Estimating Variance in the National Compensation Survey, Using Balanced Repeated Replication

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The National Compensation Survey (NCS) is an annual survey of wages. Estimates are published for mean wages, percentiles of wages, mean hours worked, and total employment. Domains include occupational clusters within localities and the nation. In addition, special mean wage estimates called PATCO estimates are produced to assist the President's Pay Agent in making comparisons between federal and non-federal pay. Special indices, called pay relatives, are also computed to compare pay across localities. The pay relative for a locality is a ratio relating locality pay to national pay.

Taylor series estimators are currently used to estimate variances of mean wages and employment. Unfortunately, these estimators are complex for certain other types of parameters, particularly: percentiles of wages and pay relative indexes, for which there are no production variance estimators. Furthermore, each new parameter often requires a custom Taylor expansion. A simpler estimator, applicable to more NCS parameters, was desired. Hence, we considered Fay's method of balanced repeated replication, or Fay's BRR (Judkins, 1990).

This paper presents formulas for Fay's method, and discusses how variance strata, variance PSUs, and half-samples are defined. Variance PSUs are pseudo-PSUs, and are the building blocks of half-samples, from which the replicate estimates are computed. For means, totals, and percentiles, Fay's BRR is straightforward, except that locality and national estimates require different variance PSUs, variance strata, and Hadamard matrices. We are unaware of a standard variance estimator for pay relatives using Fay's method, because pay relatives are functions of both locality and national parameters. We defined half-samples for pay relatives using a hybrid Hadamard matrix that references both locality and national variance strata.

NCS SAMPLE DESIGN

We must partition the sample into variance strata and PSUs for the national survey, and independently for each locality survey. These partitions depend on the sample design. The NCS is a 3-stage sample of jobs.

The following units are selected in each stage:
1) locality areas (PSUs)
2) establishments within sampled localities
3) jobs within respondent establishments

1) Metropolitan areas and counties are grouped into sampling strata based on wages, population, and Census division. First, the certainty areas are removed, which are areas with employment over a certain level, or that are required by the President's Pay Agent. Next, one area is chosen from each stratum, proportional to employment. The current sample contains 38 certainty 116 non-certainty areas.

2) Within each locality, establishments are placed into one of 34 sampling strata based on industry and public/private ownership. When sampling, first certainty establishments are removed. Next, establishments are chosen from strata proportional to employment.

3) A job (quote) is a cluster of employees in an establishment that share specific occupational characteristics. Jobs are selected from establishments as follows. First, an equal-probability sample of 8-20 workers is taken. The job-sample is the set of jobs of these workers. A job is listed once each time one of its employees is hit. Each quote-hit may contain more than one pay rate, recorded as wage-records.

Our smallest unit of study is an employee-hit *i* within a job. For each hit *i*, we have two weights:

W_{Ni} national employee-weight for employee-hit *i*,

W_{Ai} locality employee-weight for employee-hit *i*.

Both weights are the inverse probability of selecting employee-hit *i*, adjusted to account for establishment and occupational nonresponse. The probability of selecting employee-hit *i* for a locality estimate is conditional on the locality being selected.

FAY'S BRR VARIANCE ESTIMATOR

Fay's BRR is simpler than Taylor series, since replicate estimates are derived from a reweighted parameter estimator. Complexity arises only from defining half-samples, dictated by the sample design. Fay's method is similar to normal BRR since both use the same half-samples for replicate estimates; they only differ in how units are weighted. In normal BRR, units in the half-sample are weighted by 2, other units have zero weight. But for small domains some half-samples may not contain any units in the domain: for these replicates, all units have zero weight, yielding a zero in the denominator of the mean wage ratio. Fay's method, however, weights units in the given half-sample by (2-k), and those not by k, where $0 < k < 1$: (we let k = 0.5). Hence, Fay's BRR ensures that all units have a positive weight.

