Weighting in the ESS cumulative data set

HowTo

Final Version

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Purpose of the paper

This document describes how to combine estimators of multiple rounds and/or multiple countries in the cumulative ESS data set. It builds upon an earlier document on weighting European Social Survey data [2]. This document, in turn, gives a question-and-answer style overview of how design and population weights in the ESS have to be used in different situations. However, only single-round weighting is considered. The document at hand goes beyond and covers weighting issues in multi-round/multi-country situations.

1 Introduction

In some of the countries participating in the European Social Survey (ESS), respondents are sampled with unequal inclusion probabilities. In order to account for unequal inclusion probabilities in the analysis, weights have to be taken into account. However, there are some situations where it is not easy to decide which weight(s) to consider. This short HowTo firstly summarizes how ESS design and population weights are to be and, secondly, how they can be combined and used in multi-round analyses.

2 Single-round use of weights

Whether and which weights are to be used when analyzing means, proportions, and cross-tabulations of a single round is discussed in [2]. Table 1 summarizes the main recommendations given therein.

Table 1: Examples of different types of analyses; in: [2]

		Weights to be used	
	Example: voter turnout (% of respondents voting in the last election)	Design weight	Population weight
a) To examine data from a single country – whether a single variable or a cross-tabulation	Voter turnout in Germany	**X**	
	Voter turnout in Germany by age and gender	**X**	
b) To compare results for two or more countries separately – without using totals or averages	Compare voter turnout in France, Germany and the UK.	**X**	
c) To combine countries – whether on a single variable or via a cross-tabulation	i) Voter turnout in Scandinavia.	**X**	**X**
	ii) Voter turnout in the EU.	**X**	**X**
	iii) Voter turnout across all countries participating in the ESS.	**X**	**X**
	iv) Compare voter turnout between EU member states and accession countries.	**X**	**X**
	v) Voter turnout by age group across all ESS participating countries.	**X**	**X**

Population weights can be viewed as stratification weights, taking countries as strata. Formal definitions of these weights and their distribution in round II are given in [1].

3 Weights for multi-round analyses

When data from multiple rounds (and multiple countries) are combined in an analysis, varying design and population weights have to be accounted for. Overall design and maybe also population weights have to be calculated to allow for valid inference from the combined samples to the population.

The structure of the ESS cumulative data set is illustrated in table 2.

Table 2: ESS cumulative data set structure

Round I	C1	DW 1
		DW 2
		DW 3
	C2	DW 1
		DW 2
		DW 3
	C3	DW 1
		DW 2
		DW 3
	C4	DW 1
		DW 2
		DW 3
Round II	C1	DW 1
		DW 2
		DW 3
	C2	DW 1
		DW 2
		DW 3
	C3	DW 1
		DW 2
		DW 3
	C4	DW 1
		DW 2
		DW 3

In line with the above example, in the ESS cumulative data set there are nested multiple respondents (not shown) within multiple weighting classes[1] (DW 1 to DW 3) within countries (C1 to C4) within ESS rounds (Round I and II). For simplicity of presentation the number of weighting classes is assumed not to vary between countries and rounds. This is, however, not the case in reality.

The problem, then, is how to combine estimators from different rounds and maybe also different countries. In the following paragraphs these two cases will be discussed, namely combining estimators from a) different rounds and the same country, b) from different countries and different rounds.

First of all, some definitions seem useful. Let the design weight of the wth weighting class in the cth country in round r be denoted by d_{wcr} and let the

[1] Most commonly, but not always, the weighting classes correspond to the household size classes.

population weight be referred to as p_{rc}.

Let a be the vector of length z with elements r. Of course, $a \subset l$, which is the vector of length m with elements $i = \{1, \ldots, m\}$ indicating ESS rounds where data is available. If we consider rounds one and two, a would simply be $(1, 2)$, which is, as is easily seen, of length $z = 2$. Since, up to the current date, no more than the first two rounds, that were chosen, are available, $l = a$.

