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ABSTRACT

Accountability in higher education most often concentrates on what and how to measure performance, but less often on how it can be used for planning, managing, and teaching. Besides serving higher education's consumers, accountability measures should also serve those who plan and manage institutions, especially those engaged in managing enrollments. Since enrollment is jointly determined by internal and external factors, the use of forecasting and simulation models can help managers determine alternative future scenarios. A three-phase model has been developed that incorporates such performance measures as enrollment forecasting and retention. In the first phase of the model, the past 25 years of a college's enrollment is "explained" in terms of internal policies related to fees and financial aid; demand-related variables, such as community demographics and economics; and supply-related variables, such as college budget, staffing, and curriculum. In the second phase, the variables used to explain enrollment are modified to forecast future enrollments, while in the third the forecast model is linked to a simulation model that uses performance measures related to enrollment management to determine the effect of specific changes. Contains 10 references. Fifteen tables showing outcomes from an implementation of the model at Arizona's Maricopa County Community College District are attached. (HAA)

AIR 37TH ANNUAL FORUM

PERFORMANCE-BASED ENROLLMENT MANAGEMENT

Contributed Paper Presented by

Chuck McIntyre

Director of Research

Chancellor's Office, California Community Colleges

and

Director, Computer-Aided Planning (CAP)

at

37th ANNUAL AIR FORUM

Orlando, Florida

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Disney Contemporary Resort Hotel

CAP

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ABSTRACT

Accountability in higher education most often concentrates on what and how to measure performance, but less often on how it can be used for planning, managing, and teaching. This paper suggests that besides serving higher education's consumers, accountability measures also should serve those who plan and manage institutions: in this case, manage enrollments. Enrollment management is improved by use of a forecasting and simulation model in which "performance" measures - enrollment forecasting, enrollment management, and retention - play a major role. This work should be of interest to those who plan and manage higher education institutions, and to researchers and those conducting accountability efforts.

INTRODUCTION

Much of the discussion around higher education (HE) accountability during the past decade seems to have begun with indicators and what they were supposed to measure. Only at the very end of these discussions does the use for the indicators become apparent, if it does at all. Of course, there are exceptions to this, including Ewell (1989) who cited the need to tie assessment (as accountability was then called) of student performance to improvements in teaching and institutional managment and, more recently, Gaither (1996) who argues that planning and assessment (accountability) "...should be partners."

Accountability in the private sector is accomplished for consumers by the market place. Accountability for HE, however, since it is a mixed public and private good with substantial collective benefits, most often involves large information gathering and measurement projects for HE's consumers or outside

constituents: for prospective students and their parents, and for taxpayers and their representatives (legislators and elected trustees). More emphasis should be put on using "accountability" as a tool to help trustees and their staff to plan, make policy decisions, manage their institution, and teach their classes, thereby improving student learning and justifying to a greater extent the students' and taxpayers' considerable investment in HE. One way to do this properly is to specify the specific planning, management, and teaching objective(s), then work one's way back through the information, particularly about institutional and student performance - the "accountability measures" - that are needed to help achieve the objective(s). One of the most difficult of such objectives is that of institutional *enrollment management.*

PURPOSE

This paper examines the enrollment issues and management problems (Chart 1) facing institutions of HE. The work begins by looking at how enrollments are determined . Much prior work of this kind relies on enrollment demand; see, for example, Brinkman and Leslie (1987) and McIntyre (1995). Brinkman and McIntyre (forthcoming 1997) argue that enrollment is jointly determined by both demand and supply; that is, by factors that are outside the institution's control, together with factors (policies, practices and results) largely within the institution's control. Sorting or modeling the impact of these factors can empirically demonstrate the impact, say, on enrollment of tuition and fee changes relative to, for instance, a particular change in the institution's service area population or relative to a change in budget or curriculum that impacts retention.

Empirical parameters from this work are used, in a second-phase, to build a forecasting model where institutional planners may cast the uncontrollable factors in different alternative future scenarios. To complete the work - as a third phase - planners then alter the controllable factors: marketing, outreach, admissions, registration, probation, dismissal, and still other measures such as counseling and improvement of instruction that are specifically designed to improve *intra-course or inter-term retention.*

Values for the latter indicator generally receive much attention in accountability exercises, but more important are the parameters that describe the relationship of all these outcomes to changes to internal policy and practice, given the impact of external factors. The resulting level and composition of the institution's enrollment are a function of all three phases of the modeling.

These controllable or manageable factors are usually discussed under the rubric of enrollment management, a major focus of HE during the past ten years. Enrollment management generally began with a proposed definition and context put forth by Hossler and Kemerer (1986) which examined the "tools" available for managing enrollments. Different management methods were surveyed and their integration proposed by Dolence (1989) who, more recently (1993), has advocated "strategic enrollment management" to include the uncontrollable (unmanageable) factors as well.

In the first phase of our work, a model to "explain" the past 25 years of enrollment patterns is fit with data for Maricopa (MCCCD), a large, multi-campus community college district in metropolitan Phoenix Arizona. Besides the major policies of tuition, fees and financial aid at the college and the tuition of a major nearby competitor, Arizona State University, independent variables include those about demand: service area demographics and economics; together with those about supply: college budget, staffing and curriculum. In a limited number of cases, missing data are reconstructed either from subsidiary functions or from estimates by knowledgeable and experienced staff at the college.

The model itself is an econometric regression and considerable care is taken to avoid typical problems of multicollinearity (independent variables are highly correlated), heteroscedasticity (model errors are not, as assumed, independently distributed with constant variance), and simultaneous equation bias (Chart 2). The latter problem can confuse the direction of causation in the model, though the cures for this (two-stage least squares, etc.) sometimes causes further problems of interpretation. The usual statistics are analyzed not only for their significance, but also for their policy importance, two quite different concepts; see, for example, McCloskey and Ziliak (1996).

Results are quite satisfactory (Chart 3). Not only is the equation a good fit (with appropriate R^2, F-Ratio, and DW statistics), but, parameters for each of the five independent variables are significant (t values>2), with expected elasticities and signs.

Once historic enrollment patterns are "explained," the model is modified - in the second phase of the work - to forecast future enrollments, using the five independent variables plus the Phoenix area Consumer Price Index. Forecasts begin with relatively naive scenarios, partly to validate the model (Chart 4), then proceed to more-likely scenarios (Chart 5). (To construct needed future values for key variables, an expert panel can undertake an informal Delphi-like process to identify an effective consensus value or range of values for each variable.)

A final set of forecasts for Maricopa deviated from the actual result largely because we underestimated the college's budget increase (Chart 6). Had the budget been increased as we earlier predicted, the forecast would have been within 0.6% (257 FTE students) of the actual result (44,657 FTE). In any case, the model's estimates and forecasts were used by Maricopa's budget and planning group as the basis for setting both short-term 1995-96 and long-term tuition and fee policies for the college.

