

Appendix E

CALCULATIONS

Chapter II

Page II-1. Calculation of Numbers of Participants for Exhibit II-2.

Both the numbers of applicants and of participants are based on the numbers reported by PIs in DUE's annual surveys, which totaled 24,832 applicants and 17,507 participants (and which include duplicate counts). However, not all workshop PIs responded to DUE's survey. To obtain the total number of applicants and participants at *all* workshops (including those for which PIs did not complete DUE's surveys), we computed the mean number of applicants/participants for all the workshops for which we had data in a given year. We then imputed that number to that year's workshops for which we had no data and summed over all the year's workshops.

For example, 54 workshops were held in 1991. PIs reported data for 49 workshops, and the total of participants for those workshops was 1,182. To estimate the total for all 54 workshops, we took the mean number of respondents for the 49 workshops ($1,182/49=24.122$) and used it as the number of participants for the five workshops for which there were no data. Then we summed the $1,182+(5*24.122)$ to get 1,303.

Page II-2. Calculation of Numbers of Participants for Exhibit II-3.

From a thorough examination of 1996 and 1997 data, we estimated that approximately 90% of UFE participants were faculty who taught undergraduates. The same data also show that approximately 6.3% of faculty attended more than one workshop in a given year and that approximately 6.1% of faculty attended at least one workshop in two subsequent years also. We assumed that the propensity to attend another workshop decreased each year. With these estimates and assumptions, we estimated the unduplicated numbers of undergraduate faculty as follows:

	1991	1992	1993	1994	1995	1996	1997	Total
Total UFE participants	1,303	2,268	2,871	2,460	3,273	3,395	3,845	19,416
Not undergraduate faculty at 10.01%	-130	-227	-287	-246	-328	-340	-385	-1,944
Within-year duplicates at 6.30%	-82	-143	-181	-155	-206	-214	-242	-1,223
Faculty participants (nonduplicates within year)	1,090	1,898	2,403	2,059	2,739	2,842	3,218	16,250
Repeaters across years								
Repeaters from previous year (6.10%)		-66	-116	-147	-126	-167	-173	-795
Repeaters from 2 years previous (4.88%)			-53	-93	-117	-101	-134	-498
Repeaters from 3 years previous (3.90%)				-43	-74	-94	-80	-291
Repeaters from 4 years previous (3.12%)					-34	-59	-75	-168
Repeaters from 5 years previous (2.50%)						-27	-47	-75
Repeaters from 6 years previous (2.00%)							-22	-22
Unduplicated undergraduate faculty participants	1,090	1,832	2,234	1,777	2,388	2,394	2,686	14,402*

*Total equals the sum of the numbers in the column, but not the sum of the numbers in row because of duplicates across years.

Chapter IV

Page IV-4. Extrapolation for Numbers of Courses.

	New Courses	Courses with Major Revisions	Courses with Moderate Revisions
<p>Respondents who both developed and revised one or more courses (20%): The mean number of courses developed and revised for this group was 2.76. We assume that half of these courses were new and half were revised. Revised courses were assumed to be about 1/3 major revisions, 1/3 moderate revisions, and 1/3 minor revisions, yielding the following extrapolations for all participants:</p>			
(1) 6.66% of respondents developed on average 1.38 new courses and made <i>major</i> revisions on average to 1.38 courses:			
➤ New courses = 6.66% X 14,402 (adjusted number of participants) X 1.38 courses =	1,323		
➤ Major revisions = 6.66% X 14,402 X 1.38 courses		1,323	
(2) 6.66% of respondents developed on average 1.38 new courses and made <i>moderate</i> revisions on average to 1.38 courses:			
➤ New courses = 6.66% X 14,402 (adjusted number of participants) X 1.38 courses =	1,323		
➤ Moderate revisions = 6.66% X 14,402 X 1.38 courses =			1,323
(3) 6.66% of respondents developed on average 1.38 new courses and made <i>minor</i> revisions on average to 1.38 courses:			
➤ New courses = 6.66% X 14,402 X 1.38 courses =	1,323		
➤ (Courses with only minor revisions are not being counted here)			
<p>Respondents who developed one or more courses but did not revise any courses (5%): Calculation for this group was straightforward, using the mean number of courses developed by this group, which was 1.41. New courses = 5% X 14,402 X 1.41 courses =</p>	1,015		
<p>Respondents who made major revisions to one or more courses but did not develop any new courses (29%): The mean number of courses this group revised was 2.13. We assume that half of the mean number of courses (1.065) underwent major revisions. We further assume that on average 1/3 of the respondents made major revisions to the remaining 1.065 courses, 1/3 made moderate revisions, and 1/3 made minor revisions. It follows that:</p>			
(1) 9.6667% of respondents made major revisions on average to 2.13 courses:			
Major revisions = 9.6667% X 14,402 X 2.13 courses =		2,965	
(2) 9.6667% of respondents made major revisions on average to 1.065 courses and made moderate revisions on average to 1.065 courses			
➤ Major revisions = 9.6667% X 14,402 X 1.065 courses =		1,482	
➤ Moderate revisions = 9.6667% X 14,402 X 1.065 courses =			1,482
(3) 9.6667% of respondents made major revisions on average to 1.065 courses and minor revisions to 1.065 courses			
➤ Major revisions = 9.6667% X 14,402 X 1.065 courses =		1,482	
➤ (Courses with only minor revisions are not being counted here)			

Extrapolation for Numbers of Courses (concluded).

