;by country;y=z-est;subpop_i=1;run;
title 'stat3';
%mend;

******************************************4. P(50) Median equivalised disposable income;
%macro stat4;
data input_bound;set working;wj=w0;run;
%perc_bound(50);
data jrr;merge working output_bound;by country;subpop_i=1;z=y_perc;y=1;
wj=w0;run;
title 'stat4';
%mend;

******************************************5. at-risk-of-poverty threshold;
%macro stat5;
data input_bound;set working;wj=ws;run;
%perc_bound(50);
data jrr;merge working output_bound;by
country;y=1;z=0.60*y_perc;;subpop_i=1;wj=ws;run;
title 'stat5';
%mend;

******************************************6. S80/S20: ratio of income shares of the
percentiles;
%macro stat6;
data working;set working; wj=w0; run;
data input_bound;set working;run;
%perc_bound(80);
data output_bound_80;set output_bound;rename y_perc=y_perc_80;run;
%perc_bound(20);
proc means data=working noprint; output out=media mean=media;var eqinc;weight wj;by country;run;
data working1;merge working output_bound output_bound_80 media;by country;
alfai_80=sign(max(0,(eqinc-y_perc_80)));
alfai_20=1-sign(max(0,(eqinc-y_perc)));
z_80=(eqinc/media)*alfai_80;z_20=(eqinc/media)*alfai_20;run;
proc univariate data=working1 noprint; output out=est mean=est_80 mean=est_20;
var z_80 z_20;weight wj;by country;run;
data jrr;merge working1 est;by country;subpop_i=1;z=est_80/est_20;
y=(1/est_20)*(eqinc/media)*(alfai_80-z*alfai_20);run;
title 'stat6';
%mend;

*****************************7. Relative median at-risk-of-poverty gap;
%macro stat7;
data input_bound;set working;wj=w0;run;
%perc_bound(50);
data working1; merge working output_bound;by country;wj=ws;pov_l1=0.60*y_perc;
if eqinc gt pov_l1 then pov1=0;if eqinc le pov_l1 then pov1=1;run;
data input_bound;set working1; where pov1=1;run;
%perc_bound(50);
data output_bound_p1;set output_bound; rename y_perc=y_perc_p;run;
data jrr;merge working1 output_bound_p1; by country;wj=ws;
z=((pov_l1-y_perc_p)/pov_l1);subpop_i=pov1;z1=z;y=1;run;
title 'stat7';
%mend;

***********************8. median income below the at-risk-of-poverty threshold;
%macro stat8;
data input_bound;set working; wj=w0; run;
%perc_bound(50);
data working1;merge working mean output_bound;by country;wj=w0;line=0.60*y_perc;
if eqinc gt line then pov1=0;if eqinc le line then pov1=1;z=eqinc;run;
data input_bound;set working1; where pov1=1;run;
%perc_bound(50);
data output_bound_p1;set output_bound; rename y_perc=y_perc_p;run;
data jrr;merge working1 output_bound_p1; by country;wj=ws;
y=y_perc;subpop_i=pov1;run;
title 'stat8';
%mend;

************************************9. HCR P.L.as 50% median;
%macro stat9;
data input_bound;set working;wj=w0;run;
%perc_bound(50);
data working1;merge working output_bound;by country;wj=w0;line=0.50*y_perc;
if eqinc gt line then z=0;if eqinc le line then z=1;run;
proc univariate data=working1 noprint;output out=est mean=est;var z;weight wj;by country;run;
data jrr;merge working1 est;by country;y=z-est;subpop_i=1;run;
title 'stat9';
%mend;

***********************************10. HCR P.L.as 70% median;
%macro stat10;
data input_bound;set working;wj=w0;run;
%perc_bound(50);
data working1;merge working output_bound;by country;wj=w0;line=0.70*y perc;
if eqinc gt line then z=0;if eqinc le line then z=1;run;
**11. HCR P.L.as 40% median**

```sas
%macro stat11;
  data input_bound;set working;wj=w0;run;
  %perc_bound(50);
  data working1;merge working output_bound by country;wj=w0;line=0.40*y_perc;
  if eqinc gt line then z=0; if eqinc le line then z=1;run;
  proc univariate data=working1 noprint;output out=est mean=est;var z;weight wj;by country;run;
  data jrr;merge working1 est by country; y=z-est;subpop_i=1;run;
  title 'stat11';
%mend;
```