Similarly, let s be the number of countries a combined estimator is to be calculated for. The vector k_r of length q_r with elements $j = \{1, \ldots, q_r\}$ indicates the participating countries in the rth round[2]. The vector k of length s then contains the countries under consideration. For simplification of later illustration, let us assume that every element (country) of k must be an element of ever k_r, namely, all countries, c, under consideration must have participated in all rounds under consideration. For illustration, consider the countries under consideration to be Germany (DE), the United Kingdom (GB), and Portugal (PT). Then $k = (\mathrm{DE}, \mathrm{GB}, \mathrm{PT})$.

Let an unbiased estimator, θ, that takes into account either population weights, design weights or both be denoted by $\theta(p)$, $\theta(d)$, and $\theta(p, d)$ respectively. Furthermore, let their unbiased combined equivalents be denoted by $\hat{\theta}(p)$, $\hat{\theta}(d)$, and $\hat{\theta}(p, d)$[3].

3.1 Combining estimators of multiple rounds and the same country

It is often of interest to combine data of two ESS waves conducted in the same country in order to estimate a mean or proportion in that country. This may be the case when, for example, lots of respondents refused to answer a certain item. Combining two or more waves can thus help to increase the sample size. The implicit assumption, however, is that the samples are taken from the same population. This should always be kept in mind.

Our combined multi-round single-country estimator is a weighted average of combinations of the respective single-round unbiased estimators. Weights are chosen to be the effective sample sizes, namely

$$w_{rc} = \frac{n_{rc}}{\mathit{deff}_{rc}},$$

where n_{rc} is the net sample size and deff_{rc} the design effect of the variable under study[4] in round r and country c, respectively.

The combined multi-round single-country estimator, then, is given by

$$\hat{\theta}_c(d) = \frac{1}{\sum_{r \in a} w_{rc}} \sum_{r \in a} w_{rc} \times \theta_r(d).$$

[2] Note that instead of numbers, labels that correspond to international abbreviations are used to identify countries.

[3] Note that *combined* is irrespective of the kind of combination. Either one of the combinations multi-round single-country, single-round multi-country or multi-round multi-country is possible.

[4] Where design effects are not available for a certain study variable, an overall design effect may serve the purpose as well.

The construction of the combined estimator as a weighted average of the single-round estimators takes into account two basic principles: firstly, an estimator from a wave with lots of respondents is trusted more than one from a wave with less respondents. Second, at a given sample size, more trust is put into the estimator that has a lower design effect.

In the following example, the combined estimator of the STFLIFE variable is constructed for Germany, the United Kingdom, and Portugal, respectively. For this, the estimators of the first and second round of ESS are considered.

Example:
Consider the case of combining the estimators of the variable satisfaction with life (STFLIFE) of the first and second round of the ESS in Germany, the United Kingdom, and Portugal.
First of all, the weighted estimators have to be calculated. These are given in the following table.

	Weighted Mean	
Country	Round I	Round II
DE	6.96	7.17
GB	7.07	7.40
PT	5.91	6.15

When combining the estimators of Germany, the weighted average of the round I and round II estimators has to be calculated. Thus, we need the design effect and the net sample size for the STFLIFE variable in Germany in both rounds. These are, together with those of the United Kingdom and Portugal, given in the following table:

	Design Effect		Net sample size	
Country	Round I	Round II	Round I	Round II
DE	6.10	4.95	2916	2870
GB	2.32	2.37	2045	1897
PT	3.72	3.39	1498	2052

The combined estimator for overall satisfaction of life in Germany is then given by

$$\hat{\hat{y}}_{1,2;\mathrm{DE}} = \frac{1}{\frac{2916}{6.10} + \frac{2870}{4.95}} \left[\left(6.96 * \frac{2916}{6.10} \right) + \left(7.17 * \frac{2870}{4.95} \right) \right] = 7.08.$$

The combined estimators for rounds one and two in the United Kingdom and Portugal, calculated accordingly, are 7.22 and 6.06 respectively.
We can easily see that in Germany, slightly more weight is given to the estimator of the second round – mainly due to the smaller design effect. In the UK, on the other hand, it is the estimator of the first wave that is trusted slightly more, which is mainly attributed to the larger sample size (design effects of both waves are almost equal). In Portugal, however, a lot more weight is given to the estimator of the second round, as indicated by both, the net sample size and the design effect.