Once empirically fit - with robust and very sensitive statistical results - this kind of forecasting model can be connected to a simulation model - in Phase 3 - to look at possible results from what might be termed as the "micro" or at least "somewhat less-than-macro" policies for: marketing, outreach, admissions, registration; i.e., efforts that will impact first-time enrollments (Chart 7). In addition, this kind of simulation enables analysis of initiatives that will impact inter-term retention. Increases in the values of these variables, other things being equal (which they are not, but we take care of that problem simultaneously in other parts of our modeling), produce (a) significant increases in the level and (b) significant changes in the composition of a university or college's enrollment.

This structure can interact with the institutions data base and with projection models to simulate the programmatic and fiscal consequences of alternative actions and scenarios. This model can be especially useful when used in an iterative fashion by an Enrollment Management Task Force to achieve certain institutional goals, and does, at times, produce results that are quite counter-intuitive.

The simulation model uses "performance measures" for four distinct enrollment management strategies, in conjunction with more specific "pricing": tuition, fees, dormitory charges, and financial aid policies:

Action	***Measure***
Market	Marketing-elasticity of Applications Submitted
Admit	Admissions:Applications Ratios
Register or Enroll	New Enrollment:Admissions ("Yield") Ratios
Retain	Retention Ratios across terms (Chart 9)
Price	Prices and Pricing Policies (Chart 10)

In a version of this model, developed for a small land-grant University in the midwest, the five enrollment management strategies are imposed upon categories of new and continuing students that have been derived, using historic matrices (Chart 11), from a dozen basic categories of students that the school used for budget and academic planning:

undergraduate students by load (full- and part-time) and residence (on- and off-campus)

graduate students by load (full- and part-time) and residence (on- and off-campus)

summer session students by level (graduate, undergraduate) and residence

Once the model is run, using values for the performance measures supplied by the user, one sees the overall changes (Chart 12) resulting from specific actions (Chart 13), together with a summary of those specific actions taken and assumptions (Chart 14) in order to keep track of results in relation to actions. Also displayed are the resulting specific distributions of future enrollment by academic status, load and level, geographic origin, race and other special University student groups (Chart 15).

These results also are designed to feed into academic and budget planning models. Unfortunately, at the time the model was delivered in 1996, major staffing changes were taking place at the Midwestern University. And, to the author's knowledge, the model has not yet been implemented. Plans are currently underway to apply this methodology at Pima Community College in Arizona.

This kind of three-phased work should provide a breakthrough for colleges and universities that struggle with enrollment forecasting and enrollment management by effectively integrating both sets of activities. Commonly available and frequently used, measures of institutional and student "performance," including recruitment and retention, are key features of this work. It appears, therefore, that the real merit and proper rationale for maintaining such measures as not for vaguely-defined "accountability purposes," but rather for specific, indentifiable uses like that - enrollment management - examined here.

This work can be effectively replicated at any college or university with minimal modifications that may be needed to account for less-than-adequate data or for unique needs of policymakers. It can be especially useful for private HE institutions and public liberal arts colleges that rely heavily on tuition and fees as a revenue source, whose viability depends upon effective enrollment planning and management, and where effective recruitment and retention strategies can have a major impact on the institution's condition.

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ISSUES RELEVANT TO COLLEGE ENROLLMENT

MANAGEABLE

Own Pricing: tuition, fees, and financial aid

Marketing and Registration

Admissions, Probation, and Dismissal

Curriculum: programs, sectioning, ...

Support: counseling, etc.

Facilities: sites, ...

UNMANAGEABLE

Competitor Pricing

Competitor policies, practices

Demographic, geographic factors

Economic: income, unemployment, prices, ...

Social and cultural factors

Public policies

*IT'S USEFUL TO KNOW THE POSSIBLE IMPACT OF ISSUES YOU CAN'T MANAGE;
OTHERWISE, YOUR ACTIONS MAY HAVE
UNINTENDED RESULTS!!

MODELING ISSUES AND PROBLEMS

1. EXPLANATION

Are independent variables related to enrollment?
What is the BEST form of the model?

Measures: R–Square
F Ratio
Elasticities, T Values
Durban–Watson (DW) Statistic
Autocorrelation

2. SOME STATISTICAL ISSUES

Simultaneous Equation Bias: enrollment observations are result of intersection of supply and demand:

S = f(...,..., D, ...)
D = f(..., ..., S, ...)

Causation problems
Intercorrelation of independent variables

3. ANALYSIS OF MODEL ERRORS OR RESIDUALS

For time series, use measures such as DW Statistic, Autocorrelation ... AND, visual presentations....
develop "dummy variables"....
Model errors: poor specification, left something out....
Measurement errors: data incomplete or invalid...

4. FORECASTING

Can you forecast independent variables reliably?
PROBABLY NOT; USE SCENARIOS!!
Repeated use: model menus, macros....

$$E = f(P, Y, D, S)$$

E = **enrollment**, the dependent variable, specified in headcount and FTSE

P = the **price** of college-going, including:

- tuition and fees and
- other costs
  - transportation
  - child-care, if needed
  - books, supplies, and miscellaneous,

adjusted for financial aid; and with **unemployment** (rates) used as a proxy for foregon earnings

