The Madness of Weighted Mean Faculty Salaries

By:

Theodore Micceri, Ph.D.

Paper Presented at the Florida Association for Institutional Research Annual Conference, Cocoa Beach, FL. Feb 25-27, 2009

Executive Summary

This paper explains how misleading the use of weighted mean faculty salaries can be when comparing across institutions. Unfortunately, USF's faculty used weighted means in 2004 (Faculty Senate, 2004) to erroneously conclude: "...Faculty compensation at USF is unacceptably low, placing us well below peers nationally and regionally, and ranking lowest among doctoral level institutions in Florida." Although it is true that compensation at USF is not as high as a Carnegie Very High Research Institution should be, in fact, as the data herein detail, only UF (3.2%) and FSU (1.8%) have higher weighted mean salaries than USF when cost of living is used to equate locales.

The primary problem with weighted mean salaries derives from the misuse of a tool designed to estimate the salary per unit cost in the production of widgets. Attempting to treat complex higher education institutions like businesses is an error than many make today. Although several business techniques apply reasonably well in the higher education setting, many do not, and among the latter group is the weighted mean salary,

Some Problems with Weighted Mean Salaries

1. Weighted mean salaries were designed to estimate the labor cost per widget produced based on the proportion of different hourly wage contribution to each widget. Of course, different costs and proportions associate with each widget. In higher education, we have at least three different widgets (1) education, (2) research, (3) public service, and different faculty ranks contribute different amounts for each widget. However, mean faculty salaries fail to take this into account and thereby completely misapply the underlying method.
2. Weightings reflect the inappropriate simple proportion of faculty at rank for each institution. Of course, mean salaries across ranks differ substantially. Thus institutions like UF, with 42% full professors, necessarily show higher weighted mean salaries than USF with only 32%.
3. Because salaries differ substantially from discipline to discipline, the only legitimate comparison is by rank within discipline. Global means are influenced by both the proportion at rank and the proportion at rank in discipline.
4. More prestigious and mature institutions tend to have greater proportions of high salaried distinguished professors, national academy members and highly cited scholars than do less mature institutions, again biasing mean salaries upward.
5. Raw mean salaries do not reflect cost of living differences that range substantially from locale to locale. It is a priority to adjust for these.[1]
6. Point estimators of location (e.g. mean, median) are designed to represent the center of a symmetrical, centrally dense and light-tailed distribution of values. In this case, faculty salaries are always tri-modal and highly skewed at each rank, with each of the three modes defined by the ranks as was noted in point 2. A point estimator designed for a symmetric, uni-modal value distribution is inappropriate for such tri-modal asymmetric distributions.

[1] Because full and associate professors bought homes earlier, these are indicative, but not definitive.

Findings

Comparisons using IPEDS 2002 and 2007 (IPEDS, 2008) faculty salary data by rank and CNN Money (2008) cost of living indices were conducted across three groups: SUS Doctoral/Research institutions, a select group of seven peers by the faculty senate committee, and USF's eight national peers.

USF's weighted mean faculty salary of $78,274 was used as a basis for the computation of a Cost of Living Index (CLI). This mean results from 32% full professors at $101,808; 30% associate professors at $73,409, and 38% assistant professors at $61,823.

Table 1 and Figure 1 show that if every SUS institution had USF's salaries at rank in computing weighted means, that USF would be tied with FIU, somewhat behind UF and FSU, and somewhat ahead of UCF and FAU.

If adjusted for CLI (Table 2), UF's weighted mean salary is 3.2% above USF's, FSU's is 1.8% above, while USF has an advantage of respectively 3%, 14% and 26% over UCF, FIU and FAU.

Table 1 and Table 2 show that the seven elite comparison institutions all are comparatively well compensated no matter how one looks at the data. However, when adjusted for CLI, half of USF's national peers fall above, and half below USF's weighted mean salary (Table 2).

