

Starting Cohort 6: Adults (SC6)
SUF-Version 1.0.0
Data Manual [Supplement C]
Weighting
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Weighting in the Starting Cohort 6 of the National Educational Panel Study

Data Release SC6 1.x.x

Technical Report

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1 Structure of sample

The reported weights are provided to account for the sampling design and systematic nonresponse in the sample of Starting Cohort 6 (Adult Education and Lifelong Learning) of the National Educational Panel Study (NEPS), NEPS main study in 2009/2010 which is released as a scientific use file in version SC6 1.x.x. This sample is established to cover people living in private households in Germany and belonging to the birth cohorts of the years 1944 to 1986. Access to this population is gained via three subsamples. The first subsample *I* consists of the already existing sample of the survey “Arbeiten und Lernen im Wandel (ALWA)” conducted in 2009 by the Institute for Employment Research (IAB), a NEPS consortial partner, see Antoni et al.(2010). This subsample covers birth cohorts ranging from 1956 to 1986. All survey participants showing panel willingness serve as a subsample for the first NEPS survey wave in 2010. Two additional samples are established: a refreshment sample (subsample *II*) covering also the birth cohorts from 1955 to 1986 has been drawn from the same target population as the IAB-ALWA panel data in order to increase the available sample size. In addition, a sample (subsample *III*) covering the birth cohorts ranging from 1944 to 1954 is established, extending the coverage of the sample towards elder birth cohorts. For these three subsamples, the gross and net sample size are as follows:

Subsample *I*: all survey participants showing panel willingness of the IAB-ALWA-study covering birth cohorts from 1956 to 1986, gross sample size 8997, net sample size 6572,

Subsample *II*: refreshment sample covering birth cohorts from 1956 to 1986, gross sample size 6547, net sample size 1971,

Subsample *III*: additional sample covering individuals born between 1944 and 1955, gross sample size 11465, net sample size 3106.

In the following we describe the methods used to calculate the weights resulting from the disproportional stratified sampling approach, see also Aust et al. (2011) and Aßmann et al. (2011). Here we also account for potential systematic non-response. In a next step, details on the applied calibration procedures matching sample characteristics to external population totals taken from the Mikrozensus 2008 and 2009 are provided. More details are provided by Aust et al. (2011).

2 Design weights

For all considered subsamples, design weights are calculated as inverse sampling probabilities allowing to adjust the sampling design for disproportional stratification. That is, assuming for an individual an inclusion probability π , its corresponding design weight is $1/\pi$. For all three subsamples a stratified two stage sampling approach has been adopted. Stratification according to federal states and a classification of urbanization (BIK scale) is incorporated, yielding a total of L strata. As for administrative reasons per municipality only multiples of a fixed quantum, say $\bar{c}$, can be sampled, the overall goal to sample

addresses of persons is achieved via sampling artificial units called sample points. Accordingly, first stage sampling is performed based on an allocation of a fixed number of sample points, say s_l , to each stratum l comprising m_l municipalities with $\sum_{l=1}^L m_l = 12429$ in total. The allocation of sample points per stratum l aims at an accurate approximation of the distribution of the underlying population across the different strata. Since each sampling point corresponds to a fixed quantum of addresses, $s_l \bar{c}$ gives the number of addresses from which to sample within stratum l . Again for administrative reasons, the sampling is conducted using a two stage approach. At the first stage a total of s_l municipalities is sampled from each stratum l with replacement, where each municipality is sampled proportional to size (pps), where the measure of size (MOS) is given as N_{ml}/N_l , $m = 1, \dots, m_l$, with N_{ml} denoting the number of available addresses within municipality m within stratum l and N_l denotes the total number of addresses available in stratum l . Note that this approach allows for a repeated sampling of single municipalities. This is interpreted as assigning to a municipality m multiple sampling points, say s_{ml} . Then a total of $\bar{c}s_{ml}$ addresses are sampled from the available N_{ml} . Thus, the sampling probability of an individual address i in stratum l in municipality m is given as