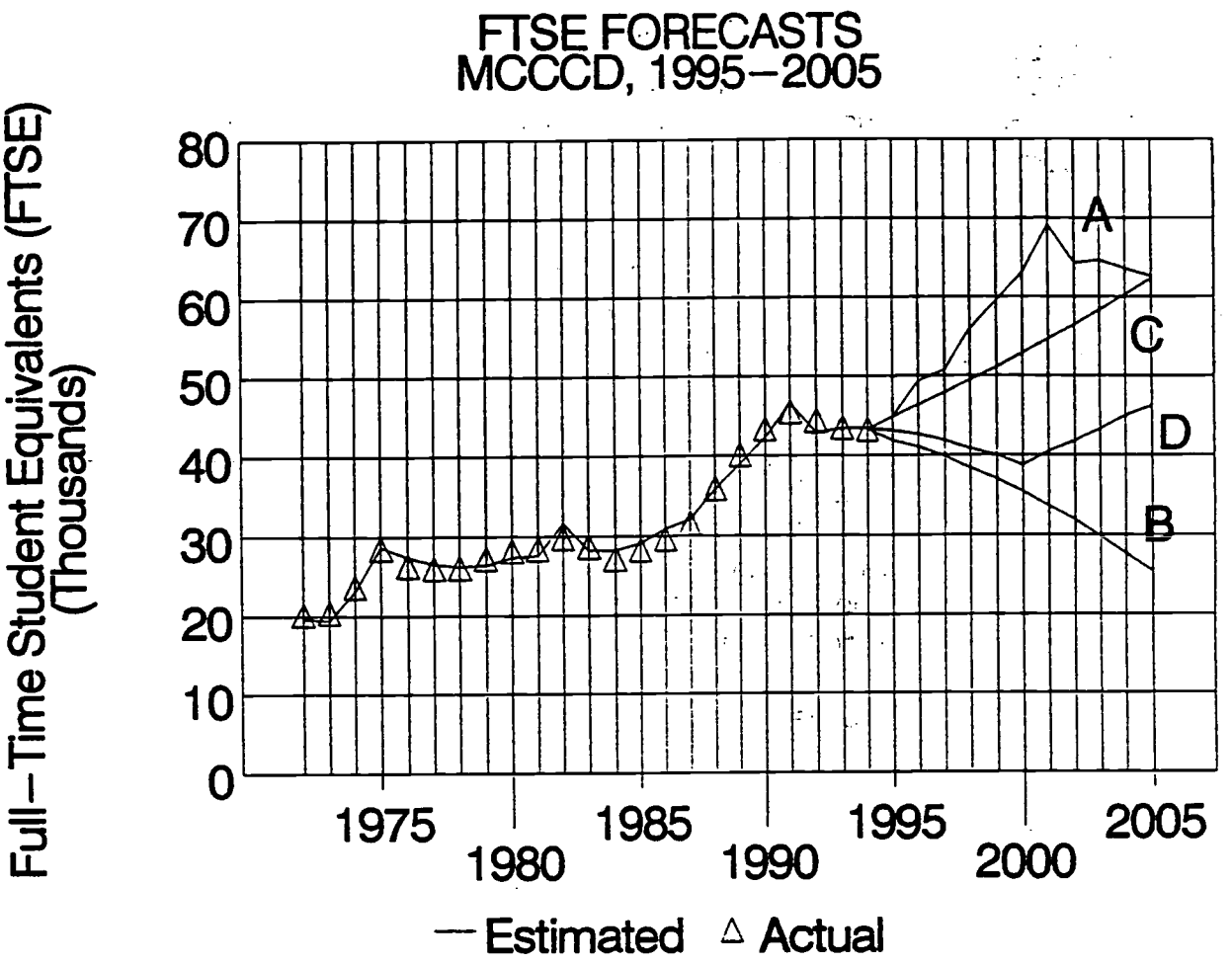
Y = disposable **income** available to potential student

D = **demographics** of potential student population

S = **supply** of MCCCD education, including

- budget (unrestricted; real: price-adjusted
- major MCCCD campuses or sites
- FTE faculty

variable	e	t
MCCCD tuition and fees	-0.40	-5.5
Maricopa income per capita	-1.51	-3.6
Maricopa population	0.98	3.4
MCCCD operating budget	0.63	3.0
ASU tuition and fees	0.38	2.1



Source: Appendix E.

FUTURE SCENARIOS:

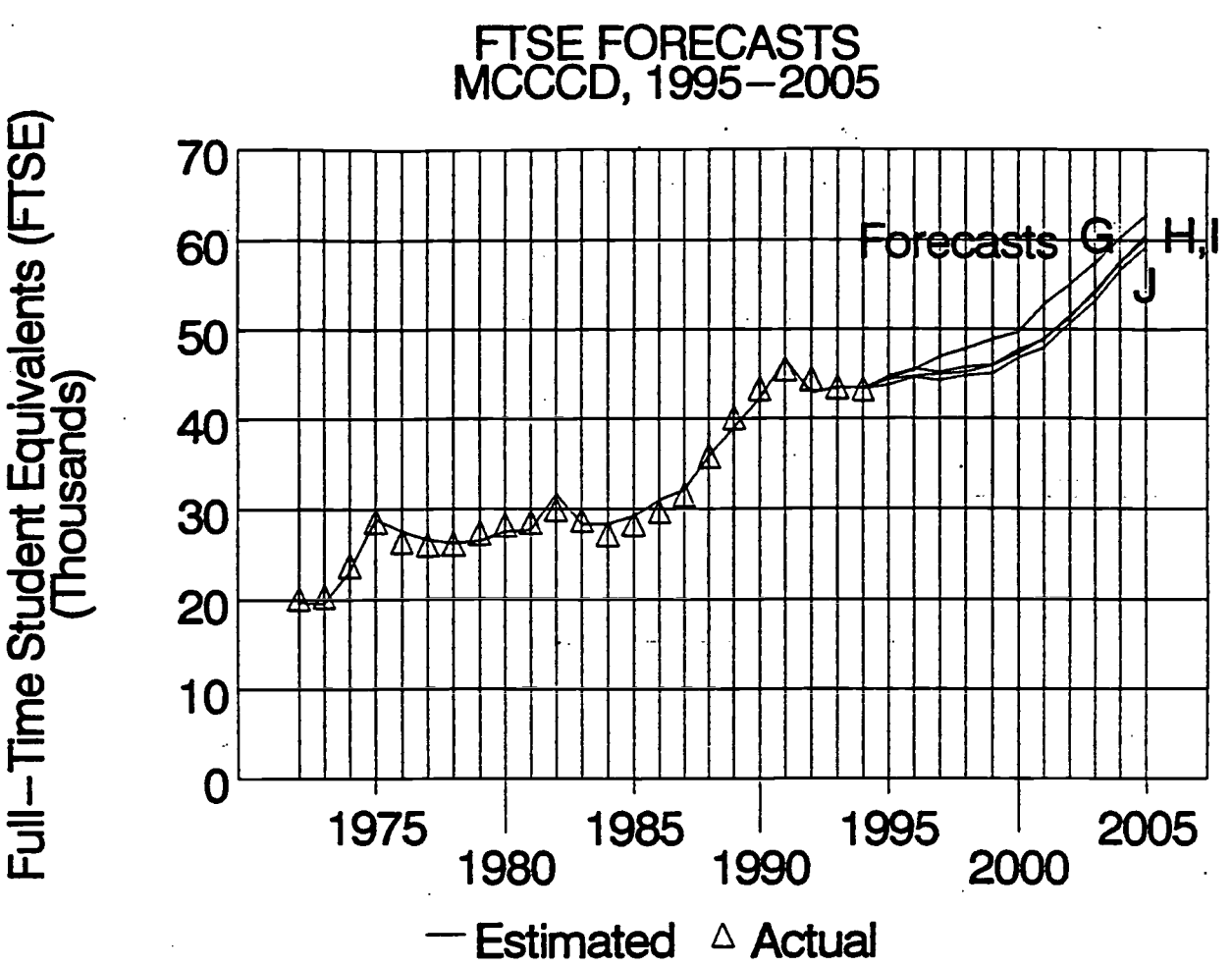
A: History "repeats itself;" the next ten years repeat the pattern of the past ten years.

B: The next ten years will trend like the past four years (since 1991).

C: The next ten years will trend like the average of the past 22 years (since 1972).

