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DATA FELLOWS FOR STUDENT SUCCESS

Dynamic Model of Student Flow

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COLLEGE OF ENGINEERING

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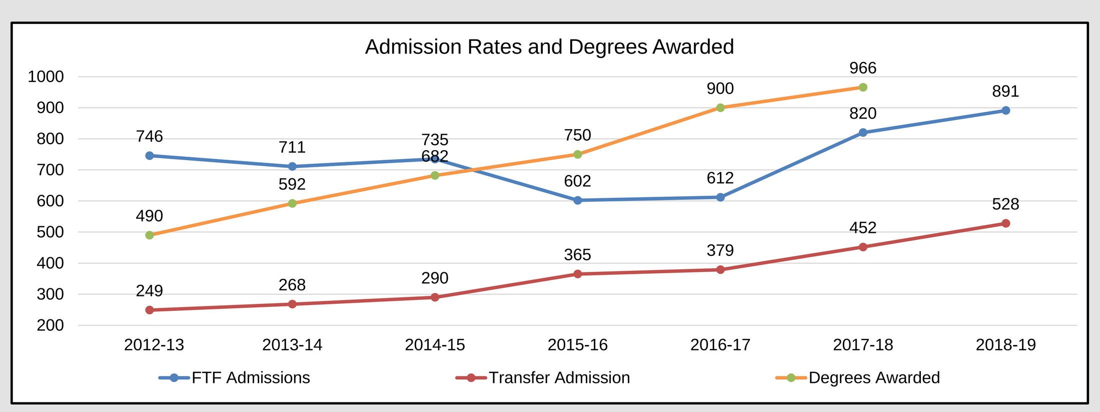
Research Questions

This project uses modeling and simulation to investigate the impacts of increased 4-year graduation rates on College of Engineering (COE) resources. Modeling is used to gain insight into the following questions:

- How will the increased admission sizes in COE impose additional stress on college resources?
- How do substantial increases in student admission impact college resources in the long term?

Introduction

The increase in both 4-year and 6-year graduation rates has necessitated increased admissions to maintain steady college enrollment. To accommodate the incoming student cohorts, the college has had to redistribute resources to provide the necessary support such as increased class offerings, advising and tutoring hours. This places a strain on college resources which has motivated this study into predicting student resource demands.



Methods

To perform this study, an engineering approach to modeling and simulation was employed. Previous approaches found in literature were studied. [1][2] Implemented in MATLAB, this simulation models student flow through 120 units of coursework by dividing it into 15 unit semester *curriculum blocks*. This model is derived from the standard COE 4-year flow models established for each major (Figure 1). Students 'flow' through the curriculum blocks, advancing to a subsequent curriculum block when they have completed 15 units of coursework. Thus, at a particular point in time, the number of students present in each curriculum block represents the students currently working on the associated 15 units of coursework. Input to the model represents *n* incoming First Time Freshmen (FTF) and occurs by cohort at *Block 1* (Figure 2). As the simulation runs for each time period, one of the following outcomes is calculated for each student in *Block K*: (1) the student completes 15-units and advances to *Block K+1*; (2) the student earns a D/F/W grade and stays in *Block K*; (3) the student fails to complete 15 units (i.e., is *slowed*) and stays in *Block K;* or (4) the student withdraws from the university and exits the model. The output from the model was calibrated with with COE data from the Fall 2013 FTF cohort (Figures 3, 6).