$$\pi_{ilm} = \frac{\bar{c}s_{ml}}{N_{ml}} \frac{s_l N_{ml}}{N_l} = \frac{\bar{c}s_{ml}s_l}{N_l} \approx \frac{\bar{c}s_l}{N_l},$$

since s_{ml} is in general equal to one. Furthermore, since s_l is chosen as approximately $s_l \propto N_l/N$, the sampling procedure resembles a simple random sampling setting, with sampling probabilities given as $\sum_{l=1}^L s_l \bar{c}/N$. For the NEPS adult sample a total of $\sum_{l=1}^L s_l = 281$ sample points corresponding to 250 municipalities out of 12429 municipalities in Germany have been allocated. The total population consisting of people born between 1944 and 1986 who are living at survey start in Germany is $N = 39,235,797$.

Given the design weights for three subsamples, trimming and calibration procedures are applied. The potential overlap between subsample I and subsample II is incorporated into the calibration procedure applying calibration and trimming on a convex combination of both design weights. Here trimming, calibration and the defined combination of weights aim at a reduction of weight variance, increasing the statistical efficiency of weighted analysis.

3 Weight adjustment for panel participation and non response

Given the sampling probabilities and corresponding design weights, we regard the willingness to participate and respond to the survey questions, i.e. we account for the response and non-response rate of selected individuals. For subsample I the participation and response probability is calculated as the probability of panel willingness $\pi_{I,PW}$ and the probability of participation $\pi_{I,P}$, i.e. survey participants of the already established ALWA survey are willing to participate in the further NEPS survey and they participate actually. The adjusted weight aw_I for subsample I is hence given as

$$aw_I = \frac{1}{\pi_I \cdot \pi_{I,PW} \cdot \pi_{I,P}},$$

where π_I denotes the original design weight of a sample unit of subsample I . For subsamples II and III , as no past survey waves have to be considered, only the participation probability $\pi_{II/III,P}$ has to be incorporated, resulting in the adjusted weights

$$aw_{II/III} = \frac{1}{\pi_{II/III} \cdot \pi_{II/III,P}}.$$

Here $\pi_{II/III}$ is the original design weight of a sample unit of subsample II or subsample III . The following subsection will shortly review the estimation of probabilities for panel willingness and survey participation.

3.1 Subsample I

Logit regressions are used to estimate the probabilities $\pi_{I,PW}$ and $\pi_{I,P}$. The set of covariates incorporated within the regression and resulting odds ratios are given in Table 1 and Table 2.

Table 1: Results of the logit regression model measuring the panel willingness.

Value	Reference Category	Odds Ratio	P-Value
<i>Birth year</i>	1980 – 1986		
1956 – 1969		1.05	0.73
1970 – 1979		1.02	0.86
<i>Gender</i>	female		
male		0.99	0.93
<i>Country of birth</i>	born in Germany		
born abroad		0.72	0.06
<i>Mother tongue</i>	Non-German		
German		1.22	0.28
<i>Marital status</i>	unmarried		
married		1.03	0.84
separated		1.89	0.00
widowed		2.34	0.16
<i>Household size</i>	three and more persons		
one person		1.30	0.08
two persons		1.08	0.47
<i>Secondary school qualification</i>	lower secondary education ‘Realschule’		
lower secondary education ‘Hauptschule’		0.92	0.41
upper secondary education		1.03	0.75
other		0.61	0.01
<i>Secondary school qualification of parents</i>	lower secondary education ‘Realschule’		
lower secondary education ‘Hauptschule’		0.91	0.35
upper secondary education		1.23	0.09
other		0.51	0.00
<i>Income</i>	1,501 – 3,500 Euro		
up to 1,500 Euro		0.80	0.08
more than 3,500 Euro		1.88	0.00
<i>Federal state</i>	Nordrhein-Westfalen		
Schleswig-Holstein		1.14	0.61
Hamburg		0.99	0.99
Niedersachsen		0.96	0.76
Bremen		0.95	0.92
Hessen		1.04	0.79
Rheinland-Pfalz		1.21	0.35
Baden-Württemberg		1.02	0.86
Bayern		0.81	0.09
Saarland		0.90	0.75
Berlin		0.94	0.79
Brandenburg		1.32	0.30
Mecklenburg-Vorpommern		0.91	0.77
Sachsen		1.08	0.70
Sachsen-Anhalt		1.38	0.25
Thüringen		1.49	0.18
Pseudo R^2	0.03		
Number of cases	10,404		

