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AUTHOR Jewett, James E.
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ABSTRACT

A major administrative and research need is the explicit integration of behavioral educational objectives, such as student body quality or student academic success, with present college costing and planning models. With this objective in mind, this study develops a freshman admissions planning model which classifies high school graduates by financial aid needed, verbal aptitude, and sex. This admissions model is used to illustrate policy alternatives with exemplary information from Ohio Wesleyan University. The market segmentation framework furnishes a unified approach to evaluate trade-offs between alternate policy strategies for tuition, financial aid, and admit/not-admit decisions. The inclusion of short-run recruitment decisions and the integration of the segmentation model with present resource planning models are natural extensions of this research. Futhermore, this segmentation model is useful in studying many national higher education problems of student access in addition to admission planning for individual colleges. (Author)

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RESEARCH DIRECTORATE

Charles J. Hitch	President, University of California
Frederick E. Balderston	Professor of Business Administration Chairman, Center for Research in Management Science University of California, Berkeley Academic Assistant to the President
George B. Weathersby	Associate Director, Office of Analytical Studies University of California

OFFICE ADDRESS

2288 Fulton Street
Berkeley, California 94720
(415) 642-5490

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COLLEGE ADMISSIONS PLANNING:

USE OF A STUDENT SEGMENTATION MODEL

James E. Jewett

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PREFACE

This is one of a continuing series of reports of the Ford Foundation sponsored Research Program in University Administration at the University of California, Berkeley. The guiding purpose of this Program is to undertake quantitative research which will assist university administrators and other individuals seriously concerned with the management of university systems both to understand the basic functions of their complex systems and to utilize effectively the tools of modern management in the allocation of educational resources.

A major administrative and research need is the explicit integration of behavioral educational objectives, such as student body quality or student academic success, with present college costing and planning models. With this objective in mind, this study develops a freshmen admissions planning model which classifies high school graduates by financial aid needed, verbal aptitude, and sex. This admissions model is used to illustrate policy alternatives with exemplary information from Ohio Wesleyan University. The market segmentation framework furnishes a unified approach to evaluate tradeoffs between alternate policy strategies for tuition, financial aid, and admit/not-admit decisions. The inclusion of short-run recruitment decisions and the integration of the segmentation model with present resource planning models are natural extensions of this research. Furthermore, this segmentation model is useful in studying many national higher education problems of student access in addition to admissions planning for individual colleges.

The appendices to this paper are not included in this publication. They may be obtained by any interested reader by writing to the Office of the Ford Foundation Research Program in University Administration.

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I. INTRODUCTION

Very little is known about the sequence of decisions a student must make in applying, being accepted, entering, and staying in undergraduate education. Even less is known about the interrelated effects recruitment, tuition, financial aid, and structural institutional policies have upon these student decisions. Private university administrators have long sought greater understanding in these very complicated areas in order to establish tuition and financial aid programs with some logical consistency.

Administrators of institutions find it particularly difficult to address questions like the following: Are we pricing ourselves out of a market? If so, how fast and how sensitive is the market to our fee structure policies? How can we simultaneously plan financial aid funds and admissions policies which explicitly reflect net revenue and student body quality alternatives? How much more effective does our recruiting have to be in order to meet net revenue and student body quality expectations? Should dormitory vacancies be filled by lower aptitude students requiring higher financial aid? What price is our institution paying for minority programs in terms of quality and net revenue?

This research is only the beginning of inquiry into these problems. Basically, a model is developed which categorizes all high school graduates in the United States by financial aid need, SAT verbal scores, and sex. Financial aid need is the amount of college expenses a student is unable to pay; financial aid need is the gap between the total educational expenses at an institution and the student and family resources available for higher education.

By describing high school graduates as "recruitable freshmen" and classifying their attributes in the above manner, a study is made of how the numbers of students in each one of the categories is changing over time. There are remarkable differences in the ways different categories of students are changing. These changes directly depend upon the fee policies of each particular institution utilizing the model.

The model is applied to information and projections obtained from Ohio Wesleyan University for the years 1955-1979. Many effects are combined to give the numbers of students in the U.S. who are potentially recruitable: growth of high school student numbers, shifting of income distribution of parents of high school graduates, changing ability of parents to pay educational costs at different income levels, and different high school retention rates between income levels. The implication of the institution's increasing tuition and room and board policy is shown as drastically reducing the number of students with little demonstrated need for financial aid.

Chapter III develops this recruitable freshmen segmentation framework. Then Chapter IV analyzes Ohio Wesleyan's fee structure implications and then shows how the national changes in recruitable freshmen can be combined with Ohio Wesleyan's enrollment experiences to evaluate these effects directly. The concluding chapter suggests how this model could be utilized in the analysis of many national education problems.

II. ADMISSIONS PLANNING

Admissions Planning Research in Private College Research

Two basic problems in private college admissions planning are: (1) lack of means with which to evaluate alternate admissions, tuition, and financial aid policies in terms of net revenue; and (2) lack of means with which to integrate behavioral objectives with educational and financial objectives.

Recently, the emphasis of planning in both private and public institutions has been cost analysis. One of the most important additions to college planning techniques in recent years has been the development and application of many computer based resource planning models. A few of the most notable models include the CONNECT/CAMPUS model pioneered by the Systems Research Group,[1] the Cost Simulation Model (CSM) of the University of California,[2] the Resource Requirements Prediction Model (RRPM) implemented by the National Center for Higher Education Management Systems,[3] the Systems Model for Management, Planning, and Resource Allocations in Institutions of Higher Education model developed at Michigan State University,[4] the Tulane University Model,[5] and the CAP:SC model developed by Peat, Marwick, Livingston and Company for small colleges.[6]

Private colleges are beginning to use these cost analysis and research developments. However, private colleges need much more research integrating the long history of cost analysis with revenue forecasting in order to generate net revenue concepts for planning. Public institutions understandably evaluate a high proportion of policies on the basis of resource use because revenue considerations are largely defined by legislation.

However, the private college is more analogous to a business where revenue can be deliberately influenced in many different ways in order to achieve college objectives. Thus, private college research should be expanded towards integrating revenue with cost analysis.

However, college administrations pursue a financial objective only as one of many objectives. In fact, most institutions pride themselves in valuing non-financial objectives very highly. Yet most research on educational administration has become more and more sophisticated in the moderately well-defined areas of cost analysis and continues to ignore non-financial objectives. Ideally, research also needs to integrate financial and non-financial considerations in a unified concept of planning.

This study illustrates one direction of integration by addressing the problem of how administrators in a private college plan for new students in both the short and long run--called admissions planning. This research integrates objectives which value non-financial attributes of new students, such as income, scholastic ability and sex, with revenue attributes of new students. The final cost attribution of new students is a direct application of RRPM or CSM and, therefore, is not included in this report.

One of the few available studies of private college admissions planning is that of Humphrey Doermann.[7] He has recently developed a bivariate model which classifies male high school graduates by SAT verbal score and the amount College Scholarship Service determines to be his ability to pay college expenses. Doermann's objective was to estimate the number of male students with both high verbal scores and high ability to pay. The ability to pay for a student was taken from his parent's adjusted effective income which was estimated for all high school graduates. However, in comparing

one year to the next, the same relationship between income and ability to pay was used. This assumed "fixed income to ability to pay relationship" and the additional lack of adjusting the income distribution growth for differential high school retention rates between income levels makes this model potentially quite misleading for planning purposes. This present research revises and extends Doermann's research in a more unified planning framework.

While there is little research in private college admissions planning available in addition to Doermann, there have been several statistical studies of the demand for public education, especially in California.[8] Recently, there have also been aggregate demand estimates for high school graduates in the U.S. which include type of institution, institutional academic selectivity, students' ability, and parents' income.[9,10] These have yielded some insights for the private college; particularly, that low achievement students are much more elastic with respect to income and cost than high achievement students. These models offer little in terms of operational planning for private colleges. Also these models ignore the amount of financial aid students are offered and in turn accept, and the models determine institutional selectivity by the average verbal score of the enrolling classes. In contrast, the most important variables to a private college include the entire distributions of financial aid and of ability of the enrolling classes.

One additional study does shed some light on the financial and admission policies of a representative sample of U.S. institutions.[11] This study shows national trends in financial aid offerings and acceptances with which to compare a particular private college's policies. It is most complete and informative and hopefully will lead to further, even

more insightful, work about admissions planning phenomena.

Before turning to the recruitable freshmen model and its application, it is appropriate to qualify the assumption of using verbal score as a non-financial objective. Verbal score has been shown to be one of the best predictors of college success.[12] However, it is only one non-financial dimension and is quite questionable whether it is the most valued. Evidence exists which shows it is erroneous in predicting college academic success in at least some cases.[13] Verbal test scoring ability of new freshmen was chosen as a segmentation dimension since administrators express concern about this attribute, since information about verbal scores of recruitable freshmen is available, and since other studies using verbal score in analyses will be comparable.

CHAPTER II - NOTES

[1]Systems Research Group, CONNECT/CAMPUS (June, 1970).

[2]Weathersby, George B., The Development and Applications of a University Cost Simulation Model, (Graduate School of Business Administration and Office of Analytical Studies, University of California, Berkeley, 1967).

[3]Western Interstate Commission for Higher Education, Resource Requirements Prediction Model: User's Manual, (1970).

[4]Koenig, Herman E., M. G. Keeney, and R. Zemoch, A Systems Model for Management Planning and Resource Allocations in Institutions of Higher Education, (Michigan State University, 1968).

[5]Fermin, Peter A., Seymour S. Goodman, Thomas E. Hendricks, and James J. Linn, University Cost Structure and Behavior (Tulane University, 1967).

[6]Peat, Marwick, Mitchell & Company; and Peat, Marwick, Livingston and Company, CAP:SC - Computer-Assisted Planning for Small Colleges (1969).

[7]Doermann, Humphrey, Crosscurrents in College Admissions (Teachers College Press, Columbia University, 1968).

[8]Hoenack, Stephen A., Private Demand for Higher Education in California (Dissertation: University of California, Berkeley, 1970).

[9]Radner, R. and L. S. Miller, "Demand and Supply in U.S. Higher Education," The American Economic Review (Volume LX, Number 2), pp. 326-334).

[10]Miller, Leonard S., Demand for Higher Education in the United States (National Bureau of Economic Research, Inc., New York, 1971), pp. 26-64.

[11]Cartter Panel, Report on a Study of College Admissions and Financial Aid Policies as Revealed by Institutional Practices (College Scholarship Service, Princeton, 1971), pp. 18-53.

[12]College Board Score Reports (CEEB, Princeton, 1971), pp. 10-13. Cumulative grade point average is usually used as college success.

[13]Doermann, op.cit., pp. 69-72. A Harvard example showed lower scoring students doing surprisingly better than higher scoring contemporaries.

III. RECRUITABLE FRESHMEN SEGMENTATION MODEL

Introduction

The concern of this chapter is a special subset of the university environment: high school graduates. A segmentation model is developed which describes three attributes of high school graduates: sex, verbal score, and need for financial aid. The model will be used to understand the changes in these three attributes of high school graduates due to simultaneous changes of both uncontrollable environmental variables and controllable university variables.

Uncontrollable environmental variables include the number of male and female high school graduates, their verbal aptitude, their dropout rates from school, the ability of their parents to pay educational expenses, the relative and current income levels of their parents, and their joint relationships between verbal aptitude and ability to pay and between verbal aptitude and relative or current income. Controllable university variables in determining need for financial aid include tuition and room and board expense levels. These last variables compose two components of the total educational expense level incurred by students. Total expense level is the sum of tuition, room and board, and personal expenses. Room and board expense is assumed priced to break even. Although room and board expense is set by the institution, it really is an uncontrollable environmental variable which is also the assumption made concerning personal expenses and the amount a student can earn during the summer before the freshman year.

This chapter shows how estimates were derived for the following two functions:

$N_t^1(a, s|T)$ = the number of male high school graduates in academic year $(t-1, t)$ who have verbal aptitude scores greater than or equal to s and also have a financial aid need less than or equal to "a" when tuition expense level is T

$N_t^2(a, s|T)$ = same for female high school graduates,

where

$$200 \leq s \leq 800 \ , \ T \geq 0 \ , \text{ and } 0 \leq a \leq T + RB_t + PE_t - SE_t^i$$

(RB_t and PE_t are room and board and personal expenses; SE_t^i is the student's summer earnings ($i=1$ for male students, $i=2$ for female students) all fixed for each t.

$N_t^k(a, s|T)$, $k = 1, 2$, is the segmentation model which estimates the number of high school graduates by sex, verbal aptitude, and financial need. The model includes the effects of uncontrollable environmental variables and shows the direct consequences of the controllable tuition variable. Time t refers to the year the graduates normally could enter their fall freshman year term.

Due to the limited information about the differences between high school seniors and high school graduates, this study assumes attributes of high school seniors to be representative of graduates. Yet three to seven percent of enrolled seniors do not graduate.[1] *A priori*, the rate of failure to graduate for a senior might decrease with increasing income and score level. However, the absence of adequate information plus the relatively small failure percentages, which decrease with time, motivated the above assumption. The model describes high school graduates who are of primary concern for college admissions, although most of the information is derived from the behavior of seniors.

In the model above note that verbal scores range between two hundred

and eight hundred. Financial aid need takes on values between zero and the total educational expense level less summer earnings,

$$T + RB_t + PE_t - SE_t^i \quad .$$

Unfortunately the above segmentation model functions cannot be directly estimated. No direct information exists about the form or attributes of these functions. This chapter uses an indirect approach to develop this model. Each assumption is stated separately, then integrated into the model. For instance, instead of estimating financial need directly, income estimates are first made and then estimates relating income to financial aid need are made. Thus, the objective of this chapter is to derive the above segmentation functions in terms of other known or estimatable relationships.

High School Graduates

The segmentation model revises and extends the work of Humphrey Doermann.[2] This model includes both male and female high school graduates in the United States because: (1) each sex has distinctive attributes relevant for college admissions, and each sex has distinctive responses to the variables affecting access to higher education, and (2) together, male and female students collectively exhaust the opportunities in the university environment for potential enrollable students. Figure III-1 shows the number of male and female high school graduates from 1955 to 1979. These numbers are also listed in Table III-1. The present higher proportion of female seniors is estimated to change in 1973 to a higher proportion of male students graduating. Total graduates are estimated to grow slightly slower in the next five years. Using 1971 as a base year, the next five years show graduates growing a slower 15.4% than the 15.8% of the last five years. If the eight year trend is studied, then the large growth of the mid-1960's due to the post World War II baby impact will not be repeated. In the last eight years, graduates increased 58% while estimates show growth for the next eight years to be only 22%. In other words, there is a major leveling off trend expected in this decade.

Verbal Aptitude

High school senior verbal aptitude tests are provided by the College Entrance Examination Board (CEEB). Two tests are offered in the fall of the senior year: the Preliminary Scholastic Aptitude Test (PSAT)--usually given in October--and the Scholastic Aptitude Test (SAT)--usually given in December. Both tests provide a measure of the level of students'

FIGURE III-1

Total Male amd Female High School Graduates: United States 1955 to 1979

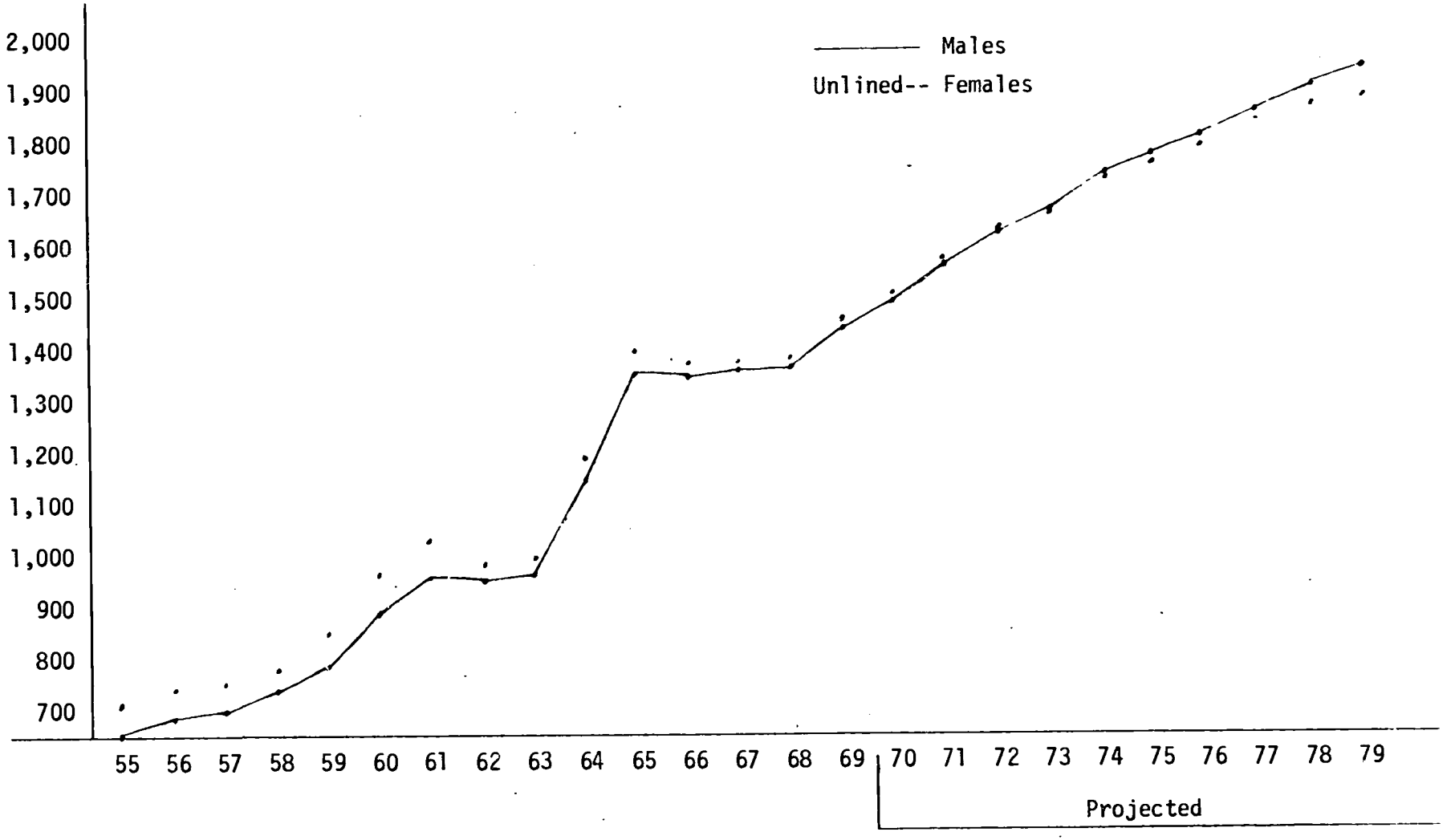


TABLE III-1

High School Graduates:[a] United States 1955 to 1979
(in thousands)

Year	Male	c	Female	d	Total	Percentage Total Change from Previous Year
1955	648	--	703	--	1,351	--
1956	682	5.2	739	5.1	1,421	5.2
1957	696	2.0	750	1.5	1,446	1.7
1958	729	4.7	784	4.5	1,513	4.6
1959	790	8.4	849	8.3	1,639	8.3
1960	898	13.7	966	13.8	1,864	13.7
1961	958	6.7	1,013	4.7	1,971	5.7
1962	941	-1.8	984	-2.9	1,925	-2.3
1963	959	1.9	991	.7	1,950	1.3
1964	1,129	17.7	1,173	18.4	2,302	18.1
1965	1,337	18.4	1,378	17.5	2,715	17.9
1966	1,326	- .9	1,346	-2.3	2,672	-1.6
1967	1,332	.5	1,348	.1	2,680	.3
1968	1,341	.7	1,360	.9	2,702	.8
1969	1,408	5.0	1,431	5.2	2,839	5.1
Projected[b]						
1970	1,479	5.0	1,490	4.1	2,969	4.6
1971	1,542	4.3	1,552	4.2	3,094	4.2
1972	1,601	3.8	1,604	3.3	3,205	3.5
1973	1,654	3.3	1,651	2.9	3,305	3.1
1974	1,707	3.2	1,701	3.0	3,408	3.1
1975	1,757	2.9	1,747	2.7	3,504	2.8
1976	1,793	2.0	1,778	1.8	3,571	1.9
1977	1,833	2.2	1,812	1.9	3,646	2.1
1978	1,891	3.2	1,857	2.5	3,748	2.8
1979	1,908	.9	1,865	.4	3,773	.7

[a]U.S. Office of Education, Projections of Educational Statistics to 1978-79, 1969 Edition (Washington: U.S. Government Printing Office, 1969), Table 20. Numbers are graduates of regular day schools representing more than 99 percent of public school graduates and 97 percent of nonpublic school graduates.