3.2 Combining estimators of multiple rounds and the multiple countries

As a rule, when combining estimators of multiple countries – in the single-round as well as in the multi-round case – population weights have to be used (see table 1). Combining, however, estimators of multiple rounds and multiple countries poses the question how to account for possibly varying population weights[5]. Assuming, again, a constant population from which the samples in various rounds are taken, a combined population weight is simply the average of the single-round weights. This can be formalized in the following way. The multi-round population weight of a specific country is defined as

$$p_{ac} = \frac{1}{z} \sum_{r \in a} p_{rc}.$$

It is, however, convenient to rescale the single-round population weights to the sum of the weights. The rescaled population weight for country c in round r is thus given by

$$\tilde{p}_{rc} = \frac{p_{rc}}{\sum_{c \in k} p_{rc}},$$

and the corresponding average population weight of rounds a in country c is thus defined as

$$\tilde{p}_{ac} = \frac{1}{z} \sum_{r \in a} \tilde{p}_{rc}.$$

To further combine multi-round estimators for multiple countries, average population weights have to be calculated for all countries under consideration. These, then, have to be used as explained in [2].

The combined multi-round multi-country estimator, then is given by

$$\hat{\theta}_{ak}(d, \tilde{p}) = \sum_{c \in k} \hat{\theta}_c(d) \times \tilde{p}_{ac}.$$

[5] Population weights may vary between rounds because of a drop out of countries or the addition of another one

Example:
Now assume we were interested in the question how satisfied people are on average, who live in countries with a rather left-wing government. To answer this question, we combine the overall satisfaction scores (STFLIFE) of Germany, the United Kingdom, and Portugal which can be seen as rather typical cases of European left-wing governments. Such a grouping of countries, however, requires us to take into account design as well as population weights.
We already have calculated the single-country multi-round estimates in the previous section. What is needed for the construction of the combined estimator are the single-country multi-round population weights of the three countries.
First of all, the population weights of each country in each round have to be rescaled. The original and the rescaled weights are given in the following table.

	Population Weight			
	Original		Rescaled	
Country	Round I	Round II	Round I	Round II
DE	2.39	2.45	0.4540	0.4498
GB	2.33	2.57	0.4416	0.4713
PT	0.55	0.43	0.1044	0.0789

The average of the rescaled population weights for Germany, the United Kingdom, and Portugal of rounds one an two are then 0.4519, 0.4564, and 0.0917 respectively.
The weighted sum of the multi-round single-country overall satisfaction score (STFLIFE) is then

$$\hat{\bar{y}}_{1,2;\mathrm{DE,GB,PT}} = (7.08 \times 0.4519)+(7.22 \times 0.4564)+(6.06 \times 0.0917) = 7.05$$

References

[1] European Social Survey. *Design weights*, 2.0 edition, 2006. `http://ess.nsd.uib.no/index.jsp?module=documentation\&year=2005\&country=\&download=%5CSurvey+documentation%5C2005%5C07%23ESS2+-+Design+weights%2C+ed.+2.0%5CLanguages%5CEnglish%5CESS2Design_Weights_2.pdf`.

[2] European Social Survey. *Weighting European Social Survey Data*, 2006. `http://ess.nsd.uib.no/index.jsp?module=documentation\&year=2005\&country=\&download=%5CSurvey+documentation%5C2005%5C06%23ESS2+-+Weighting+ESS+Data%5CLanguages%5CEnglish%5CWeightingESS.pdf`.

APPENDIX

Net sample size (n), population weight (pweight) and design effect (deff) by country and ESS round.