Table 2: Results of logit regression model measuring the participation probability of ALWA sample.

Value	Reference Category	Odds Ratio	P-Value
<i>Birth year</i>	1980 – 1986		
1956 – 1969		1.38	0.00
1970 – 1979		1.34	0.00
<i>Gender</i>	female		
male		1.08	0.12
<i>Country of birth</i>	born in Germany		
born abroad		0.76	0.03
<i>Mother tongue</i>	Non-German		
German		1.46	0.01
<i>Marital status</i>	unmarried		
married		1.20	0.03
separated		1.09	0.42
widowed		1.09	0.77
<i>Household size</i>	three persons and more		
one person		0.87	0.11
two persons		0.89	0.07
<i>Secondary school qualification</i>	lower secondary education ‘Realschule’		
lower secondary education ‘Hauptschule’		0.87	0.06
upper secondary education		1.43	0.00
other		0.93	0.62
<i>Secondary school qualification of parents</i>	lower secondary education ‘Realschule’		
lower secondary education ‘Hauptschule’		1.12	0.09
upper secondary education		1.12	0.12
other		0.83	0.11
<i>Income</i>	1,501 – 3,500 Euro		
up to 1,500 Euro		0.82	0.03
more than 3,500 Euro		1.01	0.85
<i>Federal State</i>	Nordrhein-Westfalen		
Schleswig-Holstein		0.87	0.35
Hamburg		1.35	0.15
Niedersachsen		0.92	0.38
Bremen		0.85	0.60
Hessen		0.94	0.59
Rheinland-Pfalz		0.95	0.66
Baden-Württemberg		0.92	0.37
Bayern		1.02	0.78
Saarland		1.08	0.73
Berlin		0.96	0.80
Brandenburg		0.82	0.20
Mecklenburg-Vorpommern		1.16	0.52
Sachsen		0.97	0.79
Sachsen-Anhalt		0.75	0.06
Thüringen		1.26	0.17
<i>BIK categories</i>	500,000 and more inhab. (styp 1)		
less than 2,000 inhab.		1.24	0.28
2,000 – 5,000 inhab.		1.08	0.164
5,000 – 20,000 inhab.		1.02	0.88
20,000 – 50,000 inhab.		1.10	0.34
50,000 – 100,000 inhab. (styp 2/3/4)		1.24	0.06
50,000 – 100,000 inhab. (styp 1)		0.97	0.89
100,000 – 500,000 inhab. (styp 2/3/4)		0.97	0.76
100,000 – 500,000 inhab. (styp 1)		0.86	0.08
500,000 and more inhab. (styp 2/3/4)		0.97	0.77
<i>Attempts to contact target</i>	1 to 3 attempts		
4 to 6 attempts		1.04	0.63
7 to 10 attempts		0.97	0.69
more than 10 attempts		0.35	0.00
Pseudo R^2	0.074		
Number of cases	8,997		

Overall, the regressions only point to modest selectivity connected to education and income. Individuals with a high level of education show a slightly higher probability to attend in the survey than individuals with a low educational level. Likewise, individuals with a high income are more willing to attend in the survey than individuals with a low income.