Given an estimator $\hat{\theta}_D$ of θ_D for some domain D, the Fay's BRR estimator of the variance of $\hat{\theta}_D$ is:

$$\hat{V}_{BRR}(\hat{\theta}_D) = \frac{1}{R(1-k)^2}\sum_{r=1}^{R}\left(\hat{\theta}_{Dr} - \hat{\theta}_D\right)^2 \text{, where}$$

R = number of half-samples
k = *Fay's constant*
$\hat{\theta}_D$ = *full-sample estimate*. It is simply the regular parameter estimate.
$\hat{\theta}_{Dr}$ = *rth replicate estimate* of the parameter θ_D

The number of replicates R and the formulas for the replicate estimates $\hat{\theta}_{Dr}$ depend on the formulas of the full-sample estimate $\hat{\theta}_D$, and the geographic scope of each term in this formula.

Each NCS estimator was placed in one of the following classes, based on the geographic scope of the terms in its full-sample estimation formula:
1) national estimator (all terms are national terms)
2) locality estimator (all terms are locality terms)
3) hybrid estimator (both national and locality terms)

A national term is one based on national data using national employee-hit weights. The data used to compute a locality term is restricted to a single locality, and locality weights are used. The choice of whether to use locality terms vs. national terms depends on the geographic scope of the domain D.

Means and totals, and percentiles of wages can all be expressed as functions of either all national or all locality terms (class1 and 2). Pay relatives, on the other hand, contain both national and locality terms, and thus are of class 3. The geographic class of the parameter determines how half-samples will be defined and how employee weights will be adjusted for each employee-hit i and each replicate r. For national or locality estimates, this is straightforward. For pay relatives, it is more complex.

The rth replicate estimate $\hat{\theta}_{NDr}$ for a national parameter is found using the same formula as the full-sample estimate $\hat{\theta}_{ND}$, except the *full-sample* employee-weights W_{Ni} are replaced by *replicate*-weights W_{Nir}, where:

$W_{Nir} = (2-k)W_{Ni}$; if i is in national half-sample r
$W_{Nir} = kW_{Ni}$; otherwise

For a national estimator $\hat{\theta}_{ND}$ the number of half-samples R_N = 92, and the number of variance strata, H_N = 90 (construction of strata are described later).

The locality replicate estimate $\hat{\theta}_{ADr}$ is computed differently than the national estimate. In this case we are replacing *locality* full-sample weights W_{Ai} with *locality* replicate weights W_{Air}, where:

$W_{Air} = (2-k)W_{Ai}$; if i is in *locality* half-sample r
$W_{Air} = kW_{Ai}$; otherwise

For locality parameters $\hat{\theta}_{AD}$, the number of half-samples is R_A=36, and the number of locality variance strata is H_A=34.

Non-response weighting should also be done for the replicate-weights above. Unfortunately, such reweighting requires significant computational resources and time, and is impractical in current production. It was not performed in this study.

HALF-SAMPLES, STRATA, AND PSUs

To define a replicate-weight, we must know whether or not employee-hit i lies in half-sample r. Each half-sample is defined by choosing one variance PSU from each variance stratum. Hence, we must first define such variance strata and PSUs.

For national estimates, there are two types of variance strata: clusters of non-certainty areas, and individual certainty areas. There are 52 non-certainty-area clusters, formed by collapsing 116 non-certainty areas together by census division, metropolitan-class, and annual wage.

National variance PSUs are defined in the following way. First, non-certainty areas in each non-certainty stratum are grouped by annual wage, and then areas are allocated to the two variance PSUs in an alternating fashion. For strata with an odd-number of non-certainty areas, special weight adjustments are applied to even-out the imbalance. For a certainty area stratum, establishments are grouped by industry stratum and then sorted by employment within each industry. Next, first-stage locality-units in the certainty area are split, in an alternating fashion, between the two variance PSUs. The first stage units are: entire non-certainty establishments, and individual quote-hits in certainty establishments.

