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ABSTRACT

A set of weighting factors on student credit hour production by discipline was developed so that instructional productivity could be equitably compared across disparate disciplines and within disciplines. The new statistical methodology was applied to 3 years of teaching load data from 21 major public universities (the Southern University Group Teaching Load Data Exchange) and has yielded an objective, broadly applicable set of student credit hours (SCH) weight factors. For each fall term from 1978 through 1980, participants reported on the instructional productivity of each of their academic departments. Data included: the standard federal code associated with the department's dominant instructional program; the number of filled instructional full-time-equivalent (FTE) positions, reported as ranked faculty and other faculty (primarily graduate assistants); and student credit hours produced by the faculty, reported by three levels of instruction (lower and upper division undergraduate, and graduate levels). A table of optimum weighting factors for upper division and graduate SCH (relative to lower division) is presented by the code discipline division of the National Center for Education Statistics. The weights derived from the analysis are compared with those developed by more traditional means. An explanation and example of the method are provided, and it is concluded that the number of discipline areas that responded well to the optimum weight model lends support for its acceptance. There was less confidence in the optimum weights for those discipline areas in which only ranked faculty FTE were included in the instructional productivity ratios, since they differ consistently from other reported values. (SW)

DIFFERENTIAL INSTRUCTIONAL PRODUCTIVITY INDICES

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Abstract

Teaching load formulas to provide for differential program productivity ratios are in wide use. However, the various sets of differential weights on student credit hours (SCH) that are used tend to be the result of historical accident, negotiation, or limited cost studies. To bring a unity into these formulas, a new statistical methodology applied to three years of teaching load data from 21 major public universities has yielded an objective, broadly applicable set of SCH weight factors. Those weights give promise of providing comparison of instructional productivity via unobtrusive measures. A table of optimum weighting factors for upper division and graduate SCH (relative to lower division) is presented by NCES Code discipline division. The weights derived from analysis are then compared with those developed by more traditional means.

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DIFFERENTIAL INSTRUCTIONAL PRODUCTIVITY INDICES

Introduction

Allocation of instructional faculty positions has been the subject of much research interest over the years. Models of varying complexity have been proposed to deal with the problem of equitable faculty workload, with mixed success. Many may agree that "no single formula for an equitable faculty workload can be devised for all of American higher education (AAUP, 1970, p 30). More likely is agreement that "solving the problem is both imperative and impossible" (Stickler, 1960, p 92). It is almost a natural law that when we in higher education dismiss a problem as "impossible," we find an "imperative" provided to us by state or federal government. That imperative is generally so unpalatable that it forces us to rethink the concept of impossibility. Thus, the search for an equitable method of measuring and comparing faculty workload continues.

The content and complexity of models proposed and in use reflect the varied philosophies of those who propose them. At one extreme are Hilst and McFee who state that "Any method of calculating ... departmental teaching loads should include a complete set of factors which could be used to describe the total teaching experience" (1975, p 1). To emphasize that point, they proceed to offer an equation containing 11 variables and 21 constants. The record may go to Eagleton (1977). His department at Penn State actually uses a workload evaluation model with 16 categories of "effort points" containing 22 variables and 34 constants.

THE ASSOCIATION FOR INSTITUTIONAL RESEARCH

This paper was presented at the Twenty-Second Annual Forum of the Association for Institutional Research held at the Denver Hilton Hotel in Denver, Colorado, May 16-19, 1982. This paper was reviewed by the AIR Forum Publications Committee and was judged to be of high quality and of interest to others concerned with the research of higher education. It has therefore been selected to be included in the ERIC Collection of Forum papers.

D. R. Coleman, Chairman
Forum Publication
Advisory Committee

While a multi-dimensioned formula may be utterly necessary to describe all the multi-faceted activites of a faculty member, there is a more necessary attribute that a formula must possess -- acceptability. Montgomery's first principle of "getting formulas to work" (1977, p 62) is of paramount concern:

> "The formulas should be sufficiently clear and simple that a legislator can explain them to a constituent. This point also implies that an administrator can explain them to a legislator."