	New Courses	Courses with Major Revisions	Courses with Moderate Revisions
Respondents who made at most moderate revisions to one or more courses (27%): The mean number of courses developed and revised for this group was 1.98. We assume that, on average, half of the respondents in this group (13.5%) made moderate revisions to the mean number of courses (1.98) and half (13.5%) made moderate revisions on average to .99 courses and minor revisions to .99 courses. It follows that:			
(1) 13.5% of respondents made moderate revisions to 1.98 courses:			
Moderate revisions = 13.5% X 14,402 X 1.98 courses =			3,849
(2) 13.5% of respondents made moderate revisions to .99 courses and minor revisions to .99 courses:			
➤ Moderate revisions = 13.5% X 14,402 X .99 courses =			1,925
➤ (Courses with only minor revisions are not being counted here)			
Total Courses	4,984	7,252	8,579

$$\text{Total number of new and revised courses} = 4,984 + 7,252 + 8,579 = 20,815$$

Chapter V

Page V-2. Number and Characteristics of Students in Participants' New and/or Revised Courses.

(1) N of students of participants who developed new courses and/or made major revisions to existing courses.

A. All students:

First we calculated an adjusted yearly number of students per respondent as follows:

- | | |
|---|-------|
| (1) Survey respondents who attended workshop in 1996, mean N of students completing courses per year (with deletion of observations with values of more than 3,000) | 71.94 |
| (2) Survey respondents who attended workshop in 1997, mean N of students completing courses per year (with deletion of observations with values of more than 2,000) | 69.51 |
| (3) Mean yearly N of students per participant for both years | 72.73 |
| (4) Adjustment for possible duplicate counts of students—2/3 of mean yearly N of students per participant | 47.15 |

Next, we performed the following calculations:

Year:	1991	1992	1993	1994	1995	1996	1997
(1) N participants (from Exhibit II-2)	1,090	1,898	2,403	2,059	2,739	2,842	3,218
(2) Estimated percent of participants who developed or made major revisions to courses (from Exhibit IV-2)	54%	54%	54%	54%	54%	54%	54%
(3) Estimated N of participants who developed new course or made major revisions to existing courses (line 1 X line 2)	589	1,025	1,298	1,112	1,479	1,535	1,738
(4) Adjusted mean N of students per participant X N of participants who developed or revised course (line 3 X 47.15)	27,754	48,328	61,186	52,427	69,742	72,642	81,938
(5) N of years to fall of 1999	8	7	6	5	4	3	2
(6) Estimated total number of students completing courses through summer of 1999 (line 4 X line 5)	222,033	338,295	367,118	262,136	278,967	217,925	163,877

Total for 1991-1999 (sum across cells in line 6): 1,850,351

B. N of female students: The mean percent of female students given by survey respondents who made major revisions to courses and/or developed new courses was 46.33. So:

$$46.33\% \text{ of } 1,850,351 = 857,268$$

C. N of students from underrepresented minority groups: The mean percent of underrepresented minority students given by survey respondents who made major revisions to courses and/or developed new courses was 28.49. So:

$$28.49\% \text{ of } 1,850,351 = 527,165$$

D. N of students in each type of institution: The number of students in each type of institution was calculated in the same way as the number of students in all institutions (see A above).

(2) N of students of participants who made *moderate* revisions to existing courses:

A. All students:

First we calculated an adjusted yearly number of students per respondent as follows:

- | | |
|---|-------|
| (1) Survey respondents who attended workshop in 1996, mean N of students completing courses per year (with deletion of observations with values of more than 3,000) | 57.93 |
| (2) Survey respondents who attended workshop in 1997, mean N of students completing courses per year (with deletion of observations with values of more than 2,000) | 90.45 |
| (3) Mean yearly N of students per participant for both years | 74.19 |
| (4) Adjustment for possible duplicate counts of students—2/3 of mean yearly N of students per participant | 49.46 |

Next, we performed the following calculations:

Year:	1991	1992	1993	1994	1995	1996	1997
(1) N participants (from Exhibit II-2)	1,090	1,898	2,403	2,059	2,739	2,842	3,218
(2) Estimated percent of participants who made moderate revisions to courses (from Exhibit IV-2)	27%	27%	27%	27%	27%	27%	27%
(3) Estimated N of participants who made moderate revisions to courses (line 1 X line 2)	294	512	649	556	740	767	869
(4) Adjusted mean N of students per participant X N of participants who made moderate revisions to courses (line 3 X 49.46)	14,556	25,347	32,091	27,497	36,578	36,321	42,975
(5) N of years to fall of 1999	8	7	6	5	4	3	2
(6) Estimated total number of students completing courses through summer of 1999 (line 4 X line 5)	116,451	177,428	192,545	137,485	146,312	108,962	85,950

Total for 1991-1999 (sum across cells in line 6): 965,133

B. N of female students: The mean percent of female students given by survey respondents who made moderate revisions to courses was 47.10. So:

$$47.10\% \text{ of } 965,133 = 454,577$$

C. N of students from underrepresented minority groups: The mean percent of underrepresented minority students given by survey respondents who made moderate revisions to courses was 24.05. So:

$$24.05\% \text{ of } 965,133 = 232,114$$

D. N of students in each type of institution: The number of students in each type of institution was calculated in the same way as the number of students in all types of institutions (see A above).

Chapter VI

Page VI-3. To calculate the probability of developing or revising a course associated with several variables at a time, use the coefficients in the column entitled “Log of the Odds Ratio.”

Variable	Log of the Odds Ratio
Intercept	-0.277
Length of workshop (in days)	0.058
Focus of workshop	
Included teaching methods	0.610
Included new technology	0.526
Included new content	0.022
Included lab techniques	-0.196
At workshop, participant:	
Worked on lecture notes/handouts	0.584
Worked on problem sets, project descriptions, or lab exercises	0.617
Worked on textbooks	-0.098
Gave presentation	-0.230
Completed materials	0.117
Participant's follow-up activities	
Site tested materials at own campus	0.250
Received technical assistance from PI or workshop staff	0.203
Formal follow-up session(s)	0.046
Informal gathering(s)	0.063

To calculate the change in probability associated with several variables:

(1) Add the coefficient associated with the intercept (-0.277) to the coefficient(s) whose effect you desire to calculate. (2) Take the exponent of the result (which gives the odds ratio for the combination of variables). (3) Divide the result of (2) by 1+ that result. (4) Subtract 0.431 (the probability of developing and/or revising a course associated with the intercept) from the result of (3). The result of (4) will be the change in the probability of developing and/or revising a course associated with presence of all the variables of interest (and the absence of all others).¹

For example, to calculate the difference in probability of developing and/or revising one or more courses for a participant who attended a workshop that included teaching methods *and* new technology compared with participant who attended a workshop that included none of the variables in the model, the calculation would be as follows:

- (1) $-0.277 + 0.610 + 0.526 = 0.859$
(intercept) (teach. Meth.) (new technol.)
- (2) $\exp(0.859) = 2.361$ (odds ratio for this combination of variables)
- (3) $2.361/(1+2.362) = 0.702$ (probability of developing or revising a course)
- (4) $0.702 - 0.431 = 0.271$ (change in probability)

¹ The change is the increase or decrease in probability of developing or revising a course associated with the variables of interest, compared with the probability of developing or revising a course if *all variables in the model have a value of zero* (for dichotomous variables, a value of 0 means an absence).

Thus, the probability of developing and/or revising at least one course would be 27.1 percentage points higher for the first participant than for the second participant.

Chapter VII

The number of undergraduates in the United States, from 1991-92 to 1998-99 was calculated as follows:

Appendix Table 4-32 in *Science Indicators—2000* shows the total numbers of undergraduates in the United States as follows:

1990-91	1992-93	1993-94	1994-95	1995-96	1996-97
12,011,657	12,693,778	12,482,813	12,417,701	12,399,826	12,424,750

Note that no numbers were available for 1991-92 or for after 1996-97. For the 1991-92 undergraduate population, we interpolated between the numbers for 1990-91 and 1992-93 by taking the mean or (12,352,718). We assumed that the population was the same for 1997-98 and 1998-99 as for 1996-97. Because of dropout, we also assumed that 1/3 (rather than 1/4) of the student population for each year were new students (incoming freshmen). Thus, to the number for 1991-92 we added 1/3 of the student population for each of the subsequent years, as follows:

All 1991-92 undergraduates	12,352,718
New 1992-93 students (1/3 of 1992-93 undergraduates)	4,231,259
New 1993-94 students (1/3 of 1993-94 undergraduates)	4,160,938
New 1994-95 students (1/3 of 1994-95 undergraduates)	4,139,234
New 1995-96 students (1/3 of 1995-96 undergraduates)	4,133,275
New 1996-97 students (1/3 of 1996-97 undergraduates)	4,141,523
Estimated new 1997-98 students (1/3 of estimated 1997-98 undergraduates)	4,141,523
Estimated new 1998-99 students (1/3 of estimated 1999-99 undergraduates)	4,141,523
Estimated unduplicated total undergraduates 1991-92 through 1998-99	41,441,994