**12. Gini**

```sas
%macro stat12;
  data working;set working;wj=w0;run;
  proc means data=working noprint;output out=media mean=media;var eqinc;weight wj;by country;run;
  data media;set media (keep = media country);run;
  proc sort data=working;by eqinc;run;
  proc iml;
    use working;
    read all var {hid} into hid;
    read all var {wj} into weig;
    read all var {eqinc} into eqinc;
    num=nrow(hid);
    share_w=repeat(0,num); share_inc=repeat(0,num); eqinc_w=eqinc#weig;
    tot_w=sum(weig); tot_inc=sum(eqinc_w);
    i=1;
    do while (i<num+1);
      share_inc[i]=sum(eqinc_w[1:i])/tot_inc;
      share_w[i]=sum(weig[1:i])/tot_w;
      i=i+1;
    end;
    create share var {hid share_inc share_w};append;close share;quit;run;
  proc sort data=working2;by hid;run;
  proc sort data=share;by hid;run;
  data working2;merge working1 media by country; z=2*((eqinc-media)/media)*share_w;
  proc univariate data=working2 noprint;output out=est mean=est;var z;weight wj;by country;run;
  data jrr;merge working2 est by country; y=(2*((eqinc-media)/media)*share_w) - est;subpop_i=1;run;
  title 'stat12';
%mend;
```

**13. Mean equivalised income**

```sas
%macro stat13;
  data working1;set working;wj=w0;run;
  proc means data=working1 noprint;output out=est mean=est;var eqinc;weight wj;by country;run;
  data JRR; merge working1 est by country; y=eqinc-est;z=eqinc;run;
  title 'stat13';
%mend;
```

**Perc bound**

```sas
%macro perc_bound (perc);
  data input;set input_bound;percent=&perc;run;
  proc sort data=input;by eqinc;run;
  proc iml;
    use input;
    read all var {pid} into pid;
    read all var {wj} into wj;
    read all var {eqinc} into eqinc;
    read all var {percent} into percent;
```
read all var {country} into country_vec;
num=nrow(pid); share=repeat(0,num); ratio=percent[1]/100;
tot=sum(wj); i=2; do while (i<n+1);
    share[i]=sum(wj[1:i])/tot;
    if (share[i-1] < ratio) & (share[i] >= ratio)
        then y_perc=eqinc[i-1]+(eqinc[i]-eqinc[i-1])*((ratio-share[i-1])/(share[i]-share[i-1]));
    i=i+1; end;
country=country_vec[1]; create output_bound var {y_perc country}; append ; close output_bound; quit; run;
%mend

*************************************************Jrr variable;
%macro jrr_var (local);
%do i=1 %to &local;
    proc univariate data=working3 noprint; output out=str_notuse mean=stratum mean=w_i;
    var stratum w_c; where psu eq &i; run;
    data str_notuse;set str_notuse; pr=1; run;
    data working4; merge working3 str_notuse; by stratum; run;
    data working;set working4; where psu ne &i;
        if pr eq 1 then w0=w0_old*w_h/(w_h-w_i); else w0=w0_old;
        if pr eq 1 then ws=ws_old*w_h/(w_h-w_i); else ws=ws_old; run;
    proc univariate data=working4 noprint; output out=info mean=country mean=ah mean=psu mean=stratum;
    var country ah psu stratum; where psu eq &i; run;
%if (&j ge 1) and (&j le 59) %then %do; %stat1; %end;
%if (&j ge 60) and (&j le 69) %then %do; %stat2; %end;
%if (&j ge 70) and (&j le 79) %then %do; %stat3; %end;
%if (&j eq 80) %then %do; %stat4; %end;
%if (&j ge 81) and (&j le 82) %then %do; %stat5; %end;
%if (&j eq 83) %then %do; %stat6; %end;
%if (&j ge 84) and (&j le 93) %then %do; %stat7; %end;
%if (&j eq 94) %then %do; %stat8; %end;
%if (&j eq 95) %then %do; %stat9; %end;
%if (&j eq 96) %then %do; %stat10; %end;
%if (&j eq 97) %then %do; %stat11; %end;
%if (&j eq 98) %then %do; %stat12; %end;
%if (&j eq 99) %then %do; %stat13; %end;
proc univariate data=jrr noprint; output out=est mean=est; var z; weight wj;
    where subpop_i eq 1; by country; run;
    data est; set est (keep= est country); run;
    data replicate; merge info est; by country; run;
    data h;set h replicate; run;
%end;
%mend