Most models in widespread use follow that precept. No single model has met universal approval. Those similar to Keene's differential teaching load index (1972) or to the program productivity ratio (Nichols 1976), however, seem to be gaining wide acceptance. Simply stated, this type of model differentially weights student credit hour production by discipline and by level of instruction resulting in weighted student credit hours, as in

WSCH = SCH(ld) + WT(ud) * SCH(ud) + WT(gr) * SCH(gr)

WSCH: Weighted Student Credit Hour Production

(): Level of instruction: lower division (ld), upper division (ud), or graduate (gr).

SCH(): Student Credit Hours (the product of headcount students in a class and the class credit hours) for all classes at level ().

WT(): Weighting factor applied to SCH at level () for a given discipline area, commonly one (1.00) at the lower division level, and increasing by level.

That WSCH value, divided by a discipline area's instructional faculty, yields an instructional productivity ratio, in WSCH/FTE, such that staffing and workload can be compared within and across disciplines. Such models have the virtue of simplicity, in concept and in application. Further, they use unobtrusive measures (Webb et al., 1966) and they account for two key factors in teaching load -- level of instruction and nature of subject matter. These models are increasingly used as an aid for internal allocation decisions and as bases for state budget formulas.

A principle objection to widespread acceptance of existing implementations has been that the models' indices lack rigor or applicability. They have often arisen from historical accident, from negotiation or from baseline data that raised a parochial status quo to the level of "standard." Others have been derived from single-institution or single-state productivity studies, or from similar analyses among small groups of self-selected peer institutions.

This research aimed to determine a set of multidisciplinary SCH weighting factors having substance independent of politics and parochialism. The data studied came from a regional teaching load data exchange among 21 major state universities distributed from Maryland to Texas. The data exchange has thus far yielded three years of comparable data (2,665 observations) on instructional staffing and student credit hour production over a broad range of disciplines. The number and geographic distribution of institutions, plus the number and variety of disciplines, mitigate against the research results being viewed as parochial.

The present work developed a set of weighting factors on student credit hour production by discipline so that instructional productivity (WSCH per faculty position) could be equitably compared across disparate disciplines and within discipline. Those factors could be used with confidence by academic administration in the objective measurement of instructional productivity both internally and among peer institutions.

Data Source

Three years of data from the Southern University Group Teaching Load Data Exchange (Reference Note 1) provided source data for the present work. For each Fall Term from 1978 through 1980, participants reported on the instructional productivity of each of their academic departments. Data reported included:

(1) Discipline	The standard federal code associated with the department's dominant instructional program.
(2) Faculty FTE	The number of filled instructional FTE positions, reported as "ranked" faculty and "other" faculty. The "other" were primarily graduate assistants.
(3) SCH Produced	The student credit hours produced by the faculty, reported by 3 levels of instruction: lower and upper division undergraduate, and graduate levels.

Institutionally reported discipline codes were converted from the four-digit HEGIS nomenclature to six-digit NCES Codes (National Center for Education Statistics, 1981) for this study and for consistency with the codes to be reported beginning with the Fall 1981 data exchange.

Method

The diversity of programs and differences in emphasis among universities indicated that the most appropriate SCH weighting factors would be those yielding the most statistically "normal" distributions of instructional productivity. This implies the assumption that there is a "true" productivity appropriate for a discipline and that variation in productivity is similar to random normal error. Two key characteristics of a distribution are its skew (third moment) and its kurtosis (fourth moment or "peakedness"). Skew and kurtosis were used because they are well established statistics, they are not influenced by the scale of measurement, and -- in a normal distribution -- both those central moments are zero (Hays, 1963 p 185-186 and Reference Note 2).

