The effect of course section size on the cost of instruction in agriculture
by Jacob Robert Hehn

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of DOCTOR OF PHILOSOPHY in Agricultural Economics
Montana State University
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Abstract:
The financing of a modern program of education in a university involves large sums of money. Wise managements of a university's resources requires constant analyses of costs.

Past efforts to establish the cost of instruction have centered on average costs per unit of production, specifically cost per student-credit-hour produced. This information has been of limited usefulness for decision-making.

The possibility of over-utilization (or under-utilization) of a course section as it relates to a stated optimum size and what this means in terms of unit costs, both average and marginal, is examined. It is concluded that for a large percentage of the courses offered in the two professional curricula examined, agriculture and engineering, there is no linear relationship between the number of student registrations and the total cost of a teaching section.

Data on the nature of the section of instruction--numbers of sections, distribution by size, average size and numbers of student registrations—-were acquired from the colleges of agriculture and engineering at Colorado State University. An examination of the data made it possible to conclude that additional student registrations could be absorbed at both the lower division and upper division undergraduate level without adding to the total cost of instruction; that is to say, average cost per student registration would decrease with additional student registra-tions. This is important for faculty, academic administrators, curriculum committees and other decision-makers in a university.

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A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree

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ABSTRACT

The financing of a modern program of education in a university involves large sums of money. Wise managements of a university's resources requires constant analyses of costs.

Past efforts to establish the cost of instruction have centered on average costs per unit of production, specifically cost per student-credit-hour produced. This information has been of limited usefulness for decision-making.

The possibility of over-utilization (or under-utilization) of a course section as it relates to a stated optimum size and what this means in terms of unit costs, both average and marginal, is examined. It is concluded that for a large percentage of the courses offered in the two professional curricula examined, agriculture and engineering, there is no linear relationship between the number of student registrations and the total cost of a teaching section.

Data on the nature of the section of instruction--numbers of sections, distribution by size, average size and numbers of student registrations--were acquired from the colleges of agriculture and engineering at Colorado State University. An examination of the data made it possible to conclude that additional student registrations could be absorbed at both the lower division and upper division undergraduate level without adding to the total cost of instruction; that is to say, average cost per student registration would decrease with additional student registrations. This is important for faculty, academic administrators, curriculum committees and other decision-makers in a university.

CHAPTER I

INTRODUCTION

The financing of a modern program of education in a university involves large sums of money. Anyone who is at all acquainted with modern institutions of higher education is aware of the importance of financial matters in the operation of a college or university. Correlations between institutional excellence and financial factors are known to be high. The university that cannot meet competition in faculty salaries and instructional equipment is scheduled for mediocrity. Rules of thumb are not adequate for the multi-million dollar enterprises most universities have become.

Justification for the Study

Most analyses of university costs and specifically, instructional costs are undertaken because costs may be a manifestation of good management or they may also be evidence of mismanagement. Most efforts, until very recently, to establish the cost of instruction have centered on unit costs. This approach applies an after-the-fact computation which establishes cost per some unit of production. The decision-making process which affects instructional cost involves many individuals--academic administrators, curriculum committees, faculty, presidents, and recently, students. Unit cost data have been of limited usefulness to these decision-makers. Other information must be added to unit cost data. Wide-spread apprehensions arise in most colleges and universities whenever

economic analysis, sophisticated or otherwise, is brought to bear on education. This dissertation will attempt to take account of these apprehensions.

Purpose of the Study

The purpose of this study is to evaluate objective instructional production and cost data from one university, Colorado State University, in order to isolate those factors which are pertinent to an economic analysis of the teaching function, analyze their interaction, and provide a basis for the allocation of the limited resources available to the university.

The Problem

What are the factors which must be employed in an economic analysis of instruction and what is the nature of the interaction of the factors which affect the cost of instruction?

Sub-Problems

1) What implications do low (or high) unit costs have for university admissions policies, scholarship policies, and the like?
2) Can a cost curve be developed for an individual course in an university and for groups of courses?
3) What emphasis is appropriate for the traditional cost per student credit hour approach in planning?
4) What is the relationship between the number of students enrolled in a class and the total direct costs of the class?

5) Is the relationship between numbers of students in a department, college, or university and cost of instruction a linear relationship?

6) Is the effort to measure the incremental cost of each additional student in a class effective as a planning tool?

7) Of what importance is the number of "sections" or "events" of instruction in the determination of cost?

It is not intended that this paper will answer adequately any or all of these questions.

The analysis utilized two techniques. The interaction of the factors which affect the cost of teaching were examined. Teaching production and cost data from Colorado State University records were acquired and the interaction of the factors affecting the cost of teaching analyzed. The study proceeded in the following sequence:

Step 1. A historical development of attempts to develop cost analyses in colleges and universities and a review of the literature relative to the problem.

Step 2. A description of how the data which relate to faculty productivity and costs of production were assembled in terms of the economic factors to be explored.

Step 3. The interaction of the factors were analyzed.

Step 4. Conclusions are stated in terms of their significance for university planning.

The possibility of over-utilization (or under-utilization) of a course section as it relates to a stated optimum size and what this means in terms of unit costs, both average and marginal, was examined. The study will attempt to establish whether there is a linear relationship between the number of student registrations and total costs and whether there is a relationship between the number of student registrations and the total cost of a section. Data for specific departments and colleges describing the percent of the courses offered as single-section and multi-sectioned at all levels of instruction were assembled. From this, the study will proceed to the implications for planning: projected additional faculty needs and admissions policies.

This paper attempts to look into the general economy of instructional programs by examining the nature of the section of instruction--numbers, distribution by size, average size, and numbers of student registrations. It will attempt to establish what relevancy, if any, these statistics may have for the efficient use of the resources of a department or a college within a university. It is expected that this effort will lead to additional efforts to develop the data and procedures required to facilitate projections and evaluation of alternate plans.

Further studies could attempt to establish the cost of the "teaching event" as it appears to the university and proceed from this to a more inclusive concept of cost which encompasses the investment made by the student himself. The income given up by the student is an opportunity cost which may be the largest component of the total investment in

university education. In any case, consideration of this additional element into a cost of instruction analysis may produce decisions different than those found acceptable when student opportunity costs are ignored.

CHAPTER II

HISTORICAL DEVELOPMENT OF EFFORTS TO IDENTIFY THE ELEMENTS IN THE COST OF INSTRUCTION AND ESTABLISH THEIR INTERACTION

Any effort to establish the cost of instruction must begin with the subject of financial accounting. This chapter will concern itself with the development of financial accounting in our colleges and universities, specifically the function of accounting which concerns itself with analyzing expenditures and other data in a way which might develop meaningful relationships.

Russell 1/, in describing early efforts at institutional accounting, reminded us that most accounting systems of colleges and universities prior to 1925 revealed a lack of uniformity in policies and procedures. The lack of uniformity in colleges and universities was in direct contrast to the considerable uniformity found in the public elementary and secondary school systems. Russell traced the history of progress toward uniformity in colleges and universities in some detail. Russell stated:

> Apparently the first important realization of the lack of uniformity in college and university accounting practices arose from the proposal of the Carnegie pension plan. When Andrew Carnegie in 1905 established an endowed foundation to provide pensions for faculty members in American higher institutions, it appeared necessary to limit participation in the program to the stronger and better institutions of

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1/ John Dale Russell, The Finance of Higher Education, (2nd ed.), Chicago, University of Chicago, 1954.

the country. Financial stability seemed to be one of the appropriate criteria for the selection of participating institutions, so information regarding finances was requested from all colleges and universities applying. Analysis of the reports that were submitted quickly revealed the need for agreement on terminology and practices in keeping financial records.

Motivated by this experience, the Carnegie Foundation, in its annual report for 1910, made an important series of recommendations to colleges with respect to the manner in which financial reports should be prepared. In this first attempt at the development of uniformity, the suggestions made were reasonable and at the same time progressive. They provided a base not only for improvement in existing practice but from which later efforts at improvement might proceed. The actual effect of the recommendations, however, seems to have been decidedly limited, so far as modifications of accounting practices were concerned. The Foundation itself made no attempt to coerce institutions into following its suggested accounting plan, and only slight progress toward uniformity in college accounting practices was achieved as a result of this first effort in that direction.

A committee appointed by the Association of University and College Business Officers reported in 1917 a suggested uniform classification of expenditures for higher institutions. This committee, under the leadership of J. C. Christensen, of the University of Michigan, proposed a sound system of classification of income and expenditure, essentially in harmony with the plan that had been suggested by the Carnegie Foundation. The report of the committee was contained in the Proceedings of the Association, but few institutions outside of the middle western state universities seem to have done much to revise their accounting practices in accordance with its recommendations.

The General Education Board of New York, a philanthropic foundation established by John D. Rockefeller, also became interested in the problem of college accounting at about the time of the publication of the suggestions by the Carnegie Foundation. The reasons for the interest of both foundations were somewhat similar. The General Education Board was entering on a program of philanthropic giving to American higher education, and, naturally, it wished to have some definite assurance regarding the financial position of the institutions it was seeking to aid. The unsound financial policies followed in many colleges, and the lack of uniformity in their reporting practices, soon became clearly evident. For some time the

Board, through its staff members, gave advice on financial and accounting matters individually to the institutions with which it made contact.

A great forward step was taken in 1922, when the General Education Board published a volume by Trevor Arnett entitled College and University Finance.[6] Mr. Arnett had had the opportunity to visit a large number of colleges and to inspect their accounting systems, besides having served for many years as auditor of the University of Chicago. He was thus peculiarly well qualified for the authorship of a treatise on financial management. At about the time the book was published, Mr. Arnett joined the staff of the General Education Board and later became its president, a position from which he retired in 1936.

The merits of Arnett's College and University Finance were so apparent that the book became almost immediately the bible of business managers. Besides the suggestions with reference to accounting and reporting, the book contains a sound treatment of many other phases of financial administration, including budgetary procedure and management of endowments. Although for a long period of years the book was to be found on the desk of practically every progressive business manager, the suggestions it contains with respect to budgeting and endowment management seem to have been followed more carefully than those with respect to accounting. While many colleges and universities made some modification in their accounting practices to conform with Arnett's suggestions, a decade after the publication of the book the accounting systems in a great majority of institutions still departed so markedly from the basic features of the plan that uniformity seemed a very distant goal.

In the meantime other groups had also been convinced of the need for greater uniformity in the accounting and reporting practices of colleges and universities. The staff of the United States Office of Education, having responsibility for the compilation of statistics relating to education, was keenly aware of the deficiency in the published data concerning the finances of higher institutions. A Committee of the Association of American Colleges, concerned with the cost of education, had found its work seriously hampered through inability to obtain trustworthy data for interinstitutional comparisons. The associations of college and university business officers had frequently discussed the need for some further standardization of accounting and reporting practices. The regional accrediting agencies had also encountered the problem in enforcing financial standards for accreditation.

The United States Office of Education, through Dr. Arthur J. Klein, then serving as chief of the Division of Higher Education, took the leadership in securing the appointment of a committee to work on the problem. This committee, appointed in 1930 under the title of National Committee on Standard Reports for Institutions of Higher Education, represented in its membership practically all the organizations that had displayed an interest in the problem, including the Association of American Colleges and the Council of Church Boards of Education, the various associations of college and university business officers, and the American Association of Collegiate Registrars. The General Education Board of New York gave evidence of its continued interest in the problem by providing a generous grant of funds for the work of the National Committee.

The National Committee deliberated on the problems of financial reporting for a number of years. Advice was sought from experts in the technical field of accounting, such as the Terminology Committee of the American Institute of Accountants, from research workers in the field of education, from college presidents and other administrative officers, and from various agencies which make authoritative use of financial information from colleges and universities. Preliminary bulletins on various phases of the problem, presenting tentative findings and recommendations, were issued from time to time. The definitive final report of the committee was published early in 1935.[7]

The committee not only published its recommendations but also provided a valuable follow-up in the form of advisory service to colleges. As an outgrowth of these activities the American Council on Education, assisted by a grant from an endowed foundation, established in the autumn of 1935 the Financial Advisory Service for higher institutions, with an office at its headquarters in Washington, D. C. The leadership under which this service was inaugurated was the same as that which guided the National Committee through the preparation of its final report. The Financial Advisory Service was discontinued in 1941 when further support could not be obtained. During the six years of its existence the organization rendered notable service through the publication of a series of bulletins ("American Council on Education Studies," Series III) and books and through consultations with individual college officers and various associations and agencies interested in financial accounting and reporting.

The work of the National Committee was limited chiefly to the problems of financial reporting, and the subject of accounting techniques was treated only incidentally. Although the first chapter of the committee's final report is devoted to a theoretical discussion of the characteristics and functions of institutional accounting, and the final chapter concerns the classification of accounts, the committee did not set up a complete model accounting system for colleges to follow.[8] The character of an institution's financial reports, however, goes far to determine the nature of its accounting system.

The report of the National Committee has everywhere been recognized as marking a notable advance in institutional accounting and reporting practices. Within a few years after its publication a number of influential agencies adopted it as the basis of their financial reporting. The forms on which reports are made to the United States Office of Education were changed to accord with the recommended pattern of classification. Many of the denominational boards of education revised their reporting requirements to follow the recommendations of the National Committee. The North Central Association of Colleges and Secondary Schools requires that financial reports from its member-institutions of higher education be set up in the form recommended by the National Committee, and the reports are made on the same forms as are used by the United States Office of Education; the Association further strongly urges that its member-institutions set up their financial accounting systems in the recommended manner. At least one state (Texas) has by legislative mandate required its publicly-controlled institutions to keep their financial accounts in the manner prescribed by the National Committee, and in other states the same end has been achieved by boards and other rule-making agencies. A considerable number of colleges and universities have voluntarily manifested an eagerness to modify their accounting and reporting organizations to conform to the recommended plan.

In the early 1940's there was every reason to believe that institutions would rapidly adopt the principles suggested in the report of the National Committee. There was hope that statistics concerning the finances of higher education in the United States would become increasingly reliable and informative. Some even expected that institutional reports would provide financial data on such a uniform basis that direct comparisons between and among colleges and universities would be feasible. The events of the decade of the 1940's, however, indicated that this optimism was unwarranted. The discontinuance of the

Financial Advisory Service of the American Council on Education withdrew an important stimulus toward uniformity. The absorption of the country and the institutions of higher education in the war effort, and in postwar problems of financing, prevented business officers from continuing the attention they had been giving to the development of uniform accounting procedures. Normal turnover in the field of college business management brought into positions of leadership new personnel who had not been closely identified with the earlier movement toward uniformity in accounting procedures. As a result of these and other factors, a complete standardization of financial accounting practices and procedures in institutions of higher education seems at midcentury still to be a distant, though desirable, goal.

In a Master's thesis written in 1950 at the University of Illinois, entitled "Progress in Financial Reporting in Selected Universities since 1930", Harvey Sherer reaches a rather optimistic conclusion regarding the progress that has been made in the general adoption of the recommendations of the National Committee on Standard Reports. He notes that a number of the Committee's recommendations have not been generally adopted, but his evidence clearly shows that the pronouncements of the Committee are recognized as the generally accepted principles for financial accounting in institutions of higher education. He finds also that there is a high degree of uniformity in the application of these principles by colleges and universities. His conclusion that "great progress has been made" is certainly sound, even though the evidence of his study indicates that still further progress in the direction of uniformity is possible and desirable.

In 1938 a committee was formed to prepare a manual of college and university business administration. The Carnegie Foundation in 1942 made a grant to the American Council on Education to finance the work of this committee. The project moved slowly, however, during the war years. Later the membership of the committee was changed, and a decision reached that the first task should be to prepare a revision of the manual originally published in 1935 as a result of the work of the National Committee on Standard Reports for Institutions of Higher Education. The 1935 report was out of print and difficult to obtain, so a real need existed for a revision of it. The committee completed its work and published the revised report in 1952. The revised edition supported practically all the basic principles of the 1935 report and made only a few minor changes, though it did include some chapters on additional topics.

In 1935 the National Committee on Standard Reports for Institutions of Higher Education published a volume entitled Financial Reports for Colleges and Universities. This volume contains a detailed plan for unit-cost computations including a method of allocating overhead costs as well as an analysis of direct instructional cost.

The U. S. Office of Education published Bulletin No. 21, entitled University Unit Costs, in 1937. The plan for cost computation proposed by the National Committee in the 1935 volume was used as a basis for this report. This study revealed both differences in student-credit-hour costs among curricula or disciplines within a university and substantial unit-cost variations among universities for the same subjects or disciplines. The study did establish some, but not universal, uniformity between institutions with respect to greater student-credit-hour costs at the upper division and graduate division levels than at the lower division.

Additional encouragement to the use of unit cost data came during and following World War II. The various armed services training programs at colleges and universities--e.g., V-12, V-5, ASTP--required cost data to arrive at contract rates for the educational services rendered. After World War II, colleges and universities able to demonstrate that their tuition charges did not represent the total cost of instruction were in a position to negotiate with the Veteran's Administration for reimbursement of some part of a calculated expenditure per student. This provided a direct impetus to efforts to establish unit costs. Some of these efforts were no more than a computation which

involved dividing total institutional instructional expenditures by the number of students enrolled without respect to curriculum or level of work (graduate or undergraduate). 2/ This procedure, although crude, is still in practice. President Francis H. Horn of the University of Rhode Island reported 3/:

> The last time I saw figures (they were for 1959-60) Yale stated that the net cost to Yale per student was $1,602. Upon inquiry, I was informed that the figure was arrived at by a formula which took the total University expenditures, subtracted income from charges on term bills and from gifts (exclusive of the Alumni Fund), and divided the difference by the total university enrollment. The result was the net cost of Yale's annual subsidy to each student. I question the defensibility of the formula. The practice of my predecessor at the University of Rhode Island was just as indefensible. Every year he published figures on the cost per student to the state. He arrived at this figure by dividing the total state appropriation by the number of full-time students. But what about the part-time students?

To understand the impetus to efforts to establish unit costs during and after World War II one must have some understanding of the nature of the enrollment increases which occurred after World War II. In the decade of the 1950's when the U. S. population of college age increased about 1 percent per year, college and university enrollments rose by 1.6 percent per year. In the years 1955-60 enrollments increased by

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2/ No literature is cited here; the author reports this as personal experience having followed precisely this practice as the chief business officer of a small college following World War II.

3/ The University of Wisconsin Office of Institutional Studies, The Role of Institutional Research in Planning. Proceedings of Third Annual National Institutional Research Forum, May 5-7, 1963, Madison, The University of Wisconsin, 1963, pp. 8-9.

2.6 percent annually. In the first part of the nineteenth century, new colleges took care of much of the demand for additional college education. 4/ A large share of the increases in enrollment in the decade of the 1950's took place in existing colleges and universities. Table I is descriptive of the increase in enrollments, e.g., enrollments in public institutions increased 42.5 percent in the five-year period 1955-60.

The point in this brief discussion of enrollment increases is to emphasize the importance of specific and accurate cost and management data for colleges and universities now confronted with large increases in enrollments. Many university administrators had serious doubts that the growth in resources available to higher education would parallel the growth of enrollment.

Many different approaches to analyzing expenditures were employed, but the techniques may be classified into two major types: (1) computation and comparison of percent of total educational and general expenditures that have been used by the various functions performed by the institution, and (2) the determination of the cost per unit of service, such as cost per student or cost per student-credit-hour.

4/ Selma J. Mushkin, State Financing of Higher Education, Economics of Higher Education, Office of Education, Department of Health, Education and Welfare: OE-50027, Bulletin 1962, No. 5, Washington, D. C., Government Printing Office, 1962, pp. 221-222.

TABLE I. INCREASE IN PUBLIC COLLEGE AND UNIVERSITY ENROLLMENTS AS A PERCENT OF TOTAL INCREASE IN OPENING FALL ENROLLMENTS, AND PERCENTAGE CHANGE IN ENROLLMENTS IN PUBLIC AND PRIVATE INSTITUTIONS, 5-YEAR PERIOD 1955-60, BY STATE.*

State	Percentage of Total Increase in Opening Fall Enrollments in Public Institutions	Percentage Change 1/	
		Public Institutions	Private Institutions
Alaska	100.0	106.1	--
Nevada	100.0	123.7	--
Wyoming	100.0	30.0	--
Arizona	98.5	78.4	48.8
North Dakota	98.5	50.1	14.6
Louisiana	97.1	46.6	2.7
New Mexico	96.4	61.4	34.4
Colorado	93.5	64.9	11.2
Oklahoma	90.8	28.6	8.9
California	87.4	53.4	32.3
Montana	87.3	42.3	33.0
Washington	86.9	49.0	19.9
Minnesota	86.8	68.4	18.5
Mississippi	85.9	41.8	25.4
New Jersey	85.4	178.1	9.8
Oregon	85.1	62.3	28.6
Michigan	82.6	36.1	25.7
Wisconsin	81.6	42.8	18.0
Kansas	81.4	35.7	33.1
Florida	77.6	74.5	24.0
Indiana	76.5	41.7	17.2
Nebraska	76.3	41.1	30.1
Hawaii	76.1	50.0	2/
Virginia	74.6	39.2	26.5
Tennessee	71.4	54.8	27.0
New Hampshire	71.4	52.4	19.0
Idaho	71.3	36.5	52.7
Illinois	67.8	53.2	19.2
South Dakota	67.8	33.4	43.1
Missouri	65.9	47.4	16.3
Maine	65.8	62.3	49.0
West Virginia	65.7	25.0	41.1
Kentucky	65.6	44.4	38.9

(table continued)

TABLE I. (Continued)

State	Percentage of Total Increase in Opening Fall Enrollments in Public Institutions	Percentage Change 1/	
		Public Institutions	Private Institutions
North Carolina	65.3	45.3	26.8
South Carolina	64.6	41.0	24.0
Delaware	59.9	22.1	82.3
Maryland	59.6	37.4	34.5
Rhode Island	58.7	96.0	29.7
Alabama	57.8	15.3	36.3
Utah	56.8	25.5	38.3
Vermont	54.9	28.7	20.1
Georgia	54.5	16.0	29.4
Ohio	54.0	33.2	34.7
Arkansas	52.4	25.0	84.4
Texas	46.7	14.2	39.8
Pennsylvania	39.1	49.2	18.6
Iowa	35.4	19.2	41.2
Connecticut	35.0	31.0	38.2
Massachusetts	32.5	90.1	23.4
New York	31.3	21.0	21.0
District of Columbia	1.5	3.4	32.0

1/ Alaska, Nevada, and Wyoming have no private institutions. The relatively large percent of change in public institutions in New Jersey reflects the shift of Rutgers from a private institution to a State university during this period.

2/ No degree-credit enrollment in private institutions reported in 1955.