D: The local economy improves substantially until 2000, after which there is a downturn. CPI increases at slightly higher rate until 2000. Budgets continue to be tight, and basic tuition and fees increase by $2/unit per year (including continued proportionate increases in other fees, a 9% per year increase). MAG projects a slowing of Maricopa County population growth rates.

02/24/95
FTSE5F2/5F/ah105



Source: Appendix E.

FUTURE SCENARIOS:

G: The local economy improves substantially until 2000, after which there is a downturn. CPI increases at slightly higher rate until 2000. MCCCD Budgets increase at 8% through 2000, then 3% through 2005. Tuition and fees increase by $1/unit (3%) per year and other fees held to same % increase.

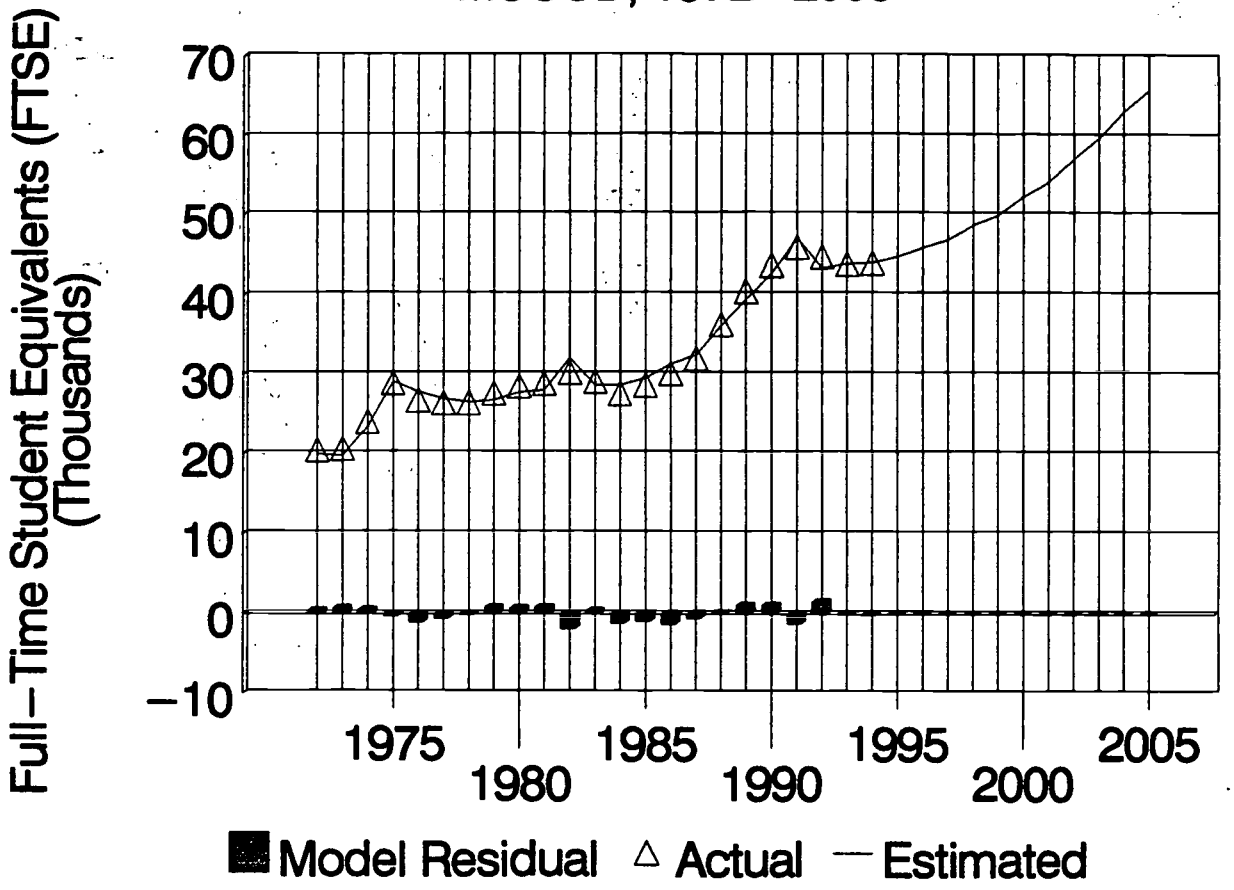
H: Like G, except that economic recovery is not as robust in near term nor does it turn down as much after 2000. Also, MCCCD budgets continue to be tight, increasing by 4% per year through 2005. Tuition and Fees up by $1/unit per year.

I: Like H, , except that basic tuition and fees do NOT increase for two years, then increase by $2/unit every other year, beginning with 1997–98.

J: Like I, except that basic tuition and fees increase by $2/unit in 1995–96, and every other year thereafter.