For a given discipline area, the aim was to find weighting factors WT(ud) and WT(gr) causing both skew and kurtosis to approach zero for the distribution of productivity ratios (WSCH/FTE) across institutions. The "objective function" was, therefore, the sum of the absolute values of skew and kurtosis, a function described as follows:

$$\text{Objective} = |\text{skew}| + |\text{kurtosis}| = f\ (\text{WT(ud,gr)},\ \text{FTE},\ \text{SCH(ld,ud,gr)})$$

If there were indeed a true instructional productivity characteristic of a discipline, the objective function would be a unimodal function of the upper division and graduate weights. That is to say that only one combination of WT(ud) and WT(gr) would yield a minimum. Any other combination of weight factors would yield a value of the objective function that increased in value with "distance" from the optimum.

For purposes of this study, a discipline area was defined by the major division, or first-two-digit level, of NCES Code. All data submittals for a given discipline area were aggregated by institution for a given analysis. This treated the individual discipline and year submittals as replications of an institution's data. Only the distribution of relative productivity (WSCH/FTE) was investigated, so that the analysis was independent of both institutional and program size.

For each discipline, a broad-range trial scan of upper division and graduate SCH weighting factors (relative to lower division's 1.00) yielded a general picture of the behavior of the objective function. That broad scan gave the values of WT(ud) and WT(gr) that defined the region of a minimum in the objective function. The precise optimum was then located via a directed search algorithm.

An example of the method is shown in Figure 1, using actual data for NCES discipline area 50-The Arts. The upper graph in Figure 1 shows four vee-shaped curves, plotting the objective function versus WT(ud) at four constant values of WT(gr) -- 2.00, 3.00, 4.00, and 5.00.

INSERT FIGURE 1 ABOUT HERE

The point of each vee represents the best (the most statistically normal) distribution of WSCH/FTE instructional productivity for its trial value of

WT(gr). That "local best" is improved as WT(gr) is increased from 2.0 to 3.0, dropping from 0.30 at WT(ud) = 2.3 to 0.05 at 2.4. Raising WT(gr) to 4.0 leaves the local optimum unchanged, but it occurs at a higher WT(ud) -- 2.6. Further increasing WT(gr) to 5.0 yields a higher local optimum (0.15), near WT(ud) = 2.6. The path traced by the points of local optimum indicates that an absolute minimum value for the objective function occurs near WT(ud) = 2.5 and WT(gr) = 3.5.

The lower graph of Figure 1 shows the same data in a different way, as a "contour diagram," connecting points of constant value of the objective function versus WT(ud) and WT(gr). The diagram is similar to a topographical map showing lines of constant elevation for a hill or mountain. Here, the objective function is a "valley," whose "elevation" decreases until reaching an absolute minimum at WT(ud,gr) = (2.47, 3.40).

Results

Table 1 summarizes the results of this research for the 26 NCES discipline areas for which data are available.

INSERT TABLE 1 ABOUT HERE

Those results are generally promising, with good-to-excellent fits of the data to the "Optimum Weight" model in 14 cases and fair fits (optimum objective function $\leq$ 1.00) in four others. Some discipline areas, however, (03-Renewable Natural Resources, 11-Computer Science, 13-Education, 25-Library Science, 26 Life Sciences, and 42-Psychology) fit the model only when graduate assistant FTE were ignored in the WSCH/FTE computation (a productivity ratio of WSCH/Ranked-FTE). Education posed a second problem, not being amenable to optimization with aggregated three-year data. Analysis of individual years was necessary to yield objective functions that behaved as expected, with Fall 1979 data yielding the best fit. Yet another problem area involved those disciplines that may be inappropriately aggregated in the NCES coding structure. Discipline area 05, Area and Ethnic Studies, showed interference-type objective functions that disappeared upon disaggregation, and two other "catchall" areas (24-Liberal Studies, 30-Interdisciplinary) did not fit the model well.

Comparison With Related Work

There is a wealth of instructional productivity data available in the literature and as unpublished reports, generally based on IEP-type cost studies or faculty activity analysis. Eight such sets of data (Board of Regents 1978, Coleman & Bolte 1976, Keating, Ryland 1978) are compared with the results of the present work in Table 2, converted to a form compatible with the optimum weight factors developed in the present work.

