A Multi-Criteria Model For Optimizing University Tuition Structures

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Abstract

The revision of tuition rates is an annual event at academic institutions. The existence of multiple and often conflicting goals, however, make the process extremely difficult. In light of rising educational costs and reduced federal and state support, the tuition structure must ensure adequate financial resources for the university. Increases in tuition rates, however, may negatively impact student enrollment and reduce the availability of higher education. The purpose of this article is to present a multi-criteria model for the tuition setting process at the university level. A goal programming approach is used to ensure the tuition structure is consistent with a variety of broad policy constraints typically faced by administrators.

Introduction

Higher education has been a rapidly growing concern during the past several decades. Consistent with an increasing interest in education is a greater awareness and concern for the financial considerations of universities, on both a governmental and an individual basis. Declining federal and state aid have forced many universities to develop formal long-range planning models in order to ensure obtainment of necessary funds, as well as an efficient allocation of these resources.

Financial considerations within an educational setting are unique from those encountered by non-academic institutions. As noted by Williams (1966, pp. 11):

"In a business enterprise, the allocation of resources is based upon the expected return on investment. In the education institution, however, there is no such clear decision criterion for resource allocation. In fact, the receipt of income has very little relationship to the use of university services. This weak tie between revenue and expenditure makes an efficient resource allocation in institutions of higher learning both extremely difficult and extremely important."

Although directed toward the broader area of resource allocation, a similar concept applies to the specific area of tuition setting. Tuition charges are of interest to administrators as well as to a variety of individuals outside the school system including the state legislature, parents, and students. Due to the "social impact" universities have on their communities, administrators must assess a variety of criteria when setting fee and tuition structures, such as the impact of tuition changes on access to higher education

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or university enrollment. The existence of multiple, and often times conflicting, objectives within the tuition setting process suggests the use of a goal programming approach.

Goal programming is an extension and modification of linear programming. Linear programming models require the decision maker to clearly define a single objective, for example maximize profits or minimize costs. More typical of many decision making processes, however, is the existence of multiple goals. The goal programming approach allows a simultaneous solution to a system of complex multiple objectives. Specifically, goal programming is capable of handling decisions that involve multiple goals and subgoals, according to their priority or importance. A typical goal programming model is illustrated by Figure 1.

Figure 1
Goal Programming Model

$$\text{Minimize } Z = \sum_{i=1}^{m} w_i P_i (d_i^- + d_i^+)$$

$$\text{subject to: } \sum_{i=1}^{m} a_{ij} x_j + d_i^- - d_i^+ = b_i$$

$(j=1,2,..n)$
$x_j, d_i^-, d_i^+ \geq 0$

Where:
P_i = Priority level
w_i = Weight assigned within priority level
d_i^- = Underachievement of goal
d_i^+ = Overachievement of goal
a_{ij} = Technology coefficient
x_j = Decision variable
b_i = Right hand side variables
m = Number of goal constraints
n = Number of decision variables

Unlike linear programming, the objective function in a goal programming model usually does not contain choice variables. Instead, the objective in goal programming is to minimize weighted deviations from desired goals. Deviations can be either negative (d_i^-) or positive (d_i^+), representing under- or overutilization of goal constraints, respectively.

Specific goals in the objective function need not be homogeneous with respect to their units of measurement. For example, the first goal constraint may represent a fixed dollar amount of funds needed to be raised. In this case d_1^- represents the dollar amount below the target, while d_1^+ is the dollar amount above the target. The second goal may be a requirement pertaining to the ratio of two choice variables. Here, d_2^- represents a ratio less than that required, while d_2^+ represents a ratio greater than that required. If the goals are to raise a minimum amount of money and maintain a constant ratio, then d_1^-, d_2^-, and d_2^+ would be included in the objective function. Goal programming allows for positive deviations, negative deviations, or both, to be included in the objective function.

Because it may not be possible to optimize each goal, this method finds a solution which satisfies the highest goal first, and attempts to satisfy remaining goals, in order of their priority. As a result, each goal constraint must be assigned a priority by the decision maker, which determines the order in which the program will optimize various goals. For example, deviations weighted by P_1 will be minimized before deviations weighted by P_2. It is also possible to assign more than one goal to any particular priority level. In this case, the decision maker can weight goals within a priority level, according to subjective preferences. For example, w_1P_2 would be assigned a higher priority than w_2P_2.

