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AN ECONOMETRIC MODEL OF THE CALIFORNIA PUBLIC JUNIOR COLLEGE OPERATING YEAR-ROUND.

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BASED ON EMPIRICAL DATA ACCUMULATED FROM TWELVE JUNIOR COLLEGES UNDER THE 2-SEMESTER CALENDAR, THE MODEL DEVELOPED IN THIS STUDY CAN BE USEFUL IN PREDICTING CHANGES IN PLANT USE UNDER THE 4-QUARTER CALENDAR. THIS CALENDAR REVISION HAS FOUR CONSTRAINTS--(1) THE SENIOR INSTITUTIONS IN THE STATE HAVE ADOPTED IT, (2) THE STUDENT'S CHOICE OF QUARTER IN WHICH TO ENROLL CAN NOT BE CONTROLLED, (3) FEEDER HIGH SCHOOLS GENERALLY FOLLOW THE JUNE GRADUATION PATTERN, MAKING ARTICULATION OF TERMS DIFFICULT, AND (4) JUNIOR COLLEGE STUDENTS HAVE A HIGH-ATTRITION AND LOW-PERSISTENCE CHARACTERISTIC. WITHIN THESE PARAMETERS, THE MODEL PROVIDES A COMPARISON OF PLANT USE UNDER VARIOUS ENROLLMENT PATTERNS AND VARYING PROPORTIONS OF STUDENTS ELECTING YEAR-ROUND ATTENDANCE. THE MODEL CAN ALSO BE USED TO EXAMINE SUBPOPULATIONS (E.G., BY SEX AND BY SCHOLASTIC ABILITY) AND TO COMPUTE THEIR EFFECTS ON FACILITY USE. THE EVIDENCE ALSO INDICATES THAT, AS PART OF THIS PREDICTIVE STUDY, FURTHER RESEARCH IS NEEDED ON THE CHARACTERISTICS OF COLLEGES AS THEY RELATE TO EACH OTHER AND TO THEIR COMMUNITIES, AND ON THE RELATIVE APTITUDES OF MEN AND WOMEN STUDENTS IN URBAN COLLEGES. THE COMPUTATIONS ARE ILLUSTRATED BY GRAPHS AND CHARTS. (HH)

An Econometric Model of the California Public Junior College Operating Year-Round

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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CALIFORNIA STATE DEPARTMENT OF EDUCATION
Max Rafferty—Superintendent of Public Instruction
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An Econometric Model of the California Public Junior College Operating Year-Round

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FOREWORD

In January, 1964, the Coordinating Council for Higher Education determined that the four-quarter system for year-round operation was best for public higher education in California and recommended that the University of California and the California State Colleges convert to the four-quarter system by 1970. The Council further recommended that ". . . each Junior College governing board appraise the recommendation's impact upon the transfer of its students, articulation with other segments of education, and other related matters; and on that basis determine the advisability of conversion to a four-quarter calendar."

In October, 1966, the State Board of Education requested (1) that the governing board of each school district operating a junior college comply with the Coordinating Council's request, reporting the results of their respective appraisals to the State Board of Education before January 1, 1968; and (2) that the State Department of Education assist the local boards by furnishing background studies and mathematical models as appropriate.

This publication presents an overview of year-round operation, a review of the literature and of recent research, and a mathematical model by which utilization indices can be computed for the semester system and for the quarter system for various proportions of students electing to enroll year-round. The user is cautioned that the model purports only to cover recent high school graduates and those only in districts serving high schools with once-a-year graduation. The problem of the demand placed on the junior college by returning students who have been out of the system for an appreciable length of time is discussed briefly in Chapter VI.

Superintendent of Public Instruction

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Chapter I

THE ACADEMIC CALENDAR

Writing in 1932, W. H. Cowley opened his study of the academic calendar with a paragraph that is equally applicable today:

> Since the founding of the first American college in 1636, four varieties of academic calendars have been at various times in vogue in American colleges and universities: the four-term system, the three-term system, the two-term system or semester and the quarter system. It might be supposed that after three centuries of experimentation one of these would have emerged as superior to the others, but the ideal calendar, strangely enough, continues in not a few institutions to be a moot and perplexing problem.[1]

In 1967 we find that, with a few notable exceptions, schools, from kindergarten through graduate school, operate from early September through early June. Traditionally, in our culture, September is "back to school month." One need only glance at the advertisements in newspapers or into the windows of the department stores from midsummer on into fall to be reminded of this. Likewise, June is the month in which "school is out," the time for graduation. This appears to stem from an agricultural society in which the presence of children on the farm was necessary during the time when the most farm work was to be done. As the culture moved from rural to urban, this pattern persisted.

One can speculate that it would not have persisted had not the pattern been entirely compatible with urban life. During the summer months travel is at its easiest. Less shelter and clothing are needed. The beaches and lakes are inviting. The oppressive heat of the cities can be escaped in the mountains which are at their most accessible in warm, dry weather. So summer became vacation time for those who could afford--and as America prospered more Americans could afford vacations. Having the children at home during this season proved equally convenient to the modal American family, but for different reasons. The "school year" continued to be fixed at nine months from early September to early June.

Given this pattern, the period during which school work could be "made up," the gifted student accelerated, and the teacher could receive additional training, or retraining, has become the summer, or "vacation" period. This led naturally to the "summer school" or "summer session" of six to twelve weeks in elementary, secondary, and higher education. These summer sessions are, with very minor exceptions, quite small relative to the capacity of the physical plant in which they are held.

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[1] W. H. Cowley, A Study of the Relative Merits of the Quarter and Semester Systems (Ohio State University, May, 1932), p. 3.

Now, in the mid-1960s, people concerned with education, both laymen and educators, are questioning the efficiency of this traditional academic calendar of nine months of intensive, full-time, often overcrowded operation of the schools followed by three summer months of minimal school activity. Off-season vacations, taken during the traditional school year, have become not only feasible, but increasingly popular. The utilization of extensive and expensive facilities on a minimal basis for twenty-five percent of the year is increasingly seen as incompatible with the American preoccupation with efficiency. Demographic factors such as earlier marriages and lower infant mortality have lowered the median age of the population into the mid-twenties. Economic and technologic factors have combined to reduce rapidly the proportion of jobs available requiring little or no education. Social and cultural factors have combined to emphasize education as a ladder to social and economic upward mobility; indeed, such emphasis has become public policy at the national level. All of these effects have combined to place unprecedented demands upon education, public or private.

It is apparent then, that if calendar revision holds any promise whatever of increasing the efficiency of the schools, it should be examined. On the face of it, any increase in plant utilization, quality over unit of time being held constant, will be an increase in the overall efficiency of the educational enterprise. The State of California has recognized this and has commenced an academic calendar revision in all segments of public higher education.[2] This paper will be concerned with this calendar revision in one of the segments, the public junior college.

It will be shown later that certain constraints have already been developed within which, as a practical matter, calendar revision within the California public junior college must be developed.[3] This research will attempt to identify those constraints and then, within those constraints, develop an econometric model of the California public junior college under a revised calendar on a theoretical basis. Certain empirical data on attendance patterns in several junior colleges will be introduced in an attempt to test, refine, and further develop the model. Finally, certain conclusions will be drawn relative to the operation of a revised or year-round calendar in the California public junior college.

To set the background, it will be necessary first to examine the academic calendar in general terms.

The academic calendar is obviously constrained by the solar or civil calendar. One year consists of 52 weeks plus one and a quarter days, more or less. If one accepts the traditional two-week academic vacation at Christmas and New Years, a two-day vacation at Thanksgiving, the usual one-day

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[2] Chapter II, infra.

[3] Ibid.

holidays, plus a short spring or Easter vacation or "break," one can very easily arrive at a 48-week year as the ultimate constraint on an academic year. Now 48 is an interesting figure. It is exactly divisible by two, three, four, six, eight, 12, 16, and 24. If one takes three-fourths of 48, he gets 36, which is divisible by two, three, four, six, nine, 12, and 18. Thus, if one sets out to divide the year of 48 weeks--or the traditional September to June school year of 36 weeks--into equal parts, he has many options.

At this point it is perhaps appropriate to establish some definitions of words commonly used in discussing the academic calendar. The word semester is derived from the Latin sex (six) plus mensis (month).[4] In practice it no longer has that meaning. It now generally refers to a term of about 18 weeks, including registration and examination periods, into which the conventional school year is divided. The word trimester is a compound from the Latin tri (three) plus mensis (month).[5] In academic circles, it seldom has this meaning. It is rather, generally speaking, a term of about 16 weeks; or what one obtains when he divides the 48-week year into three equal parts. The quarter is, generally, of 12 weeks duration. Since $3 \times 12 = 36$ and $4 \times 12 = 48$, the quarter can be obtained by dividing the 48-week year into four equal parts or by dividing the conventional 36-week year into three equal parts.

To avoid confusion, in this discussion the word term will be used to denote one complete segment of an academic calendar starting with registration, including an unbroken period of instruction, and concluding with examinations. Terms may be semesters (conventional school year divided into two equal parts), trimesters (whole year divided into three equal parts), quarters (conventional school year divided into three or whole year divided into four equal parts) or summer sessions (any length from six weeks to twelve weeks, the latter of which might more properly be described as summer quarters).

The most common academic calendar in American higher education is the semester calendar,[6] or more precisely the two-semester-plus-summer-term(s) calendar. This is obtained by dividing the conventional school year into two equal parts. In most institutions, one or two summer terms are offered. Commonly these are of six weeks duration, making two terms possible in the 12 weeks available (48 - 36 = 12). This calendar has two major disadvantages. If the fall semester is begun in early September, the Christmas vacation comes at a most inconvenient time. About 13 to 15 weeks of the semester have elapsed when Christmas vacation interrupts. Students and faculty complain that the prospect of returning directly to review and reading periods to be followed by examination week creates a miasma on the Christmas

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4 Elmer C. Easton, Year-Around Operation of Colleges (New Brunswick, N. J.: College of Engineering, Rutgers-The State University, 1958), p. 2.

5 Ibid.

6 American Association of Collegiate Registrars and Admissions Officers, The University Calendar, 1961, p. 6.

vacation. The weeks remaining in the fall semester after the Christmas holidays are commonly referred to as the "lame-duck session."

The second disadvantage inherent in the semester calendar is the asymmetry of the summer session or sessions with respect to the semester. If the summer session is 12 weeks in length, the conversion ratio will be 3 : 2; i. e., two semester-hour courses will meet three hours per week in summer session, three-hour courses will meet four hours (technically four and one-half hours), etc. If the summer session is six weeks in length, the conversion ratio will be 3 : 1, with two semester-hour courses meeting six hours and three-hour courses meeting nine hours. Teachers are reluctant to rebuild time tested lesson plans based on the more leisurely pace of the semester, so they use these same plans in the summer sessions. Students are often unhappy with the results. Term papers are due almost as soon as they are assigned. Libraries find that they do not have enough copies of books on the required reading lists--that their normal loan periods are far too long. [7]

If the full year is divided into four equal parts, or the conventional school year into three equal parts, the resulting terms are called quarters. These will be of about 12 weeks duration.

Under the quarter system, the Christmas vacation can easily be made to fall between quarters or during "intersession." Likewise, the problem of asymmetry of the summer sessions can be reduced or made to disappear. If a summer session of 12 weeks is conducted, there is no asymmetry since it will be, in length, the same as the other terms. A six-weeks summer session will be a half-quarter; the conversion ratio being 2 : 1. While not as convenient as a 1 : 1 ratio, this 2 : 1 ratio appears to be more convenient and less frantic than the corresponding 3 : 1 ratio under the semester system.

The quarter system is, however, not without its disadvantages. Records and admissions offices are quick to point out that the quarter system introduces into their operations each year an additional cycle of registration, examination, and recording of grades, and that this is expensive in both money and manpower. [8]

Institutions which attract significant numbers of school teachers to its summer offerings may find that the quarter system poses difficulties in articulation with the calendars of the schools from which the teachers come. If the Christmas vacation is to fall during intersession--one of the attractions of the quarter system--then the fall quarter cannot begin much before the last week in September. Likewise, if a brief vacation is allowed between the

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[7] At the University of California, Berkeley, the loan periods are cut in half during summer session (UCB standard form LD 21A, 1963).

[8] Interview with Myron Pollock, Dean of Admissions, California State College at Hayward, May, 1966.

winter and spring quarters, the summer quarter cannot begin much before the last week in June. Twelve weeks after the last week in June is mid-September, two or three weeks after teachers whose institutions are on the semester system must be back on the job. This may require unusual arrangements on the part of the institutions wishing to offer a summer quarter. California State College at Hayward, for example, is offering a full summer quarter and a shorter summer session concurrently, the latter for the convenience of teachers. [9]

If the full year is divided into three equal parts, the resulting terms of about 16 weeks are called trimesters. The trimester system is based on a concept of operating year-round rather than on the conventional school year--two trimesters provide about 32 weeks of school instead of 36 weeks. There are a few institutions on the trimester system which do not operate year-round in the sense that a student may attend year round and make normal progress toward his degree in each term. [10]

Since September 1 is just 16 weeks before December 22, there is little difficulty in doing away with the "lame-duck" session under the trimester system. If, however, the fall trimester is fixed at this point in the calendar, the summer trimester must begin not later than about May 11, which presents some problems in articulating with other institutions on the semester or quarter systems. If school teachers are to be accommodated at summer sessions, special arrangements must be made for them as noted above under the quarter system.

The Year-Round Calendar

Up to this point the discussion has focused on the conventional academic calendar with only incidental reference to year-round operation. Since this study proposes to develop an econometric model of the California public junior college under year-round operation, it is perhaps appropriate at this point to state a working definition of year-round operation: [11]

For purposes of this study, a college will be considered to be operating year-round when the following conditions usually prevail:

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9 *Ibid.*

10 *E. g.* Linfield College, McMinnville, Ore., 1966-67 Catalog shows two 16-week terms, Christmas vacation coincident with an intersession of three weeks, spring term ending in mid-May, and two six-week summer terms of restricted offerings. Whether these 16-week terms should be called *trimesters* or *semesters* depends on one's point of view.

11 Adapted from *A Comparison of the Trimester and Four-quarter Calendars for Year-round Operation of Public Higher Education in California* (Sacramento: Coordinating Council for Higher Education, February, 1964), p. 3. (Cited hereinafter as CCHE 1009)

1. A beginning freshman may enter at the start of any term.[12]

2. Transfer students may enter at the beginning of any term.

3. As a general rule, both entering and continuing students can enroll in courses which enable them to make a full term's progress toward their desired degree[13] or certificate.

4. Almost all students can continue in college for any number of consecutive terms in each of which they can make a full term's progress toward their desired degree or certificate.[14]

5. Near optimum use is made of the physical plant for approximately 48 weeks annually; such optimum use to include providing space for advising students, registration, instruction, and testing.

6. Student enrollment is roughly the same in all terms.[15]

Academic calendars designed to encompass the full civil calendar are by no means a recent development. For example, Harvard University from 1638 to 1801 operated with a four-term (quarter system) calendar and from 1801 to 1839 on a three-term plan (trimester system). Over the years other institutions have operated year-round within these two kinds of academic calendars.[16]

Two outcomes are generally expected from the year-round calendar: (1) better utilization of the physical facilities of the institution; and (2) opportunity for students to accelerate their programs--to accomplish four academic years of work in three calendar years. Each of these outcomes has certain ramifications for the institution. By operating year-round, an institution can, theoretically, increase its plant utilization by up to one-third. That is, if an institution now teaching n students 36 months each year taught n students 48 months, its output would become (48n ÷ 36n) one and one-third of its present output. Note that the students taught the additional 12 weeks need not be the same students. To the extent that they are, the programs of these students are said to be accelerated. Thus, if it takes four conventional school years to obtain a baccalaureate degree, the same degree may be obtained in three calendar years by students who accelerate their programs ($4 \times 36 = 3 \times 48$).

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12 However, some colleges using a four-quarter calendar may choose not to admit freshmen into a specific quarter, such as the winter quarter.

13 Degree includes both the associate degree and, in the case of transfer students, the baccalaureate degree.

14 Low demand courses need not be offered every term to comply with this provision.

15 See discussion in the following chapters.

16 Cowley (1932), op. cit., p. 5.

The mathematically inclined reader will have noted that the foregoing explanation is valid only when year-round operation is based on a four-quarter system, or some other system which recognizes about 36 weeks as a conventional school year. The trimester system of year-round operation is based on a somewhat different assumption. Since no combination of whole trimesters equates to the 36-week conventional school year, the system operates from the premise that 48 months of school constitutes one and one-half school years of work.[17] A simple division (48 ÷ 3) will show that the trimester of about 16 weeks is being equated with the semester of about 18 weeks. The validity or desirability of this from an educational point of view is outside the scope of this examination. It is fair to point out, however, that (1) compression of about 11 percent does occur (18 weeks into 16 weeks) under the trimester system; and (2) the accomplishment of one and one-half years work instead of one and one-third years work in an accelerated (or year-round) program is sometimes given as an advantage of the trimester system.[18] For purposes of this discussion, it is sufficient to note that under the trimester system, the accelerated student need attend school only 128 weeks (8 × 16) or two years and eight months to obtain a baccalaureate degree, while under the quarter system, he must attend 144 weeks (12 × 12) or three full years to accomplish the same purpose. If one wished to derive a model to compare the trimester and four-quarter systems of year-round operations, this would need to be taken into account.

The Literature (General)[19]

Stickler and Carothers[20] have produced a monograph which is perhaps currently the most widely read publication on year-round operations. The monograph, while evangelical in tone, reports the results of a study of some magnitude. A total of 54 institutions which had converted to some form of year-round operations or were studying such conversion were included in the study. Of these, 12 institutions were judged by the authors to have been able to furnish only limited information useful to the study, and one or both of the authors was able to visit 21 of the institutions.[21]

The core of the Stickler and Carothers study is contained in the second chapter which reports the status, trends, and problems encountered in

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[17] W. Hugh Stickler and Milton W. Carothers, The Year-Round Calendar in Operation (Atlanta: Southern Regional Education Board, 1963), p. 11, et seq.

[18] E. g. Increasing College Capacity by Calendar Revision, A Report to the State University of New York (Albany: Nelson Associates, 1961), p. 29. (Hereinafter cited as Nelson Associates, 1961).

[19] Review of the literature related specifically to year-round operation of higher education in California under the Master Plan will be found in Chapter II.

[20] Stickler and Carothers, 1963, op. cit.

[21] Ibid., pp. 65-66.

connection with the year-round calendar and the third chapter which deals with the financial implications of year-round operations. The latter, of prime interest to this study, is quite inconclusive and, therefore, disappointing. The authors point out:

> Relatively few institutions of higher education have adjusted their calendars and their policies in such a way as to hope for optimum use of their faculties and physical facilities. Within this group, a much smaller number have operated under their changed programs long enough for accurate statistical data relating to the financial aspects of year-round operation to be available. It is not feasible to give "before and after" comparative costs for these institutions either separately or as a group. Neither is it possible to make meaningful financial comparisons between this group and other institutions operating on traditional calendars . . . This chapter on financial implications of year-round operation must necessarily depend largely on subjective judgements of individual faculty members and administrators, faculty committees, and consultants who have had experience with new programs or who have given considerable thought and study to the subject.[22]

The authors then report that in an open end question their respondents were asked to summarize briefly the financial implications of year-round operation in their respective institutions. The condensed, grouped, and tabulated results were as follows:[23]

Comment	Frequency
Additional income will more than offset increased cost	10
Additional income and additional expense will remain in balance	6
There will be savings in capital outlay	6
Annual faculty salaries will improve substantially	6
Institutions will use facilities more effectively	5
Faculties will be used more effectively	2
Unit costs will decline	2
There will be little change in operating cost per unit	1

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22 Ibid., p. 19.

23 Ibid., p. 34.

Comment	Frequency
The change will result in a sound leave policy. . . .	1
Earnings from housing and food services can be used for other services without increasing the cost to the student	1
We have considered year-round operation in terms of service to students rather than from a financial viewpoint	1

Stickler and Carothers derive no mathematical model of an institution of higher education under year-round operation; they suggest that unit costs of operation can actually be decreased:

> Although it is not possible at present to document the statement statistically, it seems reasonable to the authors to assume that if the operation is carefully managed year-round operation of a college or university will decrease the unit costs of operation, provided that the summer enrollment can be increased to approach the enrollment level of the other periods. Fifty percent of the fall enrollment is tentatively suggested as the break-even point for a summer program comparable to that of the other periods.[24]

They also believe that the chief savings of year-round operation is in the area of capital outlay:

> The financial advantage of year-round operation is much more important in the area of capital outlay for buildings and equipment than in the area of operating cost. The financial burden of providing additional physical facilities will likely prove to be the most powerful single influence in stimulating year-round operation.[25]

The authors conclude that as enrollments mount, the trend toward year-round operation will continue to grow; the trimester calendar seems likely to emerge as the model plan; intensive and extensive studies need to be made on the effects of year-round operation on quality of education; and that particular attention needs to be paid to upgrading the character, status and attractiveness of the summer term in order to bring about a balance of enrollments among the terms, necessary to the achievement of the potential savings in year-round operation.[26]

Hungate and McGrath, writing in support of a trimester system of year-round operation, express the belief that educational rather than fiscal matters

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24 Ibid., p. 35.
25 Ibid.
26 Ibid., Chapter 5, pasim.

should receive primary consideration in any revision of the academic calendar:

> **The authors believe that educational rather than fiscal matters should receive primary consideration in any revision of the academic calendar, but potential savings cannot be regarded as inconsequential. The fourteen-week [sic] trimester plan will result in substantial economies in operating costs and material increases in teachers salaries.**[27]

They use a hypothetical college with 1,200 students presently operating on a two-semester plan and estimated the increases in cost in moving to their proposed three-trimester program.[28] They assume that a large majority of students would be in an accelerated or year-round program for the eight trimesters required to earn a baccalaureate degree.[29] Under their analysis the total annual cost of operation increased by nearly 25 percent in shifting to year-round operation, but this was more than compensated for by increased productivity to the extent that the operating cost per student semester hour decreased by 6.3 percent. According to their estimates, certain categories of expense increased as follows:

Alumni office, police, watchman, insurance, and interest	No change
Publicity, public relations, and information	5%
Most aspects of general administration, publications, utilities, grounds, roads, and walks	10%
Administration of student affairs, general institutional expense	15%
Admissions, registrar, placement, student organizations, maintenance, and repair of buildings	20%
Staff benefits in student services and in plant operation and maintenance	25%
Student advisement; testing; salaries; supplies and expense; equipment in instruction and departmental research; library salaries, books, periodicals; administration, supervision, and operation of buildings; infirmary services.	33%[30]

27 Thad L. Hungate and Earl J. McGrath, A New Trimester Three-Year Degree Program. (New York: Teachers College, Columbia University, 1963), p. vi.

28 Ibid., pp. 21-27, pasim.

29 Note that Hungate and McGrath did not vary the proportion of students choosing to accelerate their programs.

30 Adapted from ibid., p. 26 by Stickler and Carothers, op. cit., pp. 22-23.

Hungate and McGrath do not attack the problem of enrollment variations between terms. Their approach being from the point of view of educational rather than fiscal advantage, they assume, both implicitly and explicitly, that the sooner one achieves his baccalaureate degree and goes on to graduate school, or enters the labor market, the better. The institution being geared to year-round operation, year-round attendance is assumed to be the normal pattern. The 14-week trimesters enable the institution to offer two, three-week and one, four-week intersessions for a total of ten weeks of vacation per year. This the authors believe to be adequate for the modal student. They comment that "Students of limited financial means could drop out for a term or more to earn money if they had to."[31] Thus their measure of efficiency is that the institution could educate as many, or nearly as many, students in three calendar years under their trimester plan as it does under conventional operation in four school years.[32]

The classic research study of the type envisioned in this paper was conducted by Dean Elmer C. Easton of the College of Engineering, Rutgers University, a decade ago and published as a monograph in 1958.[33] In this monograph mathematical models are developed of a university operating baccalaureate, masters', and doctoral programs as well as conducting research not directly connected with the teaching programs. Easton uses two measures of output: "Plant Capacity Index" and "Degree Cost Index." Both indices have the characteristic that their relative rather than their absolute values are of major significance. Numerical values are assigned to distribution of students among classes (e. g., sophomore, second-year doctoral), to class sizes and teacher demand, and to the research program. Relative use factors of instructional facilities, of research facilities, and of the teaching staff are computed. Assumptions are made as to the number of courses required for each degree.[34] From these factors and assumptions, a "Plant Capacity Index" is computed for each of 12 calendars (called by Easton, "Programs"). In a similar manner, "Degree Costs Indices" are computed for each calendar.

Dean Easton is able by his models to make comparisons among calendars and arrive at the following conclusions:

> By adopting a year-round schedule such as Program A3 [Trimester system. Students are admitted in approximately equal numbers three times a year; attend two consecutive terms and are off for the third] in place of Program S [Semester system. Students are admitted once a year; are in class for two terms and are off during the summer], the nation's colleges could

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[31] Hungate and McGrath, 1963, op. cit., p. 14.

[32] Ibid., pp. 14-16, pasim, and particularly Table III, p. 15.

[33] Easton, op. cit.

[34] Among the assumptions are, "All freshmen take the same courses," and "There is no choice of elective courses."

(1) Grant up to 56% more degrees per year;

(2) Make up to 30% more use of instructional facilities; and

(3) Increase faculty salaries approximately 30%.

In order to gain these advantages it would be necessary to

(1) Give up some summer activities such as conferences, symposia, and short courses;

(2) Reduce faculty vacations to four weeks;

(3) In some cases, alter the traditional pattern of starting time and vacation period for students; and

(4) For maximum advantage, enforce uniform distribution of students among several entering classes per year.

Dr. Easton's research has shown the possibility of an engineering-mathematical approach and has provided valuable insights into the problem of year-round operations. The research of Nelson Associates reported below, as well as the research herein reported, are indebted to Dean Easton.

In 1961 Nelson Associates, management consultants of White Plains, New York, completed a study for the State University of New York aimed at increasing the capacity in public higher education in that state by calendar revision.[35] Four institutions were selected for specific study, each representing a major type contained within the university. These were a liberal arts college, a medical center, a teachers' college, and a community college. Generalizations were drawn which could later be tested against the particular situation of a specific institution in the system.[36]

Nelson Associates utilizes five measures of relative efficiency of one calendar over another:

1. Student Academic Years: One student academic year is equivalent to one year's academic work undertaken by one student. Other things being equal, a calendar which permits more student academic years to be completed than another is more efficient.

2. Yearly Enrollment: The number of different individual full-time students enrolled in the course of a twelve-month period. Other things being equal, a calendar which permits more yearly enrollments than another is superior in efficiency.

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35 Nelson Associates, 1961, op. cit.

36 Ibid., p. 3.

3. Number of Freshmen Admitted per Year: Other things being equal, that calendar is more efficient which provides for a larger number of entering freshmen each year.

4. Number of Graduates per Year: Changes in freshman enrollments result in changes in number of graduates per year. When calendar revision occurs, retention rates may remain constant or may be affected by the revision. Hence the number of graduates per year may or may not vary directly with the number of freshmen admitted. Other things being equal, that calendar is more efficient which produces more graduates per year.

5. Cost: It is clear that if two calendar systems are otherwise alike in character and results, the one which gets these results at lower cost is more efficient. Both capital and operating costs are relevant measures; for purposes of comparison operating cost per Student Academic Year and capital cost per student place are most useful.[37]

The study discards space utilization as a measure of efficiency. One entire appendix to their report is devoted to an explanation of this decision.[38]

The Nelson Associates study defines several "optimum conditions for year-round operations:"[39]

A. Conditions which produce maximum advantages:

1. Terms of equal length, character and status;

2. Equal admissions every term;

3. As many full length terms as can be fitted manageably into the calendar year (i. e., if fifteen-week terms, three terms; if eleven or twelve-week terms, four terms).

B. Conditions which produce a minimum of disruption:

1. Year-round operation can be installed without requiring year-round teaching by the individual faculty members.

2. A year-round calendar does not imply the necessity for acceleration by the student.

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[37] Ibid., pp. 14-15.

[38] Ibid., pp. 16-17, pasim., and Appendix A.

[39] Adapted from ibid., pp. 18-20, pasim.

3. Course reconstruction can be kept to a minimum. Especially, major overhauling may be avoided if schools now operating on a quarter system remain so, and similarly with those now using a semester-length term.[40]

Nelson Associates then develop a "concept of the balanced calendar." This concept involves the admission of equal numbers of first-time freshmen at the beginning of each quarter or trimester by an institution under year-round operations. The students so admitted would attend the next three quarters, or two trimesters, and take the following term off. This leads to a balance of enrollments among the terms. With this balance among the terms, and on the assumption that each group of first-time freshmen will exhibit the same persistence characteristics, the institution can be at or near full capacity each term. Although the authors state that their concept offers opportunities to accelerate for students who wish to do so,[41] those who do remain as an anomaly outside their model; and must therefore be regarded as few in number.

With high schools graduating classes once or twice each year and colleges under the balanced calendar admitting first-time freshmen in controlled numbers three or four times a year, a number of high school graduates would have to wait up to six or more months before they could begin their college work.

The Nelson Associates present eight general conclusions:[42]

1. A balanced year-round calendar provides the best means of increasing college capacity through calendar revision. A balanced calendar is characterized by equal term enrollments and admissions every term.

2. The balanced trimester calendar is slightly superior in efficiency to the balanced four-quarter calendar; but either system is far superior in efficiency to the conventional calendar, whether semester or quarter.

3. The balanced calendar system permits:

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40 The liberal arts college and the teachers' college were operating semesters of less than 16-weeks duration which could be converted to trimesters. The community college was on the quarter system. Condition B3 could therefore be reconciled with condition A3. The medical center was operating 20-week semesters. The "optimum conditions" were modified in this case and a solution suggested in which a new class was admitted every nine months, attended school the next nine months, was off three months, attended the next nine months, etc.

41 Nelson Associates, op. cit., p. 21.

42 Abridged from ibid., pp. 105-106.

58% more freshman admissions,		45% more freshman admissions,
58% more graduates,	(and)	45% more graduates,
71% more yearly enrollment,		61% more yearly enrollment,
58% more student academic years,		45% more student academic years,
produced under a trimester plan		produced under a four-quarter plan

than is possible under conventional calendars, without increasing the number of students on campus at any one time.

4. When equal term enrollments are not possible because equal admissions every term are not achieved, substantial advantages can still be obtained by modification of the balanced calendar.

   Even if, for example, spring admissions were only 22% of the total (56% admitted in the fall), such a pattern would permit a 32% increase in freshmen admitted, in seniors graduated and in student academic years produced, as compared with the typical semester calendar, and would also produce a 37% increase in yearly enrollment.

5. The advantages of year-round operation appear to be as great for two-year colleges as for four-year colleges.

6. Although operating costs per student will decline, total operating budgets will rise as college capacity increases with calendar revision. Increased outlays for staffing of administrative and maintenance functions will be required, although they will not increase in proportion to enrollment. Instructional costs, on the other hand, will rise in approximate proportion to increases in enrollment.

7. Balanced calendars will result in markedly reduced capital costs per student place. These savings are due to the fact that more full-time students can be accommodated in the same facilities. This saving does not apply to faculty office and research space. Each faculty member will require his own space during the entire year, just as he does at present.

8. Enrollment capacity can also be increased by lengthening the academic day and week, but only to the extent that the capacity of non-instructional space permits.

Nelson Associates develop a basic model and several versions of this model for both four-year and two-year colleges under the three-semester and four-quarter systems of "balanced" year-round operations. Attrition is taken account of, but the modal student is idealized to the extent that he is full-time and either graduates on time or drops out under the attrition effect; i.e., he does not partially fail and repeat thereby extending his demand on the system. The net attrition used is 50 percent to graduation in the four-year colleges and

25 percent to graduation in the community colleges.[43] As has been mentioned, students attending year-round are outside the model. Nevertheless, the Nelson Associates study is thorough, the model development sound and the concept of "balance" is useful for comparison against models developed in a "free" or unrestricted system.

Tickton has written a brief work that is often cited in connection with year-round operation.[44] He attempts no quantification, derives no model nor does he advocate any particular calendar or method of achieving year-round operation. He summarizes data on 40 institutions committed to, or operating on, year-round calendars. The chief interest of Tickton's work from the point of view of this study is this summary which rather clearly indicates that as of 1963, no academic calendar had emerged as best or even clearly as the most popular method of achieving year-round operation. One might predict that the shift of both four-year segments of public higher education in California to the four-quarter calendar by 1970 might change this by sheer weight of numbers.

There is inherent in the problem of year-round operation a syndrome which might be termed the "Empty Schoolhouse Effect." It is not confined to higher education and, although more pronounced in public education than in private education, is by no means confined to the former. It is based on the high visibility of the empty educational plant during periods of academic vacation or reduced utilization. Attacks against the inefficiency of educational plant utilization, whether justified or not, are relatively easy to write and attract attention in the popular press. All, or almost all, of the funds for capital outlay for public institutions comes from the public purse. Much, or perhaps most, of these funds for private institutions come from gifts and donations. Statements to the effect that school teachers "have it easy" working only nine months a year, or schools should be put on a "business-like basis" and operated year-round like businesses can defeat a bond issue or spell disaster for a building fund drive if said often enough, loud enough, and in the right places.

Much of the literature of year-round operations is bound-up in this syndrome to the extent that it is at best suspect, at its worst beneath recognition in any serious attempt to examine the problem. Not all of this literature is restricted to the popular press. Two examples should suffice.

Bauman has written a monograph on the advantages of a four-quarter calendar in the public schools.[45] Under his plan, the school is operated 11

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43 As will be shown later, this community college attrition rate is much lower than the effective attrition rate for the California public junior colleges.

44 Sidney G. Tickton, The Year-Round Campus Catches On (New York: Fund for the Advancement of Education, 1963).

45 W. Scott Bauman, The Flexible System: An Analysis of Advantages of the Quarterly Calendar in Public Schools (Toledo: Business Research Center, College of Business Administration, University of Toledo, 1966).

months a year, being closed during the month of July. The 11 months are divided into four quarters. Students attend three of the four quarters or (11 × .75) eight and one-fourth months.[46] Vacation for a student consists of the month of July plus his "off" quarter. Teachers get the month of July off. Although they teach 22.2 percent more time, Bauman feels that a 20 percent raise in their pay would be satisfactory. Since, according to Bauman, only 75 percent of the teachers would be required to teach the same number of students, the net salary savings would be 10 percent. He illustrates:[47]

Contract Period	Number of Teachers Needed	Average Salary	Total Payroll
Traditional - 9 mos.	100	$6,000	$600,000
Flexible - 11 mos.	75	7,200	540,000
		Savings in dollars:	$ 60,000
		Savings as a percent:	10

[One would suspect that Dr. Bauman does not need a lesson in arithmetic (9/11 = 82%, not 75%) but rather appears to feel, without so stating, that students can really be taught as much in eight and one-fourth months as they are in nine months. All that is needed is an increase in the "efficiency" of education by nine percent!]

Bauman estimates that annual savings in operating expenditure of 9.1 percent and in capital outlay of 11.8 percent would be realized under his plan.[48] This is in contrast to other studies[49] which concludes that the savings in capital outlay are "one-time savings in that once the system achieves the savings in plant utilization the annual need for increased capital outlay due to increase in enrollment continues at the same rate. Bauman reasons that after year-round operations is achieved, every new student station provided for increased enrollment provides for about 1.25 [sic] times as much education as the same station would have provided under conventional operation.[50] Stated another way in another study, ". . . for any specific large increase in projected enrollment, less space will be needed under year-round operation than under the traditional academic year. . ."[51]

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46 Ibid., Chapter V.

47 Ibid., p. 11.

48 Bauman, op. cit., Chapter IV.

49 Nelson Associates, p. 16, and Appendix A.

50 Bauman, op. cit., p. 18.

51 CCHE 1009, p. 11.

Bauman finds numerous advantages to year-round operation.[52] The only disadvantage he admits is the difficulty which small school districts might encounter were they to adopt year-round operation.[53] Bauman emphasizes throughout his paper the high visibility of the "empty schoolhouse" to the taxpayer.