3.2 Subsample *II* and *III*

The results of the logistic regression for the estimation of the participation probability $\pi_{II/III,P}$ are given in Table 3. Only modest selectivity can be observed related to *country of birth*. Furthermore, we detect a small age effect: people born in the years from 1944 to 1955 have a slightly lower probability to attend in the survey than people born later.

Table 3: Results of logit regression model measuring the participation probability of the refreshment sample and of the additional sample.

Value	Reference Category	Odds Ratio	P-Value
<i>Birth year</i>	1980 – 1988		
1944 – 1955		0.83	0.00
1956 – 1969		0.98	0.78
1970 – 1979		0.96	0.66
<i>Gender</i>	female		
male		0.95	0.15
<i>Country of birth</i>	born in Germany		
born abroad		0.52	0.00
<i>Federal state</i>	Nordrhein-Westfalen		
Schleswig-Holstein		0.88	0.24
Hamburg		0.95	0.67
Niedersachsen		1.04	0.58
Bremen		0.90	0.62
Hessen		1.02	0.77
Rheinland-Pfalz		0.89	0.19
Baden-Württemberg		0.93	0.24
Bayern		0.98	0.79
Saarland		1.11	0.48
Berlin		0.97	0.72
Brandenburg		0.93	0.47
Mecklenburg-Vorpommern		0.80	0.12
Sachsen		1.19	0.04
Sachsen-Anhalt		0.94	0.56
Thüringen		0.92	0.50
<i>BIK categories</i>	500,000 and more inhab. (styp 1)		
less than 2,000 inhab.		1.38	0.03
2,000 – 5,000 inhab.		0.81	0.08
5,000 – 20,000 inhab.		1.09	0.24
20,000 – 50,000 inhab.		1.13	0.05
50,000 – 100,000 inhab. (styp 2/3/4)		1.15	0.06
50,000 – 100,000 inhab. (styp 1)		1.10	0.44
100,000 – 500,000 inhab. (styp 2/3/4)		0.99	0.89
100,000 – 500,000 inhab. (styp 1)		0.91	0.13
500,000 and more inhab. (styp 2/3/4)		1.20	0.01
<i>Attempts to contact target</i>	1 to 3 attempts		
5 to 6 attempts		1.46	0.00
7 to 10 attempts		1.25	0.00
more than 10 attempts		0.72	0.00
Pseudo R^2	0.0198		
Number of cases	18,012		

In conclusion, the conducted logit regression analysis shows only modest selectivity effects in the net sample.

4 Calibration to external benchmark totals

Calibrating sample data means to adjust sampling weights by multipliers known as calibration factors that make the estimates agree with known totals. Adjusting data to external population totals reduces the bias in the sampled data, but at the same time it tends to increase the variance in the data (i.e. the sampling error). This trade-off has to be regarded in the calibration process. To avoid any substantial enhancement of the sampling error we adjust only few relevant marginal distributions of the NEPS adult sample. Calibration factors are determined using the so-called linear GREG estimation method, see Särda (2007). This method allows to specify adjusted design weights as products of design weights and calibration factors, i.e. for a sample unit i with adjusted weight aw_i and calibration factor g_i the calibrated weight is given as $cw_i = g_i aw_i$.

External population distributions to calibrate the NEPS adult sample have been taken either from the German census Mikrozensus 2008 or from the German census Mikrozensus 2009, cp. <http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Content/Statistiken/Mikrozensus/Aktuell.psml>. Accordingly, two different types of calibration factors have been computed. Calibration factors derived by means of the

Mikrozensus 2008 have been computed using marginal distributions for the following variable combinations:

- gender $\times$ educational attainment,
- birth year $\times$ educational attainment,
- place of living (federal state categories),
- BIK categories, and
- birth year $\times$ country of birth.

To adjust the educational attainment variable of the NEPS adult sample the Mikrozensus 2008 variable *school qualification combined with professional education* has been used. By means of the Mikrozensus 2009 calibration factors have been computed based on marginal distributions for the variable combinations

- sex $\times$ educational attainment and
- birth year $\times$ educational attainment.