Despite its popularity, the use of goal programming within an academic setting has been generally limited. Furthermore, much of the research has been directed toward the allocation, rather than obtainment, of resources (Schroeder, 1974; Lee and Clayton, 1972; Diminnie and Kwak, 1986; Albright, 1975; Hemaida and Hupfer, 1994). The purpose of this study is to illustrate the use of a goal programming model to determine the optimal tuition structure for a major state-supported university.

Previous research specific to the tuition setting process includes Troutt (1983) and Greenwood and Moore (1987). Troutt utilized a simple linear programming model, which allowed only for a single objective function, maximizing revenues. In contrast, Greenwood and Moore employed an inter-temporal goal programming model in which the optimal tuition structure over a three-year time period was obtained. Although it is possible to formulate a complex, multi-time-period model, the scope of this study was limited to a planning horizon of one year in order to provide a clear presentation of the goal programming methodology and the potential applications of this study. Data for the 1993-1994 academic year at the University of Nebraska-Lincoln (UNL) were employed, such that the model's results could be compared with actual tuition rates set by administrators.[1]

University of Nebraska Fee and Tuition Setting Process

The importance of changes in tuition structures was readily apparent at UNL during the sample period. In December 1993, The Board of Regents recommended a set of policy guidelines for setting tuition levels throughout the University. These guidelines represented the first explicit step in establishing written policies governing annual tuition assessments. A complex set of objectives was accounted for which included peer institution tuition charges and state funding, as well as qualitative goals, such as enhancing the cultural diversity of the University.

There are two types of revenue generated from student charges at the University of Nebraska. The first, University Program and Facilities Fees (UPFF), provides support for various services, facilities, and programs such as the University Health Center, facility maintenance, and campus recreation programs. Each program submits annual requests to the Association of Students of the University of Nebraska (ASUN), which reviews all requests and submits recommendations to the ASUN Senate. Requests are evaluated on the basis of whether the programs supported by the funds will provide valuable services to students. There are no binding constraints, or limitations, on the dollar amount of fees, typical of many resource allocation problems, therefore, fee setting is not a viable candidate for linear or goal programming models. The fee structure does, however, play an important role in determining the second type of revenue, specifically tuition charges.

The Budgets and Analysis Division is responsible for determining the annual tuition structure at UNL. Unlike fee assessments, tuition charges are subject to various written policies and explicit, as well as implicit, binding considerations. A variety of constraints, often conflicting with one another, make the decision an extremely difficult one. This makes tuition setting a viable candidate for goal programming. In the process of setting tuition structures, administrators in this division take student fees as given, therefore, total revenue from fees was exogenous in this application.

The tuition/fee structure used by UNL charges each student "credit hour fees" and "student fees." Credit hour charges (tuition) vary by program and residency status. The majority of UNL students can be categorized according to the following six definitions:

Resident / Undergraduate
Non-Resident / Undergraduate
Resident / Graduate
Non-Resident / Graduate
Resident / Professional
Non-Resident / Professional

Credit hour fees vary according to each student's credit hour enrollment. UNL utilizes a two-tiered fee system for the fall, spring, 8-week and 5-week sessions, and a single fee rate for the 3-week session. There is no distinction made for residency status or class standing. Data regarding the number of students enrolled in 1992-1993, by category and credit hour status, are given in Appendix 1. Student enrollment at UNL is considered fairly stable, or predictable, through time, therefore the 1992-1993 enrollment figures were used as estimates for the 1993-1994 academic year. This information was also used to calculate expected total fee income, as given in Appendix 2a.

Constraints and Priority Structure

A total of fourteen goals, ranked within four priority levels, were used in this application. Goals, taken from 1993 University guidelines where applicable, are discussed below in order of their priority.

Priority Level 1

The first priority level was formulated directly from 1993 guidelines and included a single constraint directed toward the amount of revenue which must be raised from tuition and fees to cover operating expenses. UNL uses "educational costs" as a basis for determining costs which tuition and fee revenues must meet. Educational costs include instruction, student services, and student aid as well as proportions of both physical plant and administrative costs. During the sample period, the University followed a fairly strict policy of paying 34% of these costs with tuition and fee revenue. This ratio maintained its comparability with peer institutions and ensured tuition increases were commensurate with increases in operating costs. Both under- and overachievement of this goal were regarded as unsatisfactory, thus both deviational variables were included in the objective function.