Salary comparisons are far from a simple process, although they are frequently reduced to a few numbers representing us and them, as has been done in this document for two reasons: (1) brevity, and (2) detailed data is simply not available, even the OSU and CUPA salary comparisons, conducted at rank within discipline fail to consider CLI and highly salaried individuals who skew means upward. Hopefully, in the future, individuals at USF will realize that any global mean, whether at the institutional level, the rank level, or the discipline level, is not a good tool to use for representing a value distribution that is always quite skewed upward. A light alpha trimmed mean, or a median (if sample size is over 20) are far better location estimators to use for such purposes.

The Madness of Weighted Mean Faculty Salaries

Higher education frequently uses weighted mean faculty salaries to compare either across institutions, or to evaluate an institution's salary growth over time. Unfortunately, faculty salaries are an extraordinarily complex phenomenon that cannot be legitimately reduced to a single number any more than the academic construct of skills, knowledge, intelligence and experience that defines a prospective student can be encompassed by a single test score. Unfortunately, USF's faculty used weighted means in 2004 (Faculty Senate, 2004) to conclude: "...Faculty compensation at USF is unacceptably low, placing us well below peers nationally and regionally, and ranking lowest among doctoral level institutions in Florida." This paper attempts to clarify some of the confusing and misleading aspects of such faculty salary analyses by providing direct comparisons across institutions and showing that the concept of a weighted mean salary for a large institution suffers from at least the following problems:

1. Weighted mean salaries were designed to estimate the labor cost of producing a widget based on the cost and hourly contribution from those at different hourly wage levels to the production. Higher education claims to produce three quite different types of widgets: (1) education, (2) research, and (3) public service. Different institutions emphasize these to different extents. For example, USF, FSU and UF emphasize research, while FAU, FIU and UCF produce comparatively small amounts of research expenditures. Further, different faculty ranks contribute differently to each of those widgets. For example, in undergraduate instruction, which makes up the bulk of education, adjunct and associate professors usually produce substantially greater student FTE than either associate or full professors. With regards to research, full professors likely produce more than lower ranked professors, and public service depends on the discipline and institutional environment. Graduate research and teaching assistants also contribute a considerable magnitude relative to the first two widgets. Thus, a simplistic proportion by rank, which excludes adjuncts and graduate assistants, is a complete misapplication of the method because the rank salaries should be applied based on their contribution to each widget, as should the adjunct and graduate assistant compensation.
2. When computing weighted mean faculty salaries, the weightings are determined by the proportion (N) of faculty at different ranks. As a result, more mature institutions having greater proportions of full professors must exhibit higher average salaries than younger ones because full professors earn substantially greater salaries than associate professors, who themselves earn considerably more than assistant professors. For the seven elite public research universities selected by the faculty committee for salary comparison,[2] in FY 2007, associate professors salaries were 17% greater than assistant professors, and full professors were 49% above associate professors. Obviously this effect can have a large influence on a weighted mean depending on the proportion of full professors. See Figure 1 which displays weighted

[2] University of Florida, University of Texas-Austin, Ohio State University, University of Minnesota-Twin Cities, Pennsylvania State University, University of Wisconsin-Madison.

mean salaries for SUS Doctoral/Research institutions if all had USF's mean salaries at rank.