For locality estimates, locality variance strata are simply the industry sampling strata. Each locality variance stratum is split into two variance PSUs in the same way that national variance PSUs are defined for certainty areas, except that now the strata are industry sampling strata, not the entire area. For each locality, there are 33 variance strata.

NCS ESTIMATORS (CLASS 1 AND 2)

Formulas for all NCS parameters θ_D, except pay relatives, are given below. All formulas will be for national parameters and use national weights W_{Ni}. For locality estimates, use locality weights W_{Ai}. Replicate estimates $\hat{\theta}_{Dr}$ are computed by replacing W_{Ni} or W_{Ai} in the full-sample estimate by the appropriate replicate weight W_{Nir} or W_{Air}.

Simple NCS Totals and Means

For various *national* domains *D*, we have:

Total employment: $\hat{E}_{ND} = \sum_{i \in D} W_{Ni}$

Mean hourly wage:

$$\hat{\bar{Y}}_{1\,ND} = \sum_{i \in D} W_{Ni} Z_i X_i Y_i \Big/ \sum_{i \in D} W_{Ni} Z_i X_i$$

Mean weekly hours:

$$\hat{\bar{H}}_{2\,ND} = \sum_{i \in D} W_{Ni} Z_i X_i \Big/ \sum_{i \in D} W_{Ni} Z_i$$

where

i is an employee-hit from a quote-hit

W_{Ni} national employee-hit weight for hit *i*

Y_i hourly wage for employee-hit *i*

X_i hours worked per week for employee-hit *i*

Z_i weeks worked per year for employee-hit *i*

Mean weekly and annual wages, and mean annual hours worked, are computed in a similar fashion.

For mean hourly wage, the variance estimator is

$$\hat{V}_{BRR}\left(\hat{\bar{Y}}_{1\,ND}\right) = \frac{1}{R_N\,(1-k)^2} \sum_{r=1}^{R_N} \left(\hat{\bar{Y}}_{1\,NDr} - \hat{\bar{Y}}_{1\,ND}\right)^2$$

where

$$\hat{\bar{Y}}_{1\,ND} = \sum_{i \in D} W_{Ni} Z_i X_i Y_i \Big/ \sum_{i \in D} W_{Ni} Z_i X_i$$

$$\hat{\bar{Y}}_{1\,NDr} = \sum_{i \in D} W_{Nir} Z_i X_i Y_i \Big/ \sum_{i \in D} W_{Nir} Z_i X_i$$

Variance estimates for other simple means and totals are computed in a similar fashion.

Percentiles of Wages

Percentiles of hourly wages are computed as follows. Suppose there are *M* data records in *D*. Sort by hourly wage, Y_i, and re-index them *m* = 1,...,*M*.

The *nth* percentile of hourly wage is

$$\hat{Y}_{1ND}(n) = \begin{cases} \left(Y_{m_1} + Y_{m_2}\right)/2 & ;\text{ if } S_1(m_1) = \frac{n}{100} S_1(M) \\ Y_{m_2} & ;\text{otherwise} \end{cases}$$

where:

$$S_1(m) = \sum_{j=1}^{m} W_{Nj} Z_j X_j \quad \text{for all } m = 1,...,M$$

$$m_2 = \min\left\{ m \;\middle|\; S_1(m) > \frac{n}{100} S_1(M) \right\}$$

$$m_1 = m_2 - 1.$$

Let the index m_2 be called the full-sample breakpoint (since full-sample weights are used).

Percentiles of weekly wages and annual wages are computed in a similar fashion.

To compute the *r*th replicate estimate of the *n*th percentile, use the same algorithm for the full-sample estimate, yet substitute

$$S_{1r}(m) = \sum_{j=1}^{m} W_{Njr} Z_j X_j$$

in place of the full-sample estimate $S_1(m)$. Also, a new breakpoint m_{2r} must be determined for each replicate. Let $m_{1r} = m_{2r} - 1$.

