Methodologies for Estimating Mean Wages for Occupational Employment Statistics (OES) Data

Mallika Kasturirangan [a], Shail Butani [b], and Tamara Sue Zimmerman [c]

[a] One GEICO Plaza, Washington, DC 20076, Email: Mkasturirangan@GEICO.com
[b,c] Bureau of Labor Statistics, Room 4985, 2 Massachusetts, N.E., Washington, DC 20212,
Email: Butani.Shail@bls.gov and Zimmerman.Tamara@bls.gov

ABSTRACT

The Occupational Employment Statistics (OES) is a joint Federal/State partnership program with a sample size of 1.2 million establishments over a 3-year period (six semi-annual panels each consisting of 200,000 establishments). The OES collects occupational employment and wage data for approximately 800 occupations at the MSA by 4-5 digit industrial (NAICS) level. Because of the burden on respondents, this survey is designed to collect wage data in intervals rather than exact wages for individual employees. In this paper, we will present the previous research work on the construction of lower and upper bounds of the intervals; alternative methods for estimating mean wages—arithmetic, geometric, and NCS mean wages; updating of wages from prior panels; and calculation of mean wages for the upper open-ended Interval L (i.e., employees making $70 or more per hour in the years 2003-2005). This study further examines several methods for approximating mean wages for Interval L for occupations that have significant employment (>5%) in Interval L and validates the OES methodology on independent data sets from the Current Population Survey for years 2003, 2004, and 2005.

Key Words. Open-ended interval wage estimation, geometric mean, kernel density

I. The Occupational Employment Statistics Survey

The Occupational Employment Statistics (OES) program is a Federal/State partnership program between the Bureau of Labor Statistics (BLS) and State Workforce Agencies (SWAs). OES collects data from approximately 1.2 million establishments over a three-year period. The data is collected in six semi-annual panels, with about 200,000 establishments surveyed per panel. Every effort is made to survey an establishment only once in each three-year period.

The OES survey is designed to cover all full- and part-time salary workers in non-farm industries; it does not cover the self-employed, owners and partners in unincorporated firms, or household workers. OES is designed to produce over 800 occupational employment and wage estimates. Occupations are classified using the Office of Management and Budget (OMB) Standard Occupational Classification (SOC) system. OES is designed to produce these estimates by geographic area—National, State, and Metropolitan Area levels—and for over 450 industry classifications corresponding to the 3-, 4- and 5-digit North American Classification System (NAICS).

OES data are available for a wide variety of uses. One of the OES's biggest clients is the Foreign Labor Certification program of the Employment Training Administration (ETA). OES data are also used in analysis of occupational employment and wages, development of occupational projections, vocational counseling and planning, industry skills and technology studies, and market analysis.

II. OES Wage Intervals

OES requests a large amount of data from respondents. In order to ease the burden on responding establishments, OES does not collect data on exact wages. Instead, establishments report the number of workers in a certain occupation earning within each of twelve wage intervals, denoted "A" through "L". Figure 1 (all figures are at the end of this document) shows an example of the form given to respondents of the OES Survey. Each row represents a certain occupation: chief executives, general and operations managers, etc. Each column represents a wage interval. Interval A represents those earning less than

$6.75 an hour, and so on. All a respondent has to do is report the number of chief executives earning wages within Interval K ($55.50-$69.99), for example.

Extensive research was conducted as to how the upper and lower bounds of these wage intervals should be constructed. Several factors were considered prior to interval construction. Research was done by Dr. Sandra West on reported weekly wages from the Current Population Survey.[1] Figure 2 shows some results of her research. Reported weekly earnings spiked at "clean" values like $200 ($5.00 per hour), $300, $400, etc. West concluded that this data does partially represent the true distribution of wages, but it also represents reporting error. Interval methodology could eliminate some of this error.

Earlier simulations showed that mean squared errors were less when the lower bound of an interval was a factor of $0.25, rather than $0.25 plus a penny. The general method for determining the bounds of the intervals was to attempt to equalize the percent relative errors and coefficients of variation within each interval. This method is applied to Intervals B-K. Construction of Interval A is a function of the federal minimum wage, and Interval L is a function of inflation.[2] Figure 3 shows the OES interval bounds for 2003-2005, along with the percent relative errors and coefficients of variation. Notice the percent relative errors are similar for Intervals B-K (11.5-11.8%) as are the coefficients of variation (6.5-6.8%). Even Interval A is fairly close to these numbers. Interval L cannot be compared because it is an open-ended interval.

There have been several proposed methods for estimating mean wages within each of these intervals, including the arithmetic mean (midpoint), geometric mean, and National Compensation Survey (NCS) mean.

Arithmetic: (Lower Bound + Upper Bound) / 2
Geometric: (Lower Bound x Upper Bound) $^{1/2}$

The NCS mean is calculated using point data from the National Compensation Survey, weighted by number of workers earning that wage. The arithmetic mean was the method used previously. The geometric mean was never used, but suggested by a participating state office. The NCS mean is the method currently used to estimate mean wages within intervals. Research showed that the arithmetic mean worked well, the geometric was better, and the NCS mean performed best of the three.[3] Figure 4 shows a comparison of these three methods as well as the weighted mean using Current Population Survey (CPS) point data for 2004. For Intervals B-K, the interval means are very similar across all methods, which is why all three methods performed well in testing. The NCS Mean is generally lower than the arithmetic mean (the midpoint) suggesting that the data are not uniformly distributed within each interval, but tend to be slightly more concentrated in the lower half of the interval.