****************************************Kish;
%macro Kish(local,index);
    proc univariate data=kish_input noprint; output out=ymean mean=ybar; var y; weight wj; by country; run;
    proc univariate data=kish_input noprint; output out=wmean mean=wbar; var wj; by country; run;
    data work; merge kish_input ymean wmean; by country;
    if &local eq 1 then zj_2=(y-ybar)**2; else zj_2=1;
    wjz_2=(wj/wbar)**2*zj_2; wjz_2_2=wjz_2_2=(wj/wbar)**2*zj_2; run;
    proc univariate data=work noprint; output out=sums sum=wjz_2_2_sum sum=wjz_2_2_sum n=n;
    var wjz_2 wjz_2_2; by country; run;
    data kish_output (keep=kish index); set sums; se_srs=sqrt(wjz_2_sum/(n*(n-1)))); index=&j;
    se_wt=sqrt(wjz_2_2_sum/(n*(n-1)))); kish=se_wt/se_srs; run;
&mend;

data r; set silc07.at; ********CHANGE THE NAME OF THE DATASET HERE*********

country=1;
rename hx090=eqinc;
if (rx020 ge 0) and (rx020 le 15) then class_age=1;
if (rx020 ge 16) and (rx020 le 24) then class_age=2;
if (rx020 ge 25) and (rx020 le 49) then class_age=3;
if (rx020 ge 50) and (rx020 le 64) then class_age=4;
if (rx020 ge 65) then class_age=5;

********new household type variable;
if (hx020 eq 1) and (hx060 in (9, 10, 11, 12, 13)) then hx020_2=1;
if (hx020 in (2, 3)) and (hx060 in (9, 10, 11, 12, 13)) then hx020_2=2;
if (hx020 eq 4) and (hx060 in (9, 10, 11, 12, 13)) then hx020_2=3;
if (hx020 eq 1) and (hx060 in (5, 6, 7, 8)) then hx020_2=4;
if (hx020 eq 2) and (hx060 in (5, 6, 7, 8)) then hx020_2=5;
if (hx020 eq 3) and (hx060 in (5, 6, 7, 8)) then hx020_2=6;
if (hx020 eq 4) and (hx060 in (5, 6, 7, 8)) then hx020_2=7;

******INDICATORS;
I1=0; if class_age=1 then I1=1;
I2=0; if class_age=2 then I2=1;
I3=0; if class_age=3 then I3=1;
I4=0; if class_age=4 then I4=1;
I5=0; if class_age=5 then I5=1;
I6=0; if (rb090 eq 1) then I6=1;***male;
I7=0; if (rb090 eq 2) then I7=1;***female;

****CLASS AGE BY GENDER;
I8=0; if (rb090 eq 1) and (class_age eq 1) then I8=1;
I9=0; if (rb090 eq 1) and (class_age eq 2) then I9=1;
I10=0; if (rb090 eq 1) and (class_age eq 3) then I10=1;
I11=0; if (rb090 eq 1) and (class_age eq 4) then I11=1;
I12=0; if (rb090 eq 1) and (class_age eq 5) then I12=1;
I13=0; if (rb090 eq 2) and (class_age eq 1) then I13=1;
I14=0; if (rb090 eq 2) and (class_age eq 2) then I14=1;
I15=0; if (rb090 eq 2) and (class_age eq 3) then I15=1;
I16=0; if (rb090 eq 2) and (class_age eq 4) then I16=1;
I17=0; if (rb090 eq 2) and (class_age eq 5) then I17=1;
I18=0; if (rb090 eq 1) and (class_age ne 1) then I18=1;
I19=0; if (rb090 eq 2) and (class_age ne 1) then I19=1;
I20=0; if (rb090 eq 1) and (class_age in (2, 3, 4)) then I20=1;
I21=0; if (rb090 eq 2) and (class_age in (2, 3, 4)) then I21=1;
I22=0; if (rb090 eq 1) and (class_age ne 5) then I22=1;
I23=0; if (rb090 eq 2) and (class_age ne 5) then I23=1;

