

# A FLIGHT SIMULATOR FOR UNIVERSITY DEPARTMENT PLANNING

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## ABSTRACT

A simulation model for university department planning is presented that allows department chairs, faculty, or administrators to "test fly" their decision choices for key variables in the model, observe the impact of these choices, and learn how to improve system performance, given their respective objectives. Simulator "pilots" have control over average class size and faculty teaching load, and they can observe the impact of their decisions on a number of system variables such as enrollment, percentage of classes taught by part-time faculty, and the number of full-time faculty.

Class size and faculty teaching load were chosen as decision variables to illustrate use of the model at California State University, Long Beach because the CSU System budgeting environment has recently been changed so that sabbaticals and faculty research time must be funded at the department level rather than the university level. Policy constraints on the hiring and firing of tenured, tenure-track, and part-time faculty are considered. Student enrollment is influenced by the university reputation and student success or failure is influenced by SAT scores. Class size is related to student and faculty "burnout" and faculty teaching load is related to faculty morale, quality of teaching, and need for part-time instructors. The academic year budget for a department is determined by recent enrollment trends.

The structure of the model used for this flight simulator is general enough to apply to any educational system.<sup>1</sup> Figure 1 shows a planning model for an academic department that is comprised of four related subsystems or "sectors" and two control blocks. The sectors are Student Acquisition and Assignment, Student Education Process, Faculty and Staff Acquisition and Assignment, and Financial and Physical Resource Acquisition and Application. Each of these sectors is influenced and controlled by the choice of Policy Variables and the calculations implicit in Class Requirements Determination. The model explicitly considers interaction and feedback among sectors rather than treating each sector separately.

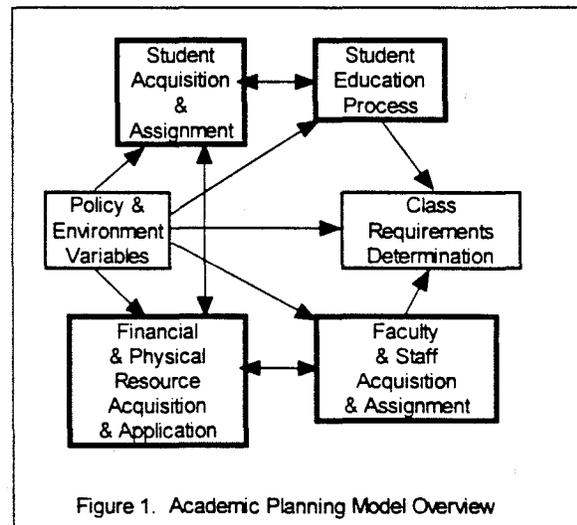


Figure 1. Academic Planning Model Overview

The model also considers the impact of several variables with systemic effects and shows key relationships that are characterized

by complex behavioral patterns. For example, the quality of teaching is likely to change as the knowledge and experience level of instructors change when use of part-time faculty increases. Likewise, faculty may experience "teaching burnout" in conjunction with larger class sizes and fewer research opportunities. "Burnout" effects equally apply to students. As class size increases, the number of sections of core courses decrease, reducing scheduling flexibility of students. In addition, when class size grows, class availability decreases, and the quality of teaching declines, the performance and morale of current students will decline, attrition will increase, and recruitment of desirable new students will be increasingly difficult.

The model assumes a given enrollment environment that leads to a potential market of students. These students are influenced in their decision to actually seek enrollment by SAT scores and the campus reputation. The reputation of the campus is, in turn, determined by reputation of the faculty, the quality of students already attending (as indicated by SAT scores), class sizes and availability, and student fees. The reputation of the faculty is a function of research performed, quality of teaching provided, and extent to which part-time faculty is used. Potential students are those seeking to enroll, but entry is constrained by capacity (as determined by available faculty and financial and physical resources) and the demand of active students continuing their enrollment. Active students continue until they graduate, fail or drop out.

The control panel for the department flight simulator has been designed to keep complexity at a minimum while not limiting the analytical capability of the model. When too many factors are allowed to change simultaneously, it becomes very difficult to sort out cause or determine relative impact for

any given variable. On the other hand, if the flight simulator does not allow users substantial freedom in making decisions and shaping the environment to their liking, then interest is easily lost and the model may be dismissed out of hand as unrealistic, too limited, and therefore not useful for real decision situations. At CSULB, the authors have attempted to deal with this dilemma by providing four pages on the control panel for users to work with.

Figure 2 shows the first page of the control panel. Model users can vary average class size and faculty teaching load and observe graphical output for enrollment, percentage of teaching done by part-time faculty, full-time faculty and other variables of interest. The graphical display shown in Figure 2 is the initial page of a "graph pad" that contains output graphs specified by the user. The output graphs can display multiple variables for a given simulation run (e.g., enrollment, student morale, and percent of sections taught by part-time faculty), or comparative information from different simulation runs for a given variable (e.g., enrollment when class size is changed from 20 to 30 to 40 and so on). Numeric displays are provided for wait-listed students, class capacity, enrollments, number of sections taught, and number of full-time and part time faculty.

The second page of the control panel is a "high-level" map that shows how sectors of the model are related (Figure 1, shown earlier, is a simplified representation of this map). Users can "drill down" into the detail level for each sector by "clicking" on a symbol in the sector's title block. Once a user has accessed the detailed model for a sector, it is possible to "drill down" still further to examine definitions of variables and functional and graphical relationships assumed by the model.