It is also important to examine the data across years. Figure 5 shows interval means using NCS and CPS data across the years 2003-2005. The interval means do not seem to change across years, yet the overall means do increase about 2-3% each year. Figure 6 gives us the reason for that 2-3% increase in overall mean wages. In all three surveys, NCS, CPS, and OES, we see a shift in percent of employment from the lower Intervals A-D to the upper Intervals E-L. It is also important to notice in Figure 5, there is a $60 difference between the mean wages for Interval L in CPS and NCS, with CPS being higher. If we consider that Interval L makes up a little over 1% of employment in CPS (Figure 6), this would create about a $0.60 difference in the overall means between NCS and CPS, which we can also see in Figure 5.

III. OES Mean Wage Estimation

OES does not publish estimates for interval means. These are simply used in calculations of overall mean wages for occupations. Currently, to determine occupational mean wages, exact data from NCS are used to determine a wage for each interval. This interval mean is then applied to the OES sample. For Intervals A and B, if the State-specific minimum wage is higher than the calculated NCS mean for that interval, then the State minimum wage is applied. Otherwise, the NCS mean will be applied as with the other intervals. Interval L, the open-ended interval ($70 per hour or more), has a special procedure. Because this interval makes up only about 1% of the population, data in Interval L has little or no impact on mean wages for most occupations. The interval means are then used to compute an overall mean wage for each occupation. To take into account the 3-year period over which data are collected, previous panels' data are updated using the employment cost index

[1] West, Sandra A. "Standard Measures of Central Tendency for Censored Earnings Data from the Current Population Survey"
[2] Tou, Albert, Christina Chiu, and Kenneth Robertson. "An Evaluation of the Occupational Staffing Pattern and Mean Wage Rates of State Government Workers"
[3] "Occupational Employment Statistics Survey: Analysis of Alternative Procedures for Interval Mean Wage Rates, Supplement II". December 2000

(ECI) by nine major occupational groups. The results of a study conducted by Kirk Wolter and Rashna Ghadialy of National Opinion Research Corporation (NORC) found this procedure performed the best of all the alternative methods used for updating prior year wage data.[4]

Recently, a Wage Comparison Study was done using 2003 data.[5] When comparing occupational wages between the two surveys it was found that about 70% of the detailed occupations did not have statistically significant differences at the 10% significance level. About one-third of the other 30% of occupations did not have economically meaningful differences between mean wages in each survey. This left about 20% of occupations that had both statistically significant differences and economically meaningful differences. These differences could arise from a number of factors including: small sample size in either survey; conceptual differences regarding definitions of occupations; occupational coding differences; and differences in methods of measurement of mean wages in open-ended Interval L for high paying occupations (the focus of this research), etc. When OES interval methodologies were applied to the NCS data, the above results did not change, suggesting it is appropriate to use NCS point data to estimate mean wages for OES.

IV. Purpose of Research

It is important to note that while OES uses interval mean methodology, the program is not designed to make occupational estimates for any specific interval. This study is not exploring differences in wage rates by area occupation. We assume a priori that wages do, in fact, differ by area and occupation. The assumption that occupational mean wage rates vary by these factors does not imply, however, that wage rates vary within a wage interval. Virtually all occupations are reported across a subset of the complete set of wage intervals, low paying occupations concentrated in the lower intervals, and high paying occupations in the higher intervals. Because of this fact, this study will concentrate only on mean wages for occupations overall. The following research has two goals: 1) Evaluate the effectiveness of the OES estimation procedures used in occupational mean wage rates, across all intervals, on an independent data set. For this study we used data from the Current Population Survey (CPS) for 2003-2005 as our independent sample. 2) Develop alternative procedures for estimating mean wages for Interval L, specifically for those occupations having significant employment in this open-ended wage interval.

V. Validation of OES Methodology

To check the accuracy and effectiveness of the OES methods, data from CPS was tabulated and used to compute mean wages using the OES methodology as described previously. CPS and OES use the same occupational coding system, which allows for some comparison. However, the CPS only offers data at the major occupational group level. In each year, about one-third of the 22 major occupational groups had statistically significant differences between the actual mean computed using CPS reported data, and the mean computed using OES methodology at the 10% significance level. Also consistently from 2003 to 2005 only one major occupational group or 5% of the groups had an economically meaningful difference of more than 10%.