Jeri Engh has published an article in the Saturday Review,[54] later condensed for the Reader's Digest,[55] advocating a four-quarter system beginning with kindergarten and with most students attending three quarters per year. The article loses much of its objective tone in condensation, which is unfortunate since the Reader's Digest has a far wider circulation than the Saturday Review.

According to the Reader's Digest version, Engh reports in glowing terms of the results achieved with four-quarter terms employed in Newark, N. J., from 1912 to 1931 and for ten years each in Ambridge and Aliquippa, Pennsylvania, in the 1920s and 1930s.[56] In view of the enthusiastic tone of the article, it is disappointing to learn that a Ford Foundation investigation disclosed that these programs were discontinued because of "public resentment against vacations during seasons other than summer."[57]

Engh argues that the situation has changed to the extent that year-round operations could now be introduced with public acceptance and support. He cites (1) the rise in popularity of the off-season vacation; (2) the desire of modern industrial organizations to schedule vacations of their employees throughout the year; (3) the desirability of having graduates hit the labor market four times a year; and (4) the increasing popularity of year-round operation in higher education.[58] Engh then concludes that the chief advantage of year-round operation is to be found in savings in capital outlay.[59]

The article concludes by hitting the "empty schoolhouse effect" rather hard, after discussion of the apparent lack of acceptability of year-round operation in the past:

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52 Bauman, op. cit., pp. 34-37.

53 Ibid., p. 31.

54 Jeri Engh, "The Case for Year-Round Schools," Saturday Review, September 17, 1966.

55 Jeri Engh, "The Case for Year-Round Schools," Reader's Digest, December, 1966.

56 Bauman reports, p. 13, that Aliquippa used the quarter system for ten years and Ambridge for six years.

57 Engh, Reader's Digest, p. 143.

58 Ibid., p. 144.

59 Ibid.

> . . . Yet economic pressure, coupled with clear educational advantages, is likely to produce increasing interest. "I believe," said an educational administrator recently, "we're rapidly approaching a point where the American taxpayer is going to tell us: 'No more money until you better utilize the facilities you have.'" . . .[60]

Several points emerge from a review of the works of Bauman and of Engh. The first point has been well expressed by another research referring to other, but similar, studies: "Both sets of documents are based more upon reasoned argument than upon evidence, a characteristic of almost all material dealing with calendars and calendar changes."[61]

The second point involves articulation of higher education with the secondary schools. There appears to be little doubt that if the lower schools were on year-round operations, the problem for higher education would be eased considerably. Inputs of secondary school graduates would be available three or four times a year. If these graduates were available in approximately equal numbers each time, the "balance" advocated by Nelson Associates, and of undoubted benefit to high plant utilization in higher education, would be almost self-achieving. Moreover, under such condition the year-round calendar would be familiar to the incoming students and to the public. Given reasonable micro-articulation of the year-round calendars of the lower schools and higher education (beginning and ending dates of terms), the problem of providing continuing education to secondary and elementary teachers in a year-round calendar would be eased or would disappear.

The third point has already been emphasized; the high visibility to the taxpayer of the "empty schoolhouse" during the summer vacation. It is entirely conceivable that an institution or system may find it prudent to move to a year-round calendar with little or no savings anticipated merely because to remain with the conventional calendar would almost insure failure of a bond election or a capital fund drive.

In the following chapter the particular problem facing public higher education in California, and specifically the California public junior colleges, will be examined in light of decisions already taken. Research conducted in connection with this problem will be reported and reviewed in that chapter.

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60 Ibid.

61 CCHE No. 1009, Appendix B, p. 42.

Chapter II

YEAR-ROUND OPERATION AND

CALIFORNIA PUBLIC HIGHER EDUCATION

The Master Plan for Higher Education in California, published in 1960, recommending inter alia, that the Coordinating Council for Higher Education:

> ...study...the relative merits of the three-semester and four-quarter plans for year-round use of the physical plants of both public and private institutions, and on the basis of that study recommend a calendar for higher education in California.[1]

In January, 1964, the Coordinating Council determined that the four-quarter system of year-round operations was best for California.[2] Both the University of California and the California State Colleges are engaged in a transition to the four-quarter system of year-round operations at this time. The entire University shifted to the quarter system in the fall of 1966. The Berkeley campus of the University is now on a four-quarter system. The Los Angeles campus will be on the four-quarter system in 1968, to be followed by the other campuses. Among the State Colleges, both campuses of California State Polytechnic College as well as California State College at Hayward are on the four-quarter system. State Colleges at Dominguez Hills, San Bernardino, and Stanislaus are now operating on a three-quarter system, with plans to shift to the four-quarter system when each achieves a sufficiently large enrollment. Plans have been announced to place California State College at Los Angeles on the four-quarter system in the summer of 1967, subject to the availability of funds. The other large State Colleges have plans to shift to the four-quarter system by 1970.[3] Thus, by this date both systems should be operating entirely on the four-quarter system.

In the case of the public junior colleges, the Coordinating Council recommended that in light of its recommendation that the University and the State Colleges proceed with year-round operations:

> ...each Junior College governing board appraise the recommendation's impact upon the transfer of its students, articulation with other segments of education, and other related matters; and on that basis determine the advisability of conversion to a four-quarter calendar.[4]

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[1] A Master Plan for Higher Education in California, 1960-1975 (Sacramento: California State Department of Education, 1960) p. 98.

[2] CCHE, op. cit., pp. ii, iii.

[3] "Minutes of the Junior College Advisory Panel to the California State Board of Education," meeting of September 16-17, 1966 (Sacramento: 1966).

[4] CCHE 1009, p. iii.

Of the 78 public junior colleges operating in school year 1966-67, none is on the four-quarter system. Only Chabot College has shifted to the three-quarter system (conventional nine-month school year divided into three terms). Merritt College and College of the Redwoods have announced their shifts to the three-quarter system in the fall of 1967. No public junior college has announced a date for shift to the four-quarter system. On October 13, 1966, the State Board of Education requested each junior college governing board to comply with the recommendation of the Coordinating Council cited above and reminded the local boards that the decision is theirs to make.[5]

Thus, the decision has been taken that (1) the University of California and the California State Colleges will shift to year-round operations by 1970; (2) the four-quarter system of year-round operations will be the system used in California; and, (3) responsibility for the calendars of the public junior colleges has been left to each of the 66 local boards of trustees.

Earlier Studies on California

Two studies[6] were prepared by the Council staff in support of the Coordinating Council's decision-making process.[7] The first study,[8] after defining year-round operation,[9] examines the benefits and problems of year-round operation.[10] These are, briefly:[11]

Benefits of Year-Round Operation

1. Year-round operations provide education for the largest possible number of students in a given physical plant.

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[5]California State Board of Education, "Summary of Actions Taken October 13-14, 1966" (Sacramento: 1966).

[6]CCHE 1009, op. cit., and Cost Estimates for Year-Round Operations at the University of California and the California State Colleges (Sacramento: Coordinating Council for Higher Education, March 16, 1964) (hereinafter cited as CCHE 64-5).

[7]Much of the information relative to the CCHE part in the selection of the four-quarter system was obtained in interviews with Willard B. Spalding, Director, and Franklin G. Matsler, Staff Member, CCHE, in September, 1966, and from the statement of Keith Sexton, Assistant Director, before the Junior College Advisory Panel, September 16-17, 1966.

[8]CCHE 1009, op. cit.

[9]See Chapter I, p. 5, supra.

[10]CCHE 1009, op. cit., pp. 9-14.

[11]Abridged from ibid., pp. 10-14.

2. Requirements for capital outlay funds are both delayed and reduced while income to fund auxiliary enterprises [e.g., cafeterias, dormitories] is increased.

3. Year-round use provides greater flexibility in respect to many faculty options and opportunities.

4. Year-round operation accords greater flexibility to student options and opportunities.

Problems of Year-Round Operation

1. Both faculty and students may become fatigued with continuous programs.

2. The year-round operation of an institution may result in the understaffing of administrative and other central offices and services.

3. Articulation with secondary schools and other institutions of higher education not on year-round operation may be less effective.

4. To be efficient, year-round operation requires adequate enrollment in classes offered during each term.

5. Year-round operation may cause an institution to compress a term into too few weeks.

The study then proceeds to examine the relative advantages and disadvantages of the trimester and four-quarter methods of achieving year-round operations, concluding:[12]

1. There is no evidence to show that the kind of academic calendar in use will influence the quality of education programs.

2. The four-quarter calendar may be more appropriately applied to the California systems of public higher education than the trimester plan because of its greater flexibility, better articulation with other educational institutions and greater educational service to the state from institutions not operating year-round.

3. Best results will be obtained if the University of California and the California State Colleges and the California public Junior Colleges have the same system-wide basic calendar.

4. Since the four-quarter calendar is best for year-round operation, its use in colleges and on campuses not on year-round operation will provide the best articulation with those which do operate year-round.

[12] Ibid., pp. 28-29.

5. Differences in costs of year-round operation under a four-quarter calendar as compared with a trimester calendar are not of such magnitude as to warrant rejection of this calendar.

6. Some added second level administration will be required when a college or campus moves to year-round operation.

7. Although each system should develop requirements by which it determines when a given campus or college should add a fourth quarter, the requirements of each system should aim toward providing more education for more students within prudent increases in operating costs due to year-round operation.

8. The year-round operation of public schools, colleges and universities has won strong support, particularly from governing boards, legislators, and the public on the principle of better use of physical plant. The full benefit of this can be achieved only by the fullest possible, reasonable use of facilities.

9. With the number of governing boards in charge of the public Junior Colleges, it is not feasible to obtain with any degree of immediacy a unified action on year-round operation. Moreover, with the great range in full-time enrollments among the Junior Colleges, statewide actions should exempt those with minimal enrollment.

10. A special summer school may be needed for teachers and others whose duties conflict with a summer quarter.

This first study was presented to the Coordinating Council in connection with its meeting of October 29, 1963. As a result of that and subsequent meetings the Council, on January 28, 1964, determined that the four-quarter system of year-round operation was best for higher education in California.[13] The Council continued examination of the problem and determined on February 28, 1964, that more comprehensive cost analyses needed to be developed by the Council staff in cooperation with the University and the State Colleges.[14] This resulted in the second staff study.[15] As an appendix to this second study, an econometric model of the four-year institution under the four-quarter system of year-round operation was developed.[16] The model assumes that dropouts and transfers will equal each other[17]--which makes it a no attrition model. Since the decision had already been taken to leave the question of conversion

[13] Ibid., pp. ii, iii.

[14] CCHE 64-5, op. cit., pp. iii, iv.

[15] CCHE 64-5, op. cit.

[16] Ibid., Appendix A.

[17] Ibid., p. 11.

of the junior colleges to the four-quarter system up to their respective local governing boards, the model was not applied to the two-year colleges.[18] It should be noted parenthetically that when one does so apply the model he obtains unexpected results--there is neither gain nor loss in plant utilization in the case of the public junior college. This is because a total of six quarters (18 school months) is required to complete the two years of junior college under a no attrition model. Approximately 95 percent of all California public high school graduates are graduated in June. Such a graduate wishing to accelerate his program enters a junior college at the beginning of the summer quarter, on or about July 1. Under conditions of no attrition, he graduates from junior college at the end of December, 18 months later. Since no recent high school graduate is available to take his place, his student station will remain unoccupied through the winter and spring quarters until the next high school class has graduated. Thus, he has occupied his space in the junior college for six of eight quarters generating a plant utilization efficiency of 75 percent. Likewise, his classmate who conventionally takes the summer quarters off occupies his space six of eight quarters for a plant utilization efficiency of 75 percent. In the case of the four-year institution, the accelerating student in a no attrition model finishes in three years, leaving his space vacant at precisely the moment when another accelerating student is ready to take his place.

In the junior college field, a study team in the Los Angeles Junior College District under the leadership of John L. Reiter has published a summary report of their work on year-round utilization of college facilities.[19] In chapter 9 of their report, they do some quantitative work comparing two versions of the semester-plus-summer, the trimester, and the quarter plans of year-round operations, using costs and enrollment figures for that district for fiscal year 1963-64. Their unit of output is average daily attendance. Their results show:

		A. d. a.	Comparison
Semester + One Summer Session (present)		38,619	100.00%
Semester + Two Summer Sessions	Year Round	40,296	104.34%
Quarter Plan	Year Round	38,839	100.56%
Trimester Plan	Year Round	40,064	103.74%

The Los Angeles study group did not examine in depth the effect of acceleration under year-round operations, apparently because summer session enrollment in the district is currently in excess of 60 percent of the fall semester enrollment. They did, however, look into added administrative costs of year-round operation in considerable detail.

18Interview with Dr. Matsler, loc. cit.

19John L. Reiter, Year-Round Utilization of College Facilities: A Summary Report (Los Angeles: Los Angeles City Schools, 1965).

Professor W. B. Simpson, Department of Economics, California State College at Los Angeles, has done a study[20] in preparation for that college's shift to year-round operations in the summer of 1967. His study, in four sections, addresses itself to:

1. Prediction of summer quarter enrollment[21] ratio G.
2. Faculty requirment[22] ratio T as a function of G.
3. Summer quarter faculty budget as a function of T; 12-month budget as a function of T; etc.
4. Faculty rotation models[23] as a function of T.

Unfortunately his work is less applicable for junior college purposes because he uses a low attrition ratio which turns out to be not significant in his results. A markedly higher attrition rate would be required in an examination of public junior colleges. Also, his prediction model is based on the situation in the state colleges where large numbers of school teachers are attracted to summer offerings with summer enrollments before conversion to year-round operations often reaching 60 percent or higher of fall enrollments.[24] The picture of the projected summer quarter at the state colleges presented by Dr. Simpson's model is further complicated by the fact that the current well-attended summer sessions are self-supporting. That is, the fees charged the students cover essentially all the costs of the session. The projected summer quarter would, of course, be essentially tax supported.[25]

The California Public Junior College: A Peculiar Problem

As has been indicated, most of the literature and research has been concerned with discovering savings, chiefly in plant utilization, in the four-year institution. It has also been noted that some of the literature is evangelical in tone; the authors' enthusiasm influencing his objectivity. The reason for this enthusiasm is not difficult to uncover. Customarily, in the United States, students attend school for nine months a year and take three months vacation

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20W. B. Simpson, "Cal. State Los Angeles Year-Round Study Committee Reports," mimeo. in four volumes, (Los Angeles: The California State Colleges, 1966).

21Ratio of summer quarter enrollment to fall quarter enrollment; by Simpson's notation, ratio G.

22Ratio of number of faculty required to teach the summer quarter to the number required to teach the fall quarter; by Simpson's notation, ratio T.

23Models showing patterns of "quarters off" for the faculty under varying conditions of faculty requirements (ratio T).

24*Ibid.*, Vol. 1, pasim, and JCAP Minutes, September 16-17, 1966, pp. 8-13, Remarks of David Clark representing the California State Colleges.

25*Ibid.*

in summer. The baccalaureate degree program takes four school years to complete or 36 months. If a student went to school year-round, he could complete a 36-months program in exactly three calendar years. With Thanksgiving and Christmas vacation, plus a few days at each intersession, he would have a total of four weeks vacation each year which is about standard for the wage earner in America.

The difficulty arises in getting this simple and theoretically sound model to work in real life. Even the most enthusiastic proponents of year-round operation in the four-year institutions are concerned with this--their concern varying inversely with their enthusiasm.

However, there is an additional dilemma in the application of this model to the two-year institution--particularly to the California public junior college with its open door policy. While the model works for the individual, it does not work for the institution. A two-year program is designed to be completed in 18 months. An able student who goes year-round can complete his program in 18 months and, hopefully, transfer to a senior institution with an articulating calendar where he can complete his work there in an additional 18 months. But, 18 months is one and one-half years. The junior college which he leaves must find a replacement for him if it is to keep its plant utilization high. Unless its feeder high schools are graduating substantial numbers at midyear, this is likely to prove impossible.[26] But most junior college students are not, in fact, able students who carry successfully full academic loads term after term until they complete their programs.

The high-attrition, low-persistence, characteristic of the junior college student is critical to a consideration of plant utilization under year-round operations. In the fall semester of 1965, the freshmen outnumbered the sophomores almost three-to-one statewide in the California public junior colleges.[27]

The effective attrition pattern is further complicated by the relatively large numbers of part time students in the junior colleges. Many students carry loads of approximately two-thirds or one-half of a full load. If these students persist, their attendance patterns in terms of demand for student spaces will vary widely over time from that of the full time student.

Attrition or its complement, persistence, presents the junior colleges with a problem which is virtually unexplored. Easton used attrition in his model, but his attrition was the mean of that of all American engineering colleges for four-year programs. In his model, of 330 freshmen who enrolled

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[26]About 95 percent of all California public high school graduates are graduated in June (CCHE 1009, op. cit., p. 13). A large number of those who are not are in the Los Angeles Junior College District (Source of 13th Grade Enrollments, Los Angeles City Schools, School Year 1965-66).

[27]Figures from Bureau of Educational Research, State Department of Education, Sacramento.

initially, 205 enrolled in good standing as second-semester seniors three and one-half years later.[28] This attrition rate is far too low for the California junior college; so low as to preclude modification of any portion of Easton's model for the problem at hand. Nelson Associates also used attrition in their model; 75 percent of those who enrolled graduated at the end of six quarters in the junior college. Not only is this attrition too low for the problem at hand, but Nelson Associates removed the influence of attrition by feeding into the model the same number of first-time freshmen at the beginning of each term. (Given the same attrition rate for each class, accepting new classes into the system at the beginning of each term will result in balanced enrollment among the terms regardless of the attrition rate assigned.)[29] The model developed by the Coordinating Council staff in 1964 eliminated attrition by making the assumption ... "that dropouts and transfers will equal each other."[30]

Problems of attrition, indeed the entire question of balancing enrollments among the terms, could be avoided by the use of controlled enrollment practices in the manner of the Nelson Associates model. Control of enrollment and of attendance patterns of students by the institution could insure the success of year-round operation. The institution could deliberately establish a policy designed to increase the number of students in the institution during periods of low enrollment and decrease the number during peak periods. To do this requires a "seller's market" with the institution in the role of purveyor and more prospective students clamoring at the gate for admittance than can be accommodated. One can visualize a prospective student being accepted for future enrollment and being handed a tag with a number thereon corresponding to his position on a waiting list. When it is most economical for the institution in terms of plant utilization, he will be notified and permitted to enroll. This device is, however, denied to the California public junior college by the open door policy. Addressing itself to the problem of controlling enrollment and attendance patterns as a device to increase the efficiency of year-round operation, the Coordinating Council staff noted:

> Requiring students to enter college at the start of a specific term and to attend subsequently only in assigned terms, or requiring them to attend all consecutive terms until graduated would be a drastic departure from present practices. Most college administrators prefer to use other means to distribute students among terms.[31]

Later in their discussion, the Council staff noted that necessity may force a change in this general policy:

> Colleges or campuses which initiate year-round operation will probably prefer to use advice and allurement rather than compulsion. However, the necessity of greater control may arise when the number of persons desiring to enter college rises sharply in relation to available space.[32]

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[28]Easton, op. cit., p. 4.

[29]Nelson Associates, op. cit., Exhibit F facing p. 32.

[30]CCHE 64-5, op. cit., p. 11.

[31]CCHE No. 1009, op. cit., p. 10.

[32]Ibid.

In a practical context, the California public junior college is sharply restricted in the options available when considering year-round operations. The Coordinating Council has, in effect, decided that the four-quarter system is the best method of achieving year-round operation in California.[33] The Council requested that each junior college governing board examine its own local situation and on that basis determine the advisability of conversion to a four-quarter calendar.[34] Recently, the State Board of Education, on the advice of its Junior College Advisory Panel, has invited the attention of the local boards of trustees to the necessity of study of the advisability of conversion to the four-quarter calendar (emphasis supplied).[35] It appears that there are only three options available to the local boards in reaching their decision:

1. Remain on the semester system.

2. Convert to the four-quarter calendar.

3. Convert to a three-quarter or three-and-one-half quarter calendar.

It would also appear that conversion to the trimester calendar, or to some other calendar, has been ruled out by decisions already taken. The statement of the Coordinating Council's representative before the Junior College Advisory Panel[36] as well as a careful reading of the Council's resolution of January 28, 1964, indicates clearly that this is the case.

The pressures on local boards to make a conversion to some form of the quarter calendar can, of course, be assessed only on a case-by-case basis. There are, however, certain pressures which bear on every local board to some degree. Two of these can be identified readily. The first is the high visibility of the "empty schoolhouse." This has been discussed in Chapter I.[37] The second is the influence on the junior colleges, on its board of trustees, and on the constituent electorate in the district of the University and the State Colleges, which are in the process of converting to the four-quarter system. Attempts have been made to minimize this influence, particularly by Vice-President Frank L. Kidner of the University of California:

> It doesn't matter if all the junior colleges go on the quarter plan, if some of them go on the quarter plan, or if none of them go on the quarter plan--articulation (with the University of California) will not become a major problem.[38]

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[33]Ibid., pp. ii, iii, resolution of the Council.

[34]Ibid.

[35]State Board of Education, "Report of Actions Taken, October 13. 1966," op. cit.

[36]JCAP Minutes, op. cit., pp. 5-6, statement of Keith Sexton, Associate Director, CCHE.

[37]Pp. 16 and 19, supra.

[38]Quoted in Reiter, op. cit., p. 60, as of November 1964, confirmed in an interview with Dr. Kidner, September, 1966.

Nevertheless, the conversion of the University and of the State Colleges to the four-quarter system has received wide notice in the press. This conversion inevitably emphasizes the "empty schoolhouse" syndrome with respect to the junior college which elects to remain on the semester system. It is hardly coincidental that the first two junior colleges to announce conversion to the quarter system are located in the county which first had both a State College and a campus of the University within its borders operating on the four-quarter system.[39]

It would appear that the California public junior college is, in mid-1967, faced with a problem of academic calendar which may be stated, in general terms, as follows:

1. There is a degree of pressure to convert to a quarter calendar, eventually to a four-quarter calendar.

2. Such conversion must take place without significant modification to the open door policy. This policy, explicitly or implicitly, demands:

   a. That all applicants who are high school graduates or who are over eighteen years of age and able to profit from instruction be accepted as students and,

   b. That no eligible student will be denied admission. This implies, in general terms, the provision of facilities and faculty to handle whatever number of students apply and in the term beginning next after they apply.

If the foregoing is accepted, one immediate and important constraint emerges. Control of enrollments or of attendance patterns, such as are inherent in the models of Easton and of Nelson Associates, is not available as a device to achieve balanced enrollment among quarters. This constraint does not preclude reasonable efforts at persuading students to enroll in quarters of expected low enrollment, such as engaging distinguished faculty to teach these quarters, offering of highly attractive elective courses in these quarters, preference in scheduling or in parking space assignments for subsequent high enrollment quarters, and similar inducements, as well as encouragement of year-round attendance by students whose scholastic ability and personal situation indicates they can handle such a pattern. Stated another way, it is clear that the student operates in a buyer's market, not the junior college in a seller's, with respect to enrollment and attendance patterns.

It would appear from the foregoing, that any model which portrays, with a reasonable degree of realism, the California public junior college under year-round operation must take account of the following constraints:

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[39] Chabot College, Merritt College--Alameda County--California State College at Hayward, University of California, Berkeley.

1. The four-quarter system of year-round operation must be employed.
2. No control of input may be employed. Students must be admitted in the quarter beginning next after they apply.
3. Account must be taken of the once-a-year graduation pattern of the feeder high schools.
4. Account must be taken of the high attrition, low persistence characteristic of the junior college student.

Chapter III

DERIVATION OF A THEORETICAL MODEL

A simple model of the two-semester calendar operating in a public junior college with its feeder high schools graduating one class a year can be derived as follows:

Let E represent the demand in terms of enrollment placed on the junior college in any term by the class which graduated from high school last June (E may be expressed in credit hours of enrollment, or in full-time equivalent students); then,

Let E' denote the demand of the class graduated a year ago last June, E'' the class graduated a year before that, etc.; and

Let the subscript 0 denote the initial term of a particular class in the junior college, 1 denote the next term, etc.; and

Let F indicate the fall semester and Sp indicate the spring semester. Then:

F	Sp	F	Sp	F	Sp	F	Sp
E'''_0	E'''_1	E'''_2	E'''_3	E'''_4	E'''_5	E'''_6	E'''_7
		E''_0	E''_1	E''_2	E''_3	E''_4	E''_5
				E'_0	E'_1	E'_2	E'_3
						E_0	E_1

Assuming that students do not persist in significant numbers in the junior college longer than four academic years, the matrix enclosed by the solid lines represents an accurate model of the demand made on the college in any given year by those students who go directly from high school into junior college.

The lines, or rows, in the matrix represent the demands made on the junior college by each successive annual high school input. The columns represent the terms. The total demand in any term is, therefore, the sum of the column representing that term.

A utilization index[1] for the system can be computed from this model. In Chapter I, the "year" of year-round operations was defined as containing approximately 48 weeks,[2] the "semester" as containing approximately 18 weeks,[3] and the quarter as containing approximately 12 weeks.[4] Now, assuming that a system may not operate at more than "capacity," the values of the E's in the matrix can increase until the sum of any column reaches capacity. At this point the entire system has reached capacity. One must then either increase capacity (i.e., expand the physical plant) or introduce a new system (i.e., revise the academic calendar). Given these restraints, one can note that in the model, $E_0 > E_1$, $E_2' > E_3'$, ..., $E_6''' > E_7'''$, hence the sum of column F $[\Sigma(F)]$ is greater than the sum of Column Sp $[\Sigma(Sp)]$ or, that the enrollment in the fall semester exceeds the enrollment in the spring semester. The utilization index of the system is then--

$$\frac{\Sigma(F) + \Sigma(Sp)}{2 \; \Sigma \; (F)} \times \frac{36 \text{ weeks}}{48 \text{ weeks}} = .75 \; \frac{\Sigma(F) + \Sigma(Sp)}{2 \; \Sigma \; (F)} .$$

This is, of course, a specific statement of the generalization that in a matrix of this type, utilization may be expressed as:

$$\frac{\Sigma \text{ (values of all the cells)}}{\text{Number of columns} \times \Sigma \text{ (largest column)}} \times \frac{\text{Duration school year in wks}}{\text{48 weeks.}}$$

The Problem of Attrition

As a practical matter, it is highly unlikely that in any two years the same number of recent high school graduates would enter the system. However, in a theoretical examination, one may arbitrarily make these numbers equal to simplify examination of the system. If then, E = E' = E'' = E''', the matrix for the semester system becomes--

F	Sp
E_6	E_7
E_4	E_5
E_2	E_3
E_0	E_1

[1] The term "utilization" has been selected rather than "efficiency" because of the standardized use of the latter term in engineering as output divided by input. What is being dealt with here is output divided by theoretically possible output. Maximum possible utilization is therefore 1.

[2] P. 6, subparagraph 5.

[3] P. 3.

[4] Ibid.

ERRATUM

Figure 1, "Discrete Values of E," which appears on page 33 of <u>An Econometric Model of the California Public Junior College Operating Year-Round,</u> should have been presented graphically as follows:

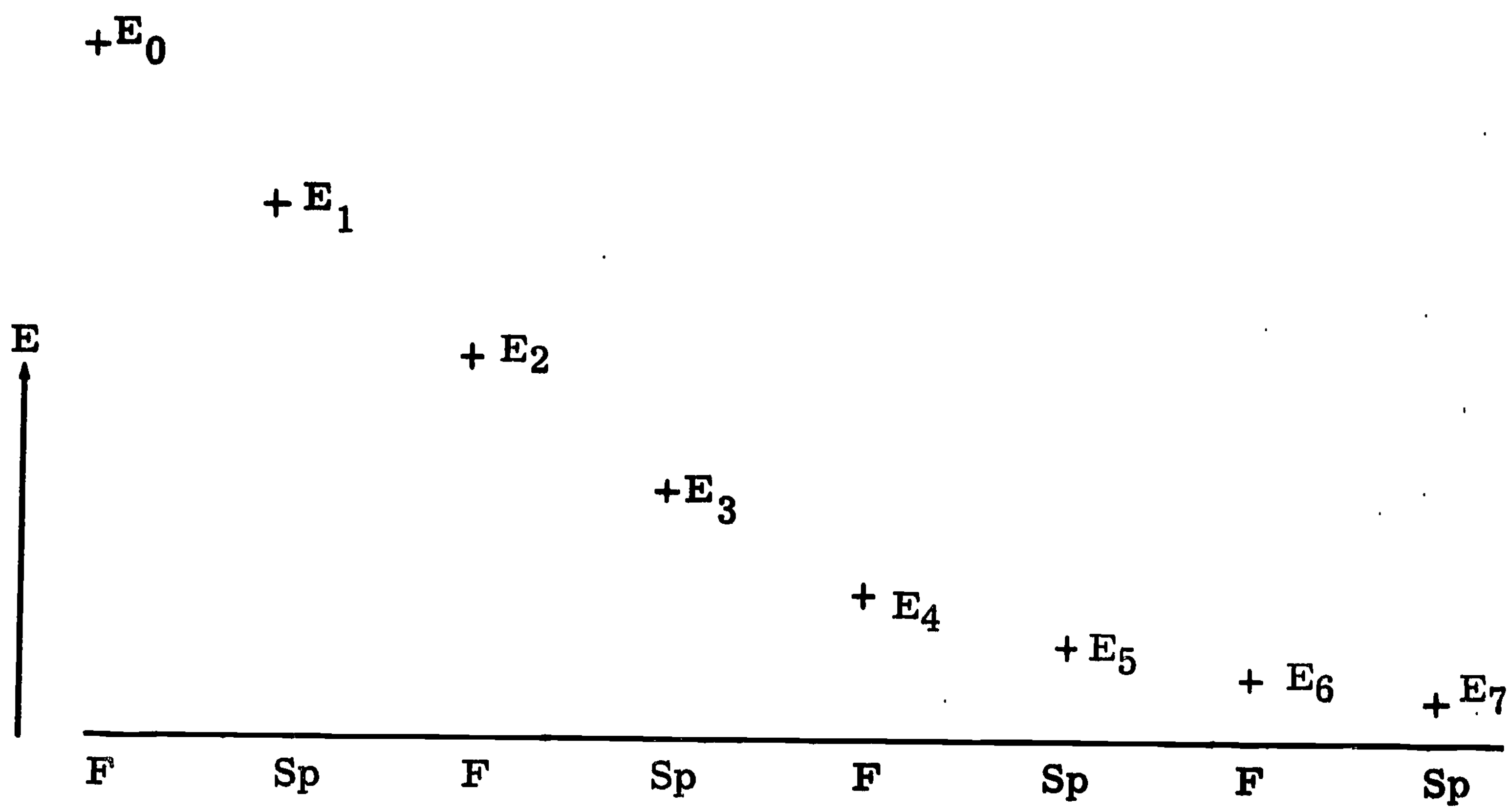

Fig. 1. Discrete Values of E

Now, if attrition of some sort is operating:

$$E_0 > E_1 > E_2 > \ldots > E_7$$ [5]

This may be expressed graphically:

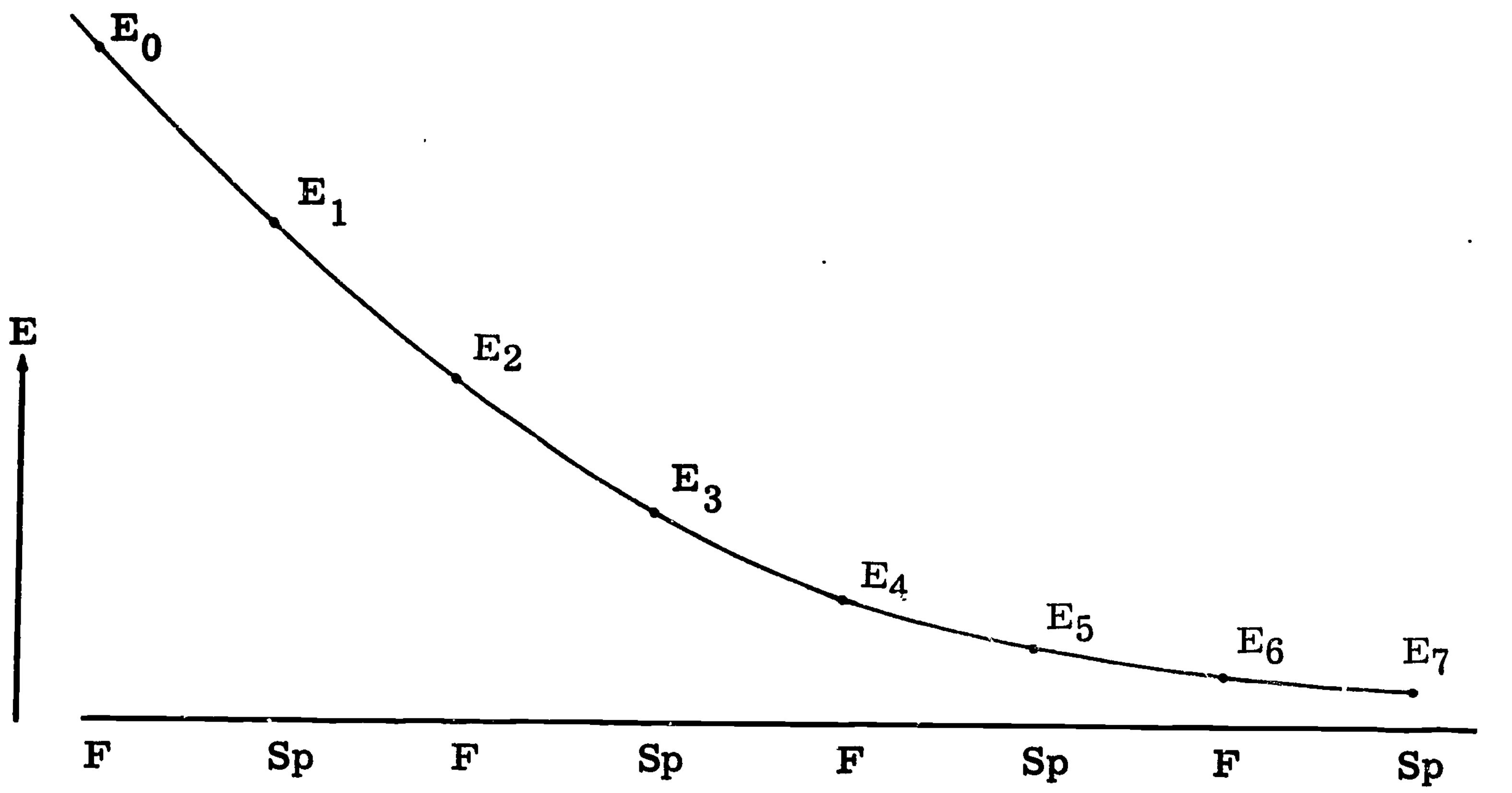

Fig. 1. Discrete Values of E

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[5] It must be emphasized that this will generally be true. E_0 will always be greater than E_1 if any attrition is operant since the matrix is concerned solely with high school graduates who go directly into junior college and E_0, by definition, includes all such graduates. However, E_7, for example, may occasionally be greater than E_5 or E_6 due to students dropping out for one or more semesters and then re-enrolling. In short, when values of E become small, the eratic behavior of a very few students may occasionally upset the general pattern.

Values of E are discrete. That is, there is a value of E for each term--the demand made by that class on the college for that term, measured at the beginning of the term. One can imagine continuous values of E over time, but facilities must be furnished and faculty engaged on the basis of the beginning enrollments of terms. The description of E as a continuous, rather than as a discrete variable is, however, useful for introducing modifications and variations into the model (i.e., conversion to the quarter system). Description of E as a continuous variable is also useful in an examination of attrition.

One can hypothesize that attrition is compound. That is, more students drop out the first term than the second, more the second than the third, etc., much in the manner that interest is charged on mortgages. Stated another way, the value of E is reduced in much the way radioactivity decays. Both the banker and the physicist use an exponential mathematical function to describe this effect. This function may be expressed as:

$$E_t = K + (E_0 - K)\ (1 - a)^t$$

in which:

E_t = enrollment at the beginning of term t.

t = the serial number of the term, with the first term assigned the number 0 (*i.e.*, t has the value of the subscript of E)

a = the attrition factor per term expressed as a proportion $(1 > a > 0)$

K = a constant, less than E_0.