Results

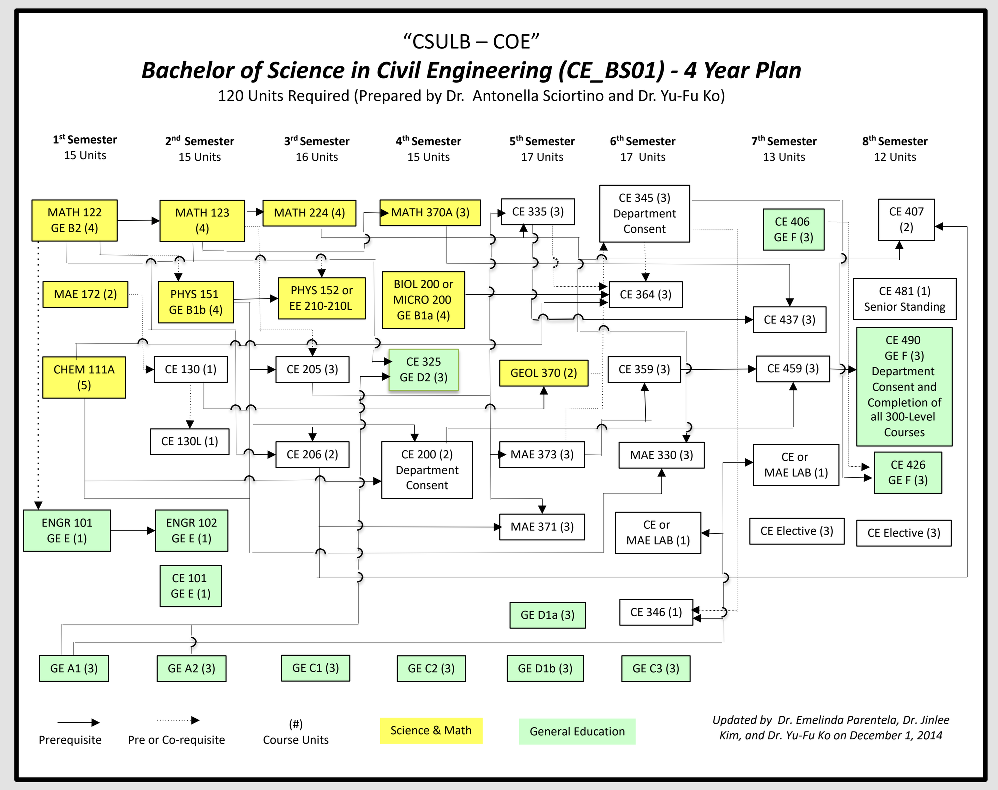


Figure 1. Sample Engineering road map (Civil Engineering)