*Source: Compiled by Justin Lewis from data on opening fall enrollment, U. S. Department of Health, Education, and Welfare, Office of Education, Research and Statistics Division, 1962.

The first of these has the advantage of being easily determined in terms of percentage of total expenditure. An example using data from Oklahoma University follows in Table II.

The method is also useful when applied to data over several years, thereby permitting a comparison between years of operation; an expenditure pattern is revealed.

There are shortcomings. This technique reveals nothing relative to the efficiency of funds expended. For example, in the Oklahoma University data, it is not possible to say that the expenditure of $5,414,109, representing 56.5 percent of total expenditures, was sufficient for this function. Obviously, any conclusions made about a particular institution and supported by data do not necessarily apply to other institutions.

The technique employing a cost per unit of service is, in brief, a computation which adds instructional salary expenditures plus instructional operating expenditures and divides the total (the direct instructional cost) by the student-credit-hours produced. The shortcoming lies with the student-credit-hour as a unit of measurement.

Generally the use of unit instructional costs has been upheld as a good measure of instructional production: Russell and Doi state emphatically: 5/ "The student-credit-hour is the best available measure of the production of instructional services in the department or institution."

5/ John Dale Russell and James I. Doi, Analysis of Expenditures for Instruction, College and University Business, Vol. 21:43, April, 1956, p. 43.

TABLE II. EXPENDITURE AND PERCENTAGE DISTRIBUTION OF TOTAL EDUCATIONAL AND GENERAL EXPENSES BY INSTITUTIONAL FUNCTIONS: OKLAHOMA UNIVERSITY, FISCAL YEAR 1961-62.*

Total	General Administration	General Expense	Instruction	Organized Activities	Organized Research	Extension & Public Services	Libraries	Physical Plant
$9,579,460	$503,793	$627,633	$5,414,109	$311,968	$230,979	$852,284	$502,494	$1,136,200
100.0%	5.3%	6.5%	56.5%	3.3%	2.4%	8.9%	5.2%	11.9%

*Source: Charles R. Walker and John J. Coffelt, Financing Current Operating Costs of Higher Education, Oklahoma State Regents for Higher Education, State Capitol, Oklahoma City, 1963, pp. 13-14.

However, the controversy on this point continues. Sherer 6/, is emphatic in his denunciation of unit cost techniques when he says:

> Unit instructional costs computed by the approved methods of today tend to emphasize the immediate specific expenditure without consideration for quality received. Furthermore, at present, we have no standards by which to judge the future quality of the immediate in higher education.

Sherer proceeded to explain that every unit cost figure, high or low, is found to have a perfectly logical explanation. High unit costs may be a manifestation of a course just getting started with few student registrations or a graduate course. Low unit costs may represent a straight lecture course with many student registrations.

In 1952 the Commission on Financing Higher Education issued a volume by John D. Millett entitled, "Financing Higher Education in the United States". 7/ Although Millett was consistently skeptical about the value of cost studies, his analysis revealed that faculty salaries are an important cost factor, but operate on the cost of instruction along with the size of teaching load and the student-faculty ratio.

As might be expected, the interest in the unit cost approach continues. Williams 8/ reported in 1961 that, as a general rule of thumb, upper division costs could be expected to be approximately twice that of lower division unit costs.

6/ Harvey Sherer, Progress in Financial Reporting in Selected Universities Since 1930, (Champaign, Illinois: The Illinois Bookstore), 1950.

7/ John D. Millett, Financing Higher Education in the United States, The Staff Report of the Commission on Financing Higher Education, New York, Columbia University Press, 1952.

8/ Robert L. Williams, "The Cost of Educating One College Student," The Educational Record, Vol. 43, No. 4, October 1961, pp. 322-323.

A comprehensive study in higher education in Oklahoma was undertaken by the Oklahoma State Regents for Higher Education in 1961. 9/ Determination of unit costs was an important part of this study. The study revealed that in only a few cases were upper division costs twice the amount of the lower division costs. The explanation offered for this was the relatively low faculty salary level in the state. The study concluded further that instructional costs increase with the advance in the class level of the student.

The research efforts beginning with that of the 1920's succeeded in establishing some of the factors affecting the cost of instruction. They include the following:

- Faculty salaries
- Distribution of faculty time
- Distribution of faculty by rank
- Class size
- Teaching load
- Scope and type of instructional program
- Level of instruction

A review of the literature relating to the analysis of expenditures in colleges and universities reveals that most of the attention has been concentrated on the concept of "average cost per unit" of service produced. The result has been undue emphasis on average unit expenditure or average

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9/ Charles R. Walker and John J. Coffelt, Financing Current Operating Costs of Higher Education, Oklahoma State Regents for Higher Education, State Capitol, Oklahoma City, 1963, pp. 13-14.

unit-cost analyses with lesser emphasis on the marginal cost aspect of this problem. The approach found most easy to comprehend by the legislatures, boards of control, faculties, and others responsible for the interpretation of budgets and budget requests has been one that divides the total cost of instruction by the total number of students receiving instruction to establish an average budget per student. Funds required in the ensuing year are then computed by multiplying the additional number of students anticipated times the expenditure per student in the prior year and adding factors for price increases and whatever quality improvement levels are to be pursued.

The most recent major step in the analysis of the instructional costs in American colleges and universities came with Cooperative Research Project No. 1853 undertaken by the Institute of Public Administration of the University of Michigan. This research effort was reported in 1966. 10/ A sample of 110 colleges and universities was selected in the study as were 16 governing boards and coordinating agencies, 5 budget offices, and 3 regional associations. This author was one of those interviewed in the sampling of 110 colleges and universities. The study had as its task the development of an analytic procedure which could be applied to all institutions of higher learning and would develop the information necessary to answer questions. One of the important areas

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10/ John E. Swanson, Wesley, Arden, and Homer E. Still, Jr., Financial Analysis of Current Operations of Colleges and Universities, Institute of Public Administration, The University of Michigan, Ann Arbor, Michigan, 1966.

of the evaluative function of management is that of costs. The study was intended to develop procedures for establishing cost, identifying the factors which caused this cost to be what it was and the relationships between these factors and the actual dollar expenditures.

The Michigan study is a landmark of progress in the field of cost analysis in colleges and universities and it is expected that it will stimulate further studies in the field.

This dissertation will attempt to look into the general economy of instructional programs by examining the nature of the section of instruction--numbers, distribution by size, average size and numbers of student registrations. It will attempt to establish what relevancy, if any, these statistics may have for the efficient use of the resources of a department or a college within a university. It is expected that this will lead to additional efforts to develop the data and procedures required to facilitate projection and evaluation of alternate plans.

CHAPTER III

PER UNIT COST OF INSTRUCTION

The cost of production incurred by a university will be considered to consist of the money outlays the university must make for resources used to produce its product. This chapter will concentrate on the "per unit" aspects of costs and will explore the advantages and disadvantages of unit expenditures as a tool for the analysis of organized instruction.

Essentially, per unit costs are no more than a definition of total costs which takes into account the units of output. The literature relating to the analysis of university expenditures has concentrated on the unit cost approach. Some of this literature has been cited in the preceding chapter. Much controversy exists over the use of the unit-cost technique in universities. Industry has made a good deal of this approach, particularly the average-unit-cost aspects. Marginal unit cost information is much more difficult to acquire, both in industry and higher education.

A serious criticism of the use of unit costs stems from the problem of obtaining a valid measure of education production in terms of some measurable unit. Universities do indeed produce units in the sense that, say, a degree is produced or a student-credit-hour is produced. The imparting of knowledge through an active production process involving teachers, students, librarians, equipment, and the like is, at best, difficult to measure. This chapter will explore specifically the student-credit-hour as the unit of measure of educational output. 1/

1/ Refer to Appendix A.

Average cost per student-credit-hour is derived by dividing the total expenditures for the various outputs by the respective outputs. In Table III total costs are those incurred at the department level and consist primarily of compensation to teaching faculty, support staff, and expenditures for routine operation of a department or college--e.g., instructional supplies and materials, and travel.

TABLE III. AVERAGE COST PER STUDENT-CREDIT-HOUR, COLLEGE OF ENGINEERING, 1963-64 THROUGH 1966-67.*

Academic Year	Dollars Expended	SCH Produced	Cost Per Student-Credit-Hour
1963-64	$394,286	16,788	$23.49
1964-65	432,301	18,728	23.11
1965-66	634,100	19,702	36.36
1966-67	708,662	21,750	32.58

*Source: Office of Budgets, Operating Budgets for Fiscal Year, 1963-64 Through 1966-67, (Fort Collins: Colorado State University), 1967.

Although the SCH approach to a description of output has some merit for instruction at the lower level (freshmen and sophomore) and the upper level (junior and senior), it may not be as useful for an analysis of graduate level work. For the latter, a distinction should be made. Generally, the graduate student in the first year beyond the baccalaureate degree is engaged in course work somewhat typical of his undergraduate years. Beyond the first year of graduate work and particularly in the later stages of the student's doctoral program, course work may be a less important part of his work. In an effort to fit a number scheme,

many colleges and universities in recent years have awarded credit for "dissertation" or "research" registrations. Unless something of the sort is done, the graduate instruction load in a college or department can be much understated. The difficulty of computing costs and projecting needs is obvious.

The first task in assessing the usefulness of the cost per student-credit-hour units is to establish that there is indeed a relationship between the expenditure items and the production items. In Table IV the expenditures in the College of Engineering have been related to the student-credit-hours which have been produced by that college. Specifically, only the direct costs of teaching are related to student-credit-hour production. Logical analysis confirms that the expenditure and production items, the input and output items, are related to each other and thus the proposition may have some usefulness.

The basic shortcoming, of course, has to do with the question whether the SCH accurately measures the output of a college. Examination of the following table reveals that there is some doubt that it does. The case concerns the College of Engineering during the academic year 1964-65.

TABLE IV. STUDENT-CREDIT-HOURS PRODUCED PER MAJOR, COLLEGE OF ENGINEERING, 1964-65.*

Lower Division		SCH Produced Per	Upper Division		SCH Produced Per	Graduate Division		SCH Produced Per
SCH Produced	Majors	Major	SCH Produced	Majors	Major	SCH Produced	Majors	Major
5,390	516	10.4	10,910	326	33.5	2,408	185	13.0

*Source: Office of Admissions and Registrar, Student Statistical Report, Fall Quarter, 1960-61 Through 1967-68, (Fort Collins: Colorado State University), 1967.

An explanation for the "Number of SCH Per Major" is essential. The College of Engineering does not, as a college, offer a great many service courses for other disciplines. An opposite situation exists in, say, the College of Science and Arts, wherein the Department of English devotes as much as 75 percent of its effort, measured in SCH, to service work for other disciplines.

The common course of study for the freshmen year for all engineering majors listed below requires only 4.5 credits of a total of 51, some 8 percent, from courses within the College of Engineering itself. The specific courses are ME 1 and ME 2 (Engineering Graphics) and CE 12 (Engineering Profession).

This clearly accounts for the low SCH produced per major at the lower division. Contrast this with the junior and senior years during which the engineering student completes only 15 to 25 percent of his course work outside the College of Engineering. This is reflected in the large number of student-credit-hours, 33.5, per major at the upper division. The student-credit-hours per major at the graduate division, 13.0, reflect in large part the progression from the normal course work typical of undergraduate work toward the one-to-one (one faculty to one student) relationship found in instruction at the graduate level. The student-credit-hour as a unit of production measure is much less useful at the graduate level.

Some useful information can be gleaned from the cost per student-credit-hour exercises. Table VI extracts specific information from Table III.

TABLE V. COURSE OF STUDY FOR FRESHMEN YEAR (AGRICULTURAL ENGINEERING, CIVIL ENGINEERING, ELECTRICAL ENGINEERING, AND MECHANICAL ENGINEERING).*

	Course	Fall	Winter	Spring
CE 12	Engineering Profession	.5		
C 2,3	Fundamental Chemistry	4.0	4.0	
C 4a	Fundamentals of Organic Chemistry			
M 17, 36,37	Anal. Geometry and Calculus	5.0	5.0	5.0
E 2,3	English Composition	3.0	3.0	3.0
Sp 23	Public Speaking			
Hy 50, 51,52	History of Civilization	3.0	3.0	3.0
ME 1,2	Engineering Graphics		2.0	2.0
PE	Physical Education	.5	.5	.5
	Total	16.0	17.5	17.5

*Source: Office of Admissions and Registrar, Biennial Catalog 1964-65 and 1965-66, (Fort Collins: Colorado State University), 1964.

TABLE VI. EXPENDITURES PER SCH AND STUDENT-FACULTY RATIOS, COLLEGE OF ENGINEERING, 1963-64 THROUGH 1966-67.*

Year	Dollars Expended	SCH Produced	$/SCH	FTE Students	FTE Faculty	FTE Ratios: Students to Faculty
1963-64	$394,286	16,788	23.49	373.03	32.67	11.42 to 1.00
1964-65	432,301	18,728	23.11	416.18	33.22	12.53 to 1.00
1965-66	634,100	19,702	36.36	437.82	46.84	9.35 to 1.00
1966-67	708,662	21,750	32.58	483.33	48.17	10.03 to 1.00

*Source: Office of Admissions and Registrar, Biennial Catalog 1964-65 and 1965-66, (Fort Collins: Colorado State University), 1964.

The year 1965-66 reveals a dramatic increase (from $432,301 to $634,100) in the budget for this college, a 46.6 percent increase. This is reflected in the increase in the expenditures per student-credit-hour from $23.11 to $36.36, an increase of 57.3 percent.

The student-faculty ratio is derived by computing the number of FTE students (SCH produced ÷ 45 SCH) as described earlier and dividing the FTE students by FTE faculty. 2/ Again, the budget increase in 1965-66 is reflected in a narrowing of the student-faculty-ratio.

It is possible that price increases absorbed a significant part of the budget increase. This deserves specific exploration. The instructional budget 3/ for this college was distributed as follows for the years 1964-65 and 1965-66:

	1964-65	1965-66	Increase
Faculty salaries	370,543	568,952	198,409
Non-professional staff salaries	44,666	48,848	4,182
Total Personal Services Budget	415,209	617,800	202,591
Operations: Supplies, Materials, Travel, etc.	10,000	16,300	6,300
Total Budget	425,209	634,100	208,891

Faculty salaries, all ranks combined, increased an average of 8.0 percent from 1964-65 to 1965-66, requiring $29,643.

2/ Refer to Appendix B.

3/ Office of Budgets, Operating Budgets for Fiscal Years, 1964-65 and 1965-66, (Fort Collins: Colorado State University), 1964 and 1965.

TABLE VII. MEAN FACULTY SALARIES, ACADEMIC YEAR EQUIVALENT, COLLEGE OF ENGINEERING, 1963-64 THROUGH 1967-68, INDIVIDUAL RANKS AND ALL RANKS COMBINED.*

	Mean Salaries--Academic Year Equivalent				
Year	Professors	Associate Professors	Assistant Professors	Instructors	All Ranks Combined
1963-64	13,008	9,498	8,209	6,200	9,988
1964-65	13,171	10,266	8,511	6,100	10,233
1965-66	14,540	10,769	9,141	6,534	10,313
1966-67	14,923	11,804	9,641	6,442	10,911
1967-68	16,714	12,583	10,322	7,242	12,195

*Source: Office of Budgets, Faculty Salaries Analysis, 1963-64 Through 1967-68, (Fort Collins: Colorado State University).

Non-professional staff salaries increased by 5.0 percent and required $2,233. In summary, increases in prices, specifically salaries, account for $31,876 in a total budget increase of $202,591 for personal services. The balance of the increase of this college budget was available for additional staff and increases in the operations budget for supplies, materials, and travel. The increase for the latter was $6,300 leaving the amount $170,715, which was available for additional staff. With a budget increase of this magnitude, given no more than 5.2 percent increase in the college teaching load, as measured in SCH, and given price increases of the order of those described, it appears probable that the budget increase in 1965-66 was able to support a reduction in teaching loads and thereby an improvement in the quality of instruction. The examination of both the "expenditure per SCH" and the "student-faculty" ratio would point in this direction. Obviously, auxiliary evidence is essential.

Reference to Table III indicates that the expenditure per SCH in 1964-65, $23.11, was 38 cents less per SCH than the $23.49 expended in 1963-64. It is entirely possible that this decrease represents a decrease in the "quality of instruction". It is also possible that the additional SCH produced in 1964-65, specifically 1,940 more than in 1963-64, did not require additional faculty or additional teaching sections. In fact, only .55 FTE additional faculty were employed. Note that these were 1,940 additional SCH produced; 1,940 SCH reduces to 43.11 additional FTE students, which obviously cannot be assigned to the addition of .55 FTE faculty.

In summary, at best, an analysis of average unit costs based on accounting records gives a rough approximation to the relative efficiencies among colleges or departments of instruction.

CHAPTER IV

THE ECONOMICS OF SECTION SIZE

In order to undertake an economic analysis of organized instruction, a number of definitions 1/ are essential:

A course is defined as a body of subject matter in which instruction is offered within a given period of time.

Course divisions are defined as subdivisions of a course in which the same students are instructed through organizations with different characteristics. In a lecture-laboratory course, for example, the lecture would comprise one course division and the laboratory (or laboratories) another course division.

Sections are defined as subdivisions of a course division in which instruction is offered in the same body of subject matter and through the same form of organization to separate groups of different students meeting at differing times and/or places within the same academic term.

A student registration is defined as one enrollment by a student in one course division or section of a course division for one term. Registrations refer only to the number of enrollments, not to the individual person. One student generally will account for more than one registration.

A student course is defined as one enrollment by a student in one course. Again, since a student may, and normally does, enroll in more than one course, one student may account for more than one student course.

A course division made up of one section only is a single-section course division; if more than one section, it is a multi-section course division.

An illustration follows:

1/ Swanson, John E., Arden, Wesley and Still, Homer E., Jr., Financial Analysis of Current Operations of Colleges and Universities, (Ann Arbor: Institute of Public Administration, The University of Michigan, 1966).

Course	Student Courses	Course Division	Student Registrations	Section	Student Registrations
(1) Entomology 6	53	Lecture	53	1	27
				2	26
		Laboratory	53	1	27
				2	26
(2) Electrical Engineering 20	50	Lecture	50	1	11
				2	24
				3	15
(3) Civil Engineering 149	20	Laboratory	20	1	20

Many other combinations are possible, but those illustrated should serve to clarify the definitions.

The average cost per SCH data described in Table II probably disguise a good deal more than they disclose. Unit cost is directly affected by the salary of the faculty member, plus the funds supporting the faculty member's effort, 2/ his teaching load, and by the number of student registrations. To demonstrate this, there was selected the case of a full professor in the Department of Entomology, a department administratively located in the College of Agriculture. His salary for the academic year 1965-66 was $10,200. During the academic year, he had no specified research duties, which is to say that for instruction purposes he constituted 1.00 FTE faculty. A record of his teaching effort for that academic year is given in Table VIII.

It is possible to assign an approximate cost of a specific teaching event or section if (1) the salary of the faculty member teaching the section is known and (2) the portion of the total load of the faculty member teaching the section is estimated. The "portion of total load" is not easy to establish. Many criteria are involved. These include:

1) Level of course: lower, upper, or graduate division;

2) Number of credits taught;

3) Number of contact hours required. This varies from student to student for graduate dissertation supervision and those other courses which tend to the one-to-one relationship, e.g., special topics, special problems, and the like;

4) Number of student registrations;

5) Distinctions between groups of students; some faculty insist that teaching the same material to different sections of students requires different amounts of time;

2/ Refer to Appendix C--Faculty Teaching Reports.

TABLE VIII. TEACHING LOAD FOR ONE PROFESSOR, COLLEGE OF AGRICULTURE, 1965-66.

Course	Credit	Contact Hours		Sections	Registrations
		Lec	Lab		
Entomology 6	3	2	-	1	27
		2		2	27
		-	2	1	26
			2	2	26
Entomology 100 Special Problems	5	5	-	1	5
Entomology 100 Special Problems	5	5	-	1	3
Entomology 106	5	3	-	1	11
		-	4	1	11
Entomology 108	6	3	-	1	5
		-	6	1	5
Entomology 109	4	3	-	1	16
			-	1	16
Entomology 110 Seminar	1	1	-	1	4
Entomology 125	3	1	-	1	4
		-	4	1	9
Entomology 210 Graduate Seminar	1	1	-	1	4
Entomology 215	5	3	-	1	6
		-	4	1	6
Entomology 299 Research	5	5	-	1	1
Entomology 299 Research	5	10	-	1	1
Entomology 299 Research	6	6	-	1	4

6) Course division: lecture or laboratory;

7) Interest in the particular course at a particular time;

8) Experience of the faculty member with the particular course.

For purposes of this example, it is assumed that the department head established the teaching assignment for the members of the staff in the Department of Entomology. It is assumed further that he is given the following arbitrary definitions:

1) Teaching at the various levels is weighted 1.00 for lower division, 1.50 for upper division, and 2.00 for graduate division.

2) For the following courses at the upper division and graduate levels, 30 student enrollments constitute a full academic load:

Special Problems
Special Topics
Master's Research
Doctoral Research

With these definitions and his knowledge of the demands of the various sections on faculty time, the department head computes the percentages in the last column (Table IX) to represent the portion of total load for each course division taught by this faculty member.

Again, the cost of a section is established by two principal factors, (overhead costs, administration, library, and plant maintenance are ignored):

1) The compensation of the individual teaching the sections (C)

2) The total teaching load of the faculty member and the portion of this which the subject section constitutes (PTL)

Thus, (PTL) (C) = (Z) Cost of Section. The number of student registrations (R) is not introduced at this point and need not be; the number of student registrations does not affect the total cost of a particular

TABLE IX. TEACHING LOAD WITH PERCENTAGE TIME DISTRIBUTION FOR ONE PROFESSOR, COLLEGE OF AGRICULTURE, 1965-66.

Course	Credit	Contact Hours Lec	Contact Hours Lab	Sections	Student Registrations	Percent of Total Load
Entomology 6	3	2	-	1	27	.020
		2		2	27	.020
		-	2	1	26	.020
			2	2	26	.020
Entomology 100 Special Problems	5	5	-	1	5	.075
Entomology 100 Special Problems	5	5	-	1	3	.075
Entomology 106	5	3	-	1	11	.045
		-	4	1	11	.060
Entomology 108	6	3	-	1	5	.045
		-	6	1	5	.090
Entomology 109	4	3	-	1	16	.045
			-	1	16	.030
Entomology 110 Seminar	1	1	-	1	4	.015
Entomology 125	3	1	-	1	9	.020
		-	4	1	9	.060
Entomology 210 Graduate Seminar	1	1	-	1	4	.020
Entomology 215	5	3	-	1	6	.060
		-	4	1	6	.080
Entomology 299 Research	5	5	-	1	1	.200
Entomology 299 Research	5	10	-	1	1	
Entomology 299 Research	6	6	-	1	4	

section unless variable costs are permitted as section size increases. The number of student registrations does affect unit cost.

