Representative Time Use Data and Calibration of the American Time Use Studies 1965-1999

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Yale Program on Non-market Accounts: A Project on Assessing Time Use Survey Datasets

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Abstract

Valid and reliable individual time use data in connection with an appriate set of socio-economic background variables are essential elements of an empirical foundation and evaluation of existing time use theories and for the search of new empirical-based hypotheses about individual behavior. Within the Yale project of Assessing American Heritage Time Use Studies (1965, 1975, 19895, 1992-94 and 1998/99), supported by the Glaser Foundation, and working with these time use studies, it is necessary to be sure about comparable representative data. As it will become evident, there is a serious bias in all of these files concerning demographic characteristics, characteristics which are important for substantive time use research analyses.

Our study and new calibration solution will circumvent these biases by delivering a comprehensive demographic adjustment for all incorporated U.S. time use surveys, which is theoretically funded (here by information theory and the minimum information loss principle with its ADJUST program package), is consistent by a simultaneous weighting including hierarchical data, considers substantial requirements for time use research analyses and is similar and thus comparable in the demographic adjustment characteristics for all U.S. time use files to support substantial analyses and allows to disentangle demographic vs. time use behavioral changes and developments.

JEL: J22, J29, J11, Z0

Keywords: *time use, calibration (adjustment re-weighting) of microdata, information theory, minimum information loss principle, American Heritage Time Use Studies, ADJUST program package*

Zusammenfassung

Valide und zuverlässige individulle Zeitverwendungsdaten zusammen mit geeigneten sozio-ökonomischen Hintergrundvariablen sind essentiell für eine empirische Fundierung und Evaluierung bestehender Zeitverwendungs-theorien and für die Suche nach neuen empirisch fundierten Hypothesen über individuelles Handeln. Innerhalb des Yale Projektes 'Assessing American Heritage Time Use Studies' (1965, 1975, 19895, 1992-94 and 1998/99), das von der Glaser Foundation unterstützt wird, und der Arbeit mit diesen Zeitbudgetdaten ist es notwendig, sich auf die Repräsentativität mit vergleichbarer demographischer Struktur verlassen zu können. Wie ersichtlich wird, gibt es deutliche Abweichungen bei der Repräsentativität demographiacher Charakteristika in allen US Zeitverwendungs-studien, und zwar hinsichtlich demographischer Charakteristika, die bedeutend für die inhaltliche Analyse der Zeitverwendung sind.

Unsere Studie und die neue Hochrechnungslösung überwindet diese Verzerrungen mit einer demographischen Hochrechnung, die vergleichbar für alle US Files ist, theoretisch fundiert ist (hier durch die Informationstheorie und dem Minimum Information Loss Prinzip mit dem ADJUST Programmpaket), konsistent durch eine simultane Gewichtung ist, die hierarchische Daten beinhaltet, substantielle Anforderungen der Zeitverwendungsforschung unterstützt und es erlaubt, demographische Veränderungen von Verhaltensänderungen zu trennen.

JEL: J22, J29, J11, Z0

Schlagworte: *Zeitverwendung, Hochrechung (Umgewichtung) von Mikrodaten, Informationstheorie, Minimum Information Loss Prinzip, American Heritage Time Use Studies, ADJUST Programmpaket*

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Executive Summary

Valid and reliable individual time use data, in connection with a proper set of socio-economicbackground variables, are essential elements for the empirical foundation and evaluation of existing theories, and the search for new empirical-based hypotheses about individual behavior in the household context. Several potentially useful time use heritage datasets have been identified for use in developing an historical series of non-market accounts. In order to evaluate the series of heritage U.S. time use surveys (1965, 1975, 1985, 1992-94, 1998-99), it is necessary to be certain about representativeness of the data.

As our analyses will show, the five U.S. heritage files - based on the given survey weights - are seriously biased according to important demographic totals which in addition are of strategic importance for substantial time use analyses. This study reports a solution that circumvents several shortcomings in delivering a comprehensive demographic adjustment to all incorporated U.S. heritage time use surveys. This adjustment is theoretically founded on information theory, consistent by a simultaneous weighting including hierarchical data like personal and family/household data, ensures desired positive weights, considers substantial requirements for time use research analyses, and is similar in the demographic adjustment characteristics for all heritage files thus facilitating substantial analyses and disentanglement of demographic vs. time use behavior changes and developments.

First part of this study – calibration for representative US time use heritage files

The first part of the study describes the calibration/adjustment procedure and its theoretical background, discusses and presents the demographic frame used for all five US heritage files, computes, delivers and describes five sets of new sample weights which guarantee the respective demographic totals.

Second part of this study – calibration io disentangle behavior from demographic changes

The second part provides four sets of alternative sample weights which allows to disentangle changes in time use behaviour from changes in the population structure. These alternative sample weights use the demographic totals from the oldest survey 1965 as the new demographic totals for the younger files within the new calibrations. We describe the population changes of the

actual survey compared to the 1965 population, compute , deliver and describe the new alternative weights for all remaining four time use surveys.

Our study has clearly shown that if using the Heritage US time use data with the given old calibration, the bias in the results of substantial analyses would be not negligible. This holds true in particular for characteristics with an obviously strong connection to individual time use behavior (like the respondent's age or the number of children); the results would be heavily under- or overrepresented respectively. In general, relying on uncalibrated data would inevitably lead to questionable conclusions.

With the available new five sets of consistent and similar structured weighting factors, it is possible, in particular, to follow up American time use behavior for about 40 years based on a reliable and valid demographic background delivering representative data for substantial time use analyses.

In addition, the re-calibrated younger US heritage files all with the 1965 population structure now are available for substantive analyses in disentangling demographic from time use behavioral changes.

Based on our calibration experience we recommend above all that

- For any new time use survey, the calibration procedure and the single substantial definitions of the adjustment characteristics with their totals have to be documented carefully.
- A new adjustment of a new ATUS file should be as close as possible to the used adjustment characteristics of the older ones to ensure a common demographic background with no biased results if using a different approach.
- Since the software Adjust can be operated easily on every desktop-computer, sensitivity analyses with different totals resulting in different weighting sets will help further to disentangle demographic effects from behavioural effects.

Without a proper calibration of the US heritage time use files, a necessary and important prerequisite for any further substantive analyses would be missing and substantive results not consider those weights would be seriously be misleading.

I INTRODUCTION

Valid and reliable individual time use data, in connection with a proper set of socio-economicbackground variables, are essential elements for the empirical foundation and evaluation of existing theories, and the search for new empirical-based hypotheses about individual behavior in the household context. Several potentially useful time use heritage datasets have been identified for use in developing an historical series of non-market accounts. In order to evaluate the series of heritage U.S. time use surveys (1965, 1975, 1985, 1992-94, 1998-99), it is necessary to be certain about representativeness of the data.

As our analyses will show, the five U.S. heritage files - based on the given survey weights - are seriously biased according to important demographic totals which in addition are of strategic importance for substantial time use analyses. This study reports a solution that circumvents several shortcomings in delivering a comprehensive demographic adjustment to all incorporated U.S. heritage time use surveys. This adjustment is theoretically founded on information theory, consistent by a simultaneous weighting including hierarchical data like personal and family/household data, ensures desired positive weights, considers substantial requirements for time use research analyses, and is similar in the demographic adjustment characteristics for all heritage files thus facilitating substantial analyses and disentanglement of demographic vs. time use behavior changes and developments.

First part of this study

The first part of the study describes the calibration/adjustment procedure and its theoretical background, discusses and presents the demographic frame used for all five US heritage files, computes, delivers and describes five sets of new sample weights which guarantee the respective demographic totals.

Re-weighting of the heritage time use data was necessary for several reasons. First, due to the lack of documentation, it was not possible to get sufficient information about the calibration according to the weighting procedure and the totals (margins) to be achieved. Therefore, a theoretically founded and transparent adjustment is needed.

Second, as far as we know, not all of the weightings of the different heritage files use an independent calibration for different weighting characteristics. Thus, a consistent adjustment (weighting, calibration), which simultaneously fulfills hierarchical information (e.g. Household and personal information), is not assured. It is necessary to remedy this.

Third, the demographic information used in the adjustments should consider substantial requirements of time use research analyses.

Fourth, a similar demographic adjustment scheme for all single heritage files was not available. Such a scheme is desirable for concentrating on substantial behavioral changes independently of further demographic developments.

To achieve representative results and to check whether five U.S. time use surveys (1965, 1975, 1985, 1992-94, 1998-99) fulfill the necessary requirements, we apply a consistent solution of the microdata adjustment (calibration) problem: a proper (re-)weighting of microdata to fit aggregate control data via the minimum information loss principle based on information theory using the Adjust software.

Second part of this study

The second part provides four sets of alternative sample weights which allows to disentangle changes in time use behaviour from changes in the population structure. These alternative sample weights use the demographic totals from the oldest survey 1965 as the new demographic totals for the younger files within the new calibrations. We describe the population changes of the actual survey compared to the 1965 population, compute , deliver and describe the new alternative weights for all remaining four time use surveys.

This paper is divided as follows: In the first part, after briefly describing the methodological background of our adjustment procedure based on the information theory, including a survey of used alternative calibration procedures (chapter 2), we discuss particularities of time use diary adjustments, and show a solution within the actual German Time Use Survey (chapter 3). In chapter 4, a calibration framework for time use analyses is chosen, sketching the microeconomic labour supply of women within the household context, household production/time allocation, multiple market and non-market analyses, as well as policy impacts of tax and transfer systems, and alternatives. Chapter 5 provides the results of the new weightings of the five heritage files from 1965, 1975, 1992-94, and 1998-99.

The second part of this study is about disentangling demographic changes from changes in time use behavior by re-calibrating the US heritage files 1975 – 1999 based on the demographic structure of 1965 (chapter 6).

Chapter 7 presents study conclusions and gives some recommendations.

II THE ADJUSTMENT/CALIBRATION OF MICRODATA – THEORY, METHODS AND ADJUST SOFTWARE

To adjust/calibrate microdata is to fit microdata to prescribed and known aggregate totals (with synonyms as control data, restrictions, margins, population totals). For each microunit of a (sample) microdata file, a suitable weight is searched so that the weighted sum of all microunit characteristics will achieve their externally given aggregates.

A microdata matrix S consists of microunits such as persons, families, households, or firms which are described by various characteristics. If, for example, these microunits are persons, they would be described by age, gender, employment, or other characteristics which correlate with the current topic under investigation.

The known population characteristics derived from, for example, a census, restrict the microdata to their desired total values. Aggregate statistics will deliver single restrictions, or a set of constraints, which could be given as a multidimensional cross tabulation. In general, the restrictions may be given by official aggregate statistics, by other samples, or by other models. Aggregate sample information, for example, may be given by a population census or a more frequent microcensus with demographic variables, labour force participation information, etc. In our application here, the American Current Population Survey (CPS) an ongoing monthly household survey to provide demographic and labor force information is delivering the totals to be achieved. Since the CPS is adjusted to the Census the calibration will fit the Census data.

The calibration of microdata is a common method in microsimulation models, where it is used not only to extrapolate a data set (static aging), but also for sensitivity analyses using alternative totals. Table 1 presents an overview of a selection of calibration procedures used in microsimulation models.

As Table 1 shows, there are different calibration procedures with different objective functions, such as the CALMAR approach used in the SAS framework. However, most of them are based on an arbitrarily chosen objective function (for example, a difference between given and new weights) to be minimized resulting in possible zero or negative weighting factors. Since non positive weights will further exclude microunits, only a procedure which provides positive weights, such as the approach used in this paper, is appropriate.

The adjustment problem

In general, the adjustment problem is to find an n-vector p of adjustment factors optimizing an objective function Z(p,q) - a function evaluating the distance between the new adjustment factors p to be computed and the available factors q- satisfying the m restrictions Sp=r:

(1) $Z(\mathbf{p},\mathbf{q}) = \min!$ s.t. $\mathbf{Sp} = \mathbf{r}$.

This adjustment problem is a simultaneous one where, for even a large number of characteristics (n), only a single weighting factor has to be computed for each microunit which after summing up, fulfils consistently all m hierarchical microdata totals (e.g. household, family and personal information) simultaneously.

The objective function minimizes the distance between new adjustment factors p and the given factors q in order to capture already available information and corrections due to non-response, sampling errors, etc. If such corrections are not given in advance (or as a simple microunit independent sampling ratio), q_j would be equal for each microunit j (j=1,...,n). In the case of demographic features in the sample information matrix S (and the restrictions), a single, absolute adjustment factor for a sample micro unit j represents p_j total population microunits.

Alternative adjustment procedures

There are various procedures and functional forms in quantitative economics where an objective function $Z(\mathbf{p},\mathbf{q})$ weight the distance of two (adjustment) factors. In general, procedures with quadratic (unweighted or weighted) and other objective functions (linear or nonlinear) are conceivable. Within the Microsimulation context and its static aging (re-weighting by more actual or future demographic structures) different calibration procedures are used (Table 1).

Table 1 Calibration procedures in different microsimulation models

Microsimulation model	Demogr. aging	Econ. aging	Alignment[1]	Objective function	Restriction	Numeric solution	New adjustment factors	Source
Transfer Income Model (TRIM)	x	x	-	$Z=(\mathbf{p}-\mathbf{q})'\mathbf{W}(\mathbf{p}-\mathbf{q})$ quadratic optimization	$\mathbf{S}_1\mathbf{p}=\mathbf{r}_1$ $\mathbf{S}_2\mathbf{p}=\mathbf{r}_2$	Gauss	$\mathbf{p}=\mathbf{W}^{-1}\mathbf{S}_1\lambda_1+\mathbf{W}^{-1}\mathbf{S}_1'\lambda_1+\mathbf{q}$	Webb and Chow 1978
Micro Analysis of Transfers to Households (MATH)	x	x	x	$Z=(\mathbf{p}-\mathbf{q})'\mathbf{W}(\mathbf{p}-\mathbf{q})$ quadratic optimization	$\mathbf{S}_1\mathbf{p}=\mathbf{r}_1$ $\mathbf{S}_2\mathbf{p}=\mathbf{r}_2$	Gauss	$\mathbf{p}=\mathbf{W}^{-1}\mathbf{S}_1\lambda_1+\mathbf{W}^{-1}\mathbf{S}_1\lambda_1+\mathbf{q}$	Hollenbeck 1976
National Health Insurance (NHI)	x	- (transfer income)	-	$Z=\sum_j (R^2_j/(2q^{1.5}))$	$\mathbf{S}(\mathbf{q}+\mathbf{R})=\mathbf{r}$	Gauss, Newton	$p_j=q_j(1+R_j/q_j)$	Devine and Wertheimer 1981
Simulated Tax and Transfer System (STATS)	x	x	-	Iterative fitting	$\mathbf{S}\mathbf{p}=\mathbf{r}$	Multi-raking	$p_j=q_jg_j$	Bridges and Johnston 1976
Treasury Personal Income Tax Simulation Model (OTA)	x	x	-	$Z=\sum_j q_j/f(x_j)$ $f(x_j)=x_j^4+x_j^{-4}-2$ $x_j=p_j/q_j$	$\mathbf{S}\mathbf{p}=\mathbf{r}$	Gauss, Newton	$p_j=q_jx_j$	Wyscarver 1980
Dynamic Simulation of Income Model (DYNASIM)	dynamic aging	dynamic aging	x	-	-	-	-	Orcutt, Caldwell and Wertheimer 1976
Sfb 3 Microsimulation Model - dynamic - static	dynamic aging	dynamic aging	x	$Z=\sum_j p_j\log(p_j/q_j)$ MIL principle	$\mathbf{S}\mathbf{p}=\mathbf{r}$	Modified Newton with global exponential approximation	$p_j=q_j\exp(\lambda'\mathbf{s}^j-1)$	Dynamic: Galler and Wagner 1986 Static: Merz 1994
MICSIM	x	x	x	$Z=\sum_j p_j\log(p_j/q_j)$ MIL principle	$\mathbf{S}\mathbf{p}=\mathbf{r}$	Modified Newton with global exponential approximation	$p_j=q_j\exp(\lambda'\mathbf{s}^j-1)$	Merz 1994

A solution based on a quadratic and unweighted objective function is used, for example, by Galler 1977 to determine a consistent adjustment procedure for the Integrated Microdata File (IMDAF-69) of the SPES project and its successor, the Sonderforschungsbereich 3 (Sfb 3) 'Microanalytic Foundations of Social Policy' at the Universities of Frankfurt and Mannheim, Germany. Hollenbeck 1976 proposed a quadratic weighted objective function for the adjustment of the micromodels of Mathematica Policy Research, Inc. (MPR) and The Policy Research Group, Inc. A constrained quadratic loss function is also used for instance by Stone 1976 and extended by Byron 1978 in an input/output context to estimate large social account matrices. Different algorithms may solve the quadratic programming approach (e.g. by Frank and Wolfe 1956, Hildreth 1957 or Houthakker 1960). These operations research procedures, however, become relatively inconvenient for large adjustment problems, particularly those with many microunits and many characteristics.

Oh and Scheuren 1980 took a multivariate raking ratio estimation in their 1973 exact match study to fit several types of sample units (design, analysis and estimation units) (see their bibliography on raking). The raking ratio estimation, reaching back to Deming and Stephan 1940, uses proportional factors in each iteration to fit the marginals of a multi-way table (see also 'iterative proportional fitting' in Bishop and Fienberg 1975 and the log linear approach within contingency tables in Mosteller 1968); this approach will be simular to our weighting procedure based on the minimum information loss principle..

Another, relative simple, weighting approach is the well known Horvitz-Thompson estimator as the inverse of the sampling ratio. This weighting approach is only well suited for real random samples, but not sufficient for the utimate non-random survey at hand. For a further treatment of different approaches, like algorithms connected with input/output tables, and procedures see Wauschkuhn 1982 and Merz 1986, Chapt. 7.

The adjustment of microdata by the minimum information loss (MIL) principle

.As seen above, there are many attempts to weight a sample However, those procedures may produce negative adjustment factors, or zero factors when restricted. But non-positive adjustment factors cannot be interpreted meaningfully in applied work because an adjustment factor has to represent a certain number of households or persons. Therefore, strictly positive weights are required to keep all sample microunits for further analyses. Another prerequisite is to take care of adequate weights according to personal and family/household characteristics in a hierarchical setting. Separate personal and household weights, as often used in survey weighting, will not ensure the simultaneous fit to the aggregate personal as well household data.

A solution procedure is described which ensures the positivity constraint by an appropriate objective function as well as the simultaneous requirements via appropriate handling a set of hierarchical restrictions. Our objective function is theoretically based on information theory, which optimizes a logarithmic function according to the Minimum Information Loss Principle. In recent years, information theory - well known in engineering sciences - has found some applications in economics. Theil's 1967 'information inaccuracy' is used, for instance, to judge the forecasting accuracy of econometric models (Merz, 1980). Measuring income inequality by an approach based on information theory is another example (Theil, 1972; Foster, 1983). More recently, minimum information was used to estimate microeconomic allocation models (Theil, Finke and Flood, 1984; Finke and Theil, 1984).

Based on the probability distribution p_j with $\mathbf{p} = (p_1,...,p_n)'$, $(p_j>0)$, $\Sigma_j p_j = 1$, $(j = 1,...,n)$, the entropy or information content of $\mathbf{p}$ is defined as

(3a) $$H(\mathbf{p}) = H(p_1,...,p_n) = \Sigma_j p_j \log(1/p_j).$$

An extension of the entropy concept is the *information loss* (or gain) when a multinomial distribution $\mathbf{q} = (q_1,...,q_n)'$ is substituted by a similar distribution $\mathbf{p} = (p_1,...,p_n)'$

(3b) $$I(\mathbf{p}:\mathbf{q}) = \Sigma_j p_j \log(1/q_j) - \Sigma_j p_j \log(1/p_j) = \Sigma_j p_j \log(p_j/q_j),$$

with $(p_j,q_j>0)$, $\Sigma_j p_j = \Sigma_j q_j = 1$, $(j=1,...,n)$.

Within this concept, the information loss is evaluated as the expected information before, weighted by p_j, minus the expected information after substitution. For an axiomatic derivation of the connected maximum entropy principle or principle of minimum cross-entropy, see Shore and Johnson (1980), and Jaynes (1957) who first proposed entropy maximization within engineering purposes.

The information theory based approach, as well as the approach with a quadratic distance function, are specific cases of the generalized entropy class [1]

(3c) $$I_\alpha(\mathbf{p},q) = [N\Sigma_j(p_j^\alpha q^{1-\alpha}-q)] / [\alpha(\alpha-1)],$$

with uniformly distributed adjustment factors $q_j=q=1/n$, and where N is the number of all microunits in the population. The quadratic objective function is given for $\alpha=2$ with

[1] As to Atkinson, Gomulka and Sutherland 1988 p. 230 who refer to the MIL adjustment procedure by Merz 1983a.

$I_2(\mathbf{p},q) = 1/2\ \Sigma_j(p_j - q)^2$ divided by q. The information theory based approach is given for $\alpha = 1$. Since the derivative of 3c with respect to p_j is $Np_j^{\alpha-1}/(\alpha-1)$, the information based approach can be interpreted as that measure with the largest value of α, where the first derivative approximates minus infinity, and the weight approximates to zero (satisfying the positivity constraint).

With reference to the above information theory concept, the adjustment problem under the minimum information loss (MIL) principle is to minimize the objective function

(4a) $$Z(\mathbf{p},\mathbf{q}) = \min_{\mathbf{p}} \{\Sigma_j p_j \log(p_j/q_j)\}$$

(4b) $$\text{s.t. } \mathbf{Sp} = \mathbf{r}.$$

where p_j = new adjustment factor for a microunit (e.g. household) j (j=l,...,n); q_j = available (known) adjustment factor for each micro unit j, n=number of micro units, with $\mathbf{S}_{(m,n)} = [s_{ij}]$ sample information matrix (i=1,...,m; j=1,...,n), $\mathbf{r}_{(m)} = [r_i]$ vector of restrictions, m=number of restrictions. The MIL-objective function minimization subject to the simultaneous set of possible hierarchical restrictions fulfills the two main requirements of positive weights and simultaneous consideration of hierarchical data.

As a solution condition, it is necessary that a) the number of micro units in a random sample is higher than the number of characteristics ($n \geq m$), and b) the matrix **S** is row regular, meaning that the distribution of the individual characteristics in a random sample is linear independent (rank **S**=m). Generally, the usual condition a) will be fulfilled; condition b) can be guaranteed by omitting one respective characteristic from an exhaustive polytomuous distribution.

The Lagrangean is

(5) $$L(\mathbf{p},\lambda) = \Sigma_j p_j(\log p_j - \log q_j) - \lambda'(\mathbf{Sp} - \mathbf{r}),$$

which yields a nonlinear equation system

(6) $$\Sigma_j s_{ij} q_j \exp(\lambda'\mathbf{s}^j - 1) = r_i \qquad (i=1,...,m),$$

that has to be solved for the Lagrange multipliers λ_k (k=1,...,m) iteratively.

The new adjustment factors with the solution λ are

(7) $$p_j = q_j \exp(\lambda'\mathbf{s}^j - 1),$$

where $\mathbf{s}^j$ are the respective characteristics of the microunit j.

Thus, the new adjustment factors can be calculated relatively simply: the single given adjustment factor q_j is multiplied by a term which is determined by a linear combination of the respective microunit (e.g. household and personal) characteristics ($\mathbf{s}^j$) and the Lagrange multipliers. Therefore, it is possible to determine the new adjustment factors after calculating λ independent of all other microunits and thus also independent from the sample size. This is important for practical work with mass (micro) data.

Absolute and relative adjustment factors

Usually the above adjustment factors p_j and q_j are not formulated as probabilities respectively relative frequencies with $0<p_j,q_j<1$, $\Sigma_j p_j = \Sigma_j q_j = 1$, but rather in absolute terms. The absolute adjustment problem,

(8) $$Z(\mathbf{p},\mathbf{q}) = \min_{\mathbf{p}} \{\Sigma_j p_j \log(p_j/q_j), \text{ s.t. } \mathbf{Sp=r}\}.$$

yields the same solution (8) as in the relative case and is only different according to the interpretation with $p_j = p_j N$, $q_j = q_j N$ and $r_i = r_i N$ (N = number of all microunits in the total population).

In the absolute case, a sample weight p_j (j=1,...,n) then represents the actual number of microunits (say households if the weights correspond to this type of microunit) in the total population. The restriction r_i (i=1,...,m) is then the absolute number of microunits with characteristic i (e.g. households with three persons and a self-employed household head) in the total population. The sample information matrix **S** remains the same in both cases and describes the microunits' characteristics in the sample.

If there are no specific weighting factors given in advance (free adjustment) and/or the sample under consideration would be a (pure) random one with an overall sampling ratio w = [sample size(n)/population size(N)] (like w=1/100 in a 1% microcensus case), then the old weights would be equal for each microunit j: In the relative case $q_j = q = 1/n$, and in the absolute case $q_j = q_j N = (1/n)N = N/n = 1/w$ as the inverse of the sampling ratio (w=n/N) (for example $q_j = q = 100$ in a 1% microcensus case) for all microunits j (j=1,...,n).

