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Developing Statistical Based Earnings Estimates: Median versus Mean Earnings

Lawrence M. Spizman

I. Introduction

When estimating losses associated with personal injury and wrongful death, a forensic economist normally examines the plaintiff's earnings records to determine lost income. When a plaintiff does not have an established work history, statistical based earnings estimates must be created. Consequently, a forensic economist must determine and understand the implications of using either mean or median earnings for such estimates.

Injured plaintiffs, such as minor children, homemakers, and college students, usually do not have an established earnings record. Determining earning losses for a minor plaintiff requires knowing the average earnings associated with the minor's pre-injury educational level. If the plaintiff is an injured homemaker who was planning on re-entering the labor market, average data may be used to establish future base earnings. A college student injured while in school may require using college graduates' average earnings as a base to estimate lost income. A vocational expert may use average data as a base for residual earnings of a plaintiff. Regardless of the circumstances and characteristics of the injured plaintiff, an economist must choose carefully which data source to use. Two widely used data sources published by the United States Census Bureau are the Current Population Survey ("CPS") and the American Community Survey ("ACS").

II. Median versus Mean Earnings

Regardless of the data source, determining whether to use mean or median earnings as a base for estimating future losses is required. For example, if the losses are for a minor child, then age-earning profiles may be used throughout the minor's working life. Age-

Lawrence M. Spizman, State University of New York at Oswego, Economics Department, Oswego, New York 13126, Office 315.343.7631, E-mail: larry.spizman@oswego.edu.

earnings profiles are provided by both the ACS and CPS for different demographic characteristics and educational levels for ages 18 to 24, 25 to 34, 35 to 44, 45 to 54, 55 to 64 and 65 and beyond.

Most people think of mean earnings when taking an average. Mean earnings is the sum of earnings of all individuals in the sample divided by the number of people in the sample. Suppose there were 10 people in the sample with nine of them earning $30,000 a year and one person earning $250,000 a year. The mean is $52,000 a year. One individual skewed the entire average. Since the sample from the CPS includes the self-employed, income may be distorted because one individual in a smaller subset in the cohort can be an outlier. Statistical measures that include the self-employed may distort income because the self-employed may have either extraordinarily large earnings or negative earnings. The self-employed may further distort earnings because it includes income derived from returns on capital investments.

Median earnings, on the other hand, is the midpoint of the salary range and is less likely than the mean salary to be skewed by outliers. The median in the above example would be $30,000. The mean distorts earnings depending on whether the outlier is a large or small number. This distortion does not occur when median earnings are used.

III. American Community Survey versus Current Population Survey

The Current Population Survey PINC-04 tables provide age earning profiles for mean earnings only.[1] PINC-04 tables do not provide earnings for 18 to 24 year olds with a Master's Degree, Ph.D. Degree or Professional Degree or for professional or Ph.D. Degrees for 25 to 29 year olds.

Median earnings from the CPS are provided by PINC-03 tables.[2] However, PINC-03 tables do not provide earnings data for any 18 to 24 year olds. Due to the missing cohort problem, earning losses prior to the plaintiff's reaching age 25 are problematic if PINC tables are used. Additionally, both PINC-03 and PINC-04 tables combine high school graduates and individuals with a GED.

The American Community Survey (ACS) solves the missing cohort problem by providing age earning profiles based on median earnings for all age cohorts. The ACS also provides separate earnings for a GED and separate earnings for a high school graduate (without a GED). This solves the problem of PINC tables combining GED and high school graduates into one cohort. The publication, *Full-Time Earnings in the United States (2013)*[3] provides ACS data in easy-touse

tables. All references in this note to ACS data are based on tables provided by *Full-Time Earnings in the United States*.

Page 5 of *Full-Time Earnings in the United States* discusses in detail the mean/median conflict and quotes the Census Bureau[4] in the following:

> "*Care should be exercised in using and interpreting mean income values for small subgroups of the population. Because the mean is influenced strongly by extreme values in the distribution, it is especially susceptible to the effects of sampling variability, misreporting, and processing errors. The median, which is not affected by extreme values, is, therefore, a better measure than the mean when the population base is small.*"

Sample Size ofACS versus CPS

The sample population used to derive the PINC tables from the CPS is significantly smaller than the ACS sample. The latest CPS data is based on the 2012 Annual Social and Economic (ASEC)

Supplement[5] which has a sample population of about 99,000 households. Of these households, 60,000 are from the regular sample of occupied households (57,000 interviewed) plus 4,500 Hispanic households (4000 interviewed) and the Children's Health Insurance Coverage (CHIP) sample of 34,500.[6] The number of households interviewed was approximately 96,659. The CPS sample includes the self-employed as well as individuals who operate farms. After disaggregating the sample for different categories of age, race, education, gender etc., the sample size in certain cohorts may be very small.[7] Consequently, a small number of outliers (or even one successful, self-employed person within the demographic group) can distort the mean earnings of the group.

The 2011 ACS sample of 3,372,520 housing units (2,128,104 interviewed) is 33 times larger than the CPS sample.[8] *Full-Time Earnings in the United States* not only provides easy-to-use tables from ACS data, but their tables also exclude the self-employed, consequently reporting earnings for wage and salary workers only. Thus ACS tables remove distortions from self-employed outliers and self-employed income from returns to capital.