Average unit costs decrease as the number of student registrations increases from the first registration. If the number of student registrations for a section, say Entomology 106, was 11, it is appropriate to say that the average cost per student registration was $9.82. The marginal cost is, after the first registration, zero up to some number. To establish that number requires a closer look at the sectioning process.

Sectioning

It is not enough to say that the optimum section (as opposed to maximum) size for a course is 20 students. One must answer the question as to when, precisely, the second section is opened. If a second section is added with the 21st registration, the result may be one section with 11 students and another with 10 students.

A formula which "maximizes the degree to which the average actual section size can approach the optimum section size with any given number of student registrations" 3/ follows:

R = Number of student registrations

P = Section size stated optimum (20)

N = Number of sections

$$\frac{R-1+\frac{P}{2}}{P} = N$$ (using the whole number only from the result; where N < 1, make N = 1)

3/ Swanson, Arden, and Still, Op. Cit., pp. 82-83.

In the selected case, Entomology 106, R = 11, P = 20. Then

$$\frac{11-1+\frac{20}{2}}{20} = 1.00 \text{ (1 section required)}$$

Had the number of student registrations been 30, then

$$\frac{30-1+\frac{20}{2}}{20} = 1.95 \text{ (1 section required)}$$

Had the number of student registrations been 31, then

$$\frac{31-1+\frac{20}{2}}{20} = 2.00 \text{ (2 sections required)}$$

The "break-point" for the second section is 31 registrations.

A particular unit cost, such as C in Figure 1, represents no more than a point on the cost curve for this section. Specifically, at C, with five student registrations, the cost is $21.80 per student registration. The marginal cost curve for this same course is depicted in Figure 2. Since the decision to teach at least one section has been made, the marginal cost is described by the horizontal axis of the diagram between 1 to 30 student registrations. With the 31st student registration, the marginal cost increases to the total cost of the second section offered. The table and diagram which follow describe the marginal cost aspects. The cost of the first and each additional section is assumed to be $108.

Figure 1 depicts an average cost curve for the course of Entomology 106. An optimum section size of 20 is stated for this course. The

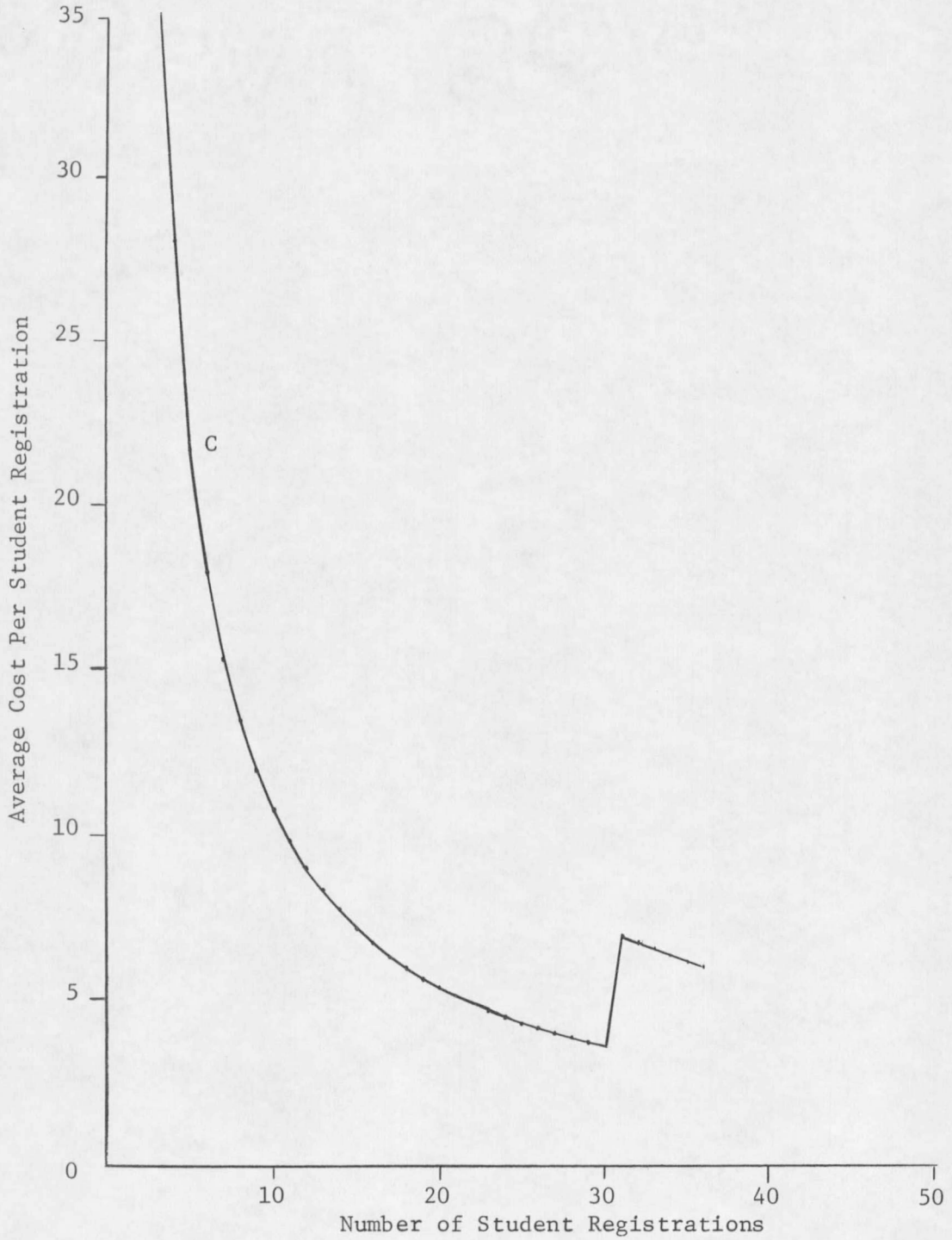

Figure 1. Average Cost Curve for Student Registrations.

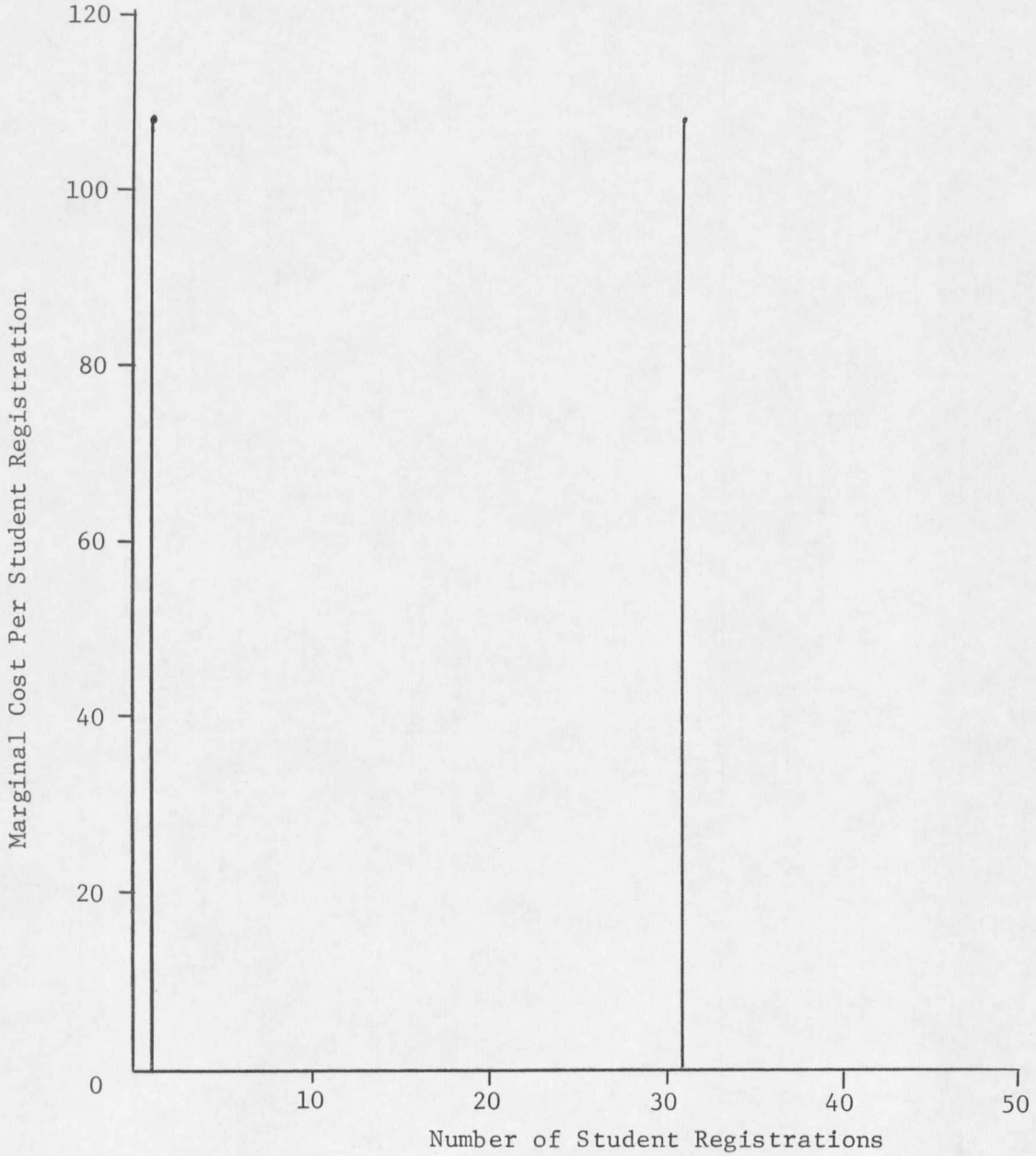

Figure 2. Marginal Cost Curve for Student Registrations.

total cost of the first section is $108. Total cost does not change for any number of student registrations between and including 1 student and 30 students. This is a critical point. There is no relationship between the number of students registered and the total cost of this section, that is, if variable costs are assumed, as they are in Table X, to be zero. Variable costs are assumed to be zero for all levels of student registration. Also, it is assumed that the product is the same regardless of the number of students in the section from 1 to 30.

Obviously, an increase in the number of student registrations can result in the use of additional teaching and laboratory supplies. Further, as the number of student registrations increases, the teacher may be required to spend more time with the mechanics of examinations and the like. For the present it is assumed that this is not the case. As student registrations increase from, say 5 to 15, no increases in variable costs are permitted.

The discontinuous marginal cost curve depicted in Figure 2 does, in reality, describe almost precisely what is taking place in much university planning. That is to say, alternatives are restricted to the addition at some point, 31 registrations in the diagram, of another section. The total cost must be $108 for the range 1 to 30 student registrations and $216 with the 31st registration. Some effort has been made to provide assistance to the teacher as the size of his classes grow with teaching aid, graduate student assistance, paper graders, and the like; but much more should be done in the way of introducing

TABLE X. COST DATA FOR COURSE: ENTOMOLOGY 106.

Registrations	Total Cost	Variable Cost	Marginal Cost	Average Cost Per Student Registration
1	108.	0	108.	108.00
2	108.	0	0	54.00
3	108.	0	0	36.00
4	108.	0	0	27.00
5	108.	0	0	21.60
6	108.	0	0	18.00
7	108.	0	0	15.43
8	108.	0	0	13.50
9	108.	0	0	12.00
10	108.	0	0	10.80
11	108.	0	0	9.82
12	108.	0	0	9.00
13	108.	0	0	8.31
14	108.	0	0	7.71
15	108.	0	0	7.20
16	108.	0	0	6.75
17	108.	0	0	6.35
18	108.	0	0	6.00
19	108.	0	0	5.68
20	108.	0	0	5.40
21	108.	0	0	5.14
22	108.	0	0	4.91
23	108.	0	0	4.70
24	108.	0	0	4.50
25	108.	0	0	4.32
26	108.	0	0	4.15
27	108.	0	0	4.00
28	108.	0	0	3.86
29	108.	0	0	3.73
30	108.	0	0	3.60
31	216.	0	108.	6.97
32	216.	0	0	6.75
33	216.	0	0	6.55
34	216.	0	0	6.35
35	216.	0	0	6.17
36	216.	0	0	6.00

expenditures which vary with the size of class with the objective of serving more students with each teacher.

The earlier examination of average costs per SCH revealed nothing about the relationship between the number of students registered and total costs. The next step will be a look at the nature of the curricula being taught; the number of courses, course divisions and sections being taught, and the number of single section course divisions and multiple section course divisions being taught.

CHAPTER V

DESCRIPTION OF THE ORGANIZED TEACHING FUNCTION IN THE COLLEGES OF AGRICULTURE AND ENGINEERING

This and subsequent chapters will examine data relating to section size for two of the seven colleges at Colorado State University. The seven colleges are: Agriculture, Business, Engineering, Forestry and Natural Resources, Home Economics, Science and Arts, and Veterinary Medicine. Large enrollment increases were experienced during the period 1960 through 1968.

TABLE XI. STUDENT ENROLLMENT, COLORADO STATE UNIVERSITY, 1960-61 THROUGH 1967-68.

Year	Student Enrollment
1960-61	6,131
1961-62	6,529
1962-63	7,304
1963-64	8,460
1964-65	10,185
1965-66	11,848
1966-67	12,701
1967-68	14,565

Colorado State University is the Land-Grant university in the State of Colorado.

The College of Agriculture and the College of Engineering are selected for detailed analysis of the organized instruction function. Both are professional colleges. The College of Agriculture did not experience the rapid increase in enrollment so typical of most of the colleges and departments in our public colleges and universities during the decade of

the 1960's. The College of Engineering experienced a more substantial rate of growth in total number of majors; it also provides a case of rapid growth in enrollment at the upper and graduate division with a more static enrollment at the lower level.

The data on the number of faculty employed to serve the students are available only for the years 1963-64 through 1967-68. A faculty member for a specific college is defined as one whose principal effort is devoted to the instruction and research program of that college. Our full-time-equivalent (FTE) faculty member for instruction is defined as the equivalent of a full-time teaching responsibility for the academic year (nine months); thus, a faculty member on a nine-month contract devoting full time to teaching is one FTE.

The output of a college can be described in a number of ways. Tables XII, XIII, XIV, and XV 1/ enumerate the number of majors enrolled in each college. These numbers, although they give some indication of the work load or output of this college, can be deceptive. For example, a freshman major in the College of Agriculture may be taking most of his course work in other colleges. The number of students who complete a curriculum and qualify for the degree, may also serve as an indicator of output. Again, this statistic by itself does not give a measure of output. Obviously, it is possible that a curriculum may have few

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1/ Office of Admissions and Registrar, Student Statistical Report, Fall Quarter 1964, (Fort Collins: Colorado State University).

TABLE XII. TOTAL ENROLLMENTS BY MAJORS AND BY COLLEGE: COLORADO STATE UNIVERSITY: FALL QUARTER, 1960-61 THROUGH 1967-68.

Year	Agri-culture	Engin-eering	Business	Forestry & NR	Home Econ.	Science & Art	Veter-inary Medicine	Unclassified Under-graduate	Unclassified Graduate	Total
1960-61	701	757	822	482	436	2,219	529	14	171	6,131
1961-62	675	749	853	507	470	2,590	581	6	98	6,529
1962-63	706	830	927	579	491	2,958	681	10	122	7,304
1963-64	686	934	1,026	657	554	3,712	735	11	145	8,460
1964-65	692	1,027	1,279	778	651	4,780	821	13	134	10,185
1965-66	688	1,090	1,532	959	707	5,791	931	23	127	11,848
1966-67	685	1,154	1,520	1,051	784	6,309	967	51	180	12,701
1967-68	790	1,290	1,683	1,147	955	7,294	969	125	312	14,565

TABLE XIII. GRADUATE ENROLLMENTS BY MAJORS AND BY COLLEGE: COLORADO STATE UNIVERSITY: FALL QUARTER, 1960-61 THROUGH 1967-68.

Year	Agriculture	Engineering	Business	Forestry & NR	Home Econ	Science & Arts	Veterinary Medicine	Graduate Unclassified
1960-61	61	43	0	34	3	134	141	171
1961-62	72	63	1	51	11	186	150	98
1962-63	72	95	8	63	14	225	173	122
1963-64	76	128	12	76	18	284	201	145
1964-65	75	185	40	91	23	458	231	134
1965-66	91	225	43	127	25	653	256	127
1966-67	108	247	43	143	32	643	256	180
1967-68	151	377	68	168	40	832	276	312

TABLE XIV. UPPER DIVISION ENROLLMENTS BY MAJORS AND BY COLLEGE: COLORADO STATE UNIVERSITY: FALL QUARTER, 1960-61 THROUGH 1967-68.

Year	Agriculture	Engineering	Business	Forestry & NR	Home Econ	Science & Arts	Veterinary Medicine	Unclassified Undergrad	Unclassified Grad
1960-61	318	289	272	179	175	834	177	14	0
1961-62	323	286	290	167	176	1,026	171	6	0
1962-63	358	295	351	175	172	1,200	190	10	0
1963-64	350	330	405	224	197	1,410	209	11	0
1964-65	372	326	434	281	233	1,666	205	13	0
1965-66	344	342	479	285	336	1,945	225	23	0
1966-67	323	331	522	345	262	2,304	273	51	0
1967-68	377	385	683	433	329	2,858	280	125	0

TABLE XV. LOWER DIVISION ENROLLMENTS BY MAJORS AND COLLEGE: COLORADO STATE UNIVERSITY: FALL QUARTER, 1960-61 THROUGH 1967-68.

Year	Agriculture	Engineering	Business	Forestry & NR	Home Econ	Science & Arts	Veterinary Medicine	Unclassified Undergrad	Unclassified Grad
1960-61	322	425	550	269	258	1,251	211	0	0
1961-62	280	400	562	289	283	1,378	260	0	0
1962-63	276	440	568	341	305	1,533	318	0	0
1963-64	260	376	609	357	339	2,018	325	0	0
1964-65	245	516	805	406	395	2,656	395	0	0
1965-66	253	523	1,010	547	446	3,193	450	0	0
1966-67	254	576	955	563	490	3,362	438	0	0
1967-68	262	528	932	546	586	3,604	413	0	0

TABLE XVI. FULL-TIME-EQUIVALENT FACULTY MEMBERS BY COLLEGE, ACADEMIC YEAR 1963-64 THROUGH 1967-68.

Year	Agriculture	Engineering	Business	Forestry & NR	Home Econ	Science & Arts	Veterinary Medicine
1963-64	30.09	32.67	27.04	17.09	17.46	243.90	37.40
1964-65	31.24	33.22	27.50	18.77	21.15	278.74	44.61
1965-66	30.93	46.84	35.50	20.22	23.14	350.98	53.39
1966-67	35.13	48.17	39.00	26.90	26.45	387.67	58.95
1967-68	37.72	52.03	45.08	29.26	32.52	413.15	68.16

TABLE XVII. STUDENT-CREDIT-HOUR PRODUCTION BY COLLEGE, 1963-64 THROUGH 1966-67.

Year	Agriculture	Engineering	Business	Forestry & NR	Home Econ	Science & Arts	Veterinary Medicine
1963-64	16,165	16,788	26,001	9,209	9,543	268,388	21,750
1964-65	15,523	18,728	29,185	11,450	11,498	321,535	25,734
1965-66	15,465	19,702	33,700	13,202	12,640	374,772	26,528
1966-67	17,786	21,750	39,785	13,957	13,991	381,449	28,108

graduates in a particular year, but may have large numbers of majors progressing through the curriculum.

Another unit used to describe educational output is the student-credit-hour (SCH). A class of 20 students in a course for which four quarter-hour credits are awarded produces 80 student-credit-hours. If the curricula in a particular college requires, say, 180 student-credit-hours for graduation, and the student normally requires four academic years or 12 quarters to complete a curriculum, it is possible to say that 45 student-credit hours constitute the equivalent of one student (45 SCH equals 1 FTE student). Given this definition, it is possible to say that a college which produces 45,000 SCH in an academic year has produced 1,000 FTE students. A computation of this sort makes the individual student's status as full-time or part-time irrelevant. It has the advantage of recording output to that department or college which serves the student, whatever his major.

Higher education cannot be exempt from constant examination of how the resources available to it are employed. Resources in education are never adequate to do all the things educators want to do and choices must be made among alternative uses of these resources. Choice of alternative course of action is inescapable. The elements which must be considered in the economics of higher education are not easily translated into money terms. Most of the inputs in the process of organized instruction are measurable in terms of money and physical units. Measuring output is much more difficult. Some of the benefits of education are measurable

in such things as income commanded by the degree-holder, achievement tests, job performance, and the like.

CHAPTER VI

AN EXAMINATION OF THE NUMBER, SIZE, AND DISTRIBUTION OF SECTIONS BY SIZE

COLLEGE OF AGRICULTURE

The College of Agriculture at Colorado State University in 1965-66 offered 180 different courses with 242 course divisions to accomplish its programs.

Courses of instruction in the College of Agriculture were aimed at training students for positions in the wide field of agriculture and its many related industries and professions. Curricula and courses listed were designed to provide basic and applied knowledge in fields of specialization chosen by the student upon satisfactory completion of his freshman year.

Major courses leading to the degree of bachelor of science in agriculture were as follows: Agronomy, agricultural business, agricultural economics, agricultural journalism, animal nutrition, animal production, animal science, crop science, dairy science, entomology, farm and ranch management, floriculture, general agriculture, horticulture, landscape and nursery management, poultry science, soil conservation, soil science, and vocational agriculture.

The following advanced degree programs were offered in the College of Agriculture: Master of Agriculture and Master of Science.

The fields of study included agricultural economics, animal genetics, animal nutrition, animal products, dairy science, entomology, crop science, horticulture, poultry genetics, poultry nutrition, soil science.

Doctor of Philosophy

The fields of study included animal genetics, nutrition, plant genetics, poultry genetics, and soil science.

The direct cost of instruction for this college was $484,548. Direct cost is defined as the sum of the expenditures made by the departments within the college for the instruction function. A total of 180 courses would have been offered whether the number of majors (total 688, including 91 graduate majors) had been substantially higher or lower than the actual number enrolled. The decision to offer the programs had been made, the number of students not withstanding. Since, in fact, many multiple section courses were taught in the College of Agriculture, the cost of the teaching program was less than $484,548. The number of sections which it was mandatory to teach was, then, a minimum of 242. Each case in which the number of student registrations forced the offering of more than one section of a course produced an increment cost with the final result that the total number of sections taught required $484,548.