Figure 7 displays the results of this validation procedure of OES methodology on CPS data for 2005. The table shows first the mean wages computed using CPS data weighted by employment, followed by the unweighted sample size for a point of reference as to relative sample size of each occupational group. For each occupational group, a 90% confidence interval was computed using standard errors produced from CPS replicate weights. Notice that the confidence intervals around the CPS computed mean are very tight. This suggests that there is very small sampling error in CPS. Next on this table is the mean wage using OES methodology. That is, CPS data were dropped into the OES wage intervals. The wage values were then replaced with mean wages for each interval computed from NCS data. State-specific minimum wages were applied when applicable for Intervals A and B. The overall mean wage for each occupation group was then calculated from the CPS sample. Means using OES methodology tended to be lower than those using CPS reported data. Some of this difference is attributable to the difference in mean wages between NCS and CPS within Interval L. As mentioned before, CPS wages in Interval L were about $60 higher than those in NCS for 2003-2005. However, only one group, as mentioned before, had an economically meaningful difference in this study. For 2005, as shown in Figure 7, this group is arts, design, entertainment, sports and media occupations. Results for the years 2003 and 2004 were generally similar, leading to the conclusion that the OES methodology is fairly accurate, with a portion of the bias being attributable to Interval L.

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[4] "Occupational Employment Statistics Survey: Analysis of Alternative Procedures for Interval Mean Wage Rates, Supplement II". December 2000

[5] Barkume, Tony. Matt Dey, Larry Ernst, Maury Gittleman, Anne Polivka. "Comparing OES and NCS Wage Estimates. Phase I: Comparison of National Estimates." May 2006.

VI. Wage Interval L

OES Interval L accounts for those earning at least $70 per hour. A relatively small portion of the OES sample falls within this interval. For the years 2003-2005 less than 1.5% of the OES sample was in Interval L. What complicates OES mean wage estimation the most is the open-ended nature of this interval. An observation in Interval L could make $72 per hour or $5000 per hour, but this cannot be discerned from the collected data. This leads to hard-to-answer questions. Is it possible that OES is currently underestimating or overestimating the mean wage within Interval L? About 40 occupations have significant employment (over 5%) in the Interval L range. This is just a handful of the 800 detailed occupations dealt with in OES, but it is for these occupations that Interval L estimation has a meaningful effect. It is therefore necessary, especially for these specific occupations, to create a special methodology for accurately estimating mean wages in Interval L.

Figures 8, 9, and 10 show occupations that have employment of 5% or more in Interval L for 2003-2005. Notice that most of these occupations consist of physicians, managers, sales occupations, and postsecondary teachers. These are the groups of high-paying occupations that are most effected by Interval L. Also of note here is the difference between percent employment in Interval L and employment level in Interval L. It is important to be aware of both numbers as each has its own merit. For example, in Figure 9, podiatrists have 27% of their employment in Interval L, compared to 25% for lawyers. However, actual employment in L is only 2,200 for podiatrists, compared to 134,000 for lawyers. Which of the two measures is more important depends on the question we are attempting to answer.

Computing Mean Wages for Interval L for Detailed Occupations

For this study it was necessary to examine several different data sources and assess the appropriateness of each to this topic. Mean and median wages from the NCS were examined for OES occupations with significant employment in Interval L. It was found that NCS data tended to be quite variable, and that the percent employment within Interval L by occupation was often quite different between the NCS and OES surveys. For example, in OES about 45% of pilots earn wages in Interval L, while in NCS about 70% of pilots fall in Interval L. Also overall pilots comprise about 2% of the total employment in Interval L for OES, compared to about 10% in NCS.

CPS data were also examined, but the lack of detailed occupational coding and large difference in mean wages for Interval L between CPS and NCS were flagged as possible issues. Data from the American Community Survey were also considered, but issues with quality of data and mean wages similar to CPS eliminated this option.

There is a methodology already in place for computing mean wages in Interval L. Currently, NCS data are used to compute a mean wage across all occupations excluding pilots for each of the years or panels in the sample. This mean wage across occupations excludes pilots because they have very high hourly wages (NCS data shows $145 per hour) and work a relatively low number of hours per year (1100 per year compared to the average 2080). Then the simple average of the yearly or panels estimates is computed. The mean wage is not updated using ECI because it is difficult to justify updating wages in this group when the Interval L mean wages for both all occupations and that excluding pilots are trending downwards or possibly fluctuating around a true mean.

Pilots

Figure 11 shows the Interval L mean wages for 1999-2002. For each of the four years, the mean wage excluding pilots is lower than the mean for all occupations. Taking a simple average of the four years' data shows still a $10 difference between the two means; pilots' data tend to bias the Interval L data upwards.

Figure 12 examines pilots mean wages more closely. NCS publishes a mean hourly wage for pilots as shown in this table, close to $100 for each year (notice the variability across years). OES used a fairly conservative hourly estimate of about $95 per hour according to the above methodology for the 2003-2005 years, yet the OES published annual wage for pilots is still higher than that calculated using NCS wages and mean annual hours for each year. Some of this difference could be explained by the fact that, in OES about 45% of pilots earn wages in Interval L, while in NCS about 70% of pilots fall in Interval L. However, most of this difference is arising from the number of hours worked by pilots. In NCS, the number of hours worked in a year by pilots is approximately 1100, whereas, in OES the assumption is 2080 hours.

Options for Estimating Mean Wages in Interval L

Along with the current methodology, four other options have been proposed for computing mean wages for Interval L.