Multiple usages of re-weighting a sample

The calibration of microdata can be used not only to adjust a specific sample to its totals given from another database. The multiple usages of re-weighting might be summarized as follows

- Achieving representative results for a given sample and its population
  - Descriptive microanalyses
  - Micreoeconometrics: weighted estimation
- Sensititivity analyses with alternative artificial totals and respective weightings
- Extrapolating/forecasting samples for an actual demographic situation
- Microsimulation context: static aging (forecasting by re-weighting), weighting of simulation files

ADJUST software package

Our program package ADJUST fulfils the above requirements in an efficient manner for unlimited sample sizes. ADJUST has been proven to be successful in many applications: for the adjustment of the recent Time Budget Survey of the German Statistical Office and a refined adjustment of the German Socio-Economic Panel; within the framework of a microsimulation analysis of financial and distributional impacts of the German Pension Reform; a consistent adjustment for the microsimulation analysis of time allocation impacts in the formal and informal economy of the recent German tax reform. In addition, ADJUST has been used in applications at the London School of Economics (LSE, UK), at the Australian Bureau of Statistics (ABS) with the National Centre of Simulation, and Economic Modelling (NATSEM) at the University of Canberra (Australia). ADJUST is available via http://ffb.uni-lueneburg.de/adjust.

III THE CALIBRATION OF TIME DIARY DATA – PARTICULARITIES OF TIME DIARY ADJUSTMENTS

To increase the representativeness of a sample, the calibration has to be based on variables which have a substantial influence on time use behavior. To find appropriate aggregates to support substantial time use analyses, we refer to socio-demographic backgrounds of individuals based on human capital and performance characteristics as well as to socio-cultural backgrounds of the families and households. In addition, day specific information with expected time use influences via workdays or weekends should be integrated within the calibration procedure. Thus a simultaneous calibration approach, which considers personal and family/household variables as well as day specific information - like our discussed approach with its further advantages - is a prerequisite and therefore applied in this study.

To improve the quality and representativeness of survey data, a set of new (re-) weighting factors has to be computed. In the first step, weights have to be found for each observation which adjust the biased sample selection resulting from unproportional quotas (e.g. from oversampling of highly interesting but small demographic groups) or not fulfilled quotas. The second step builds upon the weights found in the first free adjustment procedure. Its aim is to create adjustment factors in such a way that the weighted sums of variables meet externally given aggregate values.

Due to the non-randomness of the sample (e.g. quoted samples) and missing observation units etc., the demographic structure of the time-budget survey might differ from the actual population measured by another official statistic (e.g. a micro-census or population survey file). By using new adjustment factors, the differences between the aggregated survey data and the preferred aggregates should vanish. This is especially important when dealing with variables which might correlate with the time use-behavior. More specific details on how to choose appropriate characteristics are discussed in the following chapter.

In addition to the demographic structure variables, the distribution of time data itself (e.g. days over the week or the season of the survey) may be biased and is likely to influence the time use behavior. It is expected that one will observe different activities in the summer than in the winter, and that time use patterns will vary between working days and Sundays. Public holidays should be taken into account as well. Even with quoted samples it is difficult to match these aggregate distributions. As a result, date and time information should be considered in the adjustment as well.

Sample size considerations

Though a deeply disaggregated multidimensional set of adjustment characteristics is desired,, however, the size of the sample often limits the structure of the aggregates in that mostly one or two-dimensional aggregate distributions can be used. Combining characteristics would often result in classes with very few, if any observations, therefore most of the aggregates can only be computed separately. This means, for example, that the weighted sum of 2-person-households and the weighted sum of blue-collar-workers will both match the given aggregates of the micro-census, though the combination of both characteristics - in this case 2-person-blue-collar-worker-households - will not necessarily match the combined aggregate in the census-file. Nevertheless, the adjustment procedure will minimize these possible differences as it takes the original quotas (if available) into account.

The selection of characteristics used in the adjustment procedure underlies two major considerations. First, the number of characteristics influences the quality of the results. If too many variables are chosen, then the algorithm may not find a numerical solution and the range between lowest and highest adjustment factor will grow rapidly. Additionally, some categories without observations may occur, so the sample file cannot meet the aggregates in these aspects. Second, the chosen characteristics should be correlated with the time use behavior and should include the characteristics used in the sample.

Example: The German Time-Budget Study

Due to the non-randomness of the sample (caused by over sampling of certain subgroups) and missing observation units, the demographic structure of the time-budget survey differs from that of the German micro-census. As a result, a calibration to correct these biases (using the ADJUST-software approach and the approach used in our study here) has been applied to both German time budget studies in 1991/92 and 2001/02. The following characteristics have been used for this task:

(a) For households:

- States
- Phase of the survey crossed with region (West-/ East-Germany) code
- Social situation crossed with the region code
- Size of the household crossed with region code
- Size of the community crossed with region code
- Household-type crossed with region code
- Only for the adjustment of the episode data: Day of the week [Mon-Thu; Fri; Sat; Sun]

(b) For persons:

- States
- Phase of the survey crossed with region (West-/ East-Germany) code
- Social situation crossed with the region code
- Size of the household crossed with region code
- Size of the community crossed with region code
- Household-type crossed with region code
- Age crossed with gender

- Only for the adjustment of structural data: occupational status crossed with region code and with gender
- Only for the adjustment of episode data: occupational status crossed with day of the week and gender crossed with day of the week

With respect to information on the day of the week, the following calibration was used: for each participant two days were observed so the adjustment factors for the episode data project two days (8/7th normal workdays [Monday thru Thursday], 2/7th Fridays, 2/7th Saturdays and 2/7th Sundays adding up to 14/7th or 2 days).

IV CHOOSING A CALIBRATION FRAMEWORK FOR TIME USE ANALYSES

There are two central dimensions of time use analyses: first is the time itself, which can be spent in a multitude of market and non-market activities with an appropriate measurement by main and secondary activities (endogenous variables). The second dimension, which is at least as important as the first, encompasses the socioeconomic background variables to explain individual behavior (explanatory, exogenous variables).

Dimensions of a calibration framework

The aim is to find a calibration framework which allows valid demographic data to analyze time use behavior based on different theoretical socioeconomic approaches. To find such a calibration kernel, we briefly discuss the importance, necessity and application of time use information in explaining behaviors for theoretically based empirical and integrated economic and social research, as well as for a targeted economic and social policy.

As a basis, we sketch the economic framework of activity linked time dimensions: the optimal allocation of goods and time with constrained goods and time resources. Within this framework, the microeconomic allocation model, the optimal labor supply, and the household production approach for a model of multiple market and non-market activities is of central importance. Individual time use data, in connection with a proper set of background variables, are essential for an empirical foundation and an evaluation of those theories (‘new home economics’), as well as for the search of new empirical based hypotheses about individual behavior in the household context.

Applications of time budget data with appropriate background variables include:

1. Labour supply of women within the household context – microeconomic analyses
2. Household production/time allocation
3. Multiple market and non-market time use activities – socioeconomic analyses
4. Policy impacts of the tax and transfer system – time allocation effects in the formal and informal economy by microsimulation modeling.

These examples and research areas will illustrate the need for and the spread of appropriate background variables and demographic calibration requirements.

Labour supply of women within the household context – the microeconomic approach

Within the well known microeconomic allocation model, an individual/household is maximizing his/her/its utility based on the amounts of goods. Facing a restricted income, utility maximization under the money constraint yields an optimal allocation of goods in a static or an intertemporal approach. Based on this microeconomic allocation model, the individual's paid working hours (labor supply) are incorporated in the preference optimization model via leisure (full time minus leisure determines the working hours). Thus, total time is divided into consumption time (leisure) and time for paid work to earn income. Then, maximizing utility as a function of the market goods amounts and the consumption time subject to full income (all expenditures plus wage weighted consumption time equals non-labor income and wage weighted total time) yields the optimal allocation equations for the goods amounts as well for the working hours (labor supply).

Already within this classical approach socio-economic background variables are necessary for

- individual utility function dependent of the socioeconomic status
- individual wage, including the potential wage of nonworkers, which has been econometrically estimated by socioeconomic variables
- non-labour income dependent of the socioeconomic status
- hours of paid work.

Within the last decade, empirically based labour supply research based on advanced econometric methods has proven the importance not only of time use itself in paid work, but also the need for proper socioeconomic background variables with regard to the mentioned four microeconomic dimensions.

A very important research role is the application for the increased labour market engagement of women, where the household context in particular (children, need for care, family dependent labor force participation) is important. [Useful literature includes the survey concerning labor supply by Killingsworth, 1983; concerning female labor supply by Killingsworth and Heckmann, 1986; as well as recent issues in scientific journals (e.g. Journal of Labor Economics)].

In brief: personal as well household characteristics have to be valid for following this strand of time use research.

Household production/time allocation

With the 'new home economics' since the Nobel prize winner Becker (1965), Lancaster (1966), Muth (1966), and Ironmonger (1972), the above microeconomic approach has been broadened by household production and the connected time allocation. The utility function is now based on the basic commodities which are produced by the household with its input of non-market time and market goods. Such commodities can be defined broadly (e.g. childcare, homework, and do-it-yourself work). Shadow prices can be assigned for the basic commodities, which have no market price per se, via the dual approach. Dependent of the household technology the shadow prices are dependent or independent of the household production output amount.

Within this approach, the optimal allocation problem is solved in three steps:

- Modeling the efficient household technology (duality between production and cost function)
- Modeling and calculation of the shadow price (price of the basic commodities, duality of cost function, and valued production)
- Utility maximized allocation with regard to output (with shadow prices) or with regard to input (with explicit functionalized market goods and the necessary time for the production).

In all three steps, an empirical sound model needs the appropriate personal and household socioeconomic background variables in addition to the income restriction and the empirically production centered time within the household production function approach.

Multiple market and non-market time use activities – socioeconomic analyses

To explain and estimate a proper household production of different commodities, different time inputs and their dependencies to the socioeconomic background are necessary. If this approach is expanded by multiple paid market activities (multiple labour supply) – possibly including tax and transfer evading black work – then a full multiple market and non-market time use activity model can be formulated which will overcome the traditional one-sided focus on paid work alone.

The theoretical modeling approach allows for the formulation of the impacts of changing model parameters (like the income and substitution effects of a price/ wage change). However, only an empirically based estimation and explanation with proven socioeconomic hypotheses will finally quantify these effects and decide, for example, whether the income or the substitution effect will be dominant – an important result in explaining the final labor supply.

To do this, detailed time use information on multiple activities are necessary, and above that, and this has to be underlined, the right set of socioeconomic background variables are essential for all of the needed theoretically based above model variables. This is important for testing given models with a multitude of preferences and background, and for finding new hypotheses of what the people do via and connected by and with its time individual dimension in the household and their regional labor market and economic context.

Policy impacts of the tax and transfer system – time allocation effects on the formal and informal economy by microsimulation modeling

Explaining behavior is the basis for a targeted economic and social policy. For example, at first glance, a new tax proposal has impacts on individual (labour) income. However, as has been proven, there are significant impacts on the broad range of household production not only directly via the budget constraint, but also by the interdependencies of substitution (opportunity costs) possibilities of market and non-market work, and activities (see e.g. the impact analysis of the German tax reform on market and non-market activities resp. the formal and informal economy (including black, illicit work) by Merz (1996) or for Sweden by Flood (1988)). The microsimulation approach has been proven as a well suited instrument for such impact analyses on an individual/family/household level (Merz, 1991;

Citro and Hanushek, 1999a,b). Personal, family and household demographics have to be available for targeted analyses.

To summarize: for testing given time use models, for finding new explanations and policy impact analyses of individual time use behavior within the household/family context – based either on a microeconomic or a psychological or sociological etc. theory – appropriate socioeconomic background variables are an ultimate requirement.

To do this, the calibration procedure has to incorporate personal and household/family information to ensure a valid demographic frame which forms the basic for substantial research and analyses.

V ADJUSTING FIVE AMERICAN TIME USE STUDIES

Heritage American time use data assessment and studies under investigation

The calibration of American Time Use Studies is part of the international project 'Time use Data Assessment', which is headed by the Time use Research Program (TURP), Department of Economics, Saint Mary's University, Halifax, Canada, Prof. Andrew Harvey and done in cooperation with: Tempus Omnia Revelat (TOR), Faculty of Economic, Social and Political Sciences, Vrije Universiteit Brussel, Brussels, Belgium, Prof. Dr. Ignace Glorieux, Research Network on Time use (RNTU), Research Institute on Professions (FFB), Department of Economics and Social Sciences, University of Lüneburg, Lüneburg, Germany, Prof. Dr. Joachim Merz, and Klas Rydenstam from Satistics Sweden. This project is supported by the Yale University and the Glaser Progress Foundation.

The following studies were identified and are the subject of the present investigation:

1. 1965: Multi-national Study: United States
   Robinson, John P. (1977). How Americans Used Time in 1965, Institute for Social Research, University of Michigan: Ann Arbor, Michigan
2. 1975: Time use in Economic and Social Accounts, 1975-1976: United States
   Juster, T.F., Hill, M.S., Stafford, F.P. and J. Eccles Parsons (1983). 1975-1981 Time Use Longitudinal Panel Study, Survey Research Center, Institute for Social Research, University of Michigan: Ann Arbor, Michigan
3. 1985: Americans' Use of Time
   Robinson, John P. (1985). Americans' Use of Time, College Park, MD: University of Maryland, Survey Research Center

1985c: Americans' Use of Time
as above but created from mail episodes (see Harvey and St. Croix 2005)

4. 1992: EPA Time Use Survey, 1992-1994: United States
Triplett, Timothy. (1995). Data Collection Methods Report for Estimating Exposure to Pollutants Through Human Activity Pattern Data, A National Micro-behavioral Approach, Survey Research Centre, University of Maryland, College Park, Maryland
5. 1998: Family Interaction, Social Capital, and Trends in Time use, 1998-1999: United States
Robinson, John P., Bianchi, Suzanne M. and Stanley Presser. (1999). Family Interaction, Social Capital, and Trends in Time use, 1998-1999, College Park, MD: University of Maryland, Survey Research Center

Details of each study are listed in Table 2. A comprehensive description and evaluation of these American time use studies is given in Harvey and St. Croix (2005).

Time use theory based and standardized calibration for all heritage files

Computing new adjustment factors for the American Time Use Study (ATUS) will improve subsequent research for two major reasons: first, for substantial analyses it is important, that fundamental socio-demographic variables meet the given aggregates of reliable demographic data such as the current population survey (CPS) or the Intercensal Population Estimates of the U.S. Census Bureau. This increase in representativeness concerning the socio-demographic structure of the sample also affects the representativeness of the analysis of the episode data, if the socio-demographic variables are correlated with the time use behavior. The selection of these variables is based on time use theory and the individual-centered and social background-centered economic models discussed above.

Furthermore, time use-specific variables like the day of the week of an observation should be considered in the adjustment factors as well, as these variables directly affect time use patterns. Second, when comparing the different U.S. time use files, results will be more accurate if the adjustment factors are based on a similar structure of aggregates in every year. Changes in time use behavior may be biased if different procedures of adjustment are used.

Table 2 American time use studies under investigation

	United States, 1965-66	United States, 1975-76 (Wave 1)	United States, 1985	United States, 1992-94 EPA	United States, 1998-99
Sampling unit	Individual	Individual and Spouse	Individual and Household	Individual	Individual
Population not in sampling frame	Families where all members worked as farmers, residents of Hawaii and Alaska	Institutional population	Institutional population, households without telephones	Persons not living in private residences	Institutional population, households without telephones
Number of respondents	2,021 persons	2,406 persons (1,346 completed all four diaries)	4,940 persons (5,358 if diaries for individuals aged 12-17 are included)	9,386 persons (7,514 adults)	1,151 persons
Age of respondent	19 to 65 years of age	18+	12+	Any age	18+
Response rate	82% for Jackson sample; 74% for all other cities	72% responded to initial request; 44.9% completed all four diaries	51% mail-backs (3,340), 67% telephone interviews (1,210), 60% face to face interviews (808), 55.2% overall	63%	56%

Working with equally calibrated data will allow sensitivity analyses and disentangling demographic changes vs. time use behavior changes. For this reason we will provide a standardized calibration procedure for each of the American time use surveys.

Aggregate characteristics for the heritage files

When selecting variables for the adjustment, several considerations must be made. The structure of the sample should reflect the U.S. population with respect to major socio-demographic data. Additionally, to improve the representativeness of the data, variables should be chosen which are correlated with time use behavior. These may be socio-demographic variables or technical variables of the time use survey itself (like a certain day of the week). Choosing appropriate aggregates will support substantial analyses. We refer to demographic backgrounds and individual characteristics based on human capital and other performance characteristics within the time use analyses framework discussed. In addition, we take the socio-cultural background of families and household characteristics into account.

The sample size and the nature of the calibration algorithm limit the amount of restrictions in such a way that if there are a growing number of variables it will become more likely that the sample may not provide observations for all the categories of the desired aggregates. Furthermore, if a large number of restrictions exist, this may lead to very high variances in the adjustment factors. Finally, the data has to be available in the sample files as well as in the CPS-files (providing totals) for all of the specified years. When dealing with five samples simultaneously, the selection of the optimal set of restrictions is difficult and may vary from one which would have been chosen for a single calibration. Finding a compromise between the desired detail of restrictions, practical requirements, and the availability of data in all sample-files is a challenging task.

Considering the mentioned limitations, eligible structural variables in the heritage files available for an adjustment to CPS key data and basic population estimates are:

- Age (5-year-classes) crossed with gender
- Educational attainment
- Occupational status (full time/part time/unemployed, self-employed)
- Marital status (single/married/divorced/widowed)
- Number of children (below 18 years of age) living in household

Additionally to the structural data, following time use-variables can be used:

- Day of the week

These adjustment characteristics are the core of and in line with many other international time use calibration aggregates like the Dutch Time Use Study from 1997 (CBS, 1999)[2], the UK Time Us Study 2001[3], or the German Time Use Survey 2001/2002 (Ehling and Bieber, 2003)[4]. For a further discussion of appropriate adjustment characteristics also see Harvey, Elliott and Procos (1977).

The intercensal population estimates of the U.S. Census Bureau[5] is delivering the population totals. Due to the size and structure of the sample, classes with a width of five years were used. As the samples do not cover persons younger than 18 years, the first age class represents only persons of 18 and 19 years. The educational attainment is available via the "school attainment" variable[6] in the current population survey. However, only people over 25 years of age are represented in these statistics, which has to be considered when building the microdata-matrix from the heritage files. The occupational status can be covered with data from the Bureau of Labor Statistics[7] surveyed in the CPS. Unfortunately, the time series is starting three years too late, with the year 1968, so for time use survey of 1965, aggregate data of 1968 has to be used instead.

To build the aggregates for the marital status, Labstat data was used[8] again. One has to notice, that in the labour statistic only people older than 16 years of age are accounted, but this restriction will not affect the aggregates for occupational-status or marital-status, and the heritage files do not include respondents younger than 16 years anyway. The number of children living in the household corresponds to the information on "living arrangements of children under 18 years" provided by the CPS[9]. In this case as well, there was no information available for 1965, so numbers of 1968 had to be used.

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2 with calibration totals sex by age, marital status, social position, degree of urbanization, household composition, and that the day of the week occurs regularly often (Dutch Time Use Study 1997)

3 with two sets of population controls: age group [8-11, 12-15, 16-19, 20 (5) -74, 75 and over] by gender, and Government Office Regions plus Scotland, Wales, Northern Ireland

4 with age by sex, social status, occupation by sex, household size, household type, community type, where all items are respective to the regional division by the 16 Bundesländer. Additionally the type of weekdays is considered.

5 U.S. Census Bureau. (n.d.a).; U.S. Census Bureau. (n.d.b); U.S. Census Bureau. (n.d.c)
6 U.S. Census Bureau. (2005).
7 The tables are created with the LABSTAT- Database using following codes: LNU02500000, LNU02600000, LNU05000000
8 For the years '65 to '85: EmplymtStatus by_Maritalstatus.pdf Bureau of Labour Statistics; Labour Force Statistics Derived from the Current Population Survey, 1948-87; Bulletin 2307; August 1988; for the years after 1992-1998 the LABSTAT-Database with following codes: LNU000149, LNU000314, LNU000150, LNU000315, LNU000151, LNU000316
9 U.S. Census Bureau. (2004).

Table 3 Public holidays according to the U.S. code for the years of the heritage files

Public Holiday	1965		1975		1985		1993		1998	
	Date	Day	Date	Day	Date	Day	Date	Day	Date	Day
New Year	01/01	Fri	01/01	Wed	01/01	Tue	01/01	Fri	01/01	Thu
Martin Luther King Day	01/18	Mon	01/20	Mon	01/21	Mon	01/18	Mon	01/19	Mon
Presidents' Day	02/15	Mon	02/17	Mon	02/18	Mon	02/15	Mon	02/16	Mon
Memorial Day	05/31	Mon	05/26	Mon	05/27	Mon	05/31	Mon	05/25	Mon
Independence Day	07/04* 07/05	Sun Mon	07/04	Fri	07/04	Thu	07/04* 07/05	Sun Mon	07/04* 07/03	Sat Fri
Labour Day	09/06	Mon	09/01	Mon	09/02	Mon	09/06	Mon	09/07	Mon
Columbus Day	10/11	Mon	10/13	Mon	10/14	Mon	10/11	Mon	10/12	Mon
Veterans' Day	11/11	Thu	11/11	Tue	11/11	Mon	11/11	Thu	11/11	Wed
Thanksgiving	11/25	Thu	11/27	Thu	11/28	Thu	11/25	Thu	11/26	Thu
Christmas Day	12/25* 12/24	Sat Fri	12/25	Thu	12/25	Wed	12/25* 12/24	Sat Fri	12/25	Fri

* If the public holiday occurs on a regular non-workday, the day immediately before or after that day will be public holiday instead.

Table 4 Aggregates for the different heritage files

Category	Restriction number	Description	**1965**	**1975**	**1985**	**1993**	**1998**
Male # age	01	male, age 18-19	3.804.236	4.232.884	3.841.017	3.570.727	4.053.326
	02	male, age 20-24	6.899.289	9.838.857	10.670.549	9.506.702	9.040.112
	03	male, age 25-30	5.612.436	8.617.480	10.887.657	9.718.386	9.202.990
	04	male, age 31-34	5.517.566	7.017.543	10.019.185	11.069.951	9.922.383
	05	male, age 35-39	5.898.942	5.702.224	8.797.913	10.779.896	11.253.107
	06	male, age 40-44	6.058.104	5.496.967	6.964.647	9.550.162	10.886.210
	07	male, age 45-49	5.552.528	5.712.160	5.699.630	7.907.584	9.312.659
	08	male, age 50-54	5.101.484	5.737.247	5.253.668	6.274.160	7.734.322
	09	male, age 55-59	4.582.681	5.047.753	5.320.599	5.153.959	6.040.932
	10	male, age 60-64	3.583.081	4.368.044	5.053.423	4.781.116	4.884.251
	11	male, age 65-69	2.972.192	3.596.151	4.206.036	4.508.024	4.375.310
	12	male, age 70+	5.041.923	5.669.334	7.259.226	8.867.436	9.858.514
Female # age	13	female, age 18-19	3.672.040	4.063.067	3.730.063	3.401.195	3.852.206
	14	female, age 20-24	6.847.150	9.687.979	10.477.262	9.195.636	8.720.108
	15	female, age 25-30	5.727.774	8.662.876	10.854.516	9.698.740	9.295.932
	16	female, age 31-34	5.607.221	7.173.363	10.148.768	11.158.397	10.096.947
	17	female, age 35-39	6.121.742	5.931.446	9.041.560	10.909.318	11.364.160
	18	female, age 40-44	6.368.258	5.700.193	7.220.447	9.790.668	11.086.204
	19	female, age 45-49	5.827.607	6.072.202	5.959.224	8.205.987	9.668.866
	20	female, age 50-54	5.357.560	6.235.032	5.615.061	6.633.198	8.167.797
	21	female, age 55-59	4.922.336	5.598.004	5.889.797	5.598.891	6.539.782
	22	female, age 60-64	3.988.792	5.031.207	5.849.526	5.404.942	5.455.166
	23	female, age 65-69	3.578.099	4.536.199	5.189.190	5.501.735	5.171.407
	24	female, age 70+	6.859.179	8.894.611	11.937.666	14.076.548	15.040.033
Children	25	children < 18 years in HH	68.362.000*	64.317.000	60.784.000	65.053.000	68.419.000
Marital status	26	Married	84.734.000	96.222.000	102.217.000	109.196.000	112.552.000
	27	single (never married)	31.945.000	33.682.000	44.042.000	49.334.000	53.939.000
Occupational status	28	full-time employed	65.216.000*	72.393.000	89.201.000	99.698.000	108.770.000
	29	part-time employed	11.148.000*	14.767.000	19.226.000	21.691.000	23.655.000
Educational attainment	30	none/ only elementary	34.045.000	25.545.000	19.893.000	15.127.000	12.782.000
	31	some High School	18.617.000	18.237.000	17.553.000	17.067.000	16.776.000
	32	High School grad.	31.703.000	42.353.000	54.866.000	57.589.000	58.174.000
	33	some College	9.139.000	14.518.000	23.405.000	37.451.000	42.506.000
	34	College grad. or more	9.742.000	16.244.000	27.808.000	35.590.000	41.973.000
Weekday	35	normal working day**	199	200	199	200	201
	36	Sunday or public holiday**	62	62	62	62	62

* Data available for 1968 only.