03/14/95 FTSE5F2/5F/ah105

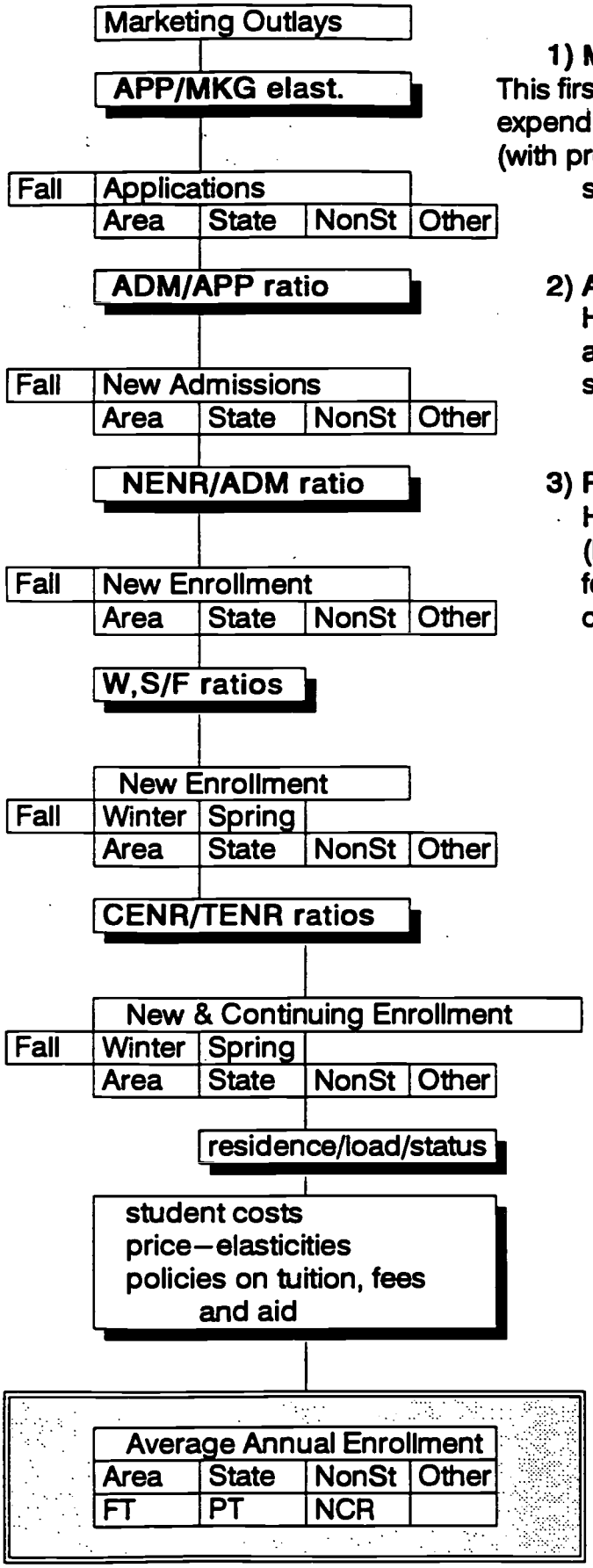
FTSE FORECAST
MCCCD, 1972–2005



SCENARIOS Annual Changes:

	Est'd 95–96	Actual 95–96	96–97	1997 and beyond
Tuition and Fees	+$2/cu	+$2/cu	$0chg.	Increases $2/cu every other year.
Budget	+4%	+8%	Increases at 1% point>income/capita increase	
ASU T&Fees	+8.2%	+3%	+3%	+8.2% (recent 22 year average)
Income/Capita	+7%	+7%	+8%	Robust through 2000...
Population	+2.5%	+2.6%	+2.6%	Slows, but always >2.0% annual increase
CPI	+5%	+6%	+5.5%	Slows to +4% annual increase by 2001
FTSE Forecast	43769	44400 , using actual 95–96 values for independent variables		
FTSE Actual	44657	44657		
Difference	888	257		
	2.0%	0.6%		

ENROLLMENT MANAGEMENT (ENRLMGMT)



1) MARKETING

This first routine provides historic data on marketing expenditures and applications (APP/MKTG), which (with proposed future marketing) projects future student applications by residence...

2) ADMISSIONS

Historic admissions/applications ratios (ADM/APP) are projected, given future plans for admissions standards and processes...

3) REGISTRATION/ENROLLMENT

Historic new enrollment/admissions ratios (NENR/ADM) are projected, given future plans for registration processes....and for curriculum, sectioning, scheduling....

for the fall terms...., then:

winter and spring terms are projected as ratios of fall (W,S/F), based on history...

4) RETENTION

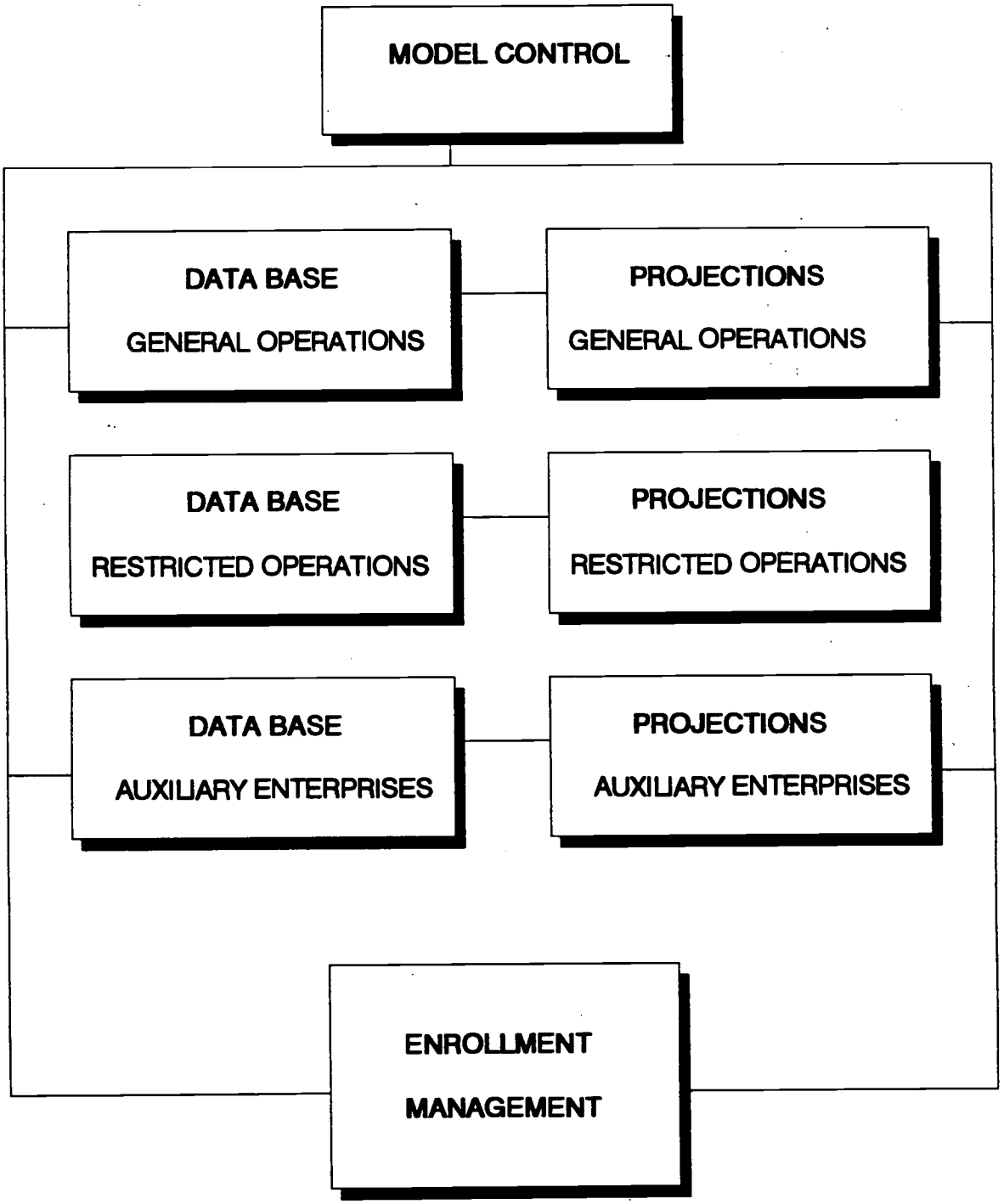
Historic retention rates (CENR/TENR) for:
(a) Winter,Spg Continuing/Fall Enrollment
(b) Fall Continuing/Spring Enrollment
are used to project future new and continuing students... given plans about retention...

Historic data on student residence/load/status readies enrollment count for...