Since persistence is the natural complement of attrition (attrition + persistence = 1), this function may be simplified to

$$E_t = K + (E_0 - K)\ p^t \qquad [f\ (E)]$$

by letting $p = (1 - a)$.

The curve described by this function should pass through or very near the series of points representing successive values of E in Figure 1:

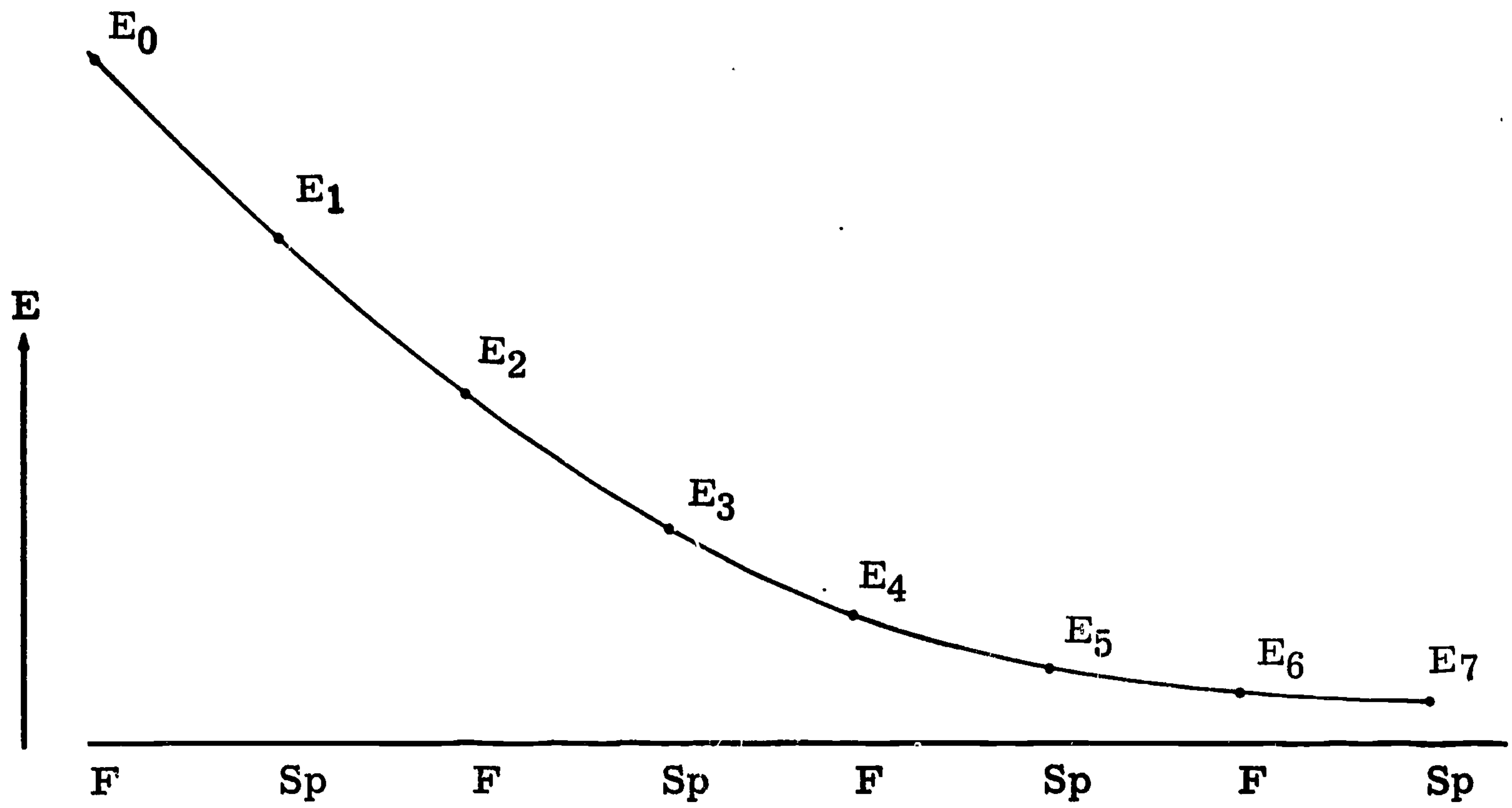

Fig. 2. Continuous Values of E

Now, by assigning numerical values to the terms of the function f (E), one can compare the theoretical effectiveness of the semester system under different patterns of student attendance:

Let $E_0 = 1000$
$K = -50$
$a = .30$, and
$p = (1 - a) = .70$:[6]

	F	Sp
	74	36
	202	126
	465	310
	1000	685
Total	1741	1157
Grand Total		2898

(First Example, Semester System)

[6] As will be seen in Chapter IV, this set of values is not at all unreasonable.

$$\text{Utilization index} = \frac{2898}{2(1741)} \times \frac{36}{48} = .6242$$

But, if $E_0 = 1000$

$K = -500$

$a = .15$, and

$p = (1 - a) = .85$:[7]

	F	Sp
	65	0
	283	166
	584	421
	1000	775
Total	1933	1362
Grand Total		3295

(Second Example, Semester System)

$$\text{Utilization index} = \frac{3295}{2(1933)} \times \frac{36}{48} = .6394$$

It will be noted that in the first example fourth-year students are still making demands on the college for about 3.1 percent of the available student spaces in the spring semester, while in the second example, fourth-year students have disappeared from the system by the spring semester. (Theoretically, in the first example, some students persist through the fall semester of the fifth year. Since they demand less than 1 percent of the student space and do not change the utilization index significantly, their presence can be disregarded.)

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[7] Ibid.

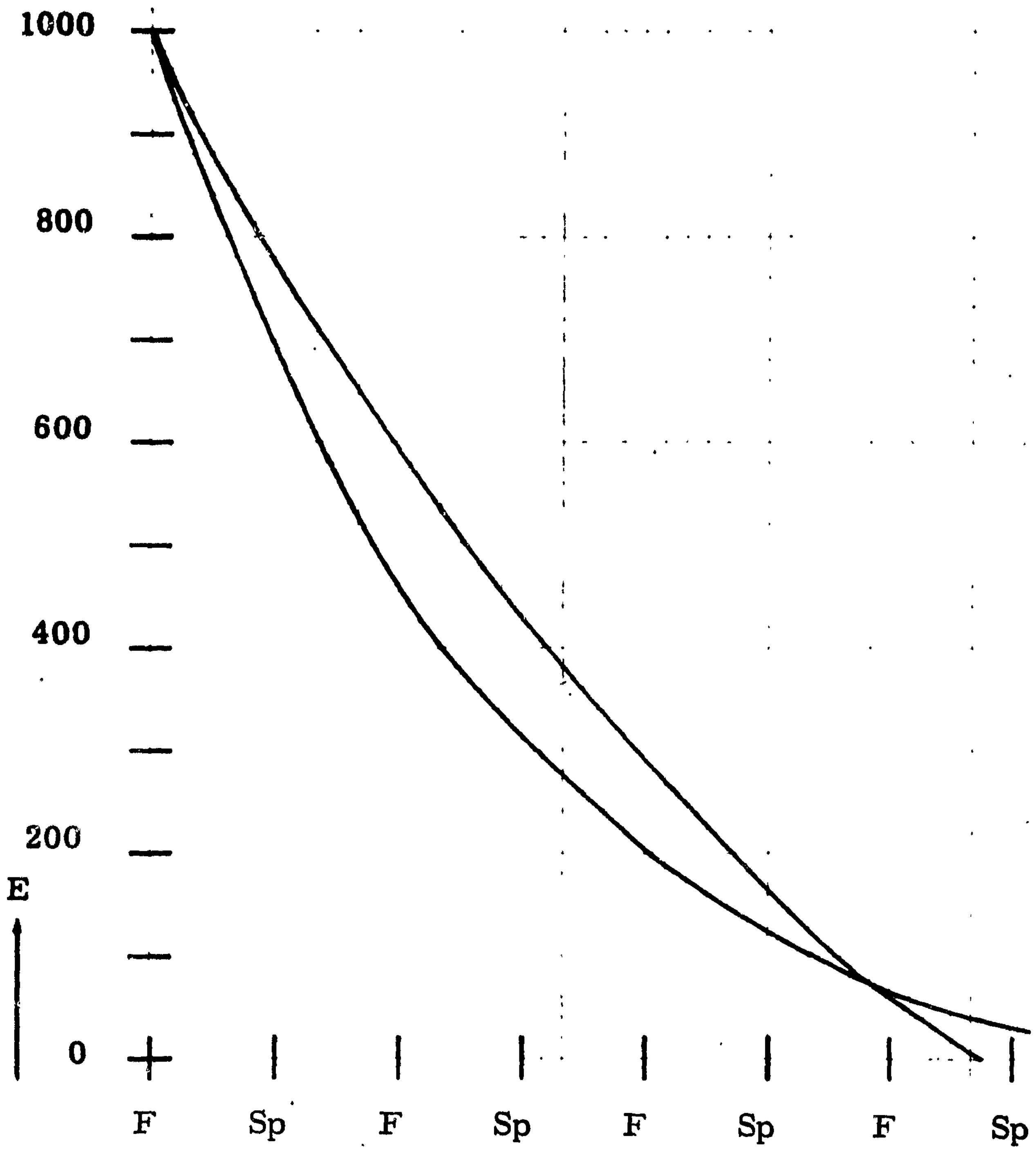

Fig. 3. Two Examples of Enrollment Patterns

It will also be noted that with attrition operant, the total enrollment in the spring semester is lower than in the fall semester. In both examples, the utilization index is about 84 percent of the maximum index of .75 theoretically achievable under the semester system when the semester enrollments are equal.

The Model Modified for a Four-Quarter System

The four-quarter calendar introduces another variable--acceleration. A student graduating from high school in June may elect to enter the junior college immediately--that is in the summer quarter--since that quarter is, by definition,[8] so structured that he may thereby begin his program. Such a student is following an "accelerated" program. He may, however, elect to take the summer as vacation in accordance with conventional practice and commence his program in the fall quarter. Thus, the student going directly from high school into junior college may follow one of two tracks.[9]

If one considers E_0 to be the total initial demand on the system made by recent high school graduates, as has been done above, and lets _y_ denote the proportion of that demand represented by accelerating students, then:

yE_0 = demand made initially by accelerating students; and

$(1 - y)E_0 = E_0 - yE_0$ = demand made initially by nonaccelerating students.

If also, to avoid confusion, demands made in subsequent terms are denoted by _e_ (with a subscript) for the quarter system to distinguish it from the E (with a subscript) in the semester system, then f(E) becomes:

$$e_t = K + (E_0 - K)\, p^{\,t} \qquad [f\ (e)].$$

This new function, f (e), bears a mathematical relationship to f (E) _provided one critical assumption is made_. That assumption is that students under the quarter system in a given track will follow essentially the same attrition pattern that they would have followed had they been under the semester system. Stated in mathematical terms, this assumption is that both functions are considered to be continuous and identical, their relationship being that of a change of scale. This is illustrated in Figure 4.

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[8] Chapter I, p. 4, _supra_.

[9] Actually, he may follow one of a number of tracks. He may attend year-round, he may elect to take _any_ quarter as vacation, or he may attend irregularly. For purposes of this analysis, the high school graduate is considered to have entered in the summer quarter _or_ in the fall quarter and thereafter have followed an accelerated _or_ a conventional pattern respectively.

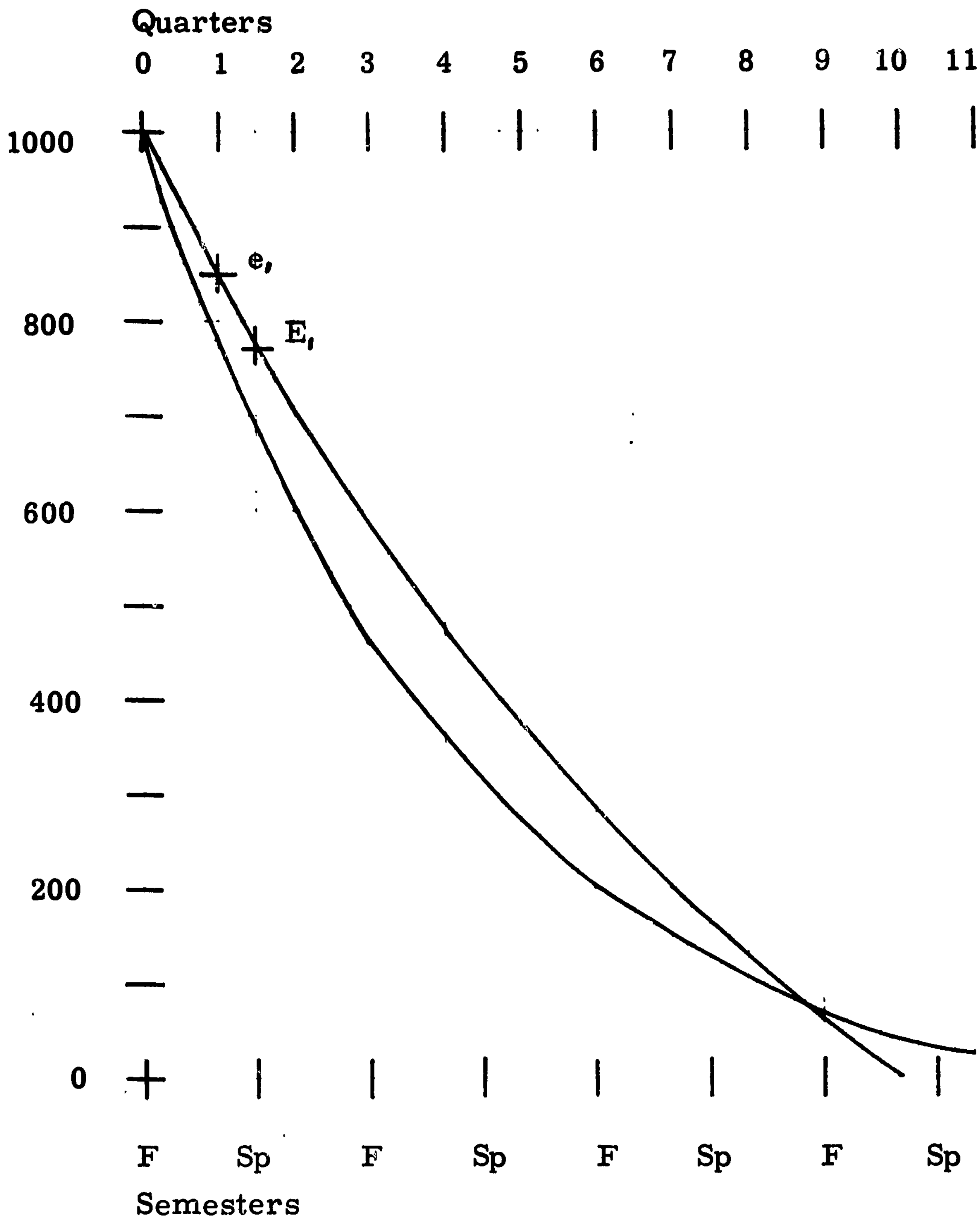

Fig. 4. Change of Scale Assumption

In Figure 4, the curves of enrollment patterns from the two examples used earlier in this chapter are reproduced. The lower horizontal scale is in the semester system, the spaces between tick marks representing 18-week terms. The upper horizontal scale is in the quarter system, the spaces between tick marks representing 12-week terms. The respective positions of E_1 and e_1 are indicated on the curve of the second example. It will be noted that the beginning enrollment of the second quarter (e_1) is greater than the beginning enrollment of the spring semester (E_1) for the same students.

Mathematically, the relationship between the functions can be expressed:

Log p, in the quarter system $= \frac{12}{18}$ Log p, in the semester system or,

$$\text{Log } p_e = \frac{2}{3} \text{ Log } p_E$$

(This assumption and the relationship derived therefrom is of not inconsiderable importance to the decision to convert the California public junior colleges to a quarter system. Reed Buffington, President of Chabot College, noted this in pointing out that in the quarter system, students were being given more opportunities to fail--and more opportunities to succeed.[10] Do shorter terms encourage persistence? Or do they encourage attrition? Until experience data are collected and analyzed in the California public junior college operating under the quarter system, these questions must remain unanswered and unanswerable. The only logical assumption appears to be the one indicated. It must be recognized, however, that this assumption is based upon the logic of no better alternative in the absence of empirical data.)

By the introduction of a "split line" or "split row" to indicate the two tracks (accelerated above dashed line and conventional below dashed line) in the four-quarter system, the model can be modified:[11]

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[10] JCAP Minutes, September 16-17, 1966, *op. cit.*, remarks of Dr. Buffington.

[11] The "total" and "grand total" are left blank merely because filling them with long and complex algebraic expressions would serve no useful purpose at this point in the derivation.

	Su	F	W	Sp
Fourth year		$e_9 - ye_9$	$e_{10} - ye_{10}$	$e_{11} - ye_{11}$
Third year	ye_8	ye_9	ye_{10}	ye_{11}
		$e_6 - ye_6$	$e_7 - ye_7$	$e_8 - ye_8$
Second year	ye_4	ye_5	ye_6	ye_7
		$e_3 - ye_3$	$e_4 - ye_4$	$e_5 - ye_5$
First year	yE_0	ye_1	ye_2	ye_3
		$E_0 - yE_0$	$e_1 - ye_1$	$e_2 - ye_2$
Total				
			Grand total	

In this case, the utilization index is computed:

$$\frac{\text{Grand total}}{4 \times (\text{Total for quarter of largest enrollment})} \times \frac{48 \text{ weeks}}{48 \text{ weeks}}$$

This array is not nearly so formidable as it may appear. For example, the "grand total" is merely the sum of all the values of e from subscript 0 to subscript 11:

$$\sum_{t=0}^{t=11} (e_t) = \text{value of the Grand Total.}$$

This is true because for every expression in the matrix containing (y), there is an absolutely[12] identical expression containing (-y). It can be shown that: except for very high values of y, the fall quarter is the quarter of largest enrollment; neither the winter quarter nor the spring quarter can ever be the quarter of largest enrollment; and, maximum utilization occurs when, at some relatively high value of y, the summer and fall quarters have equal enrollments.

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[12] Absolute in its algebraic sense means without regard to sign.

The examples used previously in the semester system can be extended into this model for comparison:

E_0 = 1000

K = - 50

p = .78832 (log p = $\frac{2}{3}$ log p. semester system)

a = (1 - p) = .21168

	Su	F	W	Sp
		74 - 74y	47 - 47y	27 - 27y
	107y	74y	47y	27y
		202 - 202y	149 - 149y	107 - 107y
	356y	270y	202y	149y
		465 - 465y	356 - 356y	270 - 270y
	1000y	778y	603y	465y
		1000 - 1000y	778 - 778y	603 - 603y
Total	1463y	1741 - 619y	1330 - 478y	1007 - 366y
			Grand Total	4078

(First Example, Four-Quarter System)

Assuming a value of y such that the fall quarter has the largest enrollment, the utilization index can be computed from the relationship:

$$\frac{4078}{4 \times (1741-619y)} \times \frac{48}{48}$$

If y is set at some reasonable value, say 40 percent, the utilization index can be computed:

$$\frac{4078}{4 \times (1741 - 247.6} = \frac{4078}{5973.6} = .6827$$

This, when compared with the index of .6242 for these same students under the semester system, shows a gain of about 9.37 percent in utilization by shifting to year-round operations, provided 40 percent of the students elect to attend year-round.

The value of y such that the utilization index is maximized can be computed by setting the enrollment for the summer quarter equal to the enrollment for the fall quarter, and solving for y:

$$1434y = 1741 - 619y$$

$$2053y = 1741$$

$$y = .848 \text{ or } 84.8\%$$

The maximum utilization index theoretically obtainable can now be computed by:

$$\frac{4078}{4(1463)(.848)} = \frac{4078}{4963} = .82175$$

Again this, when compared with the index of .6242 for these same students under the semester system, shows a gain of about 31.65 percent in utilization by shifting to year-round operations, provided 84.8 percent of the students elect to attend year-round.

Likewise, in the second example:

$$E_0 = 1000$$

$$K = -500$$

$$p = .89732 \left(\log p = \frac{2}{3} \log p, \text{ semester system}\right)$$

$$a = (1 - p) = .10268$$

	Su	F	W	Sp
		66 - 66y	8 - 8y	0
	130y	66y	8y	0
		283 - 283y	203 - 203y	130 - 130y
	472y	373y	283y	203y
		584 - 584y	472 - 472y	373 - 373y
	1000y	846y	708y	584y
		1000 - 1000y	846 - 846y	708 - 708y
Total	1602y	1933 - 648y	1529 - 530y	1211 - 424y
			Grand Total	4673

(Second Example, Four Quarter System)

Again, if y is set at 40 percent, the utilization index can be computed:

$$\frac{4673}{4 \times (1933 - 295.2)} = \frac{4673}{6695.2} = .69797$$

This, when compared with the index of .6394 for these same students under the semester system, shows a gain of about 9.16 percent in utilization by shifting to year-round operations, provided 40 percent of the students elect to attend year-round.

Again, the value of y such that the utilization index is maximized can be computed:

$$1602y = 1933 - 648y$$

$$2250y = 1933$$

$$y = .85912 \text{ or } 85.9\%$$

The maximum utilization index theoretically obtainable can likewise be computed:

$$\frac{4673}{4(1602)(.859)} = \frac{4673}{5505} = .84882$$

This, when compared with the index of .6394 for these same students under the semester system, shows a gain of about 32.76 percent in utilization by shifting to year-round operation, provided 85.9 percent of the students elect to attend year-round.

It will be noted that in both examples the maximum utilization is obtained when over 80 percent of the students elect to go year-round. It is also obvious that under more likely conditions of the fall quarter being the quarter of largest enrollment there are student spaces available in significant numbers for students who would elect to take the fall quarter as vacation and attend the other three quarters, even when the system is operating at "capacity." Such students would, of course, increase the utilization as well as the true capacity of the system. They might also find the obtaining of short-term employment easier in the pre-Christmas labor market when many of their contemporaries are in school.

Summary

The model of the California public junior college developed in this chapter appears to satisfy the constraints developed in Chapter II:[13]

1. The four-quarter system of year-round operation must be employed.

2. No control of input may be employed . . . .

3. Account must be taken of the once-a-year graduation pattern of the feeder high schools.

4. Account must be taken of the high attrition, low persistence characteristic of the junior college student.

Additionally, the model also appears to provide for the following:

1. Provision is made for comparison of plant utilization between the two-semester and four-quarter calendars under various assumptions and enrollment patterns.

2. Provision is made for determining variations in plant utilization under the four-quarter calendar when the proportion of students which elect to attend year-round is varied.

3. A theoretical method is suggested for converting data on enrollment patterns obtained under the two-semester system to the quarter system.

This conversion method is based on two assumptions:

1. Student enrollment patterns do not change significantly between the semester and the quarter systems; and

2. Junior college enrollment does, in fact, vary over time approximately according to the exponential function, f(E).

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[13]Pp. 29 and 30, *supra*.

As has been noted in this chapter, the first assumption is not subject to test at this time in the absence of empirical data. The second assumption is subject to test by the application of empirical data. Such an application will be the burden of the next chapter. If both assumptions are accepted, the model developed in this chapter should have value in predicting plant utilization under the four-quarter system of year-round operation based on data accumulated under the two-semester system.

Chapter IV

APPLICATION OF EMPIRICAL DATA TO THE THEORITICAL MODEL

It was noted at the close of the previous chapter that the assumption that junior college enrollment varies over time approximately according to the exponential function, f(E), is subject to test by the application of empirical data. Such a test is the principal burden of this chapter.

The first problem would appear to be the selection of a unit of enrollment. At first glance, the student would appear to be the obvious choice. The student may, however, be enrolled for almost any number of credit hours up to perhaps 24. The student is not then a proper unit of enrollment as enrollment represents demand upon the college for facility and faculty time.

The State of California is in the process of developing the "student contact hour of enrollment" as a measure of demand against the public junior college.[1] This measure is ideal in that it counts both class periods and laboratory periods--when the student is making demand upon facility and faculty--in actual time. Unfortunately, this unit has not yet been introduced.

The unit selected will be the credit hour of enrollment. Although this unit normally equates one class hour with two laboratory hours, it is a fairly accurate indicator of demand. Credit hours of enrollment can easily be converted to full-time equivalent students by dividing by 15 or 15.5 according to the custom of the institution.

The second problem would appear to be the obtaining of data on junior college enrollment patterns over time. Fortunately, this was available.

The Nature of the Empirical Data

There is in the Center for Research and Development in Higher Education, University of California, Berkeley, as part of a nationwide study, data on first time freshmen of the fall of 1961 in 12 randomly selected California public junior colleges. These data follow the students' academic careers through the summer of 1965.

Specific items of data were selected from the large amount of data available and punched on cards for use in this study. Appendix I, infra, contains a codebook which accounts in detail for the raw data recorded in connection with this study. Essentially, on one card for each student, the following data were recorded:

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[1]Reported by Archie McPherran, Chief, Bureau of Junior College Administration and Finance, State Department of Education, at CCHE meeting, January 30, 1967.

1. Identification number of the junior college (02 through 13)
2. Student identification number by institution
3. Sex
4. Age in September, 1961
5. Initial credit load, fall, 1961
6. Credits earned each term, fall, 1961, through summer, 1965
7. Pattern of attendance
8. Status at time of final withdrawal
9. Reason for final withdrawal, other than graduation
10. Type of scholastic ability test used
11. Scholastic ability test score by stanine ranking
12. Data on enrollment in transfer institution
13. Data on location and nature of transfer institution
14. Data on junior college:
    a. Type of community
    b. Full time enrollment, fall, 1961
    c. Ratio of regular students to full-time counselors
    d. Proportion of students intending to transfer (1961)
    e. Proportion of students intending to transfer (1965)
    f. Number of occupationally oriented curricula offered (1961)
    g. Number of occupationally oriented curricula offered (1965)

The Center, in collecting the data, had asked that from one-third to one-half of the first-time freshmen day students registering for eight or more credit hours be randomly selected by the college and included in the sample. In a computer check it was discovered that some 17 students had somehow been included who did not fit these specifications. When this correction was made, the sample included some 6,276 students. The smallest sample was 249 students from a college with a full time enrollment of between 1,501 and 2,500 students in 1961.

Description of the Twelve Junior Colleges

The original data were collected with a promise of anonymity to the colleges and students involved. That promise will, of course, be honored in this paper. The colleges are coded in the data with code numbers 02 through 13. These numbers will be used throughout to identify the individual colleges.

In the original data, "type of community" was coded "metropolitan" or "nonmetropolitan." Arthur Jensen, Chief of the Bureau of Junior College General Education, California State Department of Education, has been asked to reclassify "type of community," for purposes of this study. Several of the terms used in his classification require explanation:

1. Big City describes a community with all of the problems of large cities in the 1960s--urban blight, high concentrations of minority groups.
2. Small City describes a community which is the center about which suburbs cluster but is not itself sufficiently within the gravitational pull of a larger city to be considered a suburb. Many of its problems are urban but of much lower degree than the big city.
3. Exurban was chosen to identify a community which has suburban characteristics but is separated from the city by several layers of suburbs. To go from an exurban junior college district to a big city junior college district, one must cross a suburban junior college district.
4. Military describes a community in which the presence of a military base skews to a very significant degree the environment in which that community's junior college must operate.
5. Suburban, Rural, and Agricultural have their commonly accepted meanings.

With this brief word of explanation, the 12 junior colleges in the sample can be described. The number in parentheses is the number of students from that college included in the sample:

College 02 (333)

1. Community: Agricultural/Military
2. Full time enrollment, fall, 1961: 501-1,000
3. Regular students per full time counselor, 1961: over 500
4. Percent students intending to transfer (1961): 61-70 percent
5. Percent students intending to transfer (1965): 61-70 percent
6. Number occupationally oriented curricula offered (1961): 6-10
7. Number occupationally oriented curricula offered (1965): 11-15

College 03 (431)

1. Community: Small City/Agricultural
2. Full time enrollment, fall, 1961: Above 2,500
3. Regular students per full-time counselor, 1961: 400-500
4. Percent students intending to transfer (1961): 61-70 percent

5. Percent students intending to transfer (1965): 61-70 percent
6. Number occupationally oriented curricula offered (1961): over 30
7. Number occupationally oriented curricula offered (1965): over 30

College 04 (404)

1. Community: Exurban
2. Full time enrollment, fall, 1961: 1,501-2,500
3. Regular students per full-time counselor, 1961: over 500
4. Percent students intending to transfer (1961): 61-70 percent
5. Percent students intending to transfer (1965): 61-70 percent
6. Number occupationally oriented curricula offered (1961): 16-20
7. Number occupationally oriented curricula offered (1965): 21-30

College 05 (681)

1. Community: Big City
2. Full time enrollment, fall, 1961: above 2,500
3. Regular students per full time counselor, 1961: 400-500
4. Percent students intending to transfer (1961): 41-50 percent
5. Percent students intending to transfer (1965): 51-60 percent
6. Number occupationally oriented curricula offered (1961): over 30
7. Number occupationally oriented curricula offered (1965): over 30

College 06 (603)

1. Community: Suburban
2. Full time enrollment, fall, 1961: 501-1,000
3. Regular students per full-time counselor, 1961: 300-400
4. Percent students intending to transfer (1961): 71-80 percent
5. Percent students intending to transfer (1965): 71-80 percent
6. Number occupationally oriented curricula offered (1961): 11-15
7. Number occupationally oriented curricula offered (1965): 21-30

College 07 (558)

1. Community: Suburban
2. Full time enrollment, fall, 1961: above 2,500
3. Regular students per full-time counselor, 1961: 400-500
4. Percent students intending to transfer (1961): 61-70 percent

5. Percent students intending to transfer (1965): 51-60 percent
6. Number occupationally oriented curricula offered (1961): 16-20
7. Number occupationally oriented curricula offered (1965): 21-30

College 08 (965)

1. Community: Exurban
2. Full time enrollment, fall, 1961: 1,501-2,500
3. Regular students per full-time counselor, 1961: 300-400
4. Percent students intending to transfer (1961): 71-80 percent
5. Percent students intending to transfer (1965): 71-80 percent
6. Number occupationally oriented curricula offered (1961): 11-15
7. Number occupationally oriented curricula offered (1965): over 30

College 09 (416)

1. Community: Big City
2. Full time enrollment, fall, 1961: over 2,500
3. Regular students per full time counselor, 1961: 300-400
4. Percent students intending to transfer (1961): 71-80 percent
5. Percent students intending to transfer (1965): 71-80 percent
6. Number occupationally oriented curricula offered (1961): 16-20
7. Number occupationally oriented curricula offered (1965): over 30

College 10 (451)

1. Community: Rural/Agricultural
2. Full time enrollment, fall, 1961: 1,501-2,500
3. Regular students per full-time counselor, 1961: 300-400
4. Percent students intending to transfer (1961): 61-70 percent
5. Percent students intending to transfer (1965): 61-70 percent
6. Number occupationally oriented curricula offered (1961): 21-30
7. Number occupationally oriented curricula offered (1965): over 30

College 11 (444)

1. Community: Rural/Agricultural
2. Full time enrollment, fall, 1961: 501-1,000
3. Regular students per full-time counselor, 1961: 400-500

4. Percent students intending to transfer (1961): 51-60 percent
5. Percent students intending to transfer (1965): 51-60 percent
6. Number occupationally oriented curricula offered (1961): 11-15
7. Number occupationally oriented curricula offered (1965): 21-30

College 12 (741)

1. Community: Big City
2. Full time enrollment, fall, 1961: above 2,500
3. Regular students per full-time counselor, 1961: over 500
4. Percent students intending to transfer (1961): 21-30 percent
5. Percent students intending to transfer (1965): 31-40 percent
6. Number occupationally oriented curricula offered (1961): above 30
7. Number occupationally oriented curricula offered (1965): above 30

College 13 (249)

1. Community: Rural/Agricultural
2. Full time enrollment, fall, 1961: 501-1,000
3. Regular students per full-time counselor, 1961: 400-500
4. Percent students intending to transfer (1961): 61-70 percent
5. Percent students intending to transfer (1965): 71-80 percent
6. Number occupationally oriented curricula offered (1961): 11-15
7. Number occupationally oriented curricula offered (1965): 21-30

Computation of Enrollment Patterns

The basic data contained information on the number of credit hours each student had attempted (registered for) the fall of 1961 and the number of credit hours which he had completed successfully in that term and in each succeeding term through the summer of 1965. What was needed was the number of credit hours attempted in each regular semester (fall and spring) over the four-year period, since hours attempted represent demand upon college facility and faculty. This could be estimated using one of two procedures:

1. Normal Procedure. The following information about the student is known:

Fall '61		Spring '62		Fall '62		Spring '63		Fall '63		Spring '64	
DH	CH	DH	CH	DH	CH	DH	CH	DH	CH	DH	CH
X_0	Z_0		Z_1		Z_2		Z_3		Z_4		Z_5

DH = Demand hours (hours attempted)

CH = Completion hours

In the fall of 1961 the student had attempted X_0 credit hours and had completed Z_0 credit hours. Values of X for subsequent semesters were unknown but values of Z for these semesters were known. A "demand ratio," defined as $X_0 \div Z_0$ was computed for each student and labeled "R2." If the student had completed all work attempted, his R2 = 1.00; if he had completed half the work he had attempted, his R2 = 2.00, etc. The blank cells were then filled in by multiplying each successive Z-value by the R2 for that student $[\bar{X}_i = (R2) Z_i]$

[The assumption here is, of course, that R2 is an unbiased estimator of the academic "efficiency" of the individual student as he proceeds through the system. Some students (e.g., late bloomers) will do better in subsequent semesters, but other students will do worse.]

2. "Immediate Dropout" Procedure. If X_0 is a positive number and Z_0 is zero, then R2 is indeterminate. If all other values of Z were zero, the blank cells were filled with zeroes. This was indeed the case most of the time. In a few cases, these "immediate dropouts" reappeared in the system with Z values greater than zero.[2] In this event another demand ratio, the demand ratio of the group under consideration was computed and labeled "R1". The Z values of these reentering dropouts were then multiplied by R1 to obtain the corresponding X values. For example, if college 02 as a whole were under consideration, normal procedure would be employed on all students whose Z_0 values were greater than 0. Then R1 would be computed by:

$$\frac{\Sigma \ (X_0)}{\Sigma \ (Z_0)} \qquad [Z \neq 0]$$

for those students. The immediate dropout procedure would then be applied to those cases where Z_0 values were zero. The proportion of these immediate dropouts varied widely among colleges:

[2]In a very few cases, with very respectable Z values.

Rank order	College	Percent of immediate dropouts
1	12 Big City	24.2
2	09 Big City	23.3
3	05 Big City	20.1
4	11 Rural/Agricultural	16.9
5	06 Suburban	13.0
6	04 Exurban	12.4
7	08 Exurban	11.2
8	07 Suburban	10.9
9	03 Small City/Agricultural	7.4
10	10 Rural/Agricultural	4.2
11	02 Agricultural/Military	2.6
12	13 Rural/Agricultural	1.6

$\bar{X} = 12.3$ $m = 11.8$ $s = 7.67$

Fig. 5. Proportion of Immediate Dropouts

When all students in the group under consideration were processed, the columns were summed. The demand hours thus computed were then considered to be the demand placed on the college by those students for the respective semesters. For ease of comparison and computation, each ΣX value was multiplied by:

$$\frac{1,000}{\Sigma X_0}$$

so that demand for a specific semester was shown in terms of demand per thousand credit hours of initial enrollment as first time freshmen.[3]

The Total Demand Pattern

It had been hoped that half-time students (attempting 8-10 hours), three quarter-time students (attempting 11-13 hours) and full-time students (attempting 14 or more hours) could be considered separately. This proved infeasible, for, despite the relatively large sample size, the cell values after the fourth

[3]Data processing was done on the CD-6400 computer in the Data Processing Center, University of California, Berkeley.

semester became so small that no discernable pattern emerged. Each college was therefore treated as a whole, with the demand pattern determined as indicated above. A curve of the form f(E) was fitted to that pattern and values of K and of p_E computed. The utilization indices for the actual pattern and for the theoretical pattern resulting from f(E) were computed for comparison. In every case but one the utilization index for f(E) was lower than the corresponding index for the empirical data, but in every case this error was less than ± 8 percent, the mean error was - 3.75 percent, and the mean absolute error was 4.43 percent.