[b]1970-79 projections assume: (1) 1959-68 trends of the percentage of male and female high school graduates to total males and females 18 years of age will continue, and (2) nonpublic total graduates and male/female mix will remain constant through projection period.

[c]Percentage Male Change from Previous Year

[d]Percentage Female Change from Previous Year

verbal achievement.

In October, 1966, CEEB undertook a national norming study which administered the PSAT to 17,658 seniors (8,581 males and 9,077 females) in a statistically representative sample of 166 secondary schools.[3] Table III-2 shows the percent of students tested in this study who fell into various score intervals. PSAT scores range between 20-80 which are analogous to the SAT 200-800 scores.

The design of the SAT is to measure consistently the same level of verbal achievement from one year to the next. The important question for this study is how the distribution of SAT scores changes from one high school senior class to the next. Several countervailing forces influence these test scores. First, improved special aid and teaching programs tend to decrease the dropout rate from one class to the next. Dropouts tend to be lower ability and lower income students;[4] thus, decreasing dropouts would tend to pull down the verbal score distribution. However, offsetting this downward trend is the upward shift of senior verbal ability created by improved teaching methods and special federal, state, and local programs. Doermann relates some relevant results of unpublished CEEB studies:

> William H. Angoss, Executive Associate of Educational Testing Service, has added that other less complete, unpublished information suggests that relationships between test scores and the proportion of the high school population able to achieve various levels of performance on the test has remained relatively stable from about 1950 until the present.[5]

His study assumes that these two forces offset each other and, consequently, that the verbal distribution of high school seniors is stationary. Therefore, because CEEB attempts to measure the same verbal levels of achievement each year, if all seniors took the test, then male and female

TABLE III-2

PSAT: Percentile Performance for All Seniors[a]

Score Interval	Seniors	
	Male	Female
20-24	15	12
25-29	14	13
30-34	15	17
35-39	13	14
40-44	14	15
45-49	10	10
50-54	8	9
55-59	6	5
60-64	3	3
65-80	2	2
Mean	38	39
Standard Deviation	12	12

[a]Derived from cumulative percentile figures found in College Board Score Reports (Princeton, N.J., CEEB, 1970), Table 5, p. 16.

TABLE III-3

1966 Verbal Probability Distribution for all High School Seniors: 1966

	Male	Female
	$F^1_{1966}(S_j)$	$F^2_{1966}(S_j)$
S_1=200	1.00	1.00
S_2=250	.85	.88
S_3=300	.71	.75
S_4=350	.56	.58
S_5=400	.43	.44
S_6=450	.29	.29
S_7=500	.19	.19
S_8=550	.11	.10
S_9=600	.05	.05
S_{10}=650	.02	.02

Source: Table III-2.

score distributions would remain the same year after year and coincide with the 1966 norming study results. This assumption was also used by Doermann. If we let s_j , $j = 1, 2,\ldots,10$, be score levels and let $F_t^k(s_j)$ be the cumulative probability that a senior of sex k at time t has score greater than or equal to s_j ($k = 1$ for male seniors, $k = 2$ for female seniors), then Table III-3 shows the 1966 values for these functions taken from Table III-2.

The constraint verbal distribution assumption given in this section is simply:

$$F_t^k(s_j) = F_{t+1}^k(s_j) \quad \begin{matrix} t = 1955,\ldots,1978 \\ j = 1 \ldots 10 \\ k = 1, 2 \end{matrix} \quad . \qquad \text{III-1}$$

Financial Aid Need from Ability to Pay

Financial need for a student is defined as the difference between total educational expenses and the amount the student and his family have the ability to pay. Most colleges and universities use the procedures of the College Scholarship Service (CSS) to determine the ability to pay of the student and his immediate family from their combined total resources.

Financial need was included as one dimension of the segmentation model because students with different levels of financial need respond differently to college acceptances depending in part upon the amount of needed aid that is granted. Also, financial need information is used in deciding upon the allocation of institutional financial aid funds. Although financial need information is closely kept by institutions to safeguard confidentiality, financial aid information is usually available for those students who apply for financial aid. Non-financial aid applicants have zero need and all financial aid applicants have a unique need

determined by CSS.

Total educational expense is the sum of tuition (T), room and board (RB), and personal expenses (PE). The amount of aid needed for each student (a) ranges between zero and the total expense level less summer earnings (SE^i) :

$$0 \leq a \leq T + b_t \quad , \text{ for all } t \qquad \text{III-2}$$

where

$$b_t = RB_t + PE_t - SE_t^i \quad \text{fixed for each } t \ .$$

If τ is the level of total educational expense that a high school graduate has the ability to pay, then the financial aid needed is a linear function of both the school's tuition and his ability to pay:

$$a = \begin{cases} 0 & , \ a \geq T + b_t \\ T + b_t - \tau \ , & \tau < T + b_t \ , \ \tau \geq 0 \end{cases} \qquad \text{III-3}$$

We can also define the joint probability function of financial aid needed, a, and the verbal score level, s . Define $H_t^k(a, s|T)$ to be the probability at time t that a high school graduate of sex k , applying to an institution with tuition level T , has both financial aid need less than or equal to a and a verbal score greater than or equal to s . $H_t^k(a, s|T)$ are continuous joint cumulative probability distributions:

$$1 = \int_{200}^{800} \int_{0}^{T+b_t} h_t^k(a, s|T)\,da\,ds \ ,$$

$$H_t^k(a, s|T) = \int_{s}^{800} \int_{0}^{a} h_t^k(\bar{a}, \bar{s}|T)\,d\bar{a}\,d\bar{s} \ ,$$

and

$$h_t^k(a, s|T) \geq 0 \ , \ 200 \leq s \leq 800 \ , \ 0 \leq a \leq T + b_t \ ,$$

for all $T \geq 0$ and $k = 1, 2$, where $h_t^k(a, s|T)$ are the corresponding density

functions. If N_t^k is the number of high school graduates of sex k at time t, as presented in Table III-1, then the segmentation model follows directly:

$$N_t^k(a, s|T) = N_t^k \cdot H_t^k(a, s|T) \quad . \qquad \text{III-4}$$

Although this is the simplest statement of the segmentation model, $H_t^k(a, s|T)$ will not be directly estimated, but will be derived indirectly in terms of other functions.

As indicated above, student financial need is a direct result of tuition expense and his ability to pay; therefore, the following continuous joint cumulative probability distribution is defined:

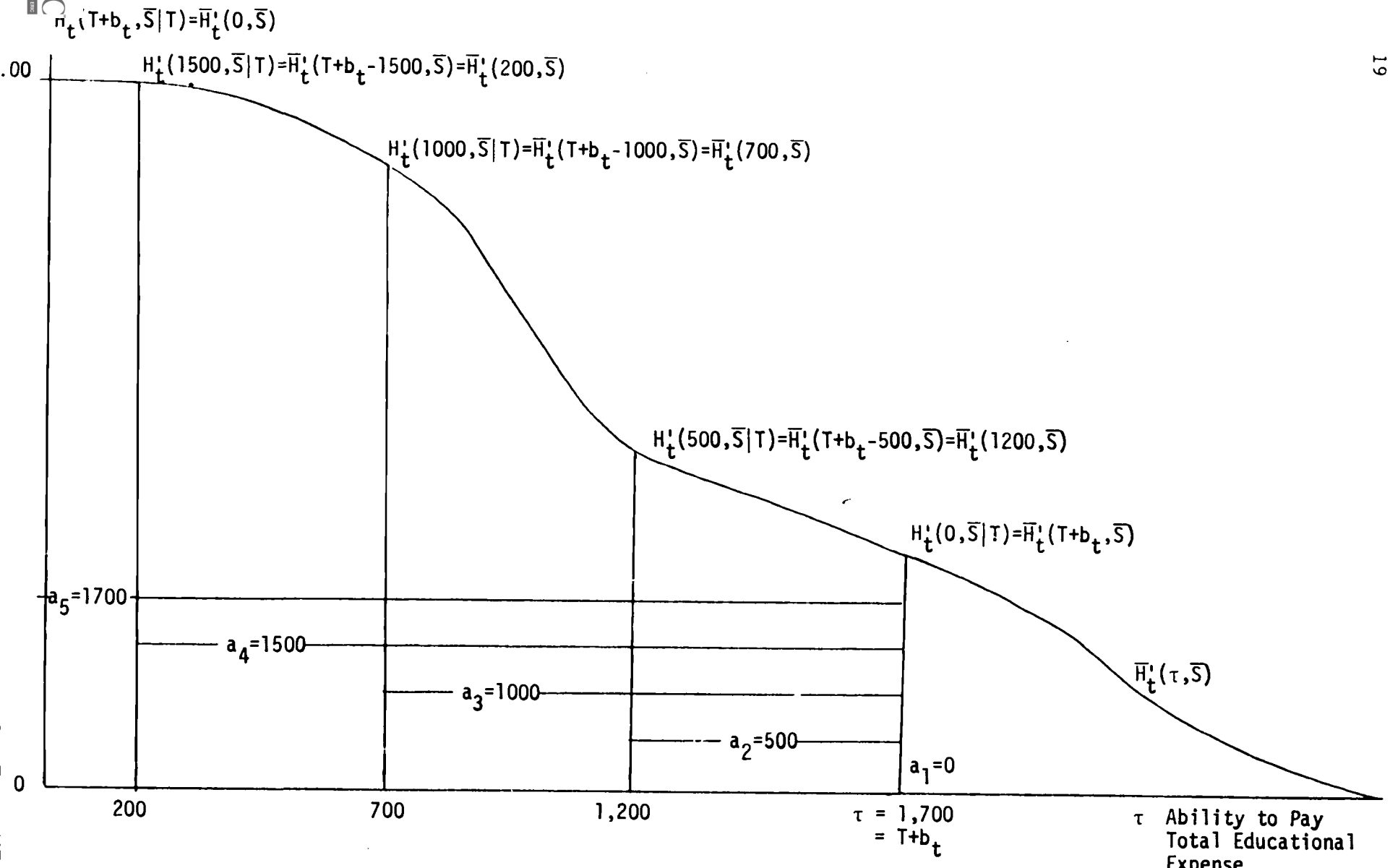
$\bar{H}_t^k(\tau, s)$ = the probability that at time t a high school graduate of sex k has ability to pay an amount greater than or equal to τ and a tested verbal score level greater than or equal to s.

From equation III-3, it follows that:

$$H_t^k(a, s|T) = \bar{H}_t^k(T + b_t - a, s) \quad , \quad t = 1955, \ldots, 1979 \quad , \qquad \text{III-5}$$
$$k = 1, 2$$
$$200 \leq s \leq 800$$
$$0 \leq a \leq T + b_t \quad , \text{ and}$$
$$T \geq 0 \quad .$$

To better understand this relation, take the following example: let the total cost to the student, $T + b_t$, be 1700 and fix s at any $\bar{s}$; then look at successive \$500 levels of financial need. Figure III-2 shows this relation for male students.

FIGURE III-2 Example



Ability to Pay as Derived from Family Net Income

In 1955, the College Scholarship Service published the first nationally applicable tables relating the current value of family resources to their ability to pay.[6] Financial aid administrators have had access to revised and updated tables since 1955 on an annual or biannual basis. While the tables in 1962 were based on many procedural decisions by the CSS Subcommittee, revisions since 1962 provide adjustments for inflation and new information derived from data collected by the United States Bureau of Labor Statistics (BLS).[7] In particular, the analysis of consumption data contained in the Survey of Consumer Expenditures, 1960-61, provided certain expenditure elasticity of about 2.0 with respect to income (including expenditures such as education, recreation, automobiles, consumer durables, gifts, contributions, and savings).[8] Meanwhile, CSS contends its role is to serve as a national standard of objective measure of ability to pay for higher education.[9]

Table A of the CSS reports indicates the standard ability to pay of parents as a function of family net income and the number of dependent children. After allowances for federal income tax business expense deductions, family net income is defined to include total wages, dividends, interest, property income, capital gains, social security benefits, pensions, child support, alimony, aid for dependent children, subsistence and quarters allowances, allotments, and aid from friends or relatives.[10] Table A is used by financial aid administrators when no unusual expenses are incurred by the family.[11]

If the number of dependents were known for the families of high school graduates, then this table would be directly applicable. However, even the Bureau of the Census does not publish information about the size

of high school seniors' or graduates' families. In this study, a family with three dependents was chosen as representative over time for the high school graduate family--based upon the fact that the 2.8 is the average number of dependents in families filing Parents' Confidential Statements with CSS.[12]

Therefore, given the net income distribution for high school graduates, the CSS table for families with three dependent children is assumed to interpret the ability to pay total educational expenses. The progressive increase in ability to pay represents the education expenditure elasticity coefficient based on the BLS information.

To extrapolate this table into the future, piecewise linear functions were derived for each year from 1955 to 1980 based on tables published for 1963 and 1970. If y is net family income as defined above, then we define $C_t(y) = \tau$ to be an estimated piecewise linear function, which is strictly increasing,[13] and which maps family net income to ability to pay educational expenses at time t. The estimation of $C_t(y)$ assumes that for each income level there is a constant rate of decline in contribution year to year:

$$C_{t+1}(y) = C_t(y)\left(1 - \varepsilon(y)\right) \quad t = 1955 \ldots 1978, \quad 0 \leq y \leq 100{,}000 \qquad \text{III-6}$$

where $\varepsilon(y)$ is the constant deflation rate[14] for absolute income level y.

One hundred net family income levels ranging from 0 to $100,000 were chosen from the 1963 and 1970 published tables. The constant deflation rates were calculated for each of the one hundred income levels and then all years other than 1963 and 1970 were interpolated or extrapolated from those years using the estimated rates.

These deflation rates were calculated by the following procedure.

If y_i , $i = 1 \ldots 100$ is the income level chosen from Table A, for 1963 and 1970, then the deflation rate, ε_i , associated with income level y_i , can be obtained by the formula:

$$\varepsilon_i = 1 - \left[\frac{C_{1970}(y_i)}{C_{1963}(y_i)}\right]^{1/7} \qquad i = 1, 2, \ldots, 100 \quad . \qquad \text{III-7}$$

Then, the estimated piecewise linear approximation becomes

$$C_t(y_i) = \begin{cases} \dfrac{C_{1963}(y_i)}{(1 - \varepsilon_i)^{1963-t}} & t = 1955, \ldots, 1962 \\ C_{1963}(y_i) & t = 1963\text{-Table A, } 1963 \\ C_{1963}(y_i)(i - \varepsilon_i)^{t-1963} & t = 1964, \ldots, 1969 \\ C_{1970}(y_i) & t = 1970\text{-Table A, } 1970 \\ C_{1970}(y_i)(1 - \varepsilon_i)^{t-1970} & t = 1971, \ldots, 1979 \end{cases} \qquad \text{III-8}$$

for $y_i = 1, \ldots, 100$ fixed.

For any given t , $C_t(y)$ is linear between y_i and y_{i+1} , $i = 1, \ldots, 99$.

The computed constant deflation rates, family net income levels, and estimated $C_t(y_i)$ points are listed in Appendix A. Figure III-3 shows both the progressive nature of $C_t(y_i)$ and how it changes over time.

If Y is the measure of income and Γ is the measure of ability, then we observe that $C_t : Y \to \Gamma$ is a one-to-one mapping and thus has a one-to-one inverse: $C_t^{-1} : \Gamma \to Y$. When we let $\bar{H}_t^k(y, s)$ be the probability that a high school graduate of sex k at time t belongs to a family with net income greater than or equal to y and has verbal score greater than or equal to s , it immediately follows from equations III-5 and III-6 that

$$H_t^k(a, s|T) = \bar{H}_t^k(T + b_t - a, s) = \bar{H}_t^k(C_t^{-1}(T + b_t - a), s) \qquad \text{III-9}$$

FIGURE III-3
Estimated CSS Curve

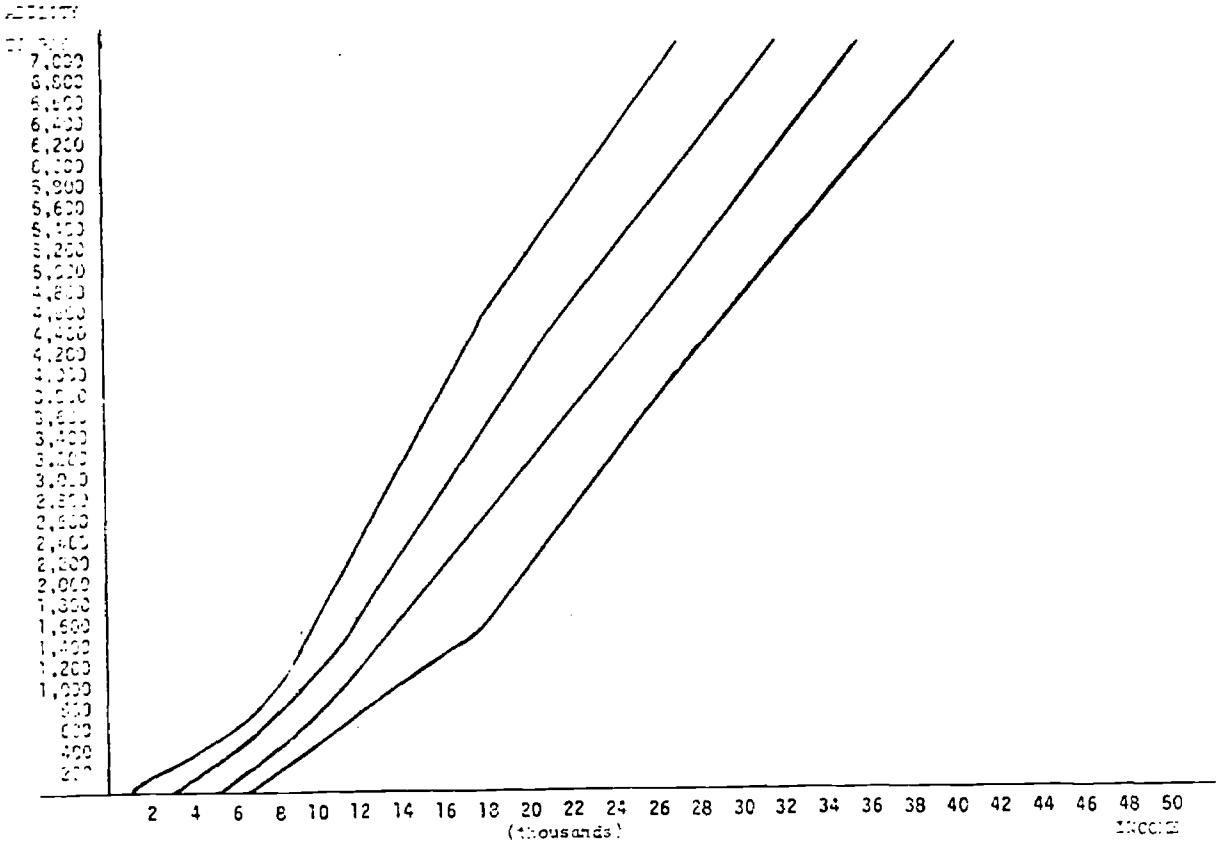
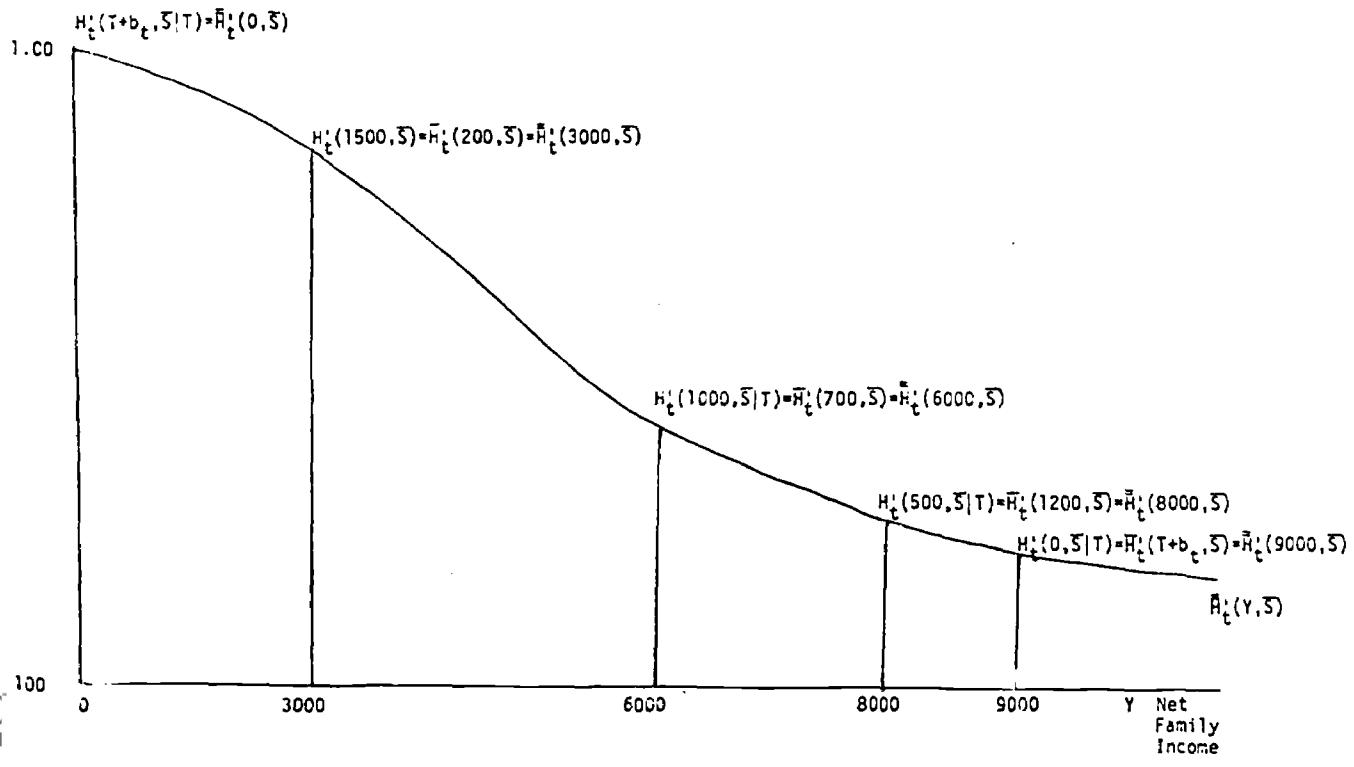


FIGURE III-4 EXAMPLE (continued)



for $k = 1, 2$, $t = 1955, \ldots, 1979$, $200 \leq s \leq 800$, $0 \leq a \leq T + b_t$, $T \geq 0$, since

$$\bar{\bar{H}}_t^k(C_t^{-1}(\tau), s) = \bar{H}_t^k(\tau, s) = \bar{H}_t^k\left(C_t\left(C_t^{-1}(\tau)\right), s\right) \text{ for all } \tau \geq 0 .$$

Hence, once $\bar{\bar{H}}_t^k(y, s)$ is estimated, $H_t^k(a, s|T)$ follows directly.