Here the educational attainment variable of the NEPS adult sample has been adjusted based on the Mikrozensus 2009 variable *educational level according to ISCED97 categories*.

To assess the quality of the computed calibration factors, the following tables provide a comparison between sample distribution and reference distribution for the above mentioned benchmark variables.

Table 4: Sample and reference distributions according to gender and school qualification combined with professional education

Gender and education	actual distribution net sample				target distribution population (Mikrozensus 2008)	
	refreshment	additional sample	panel sample	total		
	%	%	%	%	%	N
male						
no school qualification	1.32	0.97	0.33	0.67	1.34	636,320
lower secondary education, no vocational education	3.70	3.03	1.42	2.23	4.71	2,234,501
upper secondary education, no vocational education	3.40	2.16	3.15	2.93	2.59	1,226,874
lower secondary education ('Hauptschule'), vocational education	7.56	13.55	6.63	8.64	12.62	5,983,011
lower secondary education ('Realschule'), vocational education	8.88	7.57	10.53	9.46	11.71	5,554,252
upper secondary education, vocational education	4.46	2.19	4.85	4.08	3.30	1,563,414
vocational academy	5.58	8.18	6.33	6.70	5.08	2,411,117
university of applied science, University	10.81	12.01	14.09	12.98	8.04	3,812,139
phd	1.07	1.16	1.57	1.37	0.80	377,642
female						
no school qualification	1.47	1.48	0.30	0.82	1.59	754,233
lower secondary education, no vocational education	7.56	9.05	2.51	5.11	6.90	3,273,805
upper secondary education, no vocational education	4.57	2.41	2.30	2.71	2.27	1,077,728
lower secondary education ('Hauptschule'), vocational education	6.14	12.49	4.88	7.13	9.68	4,589,386
lower secondary education ('Realschule'), vocational education	16.69	10.85	17.59	15.64	14.64	6,943,580
upper secondary education, vocational education	6.24	1.87	8.00	6.07	4.11	1,951,207
vocational academy	0.81	1.80	1.16	1.27	3.67	1,740,853
university of applied science, university	8.93	8.73	13.54	11.48	6.56	3,112,262
phd	0.81	0.52	0.81	0.73	0.38	181,676
Total	100.00	100.00	100.00	100.00	100.00	47,424,000

Table 5: Sample and reference distributions according to federal state and BIK category

Federal state	actual distribution net sample				target distribution population (Mikrozensus 2008)	
	refresh- ment	addi- tional sample	panel sample	total		
	%	%	%	%	%	N
Schleswig-Holstein	2.44	2.77	3.03	2.86	3.38	1,602,000
Hamburg	1.88	2.25	1.96	2.03	2.31	1,096,000
Niedersachsen	10.10	10.14	10.16	10.15	9.50	4,505,000
Bremen	0.71	0.61	0.61	0.63	0.81	386,000
Nordrhein-Westfalen	22.32	21.25	23.42	22.65	21.63	10,258,000
Hessen	8.78	7.31	7.99	7.94	7.42	3,518,000
Rheinland-Pfalz	4.87	4.60	5.14	4.95	4.80	2,278,000
Baden-Württemberg	11.47	12.94	12.52	12.46	12.97	6,151,000
Bayern	15.68	15.49	15.35	15.44	15.36	7,286,000
Saarland	1.22	1.74	1.42	1.47	1.24	590,000
Berlin	3.75	4.54	3.38	3.75	4.46	2,113,000
Brandenburg	3.45	3.44	2.97	3.18	3.19	1,514,000
Mecklenburg-Vorpommern	1.67	1.42	1.57	1.55	2.09	991,000
Sachsen	6.85	5.96	4.56	5.32	5.08	2,408,000
Sachsen-Anhalt	2.79	3.12	2.74	2.85	2.93	1,389,000
Thüringen	2.03	2.41	3.18	2.78	2.82	1,339,000
BIK categories (10 cat.)						
less than 2,000 inhab.	3.15	0.74	2.24	1.99	1.96	928,000
2,000 – 5,000 inhab.	2.08	2.19	2.94	2.59	2.86	1,358,000
5,000 – 20,000 inhab.	9.08	8.02	7.29	7.79	7.76	3,678,000
20,000 – 50,000 inhab.	11.92	12.62	12.08	12.20	11.35	5,384,000
50,000 – 100,000 inhab. (styp 2/3/4)	8.73	9.59	8.40	8.77	7.74	3,670,000
50,000 – 100,000 inhab. (styp 1)	2.18	2.29	1.75	1.97	2.26	1,073,000
100,000 – 500,000 inhab. (styp 2/3/4)	16.13	15.26	15.70	15.66	15.13	7,173,000
100,000 – 500,000 inhab. (styp 1)	14.81	14.71	16.52	15.75	16.54	7,842,000
500,000 and more inhab. (styp 2/3/4)	8.63	8.31	9.04	8.77	8.80	4,175,000
500,000 and more inhab. (styp 1)	23.29	26.27	24.04	24.51	25.61	12,143,000
Total	100.00	100.00	100.00	100.00	100.00	47,424,000