The most recent educational cost data that would have been available to administrators during 1992-1993 would have been for the 1991-1992 academic year, therefore, the Higher Education Price Index (HEPI) was used to forecast educational costs for 1993-1994. The HEPI is similar to a price or inflation index, however, it is constructed to account for education-related costs. The goal constraint for this priority is given by equation (1).

$$484{,}338x_1 + 38{,}974x_2 + 50{,}494x_3 + 24{,}123x_4 + 12{,}570x_5 + 1{,}613x_6 + d_1^- - d_1^+ = 45{,}702{,}077 \quad (1)$$

where:

x_1 = Per credit hour charge for resident / undergraduate
x_2 = Per credit hour charge for non-resident / undergraduate
x_3 = Per credit hour charge for resident / graduate
x_4 = Per credit hour charge for non-resident / graduate
x_5 = Per credit hour charge for resident / professional
x_6 = Per credit hour charge for non-resident / professional

In equation (1), per credit hour variables (x_1-x_6) were multiplied by the number of credit hours forecasted for each category. Total educational costs forecasted for 1993-1994, assuming a 4% annual increase in educational costs, was multiplied by 34%, yielding the total dollar amount of educational costs to be funded by student tuition and student fees. Revenue expected to be generated from student fees was then subtracted from this amount, resulting in $45,702,077 required from tuition assessments.

Given that future "educational costs" are not known with certainty and must be forecasted, three additional scenarios were examined, assuming increases in educational costs of 5%, 6%, and 7%, respectively. The calculation of total revenue required for each of these scenarios is provided in Appendices 2b and 2c.

Priority Level 2

The second priority of UNL was to limit percentage increases in tuition rates. This constraint could be formulated using either peer institution tuition rates, or expected increases in operating costs.

The first method, peer institution charges, reflects the notion that administrators are highly conscious of the relationship between UNL's tuition structure and that of its peer institutions. Data are collected on tuition rates at comparable institutions, an average is calculated, and allowable percentage increases or decreases to this average are determined for each of the six categories. During the sample period, UNL tuition charges were substantially below its peer institution average. Allowable increases, in fact, ranged from 17.8% to 65%. Such large increases would most likely have a substantial impact on student enrollment, therefore, allowable percentage increases in tuition rates were constrained with respect to expected increases in operating costs.

Equations (2) - (7) were derived by allowing 1992-1993 tuition rates to increase by 6%. Because this estimate is high, given the HEPI index, only positive deviational variables were included in the objective function.

$x_1 + d_2^- - d_2^+ = 65.19$ (resident / undergraduate) (2)
$x_2 + d_3^- - d_3^+ = 177.55$ (non-resident / undergraduate) (3)
$x_3 + d_4^- - d_4^+ = 86.39$ (resident / graduate) (4)
$x_4 + d_5^- - d_5^+ = 213.33$ (non-resident / graduate) (5)
$x_5 + d_6^- - d_6^+ = 84.80$ (resident / professional) (6)
$x_6 + d_7^- - d_7^+ = 217.57$ (non-resident / professional) (7)

Priority Level 3

The next priority reflected the goals of University administrators aimed at maintaining certain relationships among the various categories of student tuition rates. The first, given by equation (8), restricts resident / undergraduate tuition as a percent of resident / graduate tuition, while the second, equation (9), restricts non-resident / undergraduate tuition as a percent of non-resident / graduate tuition. The 1993 University guidelines explicitly required graduate tuition to be at least 25% greater than undergraduate tuition, thus the objective function was modeled to minimize only the negative deviational variables of these constraints.

$x_3 - 1.25x_1 + d_8^- - d_8^+ = 0$ (resident; graduate / undergraduate) (8)
$x_4 - 1.25x_2 + d_9^- - d_9^+ = 0$ (non-resident; graduate / undergraduate) (9)

Constraints for professional students were not explicitly stated in University guidelines, therefore, this constraint was formulated on the basis of its historical relationship with undergraduate tuition. For the two years prior, undergraduate tuition had been approximately 76.8% of professional tuition, regardless of residency status. Equations (10) and (11) constrain professional tuition to maintain this relationship, thus both positive and negative deviations were included in the objective function.

$x_1 - .768x_5 + d_{10}^- - d_{10}^+ = 0$ (resident; undergraduate / professional) (10)
$x_2 - .768x_6 + d_{11}^- - d_{11}^+ = 0$ (non-resident; undergraduate / professional) (11)

Priority Level 4

Priority four restricted relationships between resident and non-resident tuition. Although not an explicit goal set by guidelines, administrators acknowledge resident tuition should be proportionately less than non-resident tuition, because residents contribute to University funding through state taxation. Because this goal was not explicitly set at the University, past relationships were used to determine the appropriate ratios, as shown below. A similar pattern applied to professional students.