The example illustrated in Figure III-2 is continued below in Figure III-4. The following function values are added:

$$C_t^{-1}(0) = 0, \; C_t^{-1}(200) = 3000, \; C_t^{-1}(700) = 6000,$$

$$C_t^{-1}(1200) = 8000, \; C_t^{-1}(1700) = 9000.$$

Joint Distribution of Family Net Income and Verbal Aptitude

The segmentation model has now been transformed from directly estimating $H_t^k(a, s|T)$ to estimating $\bar{\bar{H}}_t^k(y, s)$. Neither national nor regional studies have been undertaken which estimate the joint distribution between income and verbal aptitude or the simple correlation between these two variables. However, studies have been conducted between various other measures of aptitude and socioeconomic categories which indicate simple correlations primarily in the range of .35 to .40.[15] Project Talent and SCOPE both collected aptitude and income related data, but the broad categories by which income was estimated and the large standard deviations of the income estimates render these studies unusable for either correlation or distribution analysis.[16,17]

The current study assumes a correlation between verbal aptitude and relative income in the range of .35 - .40. Also, the correlation is assumed to be uniform throughout all levels of verbal scores and relative income levels as well as unchanging with time. (The approximated

distributions below for $\bar{\bar{H}}_t^k(y, s)$, $t = 1955, 1979$, both have correlations of .37 between verbal scores and relative income levels.)

At this point the relevant external information available to help derive $\bar{\bar{H}}_t^k(y, s)$ is virtually exhausted. No information was available on the bivariate distributions between current or relative income levels of high school seniors or graduates and their verbal aptitude. Given the above correlation between income and verbal scores and the observed marginal verbal score distributions from Table III-3, a reasonable attempt to approximate $\bar{\bar{H}}_t^k(y, s)$ has been made.

A basic behavioral assumption of this model is that the relationship of relative income levels to verbal scores for high school graduates is independent of time. By definition, relative income levels do not change with time; assume that both the marginal score distributions and the relative income-ability correlations are reasonably constant over time. However, this last assumption is stronger than the previous ones, because it assumes that the entire joint distribution between relative income levels of high school graduates and their verbal scores is independent of time; so for any relative income level at time t , the distribution of scores for students at that level is identical to the same relative income level at time $t + 1$ or $t - 1$, etc. The factors that do change with time include the number of graduates and the current dollar values associated with relative income levels.

To state this assumption mathematically, let y_t^i be the current dollar value in year t associated with relative income level i . Let n be the number of relative income levels, $i = 1, 2, \ldots, n$, and let $G_t^k(y)$ be the probability that the current dollar value of the family net income for a high school senior of sex k in year t is greater than or

equal to y. By definition of relative income levels y_t^i:

$$G_t^k(y_t^i) = G_{t+1}^k(y_{t+1}^i) = G_t(y_t^i) \quad , \; i = 1,\ldots, n \text{ over all } t \; .$$

($G_t(y_t^i)$ is assumed to be the same for both male and female students.) The assumption stated above becomes:

$$\bar{H}_t^k(y_t^i, s_j) = \bar{H}_{t+1}^k(y_{t+1}^i, s_j) \qquad \begin{array}{l} i = 1,\ldots, n \text{ over all} \\ 200 \leq s_j \leq 800; \; k = 1,2; \\ t = 1955,\ldots, 1978 \; ; \end{array} \qquad \text{III-10}$$

$$\text{such that} \quad \int_{y_t^i}^{\infty} \int_{200}^{800} \bar{h}_t^k(y, s)\,ds\,dy = G_t(y_t^i) \qquad \text{and} \qquad \text{III-11}$$

$$\int_{0}^{\infty} \int_{s_j}^{800} \bar{h}_t^k(y, s)\,ds\,dy = F^k(s_j) \qquad \text{III-12}$$

($F^k(s_j) = F_t^k(s_j)$ from III-3, and $\bar{h}_t^k(y, s)$ is the density of $\bar{H}_t^k(y, s)$ and the correlation between relative income and aptitude scores is in the range .35 - .40.

In general, these assumptions do not completely specify a bivariate distribution. However, the marginals and correlation coefficient do completely specify the bivariate distribution if the probabilities can be approximated by bivariate normal distribution. This means the marginals and correlation agree with equations III-11 and III-12, and joint probabilities approximately follow bivariate normal probabilities.

The s_j's from Table III-3 and the following relative income levels were chosen: .00 (i = 1) , .20 (i = 2) , .40 (i = 3) , .60 (i = 4) , .80 (i = 5) , .85 (i = 6) , .90 (i = 7) , .95 (i = 8) . Let y_t^i , $i = 1,\ldots, 8$, $t = 1955 \ldots 1979$, be the current dollar values associated

with these relative income levels. The next section will show how the y_t^i's were estimated. Bivariate normal distribution probabilities, P_{ij}^k, were obtained from tables.[18] These probabilities are defined below:

$$\int_{y_t^i}^{y_t^{i+1}} \int_{s_j}^{s_{j+1}} \bar{\bar{h}}_t^k(y, s)\,ds\,dy = P_{ij}^k \qquad \begin{array}{l} i = 1, \ldots, 8 ; \\ j = 1, \ldots, 10; \\ k = 1, 2 ; \\ t = 1955 \ldots 1979 ; \\ (s_{11} = 800 , y_t^9 = \infty) . \end{array} \qquad \text{III-13}$$

Finally, the approximation of the continuous distribution is:

$$\bar{\bar{H}}_t^k(y, s) = \int_y^{\infty} \int_s^{800} \bar{\bar{h}}_t^k(y, s)\,ds\,dy \simeq \left[\frac{(s_{j+1} - s)}{(s_{j+1} - s_j)} \frac{(y_t^{i+1} - y)}{(y_t^{i+1} - y_t^i)} \cdot P_{ij}^k\right] + \sum_{n=j+1}^{10} \left(\frac{y_t^{i+1} - y}{y_t^{i+1} - y_t^i}\right) P_{in}^k + \sum_{m=i+1}^{8} \left(\frac{s_{j+1} - s}{s_{j+1} - s_j}\right) P_{mj}^k + \sum_{m=i+1}^{8} \sum_{n=j+1}^{10} P_{mn}^k \qquad \text{III-14}$$

for any $0 \leq y \leq \infty$, $200 \leq s \leq 800$ where $y_t^i \leq y \leq y_t^{i+1}$

and $s_j \leq s \leq s_{j+1}$.

Equation III-14 by definition satisfied equations III-11, III-12 and the correlation equals .37. Appendix B lists P_{ij}^k, $k = 1, 2$, $i = 1, \ldots, 8$, $j = 1, \ldots, 10$.

The segmentation model follows directly by substituting the estimated equation III-14 in equations III-9 and substituting equation III-9 into equation III-4:

$$N_t^k(a, s|T) = N_t^k \cdot H_t^k(a, s|T)$$

$$= N_t^k \cdot \bar{H}_t^k \left(C_t^{-1}(T + b_t - a), s\right)$$

$$\simeq N_t^k \cdot \left\{ \left[\frac{(s_{j+1} - s)}{(s_{j+1} - s_j)} \cdot \frac{\left(y_t^{i+1} - C_t^{-1}(T + b_t - a)\right)}{(y_t^{i+1} - y_t^i)} \cdot P_{ij}^k \right] \right.$$

$$\left. \sum_{n=j+1}^{10} \left[\frac{y_t^{i+1} - C_t^{-1}(T + b_t - a)}{y_t^{i+1} - y_t^i} \right] \cdot P_{in}^k + \sum_{m=i+1}^{8} \left[\frac{s_{j+1} - s}{s_{j+1} - s_j} \right] P_{mj}^k + \sum_{m=i+1}^{8} \sum_{n=j+1}^{10} P_{mn}^k \right\} \qquad \text{III-15}$$

for $s_j \leq s \leq s_{j+1}$, $y_t^i \leq C_t^{-1}(T + b_t - a) \leq y_t^{i+1}$

$k = 1, 2$

$t = 1955, \ldots, 1979$

$200 \leq s \leq 800$

$0 \leq a \leq T + b_t$

and $T \geq 0$.

Current Dollar Income Distributions

There is no available published material about family net income distributions of high school graduates in the United States. However, the income distribution for enrolled high school seniors is retrievable for 1960 from the 1960 census tapes available from the United States Bureau of Census.[19] The 1/1000 representative national sample tapes were used to derive the 1960 income distribution.[20] The 1970 census information would be quite helpful in determining how the income distribution is changing over time, but the 1970 detailed census tapes are unavailable until late 1972.

The change in family net income distribution over time is assumed to be influenced by two factors: The first concerns the growth of income

in all families with a dependent child who "could" be enrolled as a senior; and the second concerns the relationship between students who "could" be enrolled with those students actually enrolled.

We assume that the family net income distribution of those who "could" be enrolled as high school seniors is identical to net income distribution for the United States male population between ages 34-56. Note that this assumption approximates the family income distribution of students with an income distribution of adults. The adult income distribution is not adjusted for birth and mortality rates which vary with income level. Such adjustments are necessary since lower income families tend to have a larger number of dependent children. The above assumption assumes the proportion of "could" students is evenly distributed at all income levels. Thus, there is a slight upward income bias in this assumption. The assumption was made as the closest approximation to the "could" population which has published information about the manner in which the distribution is growing. This income distribution growth information can be calculated from Current Population Survey Reports.[21]

The second assumption for deriving the income distribution for enrolled seniors is the relationship between enrolled students and dropouts at the various income levels. Table III-4 gives the total student retention rates between 1955 and 1980 for students between 5th and 12th grades. These retention rates will be used as proxies for the proportion of the "could" population which is actually still enrolled as seniors. So it is assumed that the retention rate will indicate the difference between the "could" enroll income distribution and the actual enrolled income distribution.

Let $\hat{Y}_t^i$ be the current dollar value of relative income level i at

TABLE III-4

Retention Rates between 5th and 12th Grades--
Total U.S. Students[a]

1955	.57
1956	.59
1957	.59
1958	.60
1959	.62
1960	.65
1961	.66
1962	.65
1963	.68
1964	.72
1965	.75
1966	.74
1967	.75
1968	.75
1969	.76
1970	.79
1971	.79
1972	.80
1973	.83
1974	.83
1975	.83
1976	.86
1977	.86
1978	.86
1979	.88

[a] Rates calculated using: (1) high school graduates given in Table III-1 and (2) dropouts 1955-1979 given in unpublished table: "Estimated Fall Enrollment in Fifth Grade Compared with High School Graduates Eight Years Later: United States; 1950-58 to 1972-80," made available by Mr. Robert Davies, Center for Educational Statistics, U.S. Office of Education.

time t for the "could" enroll students, i.e., U.S. males aged 35-55. Suppose for a moment $\hat{Y}^i_t$, i=1...8, t=1955...1980, is known. Let Y^i_t be the enrolled senior income distribution values, and let R_t be the total retention rate at time t . Certainly, Y^i_{1960} , i=1...8, is known. Finally, let $\bar{Y}^i_t$ be the income distribution values in year t if the retention rate at t equalled R_{1960} . If $\bar{Y}^i_t$ is known, i=1...8, t=1955...1979, then the relative value Y^i_t is between $\bar{Y}^i_t$, and $\hat{Y}^i_t$ is determined by the difference between R_t and R_{1960} . The values of Y^i_t and $\hat{Y}^i_t$ should coincide as R_t approaches 1, and the following equations result:

$$Y^i_t = (a\,R_t + b)(\bar{Y}^i_t - \hat{Y}^i_t) + \hat{Y}^i_t \quad i=1...8,\ t=1955...1980 \qquad \text{III-16}$$

such that $$a\,R_{1960} + b = 1 \qquad \text{III-17}$$

$$a + b = 0 \quad . \qquad \text{III-18}$$

Equations III-17 and III-18 uniquely determined a and b .

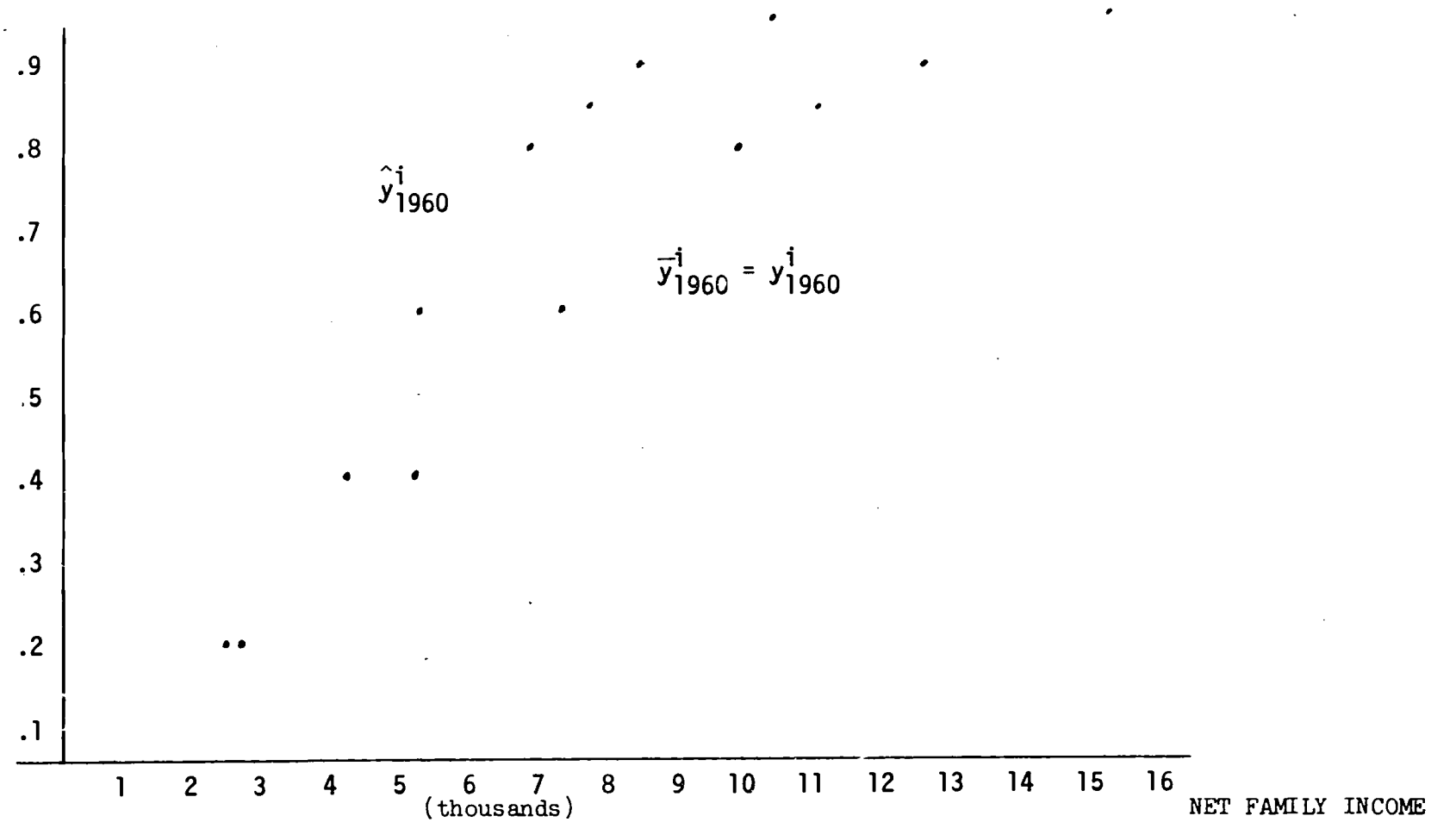
$$a = \frac{1}{R_{1960}-1}\ ,\ b = \frac{1}{1-R_{1960}} \quad .$$

Equations III-16 to III-18 show how the enrolled and "could" distributions for 1960 grow with time. Y^i_t is then determined by R_t alone. Figure III-5 shows $\bar{Y}^i_{1960} = Y^i_{1960}$ and $\hat{Y}^i_{1960}$. The fact that the difference between $\bar{Y}^i_t$ and $\hat{Y}^i_t$ grows with i replicates Sexton's work which shows that higher income students tend to drop out less.[22]

It remains to estimate $\bar{Y}^i_t$ and $\hat{Y}^i_t$, i=1...8, t=1955...1979. Table III-5 shows $\hat{Y}^i_{1959}$ and $\hat{Y}^i_{1969}$ calculated from 1960 census reports and 1969 Current Population Survey.[23,24] In calculating $\hat{Y}^i_t$, a constant inflation or growth assumption was made:

FIGURE III-5

Cumulative Income Distributions for U.S. Males Aged 35-55, 1960 and Family Net Income for Enrolled Seniors in High School[a]



[a]Income Distribution for Males 35-55 in 1960 derived from 1959 income figures Table III-6, using one year grow rates given in Table III-7. Enrolled senior income distribution interpolated from 1960 census tape extractions of total family income for enrolled seniors.

$$\hat{Y}^i_{t+1} = \hat{Y}^i_t \left[1 + \varepsilon(\hat{Y}^i_{1959})\right] \quad i = 1...8 \qquad \text{III-19}$$

where $\varepsilon(\hat{Y}^i_{1959})$ was taken from the 1959 and 1969 values:

$$\varepsilon(\hat{Y}^i_{1959}) = \left[\frac{\hat{Y}^i_{1969}}{\hat{Y}^i_{1959}}\right]^{1/10} - 1$$

so $$\hat{Y}^i_t = \hat{Y}^i_{1959}\left(1 + \varepsilon(\hat{Y}^i_{1959})\right)^{t-1959}, \quad t=1955...1979 . \qquad \text{III-20}$$

To obtain $\bar{Y}^i_t$, growth rates were interpolated and extrapolated from the $\varepsilon(\hat{Y}^i_{1959})$ rates and an equation analogous to III-20 was used. Table III-6 shows the calculated grow rates. Table III-7 shows the computed Y^i_t, i=1...8, t-1955...1979. This completes the estimation of the model.