** Occurrences as in the specified year. For calibration the person-days in the U.S. population represented by the sample will be used instead.

Table 5 Adjustment variables of the heritage files used to build the adjustment microdata-matrix (S)

Category	Restriction number	Description	1965		1975		1985		1992-94		1998-99	
			Variable	Value	Variable	Value	Variable	Value	Variable	Value	Variable	Value
Male # age	01	male, age 18-19	sex # age	1	v403 # v414	1	sex # age	1	sex # age	1	rsex # rage (computed from birthyear in variable 'p3a')	1
	02	male, age 20-24		1		1		1		1		1
	03	male, age 25-30		1		1		1		1		1
	04	male, age 31-34		1		1		1		1		1
	05	male, age 35-39		1		1		1		1		1
	06	male, age 40-44		1		1		1		1		1
	07	male, age 45-49		1		1		1		1		1
	08	male, age 50-54		1		1		1		1		1
	09	male, age 55-59		1		1		1		1		1
	10	male, age 60-64		1		1		1		1		1
	11	male, age 65-69		1		1		1		1		1
	12	male, age 70+		1		1		1		1		1
Female # age	13	female, age 18-19		2		2		2		2		2
	14	female, age 20-24		2		2		2		2		2
	15	female, age 25-30		2		2		2		2		2
	16	female, age 31-34		2		2		2		2		2
	17	female, age 35-39		2		2		2		2		2
	18	female, age 40-44		2		2		2		2		2
	19	female, age 45-49		2		2		2		2		2
	20	female, age 50-54		2		2		2		2		2
	21	female, age 55-59		2		2		2		2		2
	22	female, age 60-64		2		2		2		2		2
	23	female, age 65-69		2		2		2		2		2
	24	female, age 70+		2		2		2		2		2
Children	25	children < 18 years in HH	under18		v415		under18		kid#		p2	

Marital status	26	Married	marital	1	v32	1	marital	1	n/a	--	p6	1
	27	single (never married)		4		5		4		--		5
	28	divorced/ separated/ widowed		2; 3		2; 3; 4		2; 3		--		2; 3; 4
Occupational status	29	full-time employed	full	1	v125	>=30	full	1	employ	1	p7	1
	30	part-time employed	part	1		<30	part	1		2		2
Educational attainment	31	none/ only elementary	educ	0; 1	v118	0-8	educ	0; 1	educ	0-8	p5	0-8
	32	some High School		2		9-11		2		9-11		9-11
	33	High School grad.		3		12		3		12		12
	34	some College		4		13-15		4		13-15		13-15
	35	College grad. or more		5		>=16		5		>=16		>=16
Weekday	36	normal working day	day	1-4	v432 (only for wave 1)	1-4	day	1-4	day	1-4	pday	1-4
	37	Sunday or public holiday		7		7		7		7		7
ID		Respondents' ID	id		Id		respid		respid		respid	
Weight		Available weights	demowgt		v7973		wt		adwta		wt	

To enhance the structural data, the days of the week were taken into account. As public holidays[10] will affect the time use-behavior of the respondents, these were counted in a class together with the Sundays. Calibrating days, the aggregate to be achieved for a certain year is given by weekday margin= ((number of weekdays)/365)*total population size (N) and similar for Sundays and public holidays as sunday/public holiday margin = ((number of Sundays or public holidays)/365)*total population size (N). For simplicity, Table 4 for every year provides the number of weekdays and Sundays/public holidays only. To avoid linear dependency, one weekday – without loss of generality - has to be neglected. This reference is Saturday.

An overview of the aggregate data gathered from the different sources is provided by the following Tables 3 and 4.

Realization of the adjustment/calibration for all heritage files

The adjustment was computed with the software package ADJUST version 1.1.8, developed at the Research Institute on Professions at the University of Lüneburg, Germany. A logical matrix had to be constructed which corresponded with the given aggregates of the CPS-files and the Inter-Censual Population Estimates. Table 5 provides an overview of all restrictions used and the corresponding variables in the five different heritage files.

As the restrictions dealing with age and gender are covering the complete dataset, one characteristic of each category had to be spared respectively, to avoid linear dependencies. Unfortunately, no data on the marital status was collected in the 1992-'94 study, so this category could not be included in the calibration for that year. Whenever possible, available weights were used to initialize the calibration procedure. These weights all summed up to the sample-size and have to be multiplied by a constant factor for the final overall population size. As only cases for which all the information is available can be used for the calibration, some cases could not be included in the calibration due to missing values. However, as the categories were selected carefully, only small numbers of those cases occurred in the different studies. In the 1965 data set, 2014 valid cases were used for the calibration, and only 7 cases with missing values had to be dropped. In the 1975 data set, there were no missing values and all 2406 cases could be used for the calibration.

[10] U.S. Code Title 5, part II, Subpart E, Chapter 61, Subchapter I, §6103

For the study 10 years later, in 1985, 4467 valid and 473 missing cases occurred. In the 1992-94 file 7297 valid cases are facing and 217 missing. In the 1998-99 time use data file 1142 valid and 9 missing cases were listed.

In addition to the missing cases, in two calibration procedures (for 1975 and 1998), restriction number 34 (College Graduate) had to be removed due to linear dependencies. For those two files the mentioned restriction was taken into the reference group of the category 'school attainment' as otherwise the algorithm would not be able to converge. The remaining characteristics would fulfil the given aggregates.

Table 6 Differences to the aggregates before the calibration

Category	**Restr. no.**	**Description**	**Differences to aggregates [%]**					
			1965	**1975**	**1985**	**1985c**	**1993**	**1998**
Male # age	01	male, age 18-19	-69.9	-59.2	-19.4	-31.6	-72.5	-46.9
	02	male, age 20-24	25.8	-22.4	-7.4	-19.7	-73.2	-14.6
	03	male, age 25-30	31.3	-8.7	-14.8	-9.8	-59.4	22.8
	04	male, age 31-34	-14.2	-4.1	-6.1	-8.2	-59.8	2.5
	05	male, age 35-39	4.7	23.1	-8.4	4.5	-50.0	-12.2
	06	male, age 40-44	18.5	15.2	-6.2	-12.0	-36.3	-10.6
	07	male, age 45-49	17.1	-18.8	-19.5	-4.5	19.8	9.9
	08	male, age 50-54	11.7	-12.2	1.5	2.4	45.5	-3.4
	09	male, age 55-59	0.5	5.6	-10.3	-9.4	88.9	-7.3
	10	male, age 60-64	5.7	-20.3	8.8	-9.6	126.2	-1.0
	11	male, age 65-69	-67.7	37.5	-1.8	-6.3	110.6	28.3
	12	male, age 70+	-87.1	-31.8	30.5	53.4	25.3	-36.0
Female # age	13	female, age 18-19	-30.2	-9.2	-4.5	-1.0	-65.3	31.8
	14	female, age 20-24	43.0	-15.6	-5.8	-11.6	-50.8	-13.5
	15	female, age 25-30	17.8	4.3	-6.9	0.3	-48.0	-2.8
	16	female, age 31-34	29.8	10.0	13.9	3.6	-52.5	10.6
	17	female, age 35-39	15.5	15.1	16.2	13.5	-46.3	-1.6
	18	female, age 40-44	31.8	-4.6	-10.4	1.4	-14.1	18.4
	19	female, age 45-49	16.7	-8.8	14.6	18.6	17.4	-7.8
	20	female, age 50-54	30.7	-12.8	-1.6	7.0	74.1	-19.8
	21	female, age 55-59	13.0	-14.1	31.0	5.2	146.2	-13.4
	22	female, age 60-64	-2.4	7.9	-6.6	-9.1	143.6	-2.2
	23	female, age 65-69	-68.7	-0.1	-5.9	-19.2	100.1	-26.1
	24	female, age 70+	-86.7	-31.6	40.9	20.0	-18.2	-17.5
Children	25	Children < 18 in HH	150.1	148.0	89.4	75.1	127.9	156.2
Marital status	26	Married	9.8	18.0	7.4	8.5	n/a	6.5
	27	single (never married)	-36.6	-58.1	-23.9	-18.5	n/a	-30.6
Occupational status	28	full-time employed	13.5	7.9	22.8	4.0	9.3	9.3
	29	part-time employed	-40.2	-26.3	4.8	-12.8	-0.7	-6.4
Educational attainment	30	none/ only elementary	-19.5	-14.7	1.4	-42.8	-76.6	-27.8
	31	some High School	8.8	-0.4	4.5	-21.9	-28.0	4.4
	32	High School grad.	11.5	2.1	6.7	13.0	10.2	-2.6
	33	some College	-16.6	-6.3	-1.7	0.8	18.2	0.4
	34	College grad. or more	-33.9	n/a	-39.2	-15.2	41.9	n/a
Weekday	35	normal working day	2.0	9.3	5.5	7.1	6.6	2.1
	36	Sunday or public holiday	-18.5	11.5	-7.4	-33.6	14.9	-11.8

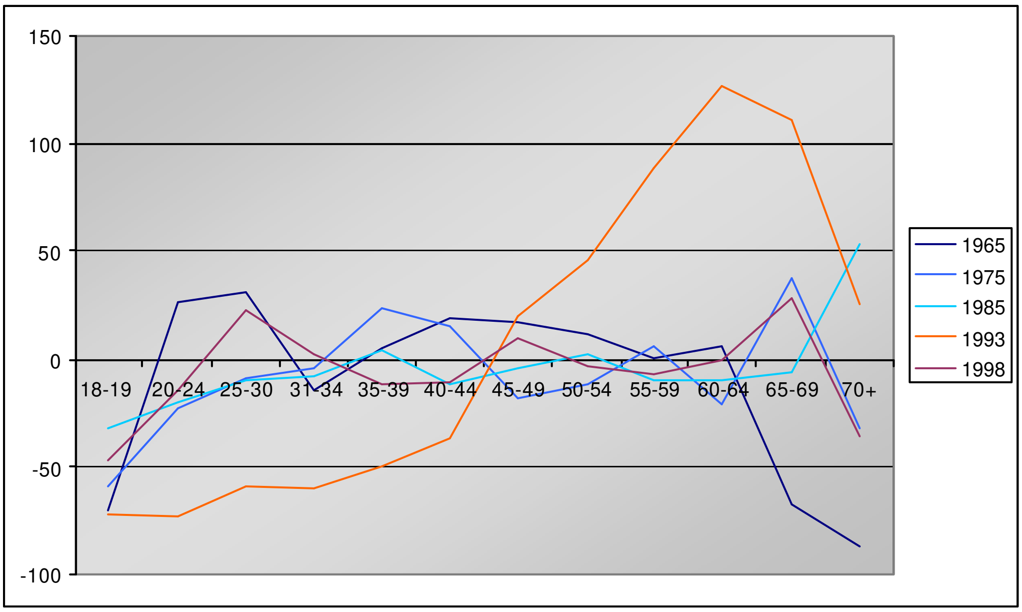
As the starting weights provided by the original heritage files are reflecting the possible quotas of the different sub samples, we multiplied them by a constant factor to achieve the population size. These multiplied weights – further called old weights - are used to build the aggregates of the five heritage files before calibration.

Table 6 shows the differences of the respective actual population size to the aggregates before the new calibration of the five heritage files from 1965, 1975, 1985, 1992-94, 1998-99. The single differences are the relative deviation of the aggregates using the former (old) weights compared to the CPS population to be achieved. A negative value, say -15%, indicates an under-representation by 15% compared to the actual US population size when using the former weights. The respective under-representation or over-representation vanishes if our new calibration weights are used.

The overall result befor calibration: The differences between the old weights provided by the surveys and the respective actual population (representation bias) are remarkable and indeed are calling for a new calibration – as ours – to eliminate these differences to achieve representative results in a respective substantial study.

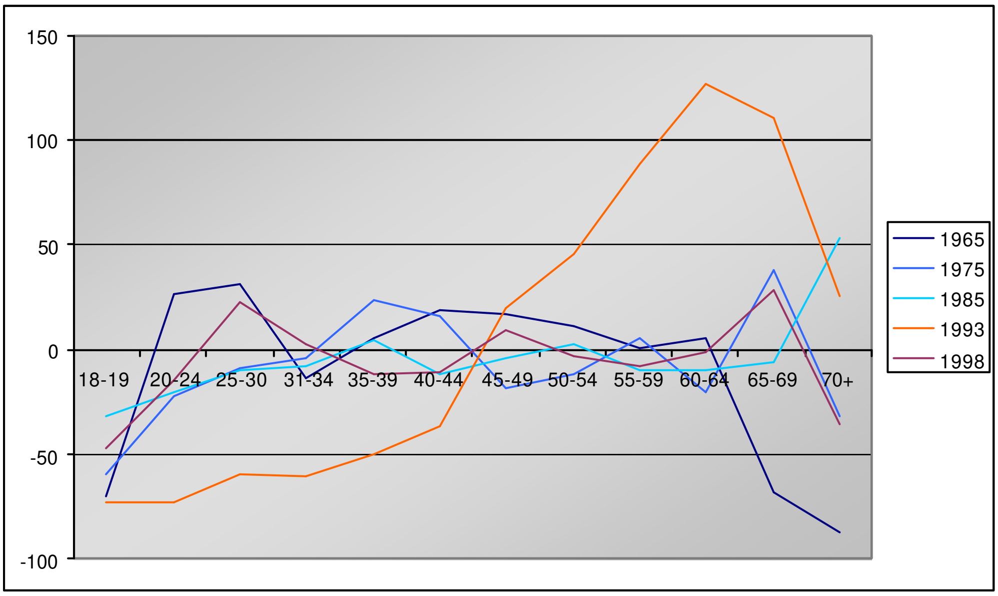
Figures 1 to 5 show the bias of the old weights for male and female age classes. With Figures 1 and 2 it will be evident that younger and older persons, regardlesse their gender, show the most differences to the desired totals. The 1993 Time Use Study, in particular, is the time use study with the most bias for peoples 50 years and older.

Figure 1: Representation of American Heritage Time Use Files 1965 – 1998/99 - Over- and underrepresentation compared to desired totals in %: Males by age classes



Source: American Heritage Time Use Files 1965 – 1998/99, own computation

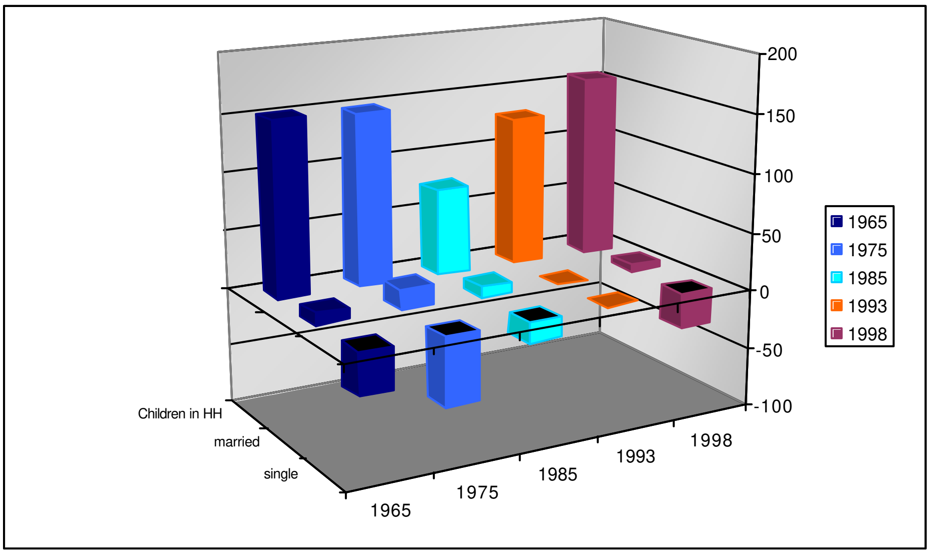
Figure 2: Representation of American Heritage Time Use Files 1965 – 1998/99 - Over- and underrepresentation compared to desired totals in %: Females by age classes



Source: American Heritage Time Use Files 1965 – 1998/99, own computation

All studies seemed to have a focus on families or at least on married couples. Singles are under-represented while married persons are well represented. All files show high over sampling rates for children living in the household, which is a factor that will highly affect time use behavior (Figure 3).

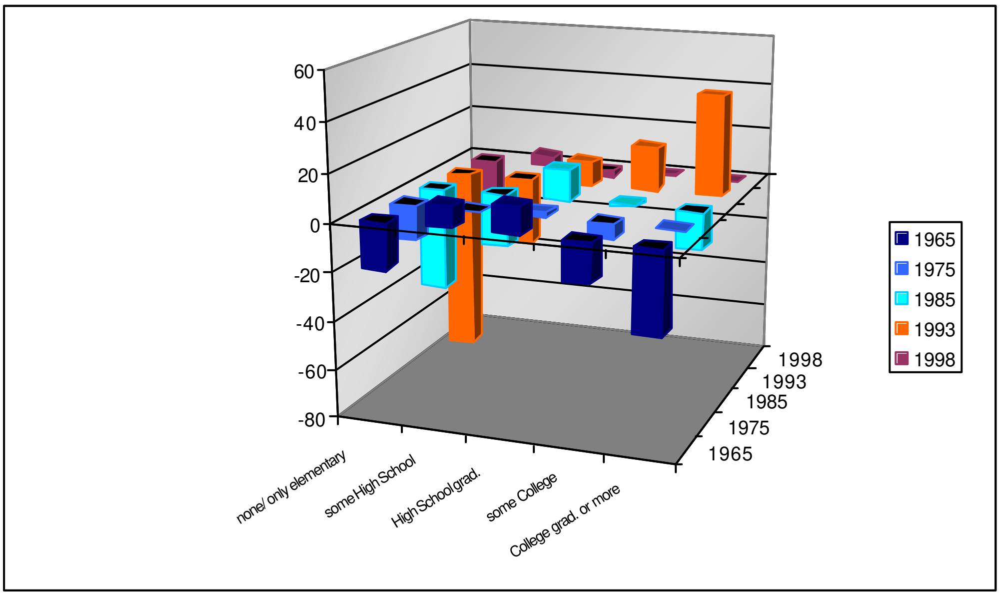
Figure 3: Representation of American Heritage Time Use Files 1965 – 1998/99 - Over- and underrepresentation compared to desired totals in %: Family status



Source: American Heritage Time Use Files 1965 – 1998/99, own computation

According to educational attainment the representation bias is most evident in the 1965 time use study with underrepresentation in a lower and upper educational attainment and in the 1993 time use study, however with an obvious overrepresentation of higher educated persons.

Figure 4: Representation of American Heritage Time Use Files 1965 – 1998/99 - Over- and underrepresentation compared to desired totals in %: Educational attainment



Source: American Heritage Time Use Files 1965 – 1998/99, own computation

The variations concerning the weekdays are interesting; the consideration of the public holidays in the 1998-file causes an overrepresentation of 3.4% for the working days and an under-representation of -17.4% for the Sundays and public holidays. It is likely that this heritage file was quoted only to the calendared distribution of the weekdays not considering the public holidays, while the 1975 and 1993-files slightly oversample the Sundays and public holidays. However, these differences already underline the importance of applying a calibration (Figure 5).

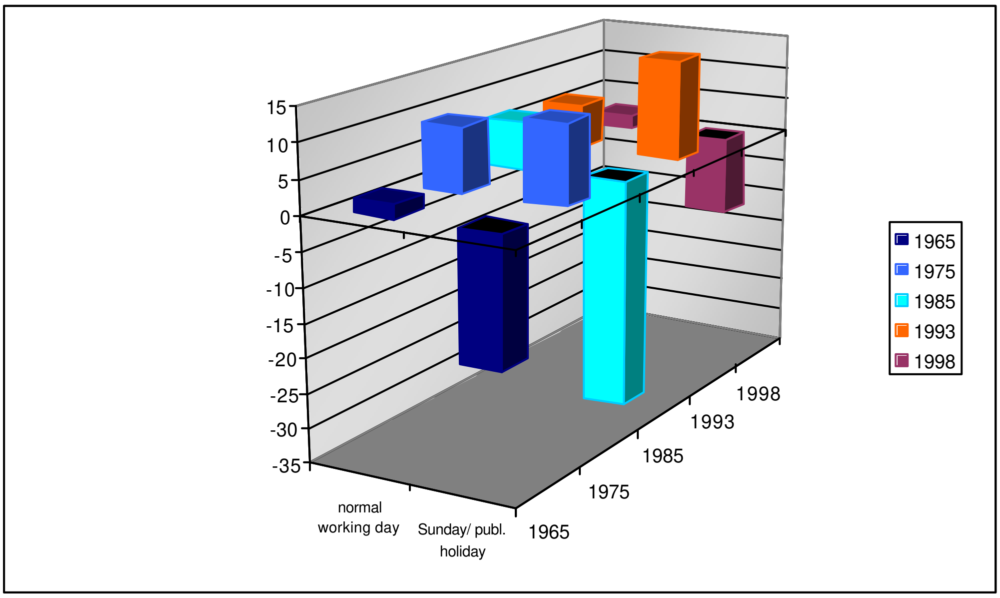
To summarize the results before calibration: There are partially remarkable differences between old weights' totals and desired totals. The bias in the representativity in all American Heritage Time Use Surveys on market and non-market time are considerable. Misleading results have to be expected when the old weights, which are given by the survey at hand, are considered according to

- the family context

- children in household
- family type
- the person's age structure (in particular the young and old)
- the day of the week distribution (public holidays)

demographic variables, which indeed seems to be important for substantive time use analyses.

Figure 5: Representation of American Heritage Time Use Files 1965 – 1998/99 - Over- and underrepresentation compared to desired totals in %: Representation of days of the week



Source: American Heritage Time Use Files 1965 – 1998/99, own computation

Calibration computational results and experiences

The adjustment algorithm converged after 14-17 iterations providing the desired new weight for each case. These results are available as ASCII-Files (see Appendix G) which connect the identification variables of the different heritage files with the new weighting factor and can be easily merged to standard statistic software or database applications[11]. Appendix A to F reports the calibration logfiles. The new weights for the five heritage files will now simultaneously fulfill the given aggregates of the respective CPS-data and population estimates. The frequency distributions of the old and new weights for all five

[11] CSV-File; Identifier followed by new weight, separated with semicolons.

heritage files are provided in Figures 1-6. Based on these weights, further descriptive and inference analyses of the time use data are available.