Year	Undergraduate Resident as a Percent of Undergraduate Non-Resident	Graduate Resident as a Percent of Graduate Non-Resident
1990-1991	36.77%	40.57%
1991-1992	36.75%	40.45%
1992-1993	36.71%	40.50%

Equations (12), (13), and (14) model the appropriate constraints, assuming rates of 36.75%, 40.50%, and 39% for undergraduate, graduate, and professional students, respectively. Because the relationships appeared to be fairly robust, both under- and overachievement of these goals were included in the objective function.

$x_1 - .3675x_2 + d_{12}^- - d_{12}^+ = 0$ (undergraduate; resident / non-resident) (12)
$x_3 - .4050x_4 + d_{13}^- - d_{13}^+ = 0$ (graduate; resident / non-resident) (13)
$x_5 - .3900x_6 + d_{14}^- - d_{14}^+ = 0$ (professional; resident / non-resident) (14)

Tuition Goal Programming Model

The general model for the tuition setting process is given by equation (15). Again, the objective function minimizes deviations from constraints, beginning with the highest priority level.

$$\text{Min } Z = P_1d_1^+ + P_1d_1^- + P_2d_3^+ + P_2d_4^+ + P_2d_5^+ + P_2d_6^+ + P_2d_7 + P_3d_8^- + P_3d_9^- + P_3d_{10}^- + P_3d_{10}^+ + P_3d_{11}^- + P_3d_1 + P_4d_{12}^- + P_4d_{12}^+ + P_4d_{13}^- + P_4d_{13}^+ + P_4d_{14}^- + P_4d_{14} \quad (15)$$

subject to:

$$484{,}338x_1 + 38{,}974x_2 + 50{,}494x_3 + 24{,}123x_4 + 12{,}570x_5 + 1{,}613x_6 + d_1^- - d_1^+ = 45{,}702{,}077$$

$x_1 + d_2^- - d_2^+ = 65.19$
$x_2 + d_3^- - d_3^+ = 177.55$
$x_3 + d_4^- - d_4^+ = 86.39$
$x_4 + d_5^- - d_5^+ = 213.33$
$x_5 + d_6^- - d_6^+ = 84.80$
$x_6 + d_7^- - d_7^+ = 217.57$
$x_3 - 1.25x_1 + d_8^- - d_8^+ = 0$
$x_4 - 1.25x_2 + d_9^- - d_9^+ = 0$
$x_1 - .768x_5 + d_{10}^- - d_{10}^+ = 0$
$x_2 - .768x_6 + d_{11}^- - d_{11}^+ = 0$
$x_1 - .3675x_2 + d_{12}^- - d_{12}^+ = 0$
$x_3 - .4050x_4 + d_{13}^- - d_{13}^+ = 0$
$x_5 - .3900x_6 + d_{14}^- - d_{14}^+ = 0$

and: $x_j, d_i^-, d_i^+ \geq 0$

Empirical Results

The model was applied to four scenarios, assuming annual increases in educational costs of 4%, 5%, 6%, and 7%, respectively. The results, including goal constraint violations, are provided in Table 1.

Table 1
Model Results

	Category	Actual	Scenario 1 4%	Scenario 2 5%	Scenario 3 6%	Scenario 4 7%
[x_1]	Resident Undergraduate	$ 64.50	$ 59.10	$ 62.31	$ 64.79	$ 67.41
[x_2]	Non-Resident Undergraduate	176.00	160.81	159.77	168.46	177.55
[x_3]	Resident Graduate	85.50	86.39	86.39	86.39	86.39
[x_4]	Non-Resident Graduate	211.25	213.31	213.31	213.33	213.33
[x_5]	Resident Professional	84.00	76.95	81.13	84.37	84.80
[x_6]	Non-Resident Professional	215.50	209.38	208.03	217.57	217.57
	Constraints Not Fully Attained (Priority)		14 (P_4)	12 (P_4)	12 (P_4)	2 (P_2) 9 (P_3) 10 (P_3) 11 (P_3) 12 (P_4) 13 (P_4) 14 (P_4)

Despite its simplicity, the goal programming model produced tuition rates that were quite similar to actual tuition assessments. Under scenarios (1), (2), and (3), only one of the fourteen goal constraints was violated, belonging to the lowest priority level. In contrast, seven of the fourteen goal constraints were violated in scenario (4).