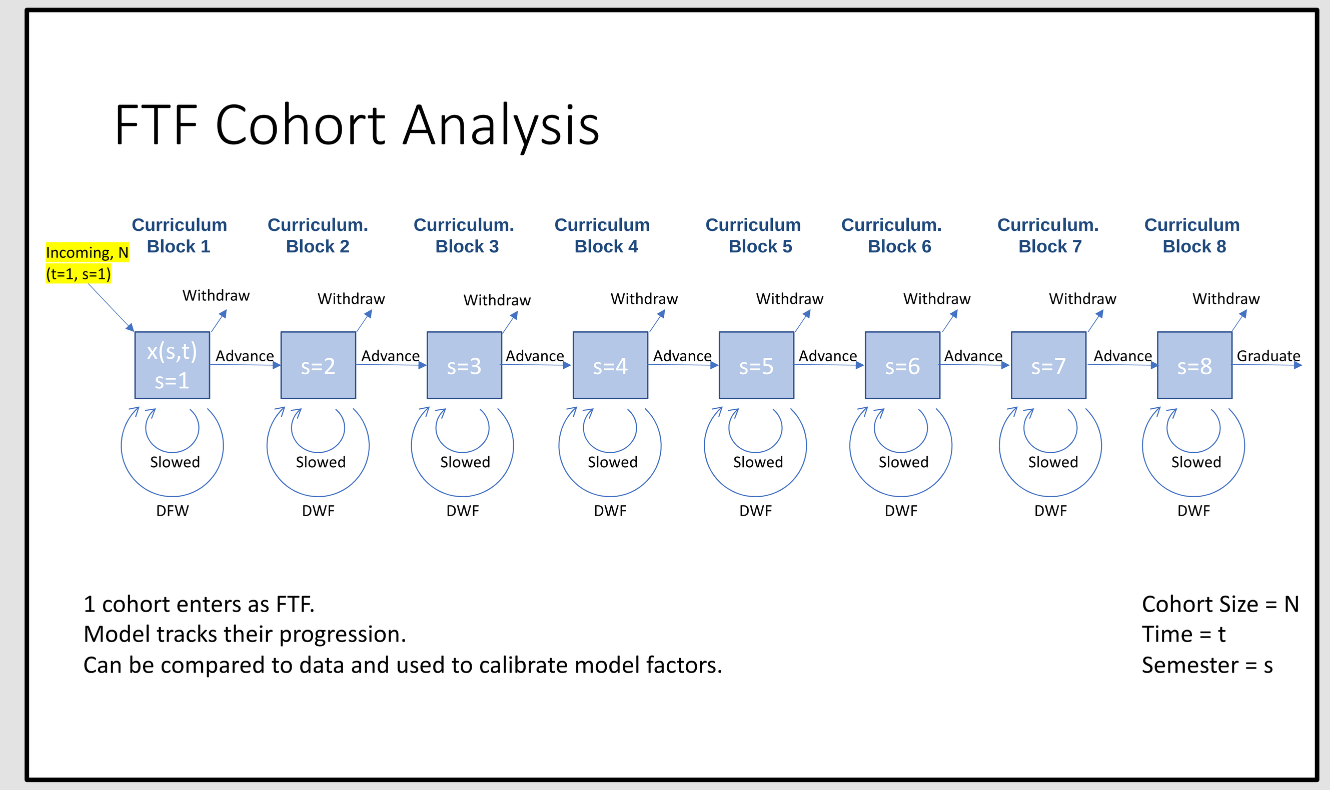


Figure 2. Model for dynamic student flow simulation

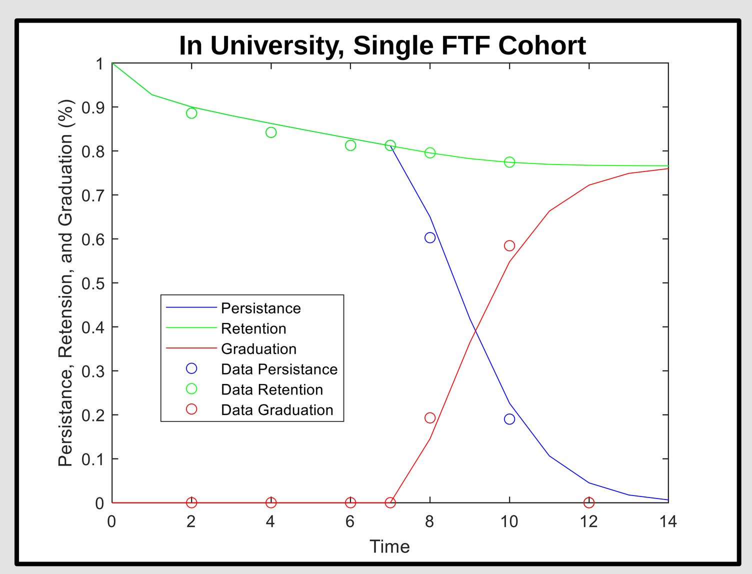


Figure 3. In university, correlation of simulation with actual F'2013 COE data

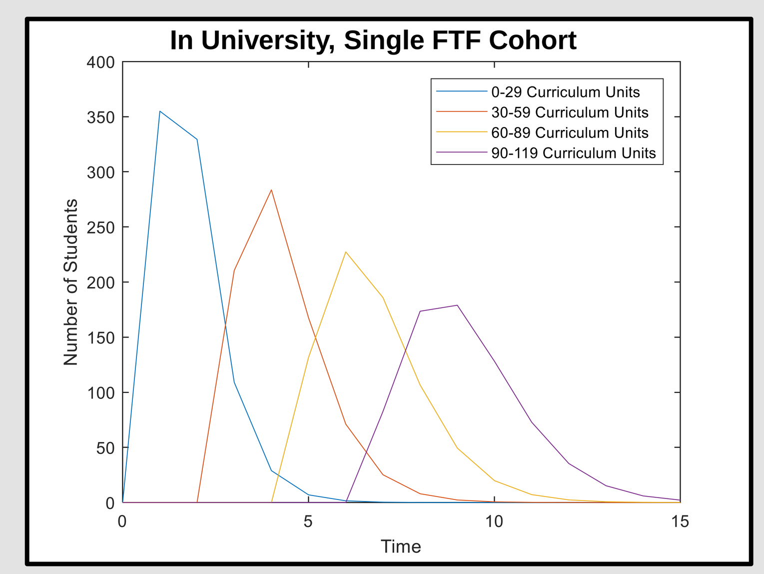


Figure 4. In university, number of COE students by 30-unit curriculum blocks over time (from 0 to 15 semesters)

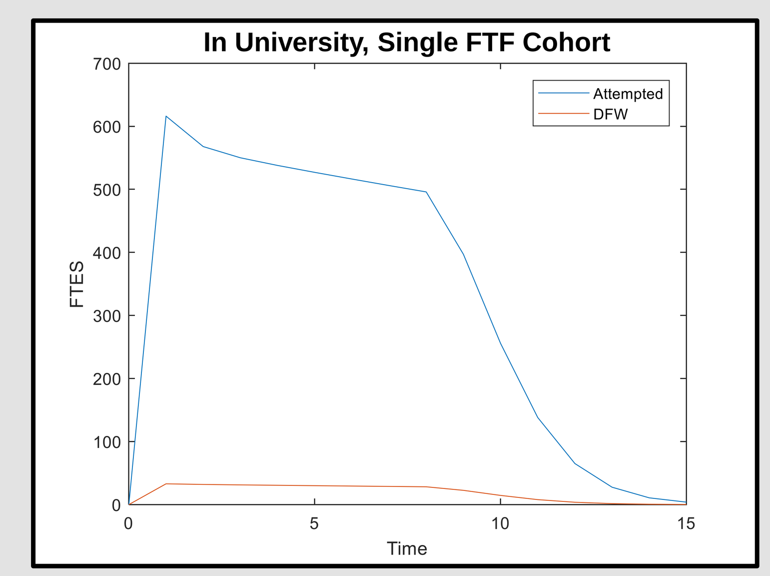


Figure 5. In university, total attempted FTES over time (from 0 to 15 semesters)