INSERT TABLE 2 ABOUT HERE

The numbers for those single-institution and single-state data sets vary widely about this study's numbers in general. The optimum weights presented here based on WSCH/Ranked-FTE, however, are generally lower at the graduate level than the weights in the comparison data.

Conclusions

The number of discipline areas that responded well to the "Optimum Weight" model lends support for its acceptance. That the model did not work well for NCES discipline areas that are really a mix of unrelated disciplines gives further confidence in the method. There is less confidence in the optimum weights for those discipline areas in which only ranked faculty FTE were included in the instructional productivity ratios, since they differ consistently from other reported values.

Further work along the same lines seems to be justified. More years of comparable teaching load data from the present source will be available. Those additional data would help the stability of the existing institutional productivity ratios. Data from additional institutions could broaden the geographical base, add to the number of disciplines available for analysis, and permit study of any differences by institutional type.

Overall, the results meet the research objective, the determination of objective, discipline-dependent SCH weighting factors for comparison of instructional productivity via unobtrusive measures. The model is easily understandable. It states that teaching differs by academic discipline and by level of instruction. The mechanism to determine exactly how they vary is complex, but it is no more than a calculation that accounts for the broad range of academic emphasis among a variety of institutions. The simplicity of the model and its objective broad-based indices permit these research results to be used easily and with confidence to base decisions on faculty teaching load.

Reference Notes

1. The Southern University Group teaching load data exchange has been coordinated by Virginia Tech for each Fall Term since 1978. Further information is available from the author. The following 21 institutions provided the source data for the present research:

U of Alabama	79	U of Maryland	79,80	South Carolina	78,79,80
U. A. B.	79,80	U Mississippi	78,79,80	U of Houston	78,79,80
Auburn Univ	78,79,80	Southern Miss	79,80	Univ of Texas	78,79,80
U of Arkansas	78,79,80	Miss. State U	78,79,80	Texas Tech	80
U of Georgia	78,79,80	N C State Univ	78	U of Virginia	78,80
U of Kentucky	79,81	U of Oklahoma	80	Virginia Tech	78,79,80
L. S. U.	78,79,80	Oklahoma State	78	W. V. U.	78,79,80

Texas A & M, a participant, was excluded from this study because its data submittals did not disaggregate undergraduate SCH by level.

2. In the present work, skew and kurtosis were each calculated by two mathematically identical, but computationally different, equations to ensure that computer limitations did not introduce error. The equations were the following:

$$\text{Skew} = \frac{\text{Sum ((x-ave)/s)**3)}}{\text{N}} \qquad \text{(Nie et al., 1975 p 194-185)}$$

$$= \text{Sqrt (N)} * \frac{\text{Sum ((x-ave)**3)}}{\text{(Sum ((x-ave)**3))**1.5}} \qquad \text{(Beyer, 1968 p 7)}$$

$$\text{Kurtosis} = \frac{\text{Sum ((x-ave)/s)**4)}}{\text{N}} - 3 \qquad \text{(Nie et al., 1975 p 185)}$$

$$= \text{N} * \frac{\text{Sum ((x-ave)**4)}}{\text{(Sum ((x-ave)**3))**2}} - 3 \qquad \text{(Beyer, 1968 p 7)}$$