Rising educational costs were mainly covered by increases in undergraduate / non-resident tuition, as changes in graduate and professional tuition rates were small. Because goal programming attempts to find the most satisfactory solution, it must be that tuition increases for non-resident / undergraduate students had the least negative impact on maintaining the relationships described by the various goal constraints.

In addition to providing specific solutions, goal programming models also provide information regarding which constraints were not fully satisfied, as illustrated in Appendix 3. To facilitate discussion, the results for scenario (1) are summarized in Table 2.

The single constraint under priority 1 was fully attained. This constraint required tuition and fee revenue to be commensurate with estimated educational costs. Both positive and negative deviational variables were included in the objective function, thus zero values for both imply this constraint was exactly met.

Goal constraints for priority 2 limited maximum percentage increases in tuition rates, therefore, only the positive deviational variables were included in the objective function. All constraints within this priority level were fully attained, as illustrated by the zero values for positive deviations. Five of the six negative deviations, in fact, had non-zero values, indicating

Table 2
Constraint Violations, Scenario 1 (4%)

Priority	Constraint	Overachievement (d+)	Underachievement (d-)
1	1	0	0
2	2	0	6.10
2	3	0	16.75
2	4	0	0
2	5	0	0.021
2	6	0	7.85
2	7	0	8.19
3	8	12.52	0
3	9	0	0
3	10	0	0
3	11	0	0
4	12	0	0
4	13	0	0
4	14	0	4.71

Priority	Nonachievement
P1	Attained
P2	Attained
P3	Attained
P4	4.71

that the percentage increase in tuition was less than the limits imposed by the model.

Priority 3 goal constraints defined specific relationships between the different categories of tuition rates (undergraduate, graduate, professional), holding constant residency status. Constraints 8 and 9 required graduate tuition to be at least 25% greater than undergraduate tuition, therefore, only negative deviational variables were included in the objective function. Both negative deviational variables had zero values, implying these requirements were met. The non-zero value for the positive deviational variable in constraint 8 suggests that resident / graduate tuition exceeded the 25% minimum requirement. Constraints 10 and 11 required undergraduate tuition to be a specific percentage of professional tuition, thus both positive and negative deviations were minimized. These constraints were exactly met.

Priority 4 was the only priority level not fully attained. Priority 4 goal constraints required certain relationships between resident and non-resident tuition within each of the three broad tuition categories (undergraduate, graduate, and professional). Both positive and negative deviational variables were included in the objective function. Of the total six deviational variables, only the constraint for professional tuition rates produced a non-zero value. This constraint required the ratio of resident / professional tuition to non-resident / professional tuition to equal 39% ($x_5 - .390x_6 + d_{14}^- - d_{14}^+ = 0$). Substituting the decision variable values from scenario (1) yields:

$$76.947 - .390\,(209.38) = -4.7112,$$

which is the value for the negative deviational variable (d_{14}^-). Non-achievement of this constraint may also be illustrated by using the model's output to calculate the ratio of resident /

professional tuition to non-resident / professional tuition, as shown below.

$$\frac{\text{Resident Professional Tuition}}{\text{Non-Resident Professional Tuition}} = \frac{\$76.95}{\$209.38} =$$

= .3675 = 36.75% < 39% requirement

Conclusions

Goal programming provides a useful tool for evaluating the tuition structure at the university level. Working with a simple system of four priority levels, the model employed in this application produced a tuition structure similar to that actually determined by university administrators. Moreover, it allows the decision maker to use a series of "what if" variations enabling the impact on decision variables to be clearly defined, as illustrated by allowing changes in estimated educational costs. Goal programming also enables the decision maker to highlight resources or goals which are constraining the system, as seen in this application. Often times, this information is equally as valuable as the model's resulting solution.

Suggestions For Future Research

The potential variations that could be explored in this model are numerous. Goal priorities could be ranked differently, differential weights could be assigned within goal levels, or ratios could be changed. Some constraints, such as those restricting the relationship between resident and non-resident tuition, could be assigned a "range," rather than a single percentage value. Constraints placing both upper and lower limits on the predetermined range could then be given differential priorities. The model could also be modified to include constraints related to fee income. Although the tuition structure at UNL is determined independently of student fees, this may not be the case at other institutions. 🕮

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Endnotes

1. All goal constraints were restricted to the use of information that would have been available to administrators in the 1992-1993 academic year to ensure that the model's results and actual tuition charges were derived from the same information set.