*******HOUSEHOLD TYPE;
I24=0; if (hx060 eq 5) and (rx020 lt 65) then I24=1;
I25=0; if (hx060 eq 5) and (rx020 ge 65) then I25=1;
I26=0; if (hx060 eq 5) and (rb090 eq 1) then I26=1;
I27=0; if (hx060 eq 5) and (rb090 eq 2) then I27=1;
I28=0; if (hx060 eq 5) then I28=1;
I29=0; if hx060 eq 6 then I29=1;
I30=0; if hx060 eq 7 then I30=1;
I31=0; if hx060 eq 8 then I31=1;
I32=0; if hx060 eq 9 then I32=1;
I33=0; if hx060 eq 10 then I33=1;
I34=0; if hx060 eq 11 then I34=1;
I35=0; if hx060 eq 12 then I35=1;
I36=0; if hx060 eq 13 then I36=1;
I37=0; if hx060 in (5, 6, 7, 8) then I37=1;
I38=0; if hx060 in (9, 10, 11, 12, 13) then I38=1;
***************accommodation tenure status;
I39=0; if hh020 in (1, 4) then I39=1;
I40=0; if hh020 in (2, 3) then I40=1;
***************most frequent activity;
I41=0; if rb210 eq 1 then I41=1;
I42=0; if rb210 eq 2 then I42=1;
I43=0; if rb210 eq 3 then I43=1;
I44=0; if rb210 eq 4 then I44=1;
I45=0; if (rb210 eq 1) and (rb090 eq 1) then I45=1;
I46=0; if (rb210 eq 2) and (rb090 eq 1) then I46=1;
I47=0; if (rb210 eq 3) and (rb090 eq 1) then I47=1;
I48=0; if (rb210 eq 4) and (rb090 eq 1) then I48=1;
I49=0; if (rb210 eq 1) and (rb090 eq 2) then I49=1;
I50=0; if (rb210 eq 2) and (rb090 eq 2) then I50=1;
I51=0; if (rb210 eq 3) and (rb090 eq 2) then I51=1;
I52=0; if (rb210 eq 4) and (rb090 eq 2) then I52=1;
**********work intensity;
I53=0; if hx020_2 eq 1 then I53=1;
I54=0; if hx020_2 eq 2 then I54=1;
I55=0; if hx020_2 eq 3 then I55=1;
I56=0; if hx020_2 eq 4 then I56=1;
I57=0; if hx020_2 eq 5 then I57=1;
I58=0; if hx020_2 eq 6 then I58=1;
I59=0; if hx020_2 eq 7 then I59=1;
I60=0; if (rb090 eq 1) and (class_age eq 1) then I60=1;
I61=0; if (rb090 eq 1) and (class_age eq 2) then I61=1;
I62=0; if (rb090 eq 1) and (class_age eq 3) then I62=1;
I63=0; if (rb090 eq 1) and (class_age eq 4) then I63=1;
I64=0; if (rb090 eq 1) and (class_age eq 5) then I64=1;
I65=0; if (rb090 eq 2) and (class_age eq 1) then I65=1;
I66=0; if (rb090 eq 2) and (class_age eq 2) then I66=1;
I67=0; if (rb090 eq 2) and (class_age eq 3) then I67=1;
I68=0; if (rb090 eq 2) and (class_age eq 4) then I68=1;
I69=0; if (rb090 eq 2) and (class_age eq 5) then I69=1;
I70=0; if (rb090 eq 1) and (class_age eq 1) then I70=1;
I71=0; if (rb090 eq 1) and (class_age eq 2) then I71=1;
I72=0; if (rb090 eq 1) and (class_age eq 3) then I72=1;
I73=0; if (rb090 eq 1) and (class_age eq 4) then I73=1;
I74=0; if (rb090 eq 1) and (class_age eq 5) then I74=1;
I75=0; if (rb090 eq 2) and (class_age eq 1) then I75=1;
I76=0; if (rb090 eq 2) and (class_age eq 2) then I76=1;
I77=0; if (rb090 eq 2) and (class_age eq 3) then I77=1;
I78=0; if (rb090 eq 2) and (class_age eq 4) then I78=1;
I79=0; if (rb090 eq 2) and (class_age eq 5) then I79=1;
I80=1;
I81=0; if (hx060 eq 5) then I81=1;
I82=0; if (hx060 eq 11) then I82=1;
I83=1;
I84=0; if (rb090 eq 1) and (class_age eq 1) then I84=1;
I85=0; if (rb090 eq 1) and (class_age eq 2) then I85=1;
I86=0; if (rb090 eq 1) and (class_age eq 3) then I86=1;
I87=0; if (rb090 eq 1) and (class_age eq 4) then I87=1;
I88=0; if (rb090 eq 1) and (class_age eq 5) then I88=1;
I89=0; if (rb090 eq 2) and (class_age eq 1) then I89=1;
I90=0; if (rb090 eq 2) and (class_age eq 2) then I90=1;
I91=0; if (rb090 eq 2) and (class_age eq 3) then I91=1;
I92=0; if (rb090 eq 2) and (class_age eq 4) then I92=1;
I93=0; if (rb090 eq 2) and (class_age eq 5) then I93=1;
I94=1;
I95=1;
I96=1;
I97=1;
I98=1;
I99=1;
run;
data r1 (drop= I1--I99); set r; run;
data h0; input country ah psu stratum stat;cards;
0 0 0 0;
;run;
data stat0; input est stat_se ;cards;
0 0;
;run;
data kish0; input kish index;cards;
0 0;
;run;
data final_output0; input subpopulation $1-100 est stat_se kish ; cards;
This_is_for_initialising_the_Subpopulation_considered_in_the_analysis________
________________________ 0 0 0;
;run;