The value of p_e was then computed for that college from the relationship:

$$\text{Log } p_e = \frac{2}{3} \text{ Log } p_E$$

Theoretical demand patterns under the quarter system were then computed from f(e). These values were placed in the model developed in Chapter III to obtain the specific version of the model for that particular college. The proportion of students electing to accelerate their programs was then varied in the model to obtain resulting values of the utilization index under the four-quarter system for comparison with the values of this index already obtained under the semester system from the empirical data and from f(E):

College 02

Semester System

Theoretical

F	Sp
8	0
181	83
481	310
1,000	708
1,670	1,101
	2,771

Utilization index = .640

K = -228.6

p_E = .75984

log p_E = 9.88072

Empirical

F	Sp
54	49
90	83
428	351
1,000	690
1,572	1,173
	2,745

Utilization index = .654

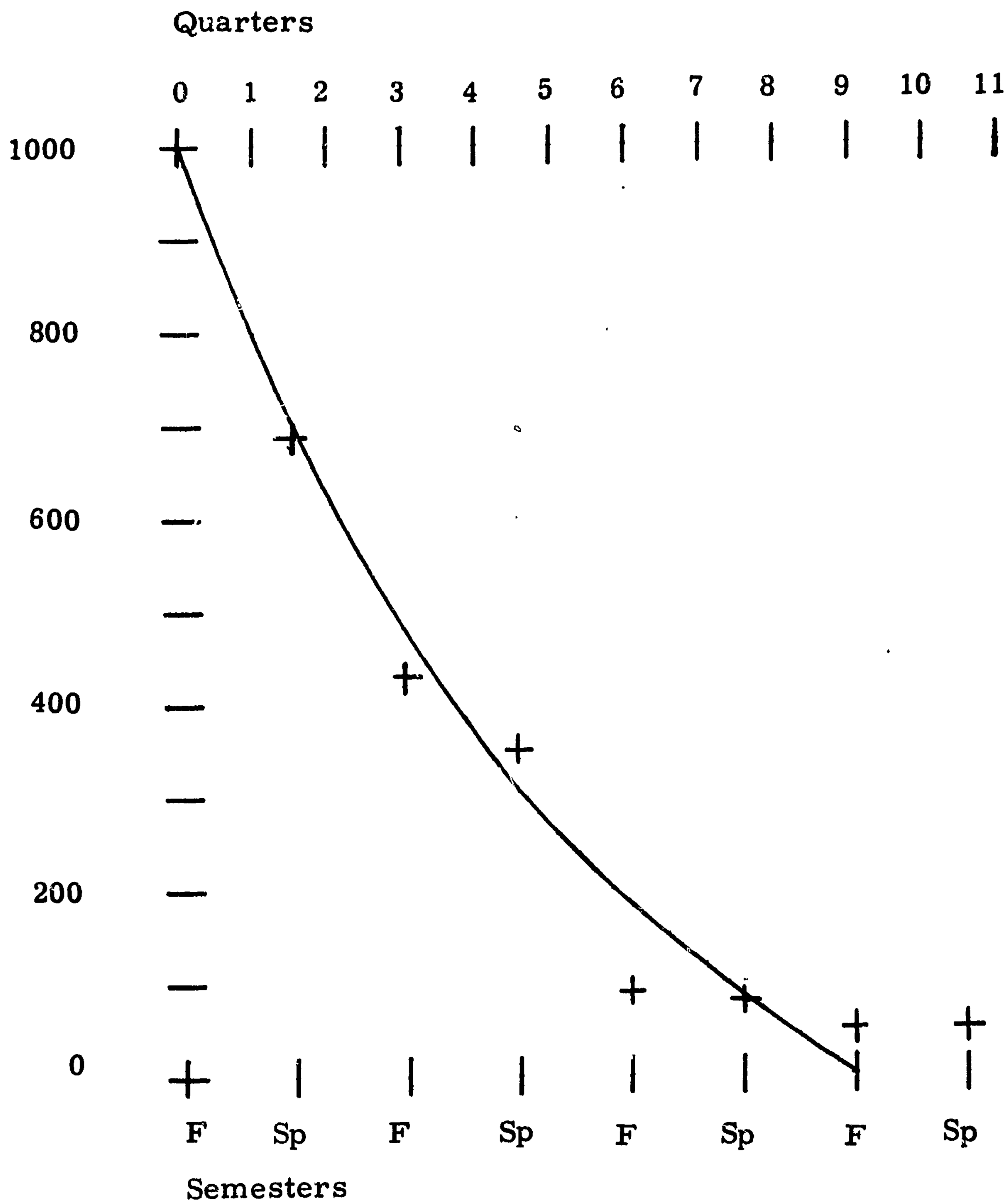

Fig. 6. Total Demand Pattern: College 02

Four-Quarter System

Su	F	W	Sp
	8- 8y	0	0
55y	8y	0	0
	181-181y	112-112y	55- 55y
362y	263y	181y	112y
	481-481y	362-362y	263-263y
1,000y	794y	623y	481y
	1,000-1,000y	794-794y	623-623y
1,417y	1,670-605y	1,268-464y	941-348y
			3879

$p_e = .83335$

$\text{Log } p_e = 9.92048$

$$\text{Utilization index}^4 = \frac{3879}{4(1670-605y)}$$

Maximum utilization index = .8286, when y = 82.6 percent

---

4 For values of y less than .826 (value of y when plant utilization is at its maximum).

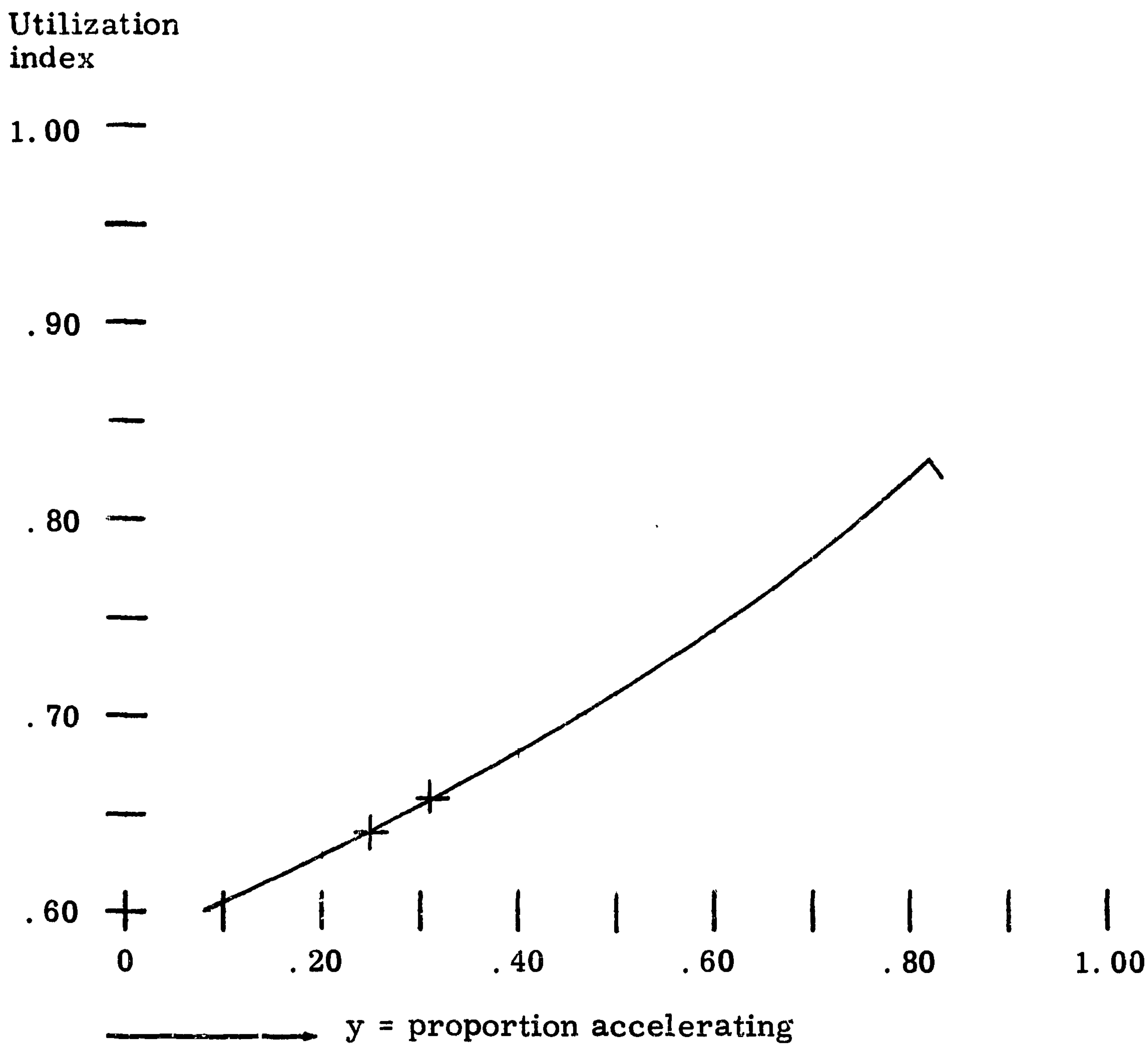

Fig. 7. Possible Gain in Plant Utilization Under Four-Quarter System: College 02

Figure 7 shows the plant utilization index theoretically obtainable under the four-quarter system, with various proportions of students electing to enroll year-round. The two +'s on Figure 7 show the theoretical and the empirical utilization indices obtained under the semester system. It will be noted that in this case 31 percent or more of the students must elect to enroll year-round before the utilization index under the four-quarter system exceeds the corresponding index presently obtaining under the two-semester system.

College 03

Semester System

Theoretical

F	Sp
0	0
287	139
618	447
1,000	802
1,905	1,388
	3,293

Utilization index = .648

$K = -1885$

$p_E = .93153$

$\log p_E = 9.969193$

Empirical

F	Sp
38	48
204	135
572	526
1,000	779
1,814	1,488
	3,302

Utilization index = .682

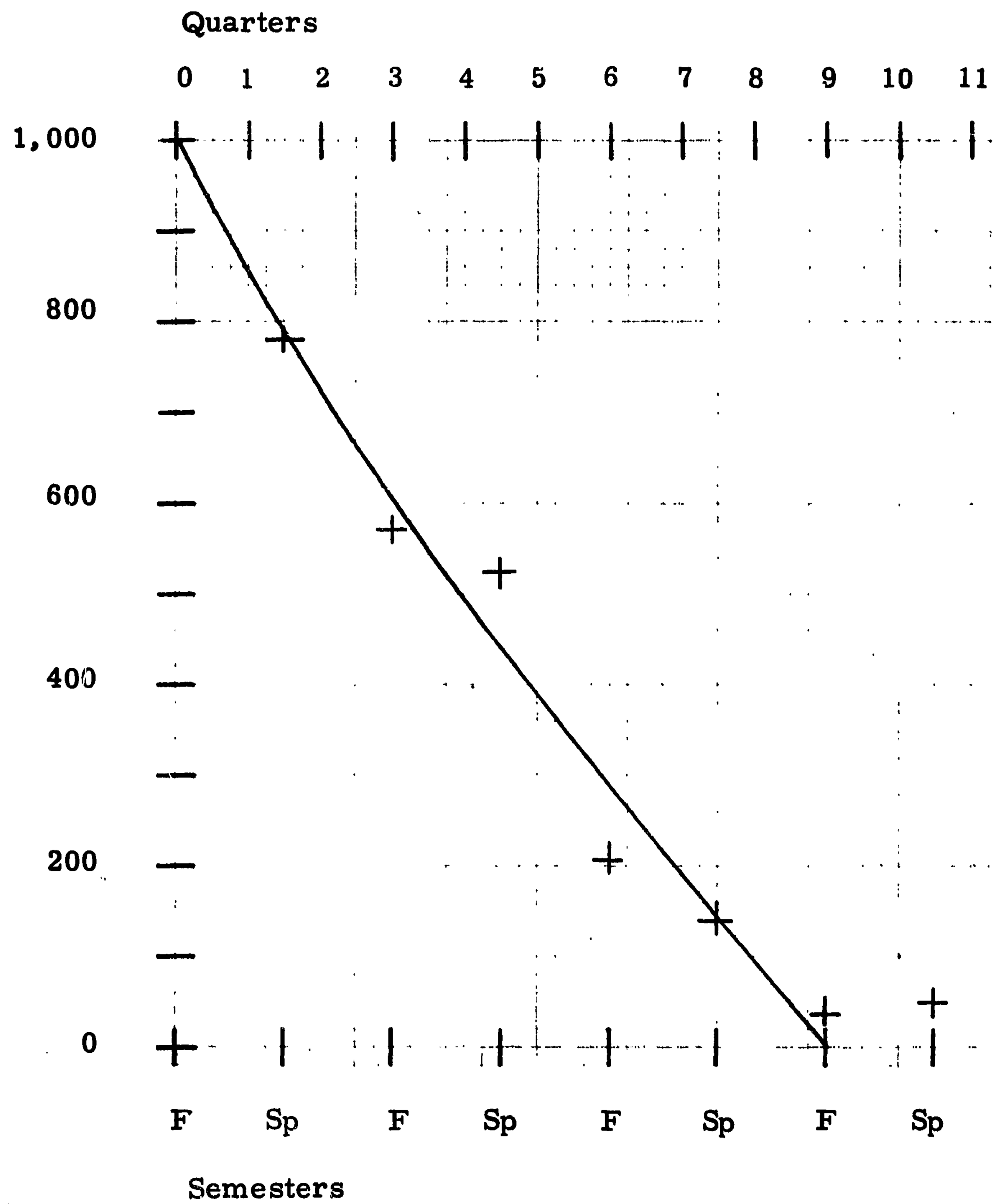

Fig. 8. Total Demand Pattern: College 03

Four-Quarter System

Su	F	W	Sp
	0	0	0
91y	0	0	0
	287- 287y	187-187y	91- 91y
503y	393y	287y	187y
	618- 618y	503-503y	393-393y
1,000y	867y	740y	618y
	1,000-1,000y	867-867y	740-740y
1,594y	1,905-645y	1,557-530y	1,224-419y
			4686

$p_e = .9538$

$\text{Log } p_e = 9.97946$

Utilization index[5] $= \frac{4686}{4(1905-645y)}$

Maximum utilization index = .865 when y = 85.08 percent

[5]For values of y less than .8508 (value of y when plant utilization is at maximum).

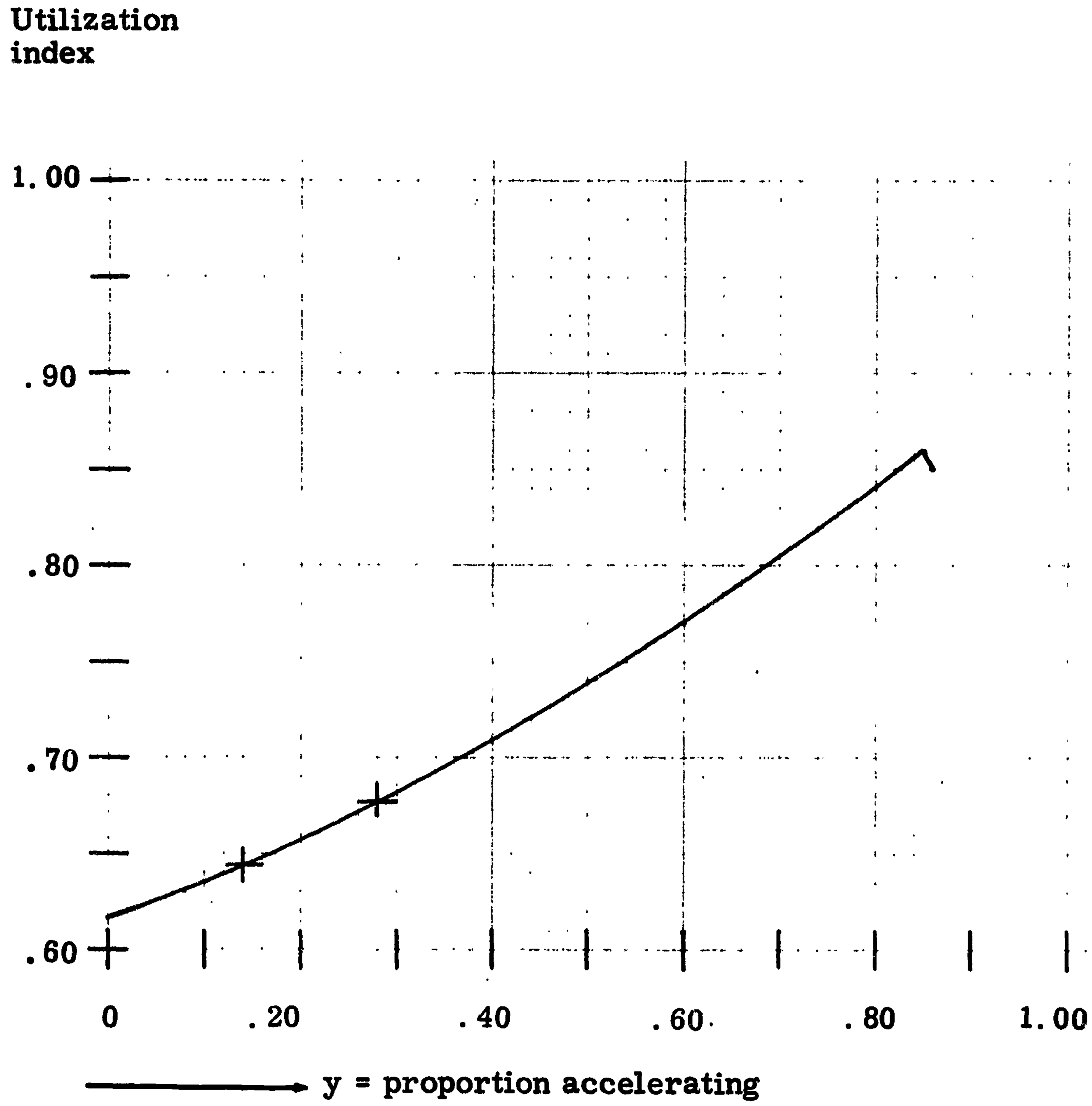

Fig. 9. Possible Gain in Plant Utilization Under Four-Quarter System: College 03

Figure 9 shows the plant utilization index theoretically obtainable under the four-quarter system with various proportions of students electing to enroll year-round. The two +'s on Figure 9 show the theoretical and empirical utilization indices obtained under the semester system. It will be noted that in this case 29 percent or more of the students must elect to enroll year-round before the utilization index under the four-quarter system exceeds the corresponding index presently obtaining under the two-semester system.

College 04

Semester System

Theoretical

F	Sp
77	19
248	152
531	372
1,000	736
1,856	1,276
	3,132

Utilization index = .633

$K = -184.3$

$p_E = .7774$

$\log p_E = 9.89062$

Empirical

F	Sp
77	60
184	128
460	437
1,000	725
1,721	1,350
	3,071

Utilization index = .668

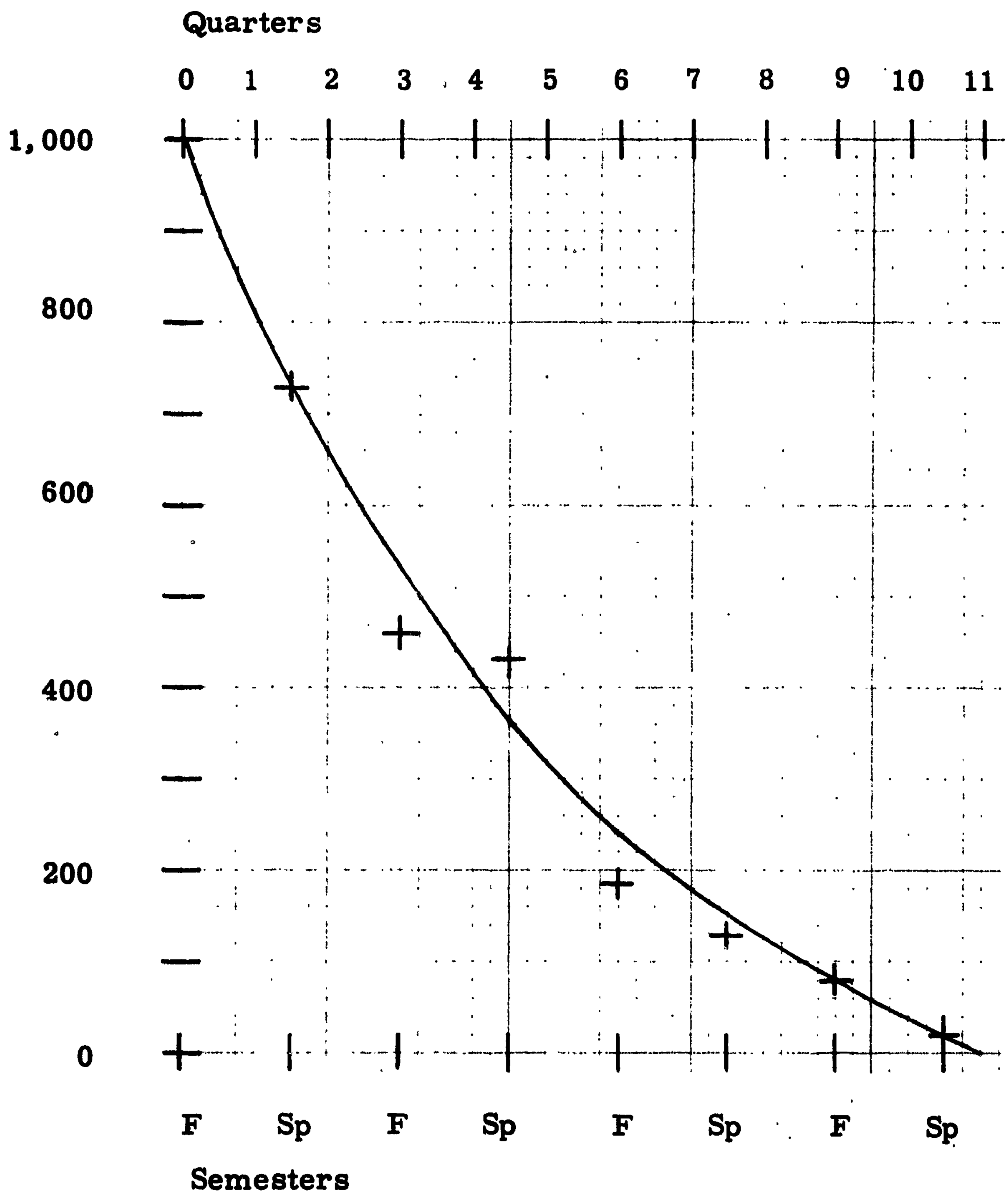

Fig. 10. Total Demand Pattern: College 04

Four-Quarter System

Su	F	W	Sp
	77- 77y	37- 37y	3- 3y
125y	77y	37y	3y
	248- 248y	181-181y	125-125y
421y	327y	248y	181y
	531- 531y	421-421y	327-327y
1,000y	817y	662y	531y
	1,000-1,000y	817-817y	662-662y
1,546y	1,856- 635y	1,456-509y	1,117-402y
			4429

$p_e = .84544$

$\log p_e = 9.92708$

$$\text{Utilization index}^{6} = \frac{4429}{4(1856-635y)}$$

Maximum utilization index = .8416 when y = 85.1 percent

---

[6] For values of y less than .851 (value of y when plant utilization is at its maximum).

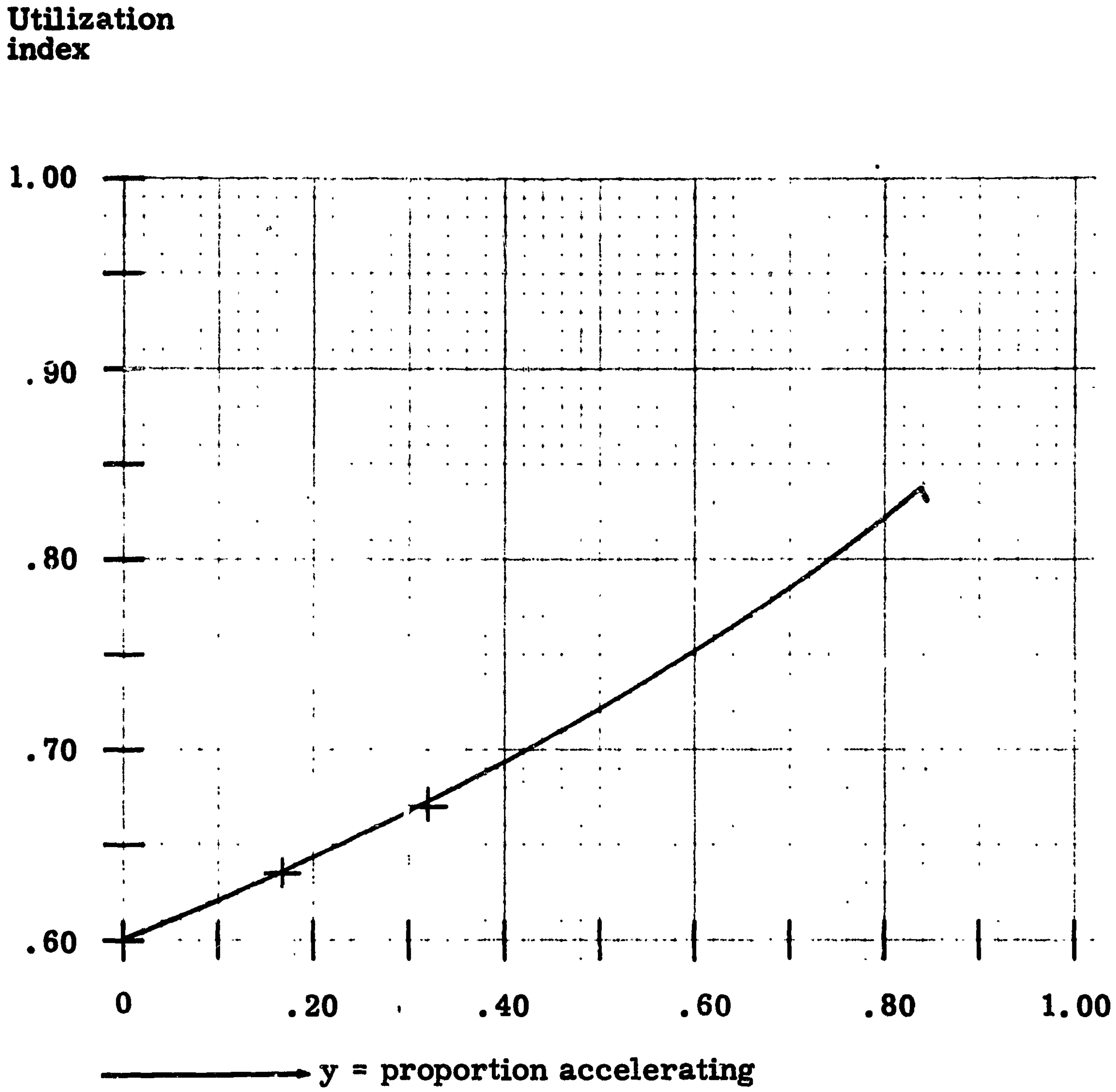

Fig. 11. Possible Gain in Plant Utilization Under Four-Quarter System: College 04

Figure 11 shows the plant utilization index theoretically obtainable under the four-quarter system, with various proportions of students electing to enroll year-round. The two +'s on Figure 11 show the theoretical and empirical utilization indices obtained under the semester system. It will be noted that in this case 32 percent or more of the students must elect to enroll year-round before the utilization index under the four-quarter system exceeds the corresponding index presently obtaining under the semester system.

College 05

Semester System

Theoretical

F	Sp
81	40
219	139
485	330
1,000	700
1,785	1,209
	2,994

Utilization index = .629

K = -65.8

p_E = .71893

log p_E = 0.85669

Empirical

F	Sp
67	40
231	131
447	412
1,000	618
1,745	1,201
	2,946

Utilization index = .634

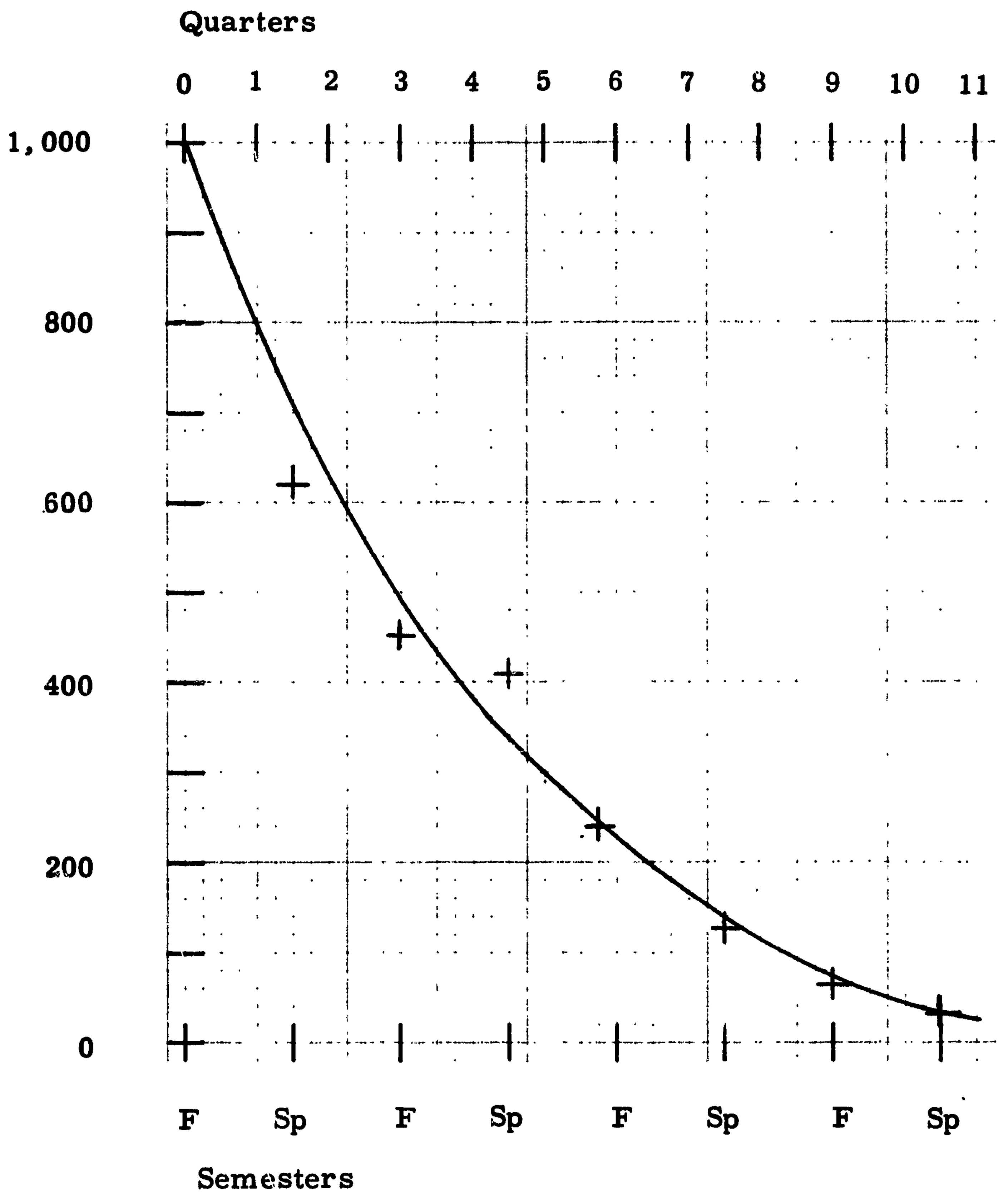

Fig. 12. Total Demand Pattern: College 05

Four-Quarter System

Su	F	W	Sp
	81- 81y	52- 52y	29- 29y
118y	81y	52y	29y
	219- 219y	163-163y	118-118y
376y	289y	219y	163y
	485- 485y	376-376y	289-289y
1,000y	790y	621y	485y
	1,000-1,000y	790-790y	621-621y
1,494y	1,785- 625y	1,381-489y	1,057-380y
			4223

$p_e = .80252$

$\log p_e = 9.90446$

$$\text{Utilization index}^{7} = \frac{4223}{4(1785-625y)}$$

Maximum utilization index = .8301 when y = 82.32 percent

[7] For values of y less than .8232 (value of y when plant utilization is at a maximum).

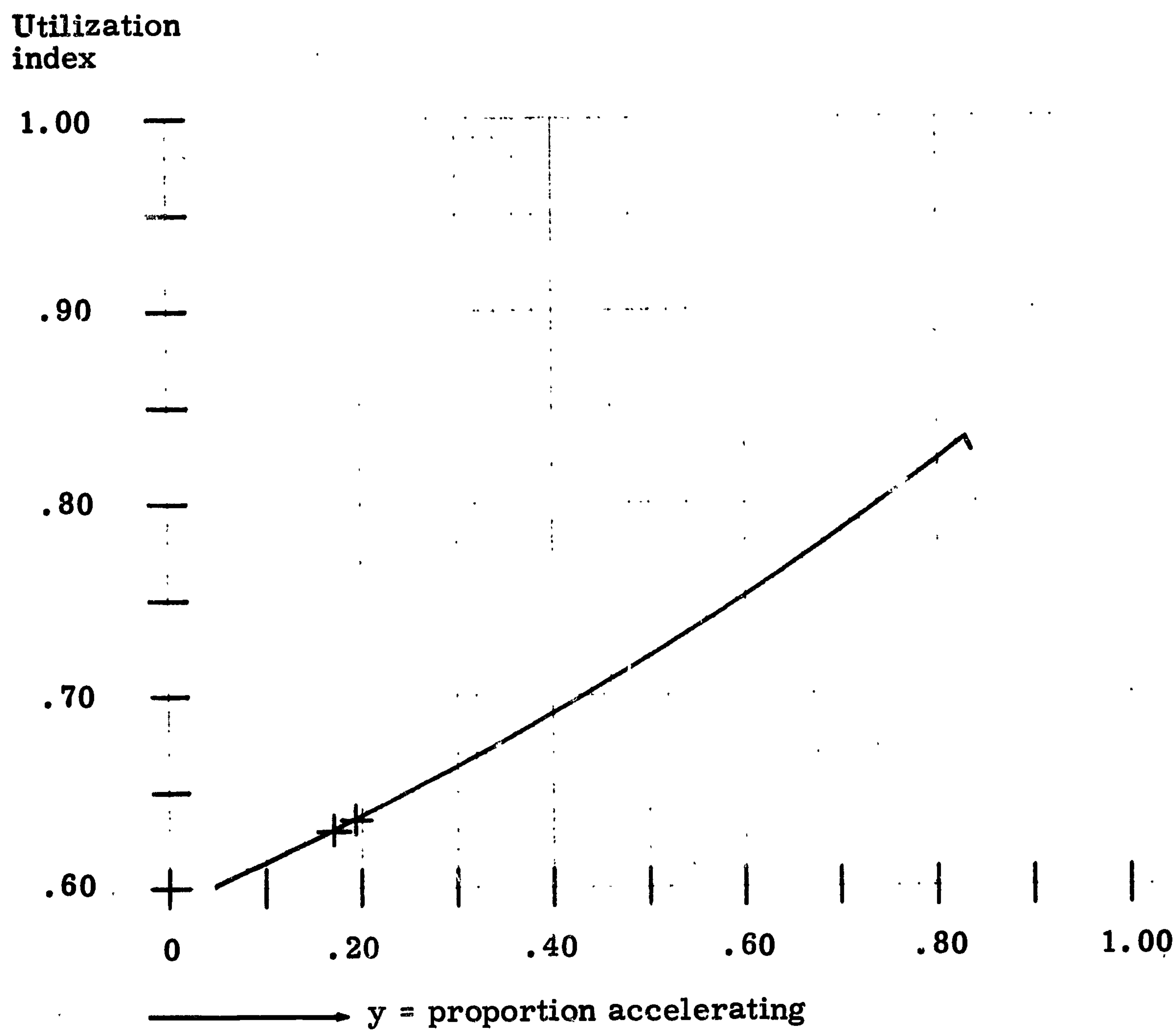

Fig. 13. Possible Gain in Plant Utilization Under Four-Quarter System: College 05

Figure 13 shows the plant utilization index theoretically obtainable under the four-quarter system with various proportions of students electing to enroll year-round. The two +'s on Figure 13 show the theoretical and empirical utilization indices obtained under the semester system. It will be noted that in this case 20 percent or more of the students must elect to enroll year-round before the utilization index under the four-quarter system exceeds the corresponding index presently obtaining under the two-semester system.