Average section size in the lower and upper level course divisions in the College of Agriculture are given in Table XVIII. Average section size is derived by dividing the total student registrations in all sections by the number of sections offered.

Recall now that there were a total of 597 majors in agriculture, 253 at the lower division and 344 at the upper division. One might suspect that the average size of section would have been larger at the

TABLE XVIII. AVERAGE SECTION SIZE, COLLEGE OF AGRICULTURE, 1965-66.

	Single Section Course Divisions	Multiple Section Course Divisions	All Courses
Lower Division	18.24	21.74	20.55
Upper Division	15.93	16.90	16.07
Total Upper and Lower Division	16.63	20.89	18.39

upper division because there were 91 more majors. This was not the case. The upper division sections averaged 16.07 registrations per section, whereas the lower division sections averaged 20.55 registrations per section.

The multiple section course divisions at the lower division averaged 21.74 student registrations per section, whereas the single section courses averaged 18.24 registrations. The disparity is not as large at the upper division with 15.93 student registrations per single section course division and 16.90 student registrations per multiple course division.

Table XIX describes the number of single sections and multiple sections as a percent of total sections. At the lower division 34.48 percent of total sections were single sections, whereas at the upper division 84.13 percent were single section courses. This is a critical piece of information and will be referred to later. At the lower division 65.52 percent of all sections were multiple sections, whereas, at the upper division, only 15.87 percent of all sections were multiple sections. Reference to Tables XIV and XV reveals that there were 344 upper division

TABLE XIX. NUMBER OF SECTIONS AND PERCENT OF TOTAL, COLLEGE OF AGRICULTURE 1965-66.

Division	Single Section		Multiple Sections		All Sections	
	Number of Sections	Percent of Total	Number of Sections	Percent of Total	Number of Sections	Percent of Total
Lower Division	50	34.48	95	65.52	145	100.00
Upper Division	106	84.13	20	15.87	126	100.00
Total Upper and Lower Division	156	57.56	115	42.44	271	100.00

majors enrolled in the College of Agriculture and only 253 undergraduate majors, for a total of 592. One might ask why with significantly fewer majors, specifically 91 fewer at the lower division, it was necessary to offer 65.52 percent of all sections in multiple sections.

Attention is directed to the 106 sections or 84.13 percent total sections (126) at the upper division taught as single sections. At this point an hypothesis can be stated: there is additional capacity in the single-section course division sections at the upper division in the College of Agriculture.

No direct verification is found in Tables XVIII or XIX. Average section size in the single section course divisions at the upper division, 15.93 registrations per section, is smaller than at the lower division, 18.24 registration per section, but smaller section size at the upper and graduate level is indeed planned and generally acceptable.

A look at the distribution of sections in terms of their size is in order. Table XX gives the distribution of sections in terms of size from both single and multiple course divisions with lecture and laboratory course divisions combined, by lower and upper division. Later tables will examine lecture and laboratory sections separately.

At the lower division 7.59 percent of total sections had 5 or less student registrations, whereas at the upper division 22.22 percent of total sections had 5 or less registrations. At the upper level this may be the first indication that unused capacity exists. (One may also take the point of view that this is an indication of quality education.)

Consider the "20 or less" size of section. At the lower division, 65.51 percent of total sections have 20 or less registrations, whereas at the upper division 76.98 percent of the sections have 20 or less registrations.

Another approach is to examine the number of student registrations which "take place" in sections with specific sizes. Tables XXII and XXIII give the data for the College of Agriculture.

From Table XXI it was learned that at the lower division 65.51 percent of the total sections had 20 or less student registrations. At the upper division 76.98 percent of the total sections had 20 or less student registrations. If small classes are indeed prerequisite to quality instruction, this prerequisite appears to have been satisfied at the upper division. The large number of sections at the upper division with 10 or less student registrations, 69 (or 54.76 percent) of the total

TABLE XX. DISTRIBUTION OF SECTIONS IN TERMS OF SIZE FROM BOTH SINGLE AND MULTIPLE COURSE DIVISIONS WITH LECTURE AND LABORATORY SECTIONS COMBINED, BY LOWER AND UPPER DIVISION, COLLEGE OF AGRICULTURE, 1965-66.

Size of Section	Lower Division Sections	Upper Division Sections
5 or less	11	41
6 - 10	21	30
11 - 15	36	12
16 - 20	27	16
21 - 25	22	11
26 - 30	17	
31 - 35	2	8
36 - 40	2	2
41 - 45	2	
46 - 50		
51 - 60	1	3
61 - 70		1
71 - 80		
81 - 90		2
91 - 100	1	1
101 - 110		
111 - 120	1	
121 - 130		
131 - 140	1	
141 - 150		
151 - 160		1
161 - 170		
171 - 180		
181 - 190		
191 - 200	1	
Over 200		
Total Sections	145	126

TABLE XXI. DISTRIBUTION OF SECTIONS BY SIZE FROM BOTH SINGLE AND MULTIPLE COURSE DIVISIONS, BY LOWER AND UPPER DIVISION, AS CUMULATIVE PERCENT OF TOTAL SECTIONS, COLLEGE OF AGRICULTURE, 1965-66.

Size of Section	Lower Division Sections	Cumulative Percent of Total Sections	Upper Division Sections	Cumulative Percent of Total Sections
5 or less	11	7.59	39	30.95
10 or less	32	22.07	69	54.76
15 or less	68	46.90	81	64.29
20 or less	95	65.51	97	76.98
25 or less	117	80.69	108	85.71
30 or less	134	92.42	108	85.71
35 or less	136	93.79	116	92.06
40 or less	138	95.17	118	93.65
45 or less	140	96.55	118	93.65
50 or less	140	96.55	118	93.65
60 or less	141	97.24	121	96.03
70 or less	141	97.24	122	96.82
80 or less	141	97.24	122	96.82
90 or less	141	97.24	124	98.41
100 or less	142	97.93	125	99.21
110 or less	142	97.93	125	99.21
120 or less	143	98.62	125	99.21
130 or less	143	98.62	125	99.21
140 or less	144	99.31	125	99.21
150 or less	144	99.31	125	99.21
160 or less	144	99.31	126	100.00
170 or less	144	99.31	126	100.00
180 or less	144	99.31	126	100.00
190 or less	144	99.31	126	100.00
200 or less	145	100.00	126	100.00

TABLE XXII. NUMBER OF STUDENT REGISTRATIONS ACCOMMODATED IN SECTIONS OF VARIOUS SIZES BY LOWER AND UPPER DIVISION: COLLEGE OF AGRICULTURE, 1965-66.

Section Size	Lower Division Student Registrations	Upper Division Student Registrations
5 or less	40	83
6 - 10	176	253
11 - 15	468	143
16 - 20	491	292
21 - 25	460	214
26 - 30	453	
31 - 35	64	258
36 - 40	76	78
41 - 45	87	
46 - 50		
51 - 60	52	175
61 - 70		61
71 - 80		
81 - 90		170
91 - 100	97	95
101 - 110		
111 - 120	113	
121 - 130		
131 - 140	138	
141 - 150		
151 - 160		159
161 - 170		
171 - 180		
181 - 190		
191 - 200	194	
Over 200		

TABLE XXIII. NUMBER OF STUDENT REGISTRATIONS ACCOMMODATED IN SECTIONS OF VARIOUS SIZES BY LOWER AND UPPER DIVISION AS CUMULATIVE PERCENT OF TOTAL STUDENT REGISTRATIONS, COLLEGE OF AGRICULTURE, 1965-66.

Section Size	Lower Division Student Registrations	Cumulative Percent of Total Student Registrations	Upper Division Student Registrations	Cumulative Percent of Total Student Registrations
5 or less	40	1.38	83	4.19
10 or less	216	7.43	336	16.96
15 or less	684	23.51	479	24.18
20 or less	1,175	40.39	771	38.92
25 or less	1,635	56.20	985	49.72
30 or less	2,088	71.78	985	49.72
35 or less	2,152	73.98	1,243	62.75
40 or less	2,228	76.59	1,321	66.68
45 or less	2,315	79.58	1,321	66.68
50 or less	2,315	79.58	1,321	66.68
60 or less	2,367	81.37	1,496	75.52
70 or less	2,367	81.37	1,557	78.60
80 or less	2,367	81.37	1,557	78.60
90 or less	2,367	81.37	1,727	87.18
100 or less	2,464	84.70	1,822	91.97
110 or less	2,464	84.70	1,822	91.97
120 or less	2,577	88.59	1,822	91.97
130 or less	2,577	88.59	1,822	91.97
140 or less	2,715	93.33	1,822	91.97
150 or less	2,715	93.33	1,822	91.97
160 or less	2,715	93.33	1,981	100.00
170 or less	2,715	93.33	1,981	100.00
180 or less	2,715	93.33	1,981	100.00
190 or less	2,715	93.33	1,981	100.00
200 or less	2,909	100.00	1,981	100.00

upper division sections, may be an indication of unused capacity. Again, additional evidence is necessary.

The number of student registrations accommodated in sections of various sizes is described in Table XXII and Table XXIII gives another view. Whereas at the lower division 65.51 percent of total sections had 20 or less registrations, only 40.39 percent of total registrations were accommodated in sections with 20 or less registrations.

Attempts to measure quality depend on the development of quantitative measures and considerations which may be largely related to intangible factors, but it is interesting nevertheless to experiment with a few crude quality scales.

A scale is devised for the upper division awarding 100 to that instruction, in terms of student registrations, which is carried out in sections with 20 or less registrations follows.

Contrary to what might be expected, using the same quality scale, 40.39 percent of the student registrations at the lower level as compared with 38.92 percent at the upper level were accommodated in sections with 20 or less students, rating 100 on the quality scale. Recall that 65.51 percent of total sections taught at the lower level were at the "20 or less" size compared with 76.98 percent at the upper level. If small classes are an indication of quality it would appear that the number of student registrations accommodated at various section size levels is a better indication of the quality of an instructional program than is the statistic which concerns itself only with the number of sections at various section sizes as a percent of total sections.

Upper Division

Section Size	Quality Scale	Percent of Student Registrations Accommodated	Cumulative Percent of Student Registrations Accommodated
5 or less	100	4.19	4.19
6 - 10	100	12.77	16.96
11 - 15	100	7.22	24.18
16 - 20	100	14.74	38.92
21 - 25	97	10.80	49.72
26 - 30	94	0.00	49.72
31 - 35	91	13.03	62.75
36 - 40	88	3.93	66.68
41 - 45	85	0.00	66.68
46 - 50	82	0.00	66.68

Lower Division

Section Size	Quality Scale	Percent of Student Registrations Accommodated	Cumulative Percent of Student Registrations Accommodated
5 or less	100	1.38	1.38
6 - 10	100	6.05	7.43
11 - 15	100	16.08	23.51
16 - 20	100	16.88	40.39
21 - 25	97	15.81	56.20
26 - 30	94	15.58	71.78
31 - 35	91	2.20	73.98
36 - 40	88	2.61	76.59
41 - 45	85	2.99	79.58
46 - 50	82	0.00	79.58

Above 20 registrations the scale is dropped 3 points for each additional 5 registrations.

A similar, but tighter, quality scale for the upper division is suggested below. At the lower division, quality was rated at 100 if the section had "20 or less" student registrations. At the upper division only those sections with 15 or less registrations are now rated at 100.

Upper Division

Section Size	Quality Scale	Percent of Student Registrations Accommodated	Cumulative Percent of Student Registrations Accommodated
5 or less	100	2.22	4.19
6 - 10	100	12.04	16.96
11 - 15	100	22.47	24.18
16 - 20	97	17.51	38.92
21 - 25	94	16.05	49.72
26 - 30	91	9.66	49.72
31 - 35	88	8.89	62.75
36 - 40	85	6.41	66.68
41 - 45	82	4.50	66.68
46 - 50	79	.98	66.68

Reference is again made to Table XXI which discloses that 64.29 percent of the upper division sections taught had "15 or less" registrations. On the quality scale above, only 24.18 percent of the total student registrations were accommodated in sections with "15 or less" registrations. In approximate terms, then, almost two-thirds of the total number of sections taught had 15 or less registrations. These sections provided an educational experience for only one-fourth of the total

student registrations which had to be accommodated. This is another indication of unused capacity and the possibility of some "bottleneck" courses.

Laboratory sections, as a general rule, are intended to be of smaller size than are lecture sections. This pattern is manifested in the foregoing tables. For example, whereas only 57.89 percent of the lower division lecture sections have 20 or less registrations, 70.45 percent of the laboratory sections are of this size. At the upper division the fact that nearly as large a percentage (76.29 percent) of the lecture sections have 20 or less registrations than is the case with the laboratory sections (79.31 percent) is another indicator of unused capacity at the upper level.

Tables XXVI and XXVII give the number of student registrations which take place in sections with specific sizes.

Consider the lecture section aspect. At the lower division 57.89 percent of the sections taught are at the "20 or less" size, but these sections accommodate only 34.20 percent of the total lecture student registrations. At the upper division 76.29 percent of the sections are at the "20 or less" size, but these sections accommodate only 33.20 percent of total student registrations.

The picture in the laboratory sections is similar. At the lower division 70.45 percent of the laboratory sections taught are at the "20 or less" size. These sections accommodate 54.17 percent of total student registrations. At the upper division 79.31 percent of the

TABLE XXIV. DISTRIBUTION OF SECTIONS IN TERMS OF SIZE FROM BOTH SINGLE AND MULTIPLE COURSE DIVISIONS WITH LECTURE AND LABORATORY SECTIONS SEPARATED, BY LOWER AND UPPER DIVISION, COLLEGE OF AGRICULTURE, 1965-66.

Section Size	Lower Division Sections		Upper Division Sections	
	Lecture	Laboratory	Lecture	Laboratory
5 or less	4	7	38	1
6 - 10	7	14	15	15
11 - 15	12	24	10	2
16 - 20	10	17	11	5
21 - 25	6	16	8	2
26 - 30	9	8		
31 - 35	1	1	4	4
36 - 40	1	1	2	
41 - 45	2			
46 - 50				
51 - 60	1		4	
61 - 70			1	
71 - 80				
81 - 90			2	
101 - 110				
111 - 120	1			
121 - 130				
131 - 140	1			
141 - 150				
151 - 160			1	
161 - 170				
171 - 180				
181 - 190				
191 - 200	1			
Over 200				
Total Sections	57	88	97	29

To this point no distinction has been made between lecture and laboratory sections. Table XXVI gives the distribution of sections in terms of size for lectures and laboratories.

TABLE XXV. NUMBER OF STUDENT REGISTRATIONS ACCOMMODATED IN SECTIONS OF VARIOUS SIZES BY LOWER AND UPPER DIVISION BY LECTURE AND LABORATORY SECTIONS AS A CUMULATIVE PERCENT OF TOTAL STUDENT REGISTRATIONS, COLLEGE OF AGRICULTURE, 1965-66.

Section Size	Lower Division Sections				Upper Division Sections			
	Lecture	Cumulative Percent	Laboratory	Cumulative Percent	Lecture	Cumulative Percent	Laboratory	Cumulative Percent
5 or less	4	7.02	7	7.95	38	39.18	1	3.45
10 or less	11	19.30	21	23.86	53	54.64	16	55.17
15 or less	23	40.35	45	51.14	63	64.95	18	62.07
20 or less	33	57.89	62	70.45	74	76.29	23	79.31
25 or less	39	68.42	78	88.64	82	84.54	25	86.21
30 or less	48	84.21	86	97.73	82	84.54	25	86.21
35 or less	49	85.96	87	98.86	86	88.66	29	100.00
40 or less	50	87.72	88	100.00	88	90.72	29	100.00
45 or less	52	91.23	88	100.00	88	90.72	29	100.00
50 or less	52	91.23	88	100.00	89	91.75	29	100.00
60 or less	53	92.98	88	100.00	92	94.85	29	100.00
70 or less	53	92.98	88	100.00	93	95.88	29	100.00
80 or less	53	92.98	88	100.00	93	95.88	29	100.00
90 or less	53	92.98	88	100.00	95	97.94	29	100.00
100 or less	54	94.74	88	100.00	96	98.97	29	100.00
110 or less	54	94.74	88	100.00	96	98.97	29	100.00
120 or less	55	96.49	88	100.00	96	98.97		100.00
130 or less	55	96.49	88	100.00	96	98.97	29	100.00
140 or less	56	98.25	88	100.00	96	98.97	29	100.00
150 or less	56	98.25	88	100.00	96	98.97	29	100.00
160 or less	56	98.25	88	100.00	97	100.00	29	100.00
170 or less	56	98.25	88	100.00	97	100.00	29	100.00
180 or less	56	98.25	88	100.00	97	100.00	29	100.00
190 or less	56	98.25	88	100.00	97	100.00	29	100.00
200 or less	57	100.00	88	100.00	97	100.00	29	100.00

TABLE XXVI. NUMBER OF STUDENT REGISTRATIONS ACCOMMODATED IN SECTIONS OF VARIOUS SIZES BY LOWER AND UPPER DIVISION BY LECTURE AND LABORATORY SECTIONS SEPARATELY, COLLEGE OF AGRICULTURE, 1965-66.

Section Size	Lower Division Student Registrations		Upper Division Student Registrations	
	Lecture	Laboratory	Lecture	Laboratory
5 or less	17	23	70	3
6 - 10	60	116	133	120
11 - 15	157	311	121	22
16 - 20	181	310	180	112
21 - 25	87	373	167	47
26 - 30	242	201		
31 - 35	32	32	129	129
36 - 40	39	37	78	
41 - 45	87			
46 - 50				
51 - 60	52		175	
61 - 70			61	
71 - 80				
81 - 90			180	
91 - 100	97		95	
101 - 110				
111 - 120	113			
121 - 130				
131 - 140				
141 - 150	148			
151 - 160			149	
161 - 170				
171 - 180				
181 - 190				
191 - 200	194			
Over 200				

TABLE XXVII. NUMBER OF STUDENT REGISTRATIONS ACCOMMODATED IN SECTIONS OF VARIOUS SIZES BY LOWER AND UPPER DIVISION BY LECTURE AND LABORATORY SECTIONS AS A CUMULATIVE PERCENT OF TOTAL STUDENT REGISTRATIONS, COLLEGE OF AGRICULTURE, 1965-66.

Section Size	Lower Division Sections				Upper Division Sections			
	Lecture	Cumulative Percent	Laboratory	Cumulative Percent	Lecture	Cumulative Percent	Laboratory	Cumulative Percent
5 or less			23	1.64	70	4.52	3	6.93
10 or less	77	5.11	139	9.91	203	13.11	123	28.41
15 or less	234	15.54	450	32.07	324	20.93	145	33.49
20 or less	415	27.56	760	54.17	514	33.20	257	59.35
25 or less	502	33.33	1,130	80.54	681	43.99	304	70.21
30 or less	744	49.40	1,344	95.79	681	43.99	304	70.21
35 or less	776	51.53	1,366	97.36	810	52.33	433	100.00
40 or less	815	54.12	1,403	100.00	888	57.36	433	100.00
45 or less	902	59.89	1,403	100.00	888	57.36	433	100.00
50 or less	902	59.89	1,403	100.00	888	57.36	433	100.00
60 or less	954	63.35	1,403	100.00	1,063	68.67	433	100.00
70 or less	954	63.35	1,403	100.00	1,124	72.61	433	100.00
80 or less	954	63.35	1,403	100.00	1,124	72.61	433	100.00
90 or less	954	63.35	1,403	100.00	1,304	84.24	433	100.00
100 or less	1,051	69.79	1,403	100.00	1,399	90.37	433	100.00
110 or less	1,051	69.79	1,403	100.00	1,399	90.37	433	100.00
120 or less	1,064	70.65	1,403	100.00	1,399	90.37	433	100.00
130 or less	1,165	77.36	1,403	100.00	1,399	90.37	433	100.00
140 or less	1,164	77.36	1,403	100.00	1,399	90.37	433	100.00
150 or less	1,312	87.12	1,403	100.00	1,399	90.37	433	100.00
160 or less	1,312	87.12	1,403	100.00	1,548	100.00	433	100.00
170 or less	1,312	87.12	1,403	100.00	1,548	100.00	433	100.00
180 or less	1,312	87.12	1,403	100.00	1,548	100.00	433	100.00
190 or less	1,312	87.12	1,403	100.00	1,548	100.00	433	100.00
200 or less	1,506	100.00	1,403	100.00	1,548	100.00	433	100.00

laboratory sections taught are at the "20 or less" size. These sections accommodate 59.35 percent of total student registration.

Here again is evidence of unused capacity. The College of Agriculture does not "need" more teaching sections. It "needs" more students.

Another comparison can be made. Tables XXVIII and XXIX explain the numbers, size, and distribution of sections in terms of a single course division sections and multiple course division sections. In this case lecture and laboratory sections are combined.

During 1965-66 the College of Agriculture was in a position to provide quality instruction to those students pursuing its curricula. Average section size for the lower division (20.55 student registrations per section), for the upper division (16.77), and for lower and upper divisions combined (18.39) must be described as conducive to quality instruction.

Average section size for laboratory sections was smaller than section size for lecture sections, in accord with stated college objectives on this point. Average section size for both lecture and laboratory sections was smaller at the upper division than at the lower division.

	Average Sections Size	
	Lower Division	Upper Division
Lecture Sections	26.42	15.95
Laboratory Sections	15.94	14.93

The distribution of sections in terms of size also provided a prerequisite for quality education. Consider the percent of sections with "20 or less" student registrations.

TABLE XXVIII. DISTRIBUTION OF SECTIONS IN TERMS OF SIZE WITH SINGLE AND MULTIPLE SECTIONS SEPARATED, COLLEGE OF AGRICULTURE, 1965-66.

Section Size	Lower Division		Upper Division	
	Single Sections	Multiple Sections	Single Sections	Multiple Sections
5 or less	8	3	39	
6 - 10	12	9	20	6
11 - 15	11	25	10	6
16 - 20	4	23	14	2
21 - 25	4	16	7	2
26 - 30	8	10		
31 - 35	1	1	4	4
36 - 40	1	2	2	
41 - 45		2	1	
46 - 50			1	
51 - 60		1	3	
61 - 70			1	
71 - 80				
81 - 90			2	
91 - 100		1	1	
101 - 110				
111 - 120		1		
121 - 130				
131 - 140		1		
141 - 150				
151 - 160			1	
161 - 170				
171 - 180				
181 - 190				
191 - 200	1			
Over 200				
Total Sections	50	95	106	20

TABLE XXIX. DISTRIBUTION OF SECTIONS IN TERMS OF SIZE WITH SINGLE AND MULTIPLE SECTIONS SEPARATED AS CUMULATIVE PERCENT OF TOTAL SECTIONS, COLLEGE OF AGRICULTURE, 1965-66.