TABLE III-5

Current Values of Relative Income Levels
1959, 1969 for U.S. Males Aged 35-54[a]

Relative Income Level	U.S. Males 1959	U.S. Males 1969
.00	0	0
.20	2,740	5,074
.40	4,200	7,446
.60	5,292	9,167
.80	6,962	11,727
.85	7,667	12,771
.90	8,588	14,930
.95	10,525	17,967

[a]Interpolated values from tables given in Notes 23 and 24. For instance, the current income of U.S. males aged 35-54 in 1969 who were at the 20th income percentile of all U.S. males aged 35-54 made an annual income of $5,074.

TABLE III-6

Estimated Growth Rates of Current Values
of Relative Income Levels

Relative Income Level	U.S. Males 35-54 1959-1969	Families of Enrolled Seniors Based on R_{1960}
.00	0	0
.20	6.4	6.3
.40	6.0	5.7
.60	5.6	5.3
.80	5.4	5.5
.85	5.2	5.4
.90	5.7	5.3
.95	5.5	5.0

TABLE III-7

Estimated Current Dollar Values of Relative Income Levels
for Total U.S. Enrolled Seniors 1955-1979

Year	Relative Income Levels							
	0	.20	.40	.60	.80	.85	.90	.95
1955	0	2,323	4,504	6,465	9,028	10,017	11,623	14,566
1956	0	2,460	4,702	6,700	9,372	10,390	12,006	14,993
1957	0	2,608	4,929	6,982	9,788	10,839	12,485	15,541
1958	0	2,766	5,167	7,274	10,215	11,300	12,976	16,100
1959	0	2,925	5,355	7,464	10,472	11,571	13,239	16,370
1960	0	3,086	5,511	7,584	10,605	11,703	13,347	16,445
1961	0	3,270	5,762	7,874	11,004	12,130	13,809	16,963
1962	0	3,480	6,116	8,342	11,696	12,880	14,645	17,942
1963	0	3,678	6,331	8,541	11,924	13,114	14,895	18,190
1964	0	3,883	6,528	8,696	12,055	13,241	15,040	18,311
1965	0	4,106	6,763	8,910	12,269	13,459	15,300	18,575
1966	0	4,365	7,149	9,388	12,934	14,172	16,117	19,517
1967	0	4,640	7,557	9,892	13,634	14,924	16,975	20,507
1968	0	4,932	7,982	10,413	14,356	15,698	17,862	21,522
1969	0	5,236	8,393	10,891	14,979	16,360	18,639	22,402
1970	0	5,542	8,726	11,212	15,283	16,669	19,067	22,866
1971	0	5,886	9,194	11,759	15,992	17,423	19,967	23,889
1972	0	6,253	9,694	12,347	16,757	18,235	20,937	24,992
1973	0	6,625	10,119	12,780	17,183	18,673	21,558	25,683
1974	0	7,041	10,682	13,439	18,031	19,573	22,649	26,924
1975	0	7,483	11,278	14,138	18,931	20,527	23,810	28,242
1976	0	7,934	11,803	14,686	19,473	21,086	24,622	29,155
1977	0	8,434	12,474	15,471	20,474	22,145	25,926	30,635
1978	0	8,965	13,180	16,291	21,508	23,237	27,285	32,172
1979	0	9,510	13,818	16,965	22,172	23,921	28,306	33,328

Discussion of the Model

The model represents an approximation to a comprehensive segmentation description of high school graduates. Because this approximation is made by combining information from diverse sources, several caveats must be made before using this composite information.

First, instead of just college bound high school seniors, the entire set of high school graduates in the United States was used. The national high school graduate set was chosen to make the model as generally applicable as possible while maintaining relevance to private colleges. Many private colleges have national alumni systems and recruit nationally. Also, there is inadequate regional or state income information for further disaggregation of the model by state location or distance from a particular college. This data constraint is the reason travelling expenses were also not included in the segmentation model.

The second caveat is the inexactness of the assumed relationship between net family income and ability to pay college expenses. The relationship used in the model is the best estimate from the available information but is obviously very imprecise. The years 1963 and 1971 were chosen to show the progression of ability to pay curves. However, both the magnitudes and shapes of these published curves are changing from year to year. For instance, the tables for a family with three dependent children published in 1967 and 1968 change enough to intersect each other at two points. This suggests that although CSS has the intent to be an objective measure of ability to pay college expenses, CSS cannot derive a fixed form for the relationship. Also the estimated income growth for the next decade is based on the anticipated replication of the past decade economic conditions, which may be unrealistic.

In addition, CSS curves are based on empirical information about what parents were willing to pay for college-like expenses at one point in time. However, this empirical basis gives little information about the willingness to pay of a family with the same income but faced with new prices, recruitment techniques, and perceived educational opportunities involved with increased low cost four-year public higher education and junior colleges, state and federal scholarship and student aid programs, and other major changes.

If the estimated CSS curves are correct, then there is a widening gap between the student's ability to pay college expenses and costs of private institutions. For example, the ninetieth percentile relative net family income level in 1971 is approximately $20,000. CSS estimates this relative income level to have the ability to pay $2,830 in college expenses. In 1963 the same relative income percentile level had the ability to pay $2,440; therefore, the estimated ability to pay has increased at an annual rate of about 2%. For the next eight years the increase in ability to pay for the ninetieth percentile level is estimated to increase at an annual rate of 4.5%. However, college costs have increased and are expected to continue to increase at least at a 6% rate. Thus, a gap has formed between the increasing ability of families to pay college expenses (4.5%) and the increasing college expenses (6%).

Furthermore, the recruitable freshmen segmentation model would be made more useful if there were (1) measures of the uncertainty of the parameters, and (2) a sensitivity analysis of parameters. Measurements of uncertainty are quite complicated due to the manner in which the information sources were aggregated. Sensitivity analysis should be performed as part of further research to understand better the relationships described by the

model. The author feels the CSS curves are the most uncertain and sensitive parameters.

Also, even if the CSS ability to pay curves did describe willingness to pay, there is a reporting discrepancy between actual net family income of census information and the amounts reported to CSS on the Parents' Confidential Statement. Consequently, to utilize the ability to pay for the high school senior parent population, the relationship between the *actual* net family income and the *reported* net family income on the Parents' Confidential Statement to CSS must be known.

This study has fallen short of deriving the sociological and economic information needed to explain or predict willingness to pay. Ability to pay from CSS is too simple a proxy for willingness to pay, although there is some relationship between the two concepts. Obviously, for each income level, some people at that income level are willing to pay more and some less than the CSS defined ability to pay amount. The distribution is quite uncertain but very worthy of future research.

The above factors must be weighed carefully in utilizing the model for decision making. These factors also show the directions for further research.

CHAPTER III - NOTES

[1]Percentages derived from numbers given in "Table 8. Estimated Retention Rates, 5th Grade through College Entrance, in Public and Nonpublic Schools: United States 1924-32 to 1959-67," U.S. Office of Education, Digest of Educational Statistics, 1968 (Washington: U.S. Government Printing Office, 1968).

[2]Every assumption except three which Doermann made was changed to provide more reliable estimates. However, the model structure is analogous. The assumptions which coincide are: (1) SAT verbal distribution independent of time, (2) three dependent children families representative of high school graduate families for the purposes of calculating family ability to pay, and (3) high school senior population representative of high school graduate population.

[3]This study is summarized in Appendix A, College Board Score Reports (Princeton, N.J., College Entrance Examination Board, 1970), p. 33.

[4]Sexton, Patricia Cayo, Education and Income (New York: Viking Press, Inc., 1965), pp. 199-211. This study, centered on public education of one city, found low income area schools dropout rates six times the drop out rates of high income area schools.

[5]Doermann, op.cit., p. 93.

[6]Tables and Charts for Use with Computational Manual: 1955-56 Edition (CSS, 1955).

[7]Bowman, James L., Some Thoughts and Reflections Regarding Parental Ability to Pay for Higher Education (Princeton: CSS, 1970) pp. 6-7. This publication provides a good summary of the controversy surrounding the development of the CSS tables and their objectives.

[8]Survey of Consumer Expenditures, 1960-61, BLS Report No. 237-38, April 1964.

[9]Bowman, op.cit., p. 12.

[10]Parents Confidential Statement--Academic Year 1971-72 (CSS, 1970), p. 2.

[11]Unusual expenses include housekeeping expenses for a working mother, medical and dental expenses, extraordinary expenses, debt repayment, schooling expenses, and expenses for other dependents. Manual for Financial Aid Officers (New York: CEEB, 1965), p. 5-2.

[12]Phone conversation with Mr. James Bowman, CSS.

[13]Several CSS curves have the property $\frac{d^2c}{dy^2} \geq 0$. However, tables for 1967 and revisions for 1968 do not have this property.

[14] $\varepsilon(y)$ is not an economic inflation index adjusting for the change in the consumer price index; rather, this deflation rate adjusts the amount a constant income three-child family has the ability to pay from one year to the next. The adjustment reflects the declining ability of a constant income family to pay expenses due to both price inflation and shifting expenditure patterns.

[15] Charters, W. S., Jr., and N. L. Gage, "Social Class and Intelligence Tests," Readings in the Social Psychology of Education (Boston: Allyn and Bacon, 1963), pp. 12-21.

[16] Shaycoft, Marion F., and John T. Dailey, Project Talent: Studies of a Complete Age Group--Age 15 (Pittsburgh: University of Pittsburgh, Project Talent Office, 1963), p. 123.

[17] Miller, Leonard S., Predicting Family Income in the SCOPE Sample Working Paper No. 4 (Berkeley: Carnegie Commission on the Future of Higher Education, 1970), p. 18.

[18] $\sum_{m=i}^{8} \sum_{n=j}^{10} p_{mn}^{k} = Z(u_i, v_j)$ where u_i and v_j are defined such that

$$\int_{-\infty}^{\infty} z(u_i, v)dv = G_j^k(y_t^i) \text{ and } \int_{-\infty}^{\infty} z(u, v_j)du = F^k(s_j)$$

where $z(u,v)$ is the bivariate normal distribution probability based on .4 correlation table: Pearson, Karl, Tables for Statisticians and Biometricians, First Edition, Part II (London: Cambridge University Press, 1931), Tables VIII and IX, pp. 90-91 and pp. 122-123. The "midpanel central difference formula" found on page xvii was used to interpolate values from these tables.

[19] Net income definitions are not exactly comparable to the CSS income definition. Census income includes wage and salary income; self employment income; net income (or loss) from rents; royalties; interest; dividends; income from estates or trust funds, Social Security benefits; pensions; veterans payments; allotments for dependents, alimony; and receipts from insurance policies or annuities. Characteristics of Population (U.S. Government Printing Office, 1963) p. LXXIX. 1960 census income was estimated to report about 94% of the total money income for persons 14 years of age and older, 99% of the total wage and salary income alone.

[20] Duplicate tapes were obtained from the Department of Demography, University of California, Berkeley.

[21] Current Population Surveys are made in years when the national census is not made. Consumer income studies are published in the P-60 Series, U.S. Department of Commerce, Bureau of Census. Income of families and persons in the U.S. have been published annually since 1947.

[22] Sexton, op.cit., p. 210.

[23]"Table 23. Age and Veteran Status: Persons 14 Years of Age and Over by Total Money Income in 1959, by Sex, for the U.S., Urban and Rural," Income of Families and Persons in the U.S.: 1959 (Washington: Bureau of Census, Series P-60, No. 35), p. 38.

[24]"Table 45. Age—Persons 14 Years Old and Over by Total Money Income in 1969, by Race and Sex," Income of Families and Persons in the U.S.: 1969 (Washington: Bureau of Census, Series P-60, No. 75), p. 97.

IV. ADMISSIONS PLANNING: THE CASE OF OHIO WESLEYAN UNIVERSITY

Introduction

Ohio Wesleyan University is a college located in Delaware, Ohio. It recruits new freshmen primarily from the Northeastern and Middle Atlantic states, and about 30% of its new freshmen enroll from Ohio. Ohio Wesleyan has graciously made available admissions information for use in the integrated model presented in this chapter.

This chapter first shows how the recruitable freshmen market has been partitioned by the Ohio Wesleyan fee policy and how it will be partitioned in the future based on fee estimates up until 1979. The dynamics of the recruitable freshmen market are explored, and the observation that the number of students in different segments change at remarkably different rates over time shows the need for segmentation analysis.

Next, the changing ability of Ohio Wesleyan to attract students in different segments is integrated with the recruitable freshmen model. The changing ability to attract students also varies between student ability and financial aid need. Finally, on the basis of the 1969-1971 Ohio Wesleyan experience, the future number and characteristics of potential student applicants are estimated and interpreted. In addition, other important recruitment factors not explicitly defined in the model are explained and their inclusion accommodated by adjusting the model in certain ways.

Applying The Model

To apply the model developed in Chapter III to Ohio Wesleyan University the following information must first be obtained: tuition fees, room and board fees, personal expenses, and expected summer earnings for male and female freshmen. Table IV-1 gives this information estimated through 1979. Personal expenses have historically grown at a rate of 4.427 percent per year.

The model in Chapter III will be used to estimate: (1) enrollments, (2) verbal ability of the enrolled classes, and (3) financial aid funds needed by assuming that historical Ohio Wesleyan trends will continue. If the model estimates differ from the expectations of the planners, the differences must be due to some deviation from the historical trends caused by either newly planned recruitment policies or external environmental changes. The planner will then be able to re-evaluate or gain confidence in his implicit expectations embodied in the Table IV-1 estimates.

Take the following illustration to see how the model in Chapter III can be applied: It is year t, so $N_t^k(a, s|T_t)$ estimates are known. Also the numbers of students in year t who applied, who were accepted, who were offered various amounts of aid, and who enrolled are known. With the planner's estimate of T_{t+1}, denoted $\hat{T}_{t+1}$, $N_{t+1}^k(a, s|\hat{T}_{t+1})$ are estimated. Suppose the same ratios between the numbers of recruitable freshmen and those offered and accepting aid and enrolling continues through time $t+1$. Then what would enrollments be, what would be the distribution of verbal ability, and how much aid would be offered to the new freshman class? What does the admissions planner conclude if the results show enrollments down 20% and financial aid funds up 25%? The planner will then attempt to

TABLE IV-1

Ohio Wesleyan University Information for
Recruitable Freshmen Segmentation Model: 1955-1979

Year	Change in Total Expenses[b]	Total Expenses[c]	Tuition	Room and Board	Personal Expenses	Expected Summer Earnings Male	Expected Summer Earnings Female
1955	--	1,550	600	650	300	300	200
1956	5.4	1,633	650	670	313	300	200
1957	3.9	1,697	700	670	327	300	200
1958	15.6	1,962	920	700	342	300	200
1959	5.6	2,072	970	745	357	300	200
1960	5.4	2,183	1,020	790	373	300	200
1961	2.6	2,239	1,050	800	389	300	200
1962	5.2	2,356	1,150	800	406	300	200
1963	7.1	2,524	1,300	800	424	300	200
1964	5.7	2,668	1,350	875	443	300	200
1965	8.2	2,888	1,550	875	463	300	200
1966	2.4	2.958	1,600	875	483	300	200
1967	5.0	3,105	1,700	900	505	300	200
1968	7.1	3,327	1,800	1,000	527	300	200
1969	7.0	3,560	1,975	1,035	550	400	300
1970	9.6	3,900	2,250	1,075	575	400	300
1971	7.7	4,200	2,480	1,120	600	400	300
1972[a]	6.0	4,452	2,650	1,175	627	400	300
1973	5.1	4,679	2,805	1,220	654	400	300
1974	4.6	4,893	2,940	1,270	683	400	300
1975	5.2	5,149	3,120	1,320	709	500	400
1976	5.3	5,420	3,310	1,370	740	500	400
1977	5.6	5,721	3,515	1,425	781	500	400
1978	5.4	6,030	3,735	1,480	815	500	400
1979	5.5	6,361	3,970	1,540	851	500	400

[a] Estimated.

[b] Information not needed for model.

[c] Does not include summer earnings assumption.

point to other circumstances such as increased attractiveness of his institution, more effective recruitment techniques, or something else, if enrollment and financial aid funds are planned to remain constant. The planner can revise the tuition estimate, or begin action for increased financial aid funds, or initiate revised recruitment strategies. For the first time, the admissions planner has a means to evaluate his implicit expectations explicitly. College planning takes on a new dimension by actively integrating attributes of new students into the planning process.

The recruitable freshman model estimates numbers for various market segments. In applying the model, the changes over time in fixed market segments will be studied. Market segments or cells will be defined by $500 levels of financial aid needed, ten score intervals, and male and female. Each segment represents an interval on each of the three segmentation dimensions. Table IV-2 gives these intervals.

This analysis first looks at the numbers of recruitable freshmen in each of these cells and how these numbers change through time. Next, this study relates, in recent years, how part of each recruitable freshmen cell has applied to Ohio Wesleyan, has been accepted and offered aid, and then enrolled. These parts of the recruitable freshmen cells going to Ohio Wesleyan will be referred to as Ohio Wesleyan's market shares. The third part of this application estimates the market shares of future markets if the recent relationship continues between the recruitable freshmen segment number and Ohio Wesleyan's share. Finally, these future estimated shares imply certain new enrollments, needed financial aid funds, and verbal score distribution of the enrolled class. These estimates will be compared to the planner's expectations from Ohio Wesleyan for evaluation and recommendations.

TABLE IV-2

Intervals in Segmentations Dimensions: 1955-1979

SEGMENTATION DIMENSIONS		
Sex	Financial Aid Need	Verbal Score
Male	$a \leq 0$	$200 \leq s < 250$
Female	$0 < a \leq 500$	$250 \leq s < 300$
	$500 < a \leq 1000$	$300 \leq s < 350$
	$1000 < a \leq 1500$	$350 \leq s < 400$
	•	$400 \leq s < 450$
	•	$450 \leq s < 500$
	•	$500 \leq s < 550$
	$a \leq T+b_t$	$550 \leq s < 600$
		$600 \leq s < 650$
		$650 \leq s \leq 800$
		Unknown

Recruitable Freshman Market Segments Over Time

Using the segments defined in Table IV-2 and Ohio Wesleyan's information in Table IV-1, and the recruitable freshman model in Chapter III, we have estimated the number of recruitable freshmen in each segment. Table III-1 and Figure III-1 of Chapter III already have shown how the total number of male and female recruitable freshmen change over time.

Here male and female numbers are broken down either by the financial aid needed intervals or by the verbal score intervals. Table IV-3 lists the numbers of male and female recruitable freshmen within three score intervals and Figure IV-1 and Figure IV-2 respectively illustrate the portions of recruitable freshmen falling into these intervals over time. Note that the verbal score distributions are independent of time so that the numbers in each score interval grow at the same rate as the total male or female recruitable students. Since no controllable college variables affect these distributions, the score segment numbers are the same for all colleges. The rates of growth of score intervals are given in Table III-1. However, numbers in financial aid needed intervals do depend upon the college expenses and summer earnings expected.