IV. ACS Median Earnings versus CPS Mean Earnings

Table 1 illustrates the differences between median earnings from *Full-Time Earnings in the United States* (based on ACS data) and mean earnings from PINC-04 tables. For example, the difference between mean earnings for a male between the ages of 25 to 34 with an

Table 1. Age Earning Profile by Educational Level Median and Mean: Male

	18–24	25–34	35–44	45–54	55–64
American Community Survey Full-Time Median Wage and Salary Earnings					
Less than High School Diploma	$19,347	$25,985	$31,182	$34,620	$35,340
GED	$21,799	$31,182	$37,729	$40,729	$40,873
High School	$21,828	$31,441	$40,729	$44,017	$43,655
Associate Degree	$26,201	$41,576	$52,401	$57,641	$55,089
Bachelor's Degree	$35,333	$52,401	$73,362	$82,477	$75,877
Master's Degree	$37,729	$64,443	$89,605	$98,769	$88,587
Ph.D. Degree	$28,511	$64,443	$94,322	$104,803	$104,803
Professional Degree	$38,458	$72,758	$125,763	$145,517	$135,426
Current Population Survey PINC-04 Mean Earnings					
Less than High School Diploma	$23,360	$29,997	$35,796	$40,075	$44,123
GED	NA	NA	NA	NA	NA
High School and GED	$26,851	$37,906	$47,607	$52,588	$51,288
Associate Degree	$28,753	$47,340	$62,159	$65,129	$63,717
Bachelor's Degree	$42,572	$60,655	$85,947	$95,671	$88,673
Master's Degree	b	$81,615	$102,758	$121,902	$117,806
Ph.D. Degree	b	$77,444	$125,088	$154,832	$143,956
Professional Degree	b	$116,037	$166,817	$168,116	$197,558
Difference between mean of PINC-04 and ACS Median					
Less than High School Diploma	20.74%	15.44%	14.80%	15.76%	24.85%
GED	NA	NA	NA	NA	NA
High School	23.09%	21.06%	21.36%	24.11%	21.35%
Associate Degree	9.74%	13.86%	18.62%	12.99%	15.66%
Bachelor's Degree	20.49%	15.75%	17.15%	16.00%	16.86%
Master's Degree	b	26.65%	14.68%	23.42%	32.98%
Ph.D. Degree	b	20.17%	32.62%	47.74%	37.36%
Professional Degree	b	59.48%	32.64%	15.53%	45.88%

b base is less than 75,000
NA Not available

Associate's Degree is 13.86% greater than the median earnings from the ACS. The mean earnings for a male between the ages of 25 and 34 with a Bachelor's Degree are 15.75% higher than the median earnings from ACS. Table 1 shows that PINC-04 mean tables consistently result in higher earnings and thus losses, compared to the median earnings from the ACS.

When comparing median earnings from PINC-03 tables to ACS tables, some cohorts of PINC-03 have greater earnings than ACS and some have lower earnings. However, given the smaller sample size of the CPS as well as missing cohort data and inclusion of the self-employed, one should be extremely cautious about using CPS tables over tables based on ACS data.[9]

V. Conclusion

Comparing ACS and PINC-04 tables show mean earnings are always greater than median earnings. The magnitude of the difference varies from a low of 9.74% to a high of 59.48% depending on the plaintiff's age and educational level. This difference is more insidious than just the difference in base earnings which are used to estimate future losses. The higher PINC-04 earnings are further compounded because earnings growth occurs on the higher base. Any errors that increase working life will also be compounded by the higher base. If fringe benefits are estimated as a percentage of earnings, then fringe benefit losses will also be distorted since they use higher base earnings. Because the ACS sample is 33 times larger than the CPS sample and provides earnings across all age groups for all educational levels as well as removing any self-employment distortions, it is an overall better source for lost earnings estimates. Caution must be exercised before using PINC-04 tables.

Endnotes

[1] (Educational Attainment- People 18 years old and over, by Total Money Earnings in 2010, Work Experience in 2010 Age, Race, Hispanic Origin, and Sex. http://www.census.gov/hhes/www/cpstables/032012/perinc/pinc04_000.htm

[2] http://www.census.gov/hhes/www/cpstables/032009/perinc/new03_000.htm

[3] Expectancy Data *Full-Time Earnings in the United States: 2011 Edition*. Shawnee Mission, Kansas, 2013. This publication is annually updated.

[4] The original quote can be found at American Community Survey and Puerto Rico Community Survey, 2011 Subject Definitions, page 82. http://www.census.gov/acs/www/data_documentation/documentation_main/

[5] Source: U.S. Census Bureau, Current Population Survey, 2012 Annual Social and Economic Supplement.

[6] http://www.census.gov/cps/

[7] PINC-04 tables found at http://www.census.gov/hhes/www/cpstables/032012/perinc/pinc04_000.htm show the number of individual in the different cohorts. *Full-Time Earnings in the United States* also provides the sample size for each Cohort.

[8] http://www.census.gov/acs/www/about_the_survey/american_community_survey/

[9] It should be noted that the data provided by *Full-Time Earnings in the United States* is for year-round, full-time workers. Some economists argue that PINC-04 tables may be appropriate to use since they provide data for both "Total Work Experience" and for "Worked Full-Time Year Round." Given the data issues presented in this note one must carefully weigh the costs and benefits of using the PINC data. Suppose we must estimate the losses of a minor child with no work history. Using mean data from PINC-04 may rest on the argument that the child may only work part-time during his working life and thus data for total work-experience should be used. However, when determining economic losses, economists almost always assume the plaintiff would have been employed full-time, year round unless there is a foundation that prior to the accident the plaintiff would not have worked full-time year round.