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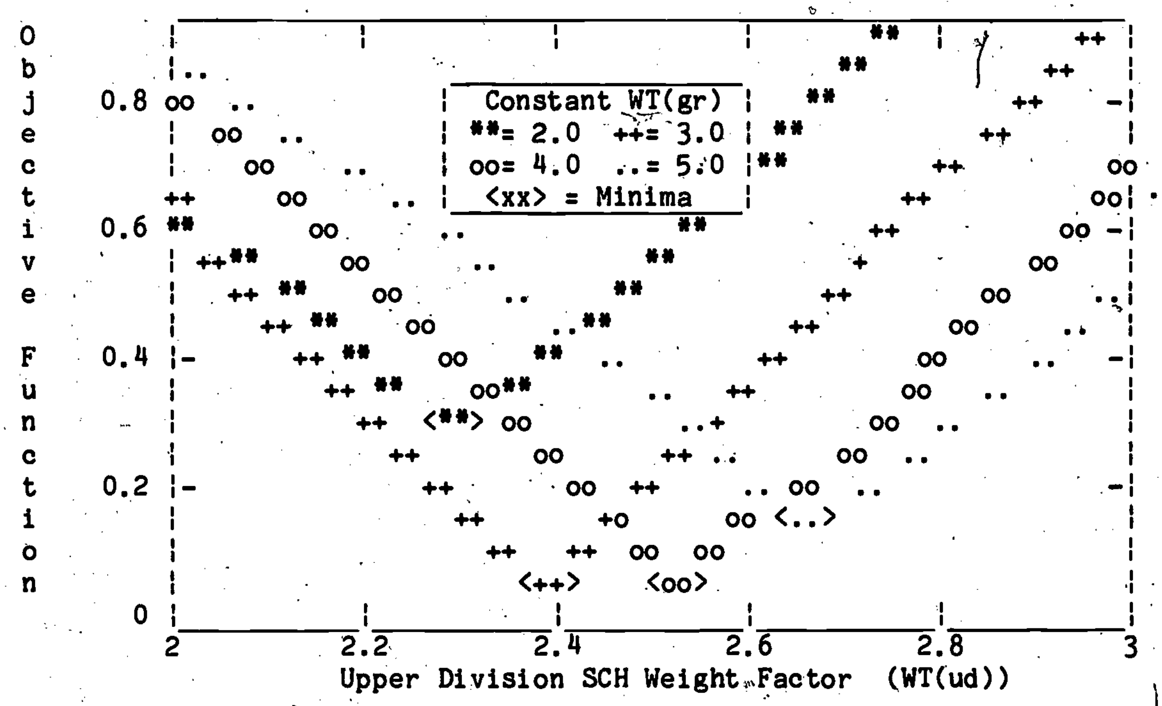
Figure 1

Distribution of WSCH/FTE for The Arts Versus SCH Weight Factors

(An Objective Function Value of 0.00 Indicates a Normal Distribution)