1. Compute mean wages across all occupations
2. Compute mean wages for NCS major occupational groups (see Figure 13)
3. Compute mean wages for two major groupings: sales and non-sales occupations
4. Compute mean wages for a combination of specific occupations and major occupational groups

Options 1 and 2 are fairly straightforward. When looking at results for Option 2 in Figure 14, it is apparent that, within Interval L, Occupational Groups D-K are negligible. These are groups that do not tend to have high employment in Interval L. It is also apparent that Occupational Groups A and B are very similar in both size and mean wages in Interval L. The most noticeable of these occupational groups is Group C, sales occupations. It is then reasonable to collapse Groups A, B, and D-K into a major grouping of non-sales and compare to the sales occupations, resulting in Option 3.

Option 4 can also be considered in this light. The occupational groups with the most employment in Interval L are Groups A, B, and C. These are professional and technical occupations, executive, administrative, and managerial occupations, and sales occupations. In other words, these are comparable to the handful of detailed occupations with significant employment in Interval L shown in Figures 8, 9, and 10. Ideally, these detailed occupations could be handled individually, to compute the most accurate overall mean wage for each occupation. Option 4, consequently, would compute a mean wage in Interval L for specific occupations—physicians, post-secondary teachers, lawyers & judges, and pilots; and major groups—managers, sales occupations, and all others. The specific occupations chosen are all in Occupational Group A, while managers is Group B, sales Group C, and the rest of Group A and D-K are grouped in "all others."

The current options, as well as the three new options, were tested. (Note: option 2 is equivalent to option 3) Figure 15 details those occupations that failed tests for each of the options. For an occupation to fail when tested with each option, it had to have at least 1000 employed (weighted) in Interval L and the given option had to produce a relative error on mean wages per hour of 10% or more for at least 2 of the 3 years of 2003-2005. All options worked fairly well. In total, 25 occupations had at least 1000 employed in Interval L. Out of this only three occupations (or about 12%) failed for the current option and Options 3 and 4, while in Option 1 five occupations (or about 20%) failed.

Any option chosen would still need to be tested on OES data. For example, let us choose Option 4. In testing on NCS data, Option 4 forces pilots to pass because a separate mean wage for Interval L is computed for pilots using NCS data. If the interval hourly mean wage for pilots from NCS ($145 per hour) is applied to the OES sample, it would further increase the OES published as $95 per hour for Interval L and 2080 hours are used for annual wages. However, when we adjust NCS mean wages for Interval L to take into account the NCS annual hours worked and OES annual hours worked assumption (i.e. Interval L mean wages in OES context are equal to about $77 or $145×1100 ÷2080), then this brings the OES annual wages close to the NCS calculated annual wages, as shown in Figure 16. This suggests that even for specific occupations, special methods may need to be applied.

VII. Future Research

More research on this topic is definitely required. As mentioned before, each proposed option for estimating mean wages in Interval L should be tested further. This should include testing the options on NCS data after it has changed to using the Standard Occupational Coding system currently used by OES. This should also include testing the options on OES data with the new Interval L lower bound of $80 per hour. It would also be beneficial to test the use of special procedures for certain occupations, as in the case of pilots as well as post-secondary teachers, who often earn wages on an annual basis rather than hourly (as a result of unusual annual hours). In question is whether this procedure should utilize one year's data in NCS or the average of three years.

To even further examine the distribution of wages within intervals, it may be useful to explore a kernel density model.[6] A non-parametric kernel density function could be used to estimate mean wages for wage intervals by occupation. This approach is particularly suitable for wage data collected from the NCS because the point data are available. It can also be useful in estimating percentiles from OES data.

[6] Lehman. Elements of Large Sample Theory, Springer 1999, pp. 406-417

References

1. Butani, Shail. “Mean OES Wages--$60.00”. October 17, 1990. Electronic message with attachment
2. Butani, Shail J., and Michael McElroy. “Managing Various Customer Needs for Occupational Employment Statistics Survey”
3. Butani, Shail, Kenneth Robertson, and George Werking. “Alternative Methods for Updating Wage Data from the Occupational Employment Statistics Survey”
4. Echols, Carrae, Albert Tou, and Kenneth W. Robertson. “Comparing Alternative Median Wage Rate Estimates for the Occupational Employment Statistics Survey”
5. Robertson, Kenneth W., Albert Tou, and Larry Huff. “A Study of Donor Pools and Imputation Methods for Missing Employment Data”
6. Robertson, Kenneth W., and Pamela L. Frugoli. “Statistical Issues for the Redesigned Occupational Employment Statistics Survey”
7. Tou, Albert, Christina Chiu, and Kenneth Robertson. “An Evaluation of the Occupational Staffing Pattern and Mean Wage Rates of State Government Workers”.
8. West, Sandra A. “Estimation of the Mean from Censored Income Data”.
9. West, Sandra A. “Standard Measures of Central Tendency for Censored Earnings Data from the Current Population Survey”.
10. West, Sandra A., Shail Butani, and Michael Witt. “Alternative Imputation Methods for Wage Data”
11. West, Sandra, Diem-Tran Kratzke, and Shail Butani. “Measures of Central Tendency for Censored Wage Data”
12. West, Sandra, Diem-Tran Kratzke, and Kenneth Robertson. “Alternative Procedures for Item Non-response from New Establishments in the Universe”
13. Wolter, Kirk, and Rashna Ghadialy. “Preliminary Report on Evaluation of the Occupational Employment Statistics Estimation and Alternative Methods of Updating Wage Estimates”
14. “Occupational Employment Statistics Survey: Analysis of Alternative Procedures for Interval Mean Wage Rates”. October 2000
15. “Occupational Employment Statistics Survey: Analysis of Alternative Procedures for Interval Mean Wage Rates, Supplement II”. December 2000
16. Lehman. Elements of Large Sample Theory, Springer 1999, pp. 406-417