PATCO Estimates of Mean Wage

PATCO estimates are produced to assist the Pay Agent in comparing federal with non-federal pay. PATCO refers to the five categories used to classify federal workers: professional, administrative, technical, clerical, and other. Two estimates are produced: non-benchmarked estimates, and estimates benchmarked to federal employment. Benchmarking adjusts for differences between the non-federal and federal employment distributions.

The domains for PATCO estimates consist of ordered pairs (*D*,*G*), where *D* is a collection of NCS occupation-levels (generic levels within census occupations), and *G* is a PATCO category. The Pay Agent desires estimates for PATCO categories and various subdomains. Yet some NCS census occupations are linked with more than one PATCO category. A "crosswalk" was made to link each occ-level with a specific collection of PATCO categories, yielding a table of values E_{FCG}, which is the *approximate federal employment* in occ-level *C* associated with PATCO category *G*. The values E_{FCG} are used to adjust the weights W_{Ni} and W_{Ai}.

The non-benchmarked PATCO estimate of mean hourly wage, for a national domain *D*, is

$$\hat{\bar{Y}}_{1\,PNDG} = \frac{\sum_{C\in D} F_{PCG} \sum_{i\in C} W_{Ni} Z_i X_i Y_i}{\sum_{C\in D} F_{PCG} \sum_{i\in C} W_{Ni} Z_i X_i}$$

The sums are over all NCS occupation-levels *C* in *D*. The term F_{PCG}, the *federal percent*, is the fraction of approximate federal employment in NCS occ-level *C* that is associated with PATCO category *G*:

$$F_{PCG} = E_{FCG} \,/\, E_{FC}\ , \text{ where } E_{FC} = \sum_{G'=1}^{5} E_{FCG'}$$

The federally-benchmarked PATCO estimate of mean hourly wage, for a national domain *D*, is

$$\hat{\bar{Y}}_{1\,BNDG} = \frac{\sum_{C\in D} \hat{F}_{BNCG} \sum_{i\in C} W_{Ni} Z_i X_i Y_i}{\sum_{C\in D} \hat{F}_{BNCG} \sum_{i\in C} W_{Ni} Z_i X_i}$$

$\hat{F}_{BNCG}$ is the *federal-benchmark adjustment factor* for occ-level *C* and PATCO category *G*:

$$\hat{F}_{BNCG} = \frac{E_{FC}}{\hat{E}_{NC}} (F_{PCG}) = \frac{E_{FC}}{\hat{E}_{NC}} \left(\frac{E_{FCG}}{E_{FC}} \right) = \frac{E_{FCG}}{\hat{E}_{NC}}$$

E_{FCG} = *approx. federal employment* in *C* and *G*

E_{FC} = *approx. federal employment* in *C*

F_{PCG} = *federal percent* for *C* and *G*

$\hat{E}_{NC} = \sum_{i\in C} W_{Ni}$ = national employment est. for *C*

Other benchmarked and non-benchmarked PATCO means and totals are estimated similarly. If domain *D* is restricted to locality *A*, then replace *N* with *A* in all subscripts above, however, the same federal percent F_{PCG} is used for national and locality estimates, because there is only one crosswalk for the nation.

For replicate estimates of benchmarked PACTO estimates, employee-weights W_{Ni} must be replaced by replicate weights W_{Nir}, not only in the usual spots, but in the benchmark adjustment factor $\hat{F}_{BNCG}$, as well. The *r*th replicate estimate of $\hat{\bar{Y}}_{1\,BNDG}$ is:

$$\hat{\bar{Y}}_{1\,BNDGr} = \frac{\sum_{C\in D} \hat{F}_{BNCGr} \sum_{i\in C} W_{Nir} Z_i X_i Y_i}{\sum_{C\in D} \hat{F}_{BNCGr} \sum_{i\in C} W_{Nir} Z_i X_i}$$

where $\hat{F}_{BNCGr} = E_{FCG} \big/ \hat{E}_{NCr} = E_{FCG} \Big/ \sum_{i\in C} W_{Nir}$.