Figure 6 Frequency distributions of the old and new weight of the 1965 American time use survey

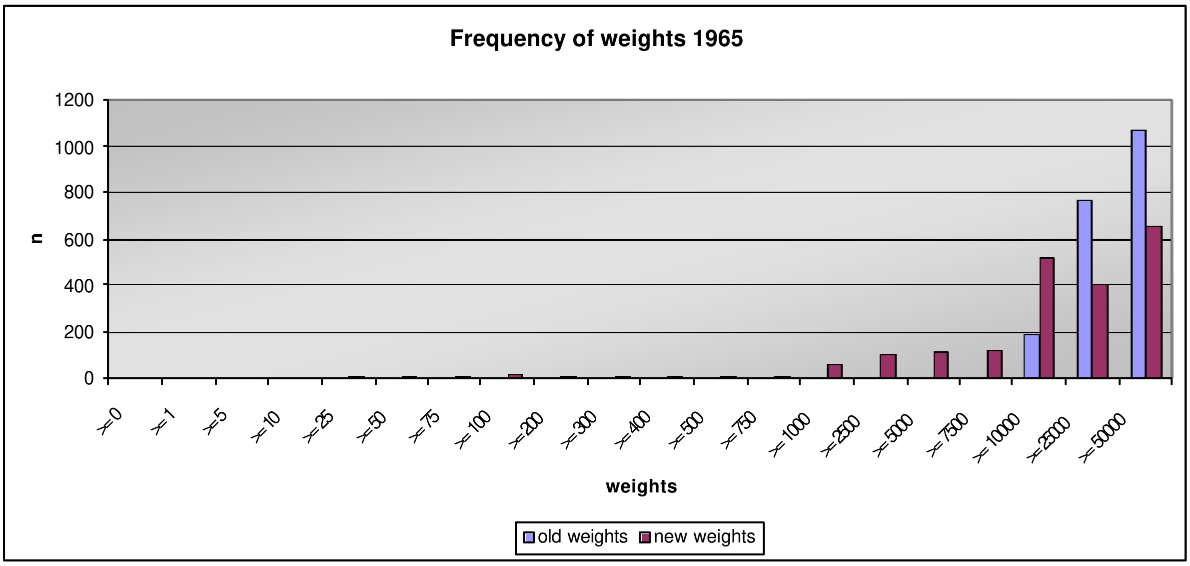


Figure 7 Frequency distributions of the old and new weight of the 1975 American time use survey

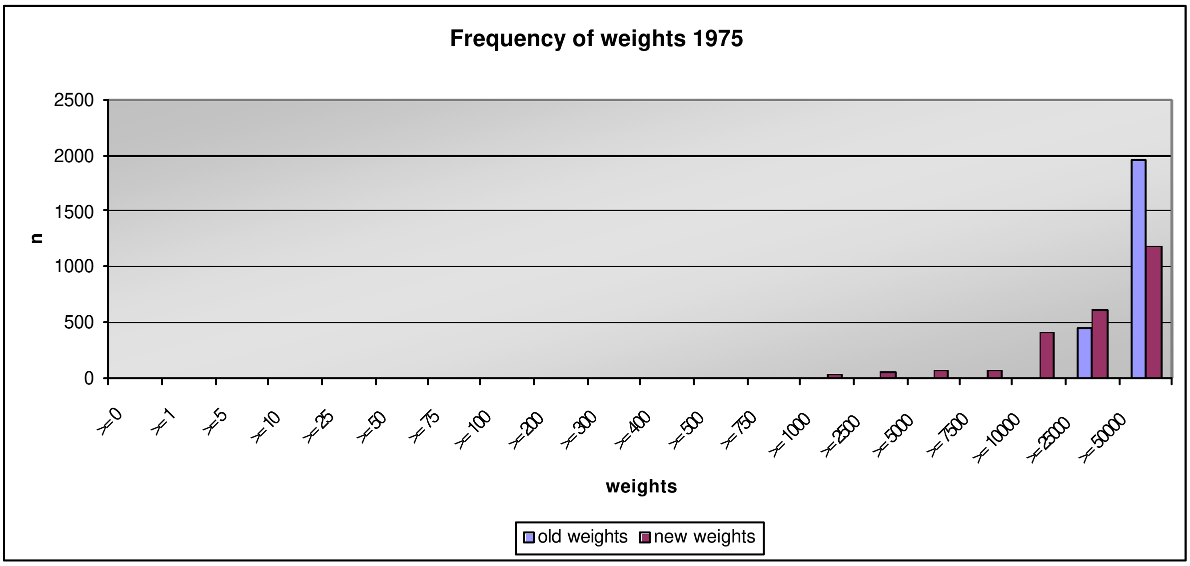


Figure 8 Frequency distributions of the old and new weight of the 1985 American time use survey

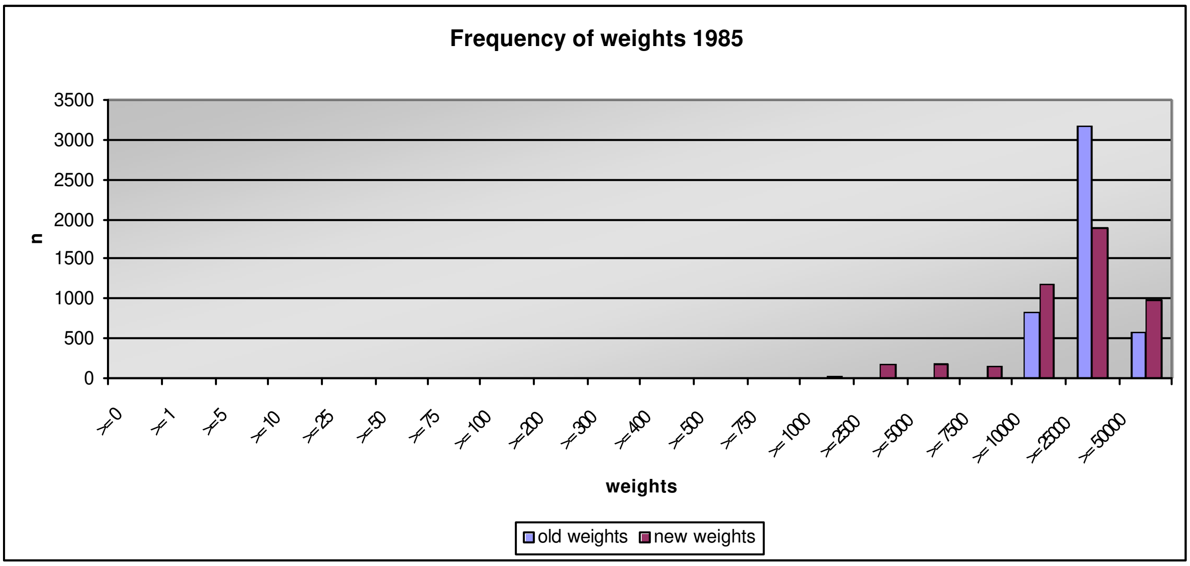


Figure 9 Frequency distributions of the old and new weight of the 1985c American time use survey

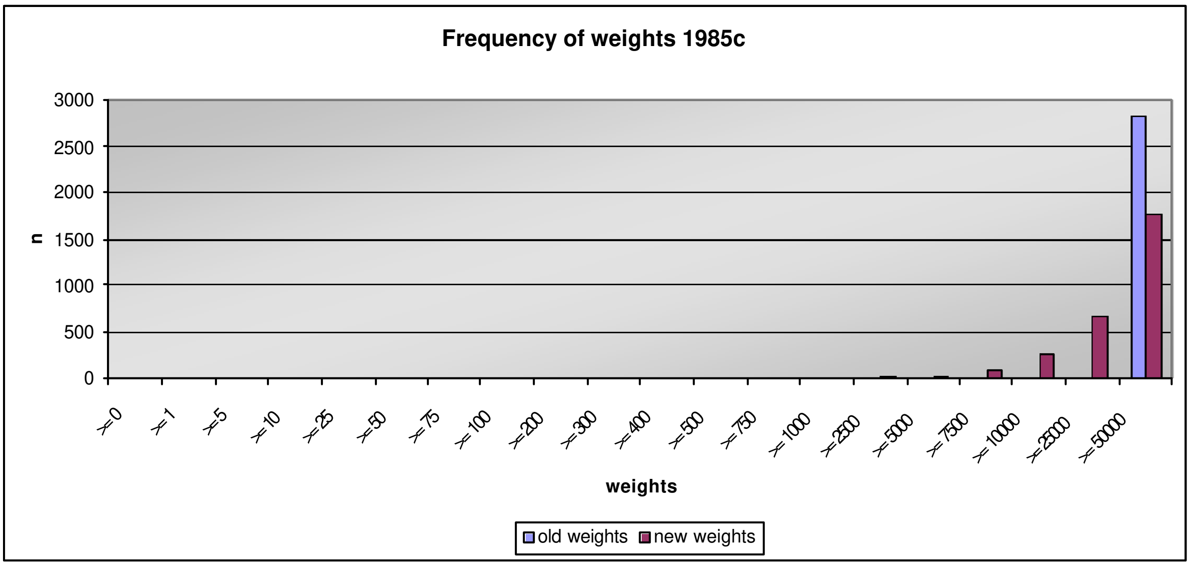


Figure 10 Frequency distributions of the old and new weight of the 1992-94 American time use survey

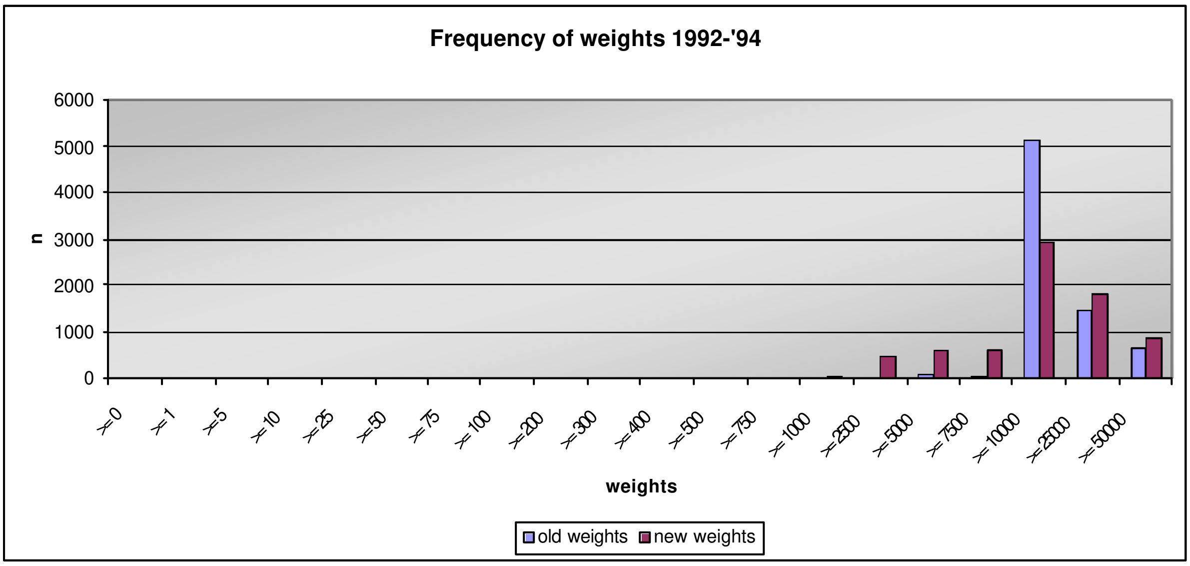
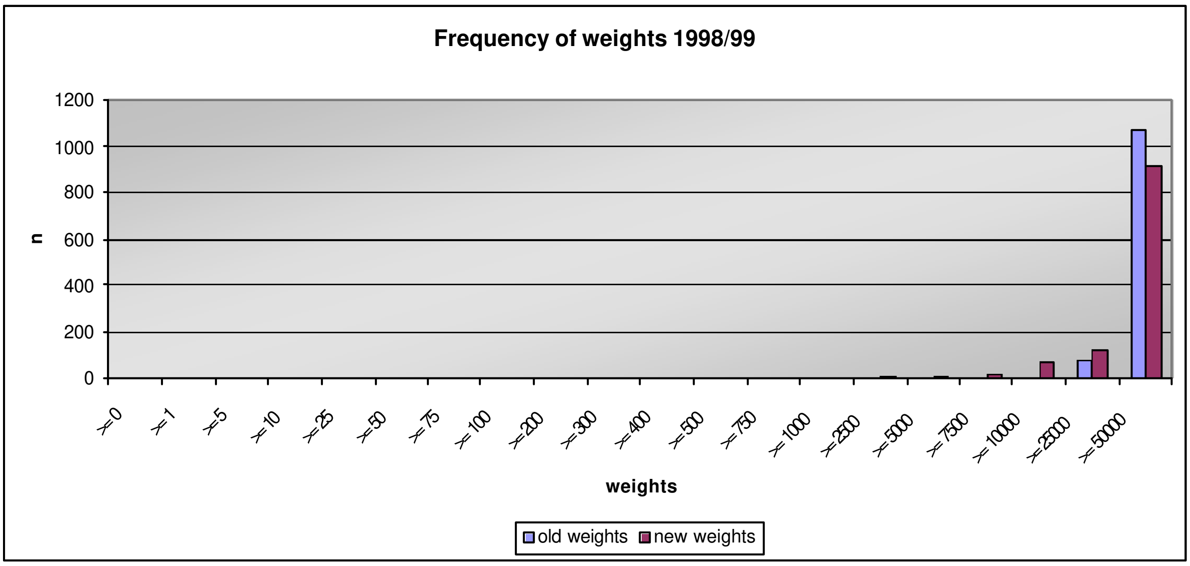


Figure 11 Frequency distributions of the old and new weight of the 1998-99 American time use survey



Nevertheless, the advantages as well as the difficulties of a calibration are obvious. It is highly important to balance between the accuracy and number of aggregates on one hand and the variance of the weights on the other. Though the algorithm was able to find a simultaneous solution after a few iterations, the sample size was too small to consider additional aggregates. Even in this constellation with relatively few restrictions to be achieved, there are some cases which have to represent far more than a million citizens. Dealing with five samples simultaneously, the set of possible restrictions is diminishing if all calibrations have to follow the same structure. Several calibration settings have to be tried before the selection of a suitable restriction set is possible. The preparation of the sample files requires a considerable amount of time as the variables have to be identified and located in the files, different schematics of characterizations have to be considered, and missing values have to be marked.

Finally, finding appropriate data for all studies, reaching 40 years back in time, turned out to be a difficult and demanding task since methods and surveys may change over a period of time like this one.

VI DISENTANGLING DEMOGRAPHIC FROM BEHAVIORAL CHANGES – RE-CALIBRATION OF THE US HERITAGE FILES 1975 - 1999

The second part of this study is about disentangling demographic from behavioral changes. One strategy is to analyse actual time use pattern given a certain unchanged population of a former period in time.

To follow this strategy we re-calibrated all younger than 1965 heritage files using the demographic totals for 1965. With our calibration objective function the distance between given weights and the new weights to be computed is minimized by a certain distance function which has desirable features. This ensures to take into account all biased sample information provided by the survey organizers. Thus, our re-calibration with the 1965 population totals is respecting this information when providing the new weights based on the former population structure.

Re-calibration results and experiences

Again, the adjustment algorithm converged after max. 16 iterations providing the desired new weight for each case. These results again are available as ASCII-Files (see Appendix CG) which connect the identification variables of the different heritage files with the new weighting factor and can be easily merged to standard statistic software or database applications[12]. Appendix CD to CF reports the four re-calibration logfiles. The new weights for the four heritage files will now simultaneously fulfill the given aggregates of the respective 1965 CPS-data and population estimates.

[12] CSV-File; Identifier followed by new weight, separated with semicolons.

Table 6c shows the relative differences in the population structure of the younger heritage files compared to the 1965 totals before the re-calibration. The resulting structural differences are remarkable. Having in mind, that every survey's sampling is different with quite remarkable biased survey weightings (see the above results of part one of this study) wide spread differences could be expected.

Substantive results in disentangling demographic and time use behavioral changes with the US historic time use files by the above strategy of a re-calibration using a former population structure compared to other strategies are prvided in Harvey 2005.

Table 6c Differences to the aggregates 1965 before the calibration

Category	Restr. No.	Description	Relative differences to aggregates 1965 [%]					
			1965	1975	1985	1985c	1993	1998
Male # age	1	male, age 18-19	3804236	-54.6	-18,7	-30,9	-74.2	-43,4
	2	male, age 20-24	6899289	10.7	43,2	24,2	-63.1	11,8
	3	male, age 25-30	5612436	40.3	65,2	75	-29.6	101,3
	4	male, age 31-34	5517566	22.0	70,5	66,7	-19.4	84,3
	5	male, age 35-39	5898942	19.0	36,6	55,9	-8.7	67,5
	6	male, age 40-44	6058104	4.5	7,8	1,2	0.4	60,7
	7	male, age 45-49	5552528	-16.4	-17,3	-2	70.6	84,4
	8	male, age 50-54	5101484	-1.2	4,5	5,5	78.9	46,5
	9	male, age 55-59	4582681	16.3	4,1	5,1	112.4	22,2
	10	male, age 60-64	3583081	-2.9	53,5	27,5	201.8	35
	11	male, age 65-69	2972192	66.3	39	32,6	219.4	88,8
	12	male, age 70+	5041923	-23.3	87,8	120,9	120.4	25,1
Female # age	13	female, age 18-19	3672040	0.5	-3	0,5	-67.9	38,3
	14	female, age 20-24	6847150	19.4	44,1	35,2	-33.9	10,1
	15	female, age 25-30	5727774	57.7	76,4	90,1	-11.9	57,8
	16	female, age 31-34	5607221	40.8	106,2	87,5	-5.5	99,1
	17	female, age 35-39	6121742	11.6	71,6	67,6	-4.3	82,6
	18	female, age 40-44	6368258	-14.6	1,6	15	32.0	106,2
	19	female, age 45-49	5827607	-4.9	17,1	21,3	65.4	52,9
	20	female, age 50-54	5357560	1.5	3,1	12,1	115.6	22,2
	21	female, age 55-59	4922336	-2.3	56,7	25,8	180.1	15
	22	female, age 60-64	3988792	36.1	36,9	33,3	230.1	33,8
	23	female, age 65-69	3578099	26.7	36,4	17,2	207.6	6,8
	24	female, age 70+	6859179	-11.3	145,2	108,9	67.9	80,9
Children	25	Children <18 in HH	68,362,000*	133.3	68,4	55,7	116.9	156,5
Marital status	26	Married	84734000	34.0	29,5	30,9	n/a	41,5
	27	Single	31945000	-55.8	4,9	12,4	n/a	17,2
Occupational status	28	full-time employed	65,216,000*	19.8	67,9	42,3	67.0	82,2
	29	part-time employed	11,148,000*	-2.3	80,7	50,4	93.1	98,5
Educational attainment	30	none/ only elementary	34045000	-36.0	-40,8	-66,6	-89.6	-72,9
	31	some High School	18617000	-2.5	-1,4	-26,4	-34.0	-5,9
	32	high school grad,	31703000	36.3	84,6	95,6	100.1	78,8
	33	some College	9139000	48.8	151,8	158,1	384.5	366,9
	34	college grad. or more	9742000	n/a	73,4	142,1	418.4	n/a
Weekday	35	normal working day	199	30.0	47,9	50,1	63.3	65,2
	36	sunday or public holiday	62	32.0	29,7	-7	75.0	41,3

VII RECOMMENDATIONS AND CONCLUSIONS

Our study has clearly shown that if using the Heritage US time use data with the provided survey weights (given old calibration), the bias in the results of substantial analyses would be not negligible. This holds true in particular for characteristics with an obviously strong connection to individual time use behavior (like the respondent's age or the number of children); the results would be heavily under- or overrepresented respectively. In general, relying on biased calibrated data would inevitably lead to questionable conclusions.

With the available new five sets of consistent and similar structured weighting factors, it is possible, in particular, to follow up American time use behavior for about 40 years now based on a reliable and valid demographic background delivering representative data for substantial time use analyses.

In addition, the re-calibrated younger US heritage files all with the 1965 population structure now are available for substantive analyses in disentangling demographic from time use behavioral changes.

Based on our calibration experience we recommend above all that

- For any new time use survey, the calibration procedure and the single substantial definitions of the adjustment characteristics with their totals have to be documented carefully.
- A new adjustment of a new ATUS file should be as close as possible to the used adjustment characteristics of the older ones to ensure a common demographic background with no biased results if using a different approach.
- Since the software Adjust can be operated easily on every desktop-computer, sensitivity analyses with different totals resulting in different weighting sets will help further to disentangle demographic effects from behavioural effects.

Without a proper calibration of the US heritage time use files, a necessary and important prerequisite for any further substantive analyses would be missing and substantive results not consider those weights would be seriously be misleading. .

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APPENDIX A: Adjustment Logfile, 1965

```
adjustment logfile
Adjust Version 1.1.8.6
Wednesday, 02-02-05     10:52


Reading restrictions file (r-vektor atus65.dat)...
Number of restrictions found: 36

Reading S-Matrix file (s-matrix atus65.dat, increased compatibility mode)...
Number of microunits found: 2014
```

I	cases	sum	Z	R	Z-R	(Z-R)/R %
1	11	11	1146862.5	3804236.0	-2657373.5	-69.9
2	100	100	8681966.7	6899289.0	1782677.7	25.8
3	129	129	7371621.9	5612436.0	1759185.9	31.3
4	92	92	4731662.5	5517566.0	-785903.5	-14.2
5	104	104	6175652.5	5898942.0	276710.5	4.7
6	108	108	7180167.4	6058104.0	1122063.4	18.5
7	118	118	6502617.1	5552528.0	950089.1	17.1
8	89	89	5698881.0	5101484.0	597397.0	11.7
9	71	71	4607341.4	4582681.0	24660.4	0.5
10	58	58	3786821.9	3583081.0	203740.9	5.7
11	13	13	959759.2	2972192.0	-2012432.8	-67.7
12	12	12	648956.3	5041923.0	-4392966.7	-87.1
13	28	28	2563501.9	3672040.0	-1108538.1	-30.2
14	146	146	9791532.9	6847150.0	2944382.9	43.0
15	131	131	6749394.7	5727774.0	1021620.7	17.8
16	135	135	7279002.7	5607221.0	1671781.7	29.8
17	126	126	7070764.7	6121742.0	949022.7	15.5
18	146	146	8391676.8	6368258.0	2023418.8	31.8
19	116	116	6800366.3	5827607.0	972759.3	16.7
20	111	111	7001144.9	5357560.0	1643584.9	30.7
21	83	83	5564614.1	4922336.0	642278.1	13.0
22	60	60	3891873.3	3988792.0	-96918.7	-2.4
23	13	13	1118890.3	3578099.0	-2459208.8	-68.7
24	14	14	915003.6	6859179.0	-5944175.4	-86.7
25	1212	2930	170966429.6	68362000.0	102604429.6	150.1
26	1634	1634	93047534.4	84734000.0	8313534.4	9.8
27	190	190	20257507.9	31945000.0	-11687492.1	-36.6
28	1337	1337	74023913.5	65216000.0	8807913.5	13.5
29	54	54	6669207.5	11148000.0	-4478792.5	-40.2
30	248	248	27399757.4	34045000.0	-6645242.6	-19.5
31	343	343	20259994.3	18617000.0	1642994.3	8.8
32	663	663	35353202.0	31703000.0	3650202.0	11.5
33	223	223	7619642.6	9139000.0	-1519357.4	-16.6
34	182	182	6440456.5	9742000.0	-3301543.5	-33.9
35	1177	1177	69795130.2	68424498.0	1370632.2	2.0
36	294	294	17378230.4	21318185.0	-3939954.6	-18.5

```
cases : number of microunits in the sample
sum: unweighted sum
Z : sum weighted by old adjustment factors (old weights)
R : restrictions to be achieved


Begin optimization process.

Information shown for each iteration include:
L : position in steplength vector
step : steplength
D²min/D²max : minimum/maximum of D²  (D=Z(I)-R(I))
Imin/Imax : Index I to D²min/D²max
* : next actual step
```

Current Iteration: 0

L	Step	Imin	D²min	Imax	D²max
1	0.50000	1	8.075670e+010	26	9.221909e+017
2	1.00000	24	1.930515e+013	28	6.533834e+022
3 *	2.50000	36	1.495489e+039	33	1.319347e+036

Current Iteration: 1

L	Step	Imin	D²min	Imax	D²max
1	0.50000	24	5.750553e+012	26	1.015695e+022
2	1.00000	24	5.719176e+011	16	2.132787e+020
3 *	2.50000	1	2.052262e+011	7	3.390549e+018

Current Iteration: 2

L	Step	Imin	D²min	Imax	D²max
1	0.50000	24	1.500646e+011	33	3.686639e+018
2	1.00000	24	1.326361e+009	4	4.170928e+018
3 *	1.09434	24	7.764170e+008	4	3.452558e+018

Current Iteration: 3

L	Step	Imin	D²min	Imax	D²max
1	0.50000	24	3.378747e+008	7	3.398899e+018
2	1.00000	24	4.689547e+005	36	4.803724e+018
3 *	1.09433	24	6.843316e+006	36	3.973366e+018

Current Iteration: 4

L	Step	Imin	D²min	Imax	D²max
1	0.50000	24	1.855069e+006	32	4.409270e+018
2	1.00000	24	1.654834e+007	25	2.876561e+021
3 *	1.09432	12	2.250976e+007	14	6.374890e+018

Current Iteration: 5

L	Step	Imin	D²min	Imax	D²max
1	0.50000	12	5.740304e+007	26	3.331575e+018
2	1.00000	1	1.746938e+008	35	3.181068e+018
3 *	1.09431	1	7.391612e+007	35	2.627660e+018

Current Iteration: 6

L	Step	Imin	D²min	Imax	D²max
1	0.50000	1	1.219089e+008	35	1.168050e+018
2	1.00000	1	3.196009e+008	25	5.324046e+019
3 *	1.09441	1	4.080591e+008	25	4.416336e+019

Current Iteration: 7

L	Step	Imin	D²min	Imax	D²max
1 *	0.50000	1	5.263672e+008	35	1.574853e+017
2	1.00000	11	5.319924e+008	25	7.581008e+018
3	1.09528	11	4.534621e+008	25	6.334196e+018

Current Iteration: 8

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	3.524381e+008	25	2.888787e+018
2 *	1.00000	11	8.620995e+008	25	1.191684e+018
3	1.09973	11	1.109865e+009	25	1.009787e+018

Current Iteration: 9

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	1.567665e+009	25	4.601975e+017
2 *	1.00000	12	1.674700e+008	25	1.974012e+017
3	1.11155	12	4.194288e+007	25	1.660457e+017

Current Iteration: 10

L	Step	Imin	D²min	Imax	D²max
1	0.50000	12	5.266940e+007	25	7.799273e+016
2 *	1.00000	12	9.743836e+006	25	3.529141e+016
3	1.11877	12	5.581200e+006	25	2.976531e+016

Current Iteration: 11

L	Step	Imin	D²min	Imax	D²max
1	0.50000	12	1.569438e+008	25	1.518633e+016
2 *	1.00000	11	6.038025e+008	25	8.197545e+015
3	1.12923	11	8.322516e+008	25	7.163922e+015

Current Iteration: 12

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	1.102215e+009	25	3.367941e+015
2 *	1.00000	23	6.432296e+009	25	1.605588e+015
3	1.17707	23	1.005707e+010	25	1.270939e+015

Current Iteration: 13

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	1.932967e+009	25	5.234588e+014
2 *	1.00000	23	2.269357e+008	25	1.017606e+014
3	1.15711	23	5.493730e+007	25	4.548234e+013

Current Iteration: 14

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	5.933735e+007	25	2.791626e+013
2 *	1.00000	23	4.643061e+005	25	8.486919e+011
3	1.04506	23	4.240731e+003	25	3.002799e+011

Current Iteration: 15

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	1.165438e+005	25	2.142819e+011
2 *	1.00000	23	7.505120e+000	25	8.273933e+007
3	1.00538	23	8.052441e-001	25	1.795092e+007

Current Iteration: 16

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	1.876377e+000	25	2.068687e+007
2	1.00000	36	3.796298e-003	36	3.796298e-003
3 *	1.00006	36	5.437786e-004	36	5.437786e-004

Current Iteration: 17

L	Step	Imin	D²min	Imax	D²max
1	0.50000	36	9.490728e-004	36	9.490728e-004
2	1.00000	36	1.387779e-017	36	1.387779e-017
3 *	1.00000	36	1.387779e-017	36	1.387779e-017

Convergence achieved.