Table IV-4 and Table IV-5 list the number of recruitable freshmen in each of the $500 intervals from 1955 through 1979. Figure IV-3 and Figure IV-4 graph these numbers. These numbers show a substantial decline in magnitude in each of the lower financial aid needed intervals. In fact, to maintain the same total number of male students with zero financial aid needed as in 1959, 159,000, progressively higher levels of aid are required in successive years. In other words, to have 159,000 students in 1979, one would move to the right to approximately the $1,625 financial need

TABLE IV-3

U.S. Recruitable Freshmen in Verbal Score Segments: 1955-1979, By Sex[a]

(in thousands)

Year	Male			Female		
	200 ≤ s ≤ 400	400 ≤ s ≤ 600	s ≥ 600	200 ≤ s ≤ 400	400 ≤ s ≤ 600	s ≥ 600
1955	369.4	244.2	32.4	393.7	274.2	35.2
1956	388.7	259.2	34.1	413.8	288.2	37.0
1957	396.7	264.5	34.8	420.0	292.5	37.5
1958	415.5	277.0	36.5	439.0	305.8	39.2
1959	453.7	302.5	39.8	475.4	331.1	42.5
1960	511.9	341.2	44.9	541.0	376.7	48.3
1961	546.1	364.0	47.9	567.3	395.1	50.7
1962	536.4	357.6	47.1	551.0	383.8	49.2
1963	546.6	364.4	48.0	555.0	386.5	50.0
1964	643.5	429.0	56.5	656.9	457.5	58.7
1965	762.1	508.1	66.9	771.7	537.4	69.0
1966	755.8	503.9	66.3	753.8	524.9	67.3
1967	759.8	506.2	66.6	754.9	525.7	67.4
1968	764.4	509.6	67.1	761.6	530.4	68.0
1969	802.6	535.0	70.4	801.4	558.1	71.6
1970	843.0	562.0	74.0	834.4	581.1	74.5
1971	878.9	586.0	77.1	869.1	605.3	77.6
1972	912.6	608.4	80.1	898.2	625.6	80.2
1973	942.8	628.5	82.7	924.6	643.9	82.6
1974	973.0	648.7	85.4	952.6	663.4	85.1
1975	1,001.5	667.7	87.9	978.3	681.3	87.4
1976	1,022.0	681.3	89.7	995.7	693.4	88.9
1977	1,044.8	696.6	91.7	1,014.7	706.7	90.6
1978	1,077.9	718.6	94.6	1,039.9	724.2	92.9
1979	1,087.6	725.1	95.4	1,047.4	727.4	93.3

[a]The ten score intervals have been aggregated into three intervals for ease in exposition.

FIGURE IV-1 -- U.S. RECRUITABLE MALE FRESHMEN IN VERBAL SCORE SEGMENTS: 1955-1979

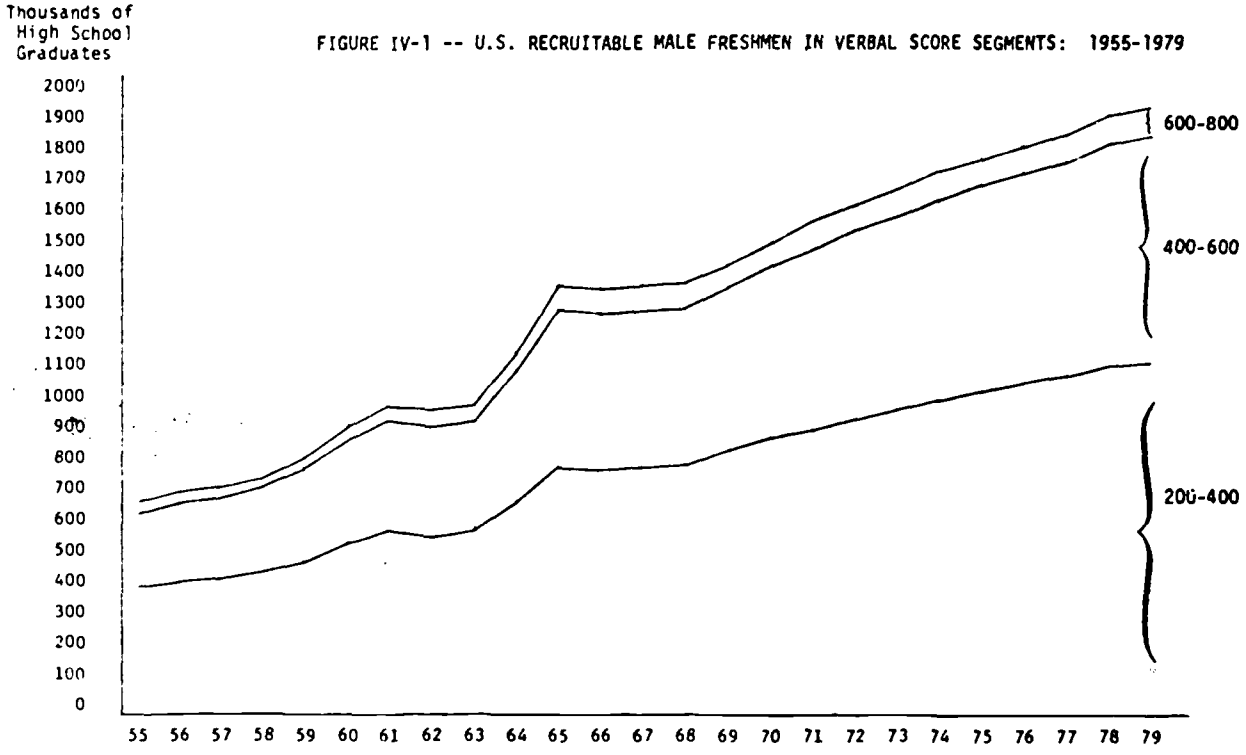


FIGURE IV-2 -- U.S. RECRUITABLE FEMALE FRESHMEN IN VERBAL SCORE SEGMENTS: 1955-1979

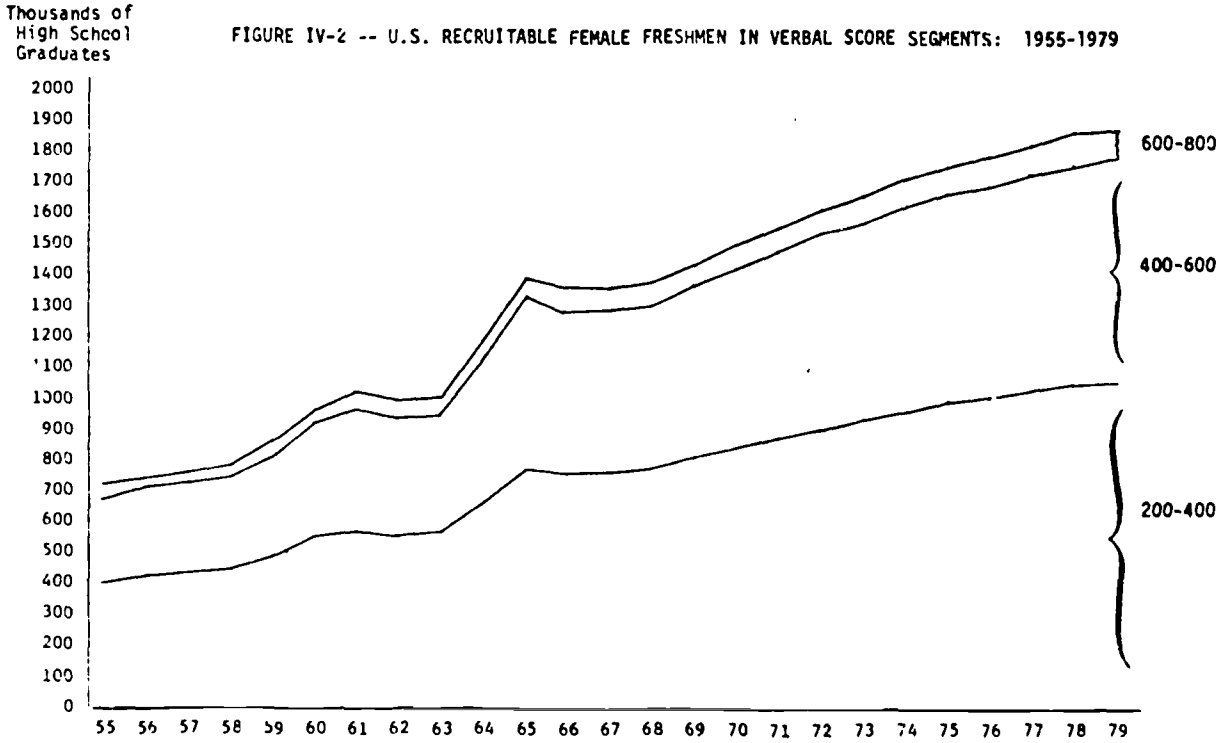


TABLE IV-4

Male Recruitable Freshmen in $500 Financial Aid Needed Intervals within U.S.: Ohio Wesleyan University, 1955-1979

(in thousands)

Year	a<0	0<a<500	500<a<1000	1000<a<1500	1500<a<2000	2000<a<2500	2500<a<3000	3000<a<3500	3500<a<4000	4000<a<4500	4500<a<5000	5000<a<5500
1955	159	124	255									
1956	158	104	216									
1957	157	100	183									
1958	134	82	132	264								
1959	134	78	122	237								
1960	131	71	121	229								
1961	135	71	129	237								
1962	133	77	113	198	343							
1963	117	60	108	179	278							
1964	112	51	111	153	310							
1965	117	47	95	166	348	350						
1966	118	48	93	171	223	425						
1967	117	49	79	151	185	381						
1968	111	40	51	136	160	265	341					
1969	112	41	58	123	169	251	403					
1970	88	40	50	73	152	160	312	575				
1971	78	39	41	53	105	193	256	291				
1972	78	35	40	56	92	150	224	326	225			
1973	76	27	40	48	62	137	198	225	300			
1974	76	27	31	44	56	121	164	300	322			
1975	76	34	42	45	53	100	179	221	370	378		
1976	69	19	53	42	50	66	147	149	382	315		
1977	63	20	45	51	49	46	115	183	202	421	267	
1978	57	21	21	64	53	48	90	140	197	328	354	201
1979	44	23	23	52	65	47	60	120	151	234	399	312

TABLE IV-5

Female Recruitable Freshmen in $500 Financial Aid Needed Intervals within U.S.: Ohio Wesleyan University, 1955-1979

(in thousands)

Year	a≤0	0<a≤500	500<a≤1000	1000<a≤1500	1500<a≤2000	2000<a≤2500	2500<a≤3000	3000<a≤3500	3500<a≤4000	4000<a≤4500	4500<a≤5000	5000<a≤5500
1955	154	111	254									
1956	152	107	198									
1957	152	99	177									
1958	133	80	120	255								
1959	131	75	115	225								
1960	130	69	130	217								
1961	132	73	120	228								
1962	131	66	112	190	298							
1963	110	58	103	140	268							
1964	111	54	104	148	296							
1965	111	54	88	161	221	454						
1966	113	44	85	150	201	410						
1967	111	41	71	144	168	287						
1968	106	36	58	119	164	342	402					
1969	106	37	61	99	177	227	402					
1970	82	40	46	65	136	190	291	219				
1971	76	34	41	59	92	177	232	292				
1972	76	29	40	52	79	135	213	319	280			
1973	74	20	40	35	58	122	182	293	310			
1974	72	23	41	41	45	98	157	254	348	275		
1975	72	26	45	42	52	83	170	190	383	287		
1976	64	20	47	42	49	52	132	184	309	241	214	
1977	58	20	36	54	46	47	95	178	180	418	296	
1978	52	21	23	63	44	48	76	131	182	241	395	240
1979	39	22	22	42	62	53	46	108	243	370	328	430

FIGURE IV-3

Number of Male Recruitable Freshmen by Financial Aid Need Level: United States 1955-1979

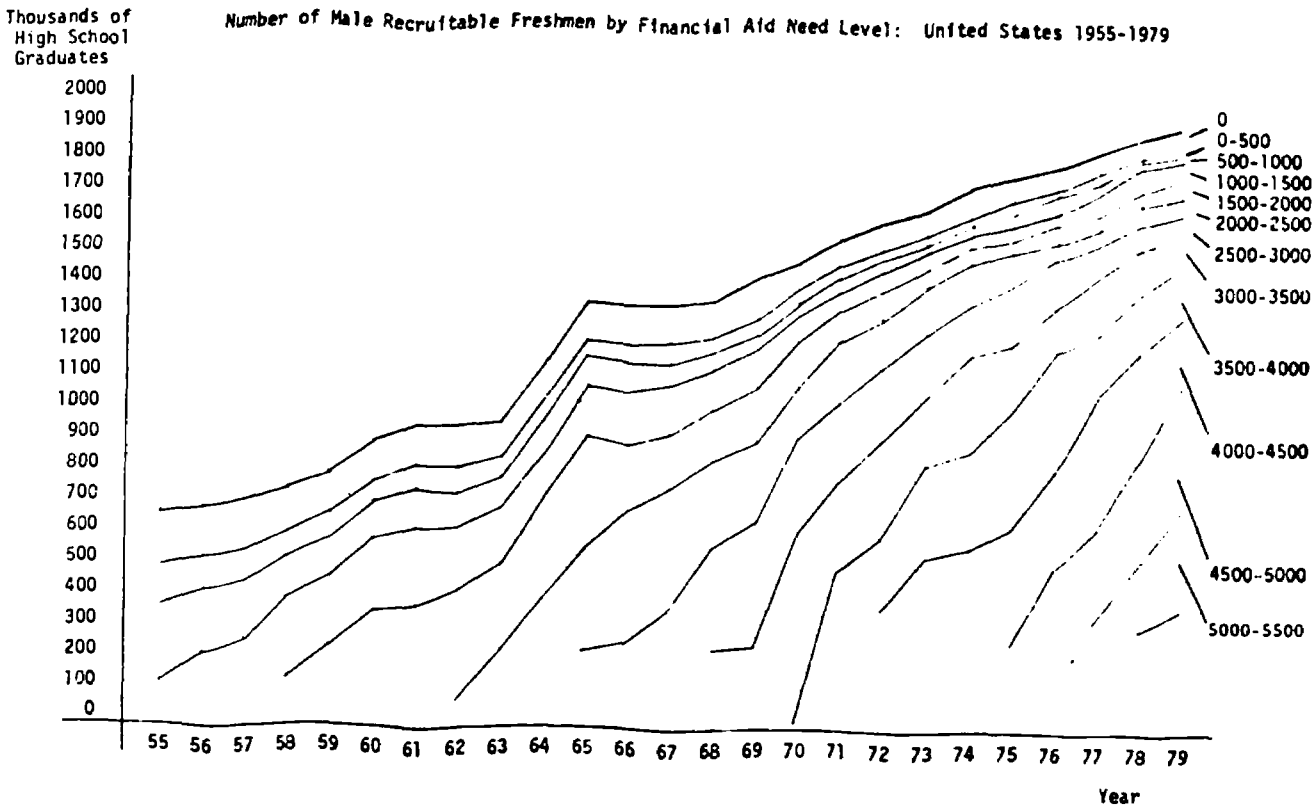
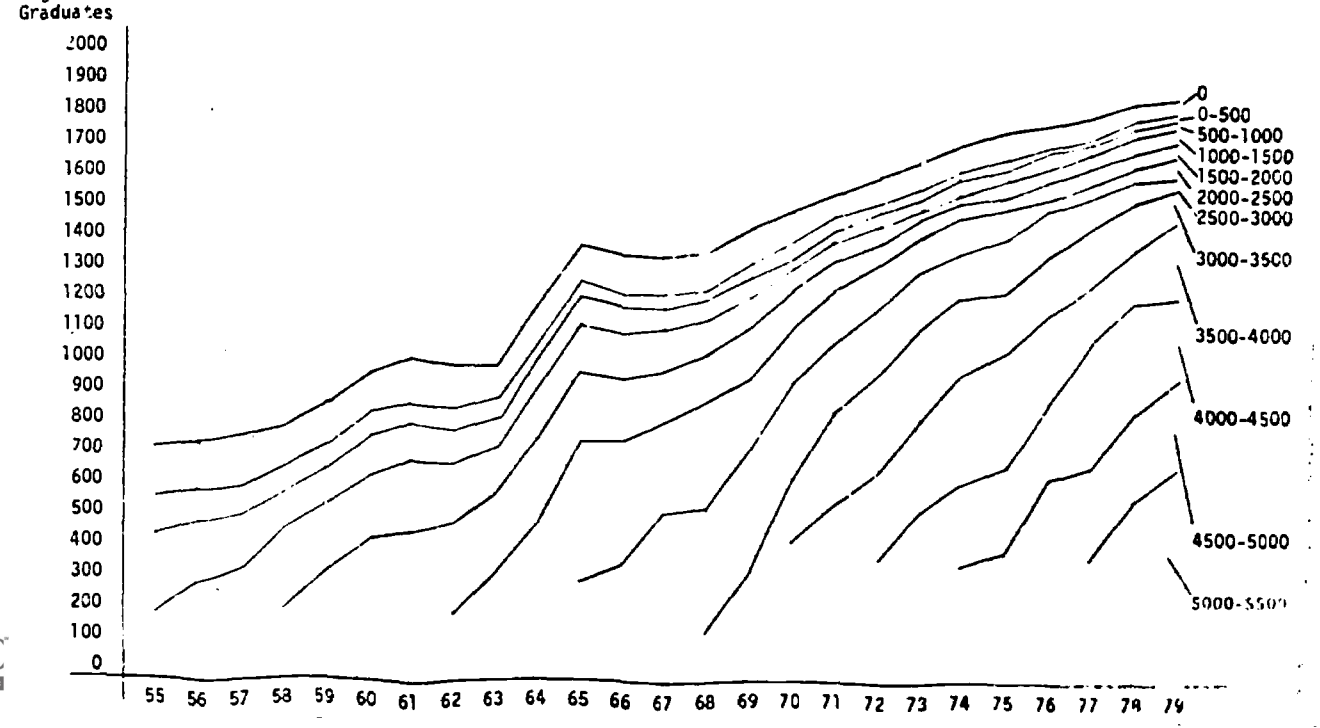


FIGURE IV-4

Number of Female Recruitable Freshmen by Financial Need Level: United States, 1955-1979



level, compared to the $0 need level in 1959. Figure IV-5 shows how the $0, $500, and $1,000 need level numbers in 1955 shift to higher financial need levels over time in order to illustrate this point. Figure IV-5 also shows what financial aid levels Ohio Wesleyan would have to adopt to maintain the same number and mix of male students as in 1955. One interpretation would be that in 1979, if additional financial aid of $1,625 were offered, then the number of people with $0 additional need would be the same as the number with $0 additional need in 1955. In a sense, Figure IV-5 represents policies for fixed numbers in financial need market segments in the student population through time.

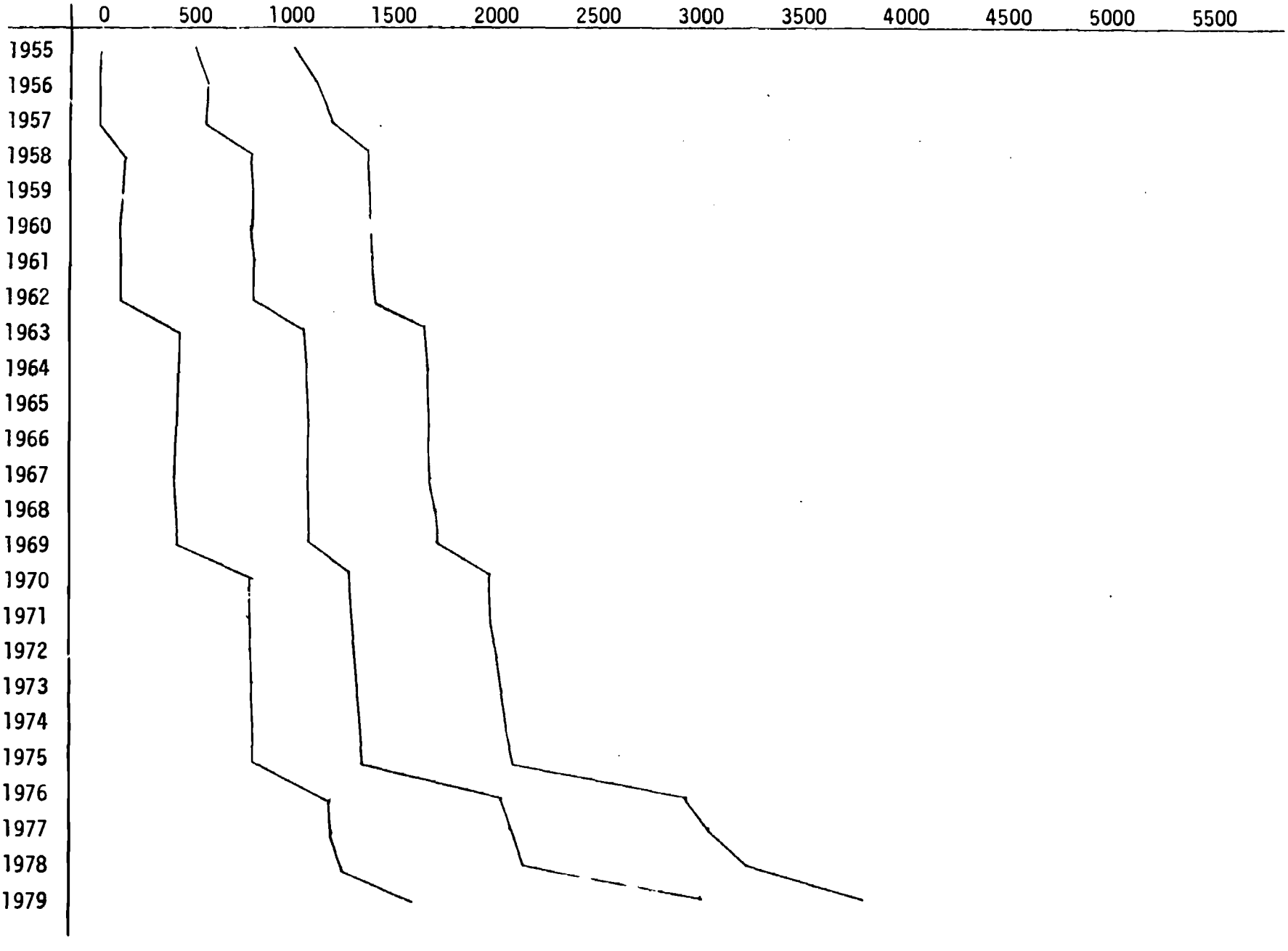
The numbers in the female segments are lower than male segments because female students are assumed to be able to earn one hundred dollars less during the summer before their freshman year (Table IV-1). This means that families of female students must be able to pay $100 more, and thus female segments have slightly smaller numbers than the same segment for male students.