3. Rather large salary differences occur between disciplines, with Business and Engineering always significantly and sometimes vastly above those of Visual and Performing Arts, the Humanities, and Languages. Using a single, university wide average by rank can give misleading estimates depending on the proportion of high salaried versus low salaried disciplines at the institution. This is also influenced by the proportion of full professors in the expensive versus less expensive disciplines.
4. At large Doctoral/Research University like USF, anomalously high salaries are not infrequently found for distinguished research professors, national academy members, highly cited scholars and other faculty owning various distinctions. Blending such salaries with the more regularly salaried faculty can cause inaccurate estimates. For example, a distinguished professor in a department like humanities might produce an effect of one salary at $250,000 and six others who average $75,000. This would create a mean salary of near $100,000 for the department, which is about 25% above the median of $75,000[3]. (Obviously, more prestigious institutions having greater proportional numbers of such high salaries will see their overall averages skewed upwards. As a result, it is only truly legitimate to compare salaries within disciplines by rank, and to only utilize either median (which is highly variable for small samples), or better, a light alpha trimmed mean when estimating a distribution's center.
5. Point estimators of location (e.g. mean, median) are designed to represent the center of a symmetrical, centrally dense and light-tailed distribution of values. In this case, faculty salaries are always tri-modal, with each of the three modes defined by the ranks as was noted in point 1. A point estimator designed for a uni-modal value distribution is inappropriate for such tri-modal distributions.
6. Finally, and perhaps most importantly, when comparing salaries in different geographical locations, it is absolutely vital to consider differences in the cost of living. Few would question that it costs significantly more to live in Orange County California (University of California-Irvine), or Chicago (University of Illinois-Chicago) than Orange County Florida (UCF). Comparing salaries without considering this factor can be misleading.

To better explicate some of the five limitations described above, this paper conducts a few exemplary comparisons of, weighted mean faculty salaries

Methods

Data are available that can demonstrate two of the effects noted in the problem list.

1. Historical IPEDS salary data for institutions enables computation of weighted mean salaries means for each rank separately as is the proportional distribution of faculty by rank (IPEDS, 2008).

[3] 33% when computed from the $75,000.

2. Cost of living estimates allow for comparison of local cost differences from city to city (CNN Money, 2008).[4]

Comparison Groups

Three comparison groups were used in these analyses:

A requested group of elite AAU institutions including: the University of Florida, Ohio State University, the University of Texas-Austin, the University of Illinois-Urbana-Champaign, the University of Minnesota-Twin Cities, the University of Wisconsin-Madison and Pennsylvania State University.

A more appropriate group of USF's National Peers: the University of California-Irvine, the University of Cincinnati, North Carolina State University, SUNY Buffalo, Rutgers-New Brunswick, the University of Alabama-Birmingham, Louisville University and the University of Illinois-Chicago.

Additionally, all SUS Doctoral/Research Universities were included to allow comparison with institutions functioning in the same state's bureaucratic environment: the University of Florida, Florida State University, the University of Central Florida, Florida International University and Florida Atlantic University.

Of these institutions, those lacking an integral medical school are: Rutgers-New Brunswick, Pennsylvania State University and Texas-Austin. Note that both Rutgers and Texas-Austin have medical schools, but they both report to IPEDS as separate institutions. Among SUS institutions, UCF, FIU and FAU lack integral medical schools.

Weighted Mean Salary

The Accounting Dictionary defines a Weighted Average as one relating to observations having different degrees of importance or frequency. The formula for a weighted average is Weighted Average = Swx, where x = the data values and w = relative weight assigned to each observation**,** expressed as a percentage or relative frequency. For example, assume the XYZ Company uses three grades of labor to produce a finished product:

Grade of Labor	Labor Hours Per Unit of Labor	Hourly Wages (x)
Skilled	6	$10.00
Semiskilled	3	8.00
Unskilled	1	6.00
	10	

The weighted average is computed as follows:

Weighted average = $10.00 (6/10) + $8.00(3/10) + $6.00(1/10)
= $ 9.00 per hour

The weighted average is:

Weighted average = $10.00 (6/10) + $8.00(3/10) + $6.00(1/10) = $ 9.00 per hour

[4] Nearest available geographical locations were used for Rutgers-New Brunswick and Pennsylvania State University.

The weights reflect the proportion of the total labor required to produce the product.

Analyses

USF Salary (USF Sal) used USF's mean salary at each rank to compute weighted mean estimates for each institution using their specific rank proportions. The purpose of this estimate is to show the differences that result from different proportions of faculty at each rank. In this case, every institution has the same mean salary at each rank, therefore between institutional differences result strictly from differences in the number of faculty at each rank.