I	cases	sum	Z	R	Z-R	(Z-R)/R %
1	11	11	3804236.0	3804236.0	0.0	0.0
2	100	100	6899289.0	6899289.0	0.0	0.0
3	129	129	5612436.0	5612436.0	-0.0	-0.0
4	92	92	5517566.0	5517566.0	-0.0	-0.0
5	104	104	5898942.0	5898942.0	-0.0	-0.0
6	108	108	6058104.0	6058104.0	0.0	0.0
7	118	118	5552528.0	5552528.0	-0.0	-0.0
8	89	89	5101484.0	5101484.0	-0.0	-0.0
9	71	71	4582681.0	4582681.0	-0.0	-0.0
10	58	58	3583081.0	3583081.0	0.0	0.0
11	13	13	2972192.0	2972192.0	0.0	0.0
12	12	12	5041923.0	5041923.0	0.0	0.0
13	28	28	3672040.0	3672040.0	0.0	0.0
14	146	146	6847150.0	6847150.0	-0.0	-0.0
15	131	131	5727774.0	5727774.0	0.0	0.0
16	135	135	5607221.0	5607221.0	0.0	0.0
17	126	126	6121742.0	6121742.0	-0.0	-0.0
18	146	146	6368258.0	6368258.0	0.0	0.0
19	116	116	5827607.0	5827607.0	-0.0	-0.0
20	111	111	5357560.0	5357560.0	0.0	0.0
21	83	83	4922336.0	4922336.0	-0.0	-0.0
22	60	60	3988792.0	3988792.0	0.0	0.0
23	13	13	3578099.0	3578099.0	-0.0	-0.0
24	14	14	6859179.0	6859179.0	0.0	0.0
25	1212	2930	68362000.0	68362000.0	0.0	0.0
26	1634	1634	84734000.0	84734000.0	-0.0	-0.0
27	190	190	31945000.0	31945000.0	-0.0	-0.0
28	1337	1337	65216000.0	65216000.0	0.0	0.0
29	54	54	11148000.0	11148000.0	0.0	0.0
30	248	248	34045000.0	34045000.0	0.0	0.0
31	343	343	18617000.0	18617000.0	0.0	0.0
32	663	663	31703000.0	31703000.0	0.0	0.0
33	223	223	9139000.0	9139000.0	-0.0	-0.0
34	182	182	9742000.0	9742000.0	0.0	0.0
35	1177	1177	68424498.0	68424498.0	-0.0	-0.0
36	294	294	21318185.0	21318185.0	0.0	0.0

cases : number of microunits in the sample
Z : sum of old adjustment factors (old weights)
sum: unweighted sum
Z : sum weighted by old adjustment factors (old weights)

Adjustment complete.

APPENDIX B: Adjustment Logfile, 1975

```
adjustment logfile
Adjust Version 1.1.8.6
Wednesday, 02-02-05     13:30


Reading restrictions file (r-vektor atus75.dat)...
Number of restrictions found: 35

Reading S-Matrix file (s-matrix atus75.dat, increased compatibility mode)...
Number of microunits found: 2406
```

I	cases	sum	Z	R	Z-R	(Z-R)/R %
1	17	17	1725754.6	4232884.0	-2507129.4	-59.2
2	102	102	7635399.7	9838857.0	-2203457.3	-22.4
3	136	136	7871711.4	8617480.0	-745768.6	-8.7
4	112	112	6729640.7	7017543.0	-287902.3	-4.1
5	106	106	7022099.8	5702224.0	1319875.8	23.1
6	93	93	6332291.5	5496967.0	835324.5	15.2
7	71	71	4640472.0	5712160.0	-1071688.0	-18.8
8	75	75	5039055.4	5737247.0	-698191.6	-12.2
9	81	81	5328429.3	5047753.0	280676.3	5.6
10	54	54	3480508.3	4368044.0	-887535.7	-20.3
11	90	90	4943420.0	3596151.0	1347269.0	37.5
12	70	70	3865517.5	5669334.0	-1803816.5	-31.8
13	38	38	3689671.9	4063067.0	-373395.1	-9.2
14	119	119	8172191.4	9687979.0	-1515787.6	-15.6
15	172	172	9033526.3	8662876.0	370650.3	4.3
16	152	152	7892689.6	7173363.0	719326.6	10.0
17	114	114	6829595.2	5931446.0	898149.2	15.1
18	87	87	5440723.7	5700193.0	-259469.3	-4.6
19	89	89	5540061.0	6072202.0	-532141.0	-8.8
20	86	86	5435787.7	6235032.0	-799244.3	-12.8
21	77	77	4809530.6	5598004.0	-788473.4	-14.1
22	89	89	5429617.7	5031207.0	398410.7	7.9
23	89	89	4532496.7	4536199.0	-3702.3	-0.1
24	116	116	6084873.8	8894611.0	-2809737.2	-31.6
25	1154	2581	159482060.0	64317000.0	95165060.0	148.0
26	1856	1856	113561069.4	96222000.0	17339069.4	18.0
27	193	193	14107133.6	33682000.0	-19574866.4	-58.1
28	1227	1227	78137750.2	72393000.0	5744750.2	7.9
29	172	172	10889468.2	14767000.0	-3877531.8	-26.3
30	355	355	21798063.8	25545000.0	-3746936.2	-14.7
31	322	322	18155283.5	18237000.0	-81716.5	-0.4
32	705	705	43223458.4	42353000.0	870458.4	2.1
33	254	254	13602426.2	14518000.0	-915573.8	-6.3
34	1447	1447	88979709.4	81437163.0	7542546.4	9.3
35	463	463	28147014.3	25245521.0	2901493.3	11.5

```
cases : number of microunits in the sample
sum: unweighted sum
Z : sum weighted by old adjustment factors (old weights)
R : restrictions to be achieved


Begin optimization process.

Information shown for each iteration include:
L : position in steplength vector
step : steplength
D²min/D²max : minimum/maximum of D²  (D=Z(I)-R(I))
Imin/Imax : Index I to D²min/D²max
* : next actual step
```

Current Iteration: 0

L	Step	Imin	D²min	Imax	D²max
1	0.50000	24	7.450956e+012	25	7.110838e+018
2	1.00000	6	7.435591e+019	30	3.713606e+020
3 *	2.50000	20	5.334993e+032	31	7.226503e+032

Current Iteration: 1

L	Step	Imin	D²min	Imax	D²max
1	0.50000	24	1.198407e+015	15	5.162017e+018
2	1.00000	24	3.822203e+014	3	4.607825e+018
3 *	2.50000	24	4.442166e+011	32	3.273466e+018

Current Iteration: 2

L	Step	Imin	D²min	Imax	D²max
1	0.50000	30	1.851124e+019	5	4.318745e+018
2	1.00000	24	3.115879e+013	35	3.213187e+018
3 *	1.09480	24	2.209773e+013	30	5.631181e+018

Current Iteration: 3

L	Step	Imin	D²min	Imax	D²max
1	0.50000	24	9.437543e+012	32	3.297385e+018
2	1.00000	24	1.090061e+012	34	4.244044e+018
3 *	1.09485	24	4.971393e+011	34	3.501641e+018

Current Iteration: 4

L	Step	Imin	D²min	Imax	D²max
1	0.50000	24	3.037825e+011	26	2.785287e+018
2	1.00000	24	1.262244e+010	25	2.951580e+019
3 *	1.09484	24	1.206847e+009	26	8.244158e+017

Current Iteration: 5

L	Step	Imin	D²min	Imax	D²max
1 *	0.50000	24	5.530487e+009	25	1.092016e+019
2	1.00000	24	5.437759e+009	25	4.083572e+018
3	1.09490	22	5.908591e+009	25	3.391700e+018

Current Iteration: 6

L	Step	Imin	D^2min	Imax	D^2max
1	0.50000	24	3.309839e+009	25	1.527599e+018
2 *	1.00000	22	5.388661e+009	25	5.910023e+017
3	1.09613	10	4.689449e+009	25	4.942601e+017

Current Iteration: 7

L	Step	Imin	D^2min	Imax	D^2max
1	0.50000	22	2.101771e+009	25	2.257869e+017
2 *	1.00000	22	1.362525e+009	25	9.275603e+016
3	1.10092	22	1.400931e+009	25	7.815347e+016

Current Iteration: 8

L	Step	Imin	D^2min	Imax	D^2max
1	0.50000	22	6.086013e+008	25	3.637269e+016
2 *	1.00000	24	5.563568e+008	25	1.577914e+016
3	1.11058	24	6.189856e+008	25	1.325015e+016

Current Iteration: 9

L	Step	Imin	D^2min	Imax	D^2max
1	0.50000	22	4.222327e+008	25	5.912120e+015
2 *	1.00000	22	1.020450e+009	25	2.182134e+015
3	1.12241	22	1.371898e+009	25	1.689077e+015

Current Iteration: 10

L	Step	Imin	D^2min	Imax	D^2max
1	0.50000	22	3.553642e+008	25	7.056348e+014
2 *	1.00000	22	1.287128e+008	25	1.310857e+014
3	1.10241	22	1.097473e+008	25	7.793128e+013

Current Iteration: 11

L	Step	Imin	D^2min	Imax	D^2max
1	0.50000	22	3.424891e+007	25	3.609876e+013
2 *	1.00000	22	5.100198e+005	25	1.185619e+012
3	1.04215	24	3.916636e+004	25	4.844217e+011

Current Iteration: 12

L	Step	Imin	D²min	Imax	D²max
1	0.50000	22	1.283451e+005	25	2.996663e+011
2 *	1.00000	24	1.410928e+001	25	1.414926e+008
3	1.00592	24	5.036269e-001	25	3.119183e+007

Current Iteration: 13

L	Step	Imin	D²min	Imax	D²max
1	0.50000	24	3.527562e+000	25	3.537744e+007
2	1.00000	35	8.264422e-003	25	2.070125e+000
3 *	1.00008	35	1.174826e-003	35	1.174826e-003

Current Iteration: 14

L	Step	Imin	D²min	Imax	D²max
1	0.50000	35	2.066104e-003	35	2.066104e-003
2	1.00000	35	8.881784e-016	35	8.881784e-016
3 *	1.00000	35	8.881784e-016	35	8.881784e-016

Convergence achieved.

I	cases	sum	Z	R	Z-R	(Z-R)/R %
1	17	17	4232884.0	4232884.0	0.0	0.0
2	102	102	9838857.0	9838857.0	0.0	0.0
3	136	136	8617480.0	8617480.0	-0.0	-0.0
4	112	112	7017543.0	7017543.0	-0.0	-0.0
5	106	106	5702224.0	5702224.0	-0.0	-0.0
6	93	93	5496967.0	5496967.0	0.0	0.0
7	71	71	5712160.0	5712160.0	0.0	0.0
8	75	75	5737247.0	5737247.0	-0.0	-0.0
9	81	81	5047753.0	5047753.0	0.0	0.0
10	54	54	4368044.0	4368044.0	0.0	0.0
11	90	90	3596151.0	3596151.0	0.0	0.0
12	70	70	5669334.0	5669334.0	-0.0	-0.0
13	38	38	4063067.0	4063067.0	0.0	0.0
14	119	119	9687979.0	9687979.0	-0.0	-0.0
15	172	172	8662876.0	8662876.0	-0.0	-0.0
16	152	152	7173363.0	7173363.0	0.0	0.0
17	114	114	5931446.0	5931446.0	0.0	0.0
18	87	87	5700193.0	5700193.0	0.0	0.0
19	89	89	6072202.0	6072202.0	-0.0	-0.0
20	86	86	6235032.0	6235032.0	-0.0	-0.0
21	77	77	5598004.0	5598004.0	0.0	0.0
22	89	89	5031207.0	5031207.0	-0.0	-0.0
23	89	89	4536199.0	4536199.0	0.0	0.0
24	116	116	8894611.0	8894611.0	-0.0	-0.0
25	1154	2581	64317000.0	64317000.0	0.0	0.0
26	1856	1856	96222000.0	96222000.0	-0.0	-0.0
27	193	193	33682000.0	33682000.0	0.0	0.0
28	1227	1227	72393000.0	72393000.0	-0.0	-0.0
29	172	172	14767000.0	14767000.0	0.0	0.0
30	355	355	25545000.0	25545000.0	0.0	0.0

31	322	322	18237000.0	18237000.0	0.0	0.0
32	705	705	42353000.0	42353000.0	0.0	0.0
33	254	254	14518000.0	14518000.0	-0.0	-0.0
34	1447	1447	81437163.0	81437163.0	-0.0	-0.0
35	463	463	25245521.0	25245521.0	-0.0	-0.0

```
cases : number of microunits in the sample
Z : sum of old adjustment factors (old weights)
sum: unweighted sum
Z : sum weighted by old adjustment factors (old weights)


Adjustment complete.
```

APPENDIX C: Adjustment Logfile, 1985

```
adjustment logfile
Adjust Version 1.1.8.6
Wednesday, 02-02-05     12:07


Reading restrictions file (r-vektor atus85.dat)...
Number of restrictions found: 36

Reading S-Matrix file (s-matrix atus85.dat, increased compatibility mode)...
Number of microunits found: 4560
```

I	cases	sum	Z	R	Z-R	(Z-R)/R %
1	66	66	3094652.0	3841017.0	-746365.0	-19.4
2	200	200	9876899.1	10670549.0	-793649.9	-7.4
3	240	240	9274499.6	10887657.0	-1613157.4	-14.8
4	238	238	9408288.3	10019185.0	-610896.7	-6.1
5	233	233	8059894.2	8797913.0	-738018.8	-8.4
6	172	172	6532881.7	6964647.0	-431765.3	-6.2
7	132	132	4589443.1	5699630.0	-1110186.9	-19.5
8	138	138	5331235.0	5253668.0	77567.0	1.5
9	126	126	4772264.3	5320599.0	-548334.7	-10.3
10	126	126	5498646.0	5053423.0	445223.0	8.8
11	105	105	4132039.8	4206036.0	-73996.2	-1.8
12	245	245	9470629.8	7259226.0	2211403.8	30.5
13	80	80	3561861.7	3730063.0	-168201.3	-4.5
14	228	228	9864641.0	10477262.0	-612621.0	-5.8
15	283	283	10101047.6	10854516.0	-753468.4	-6.9
16	298	298	11563967.6	10148768.0	1415199.6	13.9
17	288	288	10503464.4	9041560.0	1461904.4	16.2
18	192	192	6469839.9	7220447.0	-750607.1	-10.4
19	183	183	6826726.5	5959224.0	867502.5	14.6
20	156	156	5526314.3	5615061.0	-88746.7	-1.6
21	173	173	7713164.4	5889797.0	1823367.4	31.0
22	151	151	5461171.1	5849526.0	-388354.9	-6.6
23	134	134	4881886.9	5189190.0	-307303.1	-5.9
24	373	373	16819202.2	11937666.0	4881536.2	40.9
25	1612	2926	115097516.4	60784000.0	54313516.4	89.4
26	2838	2838	109751572.3	102217000.0	7534572.3	7.4
27	893	893	33514772.5	44042000.0	-10527227.5	-23.9
28	2702	2702	109527774.1	89201000.0	20326774.1	22.8
29	521	521	20143255.5	19226000.0	917255.5	4.8
30	334	334	20163569.9	19893000.0	270569.9	1.4
31	367	367	18347615.8	17553000.0	794615.8	4.5
32	1602	1602	58531860.1	54866000.0	3665860.1	6.7
33	617	617	23007455.3	23405000.0	-397544.7	-1.7
34	608	608	16896953.6	27808000.0	-10911046.4	-39.2
35	2608	2608	101215012.0	95894354.0	5320658.0	5.5
36	603	603	27654686.7	29876633.0	-2221946.3	-7.4

```
cases : number of microunits in the sample
sum: unweighted sum
Z : sum weighted by old adjustment factors (old weights)
R : restrictions to be achieved


Begin optimization process.

Information shown for each iteration include:
L : position in steplength vector
step : steplength
D²min/D²max : minimum/maximum of D²  (D=Z(I)-R(I))
Imin/Imax : Index I to D²min/D²max
* : next actual step
```

Current Iteration: 0

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	6.869988e+013	25	2.031648e+018
2	1.00000	29	7.277173e+019	28	5.632540e+020
3 *	2.50000	23	1.354339e+024	33	8.859243e+034

Current Iteration: 1

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	5.186072e+015	25	5.663097e+021
2	1.00000	11	1.833464e+015	34	4.481615e+018
3 *	2.50000	11	4.676575e+013	26	5.497497e+018

Current Iteration: 2

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	6.565129e+014	17	4.294798e+018
2	1.00000	11	2.165913e+014	32	2.176732e+018
3 *	1.09421	11	1.732453e+014	25	2.329934e+020

Current Iteration: 3

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	7.440728e+013	28	3.697382e+018
2	1.00000	11	2.027634e+013	25	3.801783e+019
3 *	1.09402	11	1.514388e+013	25	3.148271e+019

Current Iteration: 4

L	Step	Imin	D²min	Imax	D²max
1 *	0.50000	11	6.422006e+012	26	7.435807e+017
2	1.00000	23	1.009508e+012	25	5.183866e+018
3	1.09373	23	5.559014e+011	25	4.302233e+018

Current Iteration: 5

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	3.215185e+011	25	1.937425e+018
2 *	1.00000	11	4.872999e+010	25	7.475902e+017
3	1.09413	11	2.681120e+010	25	6.271073e+017

Current Iteration: 6

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	2.192344e+010	25	2.868887e+017
2 *	1.00000	11	2.182439e+010	25	1.198468e+017
3	1.09949	11	2.435619e+010	25	1.017606e+017

Current Iteration: 7

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	8.392755e+009	25	4.657845e+016
2 *	1.00000	11	4.915422e+009	25	1.971595e+016
3	1.11206	11	4.893671e+009	25	1.639146e+016

Current Iteration: 8

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	1.916296e+009	25	7.357683e+015
2 *	1.00000	11	1.184170e+009	25	2.679891e+015
3	1.11650	11	1.197350e+009	25	2.088703e+015

Current Iteration: 9

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	3.823251e+008	25	8.821421e+014
2 *	1.00000	11	8.529533e+007	25	1.816460e+014
3	1.09797	11	5.971285e+007	25	1.168140e+014

Current Iteration: 10

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	2.333862e+007	25	5.088393e+013
2 *	1.00000	11	7.128171e+005	25	2.256073e+012
3	1.04797	11	2.335857e+005	25	9.909379e+011

Current Iteration: 11

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	1.804698e+005	25	5.729006e+011
2 *	1.00000	11	1.140674e+002	25	5.479273e+008
3	1.00834	11	1.458576e+001	25	1.270895e+008

Current Iteration: 12

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	2.852322e+001	25	1.370160e+008
2 *	1.00000	36	1.330537e-001	25	3.407423e+001
3	1.00016	36	1.797003e-002	25	4.735204e+000

Current Iteration: 13

L	Step	Imin	D²min	Imax	D²max
1	0.50000	36	3.326343e-002	25	8.518559e+000
2	1.00000	36	8.673617e-015	36	8.673617e-015
3 *	1.00000	36	6.120104e-015	36	6.120104e-015

Current Iteration: 14

L	Step	Imin	D²min	Imax	D²max
1	0.50000	36	3.469447e-016	36	3.469447e-016
2	1.00000	36	1.249001e-016	36	1.249001e-016
3 *	1.00000	36	1.249001e-016	36	1.249001e-016

Convergence achieved.

I	cases	sum	Z	R	Z-R	(Z-R)/R %
1	66	66	3841017.0	3841017.0	0.0	0.0
2	200	200	10670549.0	10670549.0	0.0	0.0
3	240	240	10887657.0	10887657.0	0.0	0.0
4	238	238	10019185.0	10019185.0	-0.0	-0.0
5	233	233	8797913.0	8797913.0	-0.0	-0.0
6	172	172	6964647.0	6964647.0	-0.0	-0.0
7	132	132	5699630.0	5699630.0	0.0	0.0
8	138	138	5253668.0	5253668.0	0.0	0.0
9	126	126	5320599.0	5320599.0	-0.0	-0.0
10	126	126	5053423.0	5053423.0	0.0	0.0
11	105	105	4206036.0	4206036.0	0.0	0.0
12	245	245	7259226.0	7259226.0	-0.0	-0.0
13	80	80	3730063.0	3730063.0	0.0	0.0
14	228	228	10477262.0	10477262.0	-0.0	-0.0
15	283	283	10854516.0	10854516.0	0.0	0.0
16	298	298	10148768.0	10148768.0	-0.0	-0.0
17	288	288	9041560.0	9041560.0	-0.0	-0.0
18	192	192	7220447.0	7220447.0	0.0	0.0
19	183	183	5959224.0	5959224.0	0.0	0.0
20	156	156	5615061.0	5615061.0	-0.0	-0.0
21	173	173	5889797.0	5889797.0	-0.0	-0.0
22	151	151	5849526.0	5849526.0	-0.0	-0.0
23	134	134	5189190.0	5189190.0	0.0	0.0
24	373	373	11937666.0	11937666.0	0.0	0.0
25	1612	2926	60784000.0	60784000.0	-0.0	-0.0
26	2838	2838	102217000.0	102217000.0	-0.0	-0.0
27	893	893	44042000.0	44042000.0	0.0	0.0
28	2702	2702	89201000.0	89201000.0	0.0	0.0
29	521	521	19226000.0	19226000.0	-0.0	-0.0
30	334	334	19893000.0	19893000.0	-0.0	-0.0

31	367	367	17553000.0	17553000.0	0.0	0.0
32	1602	1602	54866000.0	54866000.0	0.0	0.0
33	617	617	23405000.0	23405000.0	0.0	0.0
34	608	608	27808000.0	27808000.0	-0.0	-0.0
35	2608	2608	95894354.0	95894354.0	0.0	0.0
36	603	603	29876633.0	29876633.0	-0.0	-0.0

cases : number of microunits in the sample
Z : sum of old adjustment factors (old weights)
sum: unweighted sum
Z : sum weighted by old adjustment factors (old weights)

Adjustment complete.