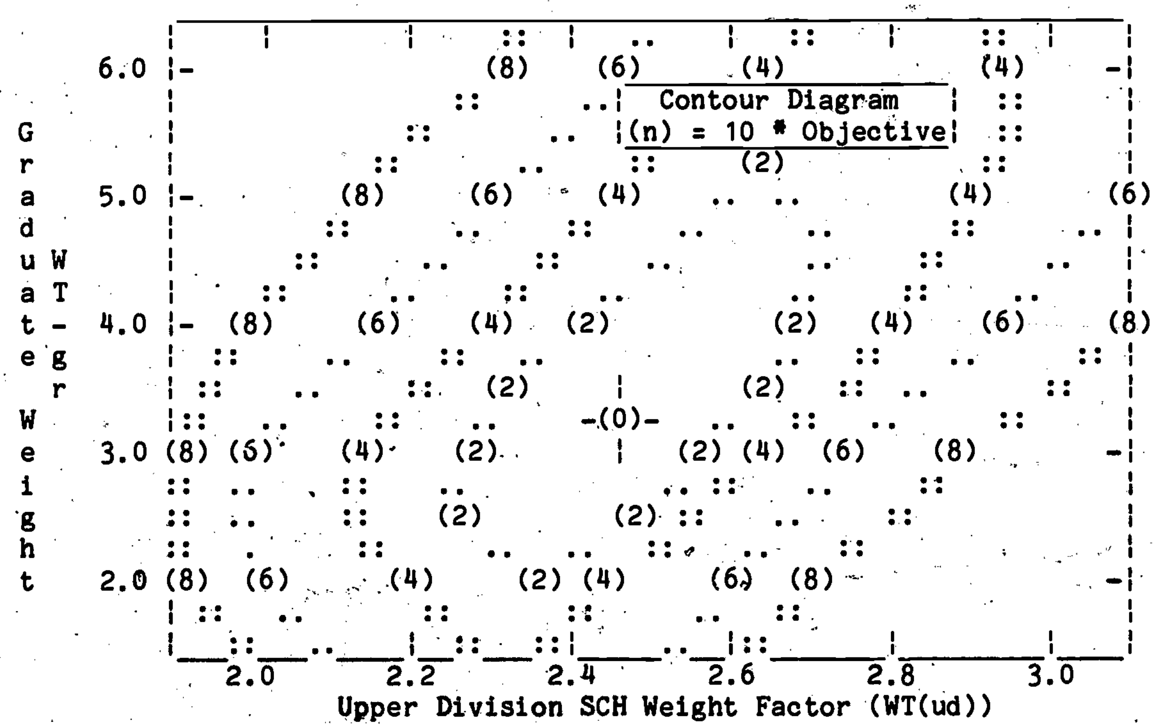


Table 1

Course-Level SCH Weighting Factors by NCES Discipline Area
Such that WSCH/FTE is Normally Distributed Among Institutions

Discipline Area NCES	Title	Wt Factor Uppr	Wt Factor Grad	Number Inst	Number Obs	Basis	WSCH/FTE Mean	WSCH/FTE SD	Objective Fnction Skew	Objective Fnction Kurt	Objective Fnction Sum
~~01~~	~~Ag Business~~	~~2.88~~	~~2.94~~	~~12~~	~~28~~	~~T-All~~	~~837~~	~~243~~	0.00	0.00	0.00
02	Ag Sciences	1.12	2.50	12	138	T-All	311	74	0.58	0.02	0.60
03	Renew Rsrces	1.70	8.16	9	42	F-All	451	117	0.00	0.00	0.00
**	Agriculture	2.56	3.52	12	208	T-All	527	114	0.46	0.00	0.46
04	Architecture	2.04	4.00	17	54	T-All	349	74	0.52	0.00	0.52
05	Area/Ethnic	Not Found		6	33						
0501	Area	0.97	5.99	5	18	T-All	340	158	0.95	0.00	0.95
0502	Ethnic	Not Found		4	15						
06	Business-Mgt	1.17	2.52	20	210	T-All	413	61	0.91	0.00	0.91
07	Business-Ofc	1.15	3.46	6	13	T-All	276	160	-0.01	1.09	1.10
**	Business	Not Found									
09	Communicat'n	1.74	5.89	19	58	T-All	388	79	0.17	-0.01	0.18
11	Comp Sci	2.53	2.50	17	40	F-All	597	183	0.00	0.63	0.63
13	Education	3.00	3.00	18	140	F-F80	506	85	0.02	-0.16	0.18
		1.58	1.90	16	140	F-F79	244	42	0.03	-0.06	0.09
		1.71	1.80	14	102	F-F78	251	46	0.75	0.00	0.75
14	Engineering	1.47	2.94	21	316	T-All	264	53	0.88	0.00	0.88
15	Eng Tech	1.35	2.80	7	15	T-All	323	50	-1.22	0.00	1.22
**	Engineering	Not Found									
16	Languages	3.52	2.98	20	137	T-All	266	44	-0.14	0.03	0.17
19	Home Ec	1.59	3.01	18	78	T-All	296	62	0.01	0.00	0.01

Note 1. Number Inst = Number of Institutions Reporting (Statistical "N").

2. Number Obs = Number of Individual Discipline (6-digit) Observations.

3. Basis(x-yyy)= The basis for the WSCH/FTE numbers reported herein:
x = T (Total Instructional FTE) -or- F (Faculty Only)
yyy = All (3-yr ave of SCH & FTE) -or- Fzz (Fall, 19zz)

4. Obj Function= Optimum weights were taken to be those that minimized absolute Skew and Kurtosis of WSCH/FTE distribution.