THE PAY-RELATIVE INDEX

The pay relative index of mean hourly wage, for a locality *A* and occupational cluster *D*, is given by:

$$\hat{P}_{AD} = \frac{\sum_{C\in D} \hat{H}_{3\,NAC} \hat{\bar{Y}}_{1\,AC}}{f_{AD} \cdot \sum_{C\in D} \hat{H}_{3\,NAC} \hat{\bar{Y}}_{1\,NC}} \ , \quad \text{where}$$

C = census occupation, with quotes in locality *A*

$\hat{\bar{Y}}_{1\,AC}$ = mean hourly wage for *C*, restricted to *A*.

$\hat{\bar{Y}}_{1\,NC}$ = mean hourly wage for *C*, for the nation.

f_{AD} = ECI factor for cluster *D* within area *A*.

$\hat{H}_{3\,NAC}$ = Index-weight applied to index-cell *C*.

It is the *minimum* of the two terms:

$$\hat{H}_{3\,NC}\ , \ \textit{and} \quad 15 \frac{\hat{H}_{3\,AC}}{\sum_{C'\in D} \hat{H}_{3\,AC'}} \left(\sum_{C'\in D} \hat{H}_{3\,NC'} \right)$$

where, for all occupations *C*, we have:

$$\hat{H}_{3\,NC} = \sum_{i\in C} W_{Ni} Z_i X_i \quad , \quad \hat{H}_{3\,AC} = \sum_{i\in C\cap A} W_{Ai} Z_i X_i$$

For *most* cells, $\hat{H}_{3\,NAC} = \hat{H}_{3\,NC}$, the total annual hours worked by employees in *C* in the nation. For some cells, however, the total annual hours for *C* restricted to locality-*A* is proportionally much smaller than $\hat{H}_{3\,NC}$. If we simply use $\hat{H}_{3\,NC}$ to weight the locality mean $\hat{\bar{Y}}_{1\,AC}$, the relatively large value of $\hat{H}_{3\,NC}$ together with a small locality sample contributing to $\hat{\bar{Y}}_{1\,AC}$ can result in an undesirably large variance for the pay relative.

The ECI-factor f_{AD} uses the Employment Cost Index for domain *D* to adjust *national* mean hourly wages $\hat{\bar{Y}}_{1\,NC}$ to account for wage inflation or deflation that occurs between the collection date for national data and the date for area *A*.

Pay Relative Variance Estimator

For all parameters in classes 1 and 2 above, the full-sample estimators contain *only* national terms, or *only* locality terms. Pay relatives for a locality *A*, on the contrary, can be broken into *both* national and locality terms. National terms use national weights, locality terms use locality weights.

Unfortunately, the half samples used to define national replicate-weights differ from those used to define locality weights. For non-certainty areas, the national variance strata and PSUs are independent of the locality strata and PSUs. If an employee-hit *i* is in national half-sample *r*, employee-hit *i* may not necessarily be in locality half-sample *r*. Also, the number of locality strata (34) is less than the number of national variance strata (90). Therefore, for pay relatives, we need a more complex way to define national and locality replicate weights. We *cannot* simply evaluate replicate estimates for each pay-relative formula term by substituting the "standard" replicate-weights W_{Nir} and W_{Air}. New "pay-relative" replicate weights are needed.

For a locality *A* and an occupational group *D*, the Fay's BRR variance estimator of the pay relative of mean hourly wage is given by:

$$\hat{V}_{BRR}\left(\hat{P}_{AD}\right) = \frac{1}{R(1-k)^2}\sum_{r=1}^{R_P}\left(\hat{P}_{ADr} - \hat{P}_{AD}\right)^2$$

where

$\hat{P}_{AD}$ = *full-sample estimate* of the pay relative.