College 06

Semester System

Theoretical

F	Sp
52	3
207	118
489	327
1,000	706
1,748	1,152
	2,902

Utilization index = .623

$K = -137.9$

$p_E = .7420$

$\log p_E = 9.870394$

Empirical

F	Sp
51	3
168	121
488	391
1,000	710
1,707	1,225
	2,932

Utilization index = .645

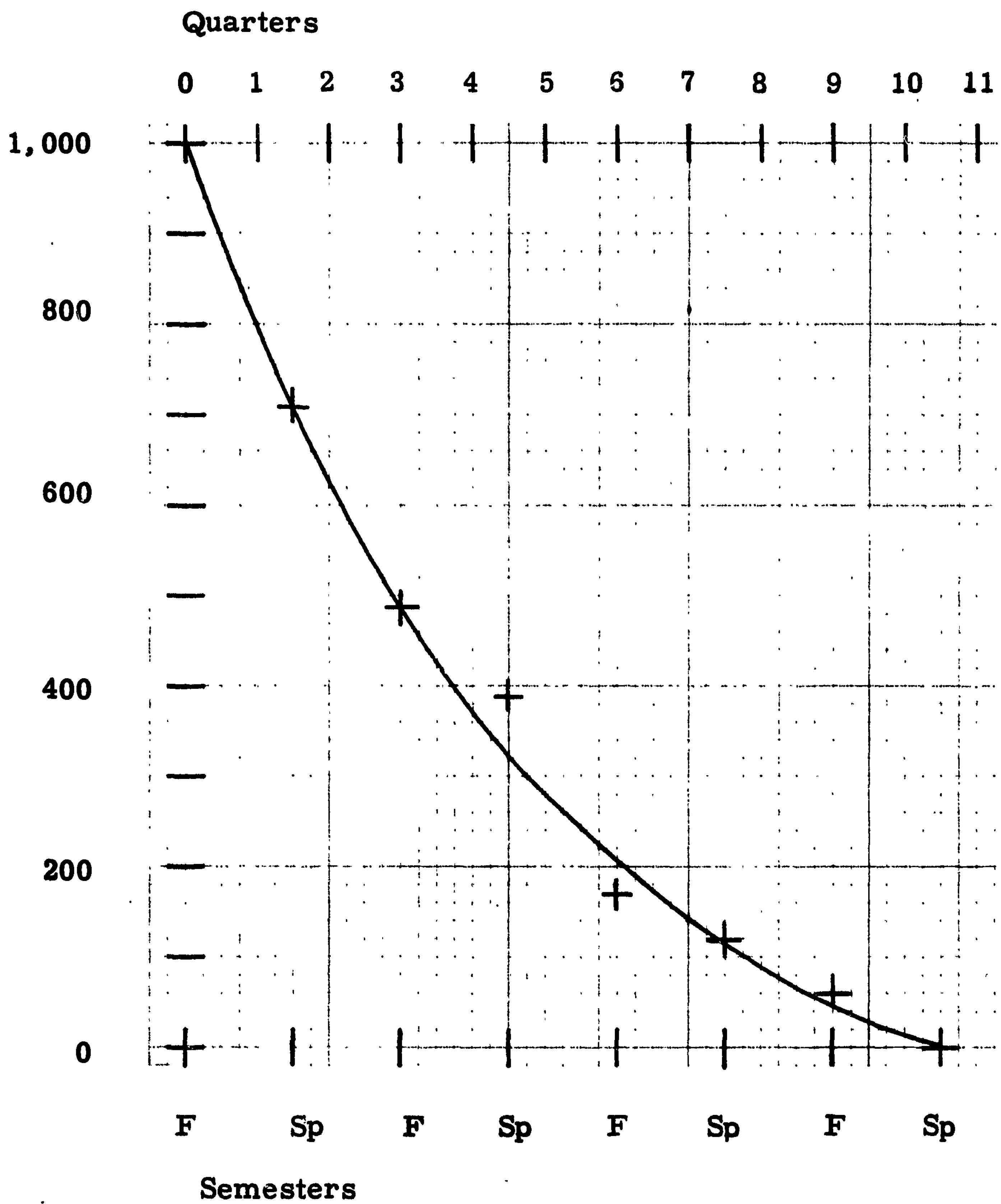

Fig. 14. Total Demand Pattern: College 06

Four-Quarter System

Su	F	W	Sp
	52- 52y	18- 18y	0
94y	52y	18y	0
	207- 207y	145-145y	94- 94y
376y	283y	207y	145y
	489- 489y	376-376y	283-283y
1,000y	795y	627y	489y
	1,000-1,000y	795-795y	627-627y
1,470y	1,748- 618y	1,334-482y	1,004-370y
			4086

$p_e = .8196$

$\log p_e = 9.913596$

$$\text{Utilization index}^{8} = \frac{4086}{4(1748-618y)}$$

Maximum utilization index = .8397 when y = 82.76 percent

[8] For values of y less than .8276 (value of y when plant utilization is at its maximum).

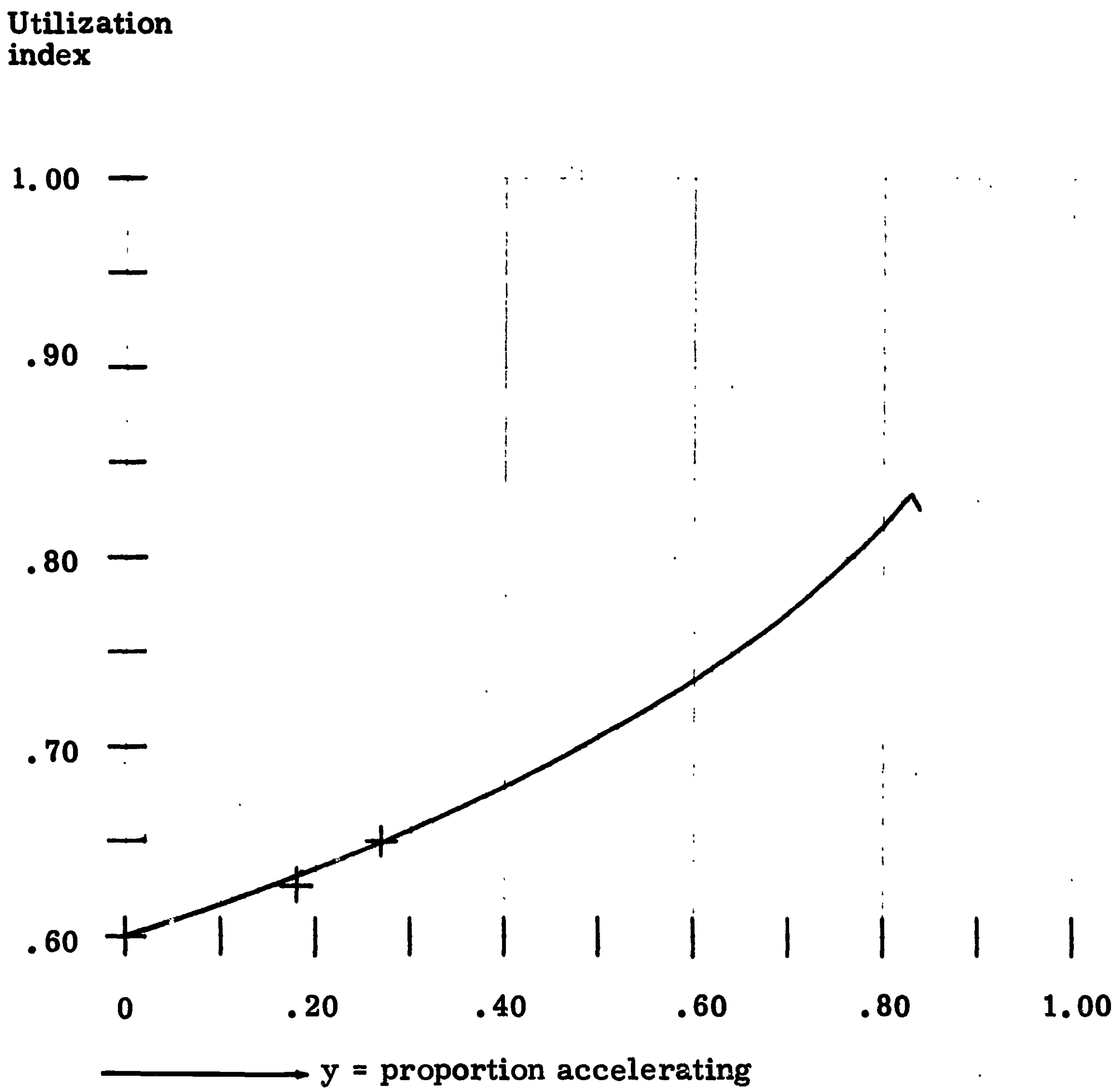

Fig. 15. Possible Gain in Plant Utilization Under Four-Quarter System: College 06

Figure 15 shows the plant utilization index theoretically obtainable under the four-quarter system with various proportions of students electing to enroll year-round. The two +'s on Figure 15 show the theoretical and empirical utilization indices obtained under the semester system. It will be noted that in this case 27 percent or more of the students must elect to enroll year-round before the utilization index under the four-quarter system exceeds the corresponding index presently obtaining under the semester system.

College 07

Semester System

Theoretical

F	Sp
77	35
213	133
480	325
1,000	697
1,770	1,190
	2,960

Utilization index = .627

$K = -69.84$

$p_E = .71707$

$\log p_E = 9.855568$

Empirical

F	Sp
64	61
196	133
410	382
1,000	789
1,670	1,365
	3,035

Utilization index = .683

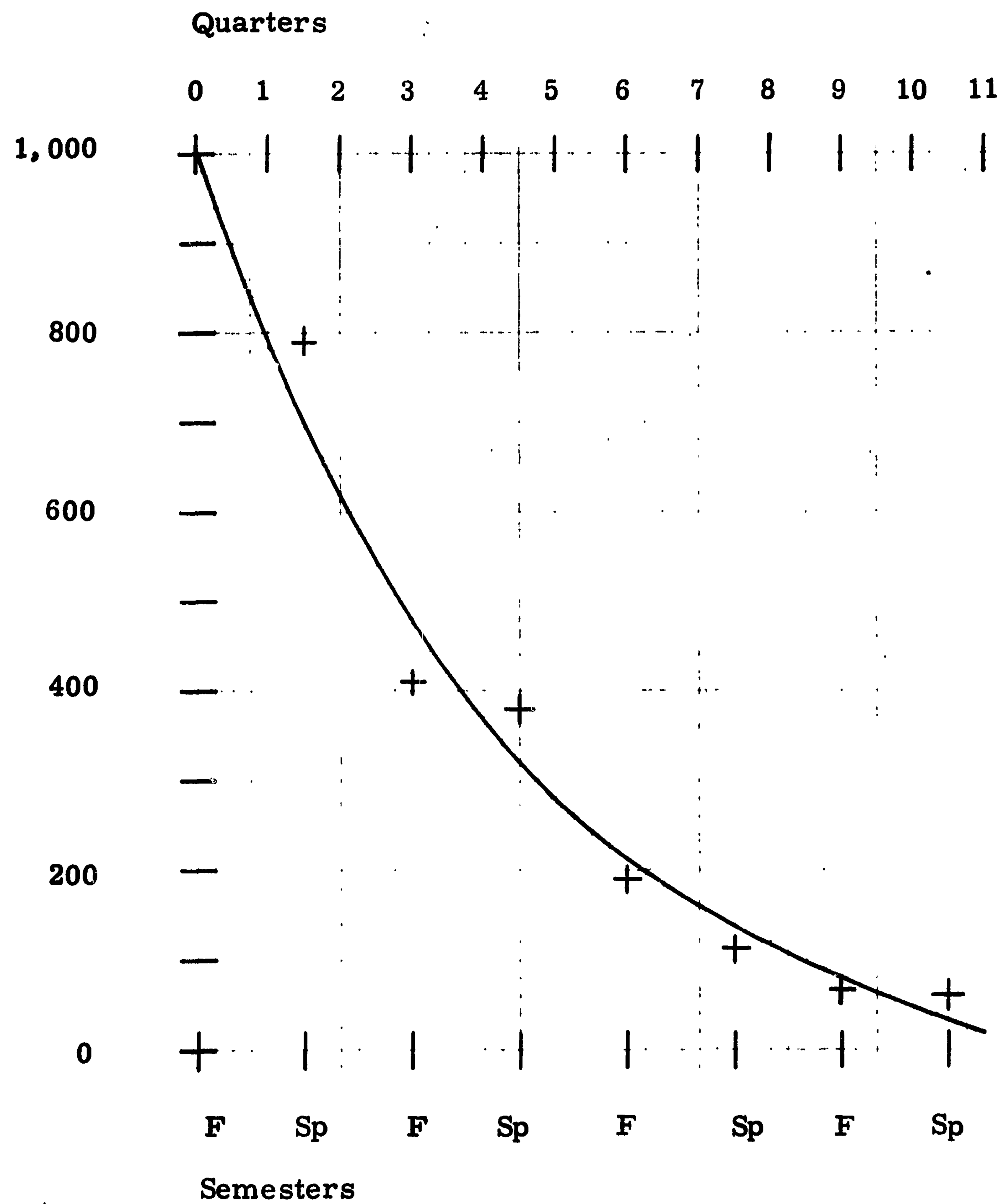

Fig. 16. Total Demand Pattern: College 07

Four-Quarter System

Su	F	W	Sp
	77- 77y	47- 47y	24- 24y
112y	77y	47y	24y
	213- 213y	157-157y	112-112y
371y	283y	213y	157y
	480- 480y	371-371y	283-283y
1,000y	787y	617y	480y
	1,000-1,000y	787-787y	617-617y
1,483y	1,770- 623y	1,362-485y	1,036-375y
			4168

$p_e = .80112$

$\log p_e = 9.903712$

$$\text{Utilization index}^{9} = \frac{4168}{4(1770-623y)}$$

Maximum utilization index = .836 when y = 84.04 percent

---

9 For values of y less than .8404 (value of y when plant utilization is at a maximum).

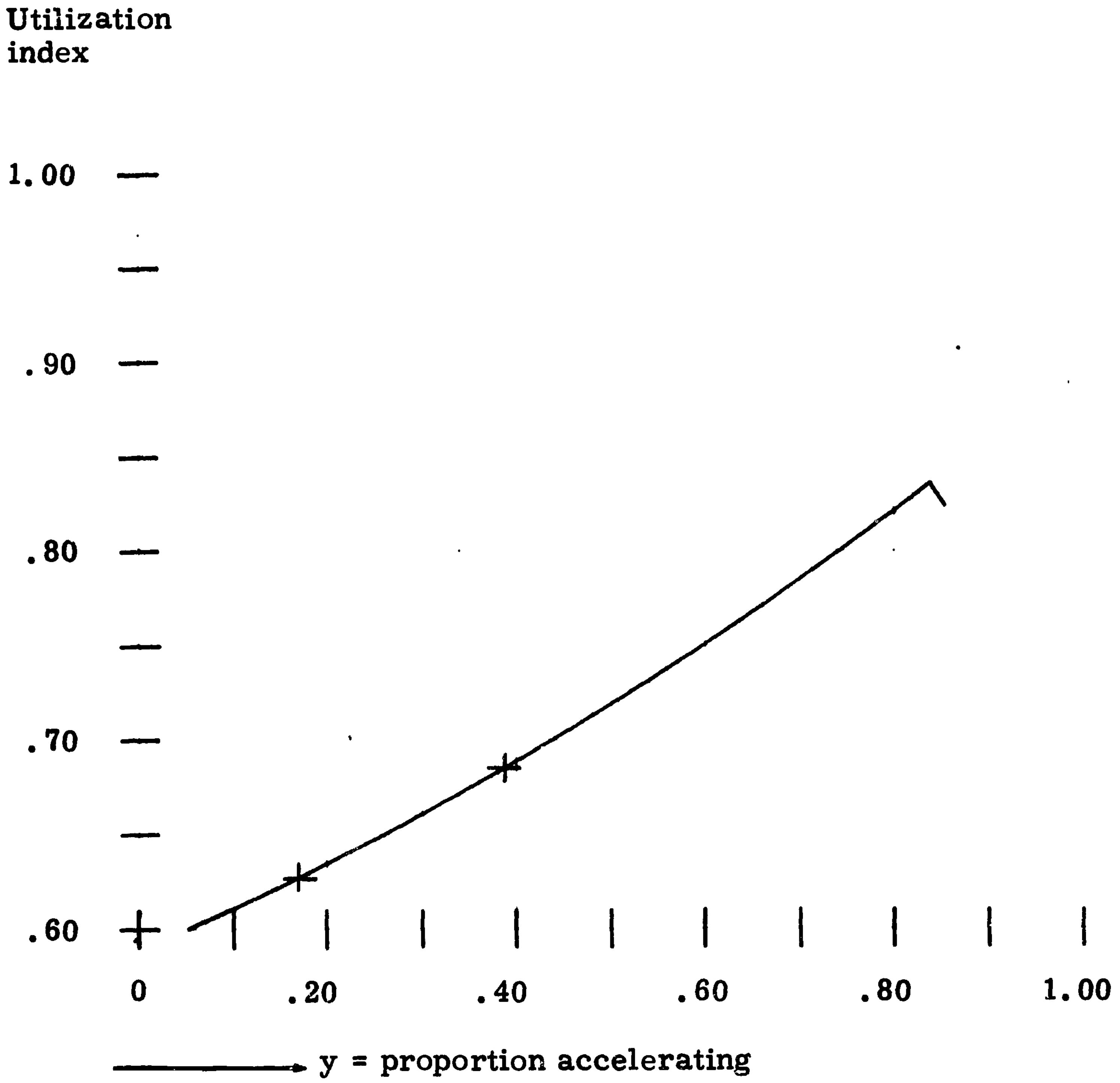

Fig. 17. Possible Gain in Plant Utilization Under Four-Quarter System: College 07

Figure 17 shows the plant utilization theoretically obtainable under the four-quarter system with various proportions of students electing to enroll year-round. The two +'s on Figure 17 show the theoretical and empirical utilization indices obtained under the semester system. It will be noted that in this case 39 percent or more of the students must elect to enroll year-round before the utilization index under the four-quarter system exceeds the corresponding index presently obtaining under the two-semester system.

College 08

Semester System

Theoretical

F	Sp
110	76
230	159
480	348
1,000	693
1,820	1,276
	3,096

$K = -1.5$

$p_E = .6934$

$\log p_E = 9.84097$

Empirical

F	Sp
95	90
247	198
461	407
1,000	643
1,803	1,398
	3,201

Utilization index = .620

Utilization index = .666

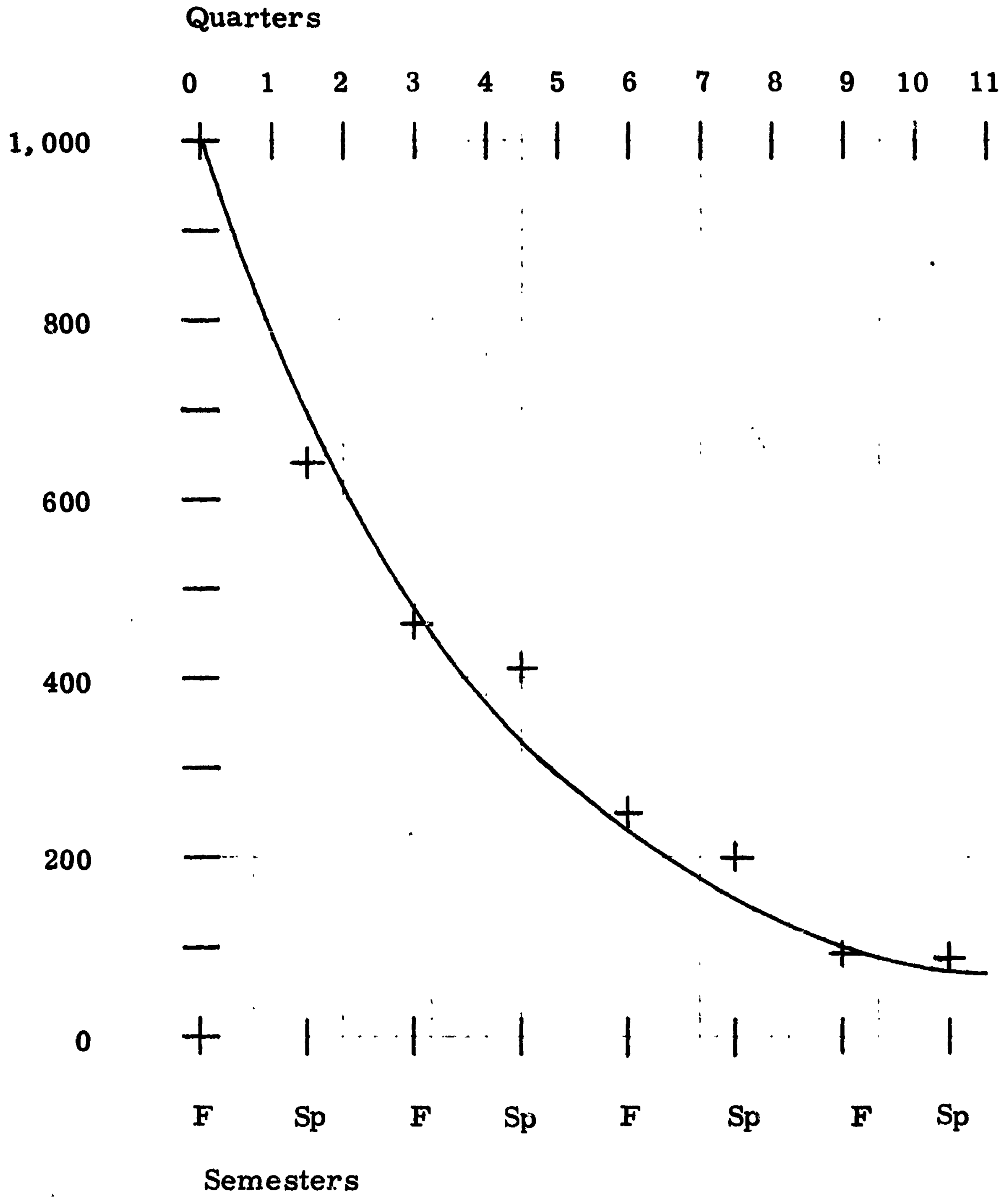

Fig. 18. Total Demand Pattern: College 08

Four-Quarter System

Su	F	W	Sp
	110- 110y	86- 86y	67- 67y
141y	110y	86y	67y
	230- 230y	180-180y	141-141y
376y	294y	230y	180y
	480- 480y	376-376y	294-294y
1,000y	783y	613y	480y
	1,000-1,000y	783-783y	613-613y
1,517y	1,820- 633y	1,425-496y	1,115-388y
			4360

$p_e = .7834$

$\log p_e = 9.89398$

Utilization index[10] $= \frac{4360}{4(1820-633y)}$

Maximum utilization index = .832 when y = 84.65 percent

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[10] For values of y less than .8465 (value of y when plant utilization is at its maximum).

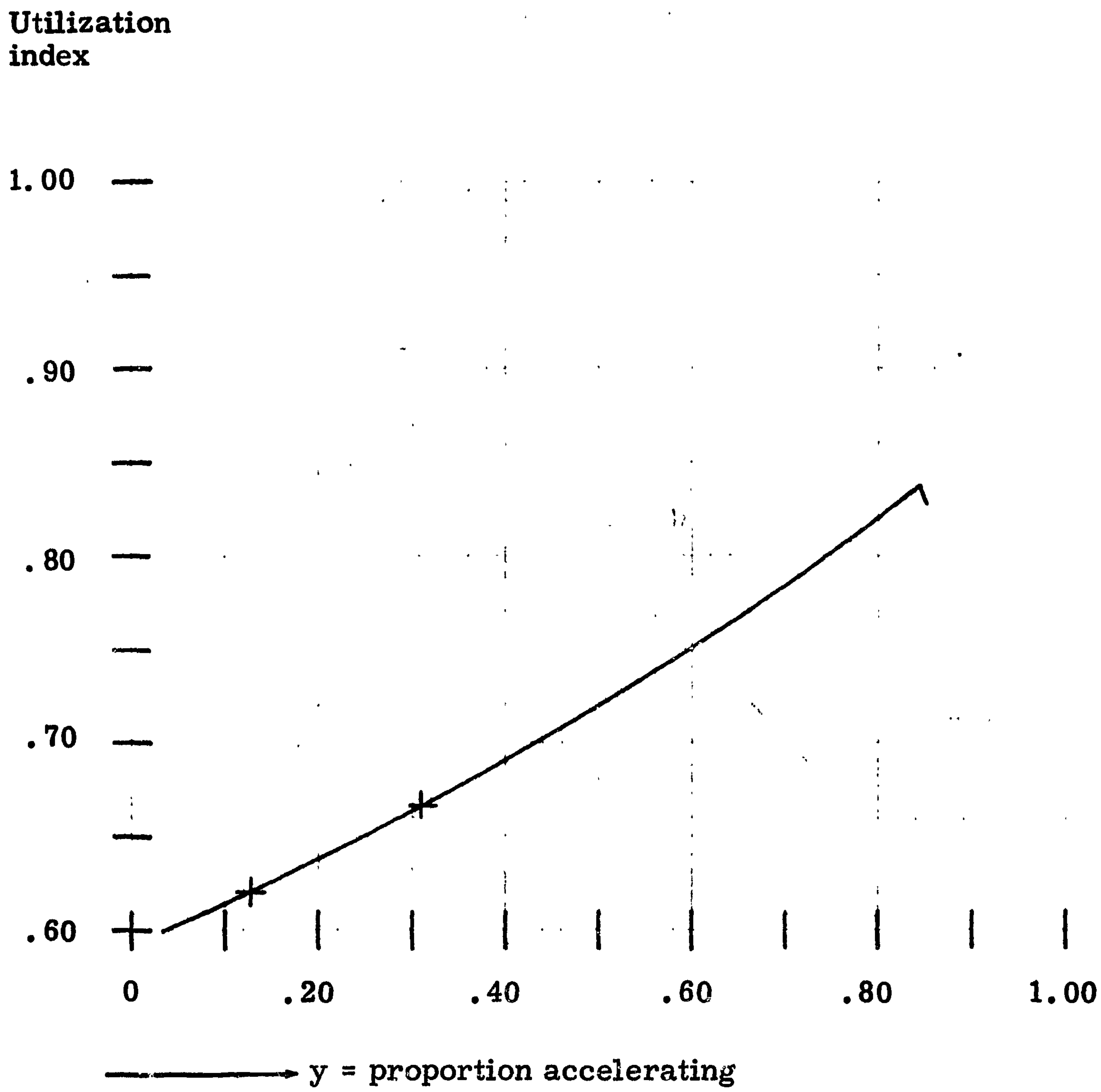

Fig. 19. Possible Gain in Plant Utilization Under Four-Quarter System: College 08

Figure 19 shows the plant utilization index theoretically obtainable under the four-quarter system with various proportions of students electing to enroll year-round. The two +'s on Figure 19 show the theoretical and empirical utilization indices obtained under the semester system. It will be noted that in this case 32 percent or more of the students must elect to enroll year-round before the utilization index under the four-quarter system exceeds the corresponding index presently obtaining under the semester system.

College 09

Semester System

Theoretical

F	Sp
88	76
150	111
350	221
1,000	582
1,588	990
	2,578

$K = +61.12$

$p_E = .5547$

$\log p_E = 9.74406$

Empirical

F	Sp
53	30
186	126
324	274
1,000	483
1,563	913
	2,476

Utilization index = .609

Utilization index = .588

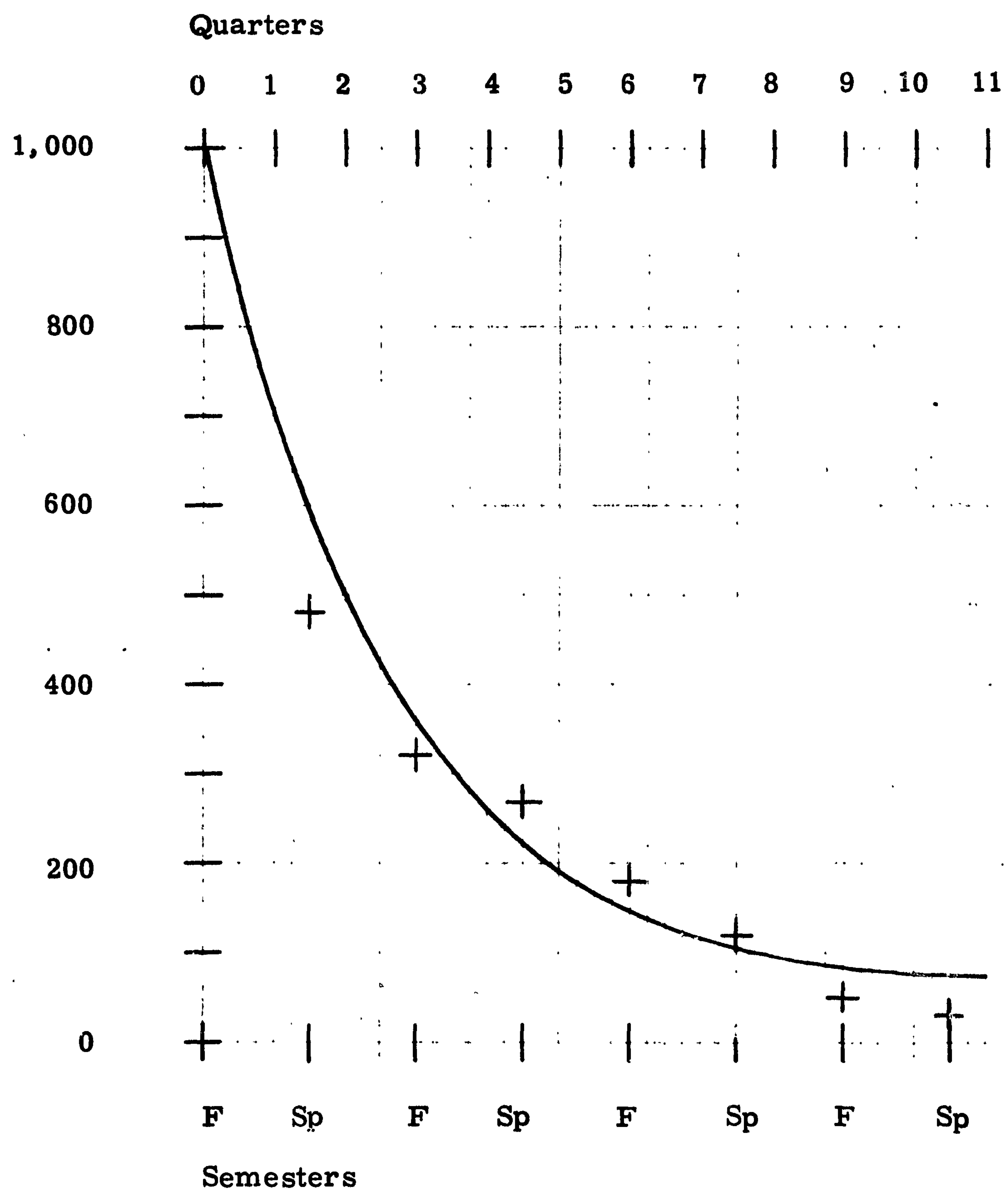

Fig. 20. Total Demand Pattern: College 09

College 09 is the only case in which the theoretical utilization index exceeds the empirical index. The reason is not difficult to find. In College 09 only 48.3 percent of the students persisted into the spring semester of the first year. A curve of the form F(E) passed through the points $E_0 = 1,000$, $E_1 = 483$, $E_2 = 324$ (the first three empirically observed discrete values) just does not describe the behavior of the remaining students in the subsequent years. Any curve of the form f(E) which does describe the behavior of the latter students does not pass near the empirical value of E_1, *viz* 483. The theoretical curve fitted must therefore represent a compromise, and although it results in a utilization index within 3.6 percent of the corresponding empirical index, it is greater than the latter by that amount.

Four-Quarter System

Su	F	W	Sp
	88- 88y	80- 80y	74- 74y
102y	88y	80y	74y
	150- 150y	121-121y	102-102y
256y	193y	150y	121y
	350- 350y	256-256y	193-193y
1,000y	710y	489y	350y
	1,000-1,000y	710-710y	489-489y
1,358y	1,588- 597y	1,167-448y	858-313y
			3613

$p_e = .6751$

$\log p_e = 9.829373$

Utilization index[11] $= \frac{3613}{4(1588-597y)}$

Maximum utilization index = .8189 when y = 81.23 percent

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[11] For values of y less than .8123 (value of y when plant utilization is at a maximum).

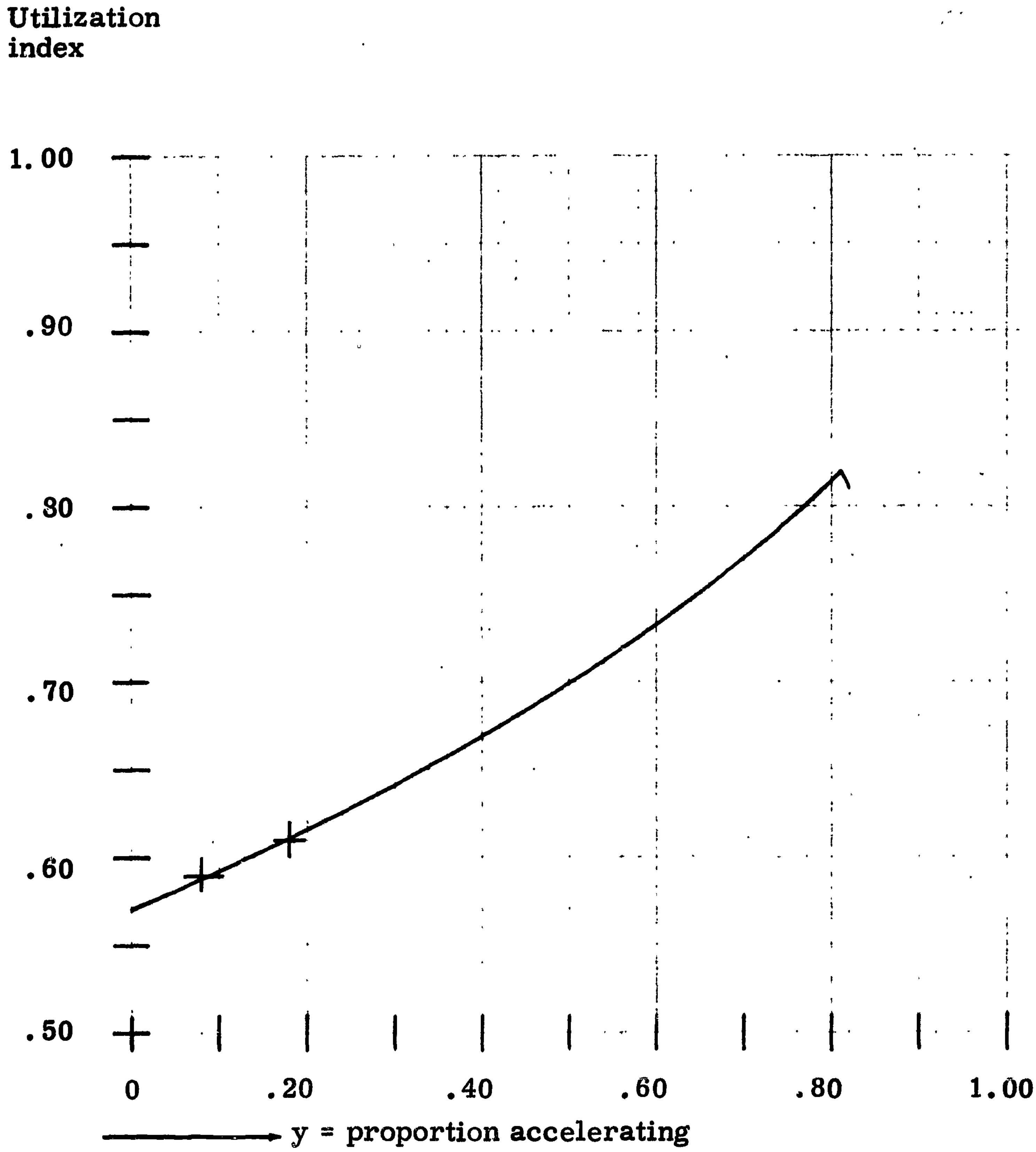

Fig. 21. Possible Gain in Plant Utilization Under Four-Quarter System: College 09

Figure 21 shows the plant utilization index theoretically obtainable under the four-quarter system, with various proportions of students electing to enroll year-round. The two +'s on Figure 21 show the empirical and theoretical[12]

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[12] In this case, as noted above, the empirical index is the smaller and thus appears on the left in Figure 21.

utilization indices obtained under the semester system. It will be noted that in this case 18 percent or more of the students must elect to enroll year-round before the utilization index under the four-quarter system exceeds the corresponding index presently obtaining under the semester system.