	ESS1 - 2002			ESS2 - 2004			ESS3 - 2006			ESS4 - 2008		
Country	n	pweight	deff*	n	pweight	deff*	n	pweight	deff**	n	pweight	deff**
Austria	2257	0,27148751	2,01	2256	0,30200638	1,84	2405	0,28911609	1,59			
Belgium	1899	0,44783992	1,22	1778	0,48356710	1,19	1798	0,48472080	1,30	1760	0,50377335	1,13942600
Bulgaria							1400	0,47676421	2,15	2230	0,29671879	1,79957600
Cyprus							995	0,06283578	1,21	1215	0,05362626	1,19578600
Czech Republic	1360	0,63514375	1,61	3026	0,28616497	3,91				2018	0,44123920	2,23533700
Denmark	1506	0,28988041	1,00	1487	0,29438157	1,00	1505	0,29312824	1,00	1610	0,27738348	1,00000000
Estonia				1989	0,05664827	1,06	1517	0,07529697	1,00	1661	0,06876773	1,00000000
Finland	2000	0,21020015	1,00	2022	0,21271182	1,00	1896	0,22936055	1,00	2195	0,20072410	1,00000000
France	1503	3,20902615	1,65	1806	2,69984330	1,62	1986	2,50842790	1,45	2073	2,43780270	1,42945300
Germany	2919	2,39215485	2,26	2870	2,45294568	2,23	2916	2,42757623	2,43	2751	2,57855838	1,49333700
Greece	2566	0,33778585	2,00	2406	0,39189938	1,64				2072	0,46394715	1,50120000
Hungary	1685	0,47956291	1,36	1498	0,56796696	5,21	1518	0,56147154	1,77	1544	0,55288854	1,50211300
Ireland	2046	0,15027581	2,01	2286	0,13936619	2,44	1800	0,18595767	1,67	1764	0,19819915	1,28600000
Israel	2499	0,18430172	2,39							2490	0,20652209	3,03510600
Italy [a]	1207	4,06788600		1529	3,24840262							
Luxembourg	1552	0,02296018	1,26	1635	0,02242807	1,15						
Netherlands	2364	0,55444319	1,19	1881	0,70442690	1,20	1889	0,70670334	1,21	1778	0,75757452	1,22291400
Norway	2036	0,17079288	1,61	1760	0,20832824	1,00	1750	0,21333760	1,00	1549	0,24724300	1,00000000
Poland	2110	1,49825180	1,87	1716	1,84276323	1,59	1721	1,85751772	1,17	1619	1,98979389	1,10574600
Portugal	1511	0,55006016	2,88	2052	0,43032027	2,61	2222	0,40168141	2,23	2367	0,37975171	1,84914900
Russian Federation							2437	4,97744091	2,42	2512	4,82422838	3,22361500
Slovakia				1512	0,29320119	1,00	1766	0,25452276	1,00	1810	0,25137867	3,01138000
Slovenia	1519	0,10953713	1,33	1442	0,11823343	1,39	1476	0,11654045	1,38	1286	0,13599260	1,28273300
Spain	1729	2,02007964	1,95	1663	2,17710349	1,41	1876	1,99449062	1,18	2576	1,50092092	1,50187500
Sweden	1999	0,36278109	1,00	1948	0,37874872	1,00	1927	0,38853015	1,00	1830	0,41755158	1,00000000
Switzerland	2040	0,29629755	1,54	2141	0,30200638	1,53	1804	0,34731752	1,21	1819	0,35276130	1,24029000
Turkey				1856	2,75482435	2,35				2416	2,14999441	7,99291800
Ukraine				2031	1,99191753	3,38	2002	2,02077148	3,08	1845	2,15128553	3,24920000
United Kingdom	2052	2,32684152	1,69	1897	2,57000121	1,69	2394	2,07296157	1,73	2352	2,14443414	1,51478500

* Overall median design effect by country and ESS round are retreived from Ganninger, M.: 2006, *Estimation of Design Effects for ESS Round* ,Paper for the 8th ESS National Coordinators meeting, Mannheim, 8th and 9th of May.

** Overall mesian design effect by country and ESS round are produced by Ganninger, Gesis ZUMA, Cologne.

[a] Design effects for Italy are not available