A Cost of Living Index (CLI) was computed using USF's weighted mean FY 2007 salary of $78,274 as 1.00 and dividing values from other locations by that number to produce an indexed estimate of cost differentials. Salaries adjusted for cost of living reflect the relevant salary for each institution or rank divided by the CLI for that institution.

Limitations

The CNN Money Cost of Living Index is a weighted salary estimate based upon the costs of groceries, housing, utilities, transportation and healthcare in a given geographical locale. Any such estimates are at best very rough, and this is particularly true when viewing things from the perspective of full or associate professors. For most such indices, because the index is designed to provide a comparative cost if one moves to a new locale, housing frequently comprises roughly 30 percent of costs. While this may be accurate for newly hired assistant professors, in the case of those who have been around for a while, unless they decided to rent, housing costs were incurred during an earlier and likely less costly era. Nonetheless, such indices provide a rough indication of how far the same salary goes in different locales.

All estimates reported are rough approximations due to the problems specified earlier: (1) different proportions of ranks at different institutions, (2) the multi-modal nature of all distributions included and the impact of that on location estimators, (3) the distribution of disciplines and ranks within disciplines, and (4) the presence or absence of extreme salaries within institutions and across disciplines.

Results

USF's mean faculty salaries for FY 2007 from the IPEDS database were, Professor, $101,808, Associate Professor, $73,409, Assistant Professor, $61,823. The weighted mean using the current USF proportions was $78,274, with 32% Professors, 30% Associate Professors and 38% Assistant Professors. Obviously, institutions having different proportions of faculty at various ranks, even if their mean salaries by rank were identical, would have higher or lower weighted averages. If USF had UF's proportions by rank (42%, 29%, 29%), and the same salaries, the weighted mean would be $81,884. Table 1 details data for the three comparison groups specified in the Methods section (SUS Doctoral/Research, seven selected institutions, and USF's national peers. The following data are shown in the table for FY 2007: the N of full-time instructional faculty reported to IPEDS, two forms of weighted salaries, one using the institution's rank means and one using USF's rank means weighted by each institution's proportion of faculty. The middle three columns give the proportion of faculty at each rank by institution for FY 2007, and the last three, the mean salary by rank for each institution.

These data make several things clear; first, looking only at the SUS, the Median of Doctoral/Research weighted salaries if using USF's values for computation is $350 greater than USF's. In that USF Salary column, the only institutions having higher salaries than USF are UF and FSU, with FIU having almost exactly the same. This shows that the factor causing USF's weighted mean salaries to be the lowest in the SUS, as shown in the Inst Sal column, is the proportion of faculty at the three ranks. The key factor, as shown by the median for the group is that USF has nine percent more lowly paid assistant professors than the group. FIU's salaries appear higher because of the large proportion of associate professors. When one looks at the rank means, for full professors, UF and UCF at respectively $109,273 and $112,348 are considerably above the others. UCF also has the highest salaries for associate professors with FIU second, while FIU has the highest salaries for Assistant professors. The main reason FIU's lower end faculty salaries are higher will be made clear by Table 2 which shows the effects of the local cost of living...

Among the seven selected comparison institutions, the average proportion of full professors is almost 30% greater than USF's percentage, while the percentage of lower paid assistant professors is almost 30% fewer. As a result of this, even using USF's rank means to compute weighted mean salaries, all of these elite institutions have higher weighted mean salaries than USF.

Among USF's national peers, a similar situation occurs regarding the proportions of rank faculty.

These data show that more mature institutions tend to exhibit higher weighted mean salaries than less mature institutions like USF, UCF, FIU and FAU. The University of California-Irvine is an exception, however, the CLI adjustments table will show that although their salaries appear high, in fact, they aren't.