APPENDIX D: Adjustment Logfile, 1985c

```
adjustment logfile
Adjust Version 1.1.8.9
Tuesday, 28-06-05     09:11


Reading restrictions file (r-vektor atus85.dat)...
Number of restrictions found: 36

Reading S-Matrix file (s-matrix atus85.dat, increased compatibility mode)...
Number of microunits found: 2811
```

I	cases	sum	Z	R	Z-R	(Z-R)/R %
1	42	42	2627975.3	3841017.0	-1213041.7	-31.6
2	137	137	8572205.1	10670549.0	-2098343.9	-19.7
3	157	157	9823621.9	10887657.0	-1064035.1	-9.8
4	147	147	9197913.5	10019185.0	-821271.5	-8.2
5	147	147	9197913.5	8797913.0	400000.5	4.5
6	98	98	6131942.3	6964647.0	-832704.7	-12.0
7	87	87	5443663.1	5699630.0	-255966.9	-4.5
8	86	86	5381092.2	5253668.0	127424.2	2.4
9	77	77	4817954.7	5320599.0	-502644.3	-9.4
10	73	73	4567671.3	5053423.0	-485751.7	-9.6
11	63	63	3941962.9	4206036.0	-264073.1	-6.3
12	178	178	11137609.5	7259226.0	3878383.5	53.4
13	59	59	3691679.6	3730063.0	-38383.4	-1.0
14	148	148	9260484.3	10477262.0	-1216777.7	-11.6
15	174	174	10887326.2	10854516.0	32810.2	0.3
16	168	168	10511901.1	10148768.0	363133.1	3.6
17	164	164	10261617.8	9041560.0	1220057.8	13.5
18	117	117	7320788.3	7220447.0	100341.3	1.4
19	113	113	7070504.9	5959224.0	1111280.9	18.6
20	96	96	6006800.6	5615061.0	391739.6	7.0
21	99	99	6194513.2	5889797.0	304716.2	5.2
22	85	85	5318521.4	5849526.0	-531004.6	-9.1
23	67	67	4192246.3	5189190.0	-996943.7	-19.2
24	229	229	14328722.4	11937666.0	2391056.4	20.0
25	988	1701	106432998.8	60784000.0	45648998.8	75.1
26	1772	1772	110875528.5	102217000.0	8658528.5	8.5
27	574	574	35915662.2	44042000.0	-8126337.8	-18.5
28	1483	1483	92792555.7	89201000.0	3591555.7	4.0
29	268	268	16768985.1	19226000.0	-2457014.9	-12.8
30	182	182	11387892.9	19893000.0	-8505107.1	-42.8
31	219	219	13703014.0	17553000.0	-3849986.0	-21.9
32	991	991	62007702.4	54866000.0	7141702.4	13.0
33	377	377	23589206.7	23405000.0	184206.7	0.8
34	377	377	23589206.7	27808000.0	-4218793.3	-15.2
35	1641	1641	102678748.4	95894354.0	6784394.4	7.1
36	317	317	19834956.3	29876633.0	-10041676.7	-33.6

```
cases : number of microunits in the sample
sum: unweighted sum
Z : sum weighted by old adjustment factors (old weights)
R : restrictions to be achieved


Begin optimization process.

Information shown for each iteration include:
L : position in steplength vector
step : steplength
D²min/D²max : minimum/maximum of D²  (D=Z(I)-R(I))
Imin/Imax : Index I to D²min/D²max
* : next actual step
```

Current Iteration: 0					
L	Step	Imin	D²min	Imax	D²max
1	0.50000	1	1.643670e+013	25	1.210286e+018
2	1.00000	23	4.096196e+015	36	4.032167e+018
3 *	2.50000	31	1.135171e+029	17	4.256930e+032

Current Iteration: 1					
L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	1.473146e+015	17	5.081523e+018
2	1.00000	23	4.950330e+014	34	3.059500e+018
3 *	2.50000	23	2.772734e+012	26	2.251952e+018

Current Iteration: 2					
L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	1.717728e+014	32	3.439545e+018
2	1.00000	23	4.918559e+013	35	4.440949e+018
3 *	1.09406	23	3.743511e+013	26	5.394321e+018

Current Iteration: 3					
L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	1.578655e+013	26	2.384150e+018
2	1.00000	23	2.897874e+012	25	9.297882e+018
3 *	1.09364	23	1.810598e+012	25	7.700135e+018

Current Iteration: 4					
L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	8.536542e+011	25	3.430453e+018
2 *	1.00000	23	7.498791e+010	25	1.268788e+018
3	1.09291	23	2.733260e+010	25	1.054382e+018

Current Iteration: 5					
L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	3.338083e+010	25	4.755220e+017
2 *	1.00000	11	2.559469e+010	25	1.839922e+017
3	1.09300	11	1.527565e+010	25	1.546229e+017

Current Iteration: 6

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	1.093664e+010	25	6.992703e+016
2 *	1.00000	11	9.819896e+009	25	2.793459e+016
3	1.09836	11	1.083043e+010	25	2.340968e+016

Current Iteration: 7

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	3.250125e+009	25	1.028005e+016
2 *	1.00000	11	8.735382e+008	25	3.619959e+015
3	1.10500	11	6.561230e+008	25	2.866323e+015

Current Iteration: 8

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	2.937282e+008	25	1.206241e+015
2 *	1.00000	11	8.447327e+007	25	2.676785e+014
3	1.09030	11	6.731679e+007	25	1.849144e+014

Current Iteration: 9

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	2.501846e+007	25	7.635982e+013
2 *	1.00000	11	2.554752e+006	25	4.442634e+012
3	1.05147	11	1.666736e+006	25	2.175205e+012

Current Iteration: 10

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	6.532542e+005	25	1.135179e+012
2 *	1.00000	11	1.305802e+003	25	2.102727e+009
3	1.01119	11	3.632729e+002	25	5.424454e+008

Current Iteration: 11

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	3.266079e+002	25	5.259411e+008
2 *	1.00000	31	7.248102e-001	25	5.118369e+002
3	1.00031	36	2.524878e-001	25	7.384677e+001

Current Iteration: 12

L	Step	Imin	D²min	Imax	D²max
1	0.50000	36	4.145443e-001	25	1.279593e+002
2	1.00000	36	9.560408e-014	36	9.560408e-014
3 *	1.00000	36	1.088019e-014	36	1.088019e-014

Current Iteration: 13

L	Step	Imin	D²min	Imax	D²max
1	0.50000	36	2.003953e-014	36	2.003953e-014
2	1.00000	36	1.124101e-015	36	1.124101e-015
3 *	1.00000	36	1.124101e-015	36	1.124101e-015

Convergence achieved.

I	cases	sum	Z	R	Z-R	(Z-R)/R %
1	42	42	3841017.0	3841017.0	-0.0	-0.0
2	137	137	10670549.0	10670549.0	0.0	0.0
3	157	157	10887657.0	10887657.0	0.0	0.0
4	147	147	10019185.0	10019185.0	0.0	0.0
5	147	147	8797913.0	8797913.0	-0.0	-0.0
6	98	98	6964647.0	6964647.0	0.0	0.0
7	87	87	5699630.0	5699630.0	-0.0	-0.0
8	86	86	5253668.0	5253668.0	0.0	0.0
9	77	77	5320599.0	5320599.0	-0.0	-0.0
10	73	73	5053423.0	5053423.0	0.0	0.0
11	63	63	4206036.0	4206036.0	0.0	0.0
12	178	178	7259226.0	7259226.0	0.0	0.0
13	59	59	3730063.0	3730063.0	0.0	0.0
14	148	148	10477262.0	10477262.0	0.0	0.0
15	174	174	10854516.0	10854516.0	-0.0	-0.0
16	168	168	10148768.0	10148768.0	0.0	0.0
17	164	164	9041560.0	9041560.0	0.0	0.0
18	117	117	7220447.0	7220447.0	0.0	0.0
19	113	113	5959224.0	5959224.0	0.0	0.0
20	96	96	5615061.0	5615061.0	-0.0	-0.0
21	99	99	5889797.0	5889797.0	0.0	0.0
22	85	85	5849526.0	5849526.0	0.0	0.0
23	67	67	5189190.0	5189190.0	-0.0	-0.0
24	229	229	11937666.0	11937666.0	0.0	0.0
25	988	1701	60784000.0	60784000.0	-0.0	-0.0
26	1772	1772	102217000.0	102217000.0	0.0	0.0
27	574	574	44042000.0	44042000.0	-0.0	-0.0
28	1483	1483	89201000.0	89201000.0	0.0	0.0
29	268	268	19226000.0	19226000.0	0.0	0.0
30	182	182	19893000.0	19893000.0	0.0	0.0
31	219	219	17553000.0	17553000.0	-0.0	-0.0
32	991	991	54866000.0	54866000.0	0.0	0.0
33	377	377	23405000.0	23405000.0	0.0	0.0
34	377	377	27808000.0	27808000.0	-0.0	-0.0
35	1641	1641	95894354.0	95894354.0	-0.0	-0.0
36	317	317	29876633.0	29876633.0	-0.0	-0.0

cases : number of microunits in the sample
Z : sum of old adjustment factors (old weights)
sum: unweighted sum
Z : sum weighted by old adjustment factors (old weights)
Adjustment complete.

APPENDIX E: Adjustment Logfile, 1992-94

```
adjustment logfile
Adjust Version 1.1.8.6
Wednesday, 02-02-05     17:57


Reading restrictions file (r-vektor atus98.dat)...
Number of restrictions found: 34

Reading S-Matrix file (s-matrix atus92.dat, increased compatibility mode)...
Number of microunits found: 7297
```

I	cases	sum	Z	R	Z-R	(Z-R)/R %
1	49	49	982605.9	3570727.0	-2588121.1	-72.5
2	122	122	2547593.1	9506702.0	-6959108.9	-73.2
3	183	183	3948602.8	9718386.0	-5769783.2	-59.4
4	193	193	4446627.5	11069951.0	-6623323.5	-59.8
5	227	227	5385456.5	10779896.0	-5394439.5	-50.0
6	240	240	6080213.2	9550162.0	-3469948.8	-36.3
7	310	310	9472981.3	7907584.0	1565397.3	19.8
8	302	302	9127339.3	6274160.0	2853179.3	45.5
9	358	358	9733362.2	5153959.0	4579403.2	88.9
10	381	381	10813091.5	4781116.0	6031975.5	126.2
11	368	368	9494255.8	4508024.0	4986231.8	110.6
12	359	359	11113294.0	8867436.0	2245858.0	25.3
13	77	77	1178907.1	3401195.0	-2222287.9	-65.3
14	256	256	4526625.9	9195636.0	-4669010.1	-50.8
15	260	260	5045854.1	9698740.0	-4652885.9	-48.0
16	256	256	5301201.1	11158397.0	-5857195.9	-52.5
17	258	258	5857748.1	10909318.0	-5051569.9	-46.3
18	318	318	8406619.5	9790668.0	-1384048.5	-14.1
19	351	351	9637478.9	8205987.0	1431491.9	17.4
20	381	381	11548758.5	6633198.0	4915560.5	74.1
21	409	409	13785806.0	5598891.0	8186915.0	146.2
22	430	430	13165600.0	5404942.0	7760658.0	143.6
23	382	382	11007922.3	5501735.0	5506187.3	100.1
24	388	388	11514974.4	14076548.0	-2561573.6	-18.2
25	1660	3124	148285102.1	65053000.0	83232102.1	127.9
26	4012	4012	108940890.3	99698000.0	9242890.3	9.3
27	740	740	21530532.9	21691000.0	-160467.1	-0.7
28	121	121	3534587.1	15127000.0	-11592412.9	-76.6
29	440	440	12296335.8	17067000.0	-4770664.2	-28.0
30	2222	2222	63438191.5	57589000.0	5849191.5	10.2
31	1589	1589	44279602.4	37451000.0	6828602.4	18.2
32	1946	1946	50500027.3	35590000.0	14910027.3	41.9
33	4275	4275	111710270.9	104801840.0	6908430.9	6.6
34	1391	1391	37315991.1	32488570.0	4827421.1	14.9

```
cases : number of microunits in the sample
sum: unweighted sum
Z : sum weighted by old adjustment factors (old weights)
R : restrictions to be achieved


Begin optimization process.

Information shown for each iteration include:
L : position in steplength vector
step : steplength
D²min/D²max : minimum/maximum of D²  (D=Z(I)-R(I))
Imin/Imax : Index I to D²min/D²max
* : next actual step
```

Current Iteration: 0					
L	Step	Imin	D²min	Imax	D²max
1	0.50000	3	1.326520e+010	25	1.928354e+018
2	1.00000	13	8.691071e+010	10	3.989466e+018
3 *	2.50000	25	4.063617e+038	5	9.801922e+023

Current Iteration: 1					
L	Step	Imin	D²min	Imax	D²max
1	0.50000	13	2.066643e+010	30	1.156414e+020
2	1.00000	13	2.198811e+008	30	4.239719e+019
3 *	2.50000	13	2.913923e+011	33	3.044394e+018

Current Iteration: 2					
L	Step	Imin	D²min	Imax	D²max
1	0.50000	13	6.359745e+007	25	1.041181e+021
2	1.00000	13	5.117691e+006	30	5.680135e+018
3 *	1.09433	1	7.438314e+005	30	4.691512e+018

Current Iteration: 3					
L	Step	Imin	D²min	Imax	D²max
1	0.50000	13	1.238872e+007	33	3.173117e+018
2	1.00000	13	9.544848e+007	25	5.212923e+019
3 *	1.09436	13	1.331106e+008	25	4.320363e+019

Current Iteration: 4					
L	Step	Imin	D²min	Imax	D²max
1 *	0.50000	13	1.360447e+008	33	4.170724e+017
2	1.00000	13	7.842267e+008	25	7.215508e+018
3	1.09467	13	1.078809e+009	25	5.997942e+018

Current Iteration: 5					
L	Step	Imin	D²min	Imax	D²max
1	0.50000	13	5.921724e+008	25	2.698580e+018
2 *	1.00000	13	1.804916e+009	25	1.045804e+018
3	1.09637	13	2.367226e+009	25	8.750026e+017

Current Iteration: 6

L	Step	Imin	D²min	Imax	D²max
1	0.50000	13	7.161690e+008	25	4.003651e+017
2 *	1.00000	13	4.928856e+008	25	1.662558e+017
3	1.10142	13	5.134037e+008	25	1.404890e+017

Current Iteration: 7

L	Step	Imin	D²min	Imax	D²max
1	0.50000	13	1.751014e+008	25	6.678868e+016
2 *	1.00000	13	7.099567e+007	25	3.109007e+016
3	1.11249	13	6.246195e+007	25	2.659013e+016

Current Iteration: 8

L	Step	Imin	D²min	Imax	D²max
1	0.50000	13	2.930798e+007	25	1.230722e+016
2 *	1.00000	13	2.266674e+007	25	5.303735e+015
3	1.13589	13	2.483546e+007	25	4.241209e+015

Current Iteration: 9

L	Step	Imin	D²min	Imax	D²max
1	0.50000	13	7.100257e+006	25	1.817374e+015
2 *	1.00000	13	1.281167e+006	25	4.632691e+014
3	1.12617	13	6.944814e+005	25	2.960965e+014

Current Iteration: 10

L	Step	Imin	D²min	Imax	D²max
1	0.50000	13	3.350557e+005	25	1.355013e+014
2 *	1.00000	13	2.659498e+003	25	1.074639e+013
3	1.06128	13	1.271704e+002	25	5.489429e+012

Current Iteration: 11

L	Step	Imin	D²min	Imax	D²max
1	0.50000	13	6.734527e+002	25	2.774356e+012
2 *	1.00000	13	4.398812e-001	25	1.097215e+010
3	1.01512	13	9.256431e-003	25	3.402834e+009

Current Iteration: 12

L	Step	Imin	D²min	Imax	D²max
1	0.50000	13	1.100343e-001	25	2.746007e+009
2 *	1.00000	18	7.440510e-001	25	1.283843e+004
3	1.00065	23	7.119580e-001	25	2.039436e+003

Current Iteration: 13

L	Step	Imin	D²min	Imax	D²max
1	0.50000	19	8.806441e-001	25	3.209611e+003
2	1.00000	34	7.334967e-011	34	7.334967e-011
3 *	1.00000	34	1.033575e-011	34	1.033575e-011

Current Iteration: 14

L	Step	Imin	D²min	Imax	D²max
1	0.50000	34	1.828959e-011	34	1.828959e-011
2	1.00000	34	2.345346e-015	34	2.345346e-015
3 *	1.00000	34	2.345346e-015	34	2.345346e-015

Convergence achieved.

I	cases	sum	Z	R	Z-R	(Z-R)/R %
1	49	49	3570727.0	3570727.0	0.0	0.0
2	122	122	9506702.0	9506702.0	-0.0	-0.0
3	183	183	9718386.0	9718386.0	-0.0	-0.0
4	193	193	11069951.0	11069951.0	0.0	0.0
5	227	227	10779896.0	10779896.0	-0.0	-0.0
6	240	240	9550162.0	9550162.0	0.0	0.0
7	310	310	7907584.0	7907584.0	0.0	0.0
8	302	302	6274160.0	6274160.0	0.0	0.0
9	358	358	5153959.0	5153959.0	0.0	0.0
10	381	381	4781116.0	4781116.0	-0.0	-0.0
11	368	368	4508024.0	4508024.0	-0.0	-0.0
12	359	359	8867436.0	8867436.0	0.0	0.0
13	77	77	3401195.0	3401195.0	-0.0	-0.0
14	256	256	9195636.0	9195636.0	0.0	0.0
15	260	260	9698740.0	9698740.0	0.0	0.0
16	256	256	11158397.0	11158397.0	0.0	0.0
17	258	258	10909318.0	10909318.0	-0.0	-0.0
18	318	318	9790668.0	9790668.0	0.0	0.0
19	351	351	8205987.0	8205987.0	0.0	0.0
20	381	381	6633198.0	6633198.0	-0.0	-0.0
21	409	409	5598891.0	5598891.0	-0.0	-0.0
22	430	430	5404942.0	5404942.0	-0.0	-0.0
23	382	382	5501735.0	5501735.0	-0.0	-0.0
24	388	388	14076548.0	14076548.0	-0.0	-0.0
25	1660	3124	65053000.0	65053000.0	0.0	0.0
26	4012	4012	99698000.0	99698000.0	0.0	0.0
27	740	740	21691000.0	21691000.0	0.0	0.0
28	121	121	15127000.0	15127000.0	0.0	0.0
29	440	440	17067000.0	17067000.0	-0.0	-0.0
30	2222	2222	57589000.0	57589000.0	-0.0	-0.0

31	1589	1589	37451000.0	37451000.0	0.0	0.0
32	1946	1946	35590000.0	35590000.0	-0.0	-0.0
33	4275	4275	104801840.0	104801840.0	0.0	0.0
34	1391	1391	32488570.0	32488570.0	0.0	0.0

```
cases : number of microunits in the sample
Z : sum of old adjustment factors (old weights)
sum: unweighted sum
Z : sum weighted by old adjustment factors (old weights)


Adjustment complete.
```

APPENDIX F: Adjustment Logfile, 1998-99

```
adjustment logfile
Adjust Version 1.1.8.6
Wednesday, 02-02-05     15:46


Reading restrictions file (r-vektor atus98.dat)...
Number of restrictions found: 35

Reading S-Matrix file (s-matrix atus98.dat, increased compatibility mode)...
Number of microunits found: 1142
```

I	cases	sum	Z	R	Z-R	(Z-R)/R %
1	12	12	2153896.8	4053326.0	-1899429.3	-46.9
2	34	34	7716288.7	9040112.0	-1323823.3	-14.6
3	61	61	11297053.9	9202990.0	2094063.9	22.8
4	55	55	10168700.7	9922383.0	246317.7	2.5
5	65	65	9882292.5	11253107.0	-1370814.5	-12.2
6	63	63	9734003.9	10886210.0	-1152206.1	-10.6
7	45	45	10239069.5	9312659.0	926410.5	9.9
8	38	38	7475209.3	7734322.0	-259112.7	-3.4
9	21	21	5599807.4	6040932.0	-441124.6	-7.3
10	16	16	4837026.7	4884251.0	-47224.3	-1.0
11	26	26	5611744.7	4375310.0	1236434.7	28.3
12	35	35	6305064.5	9858514.0	-3553449.5	-36.0
13	20	20	5078334.2	3852206.0	1226128.2	31.8
14	49	49	7540660.3	8720108.0	-1179447.7	-13.5
15	58	58	9039963.8	9295932.0	-255968.2	-2.8
16	82	82	11166199.5	10096947.0	1069252.5	10.6
17	75	75	11179934.2	11364160.0	-184225.8	-1.6
18	80	80	13130816.1	11086204.0	2044612.1	18.4
19	55	55	8912954.9	9668866.0	-755911.1	-7.8
20	44	44	6546823.0	8167797.0	-1620974.0	-19.8
21	29	29	5661455.7	6539782.0	-878326.3	-13.4
22	25	25	5336951.3	5455166.0	-118214.7	-2.2
23	23	23	3820299.3	5171407.0	-1351107.7	-26.1
24	76	76	12410721.6	15040033.0	-2629311.4	-17.5
25	501	978	175318442.9	68419000.0	106899442.9	156.2
26	615	615	119886402.4	112552000.0	7334402.4	6.5
27	241	241	37439429.1	53939000.0	-16499570.9	-30.6
28	727	727	118855508.5	108770000.0	10085508.5	9.3
29	121	121	22132894.2	23655000.0	-1522105.8	-6.4
30	27	27	9233755.4	12782000.0	-3548244.6	-27.8
31	44	44	17518636.2	16776000.0	742636.2	4.4
32	302	302	56669531.4	58174000.0	-1504468.6	-2.6
33	246	246	42669687.4	42506000.0	163687.4	0.4
34	651	651	113064979.9	110700185.0	2364794.9	2.1
35	166	166	30115582.6	34146326.0	-4030743.4	-11.8

```
cases : number of microunits in the sample
sum: unweighted sum
Z : sum weighted by old adjustment factors (old weights)
R : restrictions to be achieved


Begin optimization process.

Information shown for each iteration include:
L : position in steplength vector
step : steplength
D²min/D²max : minimum/maximum of D²  (D=Z(I)-R(I))
Imin/Imax : Index I to D²min/D²max
* : next actual step
```

Current Iteration: 0

L	Step	Imin	D²min	Imax	D²max
1	0.50000	12	1.014558e+013	25	7.632672e+018
2	1.00000	23	3.735526e+015	6	4.609844e+018
3 *	2.50000	25	2.913903e+039	29	3.924100e+031

Current Iteration: 1

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	1.345456e+015	8	1.156087e+020
2	1.00000	23	4.542360e+014	34	3.755147e+020
3 *	2.50000	12	6.625903e+010	8	2.176083e+018

Current Iteration: 2

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	1.577376e+014	35	4.213333e+018
2	1.00000	23	4.525553e+013	27	4.330023e+018
3 *	1.09460	23	3.440280e+013	34	4.205767e+019

Current Iteration: 3

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	1.449036e+013	8	2.137954e+018
2	1.00000	12	2.401845e+012	34	6.818468e+018
3 *	1.09461	12	1.238107e+012	34	5.628309e+018

Current Iteration: 4

L	Step	Imin	D²min	Imax	D²max
1	0.50000	12	6.719850e+011	28	2.841031e+018
2	1.00000	12	2.959189e+010	28	1.019084e+018
3 *	1.09455	12	3.359098e+009	25	5.800521e+019

Current Iteration: 5

L	Step	Imin	D²min	Imax	D²max
1	0.50000	12	1.129767e+010	25	2.583536e+019
2 *	1.00000	23	1.209479e+009	25	9.574168e+018
3	1.09449	23	5.131765e+008	25	7.940061e+018

Current Iteration: 6

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	5.732006e+008	25	3.558427e+018
2 *	1.00000	23	6.830211e+008	25	1.352312e+018
3	1.09506	23	7.850406e+008	25	1.128152e+018

Current Iteration: 7

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	2.663839e+008	25	5.138012e+017
2 *	1.00000	23	1.689804e+008	25	2.091570e+017
3	1.09844	23	1.718375e+008	25	1.767342e+017

Current Iteration: 8

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	1.065604e+008	25	8.394893e+016
2 *	1.00000	11	1.925051e+008	25	3.962263e+016
3	1.10893	12	1.400550e+008	25	3.427680e+016

Current Iteration: 9

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	1.838050e+008	25	1.709545e+016
2 *	1.00000	11	6.763332e+008	25	9.181029e+015
3	1.13759	11	9.977778e+008	25	7.921061e+015

Current Iteration: 10

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	4.899421e+008	25	3.559197e+015
2 *	1.00000	11	1.257101e+009	25	1.422697e+015
3	1.17783	11	1.942108e+009	25	1.019190e+015

Current Iteration: 11

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	3.686094e+008	25	4.485431e+014
2 *	1.00000	11	3.290098e+007	25	6.945137e+013
3	1.12362	11	7.916023e+006	25	3.135728e+013

Current Iteration: 12

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	8.616380e+006	25	1.863164e+013
2 *	1.00000	11	7.140583e+004	25	3.365265e+011
3	1.03427	12	5.788580e+003	25	1.113203e+011

Current Iteration: 13

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	1.793423e+004	25	8.459404e+010
2 *	1.00000	12	1.469983e+000	25	1.009154e+007
3	1.00315	12	5.941271e-004	25	1.867577e+006

Current Iteration: 14

L	Step	Imin	D²min	Imax	D²max
1	0.50000	12	3.675031e-001	25	2.522962e+006
2	1.00000	35	4.539381e-005	35	4.539381e-005
3 *	1.00002	35	6.220965e-006	35	6.220965e-006

Current Iteration: 15

L	Step	Imin	D²min	Imax	D²max
1	0.50000	35	1.134838e-005	35	1.134838e-005
2	1.00000	35	0.000000e+000	35	0.000000e+000
3 *	1.00000	35	0.000000e+000	35	0.000000e+000

Convergence achieved.