5) PRICING

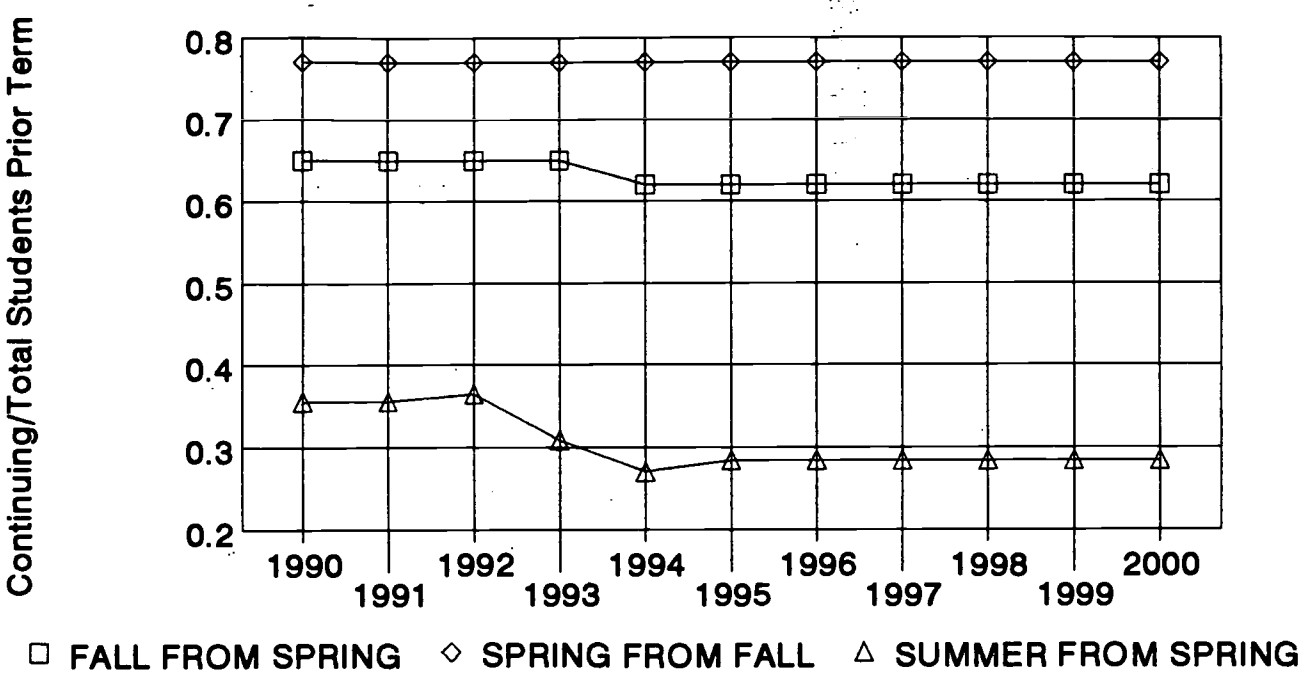
This routine takes historic data for
student costs
price–elasticities
and projected future policies on:
tuition, fees and financial aid
to produce enrollment numbers for other CAP model routines....

STRUCTURE OF CAP SIMULATION MODEL



MIDWEST UNIVERSITY

RETENTION RATES
Five–Year Actual; Six–Year Estimate



Actual and Projected
RETENTION RATIOS FOR CONTINUING STUDENTS

	FALL Cont'g	SPRING Cont'g	SUMMER Cont'g
1990	0.65	0.77	0.36
1991	0.65	0.77	0.36
1992	0.65	0.77	0.36
1993	0.65	0.77	0.31
1994	0.62	0.77	0.27
1995	0.62	0.77	0.28
1996	0.62	0.77	0.28
1997	0.62	0.77	0.28
1998	0.62	0.77	0.28
1999	0.62	0.77	0.28
2000	0.62	0.77	0.28

SOURCE: Office of Institutional Research and Planning.

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ANNUAL COST BY STUDENT TYPE, 1993–94

	Tuition	Fees	Rm/Brd	Transp't	Books	Other1	Other2	Total
RESIDENT HALL UG								
ResFT	$1,920	$104	$2,670	$540	$630			$5,864
PT	$912	$104	$2,670	$540	$630			$4,856
NR FT	$3,809	$104	$2,670	$540	$630			$7,753
PT	$1,969	$104	$2,670	$540	$630			$5,913
COMMUTING UG								
ResFT	$1,920	$104	$3,500	$720	$630			$6,874
PT	$912	$104	$2,000	$500	$400			$3,916
NR FT	$3,809	$104	$3,500	$720	$630			$8,763
PT	$1,969	$104	$2,000	$500	$400			$4,973
GRADUATE STUDENT								
ResFT	$2,051	$104	$3,500	$650	$630			$6,935
PT	$719	$104	$2,000	$400	$400			$3,623
NR FT	$4,422	$104	$3,500	$650	$630			$9,306
PT	$1,549	$104	$2,000	$400	$400			$4,453

Review, then press ENTER to proceed!

POLICY ON PRICE INCREASES

	Res–UG Tuition per SCH	Percent Annual Change Tuition	Fees	Dorms.	Student Fin.Aid
1990	$55.00 |				
1991	$55.00 |				
1992	$61.00 |	< Review history, and			
1993	$68.00 |	projections from PROJECT1,3:			
1994	$75.00 |				
1995	$79.50	6.0%	2.8%	2.3%	6.0%
1996	$83.50	5.0%	4.0%	4.8%	5.0%
1997	$87.70	5.0%	4.0%	4.0%	5.0%
1998	$92.10	5.0%	4.0%	4.0%	5.0%
1999	$95.80	4.0%	4.0%	4.5%	4.0%
2000	$99.60	4.0%	4.0%	4.0%	4.0%

When done,
press ENTER
to proceed.

AVERAGE ANNUAL ENROLLMENT, ACADEMIC 1993–94

Race by Area of Origin

	CnMO	StL/KC	OtMO	NonST	Total
African American	205	393	93	253	944
White	2155	41	252	32	2480
Other Minority	40	2	2	8	52
Alien or Unknown	24	2	4	54	84
Total	2424	438	351	347	3560