Section Size	Lower Division				Upper Division			
	Single Sections	Cumulative Percent	Multiple Sections	Cumulative Percent	Single Sections	Cumulative Percent	Multiple Sections	Cumulative Percent
5 or less	8	16.00	3	3.16	39	36.79		
10 or less	20	40.00	12	12.63	59	55.66	6	30.00
15 or less	31	62.00	37	38.95	69	65.09	12	60.00
20 or less	35	70.00	60	63.16	83	78.30	14	70.00
25 or less	39	78.00	76	80.00	90	84.91	16	80.00
30 or less	47	94.00	86	90.53	90	84.91	16	80.00
35 or less	48	96.00	87	91.58	94	88.68	20	100.00
40 or less	49	98.00	89	93.68	96	90.57	20	100.00
45 or less	49	98.00	91	95.79	97	91.51	20	100.00
50 or less	49	98.00	91	95.79	98	92.45	20	100.00
60 or less	49	98.00	92	96.84	101	95.28	20	100.00
70 or less	49	98.00	92	96.84	102	96.23	20	100.00
80 or less	49	98.00	92	96.84	102	96.23	20	100.00
90 or less	49	98.00	92	96.84	104	98.11	20	100.00
100 or less	49	98.00	93	97.89	105	99.06	20	100.00
110 or less	49	98.00	93	97.89	105	99.06	20	100.00
120 or less	49	98.00	94	98.95	105	99.06	20	100.00
130 or less	49	98.00	94	98.95	105	99.06	20	100.00
140 or less	49	98.00	95	100.00	105	99.06	20	100.00
150 or less	49	98.00	95	100.00	105	99.06	20	100.00
160 or less	49	98.00	95	100.00	106	100.00	20	100.00
170 or less	49	98.00	95	100.00	106	100.00	20	100.00
180 or less	49	98.00	95	100.00	106	100.00	20	100.00
190 or less	49	98.00	95	100.00	106	100.00	20	100.00
200 or less	50	100.00	95	100.00	106	100.00	20	100.00

TABLE XXX. NUMBERS OF STUDENT REGISTRATIONS ACCOMMODATED IN SECTIONS OF VARIOUS SIZES BY LOWER AND UPPER DIVISION, BY SINGLE AND MULTIPLE SECTIONS SEPARATELY, COLLEGE OF AGRICULTURE, 1965-66.

Section Size	Lower Division		Upper Division	
	Single Sections	Multiple Sections	Single Sections	Multiple Sections
5 or less	31	9	73	
6 - 10	104	72	171	51
11 - 15	147	321	124	66
16 - 20	74	417	235	51
21 - 25	93	367	164	50
26 - 30	184	269		
31 - 35	32	32	126	79
36 - 40	37	78	78	
41 - 45		87	43	
46 - 50			48	
51 - 60		52	172	
61 - 70			62	
71 - 80				
81 - 90			170	
91 - 100		97	95	
101 - 110				
111 - 120		113		
121 - 130				
131 - 140		99		
141 - 150				
151 - 160			123	
161 - 170				
171 - 180				
181 - 190				
191 - 200	194			
Over 200				

Student registrations accommodated in the single and multiple sections are described in Tables XXXII and XXXIII.

TABLE XXXI. NUMBERS OF STUDENT REGISTRATIONS ACCOMMODATED IN SECTIONS OF VARIOUS SIZES BY LOWER AND UPPER DIVISION, BY SINGLE AND MULTIPLE SECTIONS SEPARATELY, AS CUMULATIVE PER CENT OF TOTAL SECTIONS, COLLEGE OF AGRICULTURE, 1965-66.

Section Size	Lower Division				Upper Division			
	Single Sections	Cumulative Percent	Multiple Sections	Cumulative Percent	Single Sections	Cumulative Percent	Multiple Sections	Cumulative Percent
5 or less	31	34.60	9	44.71	73	43.35		
10 or less	135	15.07	81	40.24	244	14.49	51	17.17
15 or less	282	31.47	402	19.97	368	21.85	117	39.39
20 or less	356	39.73	819	40.69	603	35.81	168	56.57
25 or less	449	50.11	1,186	58.92	767	45.55	218	73.40
30 or less	633	70.65	1,455	72.28	767	45.55	218	73.40
35 or less	665	74.22	1,487	73.87	893	53.03	297	100.00
40 or less	702	78.35	1,565	77.74	971	57.66	297	100.00
45 or less	702	78.35	1,652	82.07	1,014	60.21	297	100.00
50 or less	702	78.35	1,652	82.07	1,062	63.04	297	100.00
60 or less	702	78.35	1,704	84.65	1,234	73.28	297	100.00
70 or less	702	78.35	1,704	84.65	1,296	76.96	297	100.00
80 or less	702	78.35	1,704	84.65	1,296	76.96	297	100.00
90 or less	702	78.35	1,704	84.65	1,466	87.05	297	100.00
100 or less	702	78.35	1,801	89.47	1,561	92.70	297	100.00
110 or less	702	78.35	1,914	95.08	1,561	92.70	297	100.00
120 or less	702	78.35	2,013	100.00	1,561	92.70	297	100.00
130 or less	702	78.35	2,013	100.00	1,561	92.70	297	100.00
140 or less	702	78.35	2,013	100.00	1,561	92.70	297	100.00
150 or less	702	78.35	2,013	100.00	1,561	92.70	297	100.00
160 or less	702	78.35	2,013	100.00	1,684	100.00	297	100.00
170 or less	702	78.35	2,013	100.00	1,684	100.00	297	100.00
180 or less	702	78.35	2,013	100.00	1,684	100.00	297	100.00
190 or less	702	78.35	2,013	100.00	1,684	100.00	297	100.00
200 or less	896	100.00	2,013	100.00	1,684	100.00	297	100.00

TABLE XXXII. SUMMARY OF SECTIONS OFFERED, STUDENT REGISTRATIONS ACCOMMODATED, AND AVERAGE SIZE OF SECTIONS, COLLEGE OF AGRICULTURE, 1965-66.

	All Sections Combined	Lower	Upper	Lecture	Laboratory	Single	Multiple
All Sections Combined							
Sections offered	271	145	126	154	117	156	115
Student registrations accommodated	4,890	2,909	1,981	3,054	1,836	2,580	2,310
Average size of section	18.39	20.55	16.07			16.63	20.89
Lower Division Sections							
Sections offered		145		57	88	50	95
Student registrations accommodated		2,909		1,506	1,403	896	2,013
Average size of section		20.55				18.24	21.74
Upper Division Sections							
Sections offered			126	97	29	106	20
Student registrations accommodated			1,981	1,548	433	1,684	297
Average size of section			16.07			15.93	16.90

TABLE XXXIII. SUMMARY OF NUMBERS AND PERCENT OF SECTIONS WITH "20 OR LESS" REGISTRATIONS, COLLEGE OF AGRICULTURE, 1965-66.

	All Sections Combined	Lower	Upper	Lecture	Lab	Single	Multiple
All Sections Combined							
Number with 20 or less	192	95	97	107	85	118	74
Percent with 20 or less	70.85	65.51	76.98	69.48	72.65	75.64	65.30
Lower Division							
Number with 20 or less		95		33	62	35	60
Percent with 20 or less		65.51		57.89	70.45	70.00	63.16
Upper Division							
Number with 20 or less			97	74	23	83	14
Percent with 20 or less			76.98	76.29	79.31	78.30	70.00

TABLE XXXIV. SUMMARY OF NUMBERS AND PERCENT OF TOTAL STUDENT REGISTRATIONS ACCOMMODATED IN SECTIONS WITH "20 OR LESS" REGISTRATIONS, COLLEGE OF AGRICULTURE, 1965-66.

	All Sections Combined	Lower	Upper	Lecture	Lab	Single	Multiple
All Sections Combined							
Number with 20 or less	1,946	1,175	771	929	1,017	959	987
Percent with 20 or less	39.80	40.39	40.39	30.42	51.44	37.17	42.73
Lower Division							
Number with 20 or less		1,175		415	760	356	819
Percent with 20 or less		40.39		34.20	54.17	39.73	40.69
Upper Division							
Number with 20 or less			771	514	257	603	168
Percent with 20 or less			38.92	33.20	59.35	35.80	56.57

	All Sections	Lecture Sections	Laboratory Sections
	Percent	Percent	Percent
Lower Division	65.51	57.89	70.45
Upper Division	76.98	76.29	79.31
All Sections	70.85	69.48	72.65

It can be concluded that there was unused capacity in terms of student registrations in The College of Agriculture, particularly in the upper division. The average section sizes stated in an earlier paragraph do not reveal this directly. The number of sections and percent of total sections for a specific section size limit are a better indication; 70.85 percent of the total sections taught had 20 or less student registrations.

Another indication of unused capacity is the number and percent of total student registrations accommodated in sections with 20 or less registrations. At the lower division, only 39.80 percent of the total student registrations were accommodated in these small classes, whereas 70.85 percent of the sections being taught were of the "20 or less" size.

Another indication of unused capacity is the large number of single sections and multiple sections with registration sizes of "20 or less".

	Lower Division		Upper Division	
	Single Sections	Multiple Sections	Single Sections	Multiple Sections
Numbers of Sections				
Sections with 20 or less	35	60	83	14
Total Sections	50	95	106	20
Percent of Total Sections				
Sections with 20 or less	70.00%	63.16%	78.30%	70.00%

Once the decision to offer the section is made, the total cost of the section is not affected by an increase in registration within some range of registrations. For a large percent of the total sections taught in this college, approximately 70 percent, the average cost per unit (per registration) would have decreased with additional registrations and the total cost of the individual section would not have increased (assuming variable costs at zero) with additional student registrations. More will be said later with respect to the implications for planning.

CHAPTER VII

AN EXAMINATION OF THE NUMBER, SIZE, AND DISTRIBUTION OF SECTIONS BY SIZE

COLLEGE OF ENGINEERING

The College of Engineering in 1965-66 offered 208 different courses with 283 course divisions to accomplish its programs. This college consists of the departments of agricultural, civil, electrical, and mechanical engineering, and the department of atmospheric science.

The engineering courses of study have a common freshman year and differ only slightly in the sophomore year. Basic subjects such as English, physics, chemistry, mathematics, humanities, engineering sciences, and graphics form an important part of the first two years. Each engineering student takes a course in orientation. The orientation subject is intended to acquaint students with the academic and professional requirements of the branches of the engineering profession. During their junior and senior years students are directed toward their respective branches.

Elective courses must be in a technical field and have the prior approval of the student's adviser or department head.

All departments within the College of Engineering offer the master's degree. In addition, the civil engineering department offers the doctor of philosophy degree.

The branches of engineering offered here are among about six that might be called fundamental or basic in the profession. Most other majors or options offered are combinations and subdivisions of the most fundamental branches. A student majoring in a fundamental branch at

an accredited institution is usually prepared to enter the profession and specialize in work of some subdivision (option) or combination. Examples might be hydraulic engineering, electronic engineering, irrigation engineering, and automotive engineering.

The direct cost of instruction for this college was $634,100. This number of courses, 208, would have been offered whether the number of majors (total 1,090, including 225 graduate majors) had been substantially higher or lower than the actual number enrolled. The decision to offer the program had been made, the number of students notwithstanding. Since, in fact, many multiple sections were taught in the College of Engineering, the basic cost of the teaching program was less than $634,100. The number of secttions which it was mandatory to teach was 283. Each case in which the number of student registrations forced the offering of more than one section of a course produced an increment of cost with the final result that the total number of sections taught required $634,100.

Average section size in the lower and upper level course divisions in the College of Engineering are given in Table XXXV.

The multiple section course divisions at the lower division averaged 34.41 registrations per section. The lower division sections averaged 70.00 registrations. Since there were only two lower division sections, it is difficult to make any meaningful comparison between these two averages.

TABLE XXXV. AVERAGE SECTION SIZE, COLLEGE OF ENGINEERING, 1965-66.

Division	Single Section Course Divisions	Multiple Section Course Divisions	All Courses
Lower Division	70.00	34.41	35.21
Upper Division	16.67	15.53	15.91
Total Upper and Lower Division	17.72	21.89	20.83

At the upper division there is relatively little difference in the average size of sections, 16.67 registrations for the single section courses and 15.53 for the multiple section courses.

An examination of the number of sections reveals that at the upper division 33.34 percent of the sections are single sections and 66.66 percent are multiple sections.

Reference to Tables XXIV and XXV reveals that there were 342 upper division majors and 523 lower division majors for a total of 865.

TABLE XXXVI. NUMBER OF SECTIONS AND PERCENT OF TOTAL, COLLEGE OF ENGINEERING, 1965-66.

	Single Section		Multiple Section		All Sections	
Division	Number of Sections	Percent of Total	Number of Sections	Percent of Total	Number of Sections	Percent of Total
Lower Division	2	1.87	105	98.13	107	100.00
Upper Division	99	33.34	198	66.66	297	100.00
Total Upper and Lower Division	101	25.00	303	75.00	404	100.00

Attention is directed to the 33.34 percent (99) of the total sections (297) at the upper division taught as single sections. Comparisons with the College of Agriculture will be made in detail later, but at this point it should be noted that whereas the College of Agriculture taught 84.13 percent of total sections in single sections in the upper division, the College of Engineering taught only 33.34 percent of its sections in this manner.

Average section size in the single section course divisions at the upper divisions, 16.67 student registrations per section, cannot be compared to the lower division average because only two sections were taught and these averaged 70.00 student registrations. For the multiple sections, the lower division class size is over twice the average for the upper division, specifically 34.41 compared with 15.53.

Table XXXVII presents the distribution of sections in terms of their size, followed by Table XXXVIII which gives the distribution of sections in terms of size from both single and multiple course divisions with lecture and laboratory course divisions combined, by lower and upper division. Later tables will examine lecture and laboratory sections separately.

At the lower division there were no sections with five or less student registrations, whereas at the upper division 10.77 percent of total sections had five or less. Taking lower and upper together, only 32 sections from a total of 404, or 7.92 percent had five or less student registrations. Recall that in the College of Agriculture 19.93 percent of all sections had five or less student registrations.

TABLE XXXVII. DISTRIBUTION OF SECTIONS IN TERMS OF SIZE FROM BOTH SINGLE AND MULTIPLE COURSE DIVISIONS WITH LECTURE AND LABORATORY COURSE DIVISIONS COMBINED, BY LOWER AND UPPER DIVISION, COLLEGE OF ENGINEERING, 1965-66.

Size of Section	Lower Division Sections	Upper Division Sections
5 or less	0	32
6 - 10	8	68
11 - 15	21	73
16 - 20	6	46
21 - 25	23	34
26 - 30	18	16
31 - 35	13	15
36 - 40	9	6
41 - 45	1	5
46 - 50	0	1
51 - 60	2	
61 - 70		1
71 - 80	1	
81 - 90	1	
91 - 100		
101 - 110		
111 - 120		
121 - 130		
131 - 140		
141 - 150		
151 - 160	1	
161 - 170		
171 - 180		
181 - 190		
191 - 200	1	
Over 200	2*	

*Specifically 300 student registrations in one section of ME1 (Engineering Graphics) and 230 student registrations in ME2 (Engineering Graphics).

TABLE XXXVIII. DISTRIBUTION OF SECTIONS IN TERMS OF SIZE FROM BOTH SINGLE AND MULTIPLE COURSE DIVISIONS WITH LECTURE AND LABORATORY COURSE DIVISIONS COMBINED, BY LOWER AND UPPER DIVISION AS CUMULATIVE PERCENTAGE OF TOTAL SECTIONS, COLLEGE OF ENGINEERING, 1965-66.

Size of Section	Lower Division Sections	Cumulative Percent of Total Sections	Upper Division Sections	Cumulative Percent of Total Sections
5 or less	0		32	10.77
10 or less	8	7.48	100	33.67
15 or less	29	27.10	173	58.25
20 or less	35	32.71	219	73.74
25 or less	58	54.21	253	85.19
30 or less	76	71.03	269	90.57
35 or less	89	83.18	284	95.62
40 or less	98	91.59	290	97.64
45 or less	99	92.52	295	99.33
50 or less	99	92.52	296	99.66
60 or less	101	94.39	296	99.66
70 or less	101	94.39	297	100.00
80 or less	102	95.33	297	100.00
90 or less	103	96.26	297	100.00
100 or less	103	96.26	297	100.00
110 or less	103	96.26	297	100.00
120 or less	103	96.26	297	100.00
130 or less	103	96.26	297	100.00
140 or less	103	96.26	297	100.00
150 or less	103	96.26	297	100.00
160 or less	104	97.20	297	100.00
170 or less	104	97.20	297	100.00
180 or less	104	97.20	297	100.00
190 or less	105	98.13	297	100.00
200 or less	105	98.13	297	100.00
250 or less	106	99.07	297	100.00
300 or less	107	100.00	297	100.00

Consider the "20 or less" size of section. At the lower division 32.71 percent of total sections had 20 or less registrations, whereas at the upper division, 74.41 percent of the sections had 20 or less.

When the numbers of student registrations which take place in sections with specific sizes are examined, another picture emerges. Tables XXXIX and XL outline the details for the College of Engineering.

Table XL reveals that at the lower division 32.71 percent of total sections had 20 or less student registrations; at the upper division 73.74 percent of total sections had 20 or less student registrations. If the availability of small classes is a prerequisite to quality instruction, this prerequisite appears to have been satisfied at the upper division. Fully one-third (specifically 33.67 percent) of the sections at the upper division had 10 or less student registrations. This may be an indication of unused capacity. Additional evidence is necessary.

The number of student registrations accommodated in sections of various sizes described in Tables XXXIX and XL gives another view. Whereas at the lower division 32.71 percent of total sections had 20 or less registrations, only 12.96 percent of total registrations were accommodated in sections with 20 or less registrations.

If it were assumed that size of section was the only determinant of quality, a quality scale can be devised for the lower division giving a grade of 100 to that instruction which is carried out in sections with 20 or less registrations. A similar scale for the upper division, again awarding 100 to that instruction, in terms of student registrations, which is carried out in sections with 20 or less registrations is also given.

TABLE XXXIX. NUMBER OF STUDENT REGISTRATIONS ACCOMMODATED IN SECTIONS OF VARIOUS SIZES BY LOWER AND UPPER DIVISION: COLLEGE OF ENGINEERING, 1965-66.

Section Size	Lower Division Student Registrations	Upper Division Student Registrations
5 or less	0	104
6 - 10	66	565
11 - 15	273	950
16 - 20	110	823
21 - 25	551	753
26 - 30	512	453
31 - 35	430	497
36 - 40	335	221
41 - 45	42	211
46 - 50		46
51 - 60	115	
61 - 70		68
71 - 80	80	
81 - 90	84	
91 - 100		
101 - 110		
111 - 120		
121 - 130		
131 - 140		
141 - 150		
151 - 160	155	
161 - 170		
171 - 180		
181 - 190	182	
191 - 200		
Over 200	530*	

*Specifically 300 student registrations in one section of ME1 (Engineering Graphics) and 230 student registrations in ME2 (Engineering Graphics).

TABLE XL. NUMBER OF STUDENT REGISTRATIONS ACCOMMODATED IN SECTIONS OF VARIOUS SIZES BY LOWER AND UPPER DIVISION AS CUMULATIVE PERCENTAGE OF TOTAL STUDENT REGISTRATIONS, COLLEGE OF ENGINEERING, 1965-66.

Section Size	Lower Division Student Registrations	Cumulative Percent of Total Student Registrations	Upper Division Student Registrations	Cumulative Percent of Total Student Registrations
5 or less	0		104	2.22
10 or less	66	1.91	669	14.26
15 or less	339	9.78	1,619	34.51
20 or less	449	12.96	2,442	52.06
25 or less	1,000	28.86	3,195	68.11
30 or less	1,512	43.64	3,648	77.77
35 or less	1,942	56.05	4,145	88.36
40 or less	2,277	65.71	4,366	93.07
45 or less	2,319	66.93	4,577	97.57
50 or less	2,319	66.93	4,623	98.55
60 or less	2,434	70.25	4,623	98.55
70 or less	2,434	70.25	4,691	100.00
80 or less	2,514	72.55	4,691	100.00
90 or less	2,598	74.98	4,691	100.00
100 or less	2,598	74.98	4,691	100.00
110 or less	2,598	74.98	4,691	100.00
120 or less	2,598	74.98	4,691	100.00
130 or less	2,598	74.98	4,691	100.00
140 or less	2,598	74.98	4,691	100.00
150 or less	2,598	74.98	4,691	100.00
160 or less	2,753	79.45	4,691	100.00
170 or less	2,753	79.45	4,691	100.00
180 or less	2,753	79.45	4,691	100.00
190 or less	2,935	84.70	4,691	100.00
200 or less	3,465	100.00	4,691	100.00

Lower Division

Section Size	Quality Scale	Percent of Student Registrations Accommodated	Cumulative Percent of Student Registrations Accommodated
5 or less	100		
6 - 10	100	1.88	1.91
11 - 15	100	9.31	9.78
16 - 20	100	3.13	12.96
21 - 25	97	15.65	28.86
26 - 30	94	14.55	43.64
31 - 35	91	12.21	56.05
36 - 40	88	9.52	65.71
41 - 45	85	1.19	66.93
46 - 50	82		66.93

Upper Division

Section Size	Quality Scale	Percent of Student Registrations Accommodated	Cumulative Percent of Student Registrations Accommodated
5 or less	100	2.22	2.22
6 - 10	100	12.04	14.26
11 - 15	100	22.47	34.51
16 - 20	100	17.51	52.06
21 - 25	97	16.05	68.11
26 - 30	94	9.66	77.77
31 - 35	91	8.89	86.66
36 - 40	88	6.41	93.07
41 - 45	85	4.50	97.57
46 - 50	82	.98	98.55

The pattern found in the College of Agriculture again appears; 73.74 percent of total sections are offered in sizes of 20 or less student registrations, but only 52.06 percent of the student registrations are accommodated in these sections.

A similar, but tighter, quality scale for the upper division is given below. At the lower division quality was rated at 100 if the section had 20 or less student registrations. At the upper division only those sections with 15 or less registrations are rated at 100.