Table IV-4 and Table IV-5 show that in each financial need category, declines in recruitable freshmen numbers are expected to continue even including the effects of the growing income of the recruitable freshmen parent population (Table III-7), the decreasing ability to pay based on fixed net family income (Table A-1, Appendix A), the growing number of high school graduates including the various increased school retention rates over time (Table III-1), and Ohio Wesleyan's fee structure (Table IV-1).

It is obvious that the planned tuition policy will force more and more of the national recruitable freshmen into categories where, if they apply, they will need increased aid to attend. Another way to illustrate

FIGURE IV-5

Shift in Numbers in 1955 Financial Aid Needed Segments Over Time



how Ohio Wesleyan is pricing itself into smaller and smaller numbers of recruitable freshmen is to look at the relative net family income levels over time that are associated with Ohio Wesleyan's financial aid needed levels. Figure IV-6 shows how each male recruitable freshmen financial aid needed level in each year has a corresponding relative net family income level. It shows how these relative income levels have been growing and will continue to grow at staggering rates, not only at the $0 need level, but also for each successive level.

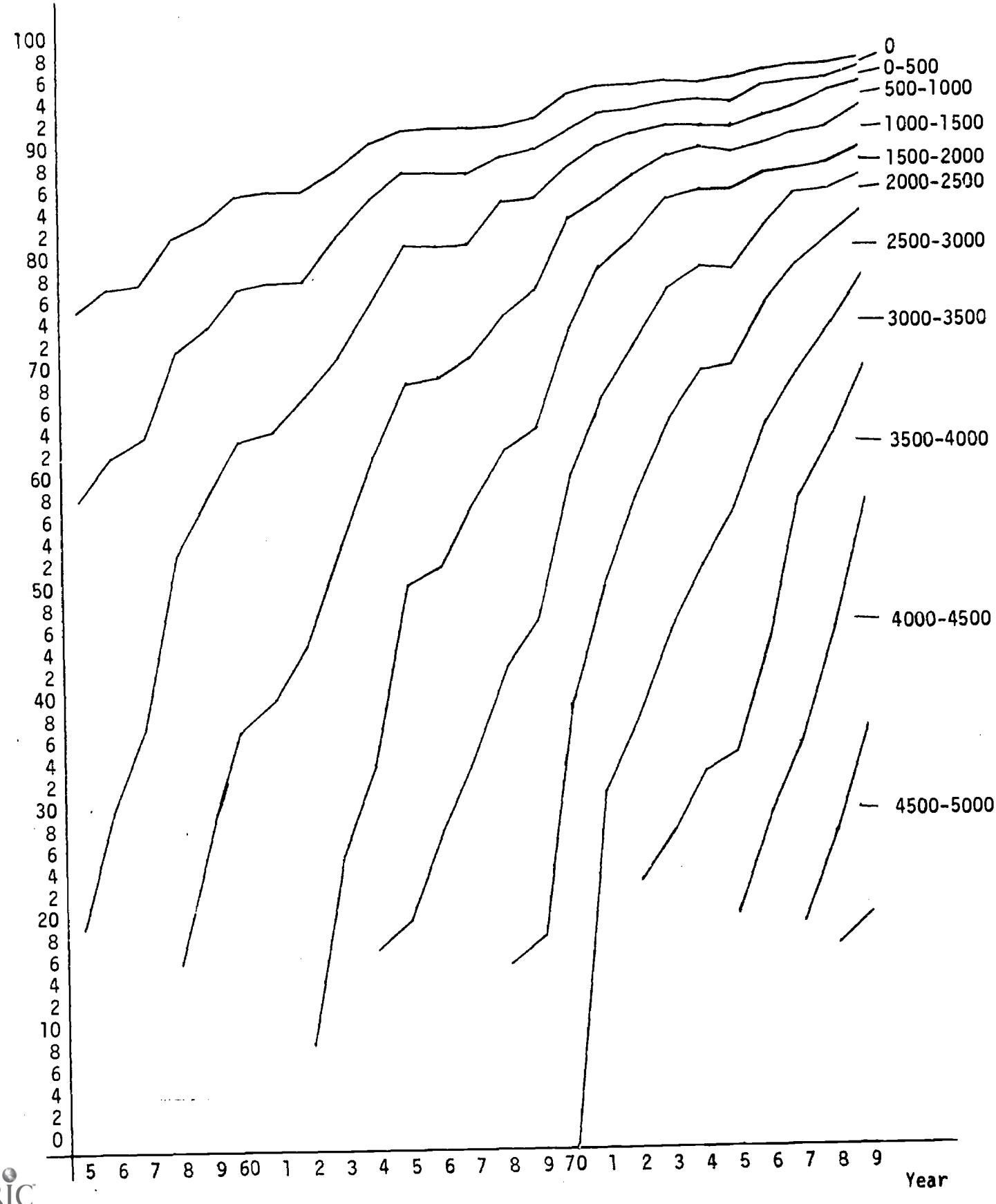
Figure IV-6 can be misleading because it illustrates only relative income and does not reflect the increasing number of high school graduates. One way this figure might be used to show the tuition policy implications in terms of the relative net family income distributions is the following. In 1971, male students with zero financial need must be in at least the 94.93 relative net family income percentile, which by 1979 jumps to 97.67. However, Ohio Wesleyan may historically have recruited and enrolled, and thus become quite dependent upon students, at exactly the 95th relative net family income percentile. So when, in 1972, the zero financial aid needed percentile jumps to 95.13, the result would be a much greater decline in admission applications and enrollments than anticipated.

While the recruitable freshmen model clearly shows how the college need for financial aid funds may have increased, the model does not predict how successful alternative recruiting strategies would be in bringing students from these recruitable segments to Ohio Wesleyan. Although the total number of students is increasing, the Ohio Wesleyan fee policy forces fewer and fewer students into segments having access to its higher education on a reasonable self-supporting basis.

At this point the analysis expands from two segmentation dimensions

FIGURE IV-6

Relative Net Family Income Percentiles Associated with $500
Financial Aid Needed Levels for Male Recruitable Freshmen: U.S. 1955-1979



(1955-1979)

to three: sex, financial aid needed, and verbal score. A separate computer printout supplement gives the estimated numbers of recruitable freshmen in these three dimensional segments from 1955-1979.

In combining verbal score and financial aid need level for each sex, the effect of the correlation between relative income and verbal scores is quite significant. Although the tuition policy limits enrollments to higher and higher relative income percentiles, the score distribution of students in the higher income percentiles is composed more and more of the higher verbal scoring students. The effect of this joint relationship means that as Ohio Wesleyan decreases the relative proportion of recruitable freshmen by forcing students to be in higher relative income brackets, the percentages of these smaller portions of students with high verbal scores increases. For example, in 1955, 43% of high school graduates are estimated to have scored at least 400 in verbal aptitude. The recruitable freshmen who could apply to Ohio Wesleyan with zero financial need was 24.6%, and the recruitable freshmen with zero financial need and scores of at least 400 was 15.5% or 63% of the recruitable freshmen with zero need (100,700 students). However, in 1979, 43% can still score at least 400 in verbal, but only 2.33% have zero financial need, and 1.77% have both zero financial need and score at least 400 which then represents 75% of the zero financial need segment (33,700 students)--a compositional increase or shift of 12%.

When jointly combining verbal score and need levels to study the changes in numbers in market segments, the influence of four factors become evident: (1) an increase in the relative percentile levels of students at various need levels illustrated in Figure IV-6; (2) the constant relative percentiles over time of students with various score levels;

(3) the growing number of total recruitable freshmen, and (4) the correlation between relative income and verbal scores. The results clearly show that segmenting by either verbal score or financial aid needed alone can be misleading. The rates at which the recruitable freshmen market is changing for a college depend completely upon the distribution of applications, acceptances and enrollments over all levels of aid and all levels of scores--once personal and institutional expenses have defined the financial aid needed segments.

Thus, between 1955 and 1979, the Ohio Wesleyan tuition policy decreases the number of recruitable freshmen with zero financial aid need from 24.6% of high school graduates to 2.33%--a decrease of 90%. However, the number of high school graduates approximately triples. Furthermore, if Ohio Wesleyan was interested only in students scoring at least 400 on the verbal test, then the upward compositional shift of 12% of the zero financial need students with at least 400 scores shows the magnitude of the decline may not be as serious as indicated in Figure IV-6. The relative income figures by themselves tend to exaggerate the rates of decline. The total market decline for zero financial aid students is from 159,000 in 1955 to 44,000 in 1979, or 72%. But for students scoring at least 400, the decline is from 100,700 to 33,700, or only 65%. The immediate conclusion is that the rate of decline in segment numbers varies with the score levels and with how high in the relative net family income distribution the tuition policy is segmenting students.

Not only have compositional changes occurred in verbal score proportions within financial aid need levels, changes have also occurred in financial aid need proportions within verbal score levels. For example, in 1955 the number of male zero financial need students with scores at

least 400 made up 35.8% of the total male recruitable students with scores at least 400. However, in 1979, male zero need students with scores at least 400 make up only 4.1% of the total male recruitable students with scores at least 400--a decrease of 88.5%.

Pushing the above example a little further shows a major conclusion of this study. The rates at which the numbers in Table IV-3 and Table IV-4 are changing within financial aid need categories are markedly different. However, these differences are exaggerated when looking at Figure IV-6. In a similar manner, if each particular need interval was chosen and the rates of change for various verbal score intervals were computed, these rates would also differ. The fact that the segments differ in rates of change necessitates segmentation as a manner of perceiving change in the entire number of recruitable freshmen. A college should not lump segments together because the rate at which a college's market changes depends upon the numbers of students with various levels of aid needed and their score levels within each of the aid categories. Using average score or any other one measure such as average need is quite deceptive. The distribution of students over all score levels within all financial aid needed levels must be considered to calculate the real changes in the size of recruitable freshmen. In other words, joint segmentation by financial aid needed level and verbal score level is necessary.

Table IV-6, Table IV-7 and Table IV-8 are designed to show how the rates of change in male recruitable freshmen differ for Ohio Wesleyan for three intervals of time; 1955-1979, 1963-1971, 1971-1979. All these rates reflect the particular Ohio Wesleyan values in Table IV-1.

These segment numbers combine all the market influences together. The tables show the percentage of change in the segment numbers during

the specified time intervals. The 1955-1979 table shows that a college with Ohio Wesleyan's fee structure which recruits from the highest scoring students is in the best position in terms of number decline. This table also shows the very difficult position a private college would be taking if it wanted to maintain lower scoring students who can afford their educational expenses.

Table IV-7 and Table IV-8 show that a college which recruits high scoring students is again in the best relative position in terms of market decline (assuming it was already recruiting high scoring students at the beginning of the time interval). However, the high scoring, zero financial aid need students are projected for an increasing decline in the next eight years. Since zero financial aid needed students are considered "bread and butter" students, these rapid future declines may be quite serious.

Overall, Tables IV-6 to IV-8 show that the rates of changes in market segments vary considerably. These differences make it necessary for a college to relate the portions of the student body coming from each segment in order to properly evaluate the future student body implications based on the estimated recruitable freshmen segment changes. Ohio Wesleyan's recent relationship between the recruitable market segments and the Ohio Wesleyan entering freshmen is the next step in this analysis.

TABLE IV-6

Percentage Rates of Change in Ohio Wesleyan's Male Recruitable Freshmen Segments: U.S. 1955-1979

Verbal Intervals	Financial Aid Intervals				
	0	0-500	500-1000	--	Total Verbal Interval
200-250	-87.9	-95.2	-98.8	--	294.4
250-300	-85.7	-91.3	-97.2	--	294.4
300-350	-83.1	-90.8	-95.4	--	294.4
350-400	-73.1	-86.6	-95.2	--	294.4
400-450	-74.6	-82.1	-90.8	--	294.4
450-500	-71.0	-77.4	-84.9	--	294.4
500-550	-67.2	-70.4	-82.5	--	294.4
550-600	-62.6	-62.1	-71.5	--	294.4
600-650	-57.0	-47.0	-55.0	--	294.4
650-800	-47.7	-14.6	-11.0	--	294.4
---	---	---	---		
Total Financial Aid Interval	-72.3	-80.4	-91.3		

TABLE IV-7

Percentage Rates of Change in Ohio Wesleyan's Male Recruitable Freshmen Segments: U.S. 1963-1971

Verbal Intervals	Financial Aid Intervals					
	0	0-500	500-1000	1000-15000	1500-2000	Total Verbal Interval
200-250	-55.8	-54.6	-81.9	-80.1	-84.7	60.8
250-300	-49.7	-63.1	-75.3	-71.3	-66.6	60.8
300-350	-45.2	-54.1	-77.1	-69.2	-56.9	60.8
350-400	-42.7	-13.1	-60.0	-68.2	-89.2	60.8
400-450	-37.1	-36.2	-63.0	-56.7	-55.5	60.8
450-500	-32.8	-31.7	-57.7	-54.3	-38.8	60.8
500-550	-28.5	-27.1	-51.9	-44.5	-42.8	60.8
550-600	-23.5	-21.6	-44.3	-35.9	-23.9	60.8
600-650	-17.8	-15.1	-35.0	-20.6	- 5.0	60.8
650-800	- 8.5	- 4.5	-18.4	-11.8	-29.9	60.8
---	---	---	---	---	---	
Total Financial Aid Interval	-33.0	-34.5	-62.6	-60.2	-62.4	

TABLE IV-8

Rates of Change in Ohio Wesleyan's Male
Recruitable Freshmen Segments: U.S. 1971-79

Verbal Intervals	Financial Aid Intervals								Total Verbal Interval
	0	0-500	500-1000	1000-1500	1500-2000	2000-2500	2500-3000	3000-3500	
200-250	-43.8	-67.4	-69.4	-41.1	-58.9	-85.5	-88.4	-80.8	23.7
250-300	-43.6	-61.9	-63.9	-34.8	-67.4	-79.4	-78.4	-65.2	23.7
300-350	-43.5	-57.5	-59.5	-30.1	-59.9	-83.1	-76.1	-51.7	23.7
350-400	-43.4	-55.5	-57.3	-24.3	52.2	-75.7	-89.5	-84.3	23.7
400-450	-43.3	-48.6	-50.6	-21.3	-38.3	-75.1	-73.3	-51.3	23.7
450-500	-43.2	-43.4	-45.3	-16.4	-33.2	-72.5	-73.0	-37.0	23.7
500-550	-43.1	-37.7	-39.5	-11.3	-27.9	-69.7	-65.6	-39.6	23.7
550-600	-43.1	-30.3	-32.0	- 4.9	-21.5	-66.2	-62.7	-23.2	23.7
600-650	-43.0	-20.9	-22.4	2.7	-13.8	-62.1	-56.3	- 6.6	23.7
650-800	-42.9	- 2.3	- 3.4	16.4	- 1.2	-55.2	-45.3	23.1	23.4
---	---								
Total Financial Aid Interval	-43.3	-43.3	-45.3	-18.3	-37.2	-75.4	-76.6	- 7.2	

Ohio Wesleyan's Relationship to the Recruitable Freshmen Segments

Conceptually, segmentation can be thought of in terms of a network. Segmentation partitions the flow of one major arc (all high school graduates) into many smaller arcs defined by three dimensions. Each segment or cell would be exactly one of the smaller arcs. The last section showed how the rate of flow of students through each arc varies considerably so each arc should be considered separately and the rate of flow of all students is the sum of the weighted rates of all the arcs.

From each cell, Ohio Wesleyan must identify the students who apply, who are accepted and offered aid, and those who enroll. This identification process further partitions each segment or arc into smaller arcs.

If an applicant does not submit a request for aid, the applicant is assumed to have zero need. An applicant is also classified as zero need if there was an aid request but no need was found. In all other cases, need is computed as positive and the $500 interval of aid specified. Similarly, verbal score uniquely identifies a student to a score interval, unless it is missing (the last verbal interval is "unknown"). Sex is always identified on the application. Hence, each application is uniquely identified as coming from one cell. The model in Chapter III gives the estimated national numbers in these cells and how these numbers are changing. It remains to define an historical relationship between cell numbers and applicants, acceptances, aid offers, and enrollments.

In describing the Ohio Wesleyan relationship to the recruitable freshmen each year, there is a flow from each recruitable freshmen cell directly to Ohio Wesleyan composed of those students who apply. The exact cell or arc is determined by sex, computer financial aid need, and verbal

score. Once the flows of applications are determined, then a subset is accepted and offered various combined aid packages of scholarship, loan, and part-time work funds. Finally, enrollments flow from accepted applicants who were given aid offers, and accepted applicants who were not given aid offers; 90% of the time, aid offers exactly cover financial aid need.

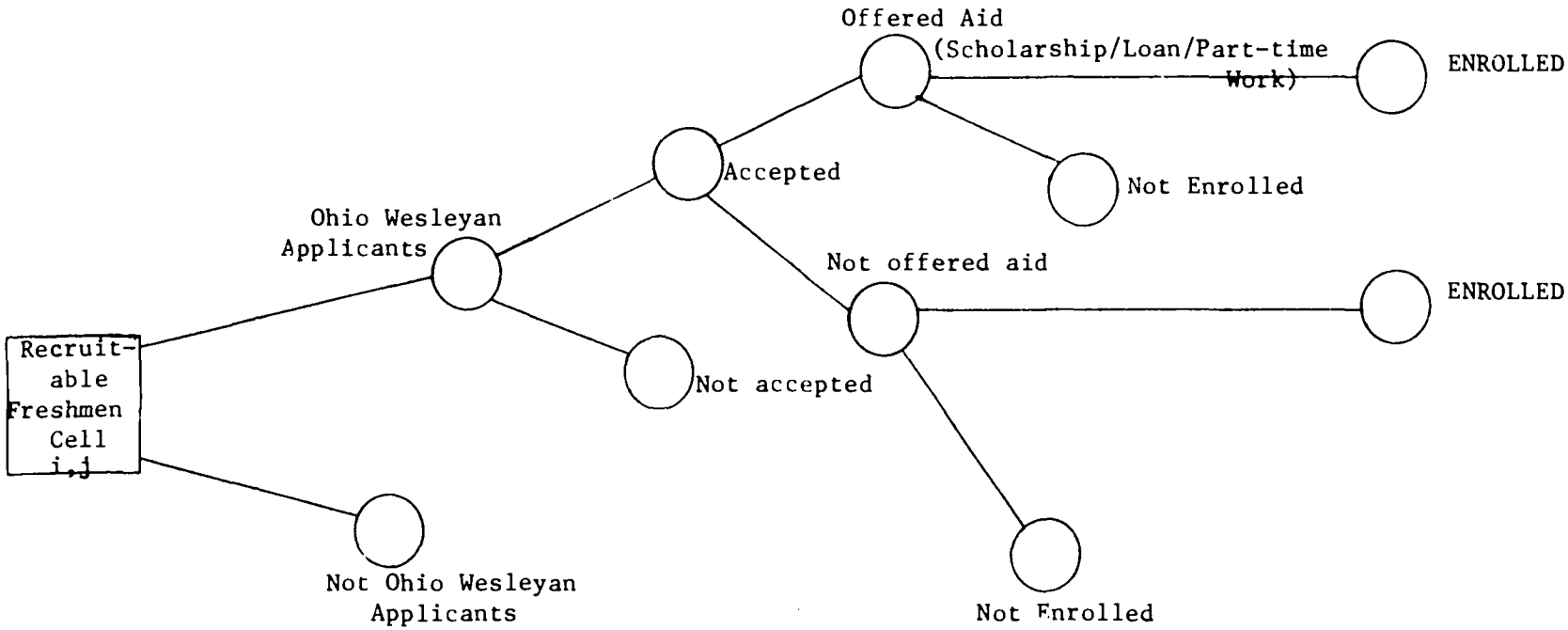
Of the enrolling students who were offered aid, approximately 93% of the aid offered is accepted by the students. The applicants who receive no offer but who were accepted and enroll are assumed to somehow obtain additional resources so their willingness to attend level is higher than the estimated CSS ability to pay level. Figure IV-7 shows how these arcs flow from each recruitable freshmen cell to Ohio Wesleyan.