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Appendix 1
Student Enrollment, University of Nebraska, 1992-1993

Fall and Spring Semesters (Combined)

Resident undergraduate 0-6 credits	3,689	Resident undergraduate 7-up credits	31,679
Non-resident undergraduate 0-6 credits	145	Non-resident undergraduate 7-up credits	2,485
Resident graduate 0-6 credits	3,761	Resident graduate 7-up credits	2,517
Non-resident graduate 0-6 credits	491	Non-resident graduate 7-up credits	1,970
Resident professional 0-6 credits	11	Resident professional 7-up credits	764
Non-resident professional 0-6 credits	0	Non-resident professional 7-up credits	92
Total 0-6 credits	8,097	Total 7-up credits	39,507

8-Week Summer Session

Resident undergraduate 1-3 credits	188	Resident undergraduate 4-up credits	214
Non-resident undergraduate 1-3 credits	31	Non-resident undergraduate 4-up credits	22
Resident graduate 1-3 credits	106	Resident graduate 4-up credits	27
Non-resident graduate 1-3 credits	64	Non-resident graduate 4-up credits	13
Resident professional 1-3 credits	0	Resident professional 4-up credits	1
Non-resident professional 1-3 credits	0	Non-resident professional 4-up credits	0
Total 1-3 credits	389	Total 4-up credits	277

5-Week Summer Sessions (Combined)

Resident undergraduate 1-3 credits	4,165	Resident undergraduate 4-up credits	2,915
Non-resident undergraduate 1-3 credits	363	Non-resident undergraduate 4-up credits	317
Resident graduate 1-3 credits	1,890	Resident graduate 4-up credits	933
Non-resident graduate 1-3 credits	835	Non-resident graduate 4-up credits	228
Resident professional 1-3 credits	151	Resident professional 4-up credits	38
Non-resident professional 1-3 credits	2	Non-resident professional 4-up credits	2
Total 1-3 credits	7,406	Total 4-up credits	4,433

3-Week Pre-Session

Resident undergraduate	1,963
Non-resident undergraduate	239
Resident graduate	368
Non-resident graduate	61
Resident professional	43
Non-Resident professional	1
Total	2,675

Appendix 2
Expected Fee Revenue, Forecasted Educational Costs, and Forecasted Tuition Requirements

A. Expected Revenue Generated From Fee Assessments

	Number of Students	Fee Per Student	Total Revenue
Fall/Spring			
0-6 credits	8,097	$82.00	$663,954
7-up credits	39,507	$174.00	$6,874,218
3-Week Session			
All students	2,675	$19.00	$50,825
8-Week Session			
1-3 credits	389	$45.75	$17,797
4-up credits	277	$86.25	$23,891
5-Week Sessions			
1-3 credits	7,406	$31.50	$233,289
4-up credits	4,433	$55.00	$243,815

Total Revenue Generated From Student Fee Assessments: $8,107,789

B. Forecasted Educational Costs for 1993-1994

Scenario	Cost Increase	Educational Costs	34% Requirement
(1)	4%	$158,264,313	$53,809,866
(2)	5%	162,873,668	55,377,047
(3)	6%	167,571,661	56,974,365
(4)	7%	172,359,137	58,602,107

C. Forecasted Tuition Revenue Requirements

Scenario (1)	$45,702,077
Scenario (2)	$47,269,258
Scenario (3)	$48,866,576
Scenario (4)	$50,494,318

Appendix 3
Deviations from Goal Constraints

	Scenario 1 (4%)		Scenario 2 (5%)		Scenario 3 (6%)		Scenario 4 (7%)	
Constraint	(d+)	(d-)	(d+)	(d-)	(d+)	(d-)	(d+)	(d-)
1	0	6.1	0	0	0	0	0	0
2	0	16.7	0	2.88	0	0.244	2.22	0
3	0	0	0	17.8	0	11.02	0	0
4	0	0.021	0	0	0	0	0	0
5	0	7.85	0	0.021	0	0.021	0	0
6	0	8.19	0	3.67	0	0.235	0	0
7	0	0	0	9.53	0	0.737	0	0
8	12.52	0	8.5	0	5.2	0	2.13	0
9	0	0	13.6	0	5.15	0	0	8.61
10	0	0	0	0	0	0	2.28	0
11	0	0	0	0	0	0	10.46	0
12	0	0	3.6	0	3.75	0	2.16	0
13	0	0	0	0	0	0	0	0.009
14	0	4.71	0	0	0	0	0	0.052
	Not Achieved		Not Achieved		Not Achieved		Not Achieved	
	(P4) 4.71		(P4) 3.6		(P4) 3.75		(P2) 2.22 (P3) 21.35 (P4) 2.22	

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