Table 1
FY 2007 Weighted and Raw Mean Salaries for USF and Three Comparison Groups

		Weighted Means		Percent of Faculty			Un-weighted Mean Salaries		
	N	Insti Sal	USF Salary	Asst	Assoc	Prof	Assistant	Associate	Professor
SUS Doctoral/Research									
Median of Others	821	$81,519	$78,638	29%	33%	30%[5]	$62,815	$73,007	$103,009
USF	1,035	$78,274	$78,274	38%	30%	32%	$61,823	$73,409	$101,808
UF	1,849	$85,069	$81,884	29%	30%	42%	$62,536	$73,007	$109,273
FSU	1,144	$81,055	$81,293	29%	32%	39%	$66,929	$70,517	$99,850
FIU	709	$82,784	$78,638	29%	40%	30%	$71,379	$75,858	$103,009
UCF	821	$81,519	$77,062	37%	36%	28%	$61,898	$77,620	$112,348
FAU	626	$74,645	$77,726	37%	33%	30%	$62,815	$69,771	$94,380

[5] As was noted earlier, for small samples, the median is highly unreliable, but remains the best estimate of center. This is the reason that the three percentage estimates do not add to 100%.

		Weighted Means		Percent of Faculty			Un-weighted Mean Salaries		
	N	Insti Sal	USF Salary	Asst	Assoc	Prof	Assistant	Associate	Professor
Seven Elite Selected Comparators									
Median of Comparators	1,849	$93,544	$81,931	25%	29%	42%	$69,380	$81,269	$121,274
USF	1,035	$78,274	$78,274	38%	30%	32%	$61,823	$73,409	$101,808
UF	1,849	$85,069	$81,884	29%	30%	42%	$62,536	$73,007	$109,273
Illinois-Urbana-Champaigne	1,963	$96,290	$81,672	31%	27%	42%	$73,033	$81,837	$122,986
Minnesota-Twin Cities	1,750	$98,673	$83,875	24%	30%	46%	$72,335	$84,343	$121,274
Ohio State	2,167	$92,295	$81,931	25%	35%	40%	$69,380	$78,709	$118,306
Pennsylvania State	1,767	$93,544	$81,645	29%	29%	41%	$65,576	$82,188	$121,804
Texas-Austin	1,883	$103,575	$85,335	24%	24%	52%	$77,585	$81,269	$126,018
Wisconsin-Madison	1,557	$88,307	$86,578	24%	20%	56%	$67,015	$75,434	$101,949
USF National Peers									
Median of Peers	1,027	$89,654	$81,220	29%	31%	39%	$68,218	$81,496	$114,292
USF	1,035	$78,274	$78,274	38%	30%	32%	$61,823	$73,409	$101,808
UAB	757	$85,314	$78,062	36%	33%	31%	$64,463	$79,957	$115,146
Cal-Irvine	878	$101,333	$84,305	28%	23%	50%	$73,415	$81,235	$126,067
Illinois-Chicago	1,044	$89,130	$79,736	31%	34%	35%	$69,837	$81,756	$113,438
Louisville	761	$81,326	$81,101	31%	29%	40%	$57,456	$77,384	$102,824
Rutgers	1,427	$104,436	$85,366	19%	31%	50%	$71,086	$87,393	$127,792
SUNY-Buffalo	1,010	$90,178	$79,366	34%	31%	35%	$66,598	$83,283	$119,365
North Carolina State	1,413	$91,792	$83,154	26%	29%	45%	$69,942	$81,975	$110,794
Cincinnati	1,195	$76,861	$81,339	27%	35%	39%	$56,460	$70,670	$96,377

Salary Estimates Adjusted for the Cost of Living

When one adjusts salaries for cost of living (CLI), only UF and FSU, using institutional salaries have higher weighted mean salaries than USF, and, these differences are very small, respectively a 3.2% advantage for UF and 1.8% for FSU. Interestingly, this occurs despite the fact that, for FSU, only assistant professors have a higher adjusted mean salary, while, for UF, only full professors have more than a $1,000 average higher salary.[6] In some cases, salaries are considerably lower than USF. For example, the institutions with the highest full professor means, UCF and FIU both are quite a bit lower than USF at their institution's weighted mean salary level, and even more so if they were paid at the level of USF's faculty. FAU's adjusted faculty salaries are very low, being some $20,000 per year under USF's at the weighted mean level.[7]

Among the elite seven comparison institutions a different story unfolds. Most of these universities faculty are well-compensated despite the fact that their CLIs range from a low of 0.99 for Ohio State University of a high of 1.19 for Minnesota-Twin Cities. UF is 1.05.