Figure 1: Example of OES Survey Form

OCCUPATIONAL TITLE AND DESCRIPTION OF DUTIES	NUMBER OF EMPLOYEES IN SELECTED WAGE RANGES (Report Part-time Workers According to an Hourly Rate)												
	A	B	C	D	E	F	G	H	I	J	K	L	T
Hourly (part-time or full-time)	under $6.75	$6.75 - 8.49	$8.50 - 10.74	$10.75 - 13.49	$13.50 - 16.99	$17.00 - 21.49	$21.50 - 27.24	$27.25 - 34.49	$34.50 - 43.74	$43.75 - 55.49	$55.50 - 69.99	$70.00 and over	Total Employment
Annual (full-time only)	under $14,040	$14,040 - 17,679	$17,680 - 22,359	$22,360 - 28,079	$28,080 - 35,359	$35,360 - 44,719	$44,720 - 56,679	$56,680 - 71,759	$71,760 - 90,999	$91,000 - 115,439	$115,440 - 145,599	$145,600 and over	

Management Occupations

(Managers in this section have other managers/supervisors reporting to them.)

	A	B	C	D	E	F	G	H	I	J	K	L	T
Chief Executives - Determine and formulate policies and provide the overall direction of companies or private and public sector organizations within the guidelines set up by a board of directors or similar governing body. **11-1011**													
General and Operations Managers - Plan, direct, or coordinate the operations of companies or public and private sector organizations. Duties include formulating policies, managing daily operations, and planning the use of materials and human resources, but are too diverse in nature to be classified in any one functional area of management or administration. **11-1021**													
Financial Managers - ***(Controller)*** Plan, direct, and coordinate accounting, investing, banking, insurance, securities, and other financial activities of a branch, office, or department of an establishment. **11-3031**													
Compensation and Benefits Managers - Plan, direct, or coordinate compensation and benefits activities and staff of an organization. Include job analysis and position description managers. **11-3041**													
Industrial Production Managers - ***(Quality Control Manager)*** Plan, direct, or coordinate the work activities and resources necessary for manufacturing products in accordance with cost, quality, and quantity specifications. **11-3051**													

Figure 2: Reported Weekly Earnings from CPS Measures of Central Tendency-Dr. Sandra West.