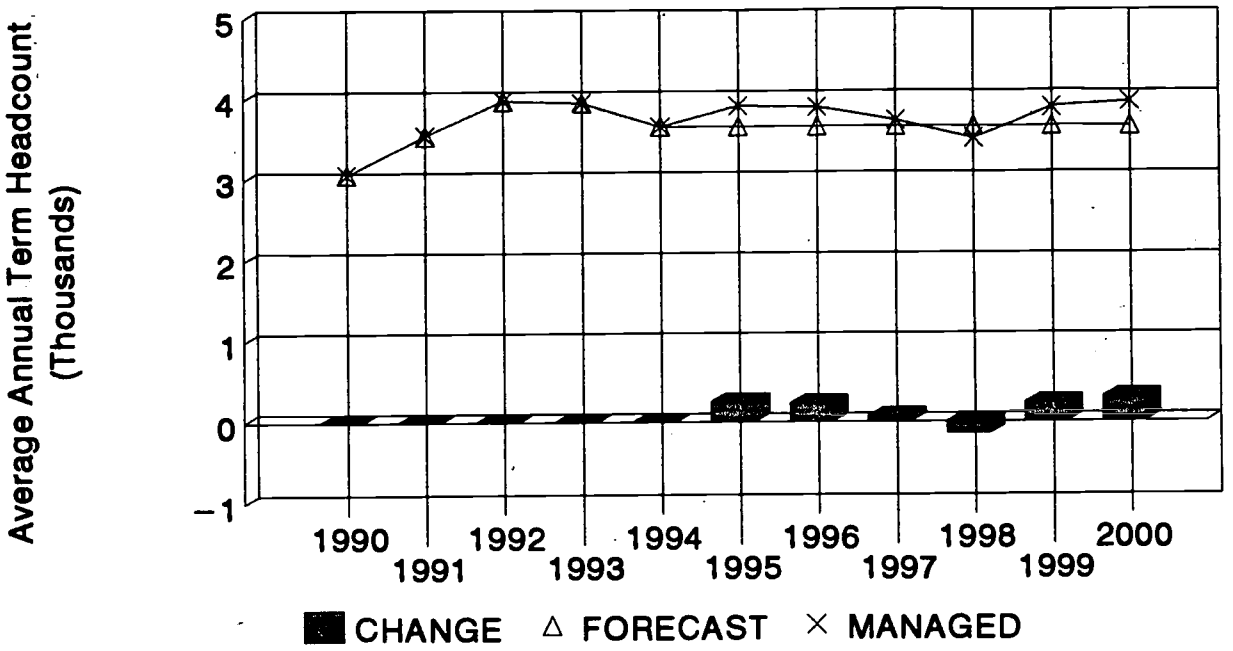
Ratio to Total

	CnMO	StL/KC	OtMO	NonST	Total
African American	0.085	0.897	0.265	0.729	0.265
White	0.889	0.094	0.718	0.092	0.697
Other Minority	0.017	0.005	0.006	0.023	0.015
Alien or Unknown	0.010	0.005	0.011	0.156	0.024
Total	1.000	1.000	1.000	1.000	1.000

DISTRIBUTION OF STUDENTS, ANNUAL AVERAGE REGULAR TERMS 1993–94

RsHallUG	(1) TradAge AfrAm	(2) TradAge AfrAm	(3) NTrAge AfrAm	(4) TradAge White	(5) NTrAge White	(6) Other Min/Int	(7) Graduate	TOTAL
ResFT	260	0	0	0	0	0	0	260
PT	0	0	0	0	0	0	0	0
NR FT	159	0	0	0	0	0	0	159
PT	0	0	0	0	0	0	0	0
CommutUG								
ResFT	0	240	52	832	254	39	0	1417
PT	0	48	72	410	680	24	0	1234
NR FT	0	72	10	10	0	22	0	114
PT	0	20	12	10	5	17	0	64
GRADUATE								
ResFT	0	0	0	0	0	0	45	45
PT	0	0	0	0	0	0	257	257
NR FT	0	0	0	0	0	0	6	6
PT	0	0	0	0	0	0	4	4
TOTAL	419	380	146	1262	939	102	312	3560

CHANGES FROM ENROLLMENT MANAGEMENT
Forecast and Managed Enrollment



Changes in ENROLLMENT from ENROLLMENT MANAGEMENT
Compared to DEMAND POTENTIAL AVERAGE ANNUAL ENROLLMENT

	(demand forecast)	(managed)			Difference
	AVE.ANNUAL	FALL	SPRING	AVE.ANNUAL	
1990	2978	3063	2893	2978	0
1991	3453	3619	3287	3453	0
1992	3885	4101	3669	3885	0
1993	3855	4031	3679	3855	0
1994	3560	3623	3498	3560	0
1995	3561	3953	3699	3814	253
1996	3561	3962	3645	3799	239
1997	3561	3799	3473	3632	72
1998	3561	3574	3258	3412	−148
1999	3561	3907	3670	3788	228
2000	3561	4018	3703	3861	300

SOURCE: Office of Institutional Research and Planning.

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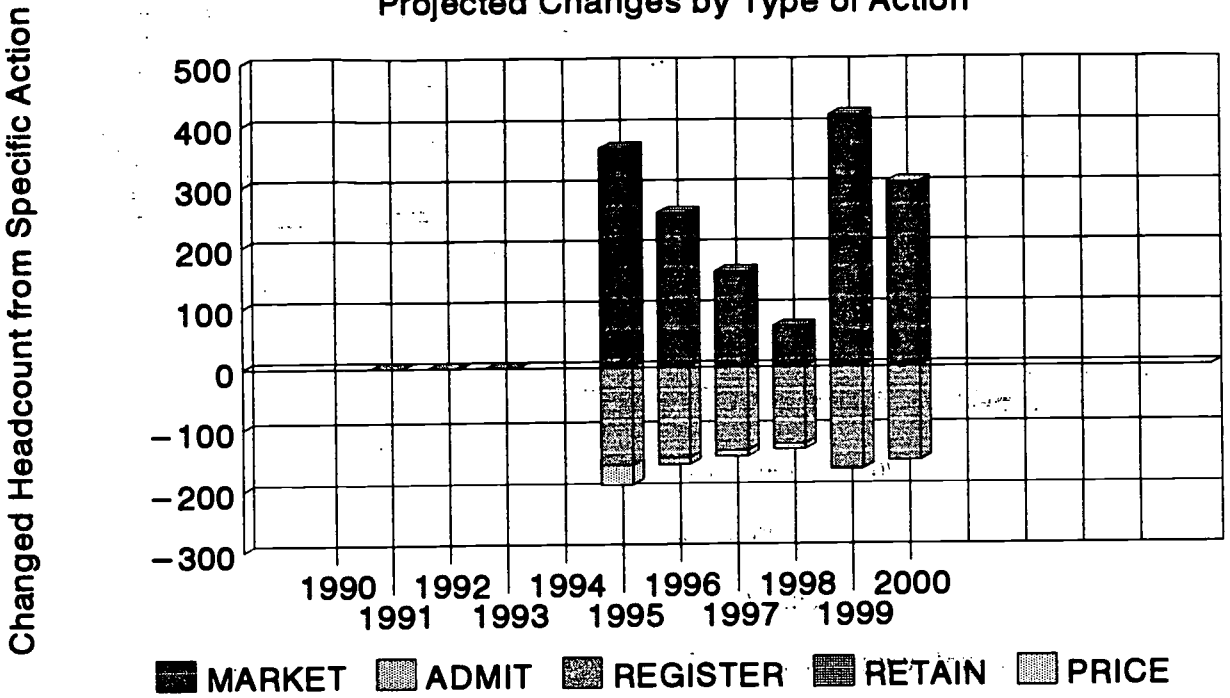
CHANGES FROM ENROLLMENT MANAGEMENT
Projected Changes by Type of Action



Changes in ENROLLMENT from
ENROLLMENT MANAGEMENT ACTIONS AND ASSUMPTIONS

	MARKET	ADMIT	REGISTER	RETAIN	PRICE
	(Average Annual Values)			(Average Annual Values)	
1990					
1991					
1992					
1993					
1994					
1995	360	3	−161	0	−31
1996	253	3	−149	0	−11
1997	155	3	−138	0	−10
1998	64	2	−127	0	−9
1999	414	3	−168	0	−1
2000	303	3	−155	0	0

NOTE: The changes attributable to each action are independently calculated; therefore, their sum will not equal the net overall impact of these interrelated actions!