I	cases	sum	Z	R	Z-R	(Z-R)/R %
1	12	12	4053326.0	4053326.0	-0.0	-0.0
2	34	34	9040112.0	9040112.0	0.0	0.0
3	61	61	9202990.0	9202990.0	0.0	0.0
4	55	55	9922383.0	9922383.0	-0.0	-0.0
5	65	65	11253107.0	11253107.0	0.0	0.0
6	63	63	10886210.0	10886210.0	0.0	0.0
7	45	45	9312659.0	9312659.0	0.0	0.0
8	38	38	7734322.0	7734322.0	-0.0	-0.0
9	21	21	6040932.0	6040932.0	0.0	0.0
10	16	16	4884251.0	4884251.0	-0.0	-0.0
11	26	26	4375310.0	4375310.0	-0.0	-0.0
12	35	35	9858514.0	9858514.0	0.0	0.0
13	20	20	3852206.0	3852206.0	0.0	0.0
14	49	49	8720108.0	8720108.0	-0.0	-0.0
15	58	58	9295932.0	9295932.0	-0.0	-0.0
16	82	82	10096947.0	10096947.0	0.0	0.0
17	75	75	11364160.0	11364160.0	0.0	0.0
18	80	80	11086204.0	11086204.0	0.0	0.0

19	55	55	9668866.0	9668866.0	0.0	0.0
20	44	44	8167797.0	8167797.0	-0.0	-0.0
21	29	29	6539782.0	6539782.0	0.0	0.0
22	25	25	5455166.0	5455166.0	0.0	0.0
23	23	23	5171407.0	5171407.0	0.0	0.0
24	76	76	15040033.0	15040033.0	-0.0	-0.0
25	501	978	68419000.0	68419000.0	0.0	0.0
26	615	615	112552000.0	112552000.0	0.0	0.0
27	241	241	53939000.0	53939000.0	0.0	0.0
28	727	727	108770000.0	108770000.0	-0.0	-0.0
29	121	121	23655000.0	23655000.0	0.0	0.0
30	27	27	12782000.0	12782000.0	0.0	0.0
31	44	44	16776000.0	16776000.0	-0.0	-0.0
32	302	302	58174000.0	58174000.0	-0.0	-0.0
33	246	246	42506000.0	42506000.0	0.0	0.0
34	651	651	110700185.0	110700185.0	-0.0	-0.0
35	166	166	34146326.0	34146326.0	0.0	0.0

cases : number of microunits in the sample
Z : sum of old adjustment factors (old weights)
sum: unweighted sum
Z : sum weighted by old adjustment factors (old weights)

Adjustment complete.

APPENDIX G: Files containing new weights

The files containing the new weights for the different ATUS-files are named “adjustment-results.txt” preceding the year of the ATUS study in the filename. The files are saved in the ASCII-code set, displaying numbers in the American numerical notation. They are following the CSV-guidelines containing one dataset in each line wherein the variables are separated by semicolons. In this case each line contains first the respondent’s identification code followed by the new weight.

APPENDIX DB: Adjustment Logfile, 1975-65

```
adjustment logfile
Adjust Version 1.1.8.9
Wednesday, 24-08-05     15:26


Reading restrictions file (r-vektor atus75-65.dat)...
Number of restrictions found: 35

Reading S-Matrix file (s-matrix atus75.dat, increased compatibility mode)...
Number of microunits found: 2406
```

I	cases	sum	Z	R	Z-R	(Z-R)/R %
1	17	17	1725754.6	3804236.0	-2078481.4	-54.6
2	102	102	7635399.7	6899289.0	736110.7	10.7
3	136	136	7871711.4	5612436.0	2259275.4	40.3
4	112	112	6729640.7	5517566.0	1212074.7	22.0
5	106	106	7022099.8	5898942.0	1123157.8	19.0
6	93	93	6332291.5	6058104.0	274187.5	4.5
7	71	71	4640472.0	5552528.0	-912056.0	-16.4
8	75	75	5039055.4	5101484.0	-62428.6	-1.2
9	81	81	5328429.3	4582681.0	745748.3	16.3
10	54	54	3480508.3	3583081.0	-102572.7	-2.9
11	90	90	4943420.0	2972192.0	1971228.0	66.3
12	70	70	3865517.5	5041923.0	-1176405.5	-23.3
13	38	38	3689671.9	3672040.0	17631.9	0.5
14	119	119	8172191.4	6847150.0	1325041.4	19.4
15	172	172	9033526.3	5727774.0	3305752.3	57.7
16	152	152	7892689.6	5607221.0	2285468.6	40.8
17	114	114	6829595.2	6121742.0	707853.2	11.6
18	87	87	5440723.7	6368258.0	-927534.3	-14.6
19	89	89	5540061.0	5827607.0	-287546.0	-4.9
20	86	86	5435787.7	5357560.0	78227.7	1.5
21	77	77	4809530.6	4922336.0	-112805.4	-2.3
22	89	89	5429617.7	3988792.0	1440825.7	36.1
23	89	89	4532496.7	3578099.0	954397.7	26.7
24	116	116	6084873.8	6859179.0	-774305.2	-11.3
25	1154	2581	159482060.0	68362000.0	91120060.0	133.3
26	1856	1856	113561069.4	84734000.0	28827069.4	34.0
27	193	193	14107133.6	31945000.0	-17837866.4	-55.8
28	1227	1227	78137750.2	65216000.0	12921750.2	19.8
29	172	172	10889468.2	11148000.0	-258531.8	-2.3
30	355	355	21798063.8	34045000.0	-12246936.2	-36.0
31	322	322	18155283.5	18617000.0	-461716.5	-2.5
32	705	705	43223458.4	31703000.0	11520458.4	36.3
33	254	254	13602426.2	9139000.0	4463426.2	48.8
34	1447	1447	88979709.4	68424498.0	20555211.4	30.0
35	463	463	28147014.3	21318185.0	6828829.3	32.0

```
cases : number of microunits in the sample
sum: unweighted sum
Z : sum weighted by old adjustment factors (old weights)
R : restrictions to be achieved


Begin optimization process.

Information shown for each iteration include:
L : position in steplength vector
step : steplength
D²min/D²max : minimum/maximum of D²  (D=Z(I)-R(I))
Imin/Imax : Index I to D²min/D²max
* : next actual step
```

Current Iteration: 0

L	Step	Imin	D²min	Imax	D²max
1	0.50000	24	2.270595e+013	25	7.089281e+018
2	1.00000	6	7.434624e+019	30	3.710331e+020
3 *	2.50000	20	5.334993e+032	31	7.226503e+032

Current Iteration: 1

L	Step	Imin	D²min	Imax	D²max
1	0.50000	24	1.295640e+015	15	5.171113e+018
2	1.00000	24	4.296908e+014	3	4.615849e+018
3 *	2.50000	24	5.742888e+011	32	3.302239e+018

Current Iteration: 2

L	Step	Imin	D²min	Imax	D²max
1	0.50000	30	1.847476e+019	5	4.318216e+018
2	1.00000	24	3.978567e+013	35	3.220111e+018
3 *	1.09480	24	2.949339e+013	30	5.609008e+018

Current Iteration: 3

L	Step	Imin	D²min	Imax	D²max
1	0.50000	24	1.244406e+013	32	3.310822e+018
2	1.00000	24	1.885172e+012	34	4.263098e+018
3 *	1.09486	24	1.044318e+012	34	3.519479e+018

Current Iteration: 4

L	Step	Imin	D²min	Imax	D²max
1	0.50000	24	5.296980e+011	26	2.796307e+018
2	1.00000	24	2.490304e+010	25	2.946957e+019
3 *	1.09483	24	3.288984e+009	26	8.303770e+017

Current Iteration: 5

L	Step	Imin	D²min	Imax	D²max

1 *	0.50000	24	9.624774e+009	25	1.088791e+019
2	1.00000	24	5.972734e+009	25	4.052731e+018
3	1.09480	24	6.054372e+009	25	3.362347e+018

Current Iteration: 6

L	Step	Imin	D²min	Imax	D²max
1	0.50000	24	4.558876e+009	25	1.508589e+018
2 *	1.00000	10	5.706124e+009	25	5.744488e+017
3	1.09555	10	3.577560e+009	25	4.788043e+017

Current Iteration: 7

L	Step	Imin	D²min	Imax	D²max
1	0.50000	10	2.976600e+009	25	2.168075e+017
2 *	1.00000	22	1.381495e+009	25	8.574183e+016
3	1.09864	22	1.204090e+009	25	7.174072e+016

Current Iteration: 8

L	Step	Imin	D²min	Imax	D²max
1	0.50000	22	4.982787e+008	25	3.298482e+016
2 *	1.00000	22	2.202171e+008	25	1.354327e+016
3	1.10436	22	2.014480e+008	25	1.130069e+016

Current Iteration: 9

L	Step	Imin	D²min	Imax	D²max
1	0.50000	22	1.418232e+008	25	4.978932e+015
2 *	1.00000	22	3.118998e+008	25	1.722034e+015
3	1.11217	22	4.041814e+008	25	1.329733e+015

Current Iteration: 10

L	Step	Imin	D²min	Imax	D²max
1	0.50000	22	1.062786e+008	25	5.464229e+014
2 *	1.00000	22	3.413021e+007	25	8.949628e+013
3	1.09206	22	2.836678e+007	25	5.266202e+013

Current Iteration: 11

L	Step	Imin	D²min	Imax	D²max
1	0.50000	22	9.104136e+006	25	2.425071e+013
2 *	1.00000	24	1.096586e+005	25	5.644929e+011
3	1.03576	24	1.221601e+004	25	2.169160e+011

Current Iteration: 12

L	Step	Imin	D²min	Imax	D²max
1	0.50000	24	2.753015e+004	25	1.421621e+011
2 *	1.00000	24	1.942660e+000	25	3.029522e+007
3	1.00410	24	2.246835e-003	25	6.093174e+006

Current Iteration: 13

L	Step	Imin	D²min	Imax	D²max
1	0.50000	24	4.856831e-001	25	7.574213e+006
2	1.00000	35	3.257355e-004	35	3.257355e-004
3 *	1.00003	35	4.500731e-005	35	4.500731e-005

Current Iteration: 14

L	Step	Imin	D²min	Imax	D²max
1	0.50000	35	8.143382e-005	35	8.143382e-005
2	1.00000	35	6.800116e-016	35	6.800116e-016
3 *	1.00000	35	6.800116e-016	35	6.800116e-016

Convergence achieved.

I	cases	sum	Z	R	Z-R	(Z-R)/R %
1	17	17	3804236.0	3804236.0	0.0	0.0
2	102	102	6899289.0	6899289.0	-0.0	-0.0
3	136	136	5612436.0	5612436.0	0.0	0.0
4	112	112	5517566.0	5517566.0	-0.0	-0.0
5	106	106	5898942.0	5898942.0	0.0	0.0
6	93	93	6058104.0	6058104.0	-0.0	-0.0
7	71	71	5552528.0	5552528.0	0.0	0.0
8	75	75	5101484.0	5101484.0	0.0	0.0
9	81	81	4582681.0	4582681.0	0.0	0.0
10	54	54	3583081.0	3583081.0	0.0	0.0
11	90	90	2972192.0	2972192.0	-0.0	-0.0
12	70	70	5041923.0	5041923.0	0.0	0.0
13	38	38	3672040.0	3672040.0	-0.0	-0.0
14	119	119	6847150.0	6847150.0	-0.0	-0.0
15	172	172	5727774.0	5727774.0	0.0	0.0
16	152	152	5607221.0	5607221.0	-0.0	-0.0
17	114	114	6121742.0	6121742.0	0.0	0.0
18	87	87	6368258.0	6368258.0	0.0	0.0
19	89	89	5827607.0	5827607.0	-0.0	-0.0

20	86	86	5357560.0	5357560.0	0.0	0.0
21	77	77	4922336.0	4922336.0	0.0	0.0
22	89	89	3988792.0	3988792.0	-0.0	-0.0
23	89	89	3578099.0	3578099.0	-0.0	-0.0
24	116	116	6859179.0	6859179.0	-0.0	-0.0
25	1154	2581	68362000.0	68362000.0	0.0	0.0
26	1856	1856	84734000.0	84734000.0	0.0	0.0
27	193	193	31945000.0	31945000.0	0.0	0.0
28	1227	1227	65216000.0	65216000.0	0.0	0.0
29	172	172	11148000.0	11148000.0	-0.0	-0.0
30	355	355	34045000.0	34045000.0	0.0	0.0
31	322	322	18617000.0	18617000.0	-0.0	-0.0
32	705	705	31703000.0	31703000.0	-0.0	-0.0
33	254	254	9139000.0	9139000.0	-0.0	-0.0
34	1447	1447	68424498.0	68424498.0	0.0	0.0
35	463	463	21318185.0	21318185.0	-0.0	-0.0

cases : number of microunits in the sample
Z : sum of old adjustment factors (old weights)
sum: unweighted sum
Z : sum weighted by old adjustment factors (old weights)

Adjustment complete.

APPENDIX DC: Adjustment Logfile, 1985-65

adjustment logfile

```
Adjust Version 1.1.8.9
Wednesday, 24-08-05     15:29


Reading restrictions file (r-vektor atus85-65.dat)...
Number of restrictions found: 36

Reading S-Matrix file (s-matrix atus85.dat, increased compatibility mode)...
Number of microunits found: 4560
```

I	cases	sum	Z	R	Z-R	(Z-R)/R %
1	66	66	3094652.0	3804236.0	-709584.0	-18.7
2	200	200	9876899.1	6899289.0	2977610.1	43.2
3	240	240	9274499.6	5612436.0	3662063.6	65.2
4	238	238	9408288.3	5517566.0	3890722.3	70.5
5	233	233	8059894.2	5898942.0	2160952.2	36.6
6	172	172	6532881.7	6058104.0	474777.7	7.8
7	132	132	4589443.1	5552528.0	-963084.9	-17.3
8	138	138	5331235.0	5101484.0	229751.0	4.5
9	126	126	4772264.3	4582681.0	189583.3	4.1
10	126	126	5498646.0	3583081.0	1915565.0	53.5
11	105	105	4132039.8	2972192.0	1159847.8	39.0
12	245	245	9470629.8	5041923.0	4428706.8	87.8
13	80	80	3561861.7	3672040.0	-110178.3	-3.0
14	228	228	9864641.0	6847150.0	3017491.0	44.1
15	283	283	10101047.6	5727774.0	4373273.6	76.4
16	298	298	11563967.6	5607221.0	5956746.6	106.2
17	288	288	10503464.4	6121742.0	4381722.4	71.6
18	192	192	6469839.9	6368258.0	101581.9	1.6
19	183	183	6826726.5	5827607.0	999119.5	17.1
20	156	156	5526314.3	5357560.0	168754.3	3.1
21	173	173	7713164.4	4922336.0	2790828.4	56.7
22	151	151	5461171.1	3988792.0	1472379.1	36.9
23	134	134	4881886.9	3578099.0	1303787.9	36.4
24	373	373	16819202.2	6859179.0	9960023.2	145.2
25	1612	2926	115097516.4	68362000.0	46735516.4	68.4
26	2838	2838	109751572.3	84734000.0	25017572.3	29.5
27	893	893	33514772.5	31945000.0	1569772.5	4.9
28	2702	2702	109527774.1	65216000.0	44311774.1	67.9
29	521	521	20143255.5	11148000.0	8995255.5	80.7
30	334	334	20163569.9	34045000.0	-13881430.1	-40.8
31	367	367	18347615.8	18617000.0	-269384.2	-1.4
32	1602	1602	58531860.1	31703000.0	26828860.1	84.6
33	617	617	23007455.3	9139000.0	13868455.3	151.8
34	608	608	16896953.6	9742000.0	7154953.6	73.4
35	2608	2608	101215012.0	68424498.0	32790514.0	47.9
36	603	603	27654686.7	21318185.0	6336501.7	29.7

```
cases : number of microunits in the sample
sum: unweighted sum
Z : sum weighted by old adjustment factors (old weights)
R : restrictions to be achieved


Begin optimization process.

Information shown for each iteration include:
L : position in steplength vector
step : steplength
D²min/D²max : minimum/maximum of D²  (D=Z(I)-R(I))
Imin/Imax : Index I to D²min/D²max
```

* : next actual step

Current Iteration: 0

L	Step	Imin	D²min	Imax	D²max
1	0.50000	13	7.406325e+013	25	2.010103e+018
2	1.00000	29	7.290962e+019	28	5.643930e+020
3 *	2.50000	23	1.354342e+024	33	8.859243e+034

Current Iteration: 1

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	5.309871e+015	25	5.662259e+021
2	1.00000	11	1.899759e+015	34	4.529633e+018
3 *	2.50000	11	6.085705e+013	26	5.561140e+018

Current Iteration: 2

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	6.856810e+014	17	4.300115e+018
2	1.00000	11	2.338303e+014	32	2.209228e+018
3 *	1.09422	11	1.890833e+014	25	2.328017e+020

Current Iteration: 3

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	8.193213e+013	28	3.729325e+018
2	1.00000	11	2.453519e+013	25	3.790839e+019
3 *	1.09403	11	1.898156e+013	25	3.137702e+019

Current Iteration: 4

L	Step	Imin	D²min	Imax	D²max
1 *	0.50000	11	8.095265e+012	26	7.497112e+017
2	1.00000	11	1.758223e+012	25	5.113217e+018
3	1.09363	11	1.192716e+012	25	4.234599e+018

Current Iteration: 5

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	5.652903e+011	25	1.893306e+018
2 *	1.00000	11	1.052286e+011	25	7.081691e+017
3	1.09328	11	6.643867e+010	25	5.898325e+017

Current Iteration: 6

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	4.525309e+010	25	2.672984e+017
2 *	1.00000	22	2.749697e+010	25	1.062234e+017
3	1.09540	22	2.154526e+010	25	8.959774e+016

Current Iteration: 7

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	1.472959e+010	25	4.052068e+016
2 *	1.00000	11	9.143578e+009	25	1.634727e+016
3	1.10398	11	9.213987e+009	25	1.359571e+016

Current Iteration: 8

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	3.516408e+009	25	6.051588e+015
2 *	1.00000	11	2.040881e+009	25	2.137530e+015
3	1.10740	11	2.020143e+009	25	1.680024e+015

Current Iteration: 9

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	7.020132e+008	25	6.982697e+014
2 *	1.00000	11	2.351566e+008	25	1.371461e+014
3	1.09222	11	1.978158e+008	25	8.864176e+013

Current Iteration: 10

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	6.342616e+007	25	3.798116e+013
2 *	1.00000	11	1.385826e+006	25	1.382094e+012
3	1.04475	11	3.573005e+005	25	5.686015e+011

Current Iteration: 11					
L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	3.493539e+005	25	3.497409e+011
2 *	1.00000	11	9.631927e+001	25	2.025252e+008
3	1.00663	23	3.373720e+000	25	4.385874e+007

Current Iteration: 12					
L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	2.408270e+001	25	5.063882e+007
2	1.00000	36	1.414145e-002	25	4.464711e+000
3 *	1.00009	36	1.826811e-003	36	1.826811e-003

Current Iteration: 13					
L	Step	Imin	D²min	Imax	D²max
1	0.50000	36	3.535364e-003	25	1.116178e+000
2	1.00000	36	3.469447e-016	36	3.469447e-016
3 *	1.00000	36	3.469447e-016	36	3.469447e-016

Current Iteration: 14					
L	Step	Imin	D²min	Imax	D²max
1	0.50000	36	5.551115e-017	36	5.551115e-017
2	1.00000	36	5.551115e-017	36	5.551115e-017
3 *	1.00000	36	5.551115e-017	36	5.551115e-017

Convergence achieved.

I	cases	sum	Z	R	Z-R	(Z-R)/R %
1	66	66	3804236.0	3804236.0	0.0	0.0
2	200	200	6899289.0	6899289.0	0.0	0.0
3	240	240	5612436.0	5612436.0	-0.0	-0.0
4	238	238	5517566.0	5517566.0	-0.0	-0.0
5	233	233	5898942.0	5898942.0	0.0	0.0
6	172	172	6058104.0	6058104.0	0.0	0.0
7	132	132	5552528.0	5552528.0	0.0	0.0
8	138	138	5101484.0	5101484.0	0.0	0.0
9	126	126	4582681.0	4582681.0	0.0	0.0
10	126	126	3583081.0	3583081.0	0.0	0.0
11	105	105	2972192.0	2972192.0	0.0	0.0
12	245	245	5041923.0	5041923.0	0.0	0.0
13	80	80	3672040.0	3672040.0	-0.0	-0.0
14	228	228	6847150.0	6847150.0	0.0	0.0
15	283	283	5727774.0	5727774.0	0.0	0.0
16	298	298	5607221.0	5607221.0	0.0	0.0
17	288	288	6121742.0	6121742.0	0.0	0.0

18	192	192	6368258.0	6368258.0	0.0	0.0
19	183	183	5827607.0	5827607.0	0.0	0.0
20	156	156	5357560.0	5357560.0	-0.0	-0.0
21	173	173	4922336.0	4922336.0	0.0	0.0
22	151	151	3988792.0	3988792.0	-0.0	-0.0
23	134	134	3578099.0	3578099.0	-0.0	-0.0
24	373	373	6859179.0	6859179.0	0.0	0.0
25	1612	2926	68362000.0	68362000.0	-0.0	-0.0
26	2838	2838	84734000.0	84734000.0	-0.0	-0.0
27	893	893	31945000.0	31945000.0	-0.0	-0.0
28	2702	2702	65216000.0	65216000.0	-0.0	-0.0
29	521	521	11148000.0	11148000.0	0.0	0.0
30	334	334	34045000.0	34045000.0	0.0	0.0
31	367	367	18617000.0	18617000.0	0.0	0.0
32	1602	1602	31703000.0	31703000.0	-0.0	-0.0
33	617	617	9139000.0	9139000.0	0.0	0.0
34	608	608	9742000.0	9742000.0	-0.0	-0.0
35	2608	2608	68424498.0	68424498.0	-0.0	-0.0
36	603	603	21318185.0	21318185.0	0.0	0.0

cases : number of microunits in the sample
Z : sum of old adjustment factors (old weights)
sum: unweighted sum
Z : sum weighted by old adjustment factors (old weights)

Adjustment complete.

APPENDIX DD: Adjustment Logfile, 1985c-65

adjustment logfile

```
Adjust Version 1.1.8.9
Wednesday, 24-08-05     15:31


Reading restrictions file (r-vektor atus85c-65.dat)...
Number of restrictions found: 36

Reading S-Matrix file (s-matrix atus85c.dat, increased compatibility mode)...
Number of microunits found: 2811
```

I	cases	sum	Z	R	Z-R	(Z-R)/R %
1	42	42	2627975.3	3804236.0	-1176260.7	-30.9
2	137	137	8572205.1	6899289.0	1672916.1	24.2
3	157	157	9823621.9	5612436.0	4211185.9	75.0
4	147	147	9197913.5	5517566.0	3680347.5	66.7
5	147	147	9197913.5	5898942.0	3298971.5	55.9
6	98	98	6131942.3	6058104.0	73838.3	1.2
7	87	87	5443663.1	5552528.0	-108864.9	-2.0
8	86	86	5381092.2	5101484.0	279608.2	5.5
9	77	77	4817954.7	4582681.0	235273.7	5.1
10	73	73	4567671.3	3583081.0	984590.3	27.5
11	63	63	3941962.9	2972192.0	969770.9	32.6
12	178	178	11137609.5	5041923.0	6095686.5	120.9
13	59	59	3691679.6	3672040.0	19639.6	0.5
14	148	148	9260484.3	6847150.0	2413334.3	35.2
15	174	174	10887326.2	5727774.0	5159552.2	90.1
16	168	168	10511901.1	5607221.0	4904680.1	87.5
17	164	164	10261617.8	6121742.0	4139875.8	67.6
18	117	117	7320788.3	6368258.0	952530.3	15.0
19	113	113	7070504.9	5827607.0	1242897.9	21.3
20	96	96	6006800.6	5357560.0	649240.6	12.1
21	99	99	6194513.2	4922336.0	1272177.2	25.8
22	85	85	5318521.4	3988792.0	1329729.4	33.3
23	67	67	4192246.3	3578099.0	614147.3	17.2
24	229	229	14328722.4	6859179.0	7469543.4	108.9
25	988	1701	106432998.8	68362000.0	38070998.8	55.7
26	1772	1772	110875528.5	84734000.0	26141528.5	30.9
27	574	574	35915662.2	31945000.0	3970662.2	12.4
28	1483	1483	92792555.7	65216000.0	27576555.7	42.3
29	268	268	16768985.1	11148000.0	5620985.1	50.4
30	182	182	11387892.9	34045000.0	-22657107.1	-66.6
31	219	219	13703014.0	18617000.0	-4913986.0	-26.4
32	991	991	62007702.4	31703000.0	30304702.4	95.6
33	377	377	23589206.7	9139000.0	14450206.7	158.1
34	377	377	23589206.7	9742000.0	13847206.7	142.1
35	1641	1641	102678748.4	68424498.0	34254250.4	50.1
36	317	317	19834956.3	21318185.0	-1483228.7	-7.0

```
cases : number of microunits in the sample
sum: unweighted sum
Z : sum weighted by old adjustment factors (old weights)
R : restrictions to be achieved


Begin optimization process.

Information shown for each iteration include:
L : position in steplength vector
step : steplength
D²min/D²max : minimum/maximum of D²  (D=Z(I)-R(I))
Imin/Imax : Index I to D²min/D²max
```

* : next actual step

Current Iteration: 0

L	Step	Imin	D²min	Imax	D²max
1	0.50000	30	1.181421e+013	25	1.193670e+018
2	1.00000	23	4.305016e+015	36	4.066611e+018
3 *	2.50000	31	1.135171e+029	17	4.256930e+032

Current Iteration: 1

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	1.559405e+015	17	5.090547e+018
2	1.00000	23	5.396932e+014	34	3.099175e+018
3 *	2.50000	23	8.365537e+012	26	2.293193e+018

Current Iteration: 2

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	1.907107e+014	32	3.478961e+018
2	1.00000	23	5.938170e+013	35	4.495354e+018
3 *	1.09409	23	4.657897e+013	26	5.433184e+018

Current Iteration: 3

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	1.985128e+013	26	2.403120e+018
2	1.00000	23	4.672566e+012	25	9.261157e+018
3 *	1.09371	23	3.288151e+012	25	7.664091e+018

Current Iteration: 4

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	1.460793e+012	25	3.406886e+018
2 *	1.00000	23	2.218726e+011	25	1.248384e+018
3	1.09295	23	1.249427e+011	25	1.034729e+018

Current Iteration: 5

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	8.333683e+010	25	4.634171e+017
2 *	1.00000	1	1.542690e+010	25	1.741425e+017
3	1.09238	1	8.921208e+009	25	1.453919e+017

Current Iteration: 6

L	Step	Imin	D²min	Imax	D²max
1	0.50000	1	1.094146e+010	25	6.543422e+016
2 *	1.00000	23	1.314095e+010	25	2.527113e+016
3	1.09473	10	1.157170e+010	25	2.112297e+016

Current Iteration: 7

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	4.427922e+009	25	9.212393e+015
2 *	1.00000	23	1.249267e+009	25	3.136832e+015
3	1.09919	23	9.604475e+008	25	2.489534e+015

Current Iteration: 8

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	4.097511e+008	25	1.031360e+015
2 *	1.00000	23	9.827014e+007	25	2.131900e+014
3	1.08570	23	7.371068e+007	25	1.459836e+014

Current Iteration: 9

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	2.804670e+007	25	6.006307e+013
2 *	1.00000	23	1.786854e+006	25	2.919824e+012
3	1.04599	23	1.009222e+006	25	1.414976e+012

Current Iteration: 10

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	4.532360e+005	25	7.427597e+011
2 *	1.00000	23	3.764522e+002	25	8.776388e+008
3	1.00893	23	6.097291e+001	25	2.216575e+008

Current Iteration: 11

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	9.413679e+001	25	2.194774e+008
2 *	1.00000	36	1.774933e-001	25	8.359740e+001
3	1.00019	36	2.564423e-002	25	1.220995e+001

Current Iteration: 12

L	Step	Imin	D²min	Imax	D²max
1	0.50000	36	4.437331e-002	25	2.089935e+001
2	1.00000	36	1.249001e-016	36	1.249001e-016
3 *	1.00000	36	5.551115e-017	36	5.551115e-017

Current Iteration: 13

L	Step	Imin	D²min	Imax	D²max
1	0.50000	36	1.249001e-016	36	1.249001e-016
2	1.00000	36	2.220446e-016	36	2.220446e-016
3 *	1.00000	36	2.220446e-016	36	2.220446e-016

Convergence achieved.