$\hat{P}_{ADr}$ = *rth replicate-estimate*, where

$$\hat{P}_{ADr} = \frac{\sum_{C\in D}\hat{H}^*_{3NACr}\hat{\bar{Y}}^*_{1ACr}}{f_{AD}\cdot\sum_{C\in D}\hat{H}^*_{3NACr}\hat{\bar{Y}}^*_{1NCr}}$$

and $\hat{H}^*_{NACr}$ is the *minimum* of the two terms:

$$\hat{H}^*_{3NCr}\ ,\ 15\frac{\hat{H}^*_{3ACr}}{\sum_{C'\in D}\hat{H}^*_{3AC'r}}\left(\sum_{C'\in D}\hat{H}^*_{3NC'r}\right)$$

The (*) is used to differentiate "pay-relative" replicate estimates from estimates that use the "standard" national or locality replicate weights W_{Nir} and W_{Air}. Pay-relative replicate estimates are computed using the same full-sample formulas as before, yet using pay-relative replicate weights, W^*_{Nir} and W^*_{Air}, in place of W_{Nir} and W_{Air}.

Pay relative weights are defined using the same formulas as used for simple means and totals, except that the determinations of "whether or not the replicate contains the employee hit *i*" has changed, since the definitions of half-samples has changed.

Pay Relative Half-Samples

The building blocks of pay-relative half-samples are national and locality variance PSUs we used before. We would like to produce a set of "pay-relative" national and locality half-samples based on *one* Hadamard matrix, rather than two, and attempt to ensure, if possible, that if an employee-hit *i* is in pay relative locality half-sample *r*, than it is *also* in pay relative national half-sample *r*.

Since there are 34 locality strata and 90 national strata, we need a Hadamard matrix with at least 124 columns. The smallest Hadamard matrix with 124 columns is of size 124; therefore, we need R_P =124 replicate estimates. This "hybrid" matrix is used to define half-samples for *both* the national terms and locality terms in the pay relative. Each row represents a replicate. Columns 1-34 are associated with the 34 industry strata. Columns 35-124 are associated with the standard 90 national variance strata, used previously to compute variance estimates for simple means and totals. See figure 1 below:

		34 "standard" locality strata			90 "standard" national strata		
		1	⋯	34	35	⋯	124
replicates	1	1	⋯	−1	1	⋯	−1
	2	−1	⋯	−1	−1	⋯	1
	⋮	⋮	⋱	⋮	⋮	⋱	⋮
	123	−1	⋯	1	1	⋯	−1
	124	1	⋯	1	−1	⋯	1

Figure 1. *Pay-Relative Hadamard Matrix*

Half-Samples for Pay Relative Locality Terms

For locality replicate-estimates $\hat{\bar{Y}}^*_{1ACr}$ and $\hat{H}^*_{3ACr}$ in the pay relative formula, the locality variance strata and PSUs are identical to those used in standard locality estimates. For pay relatives, the number of *pay relative locality variance strata* is H_{PA} = 34. The number of replicates, however, is still R_P =124 since we need 124 rows in the matrix. Only columns 1-34 are important here.

Half-Samples for Pay Relative National Terms

For national replicate-estimates $\hat{\hat{Y}}^{*}_{1NCr}$ and $\hat{H}^{*}_{3NCr}$ in the pay relative formula, the national variance strata and PSUs depend on whether or not locality area *A* is a certainty area. Area *A* is the area represented by the terms in the numerator of $\hat{P}_{AD}$.

Case1: Area A is a non-certainty area:
Pay-relative national strata and PSUs are identical to those used in standard national estimates. For case 1, the number of national strata is H_{PN} = 90. The number of replicates is still R_P =124. Only columns 35-124 are important here.

Case2: Area A is a certainty area:
For case 2, area *A* is split, by industry, into 34 variance strata and then into 68 PSUs. These strata and PSUs are *identical* to those used to compute replicate estimates of locality terms for locality *A* in the pay-relative formula. For areas other than certainty area *A*, the national variance strata and PSUs are the same as those for case 1, when *A* is a non-certainty-area. The number of *pay-relative national variance strata* is H_{PN} = 123. Quotes in *A* are placed in one of the 34 standard locality variance strata, indicated by columns 1-34. Quotes in areas other than *A* are placed in one of the 89 standard national variance strata represented by columns 35-123, minus the column representing area *A*. The number of replicates, however, is still R_P =124.