Upper Division

Section Size	Quality Scale	Percent of Student Registrations Accommodated	Cumulative Percent of Student Registrations Accommodated
5 or less	100	2.22	2.22
6 - 10	100	12.04	14.26
11 - 15	100	22.47	34.51
16 - 20	97	17.51	52.06
21 - 25	94	16.05	68.11
26 - 30	81	9.66	77.77
31 - 35	88	8.89	86.66
36 - 40	85	6.41	93.07
41 - 45	82	4.50	97.57
46 - 50	79	.98	98.55

Reference is again made to Table XXXVIII which disclosed that 58.25 percent of the upper division sections taught had 15 or less registrations. On the quality scale used above, only 34.51 percent of the total student registrations were accommodated in sections with 15 or less registrations.

To this point no distinction has been made between lecture and laboratory sections. Table XLI gives the distribution of sections in terms of size for lectures and laboratories.

The effort to maintain laboratory sections at a smaller size than is the case for lecture sections is manifested in Tables XLI and XLII. For example, whereas 28.26 percent of the lower division lecture sections have 20 or less registrations, 36.07 percent of the laboratory sections are of this size. At the upper division, the fact that nearly as large a percentage (67.27 percent) of the lecture sections had 20 or less registrations than is the case with the laboratory sections (81.82 percent) may be an indication of excess capacity at the upper level.

Tables XLIII and XLIV give the number of student registrations which took place in sections with specific sizes.

Consider the lecture section. At the lower division 28.26 percent of the sections taught are at the "20 or less" size, but these sections accommodate 43.09 percent of the total student registrations.

The picture for the laboratory sections is different. At the lower division, 36.07 percent of the laboratory sections are "20 or less" in size, but 43.09 percent of the registrations are accommodated in this manner. At the upper division, 81.82 percent of the laboratory sections are of the "20 or less" size and these accommodate 65.96 percent of total registrations. Here again is evidence of some unused capacity.

Another comparison can be made. Tables XLV and XLVI explore the numbers, size, and distribution of sections in terms of single course

TABLE XLI. DISTRIBUTION OF SECTIONS IN TERMS OF SIZE FROM BOTH SINGLE AND MULTIPLE COURSE DIVISIONS WITH LECTURE AND LABORATORY SECTIONS SEPARATED BY LOWER AND UPPER DIVISION, COLLEGE OF ENGINEERING, 1965-66.

Section Size	Lower Division Sections		Upper Division Sections	
	Lecture	Laboratory	Lecture	Laboratory
5 or less			21	11
6 - 10	1	7	27	41
11 - 15	10	11	38	35
16 - 20	2	4	25	21
21 - 25	10	13	20	14
26 - 30	6	12	12	4
31 - 35	2	11	11	4
36 - 40	6	3	5	1
41 - 45	1		4	1
46 - 50			1	
51 - 60	2		1	
61 - 70				
71 - 80	1			
81 - 90	1			
91 - 100				
101 - 110				
111 - 120				
121 - 130				
131 - 140				
141 - 150				
151 - 160	1			
161 - 170				
171 - 180				
181 - 190				
191 - 200	1			
Over 200	2			

TABLE XLII. DISTRIBUTION OF SECTIONS IN TERMS OF SIZE FROM BOTH SINGLE AND MULTIPLE COURSE DIVISIONS WITH LECTURE AND LABORATORY SECTIONS SEPARATED, BY LOWER AND UPPER DIVISION, AS CUMULATIVE PERCENTAGE OF TOTAL SECTIONS, COLLEGE OF ENGINEERING, 1965-66.

Section Size	Lower Division Sections				Upper Division Sections			
	Lecture	Cumulative Percent	Laboratory	Cumulative Percent	Lecture	Cumulative Percent	Laboratory	Cumulative Percent
5 or less					21	12.73	11	8.33
10 or less	1	2.17	7	1.15	48	29.09	52	39.39
15 or less	11	23.91	18	29.51	86	52.12	87	65.91
20 or less	13	28.26	22	36.07	111	67.27	108	81.82
25 or less	23	50.00	35	57.38	131	79.39	122	92.42
30 or less	29	63.04	47	77.05	143	86.67	126	95.45
35 or less	31	67.39	58	95.08	154	93.33	130	98.48
40 or less	37	80.43	61	100.00	159	96.36	131	99.24
45 or less	38	82.61	61	100.00	163	98.79	132	100.00
50 or less	38	82.61	61	100.00	164	99.39	132	100.00
60 or less	40	86.96	61	100.00	165	100.00	132	100.00
70 or less	40	86.96	61	100.00	165	100.00	132	100.00
80 or less	41	89.13	61	100.00	165	100.00	132	100.00
90 or less	42	91.30	61	100.00	165	100.00	132	100.00
100 or less	42	91.30	61	100.00	165	100.00	132	100.00
110 or less	42	91.30	61	100.00	165	100.00	132	100.00
120 or less	42	91.30	61	100.00	165	100.00	132	100.00
130 or less	42	91.30	61	100.00	165	100.00	132	100.00
140 or less	42	91.30	61	100.00	165	100.00	132	100.00
150 or less	42	91.30	61	100.00	165	100.00	132	100.00
160 or less	43	93.48	61	100.00	165	100.00	132	100.00
170 or less	43	93.48	61	100.00	165	100.00	132	100.00
180 or less	43	93.48	61	100.00	165	100.00	132	100.00
190 or less	43	93.48	61	100.00	165	100.00	132	100.00
200 or less	44	95.65	61	100.00	165	100.00	132	100.00
300 or less	46	100.00	61	100.00	165	100.00	132	100.00

TABLE XLIII. NUMBER OF STUDENT REGISTRATIONS ACCOMMODATED IN SECTIONS OF VARIOUS SIZES BY LOWER AND UPPER DIVISION BY LECTURE AND LABORATORY SECTIONS SEPARATED, COLLEGE OF ENGINEERING, 1965-66.

Section Size	Lower Division Student Registrations		Upper Division Student Registrations	
	Lecture	Laboratory	Lecture	Laboratory
5 or less			57	47
6 - 10	9	57	227	338
11 - 15	128	145	499	451
16 - 20	34	76	446	377
21 - 25	239	312	456	297
26 - 30	170	342	337	116
31 - 35	65	365	361	136
36 - 40	225	110	185	36
41 - 45	42		170	41
46 - 50			46	
51 - 60	115			
61 - 70			68	
71 - 80	80			
81 - 90	84			
91 - 100				
101 - 110				
111 - 120				
121 - 130				
131 - 140				
141 - 150				
151 - 160	155			
161 - 170				
171 - 180				
181 - 190	182			
191 - 200				
Over 200	530			

TABLE XLIV. NUMBER OF STUDENT REGISTRATIONS ACCOMMODATED IN SECTIONS OF VARIOUS SIZES BY LOWER AND UPPER DIVISION BY LECTURE AND LABORATORY SECTIONS AS A CUMULATIVE PERCENTAGE OF TOTAL STUDENT REGISTRATIONS, COLLEGE OF ENGINEERING, 1965-66.

Section Size	Lower Division Sections				Upper Division Sections			
	Cumulative Lecture	Cumulative Percent	Laboratory	Cumulative Percent	Cumulative Lecture	Cumulative Percent	Laboratory	Cumulative Percent
5 or less					57	2.00	47	2.56
10 or less	9	4.37	57	4.05	284	9.96	385	20.94
15 or less	137	6.66	202	14.36	783	27.45	836	45.46
20 or less	171	8.31	278	19.76	1,229	43.09	1,213	65.96
25 or less	410	19.92	590	41.93	1,685	59.08	1,510	82.11
30 or less	580	28.18	932	66.24	2,022	70.90	1,626	88.42
35 or less	645	31.34	1,297	92.18	2,383	83.56	1,762	95.81
40 or less	870	42.27	1,407	100.00	2,568	90.04	1,798	97.77
45 or less	912	44.31	1,407	100.00	2,738	96.00	1,839	100.00
50 or less	912	44.31	1,407	100.00	2,784	97.62	1,839	100.00
60 or less	1,027	49.90	1,407	100.00	2,784	97.62	1,839	100.00
70 or less	1,027	49.90	1,407	100.00	2,852	100.00	1,839	100.00
80 or less	1,107	53.79	1,407	100.00	2,852	100.00	1,839	100.00
90 or less	1,191	57.87	1,407	100.00	2,852	100.00	1,839	100.00
100 or less	1,191	57.87	1,407	100.00	2,852	100.00	1,839	100.00
110 or less	1,191	57.87	1,407	100.00	2,852	100.00	1,839	100.00
120 or less	1,191	57.87	1,407	100.00	2,852	100.00	1,839	100.00
130 or less	1,191	57.87	1,407	100.00	2,852	100.00	1,839	100.00
140 or less	1,191	57.87	1,407	100.00	2,852	100.00	1,839	100.00
150 or less	1,191	57.87	1,407	100.00	2,852	100.00	1,839	100.00
160 or less	1,346	65.40	1,407	100.00	2,852	100.00	1,839	100.00
170 or less	1,346	65.40	1,407	100.00	2,852	100.00	1,839	100.00
180 or less	1,346	65.40	1,407	100.00	2,852	100.00	1,839	100.00
190 or less	1,528	74.25	1,407	100.00	2,852	100.00	1,839	100.00
200 or less	1,528	74.25	1,407	100.00	2,852	100.00	1,839	100.00
300 or less	2,058	100.00	1,407	100.00	2,852	100.00	1,839	100.00

TABLE XLV. DISTRIBUTION OF SECTIONS IN TERMS OF SIZE WITH SINGLE AND MULTIPLE SECTIONS SEPARATED, COLLEGE OF ENGINEERING, 1965-66.

Section Size	Lower Division		Upper Division	
	Single Sections	Multiple Sections	Single Sections	Multiple Sections
5 or less			12	20
6 - 10		8	20	48
11 - 15		21	20	53
16 - 20		6	12	34
21 - 25		23	10	24
26 - 30		18	7	9
31 - 35		13	11	4
36 - 40		9	3	3
41 - 45		1	3	2
46 - 50			1	
51 - 60	1	1		
61 - 70				1
71 - 80	1			
81 - 90		1		
91 - 100				
101 - 110				
111 - 120				
121 - 130				
131 - 140				
141 - 150				
151 - 160		1		
161 - 170				
171 - 180				
181 - 190		1		
191 - 200				
Over 200		2		

TABLE XLVI. DISTRIBUTION OF SECTIONS IN TERMS OF SIZE WITH SINGLE AND MULTIPLE SECTIONS SEPARATED AS A CUMULATIVE PERCENTAGE OF TOTAL SECTIONS, COLLEGE OF ENGINEERING, 1965-66.

Section Size	Lower Division				Upper Division			
	Single Sections	Cumulative Percent	Multiple Sections	Cumulative Percent	Single Sections	Cumulative Percent	Multiple Sections	Cumulative Percent
5 or less					12	12.12	20	10.10
10 or less			8	7.62	32	32.32	68	34.34
15 or less			29	27.62	52	52.52	121	61.11
20 or less			35	33.33	64	64.65	155	78.28
25 or less			58	55.24	74	74.75	179	90.40
30 or less			76	72.38	81	81.82	188	94.95
35 or less			89	84.76	92	92.93	192	96.97
40 or less			98	93.33	95	95.96	195	98.48
45 or less			99	94.29	98	98.99	197	99.50
50 or less			99	94.29	99	100.00	197	99.50
60 or less	1	50.00	100	95.24	99	100.00	197	99.50
70 or less	1	50.00	100	95.24	99	100.00	198	100.00
80 or less	2	100.00	100	95.24	99	100.00	198	100.00
90 or less	2	100.00	101	96.19	99	100.00	198	100.00
100 or less	2	100.00	101	96.19	99	100.00	198	100.00
110 or less	2	100.00	101	96.19	99	100.00	198	100.00
120 or less	2	100.00	101	96.19	99	100.00	198	100.00
130 or less	2	100.00	101	96.19	99	100.00	198	100.00
140 or less	2	100.00	101	96.19	99	100.00	198	100.00
150 or less	2	100.00	101	96.19	99	100.00	198	100.00
160 or less	2	100.00	102	97.14	99	100.00	198	100.00
170 or less	2	100.00	102	97.14	99	100.00	198	100.00
180 or less	2	100.00	102	97.14	99	100.00	198	100.00
190 or less	2	100.00	102	97.14	99	100.00	198	100.00
200 or less	2	100.00	103	98.10	99	100.00	198	100.00
300 or less	2	100.00	105	100.00	99	100.00	198	100.00

division sections and multiple course division sections. A single section is one which by itself constitutes a course division offering. If more than one section is taught to accomplish the course division, each of the sections is labeled a multiple section.

Student registrations accommodated in the single and multiple sections are described in Tables XLVII and XLVIII.

Summary

During the year 1965-66, the College of Engineering was in a position to provide quality instruction. Average section size for the lower division (35.21 student registrations per section), for the upper division (15.91), and for lower and upper divisions combined (20.83) must be described as conducive to quality instruction.

Average section size for laboratory sections was smaller than section size for lecture sections, in accord with stated college objectives on this point. Average section size for both lecture and laboratory sections was smaller at the upper division than at the lower division.

	Average Section Size	
	Lower Division	Upper Division
Lecture Sections	26.42	15.95
Laboratory Sections	15.94	14.93

The distribution of sections in terms of size also provided a prerequisite for quality instruction. Consider the percent of sections with "20 or less" student registrations.

TABLE XLVII. NUMBER OF STUDENT REGISTRATIONS ACCOMMODATED IN SECTIONS OF VARIOUS SIZES BY LOWER AND UPPER DIVISION BY SINGLE AND MULTIPLE SECTIONS SEPARATELY, COLLEGE OF ENGINEERING, 1965-66.

Section Size	Lower Division		Upper Division	
	Single Sections	Multiple Sections	Single Sections	Multiple Sections
5 or less			46	58
6 - 10		66	164	401
11 - 15		273	249	701
16 - 20		110	220	603
21 - 25		551	163	590
26 - 30		512	203	250
31 - 35		430	403	94
36 - 40		335	113	108
41 - 45		42	129	82
46 - 50			46	
51 - 60	60	55		
61 - 70				68
71 - 80	80			
81 - 90		84		
91 - 100				
101 - 110				
111 - 120				
121 - 130				
131 - 140				
141 - 150				
151 - 160		155		
161 - 170				
171 - 180				
181 - 190		182		
191 - 200				
Over 200		530		

TABLE XLVIII. NUMBER OF STUDENT REGISTRATIONS ACCOMMODATED IN SECTIONS OF VARIOUS SIZES BY LOWER AND UPPER DIVISION BY SINGLE AND MULTIPLE SECTIONS SEPARATELY AS CUMULATIVE PERCENT OF TOTAL SECTIONS, COLLEGE OF ENGINEERING, 1965-66.

Section Size	Lower Division				Upper Division			
	Single Sections	Cumulative Percent	Multiple Sections	Cumulative Percent	Single Sections	Cumulative Percent	Multiple Sections	Cumulative Percent
5 or less					46	2.65	58	1.96
10 or less			66	1.98	210	12.10	459	15.53
15 or less			339	10.20	459	26.44	1,160	39.26
20 or less			449	13.50	679	39.11	1,763	59.66
25 or less			1,000	30.08	842	48.50	2,353	79.63
30 or less			1,512	45.47	1,045	60.20	2,603	88.09
35 or less			1,942	58.41	1,448	83.41	2,697	91.27
40 or less			2,277	68.48	1,561	89.92	2,805	94.92
45 or less			2,319	69.74	1,690	97.35	2,887	97.70
50 or less			2,319	69.74	1,736	100.00	2,887	97.70
60 or less	60	42.86	2,374	71.40	1,736	100.00	2,887	97.70
70 or less	60	42.86	2,374	71.40	1,736	100.00	2,955	100.00
80 or less	140	100.00	2,374	71.40	1,736	100.00	2,955	100.00
90 or less	140	100.00	2,458	73.92	1,736	100.00	2,955	100.00
100 or less	140	100.00	2,458	73.92	1,736	100.00	2,955	100.00
110 or less	140	100.00	2,458	73.92	1,736	100.00	2,955	100.00
120 or less	140	100.00	2,458	73.92	1,736	100.00	2,955	100.00
130 or less	140	100.00	2,458	73.92	1,736	100.00	2,955	100.00
140 or less	140	100.00	2,458	73.92	1,736	100.00	2,955	100.00
150 or less	140	100.00	2,458	73.92	1,736	100.00	2,955	100.00
160 or less	140	100.00	2,613	78.59	1,736	100.00	2,955	100.00
170 or less	140	100.00	2,613	78.59	1,736	100.00	2,955	100.00
180 or less	140	100.00	2,613	78.59	1,736	100.00	2,955	100.00
190 or less	140	100.00	2,795	84.06	1,736	100.00	2,955	100.00
200 or less	140	100.00	2,795	84.06	1,736	100.00	2,955	100.00
300 or less	140	100.00	3,325	100.00	1,736	100.00	2,955	100.00

TABLE XLIX. SUMMARY OF SECTIONS OFFERED, STUDENT REGISTRATIONS ACCOMMODATED, AND AVERAGE SIZE OF SECTIONS, COLLEGE OF ENGINEERING, 1965-66.

	All Sections Combined	Lower	Upper	Lecture	Lab	Single	Multiple
All Sections Combined							
Sections offered	404	107	297	211	193	101	303
Student registrations accomodated	8,156	3,465	4,691	4,910	3,246	1,876	6,280
Average section size	20.83	35.21	15.91	23.27	16.82	17.72	21.89
Lower Division							
Sections offered		107		46	61	2	105
Student registrations accommodated		3,465		2,058	1,407	140	3,325
Average section size		35.21		44.74	23.07	70.00	34.41
Upper Division							
Sections offered			297	165	132	99	198
Student registrations accommodated			4,691	2,852	1,839	1,736	2,955
Average section size			15.91	17.27	13.93	16.67	15.53

TABLE L. SUMMARY OF NUMBERS AND PERCENT OF SECTIONS WITH "20 OR LESS" REGISTRATIONS, COLLEGE OF ENGINEERING, 1965-66.

	All Sections Combined	Lower	Upper	Lecture	Lab	Single	Multiple
All Sections Combined							
Number with 20 or less	254	35	219	124	130	64	190
Percent with 20 or less	62.87	32.71	73.74	58.77	67.36	63.37	62.71
Lower Division							
Number with 20 or less		35		13	22		35
Percent with 20 or less		32.71		28.26	36.07		33.33
Upper Division							
Number with 20 or less			219	111	108	64	155
Percent with 20 or less			73.74	67.27	81.82	64.65	78.28

TABLE LI. SUMMARY OF NUMBERS AND PERCENT OF TOTAL STUDENT REGISTRATIONS ACCOMMODATED IN SECTIONS WITH "20 OR LESS" REGISTRATIONS, COLLEGE OF ENGINEERING, 1965-66.

	All Sections Combined	Lower	Upper	Lecture	Lab	Single	Multiple
All Sections Combined							
Number with 20 or less		449	2,442	1,400	1,491	679	2,212
Percent with 20 or less		12.96	52.06	28.51	45.93	36.19	35.22
Lower Division							
Number with 20 or less		449		171	278		449
Percent with 20 or less		12.96		8.31	19.05		13.52
Upper Division							
Number with 20 or less			2,442	1,229	1,213	679	1,763
Percent with 20 or less			52.06	43.09	65.96	39.11	59.66

	All Sections	Lecture Sections	Laboratory Sections
	Percent	Percent	Percent
Lower Division	32.71	28.26	36.07
Upper Division	73.74	67.27	81.82
All Sections	62.87	58.77	67.36

It can be concluded that there is additional capacity in terms of student registrations in the College of Engineering, specifically in the upper division. The average section sizes stated in an earlier paragraph do not reveal this directly. The number of sections and percent of total for a specific section size limit are better indicators; 62.87 percent of the total sections taught had 20 or less student registrations.

Another indication of unused capacity is the number and percent of total student registrations accommodated in sections with 20 or less registrations. At the lower division, only 12.96 percent of the total student registrations are accommodated in these small sections, which comprise 32.71 percent of the lower division sections taught. At the upper division, 52.06 percent of the student registrations are accommodated in the 73.74 percent of total sections which had 20 or less registrations.

Another indication of unused capacity is the large number of "single sections" and "multiple sections" with registration sizes of 20 or less.

	Lower Division		Upper Division	
	Single Sections	Multiple Sections	Single Sections	Multiple Sections
Number of sections with 20 or less	35	60	83	14
Total Sections	50	95	106	20
Percent of Total Sections with 20 or less	70.00%	63.16%	78.30%	70.00%

Once the decision to offer the section is made, the total cost of the section is not affected by an increase in registrations within some range of registrations. For a large percent of total sections taught in this college, approximately 70 percent, the average cost per unit (per registration) would have decreased with additional registrations and the total cost of the individual section would not have increased with additional student registrations, assuming variable costs at zero. More will be said later with respect to the implications for planning.

Large numbers of sections with small registrations constitute a problem. When pecuniary considerations are added, it becomes apparent that small registrations in large numbers of classes produces high costs of instruction. The foregoing analysis of the economics of section size in the Colleges of Engineering and the College of Agriculture points both to the (1) probability of quality instruction at the upper limit and to (2) additional capacity, resulting in high costs.

To the extent that the numbers presented are an index of quality, the colleges should plan to continue to provide those elements necessary to good instruction. To the extent that the numbers are an index to

inefficiencies related to size, curriculum planning, admissions policies, and the like, the university should proceed with efforts to reduce the inefficiencies.

CHAPTER VIII

COMPARISON OF COLLEGES OF AGRICULTURE AND ENGINEERING

This chapter will compare the data outlined in the preceding chapter in an attempt to establish similarities and contrasts.

Consider first the number of majors in each college for the year 1965-66. This discussion, as is the case in the earlier chapters, will concern itself with an analysis of the lower and upper divisions only.

	Number of Majors	
	College of	
	Agriculture	Engineering
Lower Division	253	523
Upper Division	344	342
Total	597	865

The larger number of majors in the College of Engineering might be expected to make a great deal of difference in the statistics on section sizes and numbers of sections. At the upper division, however, the numbers of majors are almost the same in both colleges.

The number of courses listed and number of sections actually required to accommodate the teaching program are of interest.

	Number of Sections Offered by College		Number of Majors Served by Sections Offered by College	
	Agriculture	Engineering	Agriculture	Engineering
Lower Division	145	107	253	523
Upper Division	126	297	344	342
Total	271	404	597	865

Interestingly, the ratio of majors to the number of sections taught in the College of Agriculture, 2.20 to 1.00, is almost that found in the College of Engineering, 2.14 to 1.00. One might ask why it required 145 sections of instruction to serve 253 majors at the lower division in the College of Agriculture when the College of Engineering used only 107 sections to serve 523 majors, or twice as many.