I	cases	sum	Z	R	Z-R	(Z-R)/R %
1	42	42	3804236.0	3804236.0	0.0	0.0
2	137	137	6899289.0	6899289.0	0.0	0.0
3	157	157	5612436.0	5612436.0	0.0	0.0
4	147	147	5517566.0	5517566.0	-0.0	-0.0
5	147	147	5898942.0	5898942.0	0.0	0.0
6	98	98	6058104.0	6058104.0	0.0	0.0
7	87	87	5552528.0	5552528.0	-0.0	-0.0
8	86	86	5101484.0	5101484.0	0.0	0.0
9	77	77	4582681.0	4582681.0	0.0	0.0
10	73	73	3583081.0	3583081.0	0.0	0.0
11	63	63	2972192.0	2972192.0	-0.0	-0.0
12	178	178	5041923.0	5041923.0	0.0	0.0
13	59	59	3672040.0	3672040.0	0.0	0.0
14	148	148	6847150.0	6847150.0	0.0	0.0
15	174	174	5727774.0	5727774.0	0.0	0.0
16	168	168	5607221.0	5607221.0	-0.0	-0.0
17	164	164	6121742.0	6121742.0	-0.0	-0.0
18	117	117	6368258.0	6368258.0	0.0	0.0
19	113	113	5827607.0	5827607.0	-0.0	-0.0
20	96	96	5357560.0	5357560.0	-0.0	-0.0
21	99	99	4922336.0	4922336.0	-0.0	-0.0
22	85	85	3988792.0	3988792.0	0.0	0.0
23	67	67	3578099.0	3578099.0	-0.0	-0.0
24	229	229	6859179.0	6859179.0	-0.0	-0.0
25	988	1701	68362000.0	68362000.0	0.0	0.0
26	1772	1772	84734000.0	84734000.0	0.0	0.0
27	574	574	31945000.0	31945000.0	0.0	0.0
28	1483	1483	65216000.0	65216000.0	0.0	0.0
29	268	268	11148000.0	11148000.0	-0.0	-0.0

30	182	182	34045000.0	34045000.0	0.0	0.0
31	219	219	18617000.0	18617000.0	-0.0	-0.0
32	991	991	31703000.0	31703000.0	0.0	0.0
33	377	377	9139000.0	9139000.0	-0.0	-0.0
34	377	377	9742000.0	9742000.0	0.0	0.0
35	1641	1641	68424498.0	68424498.0	0.0	0.0
36	317	317	21318185.0	21318185.0	0.0	0.0

cases : number of microunits in the sample
Z : sum of old adjustment factors (old weights)
sum: unweighted sum
Z : sum weighted by old adjustment factors (old weights)

Adjustment complete.

APPENDIX DE: Adjustment Logfile, 1992-94-65

adjustment logfile

```
Adjust Version 1.1.8.9
Wednesday, 24-08-05     15:33


Reading restrictions file (r-vektor atus92-65.dat)...
Number of restrictions found: 34

Reading S-Matrix file (s-matrix atus92.dat, increased compatibility mode)...
Number of microunits found: 7297
```

I	cases	sum	Z	R	Z-R	(Z-R)/R %
1	49	49	982605.9	3804236.0	-2821630.1	-74.2
2	122	122	2547593.1	6899289.0	-4351695.9	-63.1
3	183	183	3948602.8	5612436.0	-1663833.2	-29.6
4	193	193	4446627.5	5517566.0	-1070938.5	-19.4
5	227	227	5385456.5	5898942.0	-513485.5	-8.7
6	240	240	6080213.2	6058104.0	22109.2	0.4
7	310	310	9472981.3	5552528.0	3920453.3	70.6
8	302	302	9127339.3	5101484.0	4025855.3	78.9
9	358	358	9733362.2	4582681.0	5150681.2	112.4
10	381	381	10813091.5	3583081.0	7230010.5	201.8
11	368	368	9494255.8	2972192.0	6522063.8	219.4
12	359	359	11113294.0	5041923.0	6071371.0	120.4
13	77	77	1178907.1	3672040.0	-2493132.9	-67.9
14	256	256	4526625.9	6847150.0	-2320524.1	-33.9
15	260	260	5045854.1	5727774.0	-681919.9	-11.9
16	256	256	5301201.1	5607221.0	-306019.9	-5.5
17	258	258	5857748.1	6121742.0	-263993.9	-4.3
18	318	318	8406619.5	6368258.0	2038361.5	32.0
19	351	351	9637478.9	5827607.0	3809871.9	65.4
20	381	381	11548758.5	5357560.0	6191198.5	115.6
21	409	409	13785806.0	4922336.0	8863470.0	180.1
22	430	430	13165600.0	3988792.0	9176808.0	230.1
23	382	382	11007922.3	3578099.0	7429823.3	207.6
24	388	388	11514974.4	6859179.0	4655795.4	67.9
25	1660	3124	148285102.1	68362000.0	79923102.1	116.9
26	4012	4012	108940890.3	65216000.0	43724890.3	67.0
27	740	740	21530532.9	11148000.0	10382532.9	93.1
28	121	121	3534587.1	34045000.0	-30510412.9	-89.6
29	440	440	12296335.8	18617000.0	-6320664.2	-34.0
30	2222	2222	63438191.5	31703000.0	31735191.5	100.1
31	1589	1589	44279602.4	9139000.0	35140602.4	384.5
32	1946	1946	50500027.3	9742000.0	40758027.3	418.4
33	4275	4275	111710270.9	68424498.0	43285772.9	63.3
34	1391	1391	37315991.1	21318185.0	15997806.1	75.0

```
cases : number of microunits in the sample
sum: unweighted sum
Z : sum weighted by old adjustment factors (old weights)
R : restrictions to be achieved


Begin optimization process.

Information shown for each iteration include:
L : position in steplength vector
step : steplength
D²min/D²max : minimum/maximum of D²  (D=Z(I)-R(I))
Imin/Imax : Index I to D²min/D²max
* : next actual step
```

Current Iteration: 0

L	Step	Imin	D²min	Imax	D²max
1	0.50000	14	1.378120e+012	25	1.919175e+018
2	1.00000	1	1.461857e+011	10	3.994253e+018
3 *	2.50000	25	4.063617e+038	5	9.802019e+023

Current Iteration: 1

L	Step	Imin	D²min	Imax	D²max
1	0.50000	1	3.823466e+010	32	4.491875e+018
2	1.00000	1	2.956629e+008	27	4.269239e+018
3 *	2.50000	1	2.216892e+011	33	3.144562e+018

Current Iteration: 2

L	Step	Imin	D²min	Imax	D²max
1	0.50000	1	8.108972e+007	25	1.040919e+021
2	1.00000	1	2.690955e+006	25	3.830536e+020
3 *	1.09433	1	1.188841e+005	30	4.739277e+018

Current Iteration: 3

L	Step	Imin	D²min	Imax	D²max
1	0.50000	13	7.460551e+006	33	3.213018e+018
2	1.00000	13	5.083847e+007	25	5.200473e+019
3 *	1.09434	2	2.519747e+007	25	4.308488e+019

Current Iteration: 4

L	Step	Imin	D²min	Imax	D²max
1 *	0.50000	13	8.085387e+007	33	4.266592e+017
2	1.00000	13	5.030447e+008	25	7.172281e+018
3	1.09455	13	6.952390e+008	25	5.959048e+018

Current Iteration: 5

L	Step	Imin	D²min	Imax	D²max

1	0.50000	13	4.859995e+008	25	2.682037e+018
2 *	1.00000	13	1.994399e+009	25	1.041373e+018
3	1.09607	13	2.685830e+009	25	8.726640e+017

Current Iteration: 6

L	Step	Imin	D²min	Imax	D²max
1	0.50000	13	9.934829e+008	25	3.973714e+017
2 *	1.00000	13	1.381571e+009	25	1.642028e+017
3	1.10161	13	1.654875e+009	25	1.386612e+017

Current Iteration: 7

L	Step	Imin	D²min	Imax	D²max
1	0.50000	13	5.015897e+008	25	6.537041e+016
2 *	1.00000	13	2.251678e+008	25	2.991937e+016
3	1.11149	13	2.053748e+008	25	2.553231e+016

Current Iteration: 8

L	Step	Imin	D²min	Imax	D²max
1	0.50000	13	1.021772e+008	25	1.200308e+016
2 *	1.00000	13	1.058245e+008	25	5.363691e+015
3	1.13154	13	1.244128e+008	25	4.377670e+015

Current Iteration: 9

L	Step	Imin	D²min	Imax	D²max
1	0.50000	13	4.022785e+007	25	1.826525e+015
2 *	1.00000	13	2.264801e+007	25	4.543843e+014
3	1.13298	13	2.235993e+007	25	2.793419e+014

Current Iteration: 10

L	Step	Imin	D²min	Imax	D²max
1	0.50000	13	5.986314e+006	25	1.319175e+014
2 *	1.00000	13	7.200403e+004	25	9.667754e+012
3	1.05977	13	2.849817e+002	25	4.808297e+012

Current Iteration: 11

L	Step	Imin	D²min	Imax	D²max
1	0.50000	13	1.820869e+004	25	2.493487e+012
2 *	1.00000	13	9.527434e+000	25	9.299806e+009
3	1.01353	13	2.125335e-001	25	3.242831e+009

Current Iteration: 12

L	Step	Imin	D²min	Imax	D²max
1	0.50000	13	2.383659e+000	25	2.327402e+009
2 *	1.00000	19	6.713672e-001	25	1.031747e+004
3	1.00061	32	4.315808e-001	25	1.854047e+003

Current Iteration: 13

L	Step	Imin	D²min	Imax	D²max
1	0.50000	32	6.536805e-001	25	2.579370e+003
2	1.00000	34	3.110025e-011	34	3.110025e-011
3 *	1.00000	34	4.913084e-012	34	4.913084e-012

Current Iteration: 14

L	Step	Imin	D²min	Imax	D²max
1	0.50000	34	7.868831e-012	34	7.868831e-012
2	1.00000	34	1.998401e-015	34	1.998401e-015
3 *	1.00000	34	1.998401e-015	34	1.998401e-015

Convergence achieved.

I	cases	sum	Z	R	Z-R	(Z-R)/R %
1	49	49	3804236.0	3804236.0	0.0	0.0
2	122	122	6899289.0	6899289.0	0.0	0.0
3	183	183	5612436.0	5612436.0	-0.0	-0.0
4	193	193	5517566.0	5517566.0	0.0	0.0
5	227	227	5898942.0	5898942.0	0.0	0.0
6	240	240	6058104.0	6058104.0	0.0	0.0
7	310	310	5552528.0	5552528.0	0.0	0.0
8	302	302	5101484.0	5101484.0	0.0	0.0
9	358	358	4582681.0	4582681.0	0.0	0.0
10	381	381	3583081.0	3583081.0	0.0	0.0
11	368	368	2972192.0	2972192.0	0.0	0.0
12	359	359	5041923.0	5041923.0	0.0	0.0
13	77	77	3672040.0	3672040.0	0.0	0.0
14	256	256	6847150.0	6847150.0	-0.0	-0.0
15	260	260	5727774.0	5727774.0	-0.0	-0.0
16	256	256	5607221.0	5607221.0	0.0	0.0
17	258	258	6121742.0	6121742.0	-0.0	-0.0
18	318	318	6368258.0	6368258.0	-0.0	-0.0
19	351	351	5827607.0	5827607.0	-0.0	-0.0

20	381	381	5357560.0	5357560.0	-0.0	-0.0
21	409	409	4922336.0	4922336.0	-0.0	-0.0
22	430	430	3988792.0	3988792.0	-0.0	-0.0
23	382	382	3578099.0	3578099.0	0.0	0.0
24	388	388	6859179.0	6859179.0	0.0	0.0
25	1660	3124	68362000.0	68362000.0	-0.0	-0.0
26	4012	4012	65216000.0	65216000.0	0.0	0.0
27	740	740	11148000.0	11148000.0	0.0	0.0
28	121	121	34045000.0	34045000.0	0.0	0.0
29	440	440	18617000.0	18617000.0	0.0	0.0
30	2222	2222	31703000.0	31703000.0	0.0	0.0
31	1589	1589	9139000.0	9139000.0	-0.0	-0.0
32	1946	1946	9742000.0	9742000.0	-0.0	-0.0
33	4275	4275	68424498.0	68424498.0	-0.0	-0.0
34	1391	1391	21318185.0	21318185.0	0.0	0.0

cases : number of microunits in the sample
Z : sum of old adjustment factors (old weights)
sum: unweighted sum
Z : sum weighted by old adjustment factors (old weights)

Adjustment complete.

APPENDIX DF: Adjustment Logfile, 1998/99-65

adjustment logfile

```
Adjust Version 1.1.8.9
Wednesday, 24-08-05     15:34


Reading restrictions file (r-vektor atus98-65.dat)...
Number of restrictions found: 35

Reading S-Matrix file (s-matrix atus98.dat, increased compatibility mode)...
Number of microunits found: 1142
```

I	cases	sum	Z	R	Z-R	(Z-R)/R %
1	12	12	2153896.8	3804236.0	-1650339.3	-43.4
2	34	34	7716288.7	6899289.0	816999.7	11.8
3	61	61	11297053.9	5612436.0	5684617.9	101.3
4	55	55	10168700.7	5517566.0	4651134.7	84.3
5	65	65	9882292.5	5898942.0	3983350.5	67.5
6	63	63	9734003.9	6058104.0	3675899.9	60.7
7	45	45	10239069.5	5552528.0	4686541.5	84.4
8	38	38	7475209.3	5101484.0	2373725.3	46.5
9	21	21	5599807.4	4582681.0	1017126.4	22.2
10	16	16	4837026.7	3583081.0	1253945.7	35.0
11	26	26	5611744.7	2972192.0	2639552.7	88.8
12	35	35	6305064.5	5041923.0	1263141.5	25.1
13	20	20	5078334.2	3672040.0	1406294.2	38.3
14	49	49	7540660.3	6847150.0	693510.3	10.1
15	58	58	9039963.8	5727774.0	3312189.8	57.8
16	82	82	11166199.5	5607221.0	5558978.5	99.1
17	75	75	11179934.2	6121742.0	5058192.2	82.6
18	80	80	13130816.1	6368258.0	6762558.1	106.2
19	55	55	8912954.9	5827607.0	3085347.9	52.9
20	44	44	6546823.0	5357560.0	1189263.0	22.2
21	29	29	5661455.7	4922336.0	739119.7	15.0
22	25	25	5336951.3	3988792.0	1348159.3	33.8
23	23	23	3820299.3	3578099.0	242200.3	6.8
24	76	76	12410721.6	6859179.0	5551542.6	80.9
25	501	978	175318442.9	68362000.0	106956442.9	156.5
26	615	615	119886402.4	84734000.0	35152402.4	41.5
27	241	241	37439429.1	31945000.0	5494429.1	17.2
28	727	727	118855508.5	65216000.0	53639508.5	82.2
29	121	121	22132894.2	11148000.0	10984894.2	98.5
30	27	27	9233755.4	34045000.0	-24811244.6	-72.9
31	44	44	17518636.2	18617000.0	-1098363.8	-5.9
32	302	302	56669531.4	31703000.0	24966531.4	78.8
33	246	246	42669687.4	9139000.0	33530687.4	366.9
34	651	651	113064979.9	68424498.0	44640481.9	65.2
35	166	166	30115582.6	21318185.0	8797397.6	41.3

```
cases : number of microunits in the sample
sum: unweighted sum
Z : sum weighted by old adjustment factors (old weights)
R : restrictions to be achieved


Begin optimization process.

Information shown for each iteration include:
L : position in steplength vector
step : steplength
D²min/D²max : minimum/maximum of D²  (D=Z(I)-R(I))
Imin/Imax : Index I to D²min/D²max
* : next actual step
```

Current Iteration: 0

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	3.297229e+013	25	7.632987e+018
2	1.00000	23	3.932827e+015	6	4.630599e+018
3 *	2.50000	25	2.913903e+039	29	3.924100e+031

Current Iteration: 1

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	1.426896e+015	8	1.156505e+020
2	1.00000	23	4.963187e+014	34	3.765359e+020
3 *	2.50000	23	8.107367e+012	8	2.184009e+018

Current Iteration: 2

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	1.755389e+014	35	4.238615e+018
2	1.00000	23	5.478671e+013	27	4.373563e+018
3 *	1.09462	23	4.293918e+013	8	4.814743e+018

Current Iteration: 3

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	1.827140e+013	8	2.142015e+018
2	1.00000	23	4.241071e+012	34	6.906160e+018
3 *	1.09463	23	2.954948e+012	34	5.710582e+018

Current Iteration: 4

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	1.303927e+012	28	2.885927e+018
2	1.00000	23	1.731293e+011	28	1.048886e+018
3 *	1.09462	23	8.808164e+010	25	5.806983e+019

Current Iteration: 5

L	Step	Imin	D²min	Imax	D²max

1	0.50000	23	7.341542e+010	25	2.586205e+019
2 *	1.00000	11	5.819493e+010	25	9.579492e+018
3	1.09462	10	4.329675e+010	25	7.941194e+018

Current Iteration: 6

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	3.083155e+010	25	3.551794e+018
2 *	1.00000	20	4.631135e+009	25	1.338543e+018
3	1.09515	20	2.063857e+009	25	1.113810e+018

Current Iteration: 7

L	Step	Imin	D²min	Imax	D²max
1	0.50000	20	3.285028e+009	25	5.043462e+017
2 *	1.00000	20	8.727193e+009	25	1.997800e+017
3	1.09748	20	1.123519e+010	25	1.677903e+017

Current Iteration: 8

L	Step	Imin	D²min	Imax	D²max
1	0.50000	20	5.298659e+009	25	7.800251e+016
2 *	1.00000	23	1.989294e+009	25	3.413223e+016
3	1.10487	23	1.509295e+009	25	2.909218e+016

Current Iteration: 9

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	7.049507e+008	25	1.392501e+016
2 *	1.00000	23	2.795589e+008	25	6.767623e+015
3	1.12227	23	2.410247e+008	25	5.794828e+015

Current Iteration: 10

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	1.642897e+008	25	2.737591e+015
2 *	1.00000	23	3.146627e+008	25	1.243778e+015
3	1.14580	11	3.176587e+008	25	9.985453e+014

Current Iteration: 11

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	1.296478e+008	25	4.210636e+014
2 *	1.00000	11	6.710322e+007	25	9.872074e+013
3	1.13704	12	6.241245e+007	25	5.690834e+013

Current Iteration: 12

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	1.931023e+007	25	2.748527e+013
2 *	1.00000	11	1.398093e+006	25	1.089729e+012
3	1.05768	23	7.146544e+005	25	3.457049e+011

Current Iteration: 13

L	Step	Imin	D²min	Imax	D²max
1	0.50000	11	3.541494e+005	25	2.759484e+011
2 *	1.00000	23	2.456653e+002	25	1.782212e+008
3	1.00727	23	2.892181e+001	25	3.547271e+007

Current Iteration: 14

L	Step	Imin	D²min	Imax	D²max
1	0.50000	23	6.142567e+001	25	4.456269e+007
2	1.00000	35	1.849433e-002	25	4.892053e+000
3 *	1.00010	35	3.341317e-003	35	3.341317e-003

Current Iteration: 15

L	Step	Imin	D²min	Imax	D²max
1	0.50000	35	4.623582e-003	25	1.223013e+000
2	1.00000	35	5.551115e-017	35	5.551115e-017
3 *	1.00000	35	5.551115e-017	35	5.551115e-017

Current Iteration: 16

L	Step	Imin	D²min	Imax	D²max
1	0.50000	35	1.249001e-016	35	1.249001e-016
2	1.00000	35	1.387779e-017	35	1.387779e-017
3 *	1.00000	35	1.387779e-017	35	1.387779e-017

Convergence achieved.

I	cases	sum	Z	R	Z-R	(Z-R)/R %
1	12	12	3804236.0	3804236.0	-0.0	-0.0
2	34	34	6899289.0	6899289.0	-0.0	-0.0
3	61	61	5612436.0	5612436.0	0.0	0.0
4	55	55	5517566.0	5517566.0	-0.0	-0.0
5	65	65	5898942.0	5898942.0	0.0	0.0
6	63	63	6058104.0	6058104.0	-0.0	-0.0
7	45	45	5552528.0	5552528.0	-0.0	-0.0
8	38	38	5101484.0	5101484.0	-0.0	-0.0
9	21	21	4582681.0	4582681.0	-0.0	-0.0
10	16	16	3583081.0	3583081.0	-0.0	-0.0
11	26	26	2972192.0	2972192.0	-0.0	-0.0
12	35	35	5041923.0	5041923.0	0.0	0.0
13	20	20	3672040.0	3672040.0	0.0	0.0
14	49	49	6847150.0	6847150.0	-0.0	-0.0
15	58	58	5727774.0	5727774.0	0.0	0.0
16	82	82	5607221.0	5607221.0	0.0	0.0
17	75	75	6121742.0	6121742.0	-0.0	-0.0
18	80	80	6368258.0	6368258.0	-0.0	-0.0
19	55	55	5827607.0	5827607.0	0.0	0.0
20	44	44	5357560.0	5357560.0	-0.0	-0.0
21	29	29	4922336.0	4922336.0	-0.0	-0.0
22	25	25	3988792.0	3988792.0	-0.0	-0.0
23	23	23	3578099.0	3578099.0	0.0	0.0
24	76	76	6859179.0	6859179.0	0.0	0.0
25	501	978	68362000.0	68362000.0	0.0	0.0
26	615	615	84734000.0	84734000.0	-0.0	-0.0
27	241	241	31945000.0	31945000.0	0.0	0.0
28	727	727	65216000.0	65216000.0	-0.0	-0.0
29	121	121	11148000.0	11148000.0	0.0	0.0
30	27	27	34045000.0	34045000.0	0.0	0.0
31	44	44	18617000.0	18617000.0	-0.0	-0.0
32	302	302	31703000.0	31703000.0	0.0	0.0
33	246	246	9139000.0	9139000.0	0.0	0.0
34	651	651	68424498.0	68424498.0	-0.0	-0.0
35	166	166	21318185.0	21318185.0	-0.0	-0.0

cases : number of microunits in the sample
Z : sum of old adjustment factors (old weights)
sum: unweighted sum
Z : sum weighted by old adjustment factors (old weights)

Adjustment complete.

APPENDIX DG: Files containing new weights -65

The files containing the new weights for the different ATUS-files are named "adjustment-results.txt" preceding the year of the ATUS study in the filename with the additional -65 information. The files are saved in the ASCII-code set, displaying numbers in the American numerical notation. They are following the CSV-guidelines containing one dataset in each line wherein the variables are separated by semicolons. In this case each line contains first the respondent's identification code followed by the new weight.

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2 FFB-Bücher in der FFB-Schriftenreihe

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