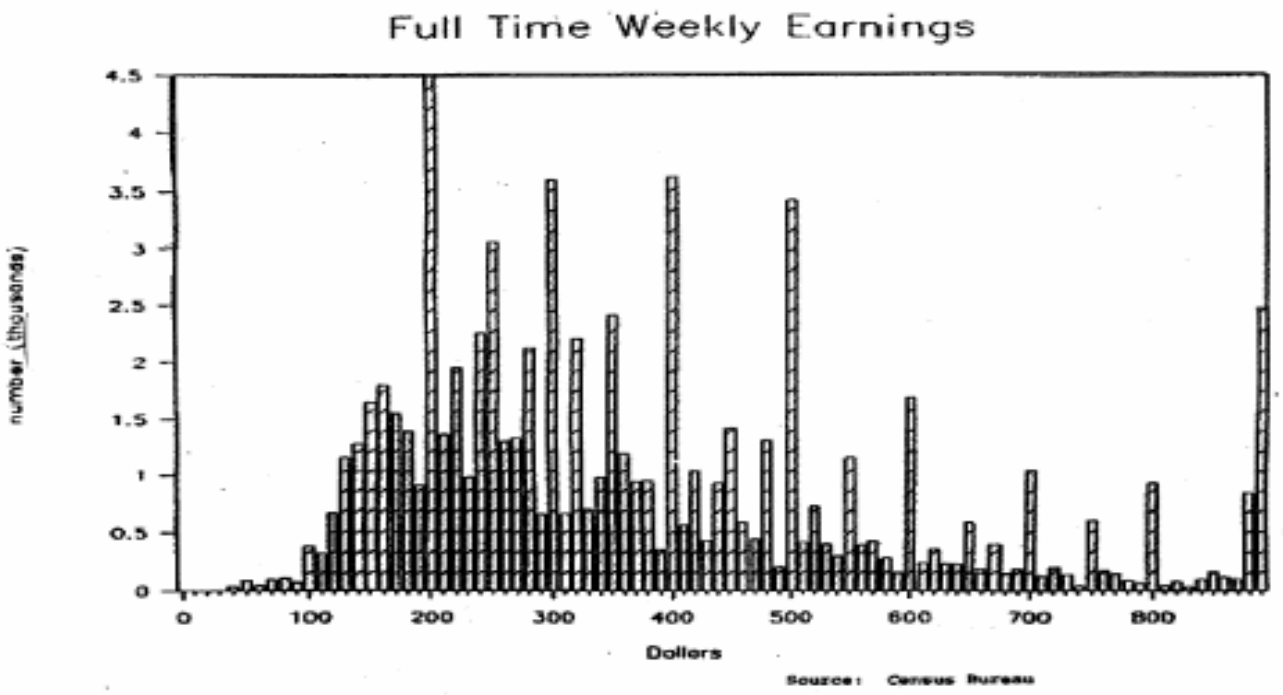

Figure 3: OES Wage Interval Boundaries 2003-2005

OES Wage Interval Boundaries					
Interval	**Lower Bound**	**Upper Bound**	**Interval Width**	**% Relative**	**% CV**
A	$5.15	$6.74	$1.60	13.4	7.8
B	$6.75	$8.49	$1.75	11.5	6.6
C	$8.50	$10.74	$2.25	11.7	6.7
D	$10.75	$13.49	$2.75	11.3	6.5
E	$13.50	$16.99	$3.50	11.5	6.6
F	$17.00	$21.49	$4.50	11.7	6.7
G	$21.50	$27.24	$5.75	11.8	6.8
H	$27.25	$34.49	$7.25	11.7	6.8
I	$34.50	$43.74	$9.25	11.8	6.8
J	$43.75	$55.49	$11.75	11.8	6.8
K	$55.50	$69.99	$14.50	11.6	6.7
L	$70.00		∞		

Figure 4: Interval mean Wages using Proposed Methods

Mean Wages within OES wage intervals A through L

CPS, NCS, and OES data

Year	OES Wage Interval	Lower Bound	Upper Bound	Arithmetic Mean	Geometric Mean	NCS Mean	CPS Mean
2004	A	5.15	6.74	5.95	5.89	5.79	5.37
	B	6.75	8.49	7.62	7.57	7.52	7.54
	C	8.50	10.74	9.62	9.55	9.55	9.56
	D	10.75	13.49	12.12	12.04	12.03	12.06
	E	13.50	16.99	15.25	15.14	15.11	15.10
	F	17.00	21.49	19.25	19.11	19.06	19.01
	G	21.50	27.24	24.37	24.20	24.27	24.05
	H	27.25	34.49	30.87	30.66	30.42	30.39
	I	34.50	43.74	39.12	38.85	38.60	38.30
	J	43.75	55.49	49.62	49.27	48.54	48.46
	K	55.50	69.99	62.75	62.33	61.39	61.29
	L	**70.00**				**103.91**	**161.43**
	Total					17.59	18.32

Figure 5: Interval Means 2003-2005

NCS and CPS Interval Means Across Years

Intervals	NCS Interval Means $				CPS Interval Means $		
	2003	2004	2005		2003	2004	2005
A	5.78	5.79	5.82		5.37	5.37	5.41
B	7.51	7.52	7.54		7.54	7.54	7.55
C	9.57	9.55	9.55		9.57	9.56	9.56
D	12.03	12.03	12.03		12.05	12.06	12.05
E	15.11	15.11	15.10		15.10	15.10	15.12
F	19.04	19.06	19.06		19.01	19.01	18.99
G	24.23	24.27	24.27		24.06	24.05	24.10
H	30.40	30.42	30.43		30.35	30.39	30.38
I	38.49	38.60	38.57		38.32	38.30	38.41
J	48.75	48.54	48.68		48.54	48.46	48.63
K	61.20	61.39	61.36		61.20	61.29	61.16
L	107.43	103.91	103.09		163.82	161.43	163.95
Overall	17.22	17.59	18.07		17.78	18.32	18.82

- **Means Wages in each interval for the three years are about the same.**

Yearly Percentage Change

	NCS%	CPS%
2004	2.15	3.04
2005	2.73	2.73

Figure 6: Distribution of Employment Across Years

NCS, CPS, and OES Employment Distribution 2003 - 2005										
Intervals	**NCS %**				**CPS %**				**OES %**	
	2003	**2004**	**2005**		**2003**	**2004**	**2005**		**2003**	**2004**	**2005**
A	8.6	8.1	7.5		8.0	7.2	6.7		7.7	7.3	6.8
B	12.4	11.7	11.3		12.1	12.0	11.1		13.0	12.3	12.2
C	15.1	14.7	14.4		15.1	14.7	14.6		14.6	14.3	14.3
D	14.0	14.2	13.8		14.4	13.9	14.0		14.2	14.0	14.0
E	13.2	13.4	13.7		13.8	14.0	14.0		13.5	13.6	13.7
F	11.7	12.0	12.2		12.7	13.0	13.0		12.4	12.4	12.5
G	10.1	10.2	10.2		10.1	10.4	10.6		9.8	10.3	10.4
H	6.9	7.4	7.7		6.4	6.5	7.0		6.4	6.7	7.0
I	4.1	4.4	4.7		4.0	4.4	4.5		3.9	4.2	4.4
J	2.2	2.3	2.7		1.9	2.1	2.4		2.1	2.3	2.4
K	1.0	1.0	1.1		0.8	0.9	1.1		1.0	1.1	1.2
L	0.6	0.7	0.7		0.9	1.0	1.1		1.3	1.4	1.4
Totals	100.0	100.0	100.0		100.0	100.0	100.0		100.0	100.0	100.0