Part of the answer is found in the nature of the curricula in agriculture. Recall that the departments of instruction in the College of Agriculture are five in number: Agronomy, Animal Science, Entomology, Horticulture, and Poultry Science. Only the Department of Entomology provides any significant number of service courses for other curricula. The College of Engineering is also comprised of five departments: Agricultural Engineering, Civil Engineering, Mechanical Engineering, Electrical Engineering, and Atmospheric Science. Some service courses are taught, primarily in the Department of Mechanical Engineering and the Department of Civil Engineering--e.g., Engineering Graphics and Elementary Surveying. Part of the explanation is found in the nature of the freshman year curriculum. The basic freshman year curriculum in engineering required that only 4.5 credits of a total of 51, or some 8 percent, be taken in the College of Engineering. This is, in part, why the College of Engineering can serve 523 majors with only 107 sections.

In the College of Agriculture, on the other hand, depending upon aptitude, scholastic background, and career interest, the entering

student is advised to elect either the Applied Agriculture or the Agricultural Science course of study for freshmen. Certain major curricula require satisfactory completion of the agricultural science freshman year, while others are open to students satisfactorily completing the applied agriculture freshman year. The course of study for the Applied Agriculture Freshman Year required 27 credits of a total of 50 credits, or 54 percent, from College of Agriculture offerings. Typically, 55 percent to 65 percent of the undergraduate majors in agriculture select the Applied Agriculture Freshman Year Curriculum.

The same explanation will not suffice at the upper division. Here the College of Engineering requires over twice the number of sections to serve the 342 majors as does the College of Agriculture to serve the same number of majors. The sophomore, junior, and senior majors in agriculture complete approximately 51 percent of their course work in terms of credit hours within the departments in the College of Agriculture. The engineering majors complete 67 percent of their work within the College during the sophomore, junior, and senior levels. The remainder of the explanation is found in mechanics of the numbering and course symbol system.

For majors in any particular department, courses in that department which are numbered from 1 to 99 are normally taken in the freshman and sophomore years. For majors in any particular department, courses in that department which are numbered 100 to 199 are normally taken by juniors and seniors. Certain 100-series courses may be taken by graduate students in meeting requirements for an advanced degree upon the approval of the department offering the course, the student's major professor, and

the dean of the graduate school. Courses identified by course numbers in the 200-series carry graduate credit only.

As might be expected, those colleges with relatively large graduate programs tend to be at that stage of curriculum and faculty development that has justified large numbers of graduate courses that enroll primarily graduate students. Smaller graduate programs tend to have more upper level courses open to graduate students for graduate credit.

Table LII describes student-credit-hour production by lower, upper, and graduate numbered courses by graduate students for 1965-66 for all colleges.

The foregoing is typical of the problem of attempting to establish the cost of graduate work as compared, say, with upper division work. A section may be composed of students who are enrolled for graduate credit at the same time that other students will receive undergraduate credit for the same course.

The number of single sections offered gives an interesting comparison. These are sections that do not have enrollments to justify, under existing class size policies, the opening of a second section of instruction.

	Single Sections					
	Agriculture			Engineering		
	Number of		Percent	Number of		Percent
	Majors	Sections	of Total	Majors	Sections	of Total
Lower Division	253	50	34.48	523	2	1.87
Upper Division	344	106	84.13	342	99	33.34
Total	597	156	57.56	865	101	25.00

TABLE LII. STUDENT-CREDIT-HOUR PRODUCTION BY GRADUATE STUDENTS, FOUR COLLEGES, COLORADO STATE UNIVERSITY, 1965-66.

College	Number of Graduate Majors	Division Courses: Lower SCH Total	Lower SCH Percent	Upper SCH Total	Upper SCH Percent	Graduate SCH Total	Graduate SCH Percent	All Courses SCH Total	All Courses SCH Percent
Veterinary Medicine	256	32	3.0	401	38.1	620	58.9	1,053	100.00
Engineering	225	15	.8	591	34.2	1,124	65.0	1,730	100.00
Forestry	127	7	.9	246	33.6	479	65.5	732	100.00
Agriculture	91	55	.8	416	63.1	188	28.5	659	100.00

The larger number of lower division majors in the College of Engineering is manifested in the small number of single sections. Quite simply, there were enough students to justify multiple sections. In the College of Agriculture additional majors could be added without adding to the cost of the lower division 50 sections.

At the upper division, the 106 single sections offered served the upper division majors plus a substantial part of the course requirements (some 51 percent) for the 91 graduate majors as well. When one adds this to the knowledge that 77 percent of these sections have 20 or less students, 64 percent had 15 or less, and 55 percent had 10 or less, it appears reasonable to conclude that the case for additional faculty in the College of Agriculture to serve the present number of majors is difficult to make. Modest increases in enrollment could be accepted without adding substantial numbers of additional faculty, assuming the curricula are not changed.

TABLE LIII. SUMMARY TABLES FOR ANALYSIS OF SECTION SIZE, DISTRIBUTION OF SIZES, AND STUDENTS ACCOMMODATED, COLLEGES OF AGRICULTURE AND ENGINEERING, 1965-66.

	College of Agriculture	College of Engineering
I. Dollars Expended	$484,548.00	$634,100.00
SCH produced	15,465.00	19,702.00
Dollars expended per SCH	$31.33	$36.36
II. Number of Majors	688.00	1,090.00
Dollars expended per major	$704.00	$582.00
III. Mean Salary (9-month equivalent)[a/]	$8,655.00	$10,313.00
Median Salary (9-month equivalent)[a/]	$8,018.00	$ 9,818.00
IV. FTE Students	343.67	437.82
FTE Faculty	30.93	46.84
Ratio FTE Students to FTE Faculty	11.11:1	9.35:1

	Number of Sections	Average Size of Section	Number of Sections	Average Size of Section
V. Total Sections Offered	271	18.39	404	20.83
Lower division sections offered	145	20.55	107	35.21
Upper division sections offered	126	16.07	297	15.91
Lecture sections offered	154	19.83	211	23.27
Laboratory sections offered	117	15.69	193	16.82
Single sections offered	156	16.63	101	17.72
Multiple sections offered	115	20.89	303	21.89

(table continued)

TABLE LIII (continued).

	College of Agriculture		College of Engineering	
V. Lower division sections offered	145	20.55	107	35.21
Lecture sections	57	26.42	46	44.74
Laboratory sections	88	15.94	61	23.07
Single sections	50	18.24	2	70.00
Multiple sections	95	21.74	105	34.41
Upper division sections offered	126	16.07	297	15.91
Lecture sections	97	15.96	165	17.27
Laboratory sections	29	14.93	132	13.93
Single sections	106	15.93	99	16.67
Multiple sections	20	16.90	198	15.53
VI. Sections With 20 or Less Student Registrations	192	70.85	254	62.87
Lower division	95	65.51	35	32.71
Upper division	97	76.98	219	73.74
Lecture	107	69.48	124	58.77
Laboratory	85	72.65	130	67.36
Single	118	75.64	64	63.37
Multiple	74	65.30	190	62.71
Lower division sections with 20 or less student registrations	95	65.51	35	32.71
Lecture	33	57.89	13	28.26
Laboratory	62	70.45	22	36.07
Single	35	70.00	--	--
Multiple	60	63.16	35	33.33

(table continued)

TABLE LIII. (continued).

	College of Agriculture		College of Engineering	
VI. Upper division sections with 20 or less student registrations	97	76.98	219	73.74
Lecture	74	76.29	111	67.27
Laboratory	23	79.31	108	81.82
Single	83	78.30	64	64.65
Multiple	14	70.00	155	78.28
		Percent of Total Student Registrations		Percent of Total Student Registrations
VII. Student Registrations Accommodated in Sections With 20 or Less Student Registrations				
All sections combined	1,946	39.80	2,891	35.45
Lower division sections	1,175	40.39	449	12.96
Upper division sections	771	38.92	2,242	52.06
Lecture sections	929	30.42	1,400	28.51
Laboratory sections	1,017	51.44	1,491	45.93
Single sections	959	37.17	679	36.19
Multiple sections	987	42.73	2,212	35.22
Lower division sections	1,175	40.39	449	12.96
Lecture sections	415	34.20	171	8.31
Laboratory sections	760	54.17	278	19.05
Single sections	356	39.73	--	--
Multiple sections	819	40.69	449	13.52

(table continued)

TABLE LIII. (continued).

	College of Agriculture		College of Engineering	
VII. Upper division sections	771	38.92	2,442	52.06
Lecture sections	514	33.20	1,229	43.09
Laboratory sections	257	59.35	1,213	65.96
Single sections	603	35.80	679	39.11
Multiple sections	168	56.57	1,763	59.66

a/ Four ranks combined.

b/ 45 SCH = 1 FTE student.

CHAPTER IX

SUMMARY AND CONCLUSIONS

The summarization of data and the drawing of conclusions is always difficult. Behind this difficulty is a truism stated most succinctly in the old Turkish proverb: "A man is a victim of the words he speaks; he is the master of those he does not speak." This thesis assignment requires the writer to "speak".

The discussion on the economics of section size established the principle that there is little direct relationship between the number of student registrations and the total cost of a course for the single-section course division. A relationship comes only as more sections are added. The chapters analyzing section size establish rather dramatically that in the colleges considered a large percentage of the sections offered are single sections, particularly at the upper division. Although this dissertation does not pursue the matter of section size at the graduate level, sections offered at the graduate level do also have capacity for more registrations. From this must be exempted the "courses" taught in a manner approaching the one-to-one relationship--e.g., special problems courses, special topics courses, and supervision of dissertations.

The existence of large numbers of sections at the upper division with fewer than 20 student registrations (or fewer than 15 or any other number that might be selected to assure teaching effectiveness) in these colleges is one of the principal determinants of higher cost per unit at this level than at the lower division. Unit costs can be reduced by adding students to the upper division sections.

A procedure which might fix the cost of adding one additional upper division major, for example, in Landscape and Nursery Management, could proceed as follows:

(1) List the specific course requirements within the College of Agriculture.

(2) List that section of each of the course division requirements with the lowest number of student registrations.

(3) Assume that the section with the smallest number of registrations is open to our student, that is, there are no scheduling problems.

(4) Assume that our student is a junior college transfer student who has not completed all of the requirements of the first two years of the curriculum in Landscape and Nursery Management and must acquire these credits during his junior and senior years.

(5) Given a stated general optimum section size policy of 20, it is then possible to find which courses would require the creation of a new section to accommodate our student.

(6) For those courses outside of the College of Agriculture, the procedures in (1) through (5) must be repeated.

One might reasonably expect to find that few, if any, new sections would be required in agriculture. It should be recalled that the percent of sections at the upper division enrolling 20 or less students are as follows: Total Sections, 76.98 percent; Lecture Sections, 76.29 percent; Laboratory sections, 79.31 percent; and Single sections, 78.30 percent.

However, the specific details regarding the course requirements within the College of Agriculture for 1965-66 are given on the following page.

Course	Credits	Lecture Sections	Number of Registrations	Laboratory Sections	Number of Registrations
Ag 110 - Principles of Genetics	5	15	19	--	--
H 15 - Greenhouse Management	5	1	13	1	13
H 46 - Landscape Plants	3	1	7	1	7
H 48 - Landscape Plants	3	1	18	1	18
H 47 - Indoor Plants	3	1	26	1	26
H 109 - Nursery Management	5	1	8	1	8
H 106 - Landscape Design & Theory	5	1	21	1	21
H 105 - Turf Management	3	1	18	--	--
H 150 - Breeding Hort. Crops	5	1	17	1	17
H 152 - Horticulture Seminar	1	1	16	--	--
H 110 - Retail Nursery Mgmt.	5	1	9	1	9
H 151 - Landscape Planning	5	1	13	1	13
H 153 - Ecology Hort. Plants	5	1	8	1	8
Ag 2 - Soils	6	2	113	11	20
En 1 - Farm and Home Insects	5	8	11	8	11
H 4 - Plant Propagation	4	1	10	1	10
H 10 - Fruit Production	5	1	19	1	19
Ag 1 - Crop Production	6	8	10	8	10
An 1 - Intro. Animal Science	4	1	194	--	--
An 2 - Intro. Animal Sci. Lab.	3	--	--	5	10
H 1 - Basic Horticulture	5	2	43	6	8

The courses Ag 2 - Soils, and H 1 - Basic Horticulture, require specific explanation. The first, Ag 2 - Soils, is taught in two large lecture sections with registrations of 138 and 113, and the second H 1 - Basic Horticulture in two sections with registrations of 52 and 43. The laboratory sections, however, are taught in 11 sections for Ag 2 - Soils with registrations numbering 20, 20, 24, 24, 24, 20, 24, 24, 24, 25, and 21 and in 6 sections for H 1 - Basic Horticulture with registrations number 16, 8, 17, 1, 16, and 19.

At this point it is possible to state that given the foregoing assumptions, the addition of one more major in the upper division Landscape and Nursery Management curriculum will not necessitate the initiation of additional sections of teaching in the College of Agriculture. This is the case, however, for this single student only. The case for the courses taken outside the College of Agriculture is not as clear.

	Credits Required
B 116 - Elements of Plant Pathology	5
B 24 - General Accounting	5
E 22 - Vocabulary Building	3
Ph 21 - General Physics	5
SP 27 - Advanced Public Speaking	3
M 20 - Basic Concepts in Algebra	5

If it is assumed that the credits taken outside the College of Agriculture have a cost equal to the average cost per student-credit-hour, a rough estimate of the cost of instruction can be made. For 1965-1966, the costs per SCH in those departments in which our student completed courses were as follows:

Department	1965-66 Department Budget	SCH Produced By Dept.	Cost Per SCH	SCH Taken by Student	Cost of Instruction
Botany and Plant Pathology	$173,470	18,550	$ 9.35	5	$ 46.75
Business	389,633	33,700	11.56	5	57.80
English	479,214	51,569	9.33	3	27.99
Physics	181,796	11,437	15.90	5	79.50
Speech Arts	105,695	9,227	11.45	3	34.35
Mathematics	408,527	46,674	8.75	5	43.75
Total					$290.14

This assumption should be explored further. All of the courses listed are taught as multiple-section course divisions with many sections offered. For example, Bu 24 - General Accounting was taught in 21 sections with registrations numbering, 41, 37, 34, 35, 41, 24, 40, 39, 33, 31, 38, 30, 27, 32, 32, 33, 41, 40, 36, 40, and 37. An average cost curve for a course of this kind would be kinked and linear with this large number of sections. From Figure 1 it is possible to visualize the average cost curve for this course. There would tend to be a linear relationship between the number of student registrations and the total cost of the course, all other factors being constant. This implies that space is not a problem, as this development does. If the factor of space were considered, one might expect the average cost curve to move upward as large numbers of students are added.

From the preceding two computations, it can be said that the cost of the course work completed by our student was as follows:

Courses taken within the College of Agriculture	$000.00
Courses taken outside the College of Agriculture	290.14
Total direct cost of instruction	$290.14

To this must be added a pro-rata share of the overhead costs of the university; that is to say, the indirect expenditures of the institution must be allocated to the various functions of the university. The total costs of a university include those expenditures which are readily identifiable as being related exclusively to a particular function, service, college of department (these are the direct costs as computed for our student above) and an appropriate share of the expenditures which are incurred in behalf of more than one function or unit (these are the indirect costs). Indirect expenditures include those for general administration and expense, library operation, and the maintenance and operation of the physical plant.

A number of methods for allocating indirect expenditures are known and widely used. Only a brief summary of the methods commonly used will be given here. Each of these methods is and has been the subject of examination and improvement for years. 1/ The expenditures for general administration and general expense may be allocated on a dollar-volume basis, that is, the relation of the direct expenditures for a function or unit to the total current expenditures for the university. Total current

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1/ Clarence Scheps, Accounting for Colleges and Universitites, Baton Rouge, Louisiana State University Press, 1949, pp. 265-305; and The National Committee on the Preparation of a Manual on College and University Business Administration, College and University Business Administration, Vol. I and II, Washington, D. C., 1955, pp. 120-134.

expenditures must exclude, of course, expenditures for general administration and general expense. This approach assumes that a dollar expended in one function requires no more "administration" than a dollar expended for another function.

Library expenditures can be allocated to instruction on the basis of the extent of use of library facilities and services by students and faculty. This requires some method of establishing load on the library expressed in terms of student-credit-hours, or the number of students, graduate and undergraduate.

Physical plant maintenance and operation expenditures can be allocated on the basis of the extent of the use made of physical plant space, facilities, and services by the various functions in the university. The area factor (or volume of space used) is adjusted for the time the plant is in use. Obviously, very complicated methods requiring much time and effort can be employed in this exercise for determining the most accurate and logical basis for allocating plant maintenance and operation expenditures.

A word must be said about depreciation. Kester 2/ describes depreciation as an element in cost arising out of the use of long-lived assets in business operation and closely bound up with problems of accounting

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2/ Roy B. Kester, Depreciation, New York, Ronald Press Company, 1924, p. 2.

for profits, taxation of business, accounting for earnings which are available for distribution of dividends, negotiations of long-time loans, the purchase and sale of business enterprises, the determination of the limitation of capitalization, and the current commercial value of going concerns. Education institutions are not profit producing enterprises. Neither their incomes nor their property ordinarily is subject to tax. Loan terms are rarely obtained by liens on real property. Hence, the fundamental purposes in determining and accounting for depreciation do not apply to these enterprises. The consensus appears to be that the taking of depreciation on the educational plant of a university has little value.

It is possible to make an approximation of the amount of indirect expenditure which should be allocated to the credits completed by our transfer student in his junior and senior years by establishing the percentage distribution of total educational and general expenses by institutional function for Colorado State University in 1965-66. This is similar to the procedure described in the Oklahoma data in Chapter II.

	Percent of Total Expenditures 3/
General Administration and General Expense	11.71
Library Expense	6.67
Physical Plant Maintenance and Operation	11.58
Total	29.96

3/. Office of Budgets, Statement of 1968-69 Budget Request for Colorado State University, Fort Collins, Colorado State University, 1967, p. 3.

The direct cost of instruction has been computed as $290.14. This, based on the percentages above, constitutes 70.04 percent of total cost; thus, $290.14 ÷ .7004 gives an approximation of total cost of $414.25 for the instruction of this student for two years.

To this point, this analysis has concerned itself with the estimated cost of instruction of a specific student, a transfer student majoring in Landscape and Nursery Management. An analysis of the income available for instructional purposes at Colorado State University in 1965-66 reveals 4/ that 32.03 percent of total income available was derived from student tuition charges.

Source of Income	Amount	Percent of Total
State Appropriation	7,395,332	63.50
Tuition Income	3,730,330	32.03
Other Income	500,450	4.47
Total	11,646,112	100.00

The average cost per FTE student for the entire university for that year was $972.54 ($11,646,112 ÷ 11,975 FTE students). The tuition charge for students who were residents of Colorado was $225 for the academic year; for non-residents the charge was $900. For the university as a whole, all students were paying an amount of tuition which was less than the average cost per FTE student.

4/ Ibid.

	Tuition Paid by Student	Average Cost Per FTE Student	Percent of Average Cost Per Student Paid by Student
Colorado Resident Student	$225.00	$972.54	23.13
Non-Resident Student	900.00	972.54	92.54

The transfer student in Landscape and Nursery Management paid, if he had been a Colorado resident, 108.63 percent of the cost of his instruction as computed in the earlier paragraphs. If he had been a non-resident, he would have paid 434.53 percent of the cost of his instruction.

In planning for the optimum use of the fiscal resources available to a university, this information has a number of implications. To enter Colorado State University, a student must surmount three barriers. The first, the income barrier, is the tuition and student fee charge (for athletics, student health services, student union fees, etc.). The tuition rate for 1965-66 has already been described. The increase in tuition rates (excluding student fees) in recent years is described in Table LIV.

The tuition escalation at Colorado State University has been particularly rapid in recent years. Some observers insist that no further escalation is possible without having a drastic effect on the demand for educational services. Colorado State University is determined that it will do everything possible to assure that no academically promising student is prevented from attending the university because of lack of funds.

TABLE LIV. TUITION CHARGES, COLORADO STATE UNIVERSITY, 1959-1960 THROUGH 1968-69.

Year	Colorado Student	Non-Resident Student
1959-60	$126	$ 426
1960-61	141	486
1961-62	141	486
1962-63	141	561
1963-64	141	561
1964-65	225	810
1965-66	225	810
1966-67	225	900
1967-68	225	1,002

The second barrier to admission is the university admission standard. The stated admissions policy for the first-time-entering freshman is as follows:

> "Colorado State University seeks to admit those first-time entering freshmen who present a record of intellectual performance and potential, evidencing the probability of satisfactory performance in the academic program of the University. The admission decision is based on information including secondary school grades, class rank, pattern of high school academic units and trend in quality of high school performance, scholastic aptitude test scores, principal-counselor recommendations, leadership qualities, citizenship record, and appropriateness of proposed field of study. The most significant factor considered is scholastic achievement in the secondary school program, but no single criterion for admission is employed.
>
> For the admission of both resident and non-resident first-time-entering freshmen, major emphasis is placed on the requirement that the student rank in the upper one-half of his high school graduating class. The other information mentioned, such as counselor recommendations and verbal and quantitative scholastic aptitude scores of the College Entrance Examination Board tests, is evaluated in conjunction with the rank in high school graduating class in arriving at the admissions decision."

The admission requirement for the transfer student is stated as follows:

> "An undergraduate student with a satisfactory academic record in another institution of recognized standing may apply for admission to Colorado State University. The applicant is accepted on the basis of his previous academic record and his proposed program.
>
> Transfer students are expected to have a "C" average in all previous college work to be considered for admission. When computing the average for admission, the University includes credits of failure (F), withdrawn failing (WF), or repeats in the total credits attempted at all colleges and universities.
>
> Evaluation of transfer record is made only from official transcripts after the student has been accepted for admission. Courses with a "D" grade are acceptable in transfer into all

colleges of the University except into the college of engineering and the college of forestry and natural resources.

As a general rule, the maximum credit which may be allowed in transfer from an approved junior college is 96 quarter credits. Students who have completed more than 96 quarter credits during two years at a junior college may apply during their senior year at Colorado State University for acceptance of the actual number of credits earned at the junior college. Such credits will be allowed provided they are needed for graduation and do not exceed one-half of the total credits required for the degree in a particular major.

After a student has completed the equivalent of 2 years of college courses, credit will not be allowed for courses completed at a junior college."

A final barrier is that imposed by the Colorado legislature with respect to the admission of the non-resident student. No specific limitations are written into the law, but the documents describing legislative intent which accompany appropriation bills constitute compulsion. Residence is not a direct condition for the admittance for either the graduate student or the transfer student, although historically, the Colorado legislature has been critical of the large numbers of students from "outside Colorado" whom the Colorado taxpayers are called upon to educate.