This method of placing the quote-hits in certainty area *A* into pay-relative national half-samples ensures that a quote-hit is in pay-relative locality half-sample *r* if and only if it is in pay-relative national half-sample. This can occur only when *A* is a certainty area, since the first stage units (establishments and quotes) that constitute national and locality variance PSUs in *A* are the same. When *A* is a non-certainty area, each pay-relative locality half-sample *r* contains about half the primary units from each industry stratum, yet the national half-sample *r* contains either all quote-hits in *A*, or no quote-hits from *A*.

FAY'S METHOD VARIANCE ESTIMATES

For simple means and totals, test programs were created for 7 surveys to compare Fay's method %RSEs with published Taylor series %RSEs. Tables for two surveys are given at right. Below each table is a Web-link to the NCS publication for the survey.

Table 1: Mean Hourly Wages and RSEs, Apr 2000, New York-Northern NJ-Long Is. CMSA

Occupational Group	Mean Hourly Wage	Percent RSE		RSE Ratio (F/T)
		Fay's Methd	Taylor Series	
All Occupations	**21.18**	**1.86**	**1.88**	**0.99**
White-collar Occs	**25.44**	**1.96**	**1.95**	**1.01**
Profess Specialty	34.11	1.89	1.94	0.97
Technical	24.33	5.11	9.21	0.55
Exec, Admin, Manag.	34.67	2.99	2.92	1.02
Sales	16.06	8.15	6.69	1.22
Administrat Support	15.53	1.73	2.08	0.83
Blue-collar Occs	**15.48**	**2.98**	**3.00**	**0.99**
Prec. Prod, .. Repair	21.75	2.65	2.94	0.90
Mach Oper, ..Inspect	11.26	4.83	4.55	1.06
Transport & Moving	16.21	5.22	4.88	1.07
Handlrs, Helprs, Labr	12.84	5.97	5.94	1.00
Service Occupations	**14.02**	**5.20**	**4.32**	**1.20**

(`http://www.bls.gov/ncs/ocs/sp/ncbl0288.pdf`)

Table 2: Mean Hourly Wages and RSEs, 1999, National Survey (All Localities in U.S.)

Occupational Group	Mean Hourly Wage	Percent RSE		RSE Ratio (F/T)
		Fay's Methd	Taylor Series	
All Occupations	**15.36**	**1.11**	**1.25**	**0.89**
White-collar Occs	**18.78**	**1.18**	**1.38**	**0.86**
Profess Specialty	26.87	2.79	2.77	1.01
Technical	17.91	1.27	1.49	0.85
Exec, Admin, Manag	27.67	2.20	1.86	1.18
Sales	12.84	2.47	2.72	0.91
Administrat Support	12.20	0.88	0.90	0.98
Blue-collar Occs	**13.03**	**1.12**	**1.03**	**1.09**
Prec. Prod, .. Repair	16.51	1.20	1.18	1.02
Mach Oper, ..Inspect	11.41	2.17	2.06	1.06
Transport & Moving	12.92	2.14	1.76	1.21
Handlrs, Helprs, Labr	9.86	2.11	2.31	0.91
Service Occupations	**9.21**	**1.19**	**1.09**	**1.10**

(`http://www.bls.gov/ncs/ocs/sp/ncbl0343.pdf`)

REFERENCES

Fay, R. E. (1989). Theory and Practice of Replicate Weighting for Variance Calculations. Proceedings of the American Statistical Association, Section on Survey Research Methods, 212-217.

Judkins, D. R. (1990). Fay's Method for Variance Estimation. Journal of Official Statistics, 6, 223-229.