Demand analysis is particularly complicated in admissions due to the multitude of environmental factors and the combinations of financial aid offers of scholarship, loan, and part-time work funds. To compute the historical trend of the recruitable freshmen - Ohio Wesleyan relationship, the base year of 1971 was chosen because it is the most relevant in terms of what total financial funds are expected to be available and what types of financial aid offer packages will be made.

The year 1969 was chosen as the second point in time to seek an historical trend. The year 1970 was not chosen because it was considered not characteristic of the Ohio Wesleyan admissions history. Briefly, in 1970, acceptance notices were mailed just before the time that state college and university campus disturbances concerning the Cambodian invasion were widely publicized. After the disturbances, an extraordinarily high proportion of accepted students enrolled at Ohio Wesleyan.

The financial need intervals in common between 1969 and 1971 range

FIGURE IV-7


Offered Aid
(Scholarship/Loan/Part-time Work)
ENROLLED
Accepted
Not Enrolled
Ohio Wesleyan Applicants
Not offered aid
ENROLLED
Recruit-able Freshmen Cell i,j
Not accepted
Not Ohio Wesleyan Applicants
Not Enrolled

from $0 to $3,500. In defining an historical trend, the following procedure was used: Let A_{ij}^{t} be the market share in segment (i,j) at time t --the proportion of the number of students enrolling at Ohio Wesleyan is of the total recruitable freshmen in that segmentation cell. A_{ij}^{1969} and A_{ij}^{1971}, i=1...8, j=1,...,11 are known. In addition, each cell has averages for financial need, verbal score, scholarship, loans, and part-time work funds. The historical trend will capture the change in recruitability for each cell as the fee structure increases relative income levels for students able to enter at different levels of financial need. Let r_i^t be the relative net family income level associated with financial need level i at time t. Figure IV-6 is a graph of the male r_i^t. Then the relative net family income interval associated with level i at t is $r_{i+1}^t - r_i^t$.

As the interval sizes change, so may the recruitability for Ohio Wesleyan. Thus, let

$$f_{ij} = \frac{A_{ij}^{1971} - A_{ij}^{1969}}{\left(r_{i+1}^{1971} - r_i^{1971}\right) - \left(r_{i+1}^{1969} - r_i^{1969}\right)} = \frac{\Delta \text{ market share } (i,j)}{\Delta \text{ relative income interval } i} \qquad \text{IV-1}$$

be the rate of change in the historical market share of Ohio Wesleyan as the fee structure in Table IV-1 reduces the relative net family income intervals associated with various financial need intervals.

Finally, for t > 1971, let the following equation estimate the market share based on the 1969-1971 historical trend:

$$A_{ij}^{t} = A_{ij}^{1971} + f_{ij}\left[\left(r_{i+1}^{t} - r_i^{t}\right) - \left(r_{i+1}^{1971} - r_i^{1971}\right)\right] \qquad \text{IV-2}$$

$$i=1...8$$

$$j=1...11$$

To obtain the enrolling number of students in a cell, the market share is multiplied by the total number of recruitable freshmen in that cell. To obtain the distributions of financial aid need and verbal scores, the means for aid accepted and verbal values of each cell in 1971 are assumed to be representative in subsequent years.

As an example, examine the cell of zero financial need female students with scores between 500 and 550. The percent of students enrolled from this cell in 1969 and 1971 was 79 and 78 respectively. But the relative net family income interval decreased 2.88 from 7.35 to 5.07 at the same time the market share increased from .46% to .62% of the national recruitable freshmen. Thus, the rate of change of market share between 1969 and 1971 is f_{ij}=-.0006. This figure means that as the Ohio Wesleyan fee policy decreases the relative net family income interval for zero financial aid need students, then the market share will increase .06% for every 1% smaller relative income interval.

Another way to interpret this example is to examine the market share as the recruitment or attractiveness efficiency in each cell. The efficiency increased from .46% to .62%, a 34.8% increase in two years. However, although efficiency increased, the recruitable freshmen numbers in the cell decreased due to the fees from 12,200 students to 9,300 students, a 23.8% decline resulting in the enrollments of 79 and 78 new freshmen in the particular cell.

Thus, equation IV-2 gives an historical trend based on the years 1969-1971. This trend shows how the change in enrollments from recruitable freshmen cells is related to the pricing structure effects on relative net family income levels.

Trends in New Freshmen

A model has now been completed which integrates the recruitable freshmen segmentation cells with Ohio Wesleyan's attractiveness to students. The result is a new admission planning tool with which to evaluate the expectations about new freshmen for the admissions planner.

In the 1969-1971 period, all the relative net family income intervals associated with each financial aid need level decreased in size. This shrinking of relative net family income intervals continues through 1980 as shown in Figure IV-6. The ability of Ohio Wesleyan to attract new freshmen shifted somewhat during the 1969-1971 period; male enrollments decreased 9.5% while female enrollments grew 3.1%. Both male and female students' verbal score distributions shifted downward; and increased numbers of high level financial aid students enrolled, particularly in the $3,000-3,500 level of financial aid female students.

Appendix C gives the enrolling numbers at Ohio Wesleyan from each of the recruitable freshmen segmentation cells in 1969 and 1971. These enrolling numbers embody the different rates of change in each of the segments in Table IV-6 in order to determine how the actual recruitable freshmen market shares are changing (equation IV-2).

The results show what may happen if the 1969-1971 trend is continued as the fee structure in Table IV-1 shifts relative income levels higher and higher. In general, the 1969-1971 trends continue at the post-1971 recruitable freshmen segment rates of change (Table IV-8). Of course, these post-1971 recruitable freshmen segment rates reflect the estimated Ohio Wesleyan fee policy and the high school graduate environment.

Figure IV-8 and Figure IV-9 show how the 1971 verbal score distribution

will continue to shift downward. These figures combine the different rates of change in the Ohio Wesleyan attractiveness in each verbal score interval. The rate of the downward shift is not as great overall as the 1969-1971 period. However, there is reason to consider that these shifts may be conservative as will be discussed shortly. Figure IV-10shows the decline in the male, female, and total verbal score means for the new freshmen.

Enrollments are also estimated to decline, but it is male students who are indicated to decline most dramatically. Figure IV-11 shows the male, female, and total enrollments. It is not until 1976 that a great departure from 1971 numbers occurs.

There are also distinctive shifts in the distribution of students by financial need level. These shifts are shown in Figures IV-12 and IV-13, where 15.6% more women than men enter with zero financial aid and in general have higher verbal scores. Both male and female financially aided students are distributed almost evenly at all levels of aid with a slightly higher proportion entering from the highest need levels. Both distributions shift only slightly toward the lower amounts of aid students by 1979.

The three types of financial aid offered are graphed in Figure IV-14 for male and female students. This figure shows how male students enroll with more scholarship funds and less loans and part-time work. Also, more aid students are male than female. The reason all the funds decline in general is because the fee structure pushes the financial aid levels into smaller and smaller relative income intervals.

Table IV-9 and Table IV-10 show the rates of change expected in the various segments for Ohio Wesleyan and the rates of change in Ohio Wesleyan