[6] **Thus, yet another problem with weighted means surfaces here.**

[7] The USF Weighted Mean in this case is computed using Table 1's weighted numbers adjusted by CLI.

Half of USF's national peers are also well compensated, with four, the University of Cincinnati (CLI 0.99), the University of California-Irvine (CLI of 1.61), Rutgers University (CLI of 1.33), and the University of Illinois-Chicago (CLI of 1.22) having lower institutional salaries than USF. Cincinnati would have a better salary if they were compensated at the level of USF's faculty, but their mean salaries at rank are somewhat lower than those of USF's faculty.

These data show that the cost of living plays a part when faculty salaries are negotiated, and that elite institutions tend to receive strong compensation whether in expensive or inexpensive locations. The inconsistencies regarding compensation for USF's National Peers is extremely interesting, although an ameliorating factor is that some institution's in high rent locales provide down payments on houses for new faculty.

Table 2
Salaries Adjusted for Cost of living

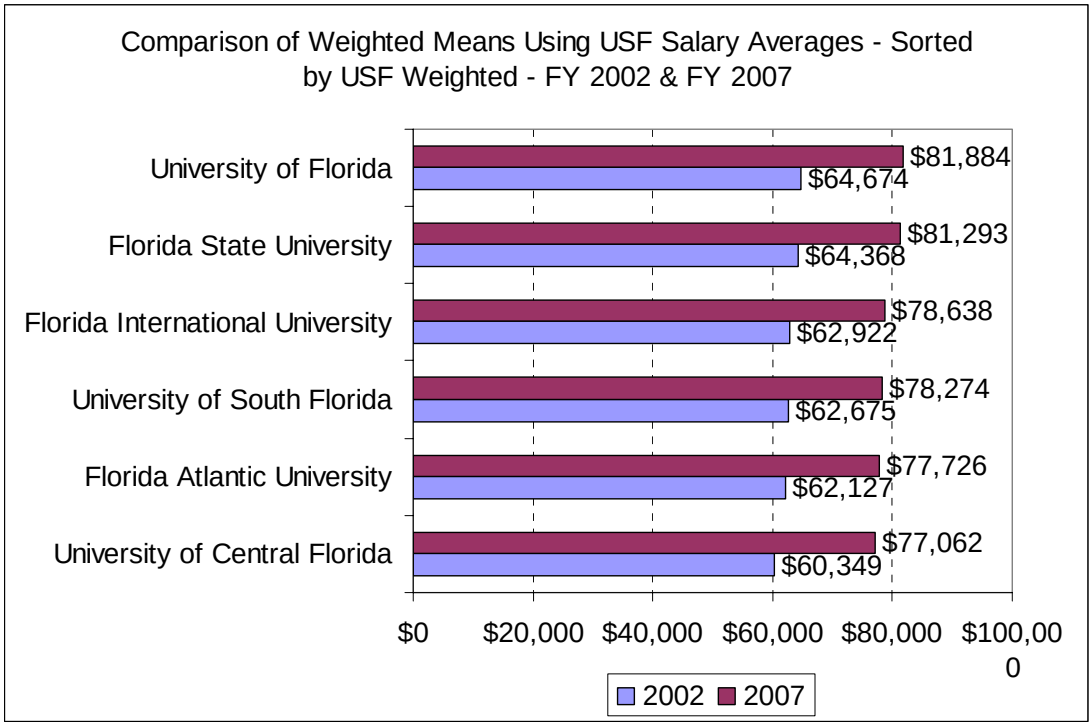
		Weighted Means		Percent of Faculty			Un-weighted Mean Salaries		
	N	Instn	USF Sal	Asst	Assoc	Prof	Assistant	Associate	Professir
SUS Doctoral/Research									
Median of Others	821	$75,887	$71,737	29%	33%	30%	$57,877	$69,290	$98,113
USF	1,035	$78,274	$78,274	38%	30%	32%	$61,823	$73,409	$101,808
UF	1,849	$80,786	$77,761	29%	30%	42%	$59,387	$69,331	$103,771
FSU	1,144	$79,645	$79,879	29%	32%	39%	$65,765	$69,290	$98,113
FIU	709	$67,125	$63,763	29%	40%	30%	$57,877	$61,509	$83,524
UCF	821	$75,887	$71,737	37%	36%	28%	$57,621	$72,257	$104,585
FAU	626	$57,572	$59,948	37%	33%	30%	$48,447	$53,812	$72,793
Seven Elite Selected Comparison Institutions									
Median of Comparators	1,849	$91,735	$79,938	25%	29%	42%	$66,660	$79,401	$118,507
USF	1,035	$78,274	$78,274	38%	30%	32%	$61,823	$73,409	$101,808
UF	1,849	$80,786	$77,761	29%	30%	42%	$59,387	$69,331	$103,771
Illinois-Urbana-Champgne	1,963	$95,180	$80,730	31%	27%	42%	$72,191	$80,893	$121,568
Minnesota-Twin Cities	1,750	$83,006	$70,557	24%	30%	46%	$60,850	$70,951	$102,018
Ohio State	2,167	$92,789	$82,369	25%	35%	40%	$69,751	$79,130	$118,938
Pennsylvania State	1,767	$90,681	$79,146	29%	29%	41%	$63,569	$79,672	$118,075
Texas-Austin	1,883	$102,274	$84,263	24%	24%	52%	$76,610	$80,248	$124,435
Wisconsin-Madison	1,557	$84,612	$82,956	24%	20%	56%	$64,211	$72,278	$97,683
USF National Peers									
Median of Peers	1,027	$84,369	$78,102	29%	31%	39%	$59,606	$76,995	$104,063
USF	1,035	$78,274	$78,274	38%	30%	32%	$61,823	$73,409	$101,808
UAB	757	$88,799	$81,251	36%	33%	31%	$67,096	$83,223	$119,850
Cal-Irvine	878	$62,784	$52,234	28%	23%	50%	$45,486	$50,332	$78,109
Illinois-Chicago	1,044	$72,896	$65,213	31%	34%	35%	$57,117	$66,866	$92,777
Louisville	761	$84,369	$84,136	31%	29%	40%	$59,606	$80,279	$106,671