College 10

Semester System

Theoretical

F	Sp
65	7
235	139
521	630
1,000	730
1,821	1,236
	3,057

Utilization index = .629

$K = -189$

$p_E = .77294$

$\log p_E = 9.888144$

Empirical

F	Sp
44	40
189	139
457	414
1,000	717
1,690	1,310
	3,000

Utilization index = .666

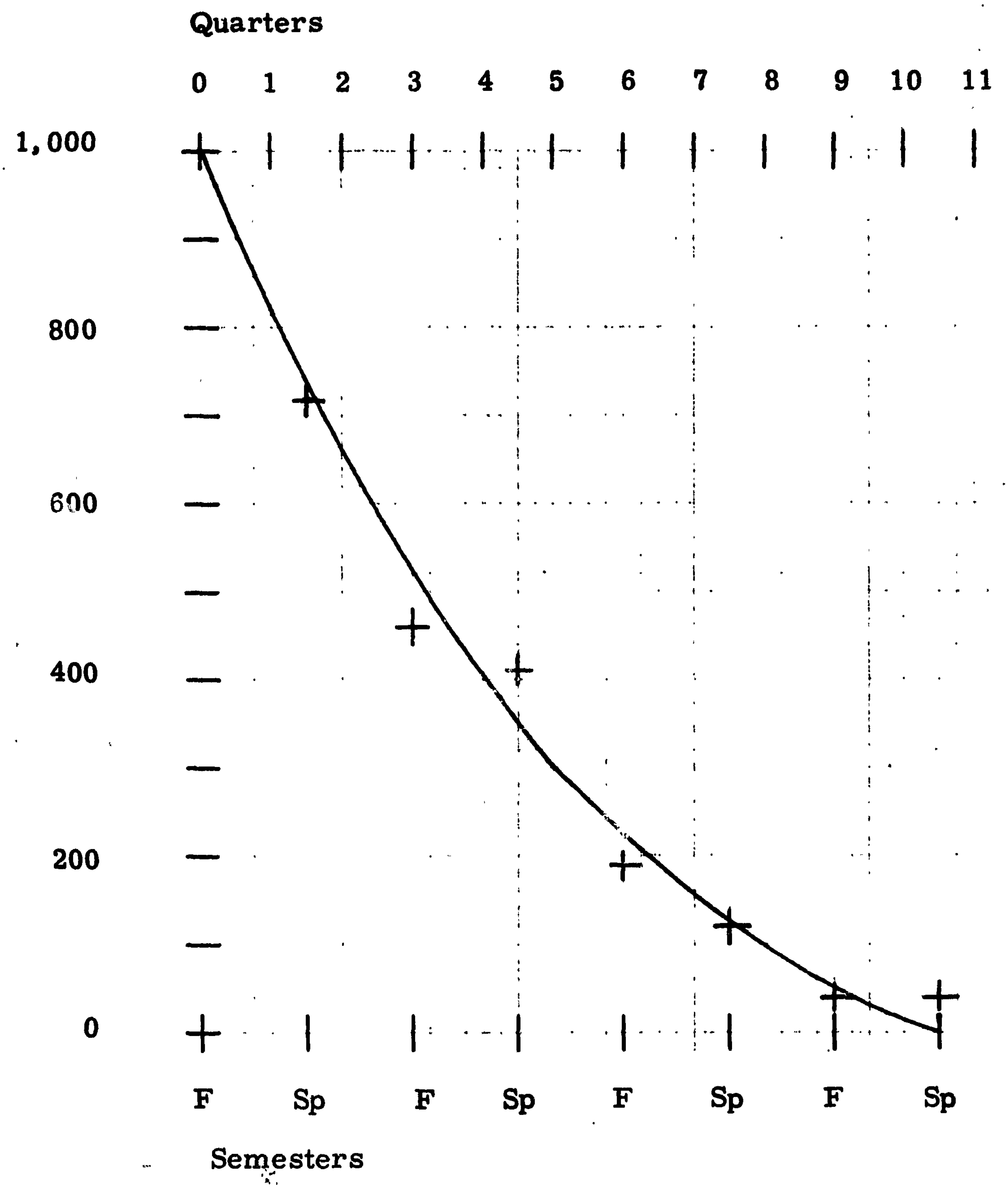

Fig. 22. Total Demand Pattern: College 10

Four-Quarter System

Su	F	W	Sp
	65- 65y	24- 24y	0
112y	65y	24y	0
	235- 235y	168-168y	112-112y
409y	315y	235y	168y
	521- 521y	409-409y	315-315y
1,000y	812y	654y	521y
	1,000-1,000y	812-812y	654-654y
1,521y	1,821- 629y	1,413-500y	1,081-392y
			4315

p_e = .842167

$\log p_e$ = 9.92540

$$\text{Utilization index}^{13} = \frac{4315}{4\,(1821-629y)}$$

Maximum utilization index = .8374 when y = 84.7 percent

[13] For values of y less than .847 (value of y when plant utilization is at a maximum).

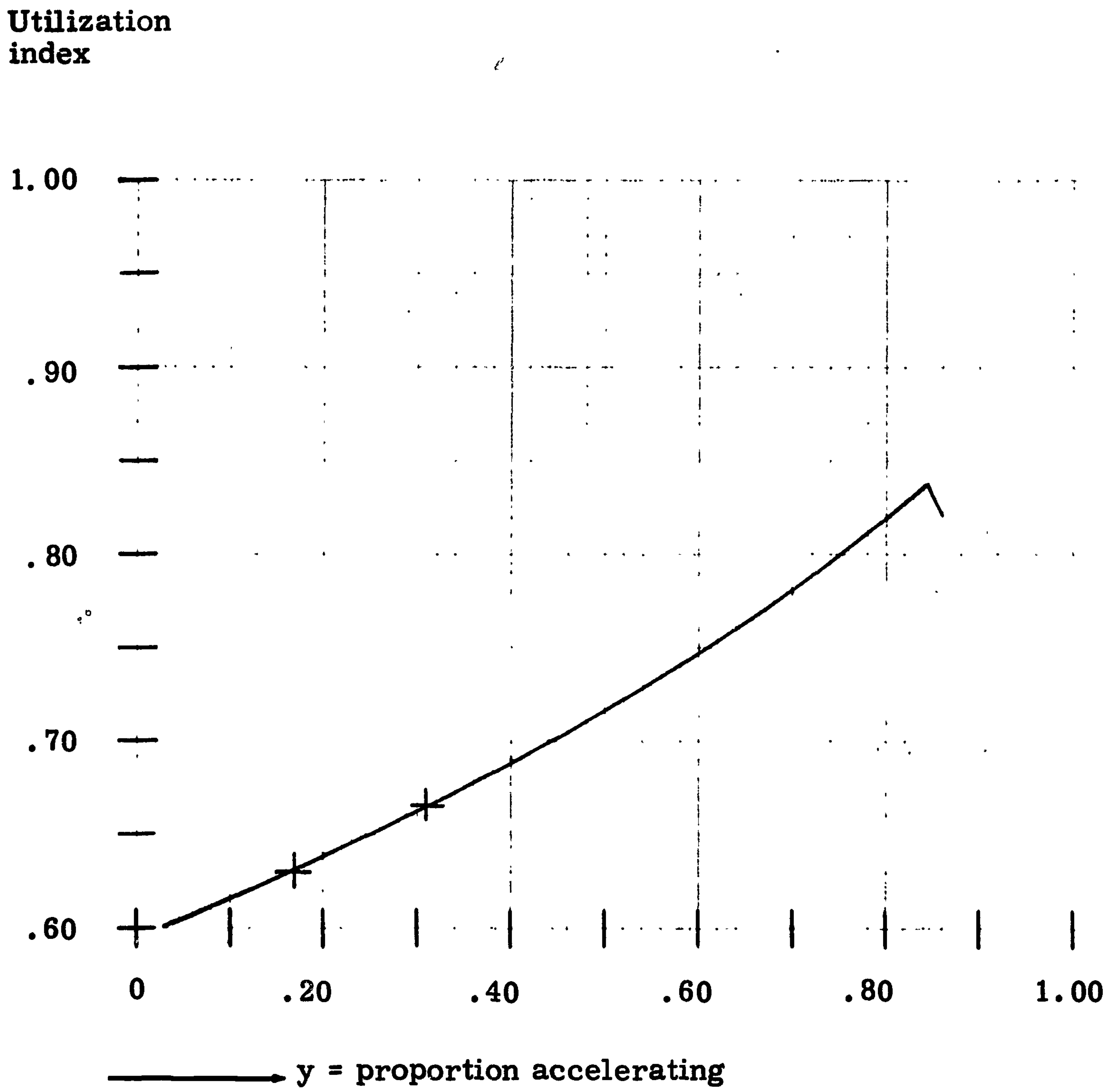

Fig. 23. Possible Gain in Plant Utilization Under Four-Quarter System: College 10

Figure 23 shows the plant utilization index theoretically obtainable under the four-quarter system, with various proportions of students electing to enroll year-round. The two +'s on Figure 23 show the theoretical and empirical utilization indices obtained under the semester system. It will be noted that in this case 32 percent or more of the students must elect to enroll year-round before the utilization index under the four-quarter system exceeds the corresponding index presently obtaining under the semester system.

College 11

Semester System

Theoretical

F	Sp
0	0
230	95
563	385
1,000	767
1,793	1,297
	3,040

Utilization index = .637

$K = -836.28$

$p_E = .87194$

$\log p_E = 9.94098$

Empirical

F	Sp
18	0
137	71
563	497
1,000	754
1,718	1,322
	3,040

Utilization index = .662

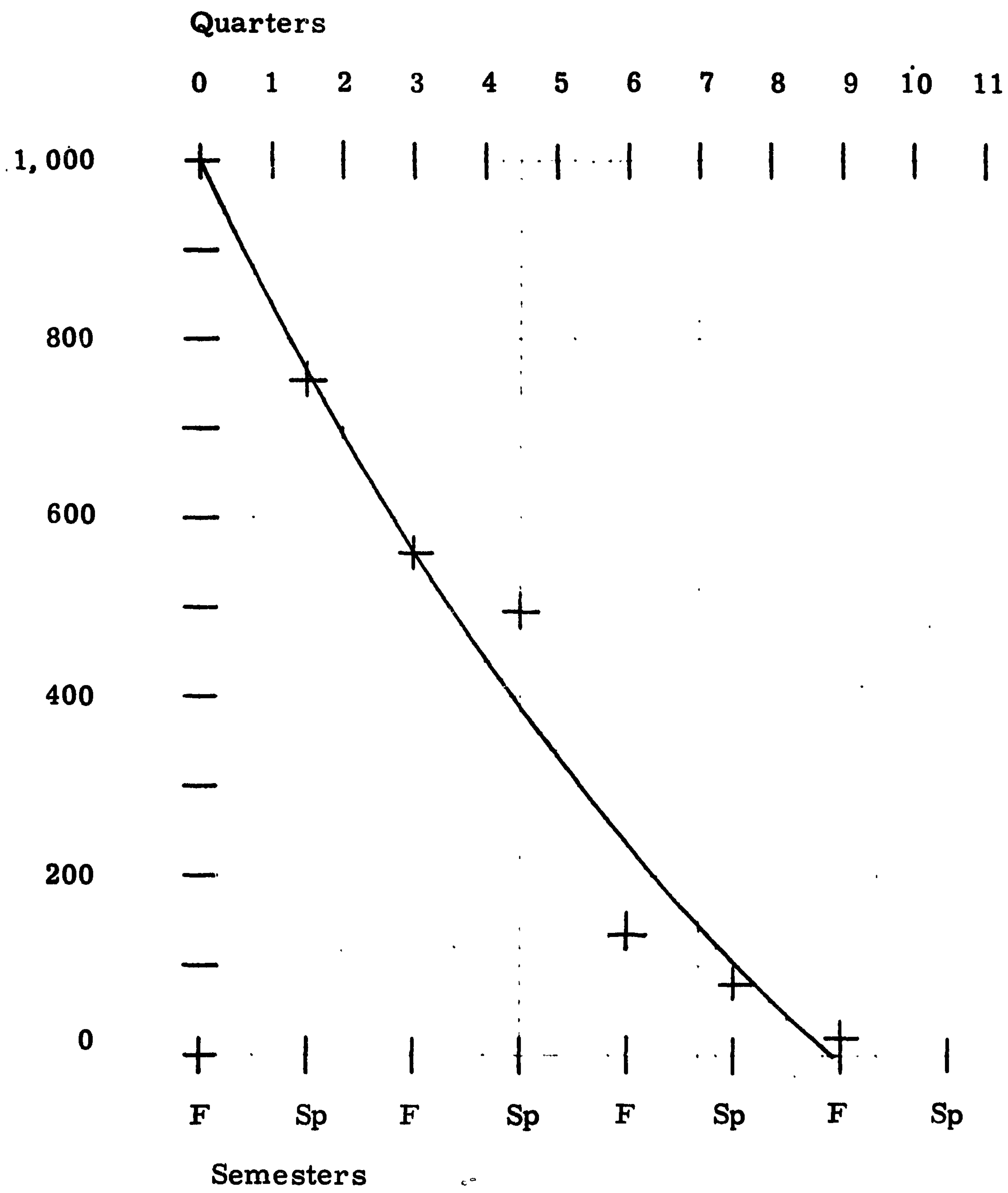

Fig. 24. Total Demand Pattern: College 11

Four-Quarter System

Su	F	W	Sp
	0	0	0
53y	0	0	0
	230- 230y	138-138y	53- 53y
442y	331y	230y	138y
	563- 563y	442-442y	331-331y
1,000y	841y	696y	563y
	1,000-1,000y	841-841y	696-696y
1,495y	1,793- 621y	1,421-495y	1,080-379y
			4294

$p_e = .91338$

$\log p_e = 9.960653$

$$\text{Utilization index}^{14} = \frac{4294}{4(1793-621y)}$$

Maximum utilization index = .8474 when y = 84.73 percent

[14] For values of y less than .8473 (value of y when plant utilization is at a maximum).

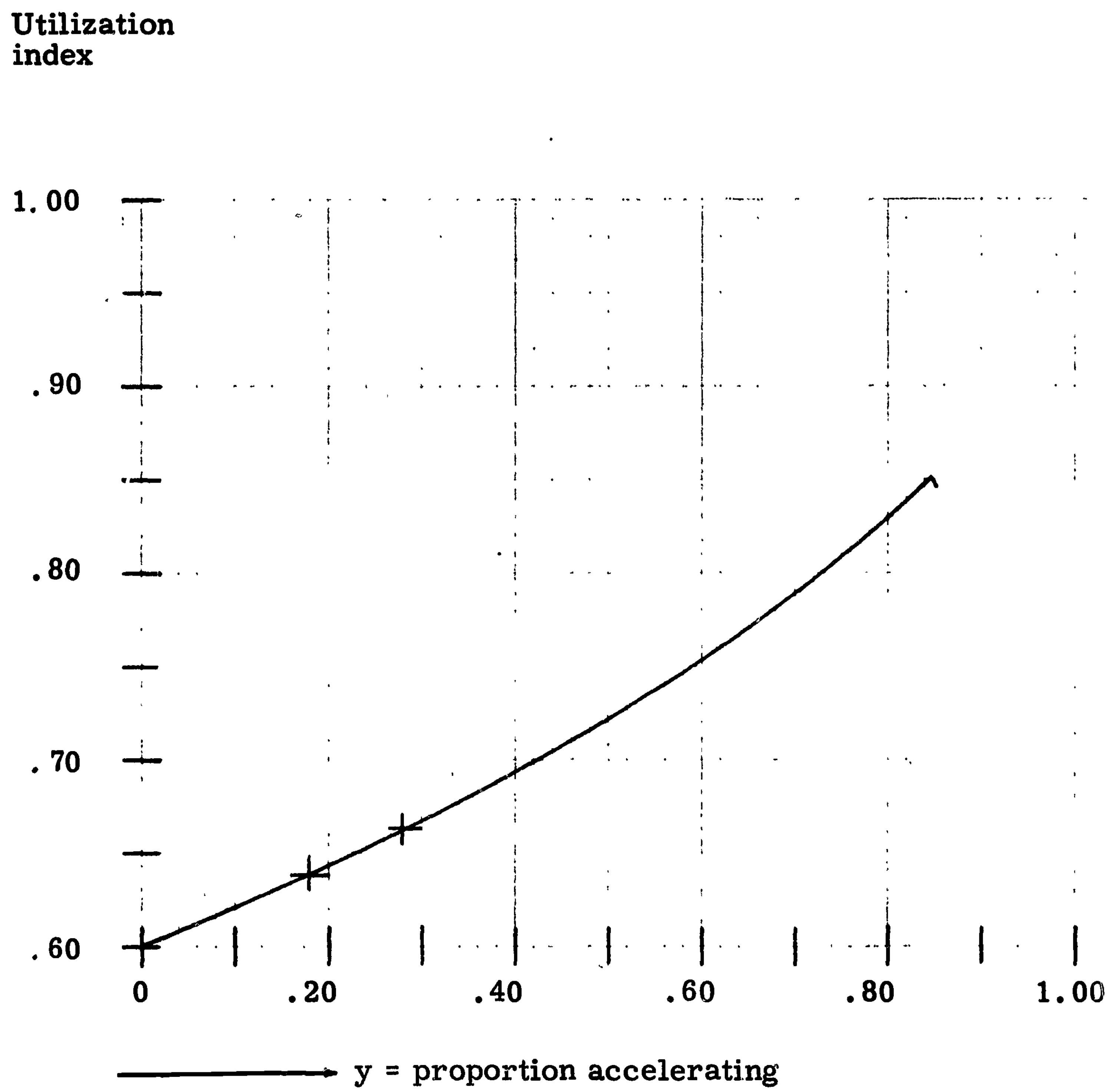

Fig. 25. Possible Gain in Plant Utilization Under Four-Quarter System: College 11

Figure 25 shows the plant utilization index theoretically obtainable under the four-quarter system, with various proportions of students electing to enroll year-round. The two +'s on Figure 25 show the theoretical and empirical utilization indices obtained under the semester system. It will be noted that in this case 28 percent or more of the students must elect to enroll year-round before the utilization index under the four-quarter system exceeds the corresponding index presently obtaining under the semester system.

College 12

Semester System

Theoretical

F	Sp
90	79
146	109
339	214
1,000	571
1,575	973
	2,548

$K = +66.4$

$p_E = .54036$

$\log p_E = 9.73268$

Empirical

F	Sp
73	58
146	107
339	312
1,000	565
1,558	1,042
	2,600

Utilization index = .607

Utilization index = .626

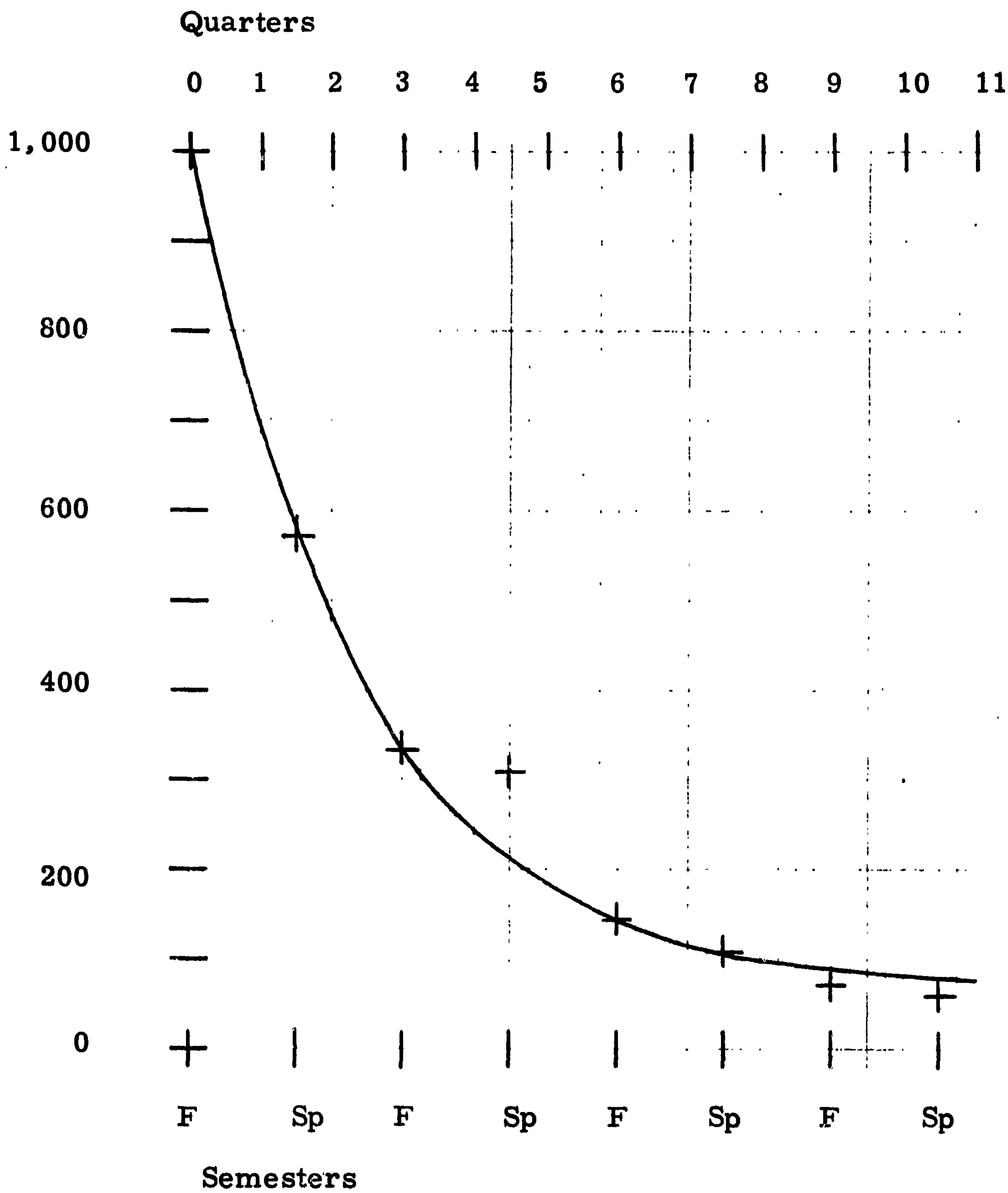

Fig. 26. Total Demand Pattern: College 12

Four-Quarter System

Su	F	W	Sp
	90- 90y	82- 82y	77- 77y
101y	90y	82y	77y
	146- 146y	119-119y	101-101y
247y	186y	146y	119y
	339- 339y	247-247y	186-186y
1,000y	686y	477y	339y
	1,000-1,000y	686-686y	477-477y
1,348y	1,575- 613y	1,134-429y	841-306y
			3550

$p_e = .66341$

$\log p_e = 9.8217867$

$$\text{Utilization index}^{15} = \frac{3550}{4(1575-613y)}$$

Maximum utilization index = .8198 when y = 80.31 percent

[15] For values of y less than .8031 (value of y when plant utilization is at a maximum).

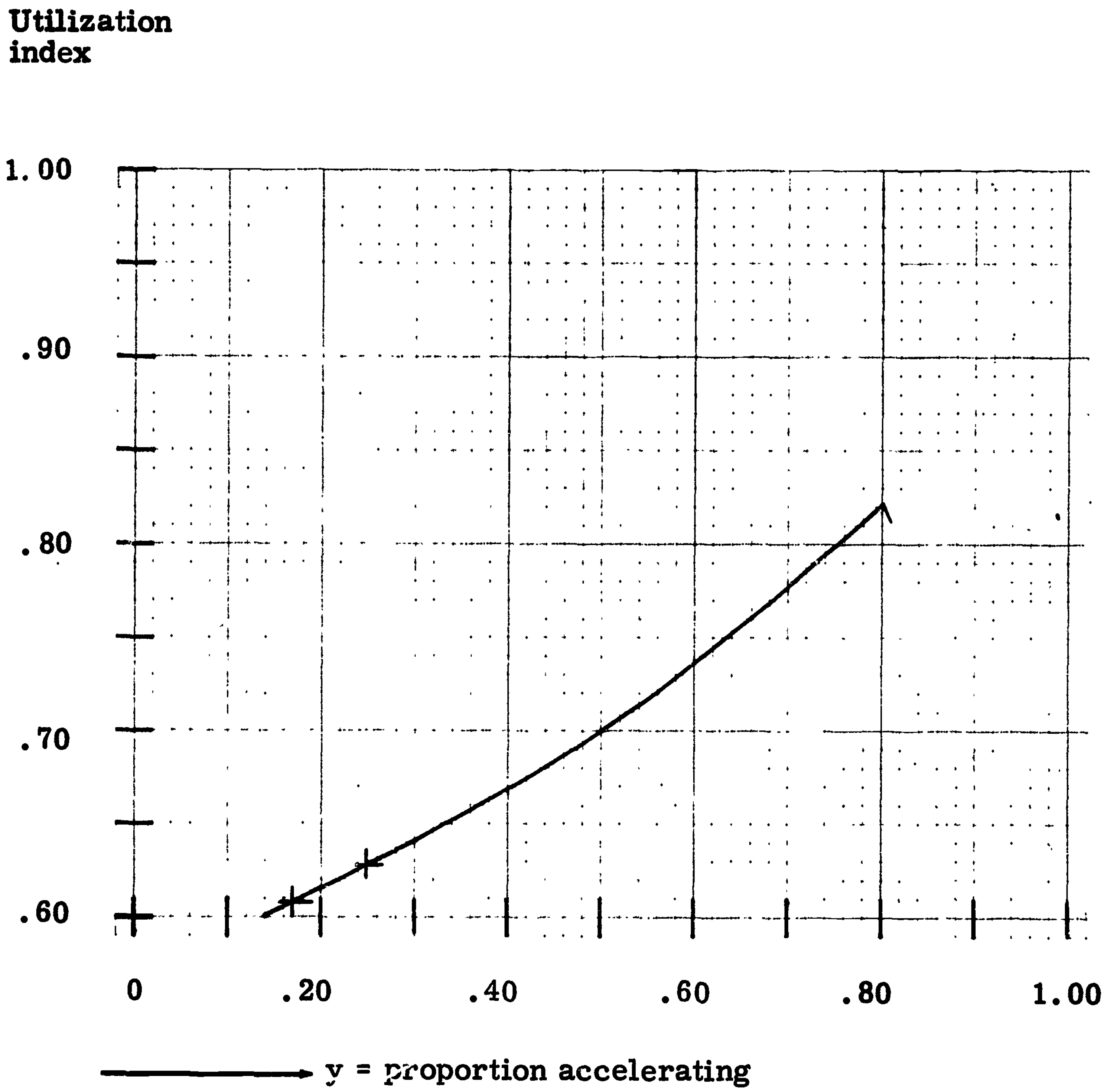

Fig. 27. Possible Gain in Plant Utilization Under Four-Quarter System: College 12

Figure 27 shows the plant utilization theoretically obtainable under the four-quarter system, with various proportions of students electing to enroll year-round. The two +'s on Figure 27 show the theoretical and empirical utilization indices obtained under the semester system. It will be noted that 25 percent or more of the students must elect to enroll year-round before the utilization index under the four-quarter system exceeds the corresponding index presently obtaining under the semester system.

College 13

Semester System

Theoretical

F	Sp
25	0
190	96
482	315
1,000	704
1,699	1,115
	2,815

Utilization index = .621

K = -187.9

p_E = .75088

log p_E = 9.87557

Empirical

F	Sp
25	0
96	58
440	368
1,000	705
1,561	1,131
	2,692

Utilization index = .646

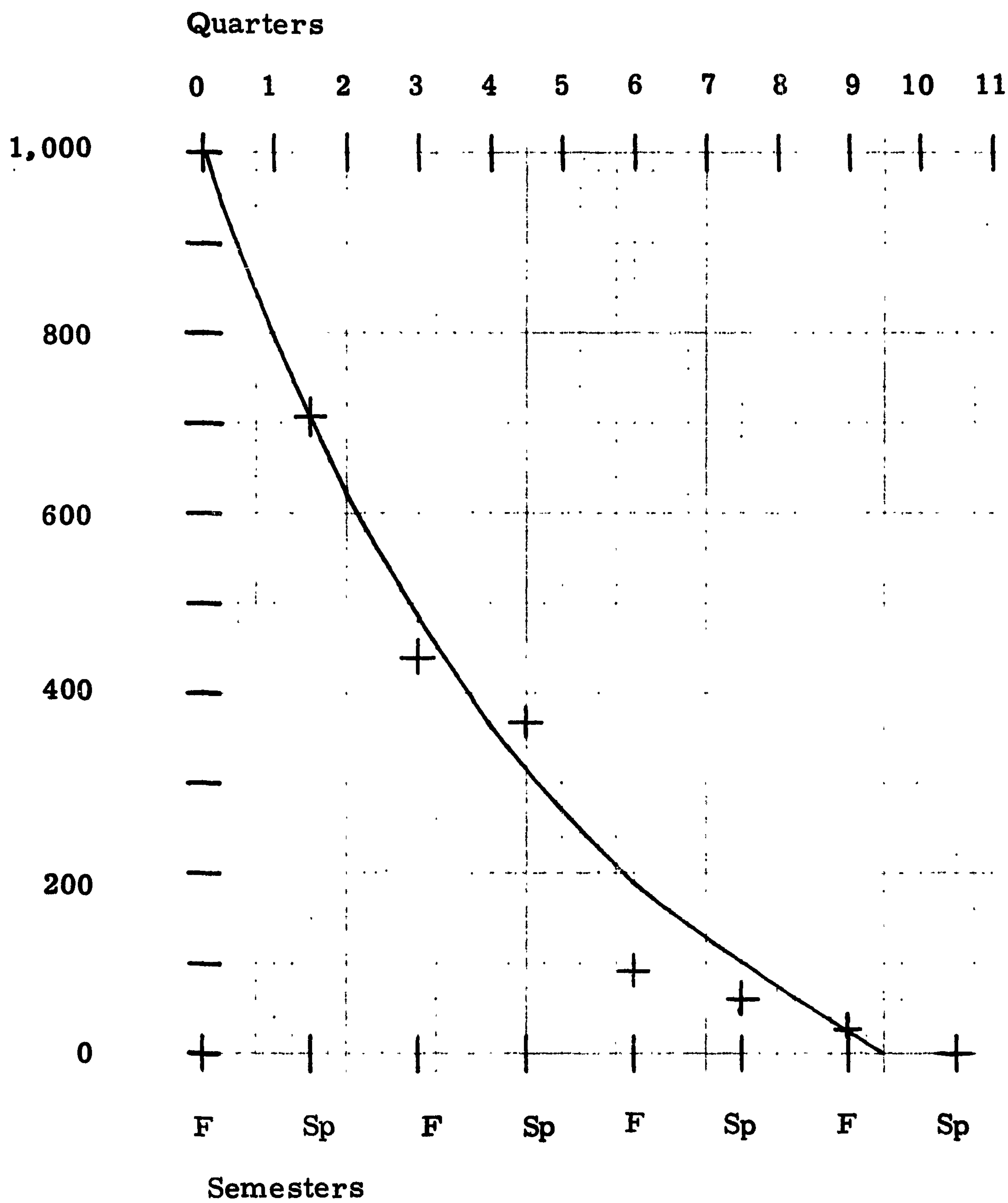

Fig. 28. Total Demand Pattern: College 13

Four-Quarter System

Su	F	W	Sp
	25- 25y	0	0
70y	25y	0	0
	190- 190y	124-124y	70- 70y
365y	269y	190y	124y
	482- 482y	365-365y	269-269y
1,000y	794y	623y	482y
	1,000-1,000y	794-794y	623-623y
1,435y	1,697- 609y	1,283-470y	962-356y
			3942

$p_e = .82613$

$\log p_e = 9.91705$

Utilization index[16] $= \frac{3942}{4(1697-609y)}$

Maximum utilization index = .8272 when y = 83.02 percent

[16] For values of y less than .8302 (value of y when plant utilization is at a maximum).

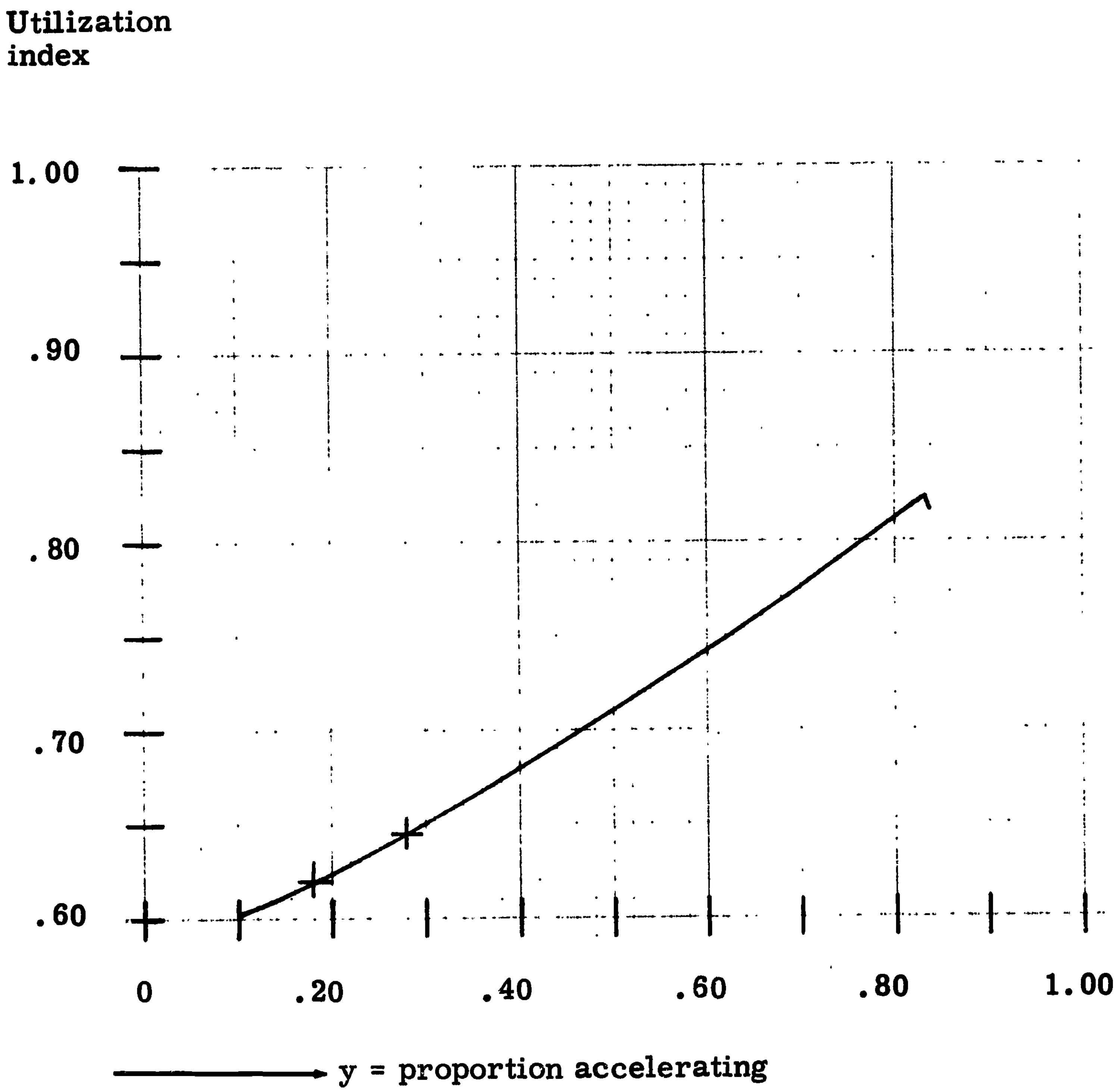

Fig. 29. Possible Gain in Plant Utilization Under Four-Quarter System: College 13

Figure 29 shows the plant utilization theoretically obtainable under the four-quarter system, with various proportions of students electing to enroll year-round. The two +'s on Figure 29 show the theoretical and empirical utilization indices obtained under the semester system. It will be noted that in this case 28 percent or more of the students must elect to enroll year-round before the utilization index under the four-quarter system exceeds the corresponding index presently obtaining under the semester system.