To return to the admissions standards, the fact that there is no single criterion for admission for the first-time-entering freshman is important. If one begins with the objective of serving as many qualified students as possible with a given level of budget, the analysis in the preceding chapters would indicate that the admissions decision could be weighted on the basis of the program of studies desired. The list of criteria employed in the admissions decision would now look like this:

Student Considerations

(1) Secondary school grades
(2) Class rank
(3) Pattern of high school academic units
(4) Trend in quality of high school performance
(5) Scholastic aptitude test scores
(6) Principal-counselor recommendations
(7) Leadership qualities
(8) Citizenship record
(9) Appropriateness of proposed field of study

University Considerations

(10) Cost circumstances of field of study selected
  (a) Do teaching sections now have unused capacity?
  (b) Is the field of study selected a new area with small numbers of students enrolled?
  (c) Is the curriculum of the vocational-technical sort?
  (d) During which quarter is the student enrolling?

The application of internal cost considerations to the admissions decision can increase educational opportunity to many students at little or no additional cost to the institution.

Return again to the tuition (or income) barrier to admission. There is considerable evidence that family income is associated with educational attainment. Brazer and David 5/ assert that among other factors incomes are associated with more than average educational attainment. At

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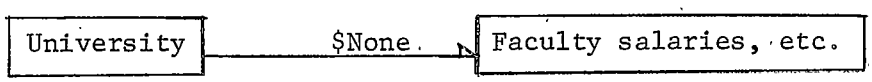
5/ Harvey E. Brazer and Martin David, Social and Economic Determinants of the Demand for Education, Economics of Higher Education (Washington, D. C.: Office of Education, U. S. Department of Health, Education, and Welfare, OE-50027).

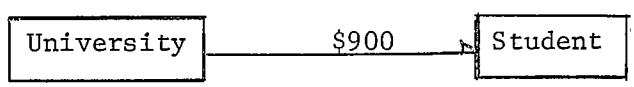
Colorado State University, approximately 800 applications for student scholarships were denied in 1965-66 for lack of university funds. The scholarships are awarded on the basis of need and scholarship. A student had little chance of being awarded any assistance unless he was a strong "B" student. Many students with C+ to B+ records who had financial needs were denied assistance. University records reveal that some students drop out each year because of lack of funds. Clearly, it would make sound fiscal sense to provide funds to those students pursuing courses of study in those departments and colleges where low or no cost teaching at the margin was possible. Given the earlier assumptions, the picture for our additional non-resident student is outlined in the diagram which follows:

I. Expenditure by the University

A. For teaching expense

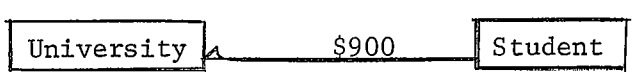


B. For one tuition scholarship



II. Income to the University

C. From one student



III. Net to University

D. C = A + B and thereby one more year of educational achievement by one more student at no cost to the university

There are other possibilities for serving additional students as well. The student attrition from quarter to quarter in 1965-66 for the two colleges considered is given here.

	All Undergraduate Majors Enrolled			
1965-66	College of Agriculture	Percent of Fall Quarter	College of Engineering	Percent of Fall Quarter
Fall Quarter	597	100.00	865	100.00
Winter Quarter	581	97.32	792	91.56
Spring Quarter	565	94.63	736	84.86

The attrition rate in the College of Engineering is particularly significant. Recall that very little course work is done by freshmen within the College of Engineering. The freshmen year curriculum is characterized by courses in mathematics, chemistry, and English composition. The specific courses in mathematics are analytic geometry and calculus. In the sophomore year the specific mathematics courses are analytic geometry, and calculus, and differential calculus. University records reveal that many of the student casualties occur in mathematics. It may be that an additional investment in the form of student academic assistance (tutors in dormitories, evening television lectures in dormitories and libraries, discussion sessions with paid graduate assistants, smaller section sizes in the mathematics sections) might retain some of the majors in their programs. The cost of this investment may be balanced against both the tuition the student will return in his junior and senior years in college and the increase in human capital which comes with his continued education.

1965-66	College of Engineering			
	Freshman Majors	Percent of Fall Quarter	Sophomore Majors	Percent of Fall Quarter
Fall Quarter	329	100.00	194	100.00
Winter Quarter	304	92.40	179	92.27
Spring Quarter	283	86.02	163	84.02

The mention of human capital introduces another possibility. The existence of unused capacity in a number of university curricula affords an opportunity to furnish financial assistance to foreign students for additional educational achievement.

Investment in human capital is a distinctive and important feature of any economy. 6/ A major source of human capital is education; economic progress is much dependent upon the knowledge and skills that education produces. In many countries of the world, the limiting factor in achieving economic growth is ignorance.

For a small university investment, it could be possible to teach substantial numbers of foreign students in agriculture and engineering. Not only would the society to which the foreign student return gain, but there could also be a gain to the university community from the foreign student's presence. The foreign student is an educational resource in a university. Part of a university education ought to include the knowledge

6/ Schultz, Theodore, Rise in the Capital Stock Represented by Education in the United States, 1900-57, Economics of Higher Education, (Washington, D.C.: Office of Education, U. S. Department of Health, Education, and Welfare, OE-50027, 1962, p. 93).

that not all the values of life are those which prevail in the American student's home, community, and nation. The fraternization of the American and the foreign student can yield enrichment for both.

The analysis in Chapters VI and VII can be useful in planning and budgeting additional faculty positions. Generally, requests for additional faculty are made by academic deans and department heads on the basis of increased teaching loads and responsibilities to the department or college. The increase in load claim is often made on the basis of increased load as manifested in increasing student-credit-hour production or increasing numbers of majors. The data for the College of Agriculture offer a case for examination. Student-credit-hour production increased significantly during the years 1963-64 through 1966-67, from 6,336 to 7,866, an increase of 24.15 percent.

	Number of Majors			Student-Credit-Hours Produced		
Year	Lower Division	Upper Division	Graduate Division	Lower Division	Upper Division	Graduate Division
1963-64	260	350	76	9,337	6,336	492
1964-65	245	273	75	8,229	6,605	689
1965-66	253	344	91	7,595	6,868	1,002
1966-67	254	323	108	9,013	7,866	907

Without the information relating to section size now available, academic administrators may have concluded that an increase in staff was necessary to carry this additional load. Add to the data on student-credit-hours produced the information relating to the number of sections at the upper division with 20 or less registrations.

Total sections	76.98 percent
Lecture sections	76.29 percent
Laboratory sections	79.31 percent
Single sections	78.30 percent
Multiple sections	70.00 percent

The case for additional staff to teach upper division courses is less clear. Additional faculty were provided for in the College of Agriculture during these years. One would hope that this increase in staff resulted

	FTE Faculty
1963-64	30.09
1964-65	31.24
1965-66	30.93
1966-67	35.13

in some reduction in teaching loads, or some enrichment in the graduate and research program.

Information relating to section size, distribution of size, and student registrations accommodated could, if made available to department and college curriculum committees, be of use in planning course additions, deletions, and changes. An action taken by a curriculum committee increasing the number of courses offered by a college is in a real sense a commitment of future resources. Funds committed to additional courses in a college curriculum cannot be spent again for salary increases or for the services of laboratory assistants. Curriculum committees should have information relating to the economics of section and class size available to them. Some incentive to control the number of courses offered might be established if the curriculum committee were to understand that any "savings" which arise within a department or college from

a curriculum revision that reduces the number of courses and/or sections offered become available to that department or college for other purposes.

Information about the capacity of a college or department to teach additional students without adding to total instructional cost can be helpful to those responsible for administering a student financial assistance program. Student financial assistance can take the form of scholarships, grants, loans, work-study assistance and the like. The existence of unused capacity can be considered in construction of a program of financial assistance for the individual student.

APPENDICES

APPENDIX A

STUDENT-CREDIT-HOUR PRODUCTION
BY COLLEGE AND DEPARTMENT
FALL-WINTER-SPRING QUARTER 65-66

COLLEGE	DEPARTMENT	LOWER	PERCENT	UPPER	PERCENT	GRAD	PERCENT	TOTAL
AGRICULTURE								
	AGRICULTURE							
	RESIDENTS	145.0	62.77	86.0	37.23			231.0
	NON-RESIDENTS	49.0	56.98	37.0	43.02			86.0
	ALL STUDENTS	194.0	61.20	123.0	38.80			317.0
	AGRONOMY							
	RESIDENTS	1482.0	41.64	1997.0	56.11	80.0	2.25	3559.0
	NON-RESIDENTS	848.0	40.38	955.0	45.48	297.0	14.14	2100.0
	ALL STUDENTS	2330.0	41.17	2952.0	52.16	377.0	6.66	5659.0
	ANIMAL SCIENCE							
	RESIDENTS	1870.0	50.82	1651.0	44.86	159.0	4.32	3680.0
	NON-RESIDENTS	1019.0	48.83	854.0	40.92	214.0	10.25	2087.0
	ALL STUDENTS	2889.0	50.10	2505.0	43.44	373.0	6.47	5767.0
	ENTOMOLOGY							
	RESIDENTS	776.0	69.60	300.0	26.91	39.0	3.50	1115.0
	NON-RESIDENTS	295.0	52.49	226.0	40.21	41.0	7.30	562.0
	ALL STUDENTS	1071.0	63.86	526.0	31.37	80.0	4.77	1677.0
	HORTICULTURE							
	RESIDENTS	660.0	57.64	463.0	40.44	22.0	1.92	1145.0
	NON-RESIDENTS	196.0	42.79	170.0	37.12	92.0	20.09	458.0
	ALL STUDENTS	856.0	53.40	633.0	39.49	114.0	7.11	1603.0
	POULTRY							
	RESIDENTS	195.0	63.11	89.0	28.80	25.0	8.09	309.0
	NON-RESIDENTS	60.0	45.11	40.0	30.08	33.0	24.81	133.0
	ALL STUDENTS	255.0	57.69	129.0	29.19	58.0	13.12	442.0
TOTAL								
	RESIDENTS	5128.0	51.08	4586.0	45.68	325.0	3.24	10039.0
	NON-RESIDENTS	2467.0	45.47	2282.0	42.06	677.0	12.48	5426.0
	ALL STUDENTS	7595.0	49.11	6868.0	44.41	1002.0	6.48	15465.0

APPENDIX B

FACULTY STUDY - FULL TIME DATE 1965-66

	EMPLOYEE NAME	BASIS OF SERVICE	DEPT.	ANNUAL SALARY RATE	NINE MONTHS EQUIVALENT	ANNUAL PERA	ANNUAL SALARY DEPT	RI LESS SUMMER	FTE
E	CURTIS BYRD C	12	11010	12,700.00	10,390.88	207.84	3,463.56	3,463.56	.333
E	DANIELSON ROBERT E	12	11010	12,900.00	10,554.52	422.28	7,036.32	7,036.32	.667
E	DOTZENKO ALEXANDER D	12	11010	11,200.00	9,163.61	366.60	6,109.08	5,090.90	.556
E	DOXTADER KENNETH G	12	11010	9,800.00	8,018.16	51.29	853.76	853.76	.106
E	HAUS THILO E	12	11010	13,400.00	10,963.61	511.68	8,527.32	8,527.32	.778
E	JOHNSON DONAL D	12	11010	13,800.00	11,290.88	401.40	6,690.96	6,690.96	.593
E	LEONARD WARREN H	12	11010	15,000.00	12,272.70	572.76	9,545.40	9,545.40	.778
E	LINDSAY WILLARD L	12	11010	11,600.00	9,490.88	253.20	3,624.36	3,624.36	.382
E	PHIPPS ROGER L	12	11010	6,000.00	4,909.08	130.92	2,181.84	2,181.84	.444
E	REEVES DALE L	12	11010	6,200.00	5,072.71	270.60	4,509.12	4,509.12	.889
E	ROMINE DALE S	12	11010	10,700.00	8,754.52	350.16	5,836.44	5,836.44	.667
E	ROMSDAL STANTON D	12	11010	8,900.00	7,281.80	145.68	2,427.24	2,427.24	.333
E	SCHMEHL WILLARD R	12	11010	15,700.00	12,845.42	513.84	8,563.56	8,563.56	.667
E	WHITNEY ROBERT S	12	11010	17,500.00	14,318.15	477.24	7,954.56	7,954.56	.556
E	WOOD DONALD R	12	11010	13,500.00	11,045.43	441.72	7,363.68	7,363.68	.667
E	TO BE ASSIGNED	12	11010	10,300.00	8,427.25	51.50	858.30	858.30	.102
E	BLACKBURN THOMAS R	10	11011	11,500.00	10,350.00	690.00	11,500.00	10,350.00	1.000
E	BULLIS DANIEL D	12	11011	9,000.00	7,363.62	-	7,363.68	7,363.68	1.000
E	CONNELL WILLIAM E	12	11011	12,100.00	9,899.97	594.00	9,900.00	9,900.00	1.000
E	DAUGHERTY FORD C	12	11011	14,200.00	11,618.15	542.16	9,036.36	9,036.36	.778
E	ESPLIN A LAMAR	12	11011	12,000.00	9,818.16	589.08	9,818.16	9,818.16	1.000
E	KNOX KIRWIN L	12	11011	10,600.00	8,672.70	106.92	1,781.76	1,781.76	.205
E	MATSUSHIMA JOHN K	12	11011	14,200.00	11,618.15	284.04	4,733.40	4,733.40	.407
E	SNYDER WALTER E	12	11011	12,000.00	9,818.16	589.08	9,818.16	9,818.16	1.000
E	STONAKER HOWARD H	12	11011	18,400.00	15,054.51	301.08	5,018.16	5,018.16	.333
E	STORY CHARLES D	12	11011	16,700.00	13,663.60	819.84	13,663.68	12,145.50	.889
E	SUTHERLAND THOMAS M	12	11011	13,400.00	10,963.61	393.48	6,557.88	6,557.88	.598
E	SWANSON VERN B	12	11011	10,500.00	8,590.89	572.76	9,545.40	8,590.86	1.000
E	WARD GERALD M	12	11011	14,300.00	11,699.97	324.00	5,400.00	5,400.00	.462
E	TO BE ASSIGNED	12	11011	8,000.00	6,545.44	349.08	5,818.20	5,818.20	.889
E	TO BE ASSIGNED	12	11011	8,000.00	6,545.44	-	2,909.16	2,909.16	.444
E	DANIELS LESLIE B	12	11013	12,900.00	10,554.52	633.24	10,554.60	9,381.87	.889
E	JOHNSEN RICHARD E	12	11013	9,300.00	7,609.07	194.47	3,240.93	3,240.93	.426
E	SIMPSON ROBERT G	12	11013	10,600.00	8,672.70	404.76	6,745.44	6,745.44	.778
E	THATCHER THEODORE O	12	11013	13,600.00	11,127.24	667.68	11,127.24	11,127.24	1.000
E	WELLSO STANLEY G	12	11013	9,000.00	7,363.62	294.60	4,909.08	4,909.08	.667
E	BEACH GEORGE	12	11014	12,400.00	10,145.43	62.01	1,033.32	1,033.32	.102
E	DENNA DONALD W	12	11014	9,500.00	7,772.71	155.40	2,590.92	2,590.92	.333
E	FOSKETT RICHARD L	12	11014	13,700.00	11,209.06	298.92	4,981.92	4,981.92	.444
E	HANAN JOE J	12	11014	8,500.00	6,954.53	92.76	1,545.48	1,545.48	.222
E	HOLLEY WINFRED D	12	11014	15,000.00	12,272.70	327.24	5,454.60	5,454.60	.444
E	JORGENSEN CARL J	12	11014	9,400.00	7,690.89	564.00	9,399.96	7,690.87	1.000
E	WORKMAN MILTON	12	11014	13,500.00	11,045.43	220.92	3,681.84	3,681.84	.333
E	TO BE ASSIGNED	12	11014	11,900.00	9,736.34	389.40	6,490.92	6,490.92	.667
E	TO BE ASSIGNED	12	11014	11,800.00	9,654.52	531.00	8,850.00	8,850.00	.917

APPENDIX C

EMP NO	EMPLOYEE NAME	TITLE	DEPT	COURSE NO-SEC	HRS	NO.	CRED	CONTACT HRS	STUD.CR.HRS	YR
142844	D M CARTER	3139	1210	BU 21 02	3.0	29	3.0	87.0	87.0	W66
142844	D M CARTER	3139	1210	BU291 E 01	3.0	4	3.0	12.0	12.0	W66
142844	D M CARTER	3139	1210	ST 30 01	1.0	11	1.0	11.0	11.0	W66
142844	D M CARTER	3139	1210	ST 30 01	6.0	11	2.0	66.0	22.0	W66
142844	D M CARTER	3139	1210	BU 22 01	2.0	29	2.0	58.0	58.0	S66
142844	D M CARTER	3139	1210	BU299 01	7.0	1	7.0	7.0	7.0	S66
142844	D M CARTER	3139	1210	BU299 01	3.0	1	3.0	3.0	3.0	S66
142844	D M CARTER	3139	1210	ST 30 01	1.0	36	1.0	36.0	36.0	S66
142844	D M CARTER	3139	1210	BU 22 01	2.0	29	1.0	58.0	29.0	S66
142844	D M CARTER	3139	1210	BU291 E 01	2.0	1	1.0	2.0	1.0	S66
142844	D M CARTER	3139	1210	ST 30 01	6.0	36	2.0	216.0	72.0	S66
142978	F C CARTER	3137	1210	BU190 01	3.0	2	3.0	6.0	6.0	F65
142978	F C CARTER	3137	1210	BU190 01	3.0	9	3.0	27.0	27.0	W66
142978	F C CARTER	3137	1210	BU191 01	3.0	3	3.0	9.0	9.0	W66
142978	F C CARTER	3137	1210	BU190 01	3.0	2	3.0	6.0	6.0	S66
159740	R B CLARK	3139	1210	BU 57 01	3.0	20	3.0	60.0	60.0	F65
159740	R B CLARK	3139	1210	BU153 01	3.0	24	3.0	72.0	72.0	F65
159740	R B CLARK	3139	1210	BU153 02	3.0	9	3.0	27.0	27.0	F65
159740	R B CLARK	3139	1210	BU 57 01	3.0	30	3.0	90.0	90.0	W66
159740	R B CLARK	3139	1210	BU150 03	4.0	25	4.0	100.0	100.0	W66
159740	R B CLARK	3139	1210	BU153 01	3.0	21	3.0	63.0	63.0	W66
159740	R B CLARK	3139	1210	BU 57 01	3.0	27	3.0	81.0	81.0	S66
159740	R B CLARK	3139	1210	BU 57 02	3.0	17	3.0	51.0	51.0	S66
159740	R B CLARK	3139	1210	BU153 01	3.0	34	3.0	102.0	102.0	S66
174420	M H COOK	3147	1210	BU 24 10	5.0	41	5.0	205.0	205.0	F65
174420	M H COOK	3147	1210	BU 24 06	5.0	29	5.0	145.0	145.0	S66
187150	J W CREIGHTON	3138	1210	BU 75 01	4.0	30	4.0	120.0	120.0	F65
187150	J W CREIGHTON	3138	1210	BU 75 02	4.0	32	4.0	128.0	128.0	F65
187150	J W CREIGHTON	3138	1210	BU293 01	3.0	3	3.0	9.0	9.0	F65
187150	J W CREIGHTON	3138	1210	BU 75 01	4.0	38	4.0	152.0	152.0	W66
187150	J W CREIGHTON	3138	1210	BU136 01	2.0	12	2.0	24.0	24.0	W66
187150	J W CREIGHTON	3138	1210	BU136 01	2.0	12	1.0	24.0	12.0	W66
187150	J W CREIGHTON	3138	1210	BU 75 01	4.0	38	4.0	152.0	152.0	S66
187150	J W CREIGHTON	3138	1210	BU190 01	3.0	13	3.0	39.0	39.0	S66
187150	J W CREIGHTON	3138	1210	BU206 01	3.0	10	3.0	30.0	30.0	S66
187150	J W CREIGHTON	3138	1210	BU291 D 01	2.0	1	2.0	2.0	2.0	S66
228380	W C DOOLEY	3147	1210	BU 2 05	2.0	36	1.0	72.0	36.0	F65
228380	W C DOOLEY	3147	1210	BU 2 06	2.0	36	1.0	72.0	36.0	F65
228380	W C DOOLEY	3147	1210	BU 2 03	2.0	36	1.0	72.0	36.0	F65
228380	W C DOOLEY	3147	1210	BU 2 03	2.0	35	1.0	70.0	35.0	W66
228380	W C DOOLEY	3147	1210	BU 2 05	2.0	32	1.0	64.0	32.0	W66
228380	W C DOOLEY	3147	1210	BU 2 06	2.0	34	1.0	68.0	34.0	W66
228380	W C DOOLEY	3147	1210	BU 2 07	2.0	35	1.0	70.0	35.0	W66
228380	W C DOOLEY	3147	1210	ST 2 01	1.0	38	1.0	38.0	38.0	S66
228380	W C DOOLEY	3147	1210	BU 2 04	2.0	37	1.0	74.0	37.0	S66
228380	W C DOOLEY	3147	1210	ST 2 01	4.0	38	1.0	152.0	38.0	S66
229325	W R DOUD	3139	1210	ST 7 02	3.0	32	3.0	96.0	96.0	F65
229325	W R DOUD	3139	1210	ST 8 01	3.0	16	3.0	48.0	48.0	F65
229325	W R DOUD	3139	1210	ST 11 01	3.0	30	3.0	90.0	90.0	F65
229325	W R DOUD	3139	1210	ST 7 02	2.0	32	1.0	64.0	32.0	F65
229325	W R DOUD	3139	1210	ST 8 01	2.0	16	1.0	32.0	16.0	F65
229325	W R DOUD	3139	1210	ST 11 01	2.0	30	1.0	60.0	30.0	F65
229325	W R DOUD	3139	1210	ST 8 01	3.0	21	3.0	63.0	63.0	W66
229325	W R DOUD	3139	1210	ST 8 02	3.0	22	3.0	66.0	66.0	W66
229325	W R DOUD	3139	1210	ST 12 02	3.0	25	3.0	75.0	75.0	W66
229325	W R DOUD	3139	1210	ST 8 01	2.0	21	1.0	42.0	21.0	W66
229325	W R DOUD	3139	1210	ST 8 02	2.0	22	1.0	44.0	22.0	W66
229325	W R DOUD	3139	1210	ST 12 02	2.0	25	1.0	50.0	25.0	W66
229325	W R DOUD	3139	1210	ST 9 01	3.0	28	3.0	84.0	84.0	S66

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