%macro sub_ciclo (sub_ciclo_start,sub_ciclo_end,psu);
  %do
  j=&sub_ciclo_start %to &sub_ciclo_end;
  data help; set r (keep=pid I&j);rename I&j=I;run;
  proc sort data=r1; by pid; run;
  proc sort data=help; by pid; run;
  data dati; merge r1 help; by pid; run;
  data working_pop_1; set dati;run;
  data kish;set kish0;run;
  data stat; set stat0; run;
  data working_pop0;set working_pop_1;w0=rb050;w_sub=w0*I;run;
  proc univariate data=working_pop0 noprint;output out=sum_w sum=sum_w
  sum=sum_w_sub;var w0 w_sub;by country;run;
  data sum_w;set sum_w (keep=sum_w sum=sum_w_sub country);run;
  data working_pop; merge working_pop0 sum_w;by country;
  w0=rb050/sum_w; ws=w_sub/sum_w_sub;whij=w0; run;
  proc sort data=working_pop;by stratum;run;
  proc univariate data=working_pop noprint;output out=weight_str sum=w_h;var w0 w_sub;by stratum;run;
  proc sort data=working_pop;by psu;run;
  proc univariate data=working_pop noprint; output out=weight_notuse sum=w_c;var
  w0;by psu;run;
  proc sort data=working_pop;by stratum;run;
  data working2;merge working_pop weight_str;by stratum;run;
  proc sort data=working2;by psu;run;
  data working3;merge working2 weight_notuse;by psu;w0_old=w0;ws_old=ws;run;
  data h;set h0;run; %jrr_var(&psu);
  data h;set h;where country ne 0;run;
  data h_var;set h;run;
  data working;set working_pop;run;
  %if (&j ge 1) and (&j le 59) %then %do; %stat1; %end;
  %if (&j ge 60) and (&j le 69) %then %do; %stat2; %end;
  %if (&j ge 70) and (&j le 79) %then %do; %stat3; %end;
  %if &j eq 80 %then %do; %stat4; %end;
  %if (&j ge 81) and (&j le 82) %then %do; %stat5; %end;
  %if &j eq 83 %then %do; %stat6; %end;
  %if (&j ge 84) and (&j le 93) %then %do; %stat7; %end;
  %if &j eq 94 %then %do; %stat8; %end;
  %if &j eq 95 %then %do; %stat9; %end;
  %if &j eq 96 %then %do; %stat10; %end;
  %if &j eq 97 %then %do; %stat11; %end;
  %end;
data kish;set kish kish_output;where index gt 0;run;
proc univariate data=jrr noprint; output out=est me an=est n=n; var z; weight wj; where I eq 1; by country; run;
data est; set est (keep= est n country);run;
proc univariate data=h noprint; output out=jks mean= ah; var ah; by stratum; run;
proc sort data=h; by country stratum; run;
proc univariate data=h noprint; output out=jkm sum= yhsum_stat; var est; by country stratum; run;
proc sort data=jk; by stratum; run;
data prova; merge h jk; by stratum; factor=(ah-1)/ah; run;
data jk2_0; set prova; statdif2_0=(est-yh_stat)**2; run;
proc sort data=jk2_0; by country; run;
data jk2; merge jk2_0 mean; by country; statdif2=statdif2_0; limit=6*mean;
if statdif2_0 gt limit then statdif2=limit; run;
proc univariate data=jk2 noprint; output out=var_stat sum= stat_v; var statdif2; weight factor; by country; run;
data se_stat; set var_stat; stat_se=stat_v**0.5; run;
data stat_act (keep= est stat_se n index); merge est se_stat; by country; index=&j;
data stat; set stat stat_act; run;
proc freq data=stat_act; table index; run;
data JRR1;set stat;
where (est ne 0) and (stat_se ne 0);run;
data stat_output0; merge stat kish; by index; run;
data stat_output; set stat_output0; where (est ne 0) and (stat_se ne 0); run;
data stat_sub&j (drop=index); set stat_output;
if &j eq 1 then Subpopulation='HCR, after social transfers: Age 0-15'
';
if &j eq 2 then Subpopulation='HCR, after social transfers: Age 16-24'
';
if &j eq 3 then Subpopulation='HCR, after social transfers: Age 25-49'
';
if &j eq 4 then Subpopulation='HCR, after social transfers: Age 50-64'
';
if &j eq 5 then Subpopulation='HCR, after social transfers: Age more then 64'
';
if &j eq 6 then Subpopulation='HCR, after social transfers: Male'
';
if &j eq 7 then Subpopulation='HCR, after social transfers: Female'
';
if &j eq 8 then Subpopulation='HCR, after social transfers: Male Age 0-15'
';
if &j eq 9 then Subpopulation='HCR, after social transfers: Male Age 16-24'
';
if &j eq 10 then Subpopulation='HCR, after social transfers: Male Age 25-49'
';
if &j eq 11 then Subpopulation='HCR, after social transfers: Male Age 50-64';
if &j eq 12 then Subpopulation='HCR, after social transfers: Male Age more than 64';
if &j eq 13 then Subpopulation='HCR, after social transfers: Female Age 0-15';
if &j eq 14 then Subpopulation='HCR, after social transfers: Female Age 16-24';
if &j eq 15 then Subpopulation='HCR, after social transfers: Female Age 25-49';
if &j eq 16 then Subpopulation='HCR, after social transfers: Female Age 50-64';
if &j eq 17 then Subpopulation='HCR, after social transfers: Female Age more than 64';
if &j eq 18 then Subpopulation='HCR, after social transfers: Male Age more than 16';
if &j eq 19 then Subpopulation='HCR, after social transfers: Female Age more than 16';
if &j eq 20 then Subpopulation='HCR, after social transfers: Male Age 16-64';
if &j eq 21 then Subpopulation='HCR, after social transfers: Male Age 0-64';
if &j eq 22 then Subpopulation='HCR, after social transfers: Female Age 0-64';
if &j eq 23 then Subpopulation='HCR, after social transfers: Female Age more than 64';
if &j eq 24 then Subpopulation='HCR, after social transfers: One person hh under 65 years';
if &j eq 25 then Subpopulation='HCR, after social transfers: One person hh 65 years and over';
if &j eq 26 then Subpopulation='HCR, after social transfers: One person hh male';
if &j eq 27 then Subpopulation='HCR, after social transfers: One person hh female';
if &j eq 28 then Subpopulation='HCR, after social transfers: One person hh total';