Figure 7: Validation of OES Methodologies for 2005

Comparison of CPS mean wages to means calculated using NCS Interval means, state minimum wages and a proposed option Interval L methodology *							
Year	**Occupational Group**	**CPS Mean Wage**	**Unweighted Sample Size**	**90% Confidence Intervals About the CPS Mean Wage**	**Mean Wage using OES Interval Methodology**	**Error**	**% Relative Error**
2005	Management Occupations	$29.96	15,758	(29.51,30.42)	$28.77	-1.20	(4.00%)
	Business and financial operations occupations	$25.15	7,131	(24.53,25.77)	$24.76	-0.39	(1.56%)
	Computer and mathematical science occupations	$30.64	4,166	(29.67,31.60)	$29.16	-1.47	(4.81%)
	Architecture and engineering occupations	$28.90	3,656	(27.95,29.87)	$28.19	-0.72	(2.50%)
	Life, physical, and social science occupations	$26.74	1,959	(25.92,27.55)	$26.16	-0.58	(2.18%)
	Community and social service occupations	$19.96	3,096	(19.03,20.90)	$19.35	-0.62	(3.09%)
	Legal occupations	$32.71	1,872	(31.51,33.92)	$30.05	-2.67	(8.15%)
	Education, training, and library occupations	$22.40	11,546	(21.83,22.98)	$21.14	-1.27	(5.65%)
	Arts, design, entertainment, sports, and media occupations	**$25.52**	**2,711**	**(24.80,26.24)**	**$22.10**	**-3.42**	**(13.4%)**
	Healthcare practitioner and technical occupations	$25.77	8,999	(25.39,26.16)	$25.30	-0.47	(1.84%)
	Healthcare support occupations	$11.44	4,234	(11.17,11.71)	$11.41	-0.03	(0.24%)
	Protective service occupations	$17.80	3,891	(17.43,18.16)	$17.71	-0.08	(0.46%)
	Food preparation and serving related occupations	$9.68	10,489	(9.58, 9.79)	$9.83	0.15	1.53%
	Building and grounds cleaning and maintenance occupations	$10.91	6,377	(10.76,11.06)	$11.02	0.11	1.04%
	Personal care and service occupations	$11.36	4,755	(11.12,11.60)	$11.44	0.08	0.75%
	Sales and related occupations	$17.90	19,043	(17.52,18.28)	$17.23	-0.67	(3.76%)
	Office and administrative support occupations	$14.76	27,053	(14.59,14.92)	$14.54	-0.21	(1.44%)
	Farming, fishing, and forestry occupations	$9.98	1,355	(9.58,10.37)	$10.19	0.21	2.11%
	Construction and extraction occupations	$16.95	10,037	(16.55,17.34)	$16.68	-0.27	(1.59%)
	Installation, maintenance, and repair occupations	$18.65	6,651	(18.01,19.29)	$18.16	-0.49	(2.65%)
	Production occupations	$14.95	12,487	(14.79,15.12)	$14.79	-0.16	(1.09%)
	Transportation and material moving occupations	$14.73	11,153	(14.49,14.97)	$14.35	-0.38	(2.56%)
2005	All Occupations	$18.80	178,419	(18.69,18.91)	$18.27	-0.53	(2.81%)

Figure 8

Group I - OES Occupations with 40% Employment in Interval L					
			Weighted Employment	Interval L	
No.	SOC	Occ #	Occupation	% Emp in L	Emp in L
1	29-1067	84	Surgeons	82	44,000
2	29-1061	84	Anesthesiologists	78	22,000
3	29-1064	84	OBGyn	77	17,000
4	29-1063	84	Internists, general	59	29,000
5	29-1066	84	Psychiatrists	50	12,000
6	29-1069	84	Physicians/Surgeons	49	88,000
7	11-1011	4	Chief Executives	49	156,000
8	29-1062	84	Family/Gen. practition	46	52,000
9	53-2011	226	Pilot/Copilot/Fl.engin.	46	35,000
10	29-1065	84	Pediatricians, gen.	43	12,000

Figure 9

Group II - OES Occupations with 15 - 30% Employment in Interval I					
			Weighted Employment	Interval L	
No.	SOC	Occ #	Occupation	% Emp in L	Emp in L
11	29-1081	88	Podiatrists	27	2,200
12	23-1011	178	Lawyers	25	134,000
13	29-1199	84	Health Dia/Treat Prac	24	14,000
14	27-2021	199	Athletes and Sports	21	2,600
15	41-3031	255	Secur./Comm./Finance.	19	48,000
16	11-1021	22	General/Operation Mgr.	18	304,000
17	11-2022	243	Sales Managers	18	57,000
18	11-2021	13	Mkt. Managers	17	29,000
19	13-2052	25	Personal Financial Ad.	16	18,000
20	13-2051	7	Financial Managers	15	70,000
21	41-9021	254	Real Estate Brokers	15	6,100
22	25-1112	145	Law teachers, postsec.	15	2,000