Table 1 (Continued)

Course-Level SCH Weighting Factors by NCES Discipline Area
Such that WSCH/FTE is Normally Distributed Among Institutions

Discipline Area NCES Title	Wt Factor Uppr	Wt Factor Grad	Number Inst	Number Obs	Basis	WSCH/FTE Mean	WSCH/FTE SD	Objective Fnction Skew	Objective Fnction Kurt	Sum
23 Letters	0.92	5.12	21	111	T-All	279	51	0.00	1.00	1.00
24 Liberal Stdy	1.31	2.18	10	17	T-All	194	159	1.25	0.00	1.25
25 Library Sci	1.47	1.50	10	23	F-All	173	62	-1.23	-0.01	1.24
26 Life Sci	1.94	2.15	21	183	F-All	398	97	0.05	0.01	0.06
27 Mathematics	1.02	2.45	21	61	T-All	343	75	0.00	0.00	0.00
30 Inter-Disc	1.11	2.79	9	17	T-All	202	113	1.13	0.00	1.13
38 Phil & Rel	0.87	4.29	18	55	T-All	266	42	0.01	0.00	0.01
40 Physical Sc	2.66	3.50	21	152	T-All	328	80	0.84	0.00	0.84
42 Psychology	0.95	7.10	20	47	F-All	646	117	0.00	0.00	0.00
44 Pub Affairs	2.04	2.53	14	38	T-All	319	73	0.01	-0.48	0.49
49 Social Sci	2.49	4.46	21	242	T-All	473	56	-0.55	0.00	0.55
50 The Arts	2.47	3.40	20	136	T-All	248	51	0.00	0.00	0.00

Note 1. Number Inst = Number of Institutions Reporting (Statistical "N").

2. Number Obs = Number of Individual Discipline (6-digit) Observations.

3. Basis(x-yyy)= The basis for the WSCH/FTE numbers reported herein:
x = T (Total Instructional FTE) -or- F (Faculty Only)
yyy = All (3-yr ave of SCH & FTE) -or- Fzz (Fall, 19zz)

4. Obj Function= Optimum weights were taken to be those that minimized absolute Skew and Kurtosis of WSCH/FTE distribution.

17

Table 2

Comparison of Present-Work Optimum SCH Weighting Factors With Previously Reported Values and State Budget Formulas

Discipline Area (Basis/Obj)		Pres Work	VA IEP 77-78 U VA	VA IEP 77-78 VPI	Kansas Cost U KS	Kansas Cost K St	State Budget Frmla CO	State Budget Frmla TN	State Budget Frmla WA	Fla. Tech
Agriculture	UD	2.56		1.41		1.54	1.60	1.56	1.59	
(T-All/0.46)	GR	3.52		5.14		5.76	3.43	3.81	4.24	
Architecture	UD	2.04	1.66	1.16	1.25	1.14	1.33	2.08	1.80	
(T-All/0.52)	GR	4.00	6.82	8.96	3.69	4.39	2.22	5.59	4.55	
Area Studies	UD	0.97					1.36	0.90	1.80	
(T-All/0.95)	GR	5.99					3.33	2.07	4.55	
Bio Sciences	UD	1.94	3.48	3.24	2.25	1.47	1.67	1.82	1.59	1.23
(F-All/0.06)	GR	2.15	6.82	8.96	4.74	4.90	3.13	4.91	4.24	
Business Mgt	UD	1.17	2.24	2.02	1.17	2.09	1.18	1.42	1.64	1.10
(T-All/0.91)	GR	2.52	3.63	7.19	2.81	4.69	2.36	3.15	2.86	
Communication	UD	1.74		2.51	1.55	2.05	1.23	1.60	1.64	1.16
(T-All/0.18)	GR	5.89			3.17	5.05	1.91	3.96	2.86	
Comp Science	UD	2.53	2.11	2.52	2.91	2.12	1.83	1.81	1.59	
(F-All/0.63)	GR	2.50	5.87	11.16	7.74	3.19	3.14	3.45	4.24	
Education	UD	1.71	0.17	1.26	1.22	1.15	1.00	1.47	1.41	1.25
(F-F79/0.09)	GR	1.80	0.35	4.82	1.33	2.23	2.00	2.08	2.10	
Engineering	UD	1.47	1.25	1.65	1.69	2.22	1.46	1.54	1.80	1.34
(T-All/0.88)	GR	2.94	3.03	4.72	3.35	5.74	2.53	3.65	4.55	
The Arts	UD	2.47	3.68	2.71	1.51	2.66	1.50	1.56	1.61	0.88
(T-All/0.00)	GR	3.40	5.28		2.45	5.68	2.00	3.42	3.68	

Note 1. Virginia IEP data for University of Virginia and Virginia Tech from Keating, Tables 23-25, "Productivity Ratios by Discipline Areas."