if &j eq 29 then Subpopulation='HCR, after social transfers: 2 adults, no dependant children, both adults under 65 years';
if &j eq 30 then Subpopulation='HCR, after social transfers: 2 adults, no dependant children, at least one adult 65 years or more';
if &j eq 31 then Subpopulation='HCR, after social transfers: Other hh without dependant children';
if &j eq 32 then Subpopulation='HCR, after social transfers: Single hh, one or more dependant children';
if &j eq 33 then Subpopulation='HCR, after social transfers: 2 adults, one dependant child';
if &j eq 34 then Subpopulation='HCR, after social transfers: 2 adults, two dependant children';
if &j eq 35 then Subpopulation='HCR, after social transfers: 2 adults, three or more dependant children';
if &j eq 36 then Subpopulation='HCR, after social transfers: Other hh with dependant children';
if &j eq 37 then Subpopulation='HCR, after social transfers: Hh without dependant children';
if &j eq 38 then Subpopulation='HCR, after social transfers: Hh with dependant children';
if &j eq 39 then Subpopulation='HCR, after social transfers: Accommodation tenure status:Owner or rent free';
if &j eq 40 then Subpopulation='HCR, after social transfers: Accommodation tenure status:Tenant';
if &j eq 41 then Subpopulation='HCR, after social transfers: Main activity status: Employed';
if &j eq 42 then Subpopulation='HCR, after social transfers: Main activity status: Unemployed';
if &j eq 43 then Subpopulation='HCR, after social transfers: Main activity status: Retired';
if &j eq 44 then Subpopulation='HCR, after social transfers: Main activity status: Other inactive';
if &j eq 45 then Subpopulation='HCR, after social transfers: Main activity status: Employed, Male';
if &j eq 46 then Subpopulation='HCR, after social transfers: Main activity status: Unemployed, Male';
if &j eq 47 then Subpopulation='HCR, after social transfers: Main activity status: Retired, Male';
if &j eq 48 then Subpopulation='HCR, after social transfers: Main activity status: Other inactive, Male';
if &j eq 49 then Subpopulation='HCR, after social transfers: Main activity status: Employed, Female';
if &j eq 50 then Subpopulation='HCR, after social transfers: Main activity status: Unemployed, Female';
if &j eq 51 then Subpopulation='HCR, after social transfers: Main activity status: Retired, Female';
if &j eq 52 then Subpopulation='HCR, after social transfers: Main activity status: Other inactive, Female';
if &j eq 53 then Subpopulation='HCR, after social transfers: Work intensity: hh without dependent children, w=0';
if &j eq 54 then Subpopulation='HCR, after social transfers: Work intensity: hh without dependent children, 0<w<1';
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if &j eq 57 then Subpopulation='HCR, after social transfers: Work intensity: hh with dependent children, 0<w<0.5';
if &j eq 58 then Subpopulation='HCR, after social transfers: Work intensity: hh with dependent children, 0.5<=w<1';
if &j eq 59 then Subpopulation='HCR, after social transfers: Work intensity: hh with dependent children, w=1';
if &j eq 60 then Subpopulation='HCR, before social transfers including pensions: Male Age 0-15';
if &j eq 61 then Subpopulation='HCR, before social transfers including pensions: Male Age 16-24';
if &j eq 62 then Subpopulation='HCR, before social transfers including pensions: Male Age 25-49';
if &j eq 63 then Subpopulation='HCR, before social transfers including pensions: Male Age 50-64';
if &j eq 64 then Subpopulation='HCR, before social transfers including pensions: Male Age more then 64';
if &j eq 65 then Subpopulation='HCR, before social transfers including pensions: Female Age 0-15';
if &j eq 66 then Subpopulation='HCR, before social transfers including pensions: Female Age 16-24';
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if &j eq 78 then Subpopulation='HCR, before social transfers excluding pensions: Female Age 50-64';
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if &j eq 80 then Subpopulation='Median equivalised disposable income';
if &j eq 81 then Subpopulation='At-risk-of-poverty threshold, one person hh';
if &j eq 82 then Subpopulation='At-risk-of-poverty threshold, hh 2 adults 2 dependent children';
if &j eq 83 then Subpopulation='S80/S20';
if &j eq 84 then Subpopulation='Relative median at-risk-of-poverty gap: Male Age 0-15';
if &j eq 85 then Subpopulation='Relative median at-risk-of-poverty gap: Male Age 16-24';
if &j eq 86 then Subpopulation='Relative median at-risk-of-poverty gap: Male Age 25-49';
if &j eq 87 then Subpopulation='Relative median at-risk-of-poverty gap: Male Age 50-64';
if &j eq 88 then Subpopulation='Relative median at-risk-of-poverty gap: Male Age more then 64';
if &j eq 89 then Subpopulation='Relative median at-risk-of-poverty gap: Female Age 0-15';
if &j eq 90 then Subpopulation='Relative median at-risk-of-poverty gap: Female Age 16-24';
if &j eq 91 then Subpopulation='Relative median at-risk-of-poverty gap: Female Age 25-49';
if &j eq 92 then Subpopulation='Relative median at-risk-of-poverty gap: Female Age 50-64';
if &j eq 93 then Subpopulation='Relative median at-risk-of-poverty gap: Female Age more then 64';
if &j eq 94 then Subpopulation='Median income below the at-risk-of-poverty threshold';
if &j eq 95 then Subpopulation='HCR P.L.as 50% median';
if &j eq 96 then Subpopulation='HCR P.L.as 70% median';
if &j eq 97 then Subpopulation='HCR P.L.as 40% median';
if &j eq 98 then Subpopulation='Gini coefficient';
if &j eq 99 then Subpopulation='Mean equivalised disposable income';run;