## University Department Budget Planning Flight Simulator

This Simulator has three levels of detail :

- 1) Page1 of the Control Panel provides an introduction to the model and its elements.
- 2) The next level of detail is seen by "clicking" on any of the Sectors shown on the Overview map of the model, Page2.
- 3) The element level is accessed by "clicking" on a specific element to see that element's definition or relationship to other variables.

By changing selected elements, users can see how various management choices will impact the department, the faculty, and the students.

Page 1 is setup so that the impacts of changes to Class Size [slider labeled "Class Size Chosen"] and Sections Taught per FT Faculty [slider labeled "Sectn per FT Fac Chosen"] can be seen on the Graphs on this page

- The Graphs are :
- o Class Enrollments
  - o Number of Fulltime Faculty
  - o Class Enrollments + Number of Fulltime Faculty + Percent of Section Taught by Parttime Faculty

Page 2 shows the sectors of the model. The detail model for any of the displayed sectors can be viewed by "clicking" on the triangle symbol in the sector title block

to Page 2 of 4



Page 3 displays the Faculty and Student Morale Indicators. The graphically defined functions underlying these indicators can be changed at this level (ie., you do not have to go to the model detail level)

Restore Class Size Chosen = 34  
 15  45

Restore Sectn per FT Fac Chosen = 3.3  
 2.0  5.0

Wait Listed Stud... 76.9

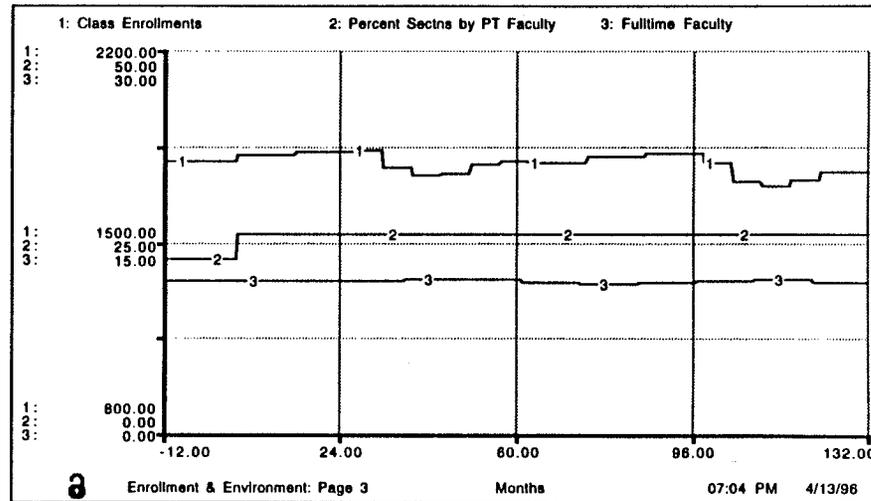
Sections Taught 51.8

Class Capacity 1,759.7

Fulltime Faculty 11.9

Class Enrollments 1,759.7

FTE PT Faculty 2.9



Page 4 contains additional sliders and Graph Pads for user selected variables. [for example, changes to the potential student market such as growth or decline]

Figure 2. The Control Panel (Page 1)

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The third page of the control panel contains two graphical displays that determine student morale and two different graphical displays that determine faculty morale. Also included is a "graph pad" for tracking student and faculty morale either in combination for a given simulation run or individually for different runs. If a user wishes to change any of the functional relationships shown in the graphic displays, the user simply "clicks" on a graphical display, and then "clicks" on the dialogue box version of the graph which appears. A graphical function of any shape can then be specified by "clicking" on the graphical grid of the dialogue box.

The fourth page of the control panel is intended to provide flexibility to expand the scope of the user's investigation. Input sliders and output displays can be added in response to a given user's desires. For example, a user might wish to add a slider for setting an assumed growth rate for the market of potential students.

As users work with the simulator to investigate possible consequences of actions they would like to see taken (e.g., a reduction in teaching load or smaller classes), and as they become more familiar with the model and its assumptions, they may call into question values of parameters and/or the existence or strength of relationships posited by the authors. A key advantage of the model is that the software allows users to make selected changes. For example, the authors have posited a particular inverted, U-shaped curve that shows how class size is assumed to impact student morale. If users do not believe the authors have accurately portrayed the impact of changing class size on student morale, they need only specify their own preferences.

Likewise, as users become still more familiar with the model, it is likely that they

may wish to broaden the range of variables over which they have control. Page 4 of the control panel is designed for this purpose. For example, changes in class size and teaching load impact enrollment, so it is logical for users to wish to examine other factors which will affect enrollment as well. Obvious candidates would be SAT score requirements and tuition fees. It is a simple matter to add input sliders to the model for these or other variables. This was not done on page 1 of the control panel in order to keep complexity at a minimum and to promote better understanding of the interactive effects of only two decision variables.

The simulator presented here illustrates that a simple intuitive approach or even a spreadsheet analysis of the decision to fund sabbaticals and research time by increasing class sizes is inadequate. This is because neither approach explicitly takes into account complex interactive effects. This study also helps to illustrate the importance of taking into account the potentially wide influence of selected decision variables. For example, as class size changes are seen to affect enrollment and pedagogy, enrollment changes may impact admission standards, and changes in pedagogy may affect educational objectives or institutional strategy. Lastly, although the focus of this study was a framework for analysis of department budgeting issues, it is clear that the model lends itself well to problems of enrollment management. By shifting concern from class size and faculty teaching load to admission standards, relative pricing, and growth of potential student population, the model can easily be adapted to address a broad range of other academic planning issues.

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<sup>1</sup> The model was constructed using **ithink** software, Version 3.0.5, High Performance Systems, Inc. 1994, Hanover, NH.