2. Colorado and Washington state budget formula data from Ryland (1978), based on rate per SCH at the lower, upper, and masters levels.

3. Tennessee state budget formula data from Linhart & Yeager (1978), based on rate per SCH at the lower, upper, and masters levels.

4. Kansas cost study data for University of Kansas and Kansas State from Board of Regents, State of Kansas (1978, p 37-38) based on total expense per SCH at the lower, upper, and masters levels.

5. Florida Tech data from Coleman & Bolte (1976, p 197), based on instructional productivity at the lower and upper levels.

Table 2 (Continued)

Comparison of Present-Work Optimum SCH Weighting Factors With Previously Reported Values and State Budget Formulas

Discipline Area (Basis/Obj)		Pres Work	VA IEP 77-78 U VA	VPI	Kansas Cost U KS	K St	State Budget Frmla CO	TN	WA	Fla. Tech
Languages	UD	3.52	1.77	1.64	3.79	1.93	1.90	2.59	2.19	0.93
(T-All/0.17)	GR	2.98	3.60		5.38	2.31	2.38	4.89	4.90	
Home Econ.	UD	1.59		2.70		1.95	1.61	1.78	1.59	
(T-All/0.01)	GR	3.01		5.00		4.88	3.00	3.79	4.24	
Letters	UD	0.92	1.34	1.41	2.16	3.99	1.64	1.80	1.59	1.37
(T-All/1.00)	GR	5.12	3.10	5.59	3.88	6.64	2.88	4.47	4.24	
Library Sci.	UD	1.47					1.20	4.68	1.00	
(F-All/1.24)	GR	1.50					1.64	10.34	2.75	
Mathematics	UD	1.02	1.77	2.21	4.43	2.13	2.08	2.12	1.80	1.24
(T-All/0.00)	GR	2.45	5.48	4.79	14.43	6.25	3.57	4.93	4.55	
Physical Sci.	UD	2.66	1.84	2.95	2.17	1.33	2.00	1.83	1.80	1.46
(T-All/0.84)	GR	3.50	3.65	11.74	6.47	8.12	3.43	5.42	4.55	
Psychology	UD	0.95	4.85	3.90	2.17	1.33	1.68	1.89	1.64	2.06
(F-All/0.00)	GR	7.10	13.82	5.29	4.38	8.60	4.27	4.76	2.86	
Pub. Affairs	UD	2.04			1.31		1.19	1.48	1.64	
(T-All/0.49)	GR	2.53			1.01		2.27	5.84	2.86	
Social Sci.	UD	2.49	2.12	2.06	3.03	1.77	1.75	1.90	1.64	2.30
(T-All/0.55)	GR	4.46	4.72	12.42	7.87	4.33	4.38	4.98	2.86	
Inter-disc.	UD	1.11	6.25	1.65	0.60		1.29	3.54	1.71	
(T-All/1.13)	GR	2.79	18.38				3.00	3.80	3.53	

Note 1. Virginia IEP data for University of Virginia and Virginia Tech from Keating, Tables 23-25, "Productivity Ratios by Discipline Areas."

2. Colorado and Washington state budget formula data from Ryland (1978), based on rate per SCH at the lower, upper, and masters levels.

3. Tennessee state budget formula data from Linhart & Yeager (1978), based on rate per SCH at the lower, upper, and masters levels.

4. Kansas cost study data for University of Kansas and Kansas State from Board of Regents, State of Kansas (1978, p 37-38) based on total expense per SCH at the lower, upper, and masters levels.

5. Florida Tech data from Coleman & Bolte (1976, p 197), based on instructional productivity at the lower and upper levels.