Conclusions Drawn from Application of Empirical Data

It appears that the pattern of total demand placed on a junior college by the first-time freshman student as such demand develops over time can be described approximately by an exponential function of the form f(E); and, that the error generally will be on the conservative side; i.e., the utilization index computed from f(E) was less than the corresponding index computed directly from the empirical data 11 times out of 12.

By transforming f(E) to f(e) through the relationship: $\log p_e = \frac{2}{3} \log p_E$, a change of scale operation, a matrix can be constructed which describes the corresponding enrollment for the same students under the four-quarter system of year-round operation. From this matrix, utilization indices can be computed for various proportions of students electing to enroll year-round. These indices can be compared with the corresponding utilization indices computed for the semester system to show the theoretical gain (or loss) in utilization to be expected from a conversion to the four-quarter system. Such a comparison for each of the 12 colleges in the sample is shown in Figure 30.

College	Percent gain in utilization index, 40 percent accelerating	Percent gain in utilization index, 50 percent accelerating
02 Agricultural/Military	4.11	8.56
03 Small City/Agricultural	3.95	8.33
04 Exurban	1.65	7.78
05 Big City	8.52	13.25
06 Suburban	5.74	10.23
07 Suburban	0.59	4.83
08 Exurban	3.16	7.66
09 Big City	13.94	21.43
10 Rural/Agricultural	3.30	7.51
11 Rural/Agricultural	5.03	9.37
12 Big City	6.71	12.14
13 Rural/Agricultural	4.95	9.75
Median	4.53	8.45

Fig. 30. Gain in Plant Utilization by Conversion to Four-Quarter System Under Two Assumptions of Student Acceleration

These gains appear to be small in absolute terms, with the exception of College 09.[17] In Chapters I and II, it was noted that gains to be expected from conversion to a year-round calendar are commonly discussed in terms of the four-year institutions, and that generally a "no attrition" model is implicit in these discussions. Now in a no attrition model, the utilization index under the two-semester system will always be: $\frac{9 \text{ months}}{12 \text{ months}} = .75.$
A no attrition model of the four-year institution under the four-quarter system can be easily constructed for comparison purposes:

"No Attrition" Model
Four-Year Institution

Su	F	W	Sp
	1,000-1,000y	1,000-1,000y	1,000-1,000y
1,000y	1,000y	1,000y	1,000y
	1,000-1,000y	1,000-1,000y	1,000-1,000y
1,000y	1,000y	1,000y	1,000y
	1,000-1,000y	1,000-1,000y	1,000-1,000y
1,000y	1,000y	1,000y	1,000y
	1,000-1,000y	1,000-1,000y	1,000-1,000y
3,000y	4,000-1,000y	4,000-1,000y	4,000-1,000y
			12,000

$$\text{Utilization index} = \frac{12,000}{4(4,000-1,000y)} = \frac{3}{4-y}$$

Utilization index = .8333 when 40 percent accelerate, for a gain over the corresponding index for the two-semester system of <u>11.11</u> percent.[18]

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[17] The high relative gains of "Big City" colleges will be discussed in Chapter VI, *infra*.

[18] One must be careful to distinguish between the percent of students accelerating and the enrollment of the summer quarter as a percent of the enrollment of the quarter of largest enrollment--generally the fall quarter. The latter term one is likely to encounter in discussing year-round operations with the staff of the University of California and of the California State Colleges. In the four-year model above 47.06 percent of the students would have to accelerate their programs before the summer quarter enrollment reached 40 percent of the fall quarter enrollment: $3,000y = .40\ (4,000-1,000y)$
$y = .4706$

Utilization index = .8571 when 50 percent accelerate, for a gain over the corresponding index for the two-semester system of 14.29 percent.

Chapter II also pointed out that under a no attrition model the utilization index for the two-year institution remained at .75 regardless of the proportion of students accelerating for those students entering directly from high schools which did not have midyear graduation.

Thus, it would appear that a model which recognizes attrition shows some gain in plant utilization in the junior colleges, given significant proportions of students electing to enroll year-round. These gains are, generally, not so dramatic as those shown by a no attrition model in the four-year institution under corresponding conditions of student acceleration.

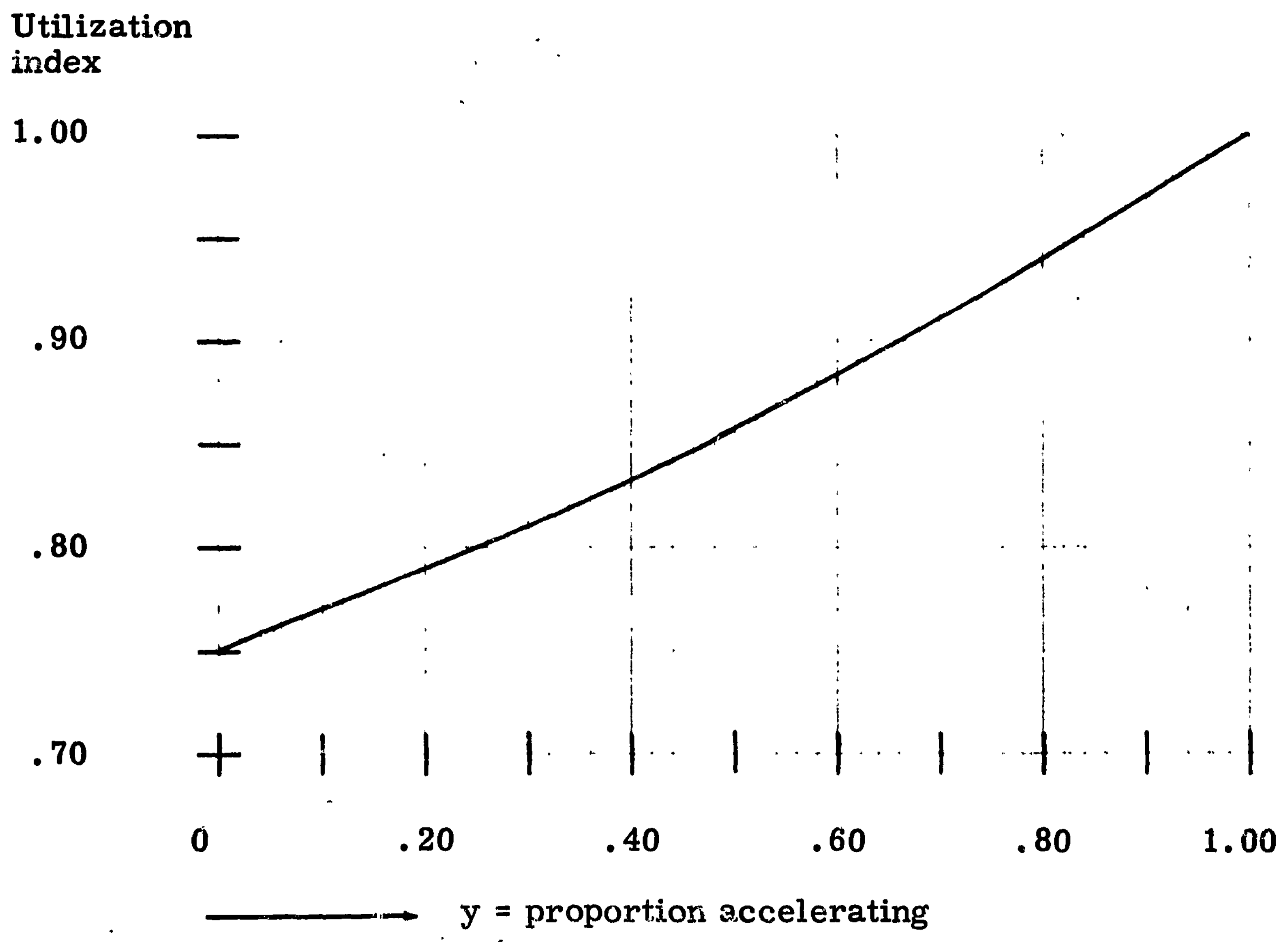


Fig. 31. Possible Gain in Plant Utilization Under Four-Quarter System: Four-Year Institution, No Attrition

Chapter V

APPLICATION OF THE MODEL TO SUBPOPULATIONS

In the previous chapter it was determined that enrollment demands made under the two-semester system by total populations of junior college students over time could be described approximately by a mathematical function. This function could then be manipulated to describe the demands made by these same students under the four-quarter system of year-round operations with various proportions of these students electing to enroll year-round. Implicit in this operation is the assumption that the students electing to enroll year-round will exhibit the same demand pattern over time as do the students who do not elect to enroll year-round.

As a practical matter, one may wish to use the model without having to make such an assumption. For example, suppose that one wishes to determine the change in utilization index obtainable under the four-quarter system if 50 percent of the high ability students, 40 percent of the average ability students, and 30 percent of the low ability students elect to enroll year-round. One is then faced with the problem of handling subpopulations.

It is evident that the empirical data available are readily divisible into subpopulations by at least two criteria:

1. Sex
2. Scholastic ability

This chapter will, therefore, extend the application of the model as developed in Chapter IV to a set of subpopulations.

Characteristics of the Sample by Sex and by Scholastic Ability

Standard test scores on 3,548 of the males and 2,362 of the females were available to the Center for Research and Development in Higher Education when the data were originally assembled. These data were converted to stanines based on national thirteenth grade norms and were coded into the individual data cards.[1] For the total sample, the numbers of each sex falling in the respective stanines were:

Stanine	(Low) 1	2	3	4	5	6	7	8	9 (High)
Males	155	410	479	728	661	523	385	158	49
Females	126	357	344	538	437	279	184	74	23
Total	281	767	823	1,266	1,098	802	569	232	72

[1]See Appendix I, *infra*, card columns 51-53.

This can be converted to percents:

Stanine	(Low) 1	2	3	4	5	6	7	8	9 (High)
Males	4.4	11.5	13.5	20.5	18.6	14.7	10.9	4.5	1.4
Females	5.3	15.1	14.6	22.8	18.5	11.8	7.8	3.1	1.0
Total sample	4.7	13.0	13.9	21.4	18.6	13.5	9.8	3.9	1.2

It will be noted that the females are less able than the males. A test for homogeniety of populations reveals that this difference is significant at the .001 level.

Since this detailed breakdown gives very low cell values, the stanines can be grouped as follows:

Low = Stanines 1, 2, and 3

Medium = Stanines 4, 5, and 6

High = Stanines 7, 8, and 9

This gives the following distribution in terms of individuals:

	Low	Medium	High	Total
Males	1,044	1,912	592	3,548
Females	827	1,254	281	2,362
Total	1,871	3,166	873	5,910

and by percents:

	Low	Medium	High	Total
Males	29.4	53.8	16.8	100
Females	35.0	53.1	11.9	100
Total sample	31.7	53.5	14.8	100

The distribution of ability among colleges was by no means uniform. The cumulative frequency distribution curve for colleges 05 and 09, total males and females, crossed the midpoint approximately 1.1 stanines below the corresponding curves for colleges 02, 06, and 10. The latter three colleges, with the most able students, showed their median students to be about 0.1 stanines below the national median for the thirteenth grade.

Among the 12 colleges, the ability of the median female varied over a range of 1.5 stanines while the corresponding figure for the males was 1.2 stanines. In colleges 10, 11, and 13, the females were more able than the males; in the other nine, the males were more able than the females. In seven of the colleges, this difference is statistically significant. In Figure 32 the colleges are arranged in order from males more able at the top to females more able at the bottom:

Rank order		College	Sig.
1	09	Big City	.001
2	12	Big City	.002
3	05	Big City	.01
4	06	Suburban	.02
5	07	Suburban	.10
6	08	Exurban	.10
7	02	Agricultural/Military	N.S.
8	04	Exurban	N.S.
9	03	Small City/Agricultural	N.S.
10	10	Rural/Agricultural	N.S.
11	13	Rural/Agricultural	N.S.
12	11	Rural/Agricultural	.05

Fig. 32. Relative Aptitude, Males vs. Females

It will be noted that the order in which the colleges are listed in Figure 32 is very near the same as that of Figure 5 in Chapter IV which lists the colleges in order of magnitude of immediate dropouts:

Rank order relative aptitude		College	Rank order immediate dropouts	Difference
1	09	Big City	2	-1
2	12	Big City	1	1
3	05	Big City	3	0
4	06	Suburban	5	-1
5	07	Suburban	8	-3
6	08	Exurban	7	-1
7	02	Agricultural/Military	11	-4
8	04	Exurban	6	2
9	03	Small City/Agricultural	9	0
10	10	Rural/Agricultural	10	0
11	13	Rural/Agricultural	12	-1
12	11	Rural/Agricultural	4	8

r_s (Rank Correlation) = .657 Hypothesis that variables are independent rejected at .02 level.

Fig. 33. Rank Order Correlation: Relative Aptitude of Males and Females (Fig. 32) vs. Percent of Immediate Dropouts (Fig. 5)

A modification to the demand pattern program described in Chapter IV[2] was written and placed in the computer. A print out was obtained describing the demand pattern in each college generated by each of the three ability groups and within each ability group by sex. In the colleges in which the numbers in the sample were small, the results tended to be somewhat inconclusive beyond the fourth semester because of small cell values. It was evident, however, that in all colleges there was little difference in the demand patterns generated by the sexes within the same ability group. Sex was, therefore, dropped from further consideration.

Considering only the differences in demand patterns between ability groups, the results were not unexpected. The low ability group showed a high early attrition in every college. The high ability group showed a low early attrition but dropped rapidly after the fourth semester; the demand curve of the high ability group typically crossing the curve of the medium ability group between the fourth and fifth semesters. Since the medium ability group was the most numerous--from 48 percent to 59 percent of the sample in each college--the demand curve of that group lay very close to the total demand curve for the respective colleges as described in Chapter IV.

Treatment of a College by Subpopulations

The application of the model to subpopulations may be illustrated by selecting one of the colleges and applying the model to the low, middle, and high ability groups. From such application three curves of possible gain in plant utilization emerge, one for each ability group. By the use of these curves, problems of the type posed in the second paragraph at the opening of this chapter can be solved.

The college selected for this purpose is College 08. This college is the median college in Figure 33, has students of near median ability for the total sample, and has the largest "n" of the 12 colleges.

Low Ability Group: College 08 (N = 263)

Semester System

Theoretical

F	Sp
104	98
144	117
309	198
1,000	538
1,557	951
	2,408

Utilization index = .605[3]

$K = 92.3$

$p_E = .4863$

$\log p_E = 9.689596$

Empirical

F	Sp
77	75
186	117
271	213
1,000	467
1,534	872
	2,406

Utilization index = .587

[2]Pp. 52-54.

[3]See parenthetical remark, p. 82, *supra*.

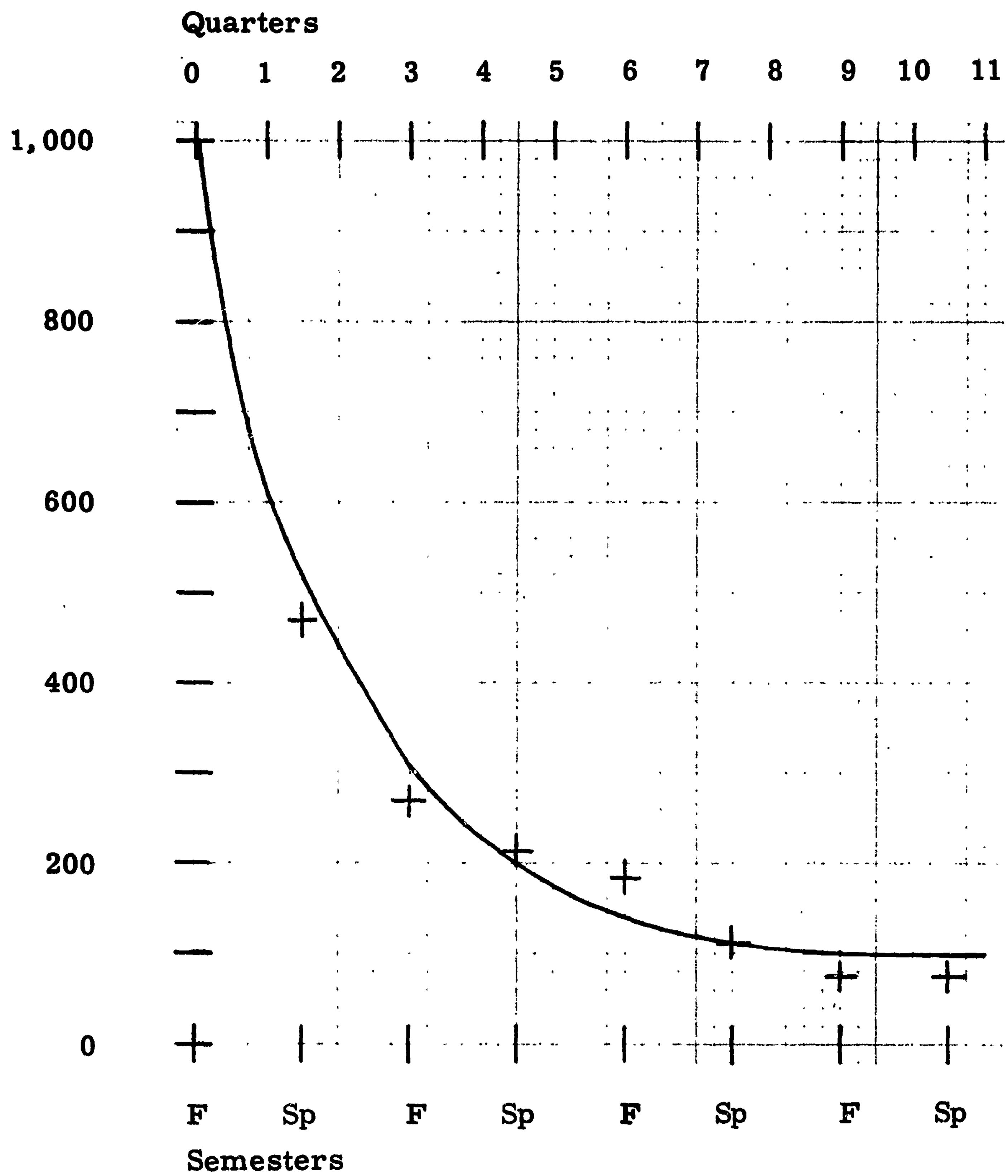


Fig. 34. Demand Pattern: Low Ability Group: College 08

Low Ability Group

Four-Quarter System

Su	F	W	Sp
	104- 104y	100- 100y	96- 96y
112y	104y	100y	96y
	144- 144y	127- 127y	112-112y
227y	174y	144y	127y
	309- 309y	227- 227y	174-174y
1,000y	659y	443y	309y
	1,000-1,000y	659- 659y	443-443y
1,339y	1,557- 620y	1,113-426y	825-293y
			3,495

$p_e = .6184$

$\log p_e = 9.791264$

Utilization index[4] $= \dfrac{3,495}{4(1,557-620y)}$

Maximum utilization index = .8212 when y = 79.48 percent

[4] For values of y less than .7948 (value of y when utilization index is at the maximum).

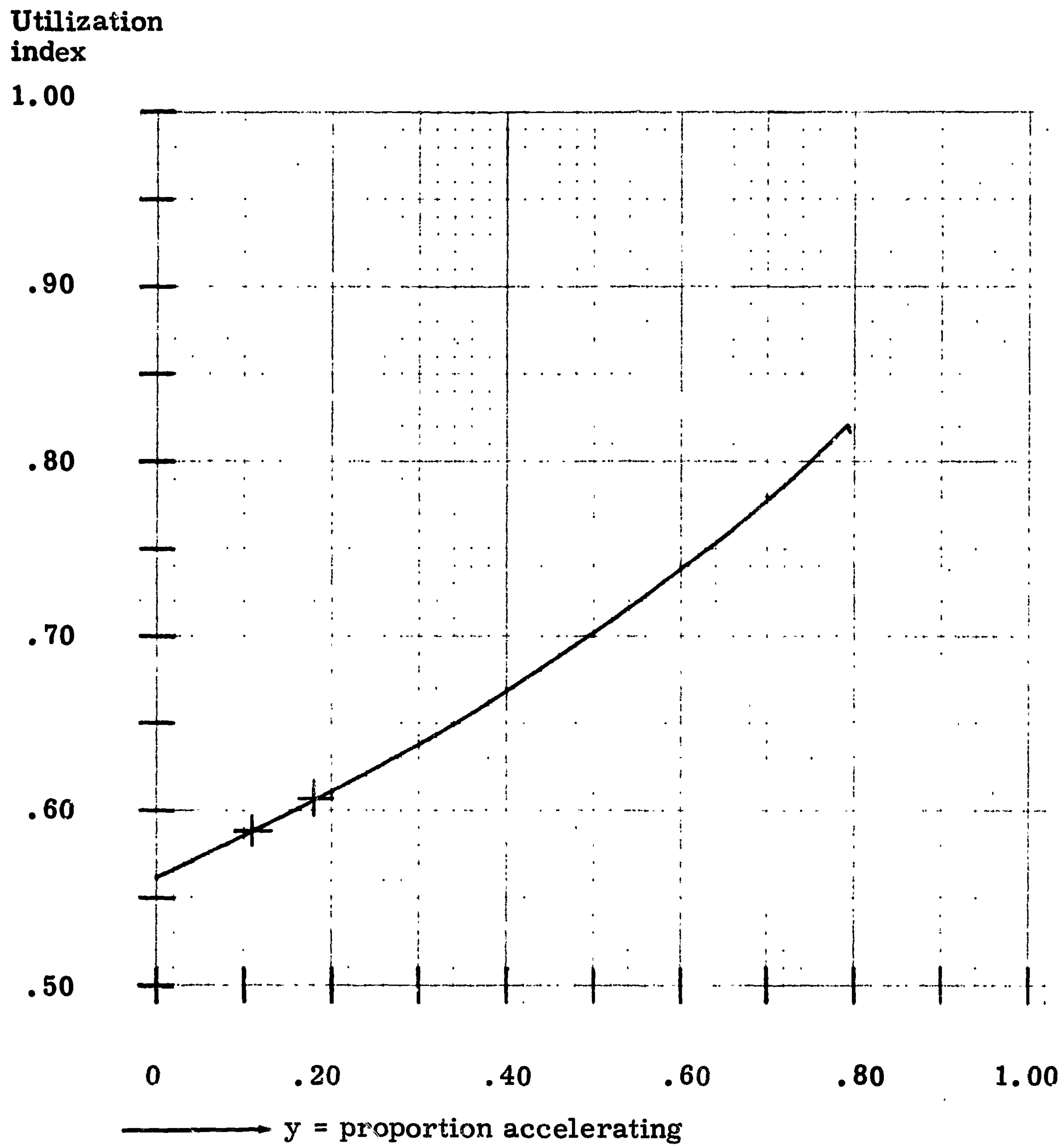


Fig. 35. Possible Gain in Plant Utilization Under Four-Quarter System: Low Ability Group: College 08

Figure 35 shows the plant utilization index theoretically obtainable by this subpopulation under the four-quarter system, with various proportions of students electing to enroll year-round. The two +'s on Figure 35 show the empirical and theoretical utilization indices obtained by this subpopulation under the semester system. It will be noted that in this case 19 percent or more of these students must elect to enroll year-round before the utilization index under the four-quarter system exceeds the corresponding index presently obtaining under the semester system.

Medium Ability Group: College 08 (N = 549)

Semester System

Theoretical

F	Sp
130	76
290	200
557	407
1,000	750
1,977	1,433
	3,410

$K = 111.9$

$p_E = .77552$

$\log p_E = 9.889592$

Empirical

F	Sp
109	95
271	220
496	459
1,000	694
1,876	1,468
	3,344

Utilization index = .646

Utilization index = .667

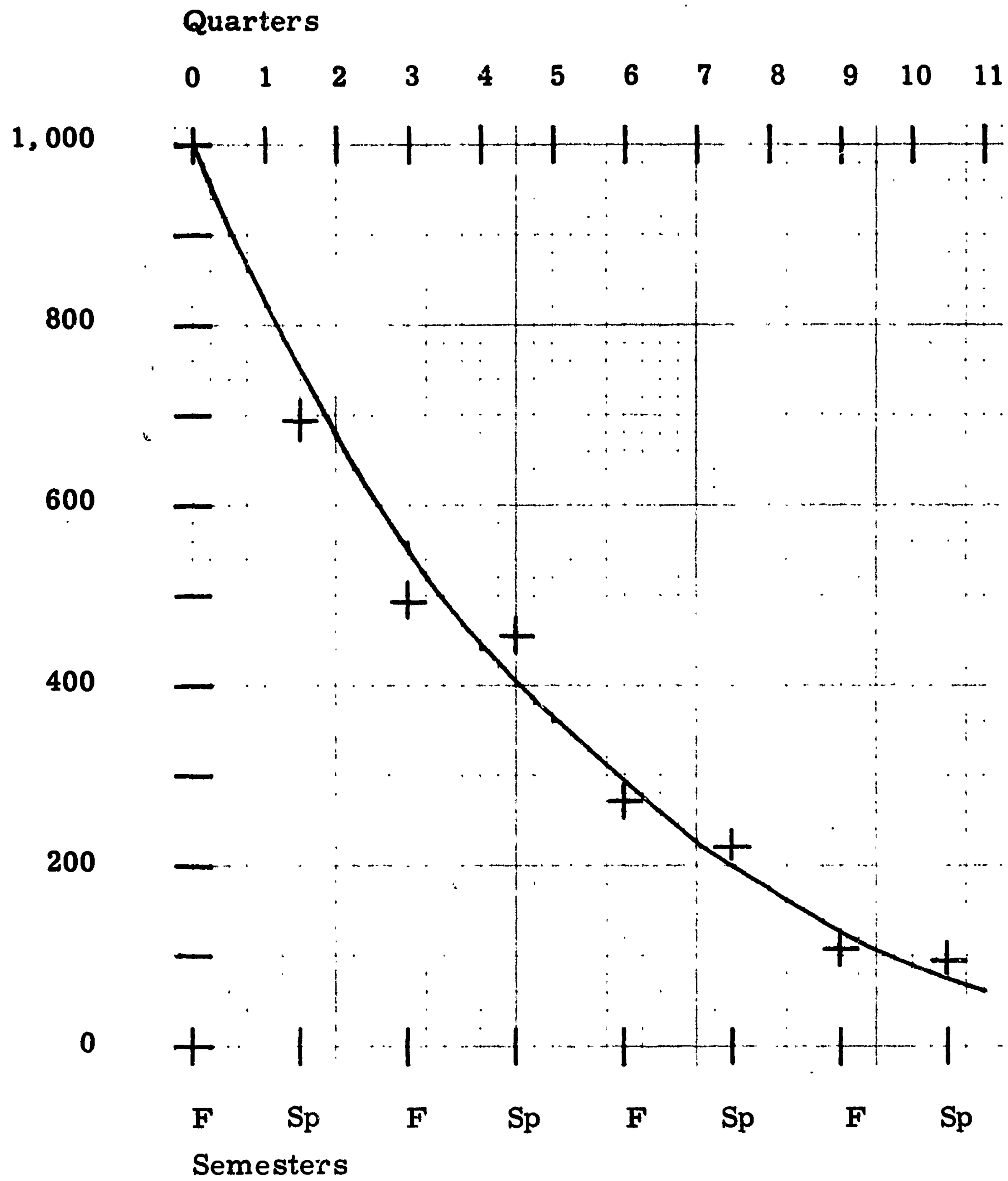


Fig. 36. Demand Pattern: Medium Ability Group: College 08

Medium Ability Group

Four-Quarter System

Su	F	W	Sp
	130- 130y	90- 90y	60- 60y
175y	130y	90y	60y
	290- 290y	228-228y	175-175y
453y	365y	290y	228y
	557- 557y	453-453y	365-365y
1,000y	827y	681y	557y
	1,000-1,000y	827-827y	681-681y
1,628y	1,977- 655y	1,598-537y	1,281-436y
			4,836

$p_e = .8441$
$\log p_e = 9.926394$

$$\text{Utilization index}^5 = \frac{4,836}{4(1977-655y)}$$

Maximum utilization index = .8576 when y = 86.50 percent

[5]For values of y less than .865 (value of y when utilization index is at the maximum).

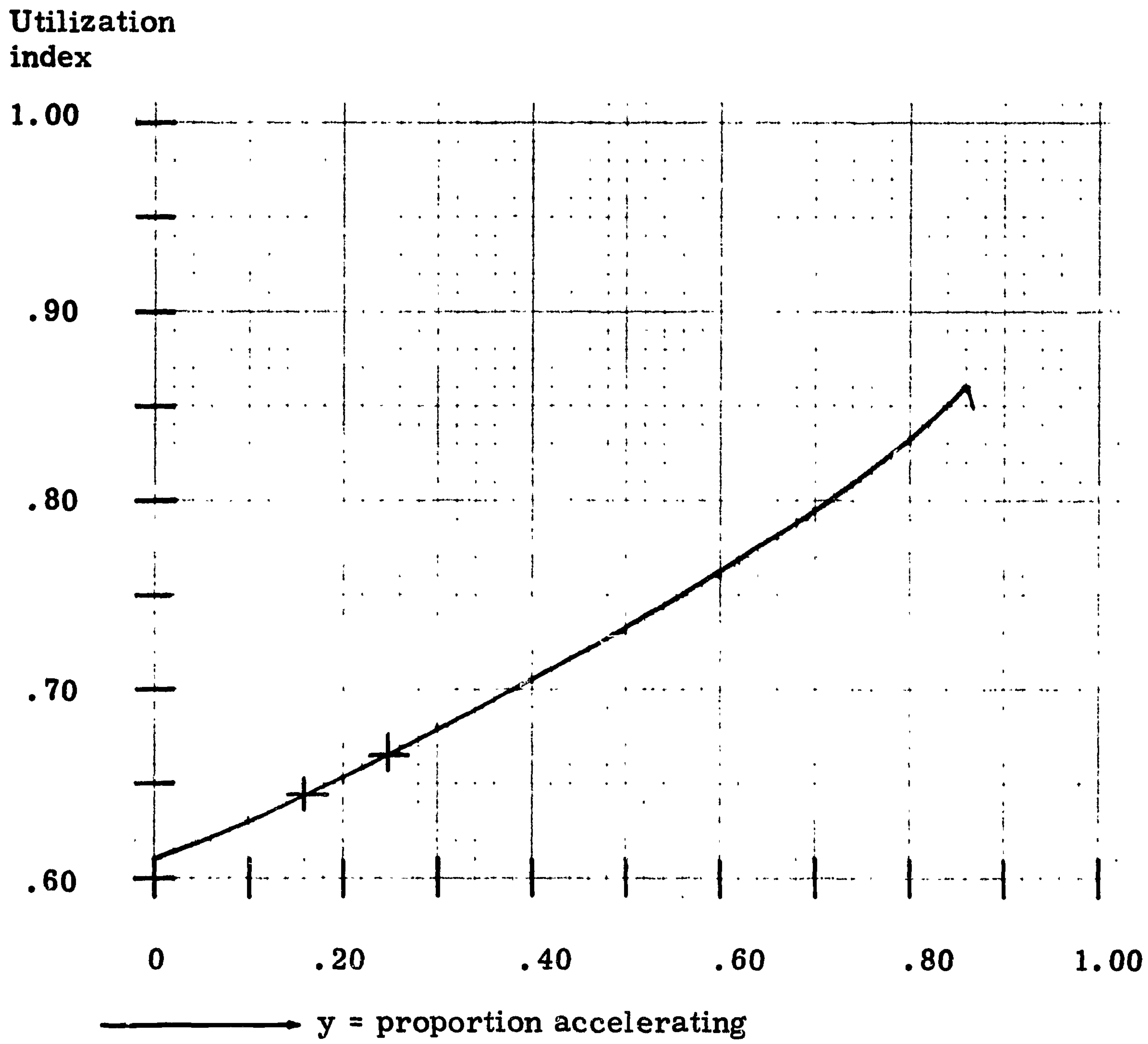


Fig. 37. Possible Gain in Plant Utilization Under Four-Quarter System: Medium Ability Group: College 08

Figure 37 shows the plant utilization index theoretically obtainable by this subpopulation under the four-quarter system, with various proportions of students electing to enroll year-round. The two +'s on Figure 37 show the theoretical and empirical utilization indices obtained by this subpopulation under the semester system. It will be noted that in this case 25 percent or more of these students must elect to enroll year-round before the utilization index under the four-quarter system exceeds the corresponding index presently obtaining under the semester system.