The observed differences can be gauged on the basis of an efficiency measure given as $E = \left((\sum_{i=1}^n g_i)^2 \right) / (n \sum_{i=1}^n g_i^2) \in (0, 1)$. With respect to the above mentioned reference distribution concerning *educational attainment*, efficiency is ranging from 58% to 60%.

5 Use of weights

Given the quite complex structure of the sample of the adult cohort, NEPS main study in 2009/2010, no final recommendation are at hand concerning the use of design and calibrated weights. In general, the use of design weights is recommended when analysis is concerned with sample data stemming from different strata – presumably the case in most analysis. Although, there are no general results available how the use of design or calibrated weights render any possible analysis (see Rohwer (2011) for a general discussion) the use of weights may possibly help to highlight important features of the analysis under consideration not at least serving as a robustness check for the performed analysis. Adjusted design weights provided are labeled as `weight_design`, whereas calibrated weights are labeled as `weight_mc08` and `weight_mc09`, when calibrated using the Mikrozensus 2008 and Mikrozensus 2009 respectively. Note that also standardized weights with mean one are provided, which are often used in statistical analysis. These are labeled as `weight_design_std`, `weight_mc08_std` and `weight_mc09_std`. The subsequent table summarizes all type of weights provided:

Type of weight	not standardized	standardized with mean one
adjusted design weight	<code>weight_design</code>	<code>weight_design_std</code>
calibrated weight (Mikrozensus 2008)	<code>weight_mc08</code>	<code>weight_mc08_std</code>
calibrated weight (Mikrozensus 2009)	<code>weight_mc09</code>	<code>weight_mc09_std</code>

The following syntax may be useful as a starting point when weights are incorporated into analysis using *Stata*:

* Put this before relevant command lines

```
svyset psu [pweight=weight_design_std], strata(stratum) singleunit(certainty)
```

* Commands

```
svy: command...
```

The `svyset` command is used to specify the sampling weights (via `pweight`), the stratification scheme (via `strata`), and the primary sampling units used in clustering (via `psu`). Variable `psu` is an indicator of the primary sampling units, `weight_design_std` contains the weights, and `stratum` represents an indicator for the stratification, which is constructed from BIK scale (10) and the indicator of federal states. All three variables are included in the *Methods* file of the data release. If you want to account for the survey design, following commands have to start with the prefix `svy:`. Please consult the data manual of Starting Cohort 6 (see Leopold, Raab & Skopek 2011) file for a more comprehensive example of how to use weights and how to account for sample stratification in *Stata*.

For further information on weighting please contact `methods.neps@uni-bamberg.de`

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