		Weighted Means		Percent of Faculty			Un-weighted Mean Salaries		
	N	Instn	USF Sal	Asst	Assoc	Prof	Assistant	Associate	Professir
Rutgers	1,427	$78,348	$64,042	19%	31%	50%	$53,329	$65,563	$95,870
SUNY-Buffalo	1,010	$88,766	$78,123	34%	31%	35%	$65,555	$81,979	$117,496
North Carolina State	1,413	$86,216	$78,102	26%	29%	45%	$65,693	$76,995	$104,063
Cincinnati	1,195	$77,436	$81,948	27%	35%	39%	$56,883	$71,199	$97,099

Graphic Illustration of Differential Faculty Rank Proportions and Weighted Means

Figure 1 depicts weighted mean faculty salaries for the six SUS institutions for 2002 if every institution had USF's rank averages. Again, the figure shows that much of the perceived difference in salary results from nothing other than differences in rank proportions from institution to institution. Also, considering that FIU is located in a very expensive locale (Miami), their seeming salary advantages are apparent rather than real.

Figure 1



Summary

As this paper has hopefully shown, attempting to use raw, weighted mean faculty salaries to compare institutions is not a meaningful approach for a wide variety of reasons. The only legitimate way to compare salaries is by rank, within discipline, and a cost of living factor should almost surely be used due to the rather wide range of costs incurred from locale to locale, both in Florida, and around the United States.

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