%end;
%end;

data final_output; set final_output stat_sub&j; run;

data final_output; set final_output0; run;
%sub_ciclo(1,99,100); ***********choose appropriate numbers here;

data silc07.results_IQR; set final_output; run;
## ANNEX II: Illustrative output

<table>
<thead>
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<th>est</th>
<th>stat_se</th>
<th>kish</th>
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<tbody>
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<td>HCR, after social transfers: Age 0-15</td>
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<td>HCR, after social transfers: One person hh 65 years and over</td>
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<td>HCR, after social transfers: One person hh total</td>
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<td>HCR, after social transfers: Single parent hh, one or more dependant children</td>
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<td>HCR, after social transfers: Other hh with dependant children</td>
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<td>HCR, after social transfers: Main activity status: Other inactive</td>
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<td>HCR, before social transfers including pensions: Female Age 16-24</td>
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ANNEX III:
Technical note on JRR procedure for estimating variance and design effect

Jackknife Repeated Replication (JRR) for variance estimation

The Jackknife Repeated Replication (JRR) is one of a class of methods for estimating sampling errors from comparisons among sample replications which are generated through repeated sampling of the same parent sample. Each replication needs to be a representative sample in itself and to reflect the full complexity of the parent sample.

The basic model of the JRR may be summarised as follows. Consider a design in which two or more primary units have been selected independently from each stratum in the population. Within each primary sampling unit (PSU), sub-sampling of any complexity may be involved, including weighting of the ultimate units. In the standard version, each JRR replication can be formed by eliminating one sample PSU from a particular stratum at a time, and increasing the weights of the remaining sample PSUs in that stratum appropriately so as to obtain an alternative but equally valid estimate to that obtained from the full sample.

Briefly, the standard JRR involves the following.

Let \( y \) be a full-sample estimate of any complexity, and \( y_{(h)} \) be the estimate produced using the same procedure after eliminating primary unit \( i \) in the stratum \( h \) and increasing the weight of the remaining \( (a_h - 1) \) units in the stratum by an appropriate factor \( g_h \). Let \( y_{(h)} \) be the simple average of the \( y_{(hi)} \) over \( a_h \) values of \( i \) in \( h \). The variance of \( y \) is then estimated as:

\[
\text{var}(y) = \sum_h \left(1 - f_h\right) \cdot \frac{a_h - 1}{a_h} \sum_i \left(y_{(hi)} - y_{(h)}\right)^2. \tag{1}
\]

A possible variation may be replacing \( y_{(h)} \), the simple average of the \( y_{(hi)} \) over the \( a_h \) replication created from \( h \), by the full-sample estimate of \( y \).