Figure 10

Group III - OES Occupations with 5 - 14% Employment in Interval L					
			Weighted	Interval L Employment	
No.	SOC	Occ #	Occupation	% Emp in L	Emp in L
23	29-1041	87	**Optometrists**	**14**	3,000
24	29-1011	84	**Chiropractors**	**13**	3,000
25	11-3021	64	**Computer/Info Sys Mgr**	**13**	34,000
26	11-9121	22	**Natural Sciences Mgr.**	**13**	5,000
27	11-9041	59	**Engineering Managers**	**12**	23,000
28	15-2011	66	**Actuaries**	**12**	1,900
29	29-1199	134	**Health Spec. teachers**	**11**	12,000
30	13-1011	22	**Agents/Business Mgr.**	**11**	1,200
31	11-2011	13	**Ad. & Promo. Mgr.**	**11**	5,000
32	25-1042	114	**Bio. Teacher, Postsec.**	**11**	6,000
33	11-2031	13	**PR Managers**	**10**	4,000
34	27-2012	187	**Producers/Directors**	**9**	5,000
35	41-1012	22	**First-line Supv./Mgr.**	**8**	22,000
36	29-1131	86	**Veterinarians**	**7**	3,000
37	19-3011	166	**Economists**	**6**	800
38	13-2051	25	**Financial Analysts**	**6**	11,000
39	19-2042	75	**Geoscientists**	**6**	1,700

Figure 11. Mean Wages for Interval L

	All data	Excluding Pilots
1999	$124.55	$109.44
2000	107.33	100.76
2001	107.37	101.35
2002	101.14	94.23
Avg	**110.10**	**101.44**

Figure 12. Airline Pilots Mean Wages

	NCS Published	NCS Calculated	OES Published
2003	$ 98.47 / hr	$ 111,800 / yr	$ 129,900 / yr
2004	113.82 / hr	121,100 / yr	129,600 / yr
2005	95.50 / hr	116,300 / yr	135,000 / yr

Figure 13

NCS Occupational Groups	
Group	**Occupational Description**
A	Professional and Technical Occupations
B	Executive, Administrative, and Managerial Occupations
C	Sales Occupations
D	Administrative Support Occupations, Including Clerical
E	Precision Production, Craft, and Repair Occupations
F	Machine Operators, Assemblers, and Inspectors
G	Transportations and Material Moving Occupations
H	Handlers, Equipment Cleaners, Helper, and Labors
K	Service Occupations, Expert Private Household

Figure 14

Options II and III- - NCS Major Occupational Groups				
Mean 2004				
NCS Group	**Occupations**	**Weighted Employment in Interval L**	**% Employment in Interval L**	**Mean Wage for Interval L**
A	Professional and Technical Occupations	288,800	2.002	$101.38
B	Executive, Administrative, and Managerial Occupations	210,500	3.584	101.99
C	Sales Occupations	50,100	0.628	127.34
D	Administrative Support Occupations, Including Clerical	500	0.004	116.73
E	Precision Production, Craft, and Repair Occupations	200	0.003	91.59
F	Machine Operators, Assemblers, and Inspectors	0	0.000	.
G	Transportations and Material Moving Occupations	0	0.000	72.43
H	Handlers, Equipment Cleaners, Helper, and Labors	0	0.000	.
K	Service Occupations, Expert Private Household	1,900	0.011	80.99
Overall	All Occupations	552,100	0.681	103.91

Figure 15

RESULTS

Fail Criteria: Weighted employment in interval L ≥ 1000 and

Relative error on mean wages per hour ≥ 10% for 2 or 3 years

Occ Code	Title	Average Weighted employment in interval L	Average % employment in interval L	Current Method	Overall Mean Option I	Sales vs. Non-Sales Option III	Combination of Occupation Option IV
119	College & University, Teachers	6,000	45	Pass	Failed	Failed	Pass
127	College & University, Teachers	6,000	33	Pass	Failed	Borderline	Pass
179	Judges	3,000	30	Failed	Failed	Failed	Pass
226	**Pilots**	**62,000**	**70**	**Failed**	**Failed**	**Failed**	**N/A**
255	Financial Service Sales	19,000	12	Failed	Failed	Pass	Pass
166	Economists	4,000	6	Pass	Pass	Pass	Failed
186	Musicians & Composers	4,000	15	Pass	Pass	Pass	Failed
198	Announcers	6,000	10	Pass	Pass	Pass	Failed

Figure 16: Pilots Mean Wages

	NCS Published	NCS Calculated	OES Published		OES Calculated w/NCS Pilots yearly mean for interval L (Approximation)
2003	$ 98.47 / hr	$ 111,800 / yr	$ 129,900 / yr		$ 114,600 / yr
2004	113.82 / hr	121,100 / yr	129,600 / yr		114,300 / yr
2005	95.50 / hr	116,300 / yr	135,000 / yr		119,700 / yr