SOURCE: Office of Institutional Research and Planning.

05/15/97

ASSUMPTIONS/ACTIONS for ENROLLMENT MANAGEMENT, Scenario: B

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MARKET TO NEW STUDENTS

Projected # apps based on: "elasticity" method. Mktg E = 2.00
Distribution of apps: Future distribution based on PLUGGED VALUES!
NOTE: Increase marketing budget to $145,000 (up 25%) in 1995 and to $175,000 in 1999.

ADMIT NEW STUDENTS

Ratio Admits to Apps: Future admissions based on CURRENT YEAR practices!
NOTE: No change: 90% from local; 80% from nearby metro areas; 85% from elsewhere in state; 75% from out−of−state.

REGISTER AND ENROLL NEW STUDENTS

Ratio of Fall to Admits: Future enrollment based on CURRENT registration practices!
Ratio Spring to Fall: Projection uses "PLUGGED" values for future ratios!
Ratio Summer to Fall: Projection uses CURRENT year ratio!
NOTE: No change in registration processes...constant ratio for fall: 75%. Correction for Spring 1994 miscount...

FUTURE CURRICULUM CHANGES LIKELY TO IMPACT ENROLLMENT? NO

RETAIN CONTINUING STUDENTS

From Fall to Spring Term:	Current ratio!	0.77 : now	0.77 : in 6 years
From Spring to Summer Term:	Current ratio!	0.27 : now	0.28 : in 6 years
From Spring to Fall Term:	Current ratio!	0.62 : now	0.62 : in 6 years

NOTE: Virtually no change....

PRICE ALL STUDENTS

Price elasticity = −1.2 .....by income level: low: −2.1 mid: −1.05 high: −0.45

Percent of students on aid, by income level: low: 60% mid: 25% high: 5%

Students on aid? 1= Yes, 0=No.

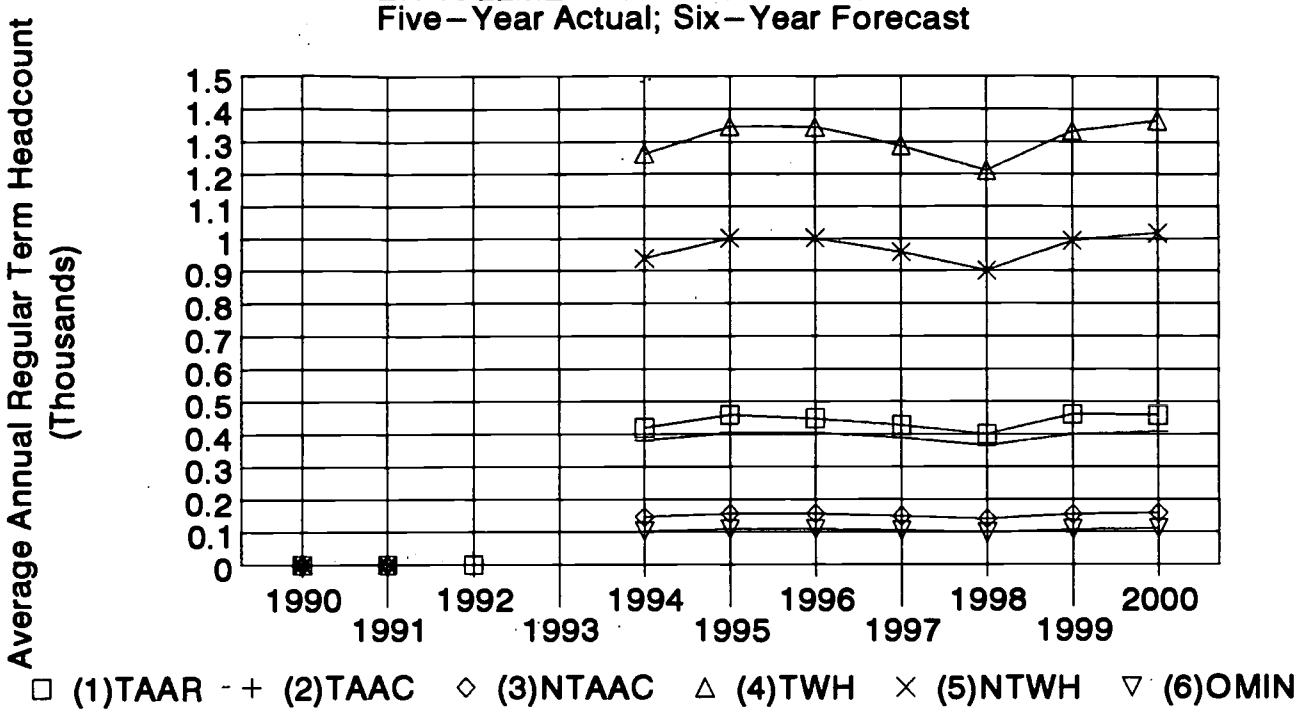
Types:	In Res.Halls	Commuting	Graduate
Resident, FT	1	1	1
Resident, PT	1	0	0
Nonres. FT	1	1	1
Nonres. PT	1	0	0

NOTE:

Chart 15

McIntyre 5/97

ENROLLMENT BY STUDENT GROUP
Five–Year Actual; Six–Year Forecast



AVERAGE ANNUAL HEADCOUNT ENROLLMENT
by STUDENT GROUP

YEAR	(1)	(2)	(3)	(4)	(5)	(6)	(7)	TOTAL
1990	TradAge	TradAge	NTrAge	TradAge	NTrAge	Other	Graduate	
1991	AfrAm	AfrAm	AfrAm	White	White	Min/Int		
1992	ResHall							
1993								
1994	419	380	146	1262	939	102	312	3560
1995	459	404	155	1346	1002	108	339	3814
1996	449	405	156	1346	1001	109	334	3799
1997	427	388	149	1288	958	104	318	3632
1998	399	365	140	1211	901	98	298	3412
1999	461	400	154	1333	994	107	339	3788
2000	460	411	158	1365	1016	110	341	3861

SOURCE: Office of Institutional Research and Planning.

05/15/97

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