\[
\text{var}(y) = \sum_h \left(1 - f_h\right) \cdot \frac{a_h - 1}{a_h} \sum_i \left(y_{(hi)} - y\right)^2. \tag{2}
\]

Concerning the re-weighting the of units in a stratum after dropping one unit, normally the factor \( g_h \) is taken as:

\[
g_h = \frac{a_h}{a_h - 1}. \tag{3}
\]

However, a different form of \( g_h \) can be used for practical reasons:

\[
g_h = \frac{w_h}{w_h - w_{hi}}. \tag{4}
\]

where \( w_h = \sum_i w_{hi} \), \( w_{hi} = \sum_j w_{hij} \), the sum of sample weights of ultimate units \( j \) in the primary selection \( i \). This form retains the total weight of the included sample cases unchanged across the replications created – the same total as that for the full-sample. With sample weights scaled such that their sum is equal (or proportional) to some external more reliable population total, population aggregates from the sample can be estimated more effectively, often with the same precision as proportions or means.
Design effect

Design effect (deft) is estimated by the ratio of actual standard error (se) of a statistic under the given sample design, to standard error (se_srs) under a simple random sample of same size. The aims of this section is to outline the procedure for estimating design effect, under the JRR approach.

The approach involves decomposition of the design effect into components each of which can be separately estimated. The required components are

1. the effect of sample weights on variance, and
2. the effect of clustering stratification and other aspects of the design.

In fact, the identification of the effect of weighting is in itself of substantive interest apart from its usefulness for the above purpose.

A question of great practical interest is the following. How does the weighting affect variances?

There are effects in both directions:

(i) Calibration weights and other weighting correlated with the survey variables can reduce, not only bias, but also variances. (Optimal allocation in stratified samples and the corresponding weighting involved is an obvious example.)

(ii) On the other hand, very often weighting is determined on the basis of ‘external’ factors (e.g., need to over-sample small regions; compensation for high non-response in certain areas due to the performance of particular interviewers, etc.). Such weighting, essentially uncorrelated with survey variables, results in increased variance.

Generally, the second of the above effects is found to predominate in practice. That is, usually the net effect of weighing is to inflate variances\(^1\).

Effect of clustering, stratification and aspects other than sample weighting

Effect of clustering and stratification on variance can be obtained by “randomising” the sample and applying the ordinary stratified multistage variance estimation formula to it.

A randomised sample is created from the actual sample by completely randomising the position of individual elements (households, persons) within the sample structure. In principle, this creates a random element sample, which is not subject to clustering or stratification effects, and differs from a true simple random sample simply because of the presence of unequal weights. Random grouping of the elements can be formed to serve as clusters and strata in the variance estimation with affecting the expected results.

The standard error estimated from such a randomised sample using JRR is termed (se_rnd). On this basis, the effect clustering, stratification and any factors other than weighting can be estimated as:

\[
\text{Effect of clustering and stratification} = \left( \frac{se}{se_{\text{rnd}}} \right)
\]

The full design effect is obtained by multiplying the above ratio by an estimate of the effect of weighting on the standard error.

Effect of sample weights

The effect of weighting can be estimated as follows under the JRR approach.

For a ratio \(r=(y/x)\), with

---

\(^1\) Proper weighting should of course reduce mean squared error, by controlling bias even if there is some increase in variance.
\[ y = \sum w_i y_i, \quad x = \sum w_i x_i, \quad \text{and} \quad z_i = y_i - r_i x_i \]

the effect of weighting is given by

\[
(Kish\_Jrr)^2 = \left[ \frac{n}{\sum w_i} \right] \frac{\sum w_i^2 \cdot z_i^2}{\sum w_i \cdot z_i^2}
\]

The above has been named “Kish\_Jrr” as it is based on the original formulation proposed by Kish (Survey Sampling, 1965) an approximate estimate of the effect of essentially “random” weights on variance:

\[
(Kish\_Factor)^2 = D_w^2 = n \cdot \left( \frac{\sum w_j^2}{\sum w_j} \right)^2 = \left( \frac{n}{\sum w_j} \right) \cdot \frac{\sum w_j^2}{\sum w_j} = 1 + cv^2(w_j).
\]

In previous research it has been empirically demonstrated, at least for a wide variety of measures, the expression “Kish\_Jrr” is also valid for more statistics more complex than simple ratios, such as various measures of poverty and income inequality. ²

**Design effect**

Finally, the design effect is estimated as the product of the components defined above:

\[
deft = \left( \frac{se}{se\_rnd} \right) \cdot (Kish\_Jrr)
\]

---

² Any complex statistic may be expressed as a ratio, but involving unknown parameters themselves subject to sampling variability. Application of the above equation amounts to ignoring the variability of the parameters involved.