High Ability Group: College 08 (N = 136)

Semester System

Theoretical

F	Sp
100	38
276	178
556	400
1,000	752
1,932	1,368
	3,300

$K = -200$

$p_E = .7937$

$\log p_E = 9.89966$

Empirical

F	Sp
78	68
209	157
557	495
1,000	710
1,844	1,530
	3,374

Utilization index = .640

Utilization index = .667

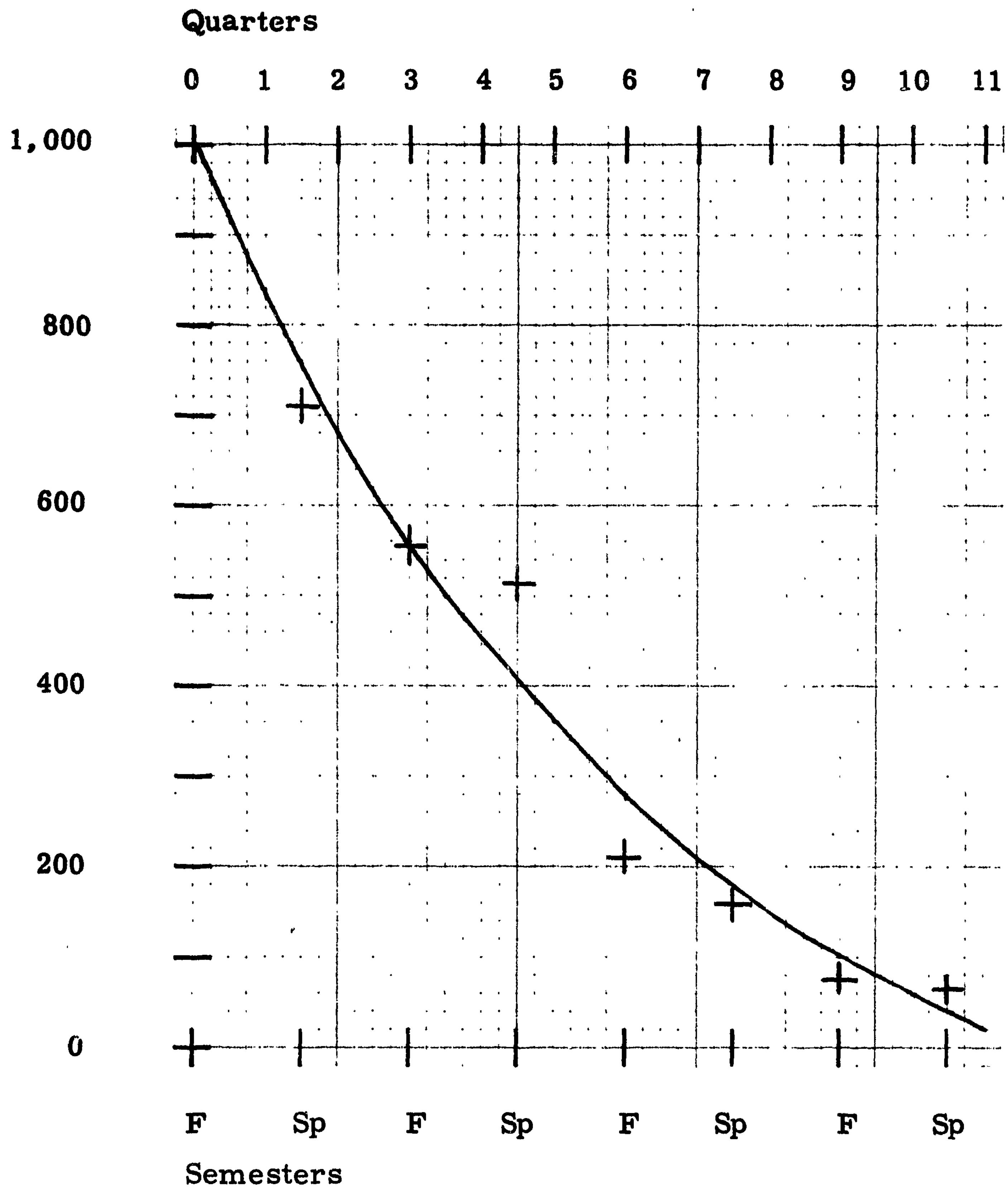
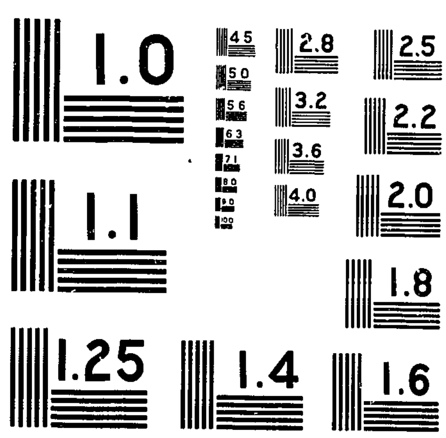


Fig. 38. Demand Pattern: High Ability Group: College 08

3 OF 3

ED 013654



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963

High Ability Group

Four-Quarter System

Su	F	W	Sp
	100- 100y	57- 57y	20- 20y
150y	100y	57y	20y
	276- 276y	208-208y	150-150y
448y	359y	276y	208y
	556- 556y	448-448y	359-359y
1,000y	829y	682y	556y
	1,000-1,000y	829-829y	682-682y
1,598y	1,932- 644y	1,542-527y	1,211-427y
			4,685

$p_e = .85725$

$\log p_e = 9.933104$

Utilization index[6] $= \dfrac{4,685}{4(1932-644y)}$

Maximum utilization index = .8506 when y = 86.17 percent

[6]For values of y less than .8617 (value of y when utilization index is at the maximum).

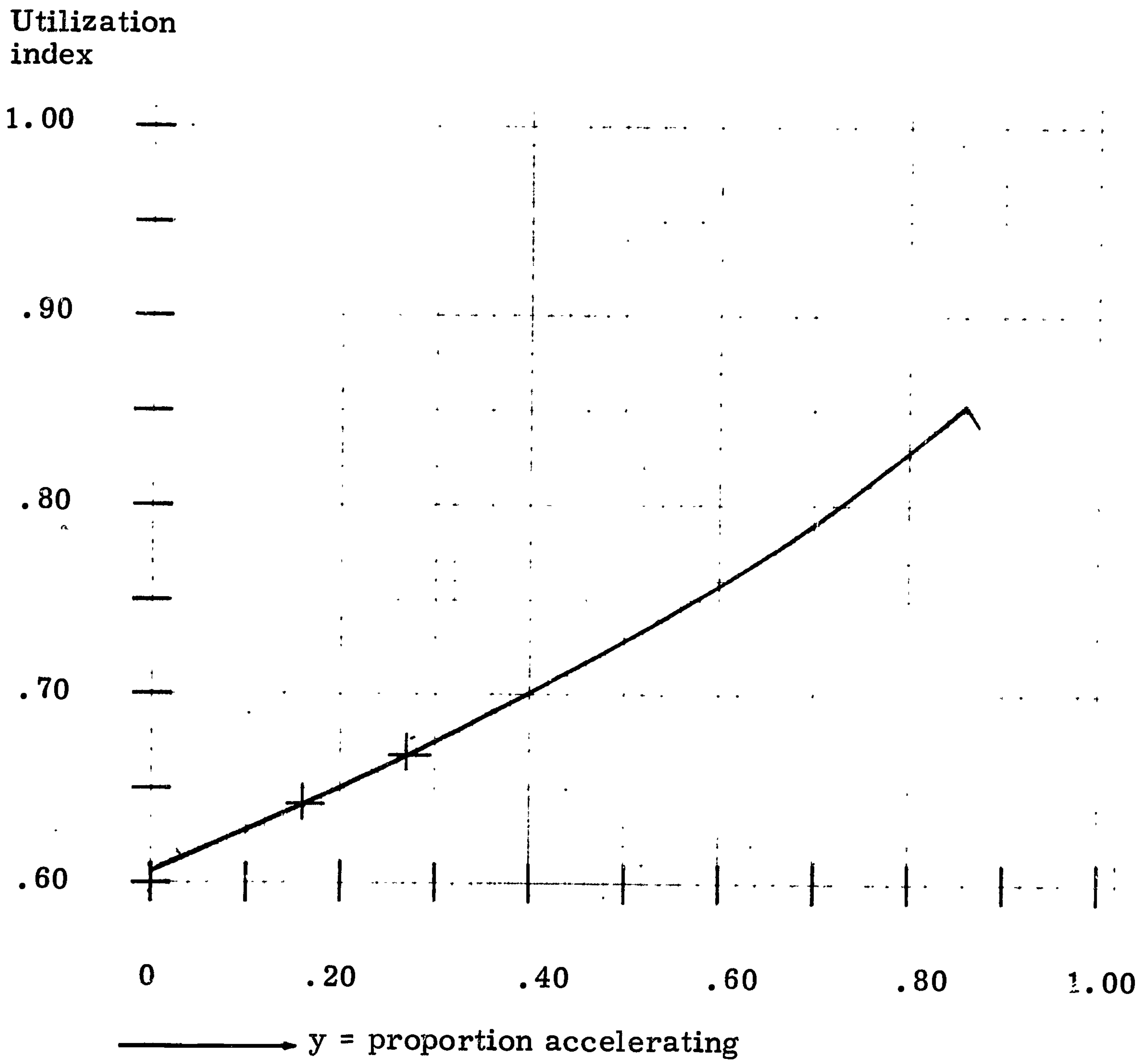


Fig. 39. Possible Gain in Plant Utilization Under Four-Quarter System: High Ability Group: College 08

Figure 39 shows the plant utilization index theoretically obtainable by this subpopulation under the four-quarter system, with various proportions of students electing to enroll year-round. The two +'s on Figure 39 show the theoretical and empirical utilization indices obtained by this subpopulation under the semester system. It will be noted that in this case 27 percent or more of these students must elect to enroll year-round before the utilization index under the four-quarter system exceeds the corresponding index presently obtaining under the semester system.

If one wishes to solve the problem stated in the second paragraph of this chapter--to determine the change in utilization index obtainable under the four-quarter system if 50 percent of the high ability students, 40 percent of the average ability students, and 30 percent of the low ability students elect to enroll year-round--he is now equipped to do so.

Of the total demand pattern in College 08, (Fig. 18) the high ability students accounted for 26.5 percent of the initial demand, the medium ability students accounted for 58.0 percent, and the low ability students for 15.5 percent. These percentages can be used to weight the theoretical gains in utilization index.

Figure 35 shows a utilization index of .638 for the low ability students when 30 percent enroll year-round. Figure 37 shows a utilization index of .705 for the medium ability students when 40 percent enroll year-round. Figure 39 shows a utilization index of .728 for the high ability students when 50 percent enroll year-round. The problem can thus be solved:

$$
\begin{aligned}
.155 \times .638 &= .0989 \\
.580 \times .705 &= .4089 \\
.265 \times .728 &= \underline{.1929} \\
\text{Utilization index} &= .7007
\end{aligned}
$$

This represents a gain in plant utilization over that presently obtaining under the semester system[7] of 5.21 percent.

Summary

It would appear that the model can be used to estimate gains (or losses) to be expected under conversion to the four-quarter calendar attributable to subpopulations by treating the subpopulations as independent populations and then weighting the results according to the proportion of the initial demand attributable to the respective subpopulations.

It would also appear that between sex and scholastic ability, the latter determines the enrollment demand pattern rather than the former insofar as can be determined from the data at hand. It might be useful in utilizing the model in a detailed study of a single institution to draw a very large sample to determine if, in fact, this is true for that particular institution before deciding which criterion to use in breaking the population down into subpopulations, if indeed such a breakdown is deemed desirable.

[7]Utilization index of .666, p. 79, supra.

Chapter VI

REVIEW, CONCLUSIONS, AND IMPLICATIONS

In the opening chapter, the purpose of this research was stated[1] as an attempt to identify the practical constraints within which calendar revision in the California public junior college must be developed and then, within those constraints, develop an econometric model of the California public junior college under a revised calendar on a theoretical basis. The model so developed was to be tested by the introduction of empirical data. Finally, certain conclusions were to be drawn relative to the operation of a revised or year-round calendar in the California public junior college. It is the purpose of this chapter to discuss briefly the first three tasks--identification, development, test and revision--as they have been accomplished. The final step, the drawing of conclusions will then be undertaken.

Identification of Constraints[2]

Most literature dealing with year-round operation assumes no attrition or very low attrition in the flow of students through the system. The California public junior college student just does not fit this model. In the fall semester of 1965, the freshmen outnumbered the sophomores almost three-to-one statewide in the California public junior colleges.

The decision to revise the academic calendar of both four-year segments of public higher education in California to the four-quarter calendar has been taken, and the conversion of individual campuses is already underway. The local boards governing the junior colleges, as a practical matter, now have only three academic calendar options available:

1. Remain on the semester system.
2. Convert to the four-quarter calendar.
3. Convert to a three-quarter or three-and-one-half-quarter calendar.

There are certain pressures on local boards to adopt one of the latter two options. Any conversion must take place without significant modification to the open door policy of the public junior college. This policy explicitly or implicitly demands:

1. That all applicants who are high school graduates or who are over eighteen years of age and able to profit from instruction be accepted as students; and,
2. That no eligible student will be denied admission. This implies, in general terms, the provision of facilities and faculty to handle

[1]P. 2, *supra*.

[2]Chapter II, pp. 25-30, *supra*.

whatever number of students apply and in the term beginning next after they apply.

Control of enrollments or of attendance patterns is, therefore, not available as a device to the junior college to achieve balanced enrollment among terms. This constraint does not preclude reasonable efforts at persuading students to enroll in terms of expected low enrollment.

Outside the Los Angeles district, very few high school students in California graduate in a month other than June.

Any model which portrays, with a reasonable degree of realism, the California public junior college under year-round operation must, therefore, take account of the following constraints:

1. The four-quarter system of year-round operation must be employed.
2. No control of input may be employed. Students must be admitted in the quarter beginning next after they apply.
3. Account must be taken of the once-a-year graduation pattern of the feeder high schools.
4. Account must be taken of the high attrition, low persistence characteristic of the junior college student.

Model Development

In Chapter III a model of the enrollment pattern (treated as a demand upon the college) of students coming into the junior college from high school over the succeeding four academic years under the semester system was developed. Based on the following two assumptions, a theoretical method was suggested for converting data on enrollment (demand) patterns obtained under the semester system to the quarter system:

1. Student enrollment patterns do not change significantly between the semester and the quarter systems; and,
2. Enrollment varies over time approximately according to an exponential mathematical function.

A complex model was then developed for the processing of these data as demand patterns under the four-quarter system of year-round operations.

A utilization index of the form:

$$\frac{\text{(Sum of the enrollment in all terms)}}{\text{(Number of terms)}\times\text{(Enrollment of largest term)}}\times\frac{\text{(Duration of school year in weeks)}}{\text{(48 weeks)}}$$

was defined as a measure of relative plant utilization. This index was common to both models--hence could serve as the vehicle of comparison between the conventional semester system and the four-quarter system of year-round operations.

The model for the four-quarter system was necessarily complex to handle an additional variable: acceleration. Acceleration was defined as enrolling year-round. (An accelerating student completes a four-academic-year enrollment pattern in three years.)

It was noted that the assumption that student enrollment patterns do not change between the semester and the quarter system is subject to challenge, but, in the absence of experience data on California public junior colleges operating under the quarter system, this issue could not be resolved.

It was also noted that the assumption that student enrollment patterns vary over time approximately according to an exponential mathematical function was subject to test by the application of empirical data. Such application was the purpose of Chapter IV.

Test of the Model

The empirical data consisted essentially of records of attendance of first time freshmen of the fall of 1961 in 12 randomly selected California public junior colleges. These data follow the academic careers of some 6,276 students through the summer of 1965.

A computer program was written to sum the "demand hours" of each student in the fall and spring semesters for the four academic years, 1961 through 1965. This program was then applied to the student records for each of the 12 colleges. A factor was applied to the print-out such that data for each semester was given in terms of "demand hours per thousand demand hours in the fall, 1961 semester" so that all models and all colleges would be on the same datum base.

The data were then arrayed in a two-semester by four-year matrix to give the empirical pattern of demand of these students on each college. These data were then displayed graphically,[3] and an exponential curve was fitted to the data. The function describing this curve was then solved for the theoretical demand values for the semesters and for the quarters. These solutions were arrayed in semester and four-quarter models which were solved for the respective utilization indices. Finally, the proportion of students electing to enroll year-round was varied in each four-quarter model to derive a curve describing the utilization index as a function of the proportion of students electing to enroll year-round. On this curve were plotted the values of the empirical and theoretical utilization indices computed for the semester system for comparison.

It was found that in 11 of the 12 colleges, the exponential function underestimated the utilization index by a small amount. In all cases this theoretical utilization index was within ± 8 percent of the corresponding empirical

[3]Even numbered figures, Figure 6--Figure 28, inclusive.

index. The mean error was -3.75 percent, and the mean absolute error was 4.43 percent. Thus, it appeared that the assumption that student enrollment patterns vary over time approximately according to an exponential mathematic function was valid.

A recapitulation of results showed that under a shift to the four-quarter system, with 40 percent of the students electing to enroll year-round, the median gain in plant utilization to be expected was 4.53 percent. The corresponding figure for 50 percent acceleration was 8.45 percent. This recapitulation showed the "Big City" colleges making substantial gains. This will be discussed in a subsequent section.

Application

It was noted that implicit in the four-quarter model is the assumption that the students electing to enroll year-round will exhibit the same demand pattern over time as do the students who do not elect to enroll year-round. As a practical matter, one may wish to apply the model without having to make such an assumption. This means the division of a population into subpopulations, the application of the model to each of these subpopulations, and the weighted recombination of the respective results into a result for the entire population.

It was noted that the empirical data were readily divisible into subpopulations by sex and by scholastic ability. An analysis of the data showed that the distribution of ability among the colleges was by no means uniform, that the range of median ability among the colleges was one full stanine, and that the median ability in the three colleges with the most able students was about 0.1 stanines below the national norm for the thirteenth grade.

In the total sample, the females were significantly less able than the males. In nine of the colleges, the males were more able than the females; in six of the nine colleges, this difference was statistically significant. In three colleges the females were more able, and in one of the three this difference was significant.

When the sample for each college was examined by three ability groups--low, medium, and high--and within each ability group by sex, it was found that there was little difference in the demand (enrollment) patterns generated by the sexes within the same ability group.

As expected, the low ability groups showed a high early attrition in every college. The high ability group showed low early attrition but dropped rapidly after the fourth semester, the demand curve of this group typically crossing the curve of the medium group between the fourth and fifth semesters. Since the medium ability group was by far the most numerous, its demand curve lay very close to the total demand curve for that college.

The college which had the median group of students by ability and also had the largest "n" was selected for an illustrative example in the application of the model to subpopulations. By this procedure it was shown that a composite utilization index could be computed for a college under the four-quarter system of year-round operation when 30 percent of the low ability students, 40 percent of the medium ability students, and 50 percent of the high ability students elected to enroll year-round.

Conclusions

It would appear that a model has been developed which should be of some predictive value in facing the decision of calendar revision in the California public junior college. This decision appears, as a practical matter to be limited to three alternatives:

1. Remain on the semester calendar.
2. Convert to the four-quarter calendar.
3. Convert to the three-quarter or the three-and-a-half-quarter calendar.

This model takes into account the open door and the once-a-year pattern of graduation of the feeder high schools.

The model does not take into account those students who do not enter the junior college directly from high schools. Any application of the model in support of decision making will have to take this into account. A random sampling of the records in the files of the college should give some indication of the relative magnitude of the demands being made on the college by this category of student. If a shift to the four-quarter system of year-round operation, as year-round operations are defined in Chapter I,[4] is accomplished, the demand made on the college by these students <u>may</u> achieve a near uniform distribution over the four quarters. Young men return from service in the armed forces throughout the year on a random pattern. There is little reason to believe that the decision to return to the system of public education is made on other than a random basis with respect to time, although the seasonal fluctuation in the availability of employment may have some influence. Once it is widely understood throughout the community that a student may enroll in any term and thereafter make full progress toward his educational objective, the demand pattern of these students should approach a uniform distribution over the four quarters.

The high-attrition, low-persistence characteristic of the junior college student has a significant influence on the plant utilization achieved under any calendar. This is also true of the difference in plant utilization of one calendar with respect to another. This is well illustrated in the examination of the total demand patterns of the 12 junior colleges in Chapter IV. The utilization index

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[4]Pp. 5 and 6.

under the semester system, calculated directly from the empirical data, varied from .588 to .683, a range of .095 or 9.5 percent of capacity. When the data were applied to the model, it was found that when 40 percent of the students elected to enroll year-round, the percent of gain in utilization index over the corresponding index calculated for the semester system directly from the empirical data varied from 13.94 percent to 0.59 percent.[5] The colleges which had relatively high empirical utilization indices under the semester system stood to gain the least from conversion, and conversely. [This negative correlation is almost perfect ($r_s = -.9248$).] Thus, it would appear that some sort of mathematical analysis of what degree of plant utilization is now being achieved versus what degree is to be expected under a contemplated calendar revision is a necessary or at least highly desirable aid to rational decision making.

In Chapters I and II, it was noted that gains to be expected from conversion to a year-round calendar are commonly discussed in terms of the four-year institutions, and that generally a "no attrition" model is implicit in these discussions. It would appear that a model which recognizes attrition shows some gain in plant utilization in the junior colleges, given significant proportions of students electing to enroll year-round. These gains are, generally, not so dramatic as those shown by a no attrition model in the four-year institution under corresponding conditions of student acceleration.

Implications

It is clear that in any junior college operating under the four-quarter system, wide differences are likely to develop in enrollment between quarters. This can perhaps best be illustrated by example. Assume that College 11 has a capacity of 1,545 full-time equivalent students, is operating on the four-quarter calendar, has reached capacity, and 40 percent of the students are enrolling year-round. Referring to the model on page 130 and substituting .40 for _y_, one finds that the enrollments among the quarters would be:

Su	F	W	Sp
598	1,545	1,223	928

The utilization index of College 11 in these circumstances is plainly:

$$\frac{598 + 1,545 + 1,223 + 948}{4(1,545)} = \frac{4,294}{6,180} = .6948$$

The board of trustees is now faced with the necessity of expanding a plant which is operating at not quite 70 percent of capacity. Yet, it is evident that vacancies exist for another 322 (1,545 - 1,223 = 322) students in the winter quarter who are willing to take the fall quarter as vacation. Reference

[5]Figure 30, p. 103, <u>supra</u>.

to Figure 24 shows that such students would have the following attendance pattern under the quarter system if they enter directly from high school:

	Su	F	W	Sp
Third year	51	-	31	12
Second year	126	-	100	75
First year	227	-	191	158
Total	404	-	322	245

The enrollment among the four quarters would now be:

Su	F	W	Sp
1,002	1,545	1,545	1,173

And the utilization index would be:

$$\frac{1,002 + 1,545 + 1,545 + 1,173}{4(1,545)} = \frac{5,265}{6,180} = .8519$$

Under these circumstances the college would be providing 22.6 percent more education without expansion of the physical plant. This is actually a slightly higher utilization than the maximum of .8474 theoretically achievable when 84.73 percent of the students elect to attend year-round; yet, only 51.2 percent of the entering students are starting their programs in the summer quarter.

This example serves to illustrate the dramatic gains that can be achieved by influencing enrollment patterns. One can envision similar results being achieved by the college and community cooperating in finding temporary jobs during the fall quarter for students who have completed a summer quarter of work. One can go so far as to envision a "work study" program without requirement for federal funds in which the college and the community cooperate in finding employment during the fall quarter for students requiring or desiring one quarter a year of employment and three quarters of full-time attendance. For students with greater financial need, this program might be extended to fall and winter quarters of employment with spring and summer quarters in full-time attendance at the college.

The implication here is that a great deal of ingenuity, thought, and research needs to be applied to the problem of influencing enrollment patterns. The community and the students need to understand the advantages accruing to all by the equalizing of enrollment demands among the quarters. The college needs to tax its ingenuity as well in making attendance at quarters of anticipated low enrollment attractive. It may come to pass, as the staff of the Coordinating Council has suggested, that control will be imposed on enrollment.[6]

[6]CCHE No. 1009, p. 10, op. cit.; and supra., pp. 48-49 and pp. 52-53.

To do so when other voluntary methods could achieve the same ends would be unfortunate as is always the case when controls are established unnecessarily in a free society.

It would appear prudent for a junior college to examine possible implications of revising the length of the day and of the week before making a decision to shift to a year-round calendar. If a college is now operating its "day" program from 8:00 a.m. to 12:00 noon and from 1:00 p.m. to 5:00 p.m. five days a week with the evening program reserving the plant from 7:00 p.m. until 10:00 p.m., certain gains in plant utilization are possible by expansion of the academic week.[7] The scheduling of classes from 8:00 a.m. until 1:00 p.m. on Saturday would increase the capacity of the plant by 11.25 percent. (This also makes easier the scheduling of classes which meet three times per week. The Tu-Th-Sat combination becomes possible as well as the ubiquitous Mon-Wed-Fri combination.) Scheduling classes from 12:00 noon until 1:00 p.m. daily gives the same 11.25 percent increase. Extending class scheduling through 6:00 p.m. gives an 11.25 percent increase and until 7:00 p.m., when the evening program takes over, a 22.5 percent increase. Some of these changes may cause problems. The severity of these problems will have to be weighed against the severity of other problems caused by a shift to a year-round calendar. In any event, each of the above revisions of the number of class hours in the academic week promises greater gains than are likely to be encountered in a shift to a year-round calendar; hence, they should be seriously considered.

Another implication of calendar revision concerns the faculty. No serious suggestion has been put forward in California to the effect that faculty be required, or indeed permitted, to teach year-round.[8] Therefore, an increase in faculty, roughly proportionate to the increase in utilization, will be required whether the increase be the result of calendar revision or of a change in the number of class hours in the academic week. This will hold true unless some significant change is contemplated in faculty load or faculty-student ratio. Now one can postulate that without any increase in plant (i.e., student station) capacity, there will be no reason to increase the capacity of that portion of the plant used primarily to accommodate the faculty (e.g., faculty office space, faculty lounges, faculty dining rooms). This appears to be true only in part.

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[7] This may require certain revisions in the Education Code and the California Administrative Code, Title 5, Education. If these changes would result in better utilization of the capital investment in the junior colleges, they should be easy to obtain.

[8] The pattern of faculty employment among the four quarters is outside the scope of this study. Extensive studies have been made of this problem by the California State Colleges. Information on these studies is available through the Chancellor's office. For a particularly sophisticated handling of this problem, see Simpson, op. cit., Vol. 4.

The faculty office space in immediate use at any point in time should bear a direct relationship to the student demand (enrollment) at the same point in time; that is, it should be a function of the faculty-student ratio. There will be, however, under the four-quarter calendar, faculty members taking their "quarters off" at any given point in time. To require faculty to vacate their offices during their respective quarters off would be not only unreasonable, it would also result in chaotic confusion in the faculty office spaces four times a year. In short, it seems reasonable to expect that each member of the faculty should be provided with adequate office space year-round. If he is required to vacate this space, it should be only for sabbatical or other extended leave periods. This would lead to the conclusion that any increase in plant utilization--plant being defined in terms of student stations--is likely to require a corresponding proportionate or near-proportionate expansion of that segment of the plant devoted to faculty office space. (The same logic may be applicable to the admissions office and to space devoted to student records.)

This logic is perhaps not applicable to such spaces as faculty lounges and faculty dining rooms. Their use is directly dependent on the number of faculty actually present. This is, to a considerable degree, a function of the faculty-student ratio. It may be that the achievement of a dramatic gain in plant utilization will require an extensive expansion of the segment of the plant devoted to faculty office space. In such a case, the existing faculty lounge space may be inconveniently located with respect to the new offices and a new lounge must be provided. This hardly seems likely with respect to the faculty dining room, assuming the present dining room is adequate.

The final implication of this study should perhaps be drawn from the differences between the colleges as revealed in Chapters IV and V. The variation among colleges with respect to immediate dropouts--students who registered for eight or more hours as first-time freshmen but failed to complete any work for credit--and with respect to the scholastic aptitude of their respective student bodies has been noted. One other variable can be considered briefly--the empirical attrition between the beginning of the fall semester and the beginning of the spring semester of the first year.

College	Attrition between first and second semester (%)[9]
09 Big City	51.7
12 Big City	43.5
05 Big City	38.2

[9] This figure can be obtained by going through Chapter IV and noting the difference between the "fall" figure--always 1,000--and the "spring" figure in the bottom line of the "Empirical" matrix, and pointing off one decimal place.

College	Attrition between first and second semester (%)
08 Exurban	35.6
02 Agricultural/Military	31.0
13 Rural/Agricultural	29.5
06 Suburban	29.0
10 Rural/Agricultural	28.3
04 Exurban	27.5
11 Rural/Agricultural	24.6
03 Small City/Agricultural	22.1
07 Suburban	21.2

$\bar{X}$ Twelve colleges = 31.85

$\bar{X}$ Three Big City colleges = 44.47

$\bar{X}$ Other nine colleges = 29.75

The percents above refer to demand hours or to "full-time-equivalent" students, but they are a good approximation of what is happening in terms of students. The "Big City" colleges are losing almost half of their students by the beginning of the second semester; the other colleges, better than a quarter of theirs.

The "Big City" colleges would appear to have peculiar characteristics: (1) higher attrition, including more immediate dropouts; (2) less able students;[10] and (3) significantly less able females than males.[11] These same colleges appear to show the highest promise of gain in utilization index in shifting to the four-quarter system,[12] and presently have the lowest utilization indices under the semester system.[13]

It is apparent that to many students entering these colleges, the open door is a "revolving door." If one adopts the more or less cynical attitude that one of the functions of the junior college is to provide "some college experience" to as many students as possible, one may argue that the public interest would be served by shifting these colleges immediately to the four-quarter system and urging as many recent high school graduates as possible

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[10]P. 108.

[11]Figure 32, p. 108.

[12]Figure 30, p. 103.

[13]Pp. 55-102, pasim.

to register for the summer quarter. About a third to almost a half of these students would not return for the fall quarter having gained "some college experience" but thereby making room for other students to enroll in the fall quarter. Presently obtaining low utilization indices would show substantial gains under these circumstances.

The implication which emerges here is a two-edged one. As was shown in Chapter II,[14] under conditions of once-a-year graduation in feeder high schools, the junior college under year-round operation gains nothing from the able student who enrolls for a full load and completes his program in two academic years. The gains under year-round operation are made possible by the fact that the demand pattern of a number of students is characterized by attrition. When these diminishing patterns are fitted together over three or four years, it is possible to take advantage of the vacancies created by attrition by filling these vacancies with students from following classes. Generally, the higher the attrition, the higher the gain in plant utilization. But the research in support of the decision-making process as an individual college contemplates calendar revision may reveal that the attrition presently operant in the college is far too high in absolute terms.

It is also evident that there are implications here for further research into characteristics of colleges with respect to each other and with respect to the characteristics of the communities they serve. The characteristics of the urban colleges with respect to the relative aptitude of their students and the dramatic sex differences with respect to aptitude within the urban colleges both need further investigation.

As has been stated earlier, it appears that the model developed in this study should be of value in predicting changes in plant utilization under a proposed change to the four-quarter calendar using data accumulated under the two-semester calendar. The model should, however, be used with judgement and care. It does not predict everything, and such predictions as it does make are approximate.

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[14]Pp. 23-24, 26.

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Appendix I

CODEBOOK FOR INDIVIDUAL DATA CARDS

Card column	Data
1-2	Junior College Number
3-6	Student Identification Number by Institution
7	Sex: 1 = male 2 = female
8	Age: 0 = No answer 1 = 17 years 2 = 18 years 3 = 19 years 4 = 20-22 years 5 = 23-25 years 6 = 26-29 years 7 = 30 and over
9-10	Initial Credit Load, Fall, 1966: Semester system 08 to --
11	Initial Credit Load Distribution: 0 = less than 8 3 = 16 to 19 1 = 8 to 11 4 = 20 to 23 2 = 12 to 15 5 = 24 or over
12-35	Credits Earned Each Term: (0 coded if no units were completed)
12-13	F 1961
14-15	Sp 1962
16-17	Su 1962
18-19	F 1962
20-21	Sp 1963
22-23	Su 1963
24-25	F 1963
26-27	Sp 1964
28-29	Su 1964
30-31	F 1964
32-33	Sp 1965
34-35	Su 1965

36-43 Total Credit Earned by Academic Year:

- 36-37 Units earned in 1961-62
- 38-39 Units earned in 1962-63
- 40-41 Units earned in 1963-64
- 42-43 Units earned in 1964-65

44 Total Credit Earned in Junior College:

1 = No units	5 = 46-60 units
2 = 1-15 units	6 = 61-65 units
3 = 16-30 units	7 = 76 units or more
4 = 31-45 units	

45 Pattern of Attendance:

1 = Consecutive
No lapses in attendance during regular (non-summer) terms from Fall 1961 to final withdrawal. This designation includes students who withdrew without completing the first term and never returned.

2 = Non-consecutive
A gap in attendance in a regular term.

46 Status at Time of Final Withdrawal:

1 = Voluntary withdrawal, no certificate, no degree, less than 60 semester units of work completed.

2 = Dismissed by college.

3 = Earned certificate for special 1 year course.

4 = Earned certificate for 2 year course.

5 = 60 sem. units completed but no degree.

6 = AA degree or equivalent, then withdrew.

7 = AA degree or equivalent and still enrolled after that date.

8 = Still enrolled, Sp sem. 1965.

47 Final Status Recombination:

1 = Voluntary withdrawal, less than 60 units.
2 = Dismissed.
3 = Certificate.
4 = Voluntary withdrawal, 60 or more units.
5 = AA degree.
6 = Enrolled Sp 1965, continuing.

48 Reason for Final Withdrawal, Other Than Graduation:

0 = Not applicable, earned certificate or degree.
3 = Voluntary withdrawal.
4 = Dropped by college--no reason reported.
5 = Dropped by college--poor scholarship.
6 = Dropped by college--discipline for conduct.
7 = Dropped by college--lack of attendance.
8 = Dropped by college--other.
9 = Not applicable, still enrolled.

Final Credit. Last Term Credit Earned:

49 Blank = Initial dropout.
1 = Completed F 1961 term, then withdrew; or began Sp 1962 term but dropped out mid-term.
3 = Completed Sp 1962 term..., etc.
4 = Completed F 1962 term..., etc.
6 = Completed Sp 1963 term..., etc.
0 = Not applicable, go to col. 50.

50 1 = Completed F 1963 term..., etc.
3 = Completed Sp 1963 term..., etc.
4 = Completed F 1964 term..., etc.
6 = Enrolled in Sp term or Su session 1965.
0 = Not applicable, go to col. 49.

51 Type of Scholastic Ability Test Used:

Blank = No test scores available
0 = SCAT
1 = ACT
2 = CQT
3 = ACE
4 = SAT
5 = MSAT
6 = Ohio Psych.
7 = Washington Predicted GPA
8 = Henmon-Nelson
9 = Otis IQ

52 Scholastic Ability Test Score:

Stanine Rankings (1 low --- 9 high) according to national 13th grade norms. In the case of SCAT these are

1 = 253-269	4 = 288-295	7 = 308-315
2 = 270-281	5 = 296-301	8 = 316-323
3 = 282-287	6 = 302-307	9 = 324-over

53 Stanine Regrouping:

Stanine 1, 2, 3 = 1 low
4, 5, 6 = 2 Medium
7, 8, 9 = 3 High

Date of 1st Enrollment in Transfer College:

54
0 = F 1961
1 = W 1962
2 = Sp 1962
3 = Su 1962
4 = F 1962
5 = W 1963
6 = Sp 1963
7 = Su 1963
8 = F 1963
9 = W 1964

55
1 = Sp 1964
2 = Su 1964
3 = F 1964
4 = W 1965
5 = Sp 1965
6 = Su 1965
7 = F 1965
8 = W 1966
9 = Sp 1966 or later

56 Number of Transfer Schools Entered:

R = Transferred to 1 institution.
2 = Transferred to 2 institutions.
3 = Transferred to 3 institutions.

57-60 Transfer College Number:

From the College Number Listing derived from the Education Directory.

61 Control of Transfer Institution:

1, 2 = Public.
3, 4, 5, 6 = Private.

62 Level of Institutional Offering:

1 = Junior College.
2 = 4-year College.
3 = Master's Degree.
4 = Doctorate.
5 = Other.

63-64 Transfer College Location:

(College number listing contains state code.)

65 Transfer Summary:

1 = Did not transfer after junior college.
2 = Transferred after junior college.

66 Control of Transfer Institution:

1 = Public.
2 = Private.

67 Control-Level of Transfer Institution:

0 = Public, junior college.
1 = Public, 4-year college.
2 = Public, master's degree.
3 = Public, doctorate.
4 = Public, other.
5 = Private, junior college.
6 = Private, 4-year college.
7 = Private, master's degree.
8 = Private, doctorate.
9 = Private, other.

68 Region of Transfer:

1 = In state.
2 = Out of state.

CHARACTERISTICS OF THE JUNIOR COLLEGES

69 Type of Community:

1 = Metropolitan.
2 = Non-metropolitan.

70 Full-Time Enrollment, Fall, 1961:

1 = 500 or fewer.
2 = 501-1,000.
3 = 1,001-1,500.
4 = 1,501-2,500.
5 = 2,500 or more.

71 Number Regular Students per Full-Time Counselor:

1 = Fewer than 200.
2 = 200-300.
3 = 301-400.
4 = 401-500.
5 = Over 500.

72 Percents of Students Intending to Transfer (1961):

0 = None	5 = 41-50%	X = 91-100%
1 = 10% or less	6 = 51-60%	
2 = 11-20%	7 = 61-70%	
3 = 21-30%	8 = 71-80%	
4 = 31-40%	9 = 81-90%	

73 Same as above but for 1965

74 No. Occupationally Oriented Curricula Offered (1961):

R = None	4 = 16-20
1 = 1-5	5 = 20-30
2 = 6-10	6 = 31 and above
3 = 11-15	

75 Same as above but for 1965

He6-185 9-67 200

END

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