FIGURE IV-8: MALE VERBAL SCORE DISTRIBUTIONS: OHIO WESLEYAN, 1971-1979

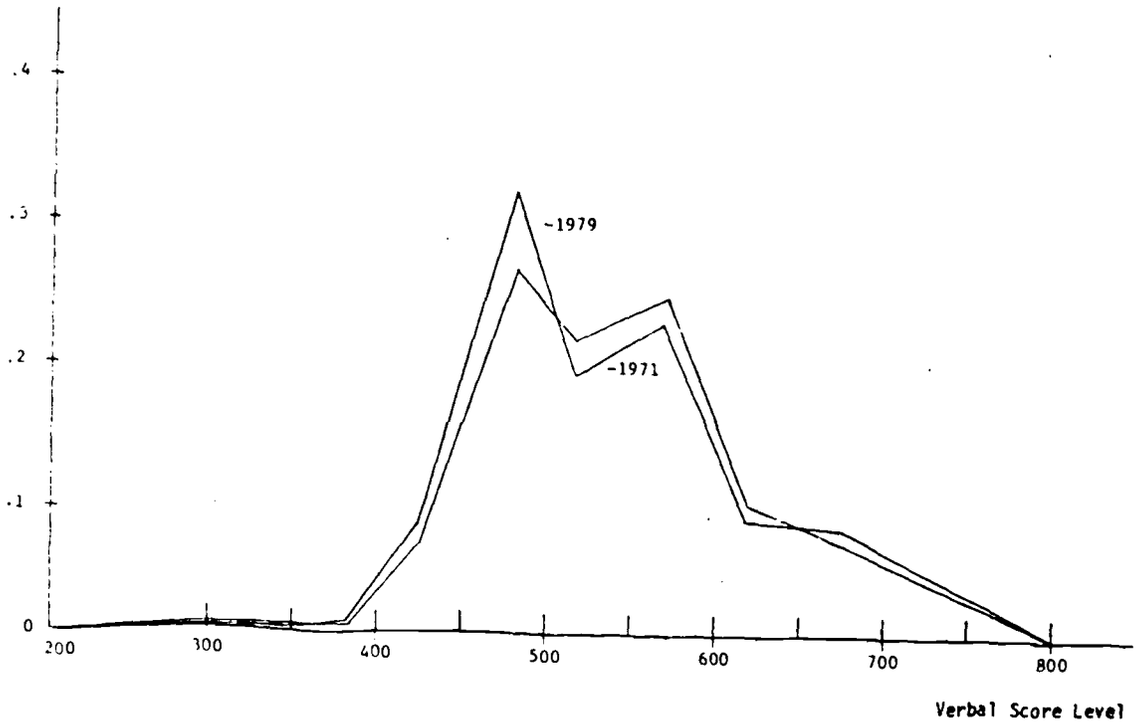


FIGURE IV-9: FEMALE VERBAL SCORE DISTRIBUTIONS: OHIO WESLEYAN, 1971-1979

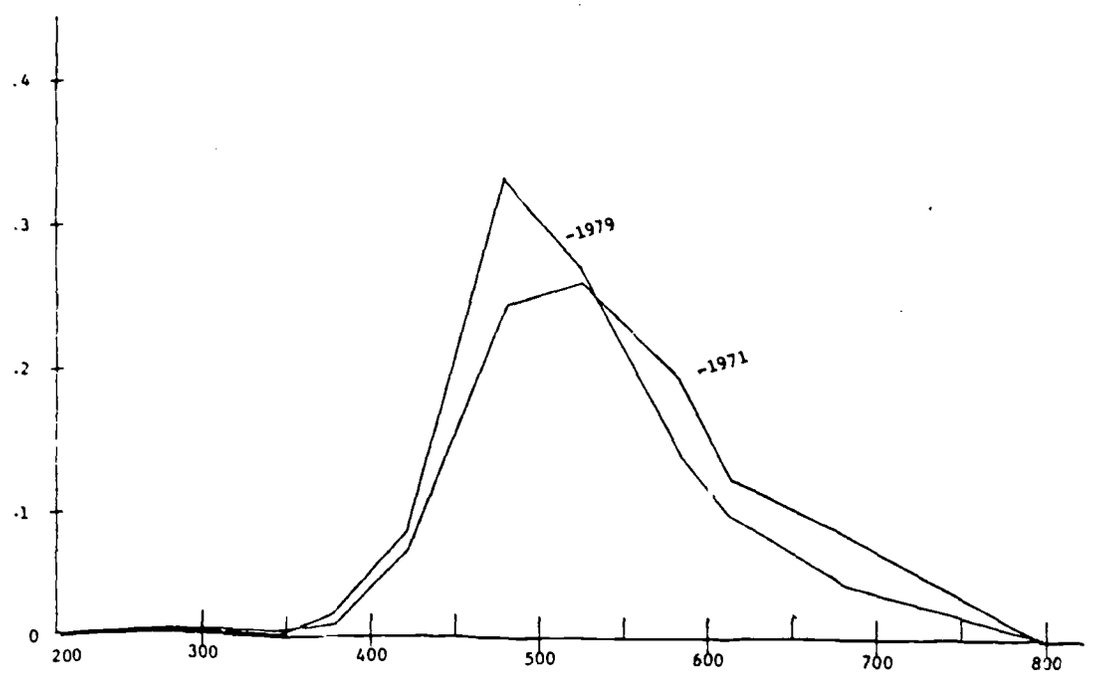


FIGURE IV-10: FRESHMEN CLASS VERBAL APTITUDE SCORE MEANS: OHIO WESLEYAN, 1971-1979

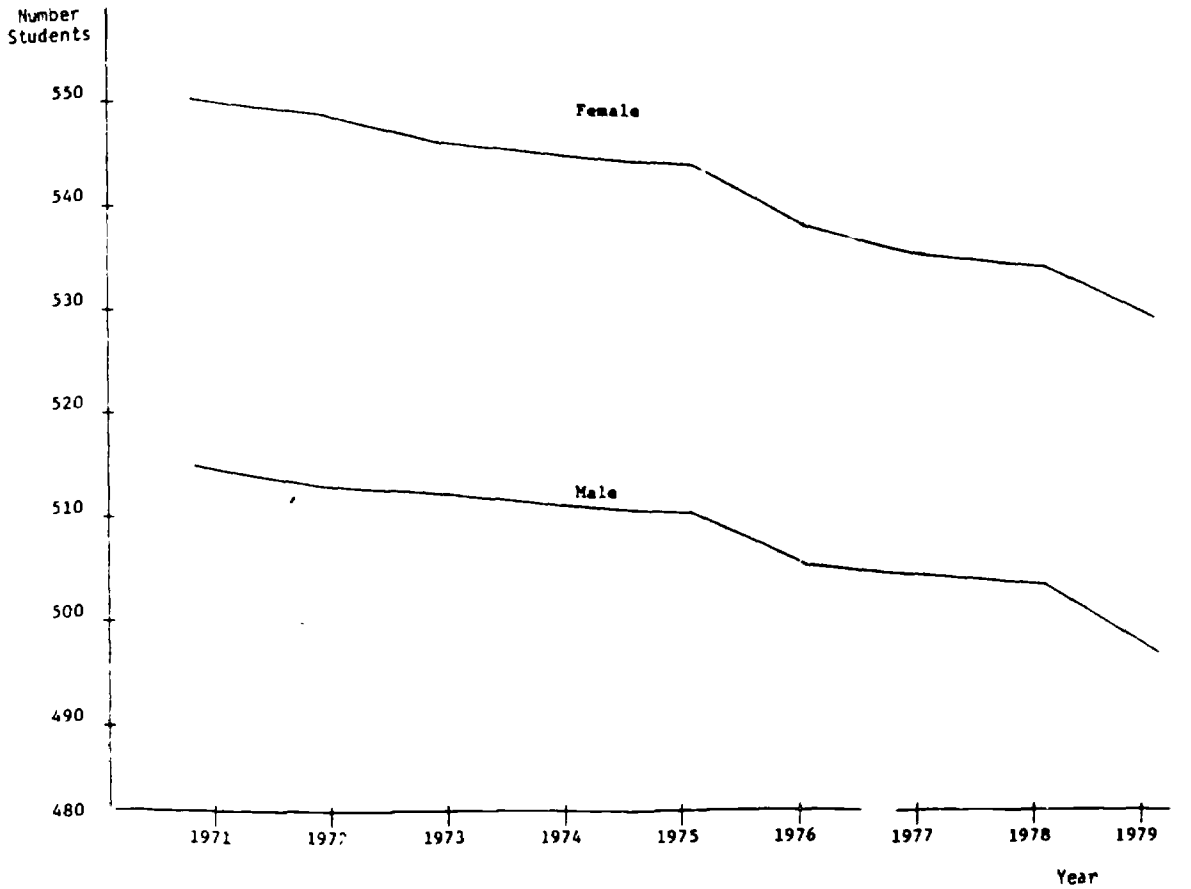


FIGURE IV-11: NEW FRESHMEN CLASS ENROLLMENTS: OHIO WESLEYAN, 1969-1971

FIGURE IV-12: MALE FINANCIAL AID DISTRIBUTION: OHIO WESLEYAN, 1971-1979

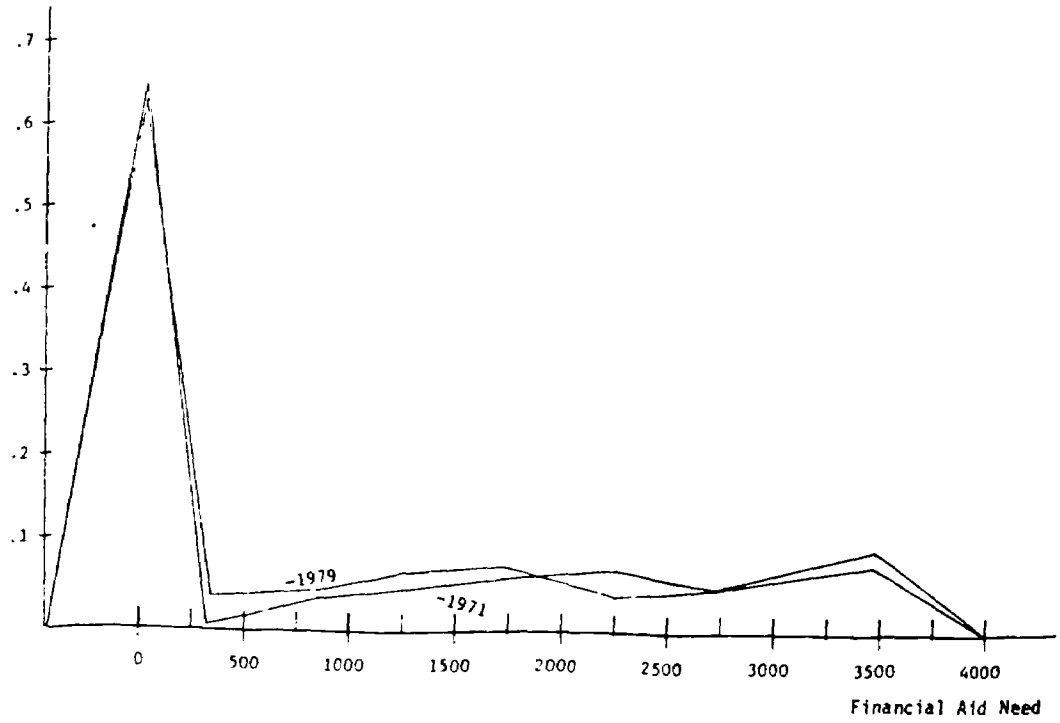


FIGURE IV-13: FEMALE FINANCIAL AID DISTRIBUTION: OHIO WESLEYAN, 1971-1979

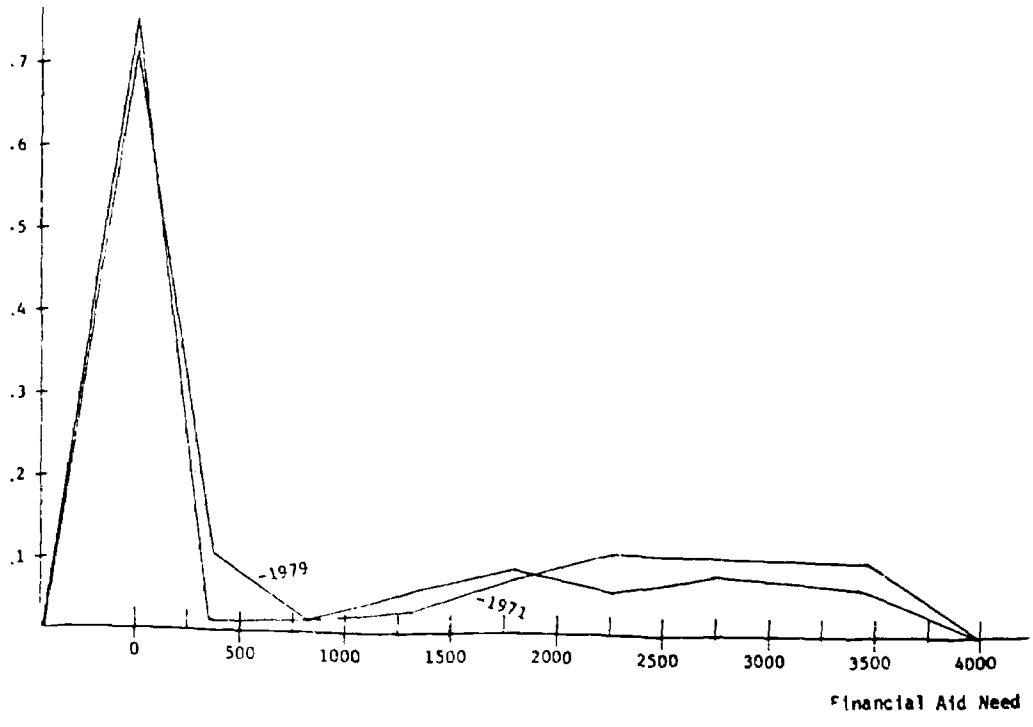
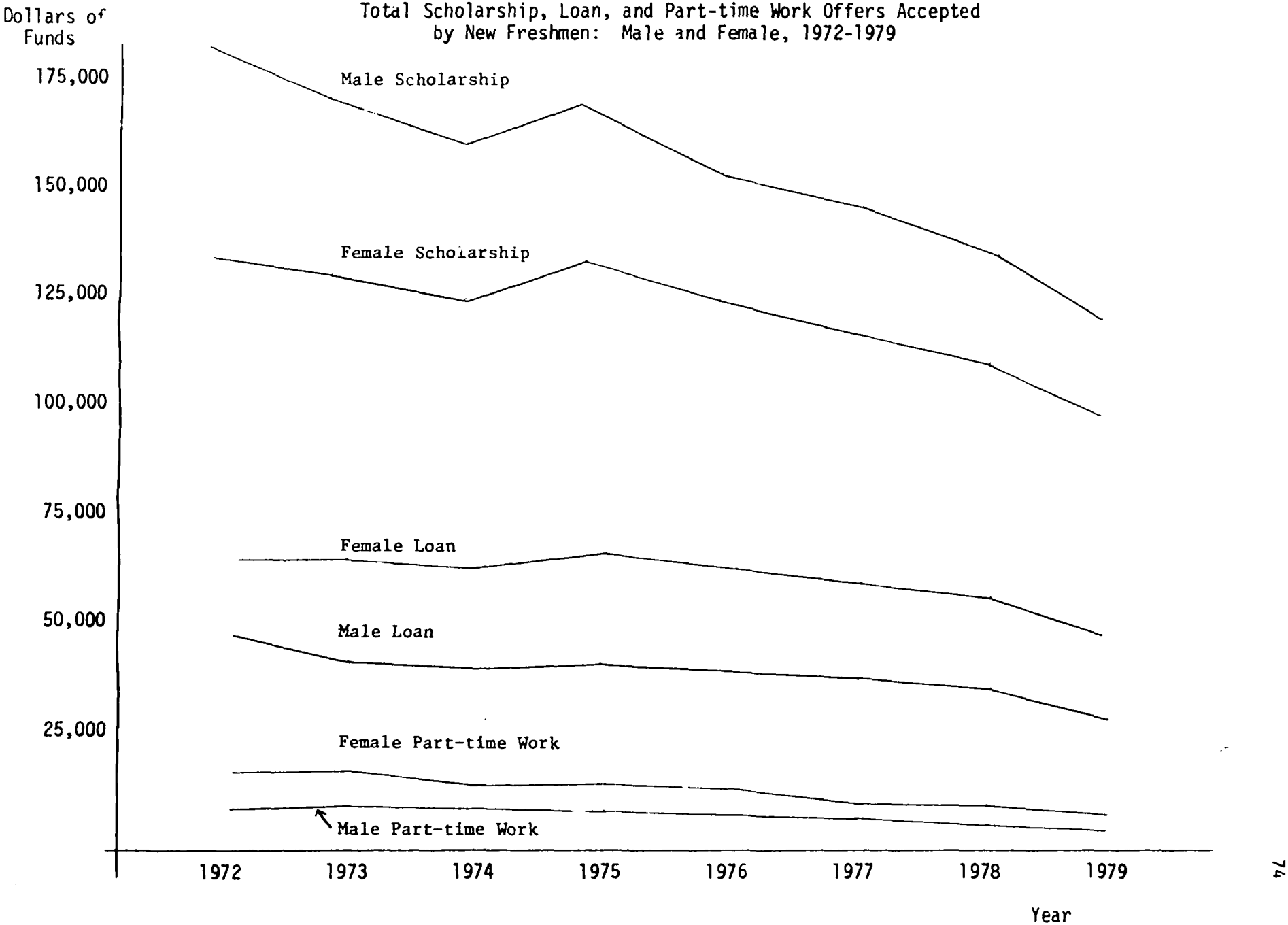


FIGURE IV-14

Total Scholarship, Loan, and Part-time Work Offers Accepted by New Freshmen: Male and Female, 1972-1979



market shares. Even though the market share is increasing, the fee structure is decreasing the sizes of the segments (see Tables IV-6 through IV-8), so enrollments in general still decline. Tables IV-11 and IV-12 present the same information for female students.

Tables IV-9 and IV-11 are the primary informational outputs of this analysis. These tables were used in deriving the other figures of this section. It is important to note that the actual estimated changes in enrollments Ohio Wesleyan can expect based on the 1969-1971 trend integrates (1) the recruitable freshmen segment changes from environmental factors and the Ohio Wesleyan fee structure (Table IV-8), and (2) the estimated change in recruitability performance based on the 1969-1971 trend (Tables IV-10 and IV-12). Both the numbers in recruitable freshmen segments and Ohio Wesleyan's recruitability performance vary from segment to segment. Variations in either factor would necessitate segmentation in planning analysis. Since both factors vary, segmentation becomes even more important.

The first insight obtained from the model is that Ohio Wesleyan is facing a serious admissions problem if verbal distribution downward shifts are to be halted, even more serious if the downward shifts are to be reversed. This problem arises from the fact that acceptances have been as high as 83% of applications in recent years so there is little excess demand available to exploit with desired attributes. Enrollments and verbal distributions are on the decline. However, there remain some financial aid funds to be re-allocated.

The most striking insight presented in the results is the willingness of the institution to maintain a 1:1 male/female ratio. If both financial aid funds and verbal scores are highly valued, then keeping the male/female

TABLE IV-9

Percentage Change in Male Enrollments Between 1971 and 1979
Based on 1969-1971 Trend: Ohio Wesleyan

Score Level	Financial Aid Intervals							
	0	0-500	500-1000	1000-1500	1500-2000	2000-2500	2500-3000	3000-3500
200-250	--	--	--	--	--	--	--	--
250-300	--	--	--	--	--	--	--	--
300-350	--	--	--	--	--	--	--	- 50.0
350-400	0	--	--	--	--	--	--	-100.0
400-450	-16.7	--	--	--	0	-100.0	- 50.0	-100.0
450-500	-21.8	--	--	0	- 50.0	- 28.6	- 66.7	- 75.0
500-550	-56.8	200.0	-100.0	0	- 25.0	- 60.0	-100.0	- 50.0
550-600	-43.5	--	--	0	- 14.3	- 71.4	- 42.9	- 60.0
600-650	-55.6	--	0	--	--	-100.0	0	0
650-800	-38.5	--	0	50.0	-100.0	-100.0	0	--
Unknown	0	200.0	--	0	0	--	--	-100.0

TABLE IV-10

Percentage Change in Male Market Shares Between 1971 and 1979
Based on 1969-1971 Trend: Ohio Wesleyan

Score Level	Financial Aid Intervals							
	0	0-500	500-1000	1000-1500	1500-2000	2000-2500	2500-3000	3000-3500
200-250	--	--	--	--	--	--	--	--
250-300	--	--	--	--	--	--	--	--
300-350	--	--	--	--	--	--	--	79.9
350-400	34.6	--	--	--	--	--	--	-100.0
400-450	41.7	--	--	--	- 16.2	-100.0	111.0	-100.0
450-500	37.2	--	--	- 2.9	- 42.1	147.9	29.2	18.9
500-550	-23.4	397.1	-100.0	-22.3	18.9	1.0	-100.0	31.9
550-600	- .8	--	--	- 7.3	16.0	3.5	47.8	22.5
600-650	-24.0	--	57.1	--	--	-100.0	111.0	111.0
650-800	4.8	--	10.9	18.9	-100.0	-100.0	37.5	--
Unknown	50.8	397.1	--	29.8	63.6	--	--	111.0

TABLE IV-11

Percentage Change in Female Enrollments Between 1971 and 1979
Based on 1969-1971 Trend: Ohio Wesleyan

Score Level	Financial Aid Intervals							
	0	0-500	500-1000	1000-1500	1500-2000	2000-2500	2500-3000	3000-3500
200-250	--	--	--	--	--	--	--	--
250-300	--	--	--	--	--	--	--	--
300-350	--	--	--	--	--	--	--	- 50.0
350-400	-100.0	--	--	0	--	- 50.0	--	--
400-450	- 4.5	--	0	--	--	--	-100.0	-100.0
450-500	- 4.0	100.0	0	0	0	- 50.0	-100.0	- 57.1
500-550	- 34.6	--	- 50.0	0	0	16.7	- 50.0	0
550-600	- 58.5	200.0	-100.0	0	0	-100.0	-100.0	- 40.0
600-650	- 51.4	--	0	0	-50.0	-100.0	0	- 28.6
650-800	- 73.7	--	0	0	-50.0	-100.0	- 50.0	0
Unknown	0	--	--	--	0	--	--	-100.0

TABLE IV-12

Percentage Change in Female Market Shares Between 1971 and 1979
Based on 1969-1971 Trend: Ohio Wesleyan

Score Level	Financial Aid Intervals							
	0	0-500	500-1000	1000-1500	1500-2000	2000-2500	2500-3000	3000-3500
200-250	--	--	--	--	--	--	--	--
250-300	--	--	--	--	--	--	--	--
300-350	--	--	--	--	--	--	--	49.2
350-400	-100.0	--	--	50.3	--	207.0	--	--
400-450	85.7	--	93.6	--	--	--	-100.0	-100.0
450-500	85.8	260.0	61.1	50.3	32.1	121.6	-100.0	83.1
500-550	27.8	--	- 9.0	37.1	27.5	207.0	45.9	95.6
550-600	- 18.1	260.0	-100.0	15.6	8.1	-100.0	-100.0	95.6
600-650	- 4.6	--	17.5	-22.5	-45.8	-100.0	95.6	95.6
650-800	- 48.0	--	10.6	- 8.5	-40.8	-100.0	38.3	95.6
Unknown	109.8	--	--	--	19.1	--	--	95.6

ratio equal to one is even a more valuable goal. Female students require less financial aid and are above the male score distribution with verbal scores. Thus, the additional or marginal recruitment cost must be much less for female students. Yet for years the institution has recruited vigorously to maintain the sex ratio--incurring higher recruitment costs, consuming more financial aid scholarship funds, and meeting lower verbal score standards. The 1:1 male/female ratio goal is very important to this institution, and it is reasonable to assume this goal will be pursued with even more difficulty during the next decade. A similar goal is that of minority recruitment where low verbal scores occur and high aid allocations are required; however, the explicit minority effects to financial aid funds and verbal distributions are an extension of this study.

Another institutional insight for Ohio Wesleyan is the even distribution of financial aid students at all levels of need. During the past several years, Ohio Wesleyan has successfully maintained a good proportion of students, 64.8% for male and 74.9% for female, entering with zero financial aid. However, very few students apply for the lower levels of financial need (see Figure IV-11 and Figure IV-12). As the higher relative income levels are "priced out" by the fee structure, very few students still apply for the lower levels of financial need. Thus, as Ohio Wesleyan cuts off students who can apply with zero aid, the students cut off do not simply shift down and apply under the lower levels of financial aid. This lack of applications suggests that the recruitment policy may encourage a "pay total expenses or don't apply" policy to these recruitable freshmen who have been priced out by the fee structure. But these low financial aid students offer vast opportunities for the institution. For instance, if instead of an even distribution of financial aid students

over all levels of need, the enrolling students were the lower financial aid level students who shifted down, then the net revenue implications are obviously beneficial.

Lastly, there are reasons to believe that the downward shifts in verbal scores and the amounts of financial aid funds required are conservative. These scores and funds may be reasonable for the enrollments presented. However, the downward decline in enrollments and upward climb in tuition structure means that the excess demand of students to be admitted to fill enrollment targets will be of the lower score and higher financial need students. Thus, if targets are attempted to be met under the present application trends, then both the verbal score declines and financial aid funds would be conservative estimates.

This section so far has shown how the integrated model derives what may be the future based on past experience. In other words, the information in this section has shown an educated guess as to what is ahead in admissions for Ohio Wesleyan based on the future fee structure estimates of the admissions planner in Table IV-1. If the amounts of financial aid expended, or the continued downward trend of verbal distributions, or unequal male/female ratio, or other results differ from the expectations of the admissions planner, then other circumstances not explicitly identified in the model or the assumptions of the model must be questioned to understand what will occur. The next section identifies many important factors the model does not attempt to explain.

In making the model more operationally valuable, it will be seen how important tradeoffs can partially be evaluated through use of the model results. For example, the admissions planner may ask how to halt the downward trend in male verbal scores. Since the increased market efficiencies

are known for each cell segment, and the verbal averages and financial aid funds averages are known for each segment, and the rate of growth of each segment is known, then depending upon precisely which cell segment enrollments are to be increased or decreased in order to halt the verbal decline, the verbal score influence, the financial aid funds influence (and hence revenue), and the enrollment influence are straightforward derivations of the model.

In 1972, the downward shift in scores can be halted by two more students from the 650-800 interval, or three more students from the 600-650 interval, or four more students from the 550-600 score interval. Thus, the exact market share increases required to halt the score decline are directly obtainable depending upon which levels of financial aid the new students come from. Then the required increased efficiency of recruitment is known and the increased financial aid funds required results.

A similar tradeoff occurs when asking the ways the male mean verbal score could be increased to the female mean verbal score. Other tradeoffs include giving additional dormitory spaces to various levels of financial aid students versus leaving vacancies, and equating male and female total enrollments versus financial aid funds and verbal scores. Many other tradeoffs are important and each private college may choose its most relevant tradeoffs.

This study does not intend to crank out the numbers in a thorough analysis for every possible tradeoff. But this study does show how the model is applicable in addition to what might be expected if the past repeats itself. The information in the model provides the framework to pursue these important tradeoffs which, for the various goals, shows how much more efficient recruitment must be, and how much more financial aid

funds would be required, and where the obvious admissions opportunities lie. Ohio Wesleyan must decide how to allocate the funds estimated to be available for financial aid which are not required to generate the enrollments given in this section.

The major constraints to the further application of the model are: (1) the marginal efficiencies of recruitment for each segment, and (2) the progress at the institution for each segment type student. For instance, knowing that doubling the market share efficiency of 600-800 students would increase the verbal average 50 points doesn't become operationally meaningful until an approximate difficulty of increasing that recruiting efficiency 100% is also known. Also certain zero aid students may transfer away from the college quickly, a flunk out. These facts have important implications to the recruiting goals. Thus, the next step in this research is to integrate the model further with the operational recruitment returns and institutional progress of students—both areas identifying students by the segmentation cells.

In summary, this section has shown the results of the future trends for Ohio Wesleyan based on the 1969-1971 admissions experience. Interpreting the results does not tell where to recruit and how much it will cost or who to give an additional $500 of aid. However, it provides information by which the admissions planner sees the future implications of the fee policy based on past experience and shows the future difficulty of pursuing many different goals which were unable to be adequately evaluated without the model. Tradeoffs between other enrollment targets and score distributions, or tradeoffs between revenue and enrollment are increasingly understood with the information provided. In addition, the model provides new insight into the market dynamics of the growth of high

school graduates, the ability to pay college expenses. the score distributions, and the fee structure segmentation implications for the institution. In short, this modeling device has become a first approximation for unified college admissions planning.

V. CONCLUSIONS

In summary, this recruitable freshmen segmentation model provides a description of potentially recruitable freshmen which explicitly interrelates such important factors as growth of population, high school retention rates, parental ability to pay college expenses, growth in parental income, and verbal aptitude. Many questions remain unanswered; a more careful analysis of the CSS curves is needed and further study must be done to relate willingness to pay with ability to pay. An additional dimension of the distance the student lives from the private college would allow for more specific recruitment techniques to be included in the model and would include travelling expenses as a part of financial need consideration. Furthermore, more appropriate and directly measurable student behavioral attributes are certainly needed.

One conclusion of this research is that there is a great need for further research into the decisions of high school seniors when they are confronted with alternative routes of access to higher education. Not only must the parameters of these decisions be much more explicitly defined, but the effect recruitment techniques have on these decisions must also be understood for students with different attributes. Also student attributes must be more specifically related to well articulated objectives of colleges.

This study has shown the complicated nature of admission planning phenomena. It is quite instructive to review the sequence of research steps in this work. Each of these research steps simultaneously revealed uncertainties in our information and yet provided a tentative basis for

furthering our understanding.

The first research step looked at total high school graduates and attempted to estimate the income distribution of their parents. Because inadequate information was available, the first assumption made was that the parental income distribution of high school graduates was the same as the income distribution of all U.S. males between ages 35-65. It is this age group which was assumed most likely to have high school age children. In addition, Doermann's admissions work also used this assumption and estimated the income growth.

However, there are several problems with this assumption. It ignores (1) the relationship between income level and number of children and (2) the relationship between children of various family income levels and the dropout rate before high school graduation.

The purpose of including the parental income distribution was to estimate numbers of high school graduates willing to pay different levels of total higher educational expenses. Other research has indicated that variation in willingness to pay is explained mainly by socio-economic background. However, very little information is available about how these characteristics of high school graduates are changing.

Additional income estimates were made by assuming that if all high school graduate age children were in school, then the income population of the families is the same as U.S. males ages 35-54. This ignores socio-economic background, different family sizes as related to income level, different mortality rates as related to income level, and different ages of children at time of graduation as related to income. Next, the different dropout rates relationship was estimated as related to relative income level.

The new income estimates which took into account a general increase in overall graduation retention showed the retention of low income students growing much faster than for high income students.

The next research step was to estimate the number of high school graduates willing to pay different higher education expense levels from the number of high school graduates with different income levels. Doermann used a fixed relationship between 195[illegible]-1975. However, this was shown to understate the graduates in the early years and overstate in the later years. This study estimated how the "ability to pay" from CSS was changing from year to year. The approximation is much closer to the current year willingness to pay, yet the dynamics of deeper socio-economic background still must be studied. Finally, two additional dimensions were included: sex, and aptitude. The SAT verbal test score was used as a proxy for aptitude.

The recruitable freshmen segmentation shows the importance of studying high school graduates in the three dimensional segmentation manner. First, the national numbers of students classified by various characteristics were shown to be changing at very different rates. Secondly, the market shares in segments for a private college, Ohio Wesleyan University in our example, were also shown to be changing at very different rates. Thus, the model is quite useful in understanding how the characteristics of available students are changing and in providing insight into the consequences of alternative future admissions policies. Yet these dimensions still fall short of the objective of describing recruitable freshmen by willingness to pay and other valued attributes.

This model shows the great difficulty a private (or public) college faces in increasing access to lower income students. Many questions are

still unexplored. For example, what subsidy would be required to make the income distribution of the new freshmen in the private college the same as the income distribution of all U.S. high school graduates? The model can be used to show the elitist policies which private higher education must pursue, without subsidies from outside sources, for their own fiscal viability. Furthermore, the effects of the widening gap between parental ability to pay and private college costs can be evaluated. The subsidy cost of allowing private colleges to pursue other social values can also begin to be studied.

Finally, this study provides a versatile tool for the college administrator. It represents an on-line model which is easily revised and is integrated into the college information systems for planning purposes. The model can evaluate tradeoffs between alternative goals and include new recruitment policies and intuitively judged environmental changes. Moreover, its on-line use by administrators may be the greatest value by providing a unified framework to think about, analyze, and understand the consequences of various admission planning policy variables. For these reasons, a new type of admissions planning can now emerge; this new type of admissions planning would be a major step forward.

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