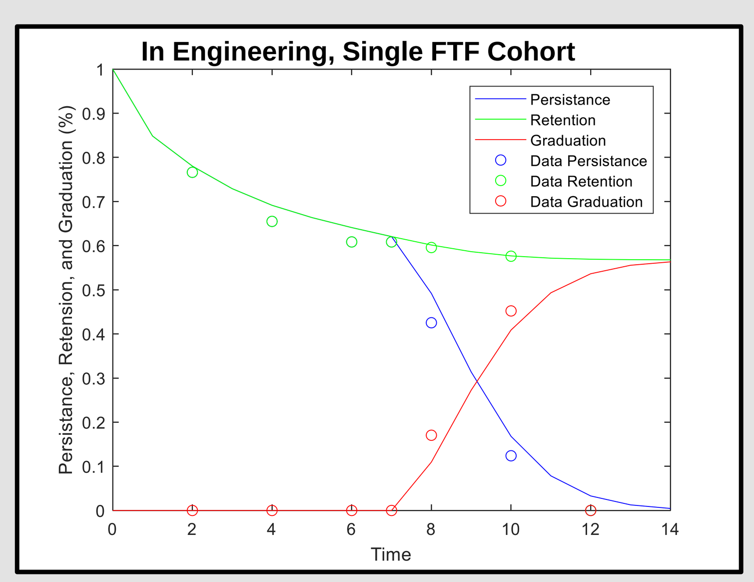


Figure 6. In COE, correlation of simulation with actual F'2013 COE data

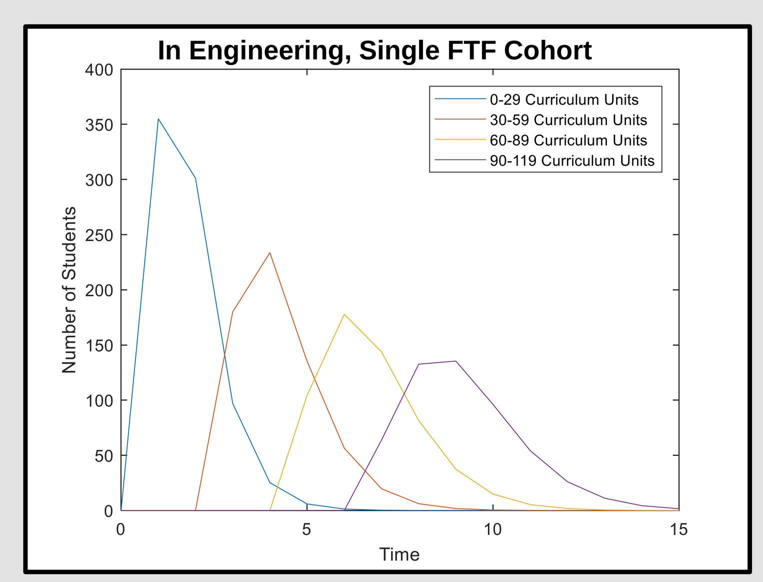


Figure 7. In COE, number of COE students by 30-unit curriculum blocks over time (from 0 to 15 semesters)

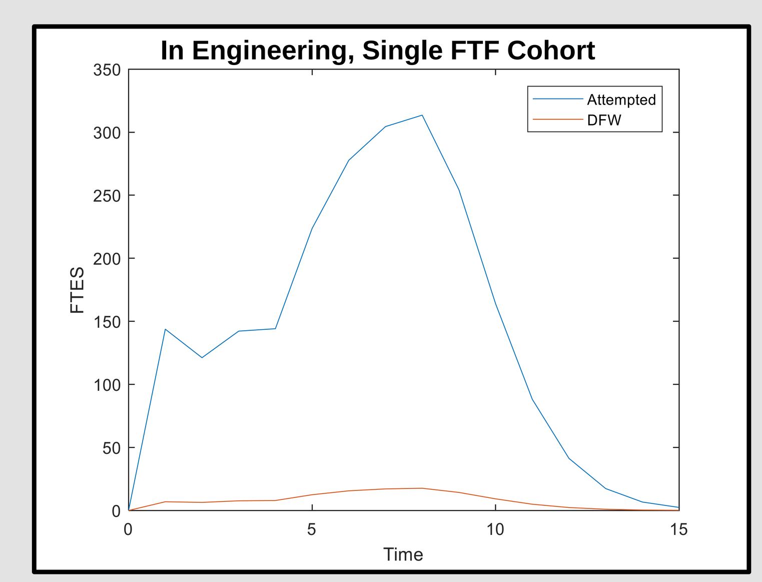


Figure 8. In COE, Total Attempted COE FTES over Time (from 0 to 15 semesters)

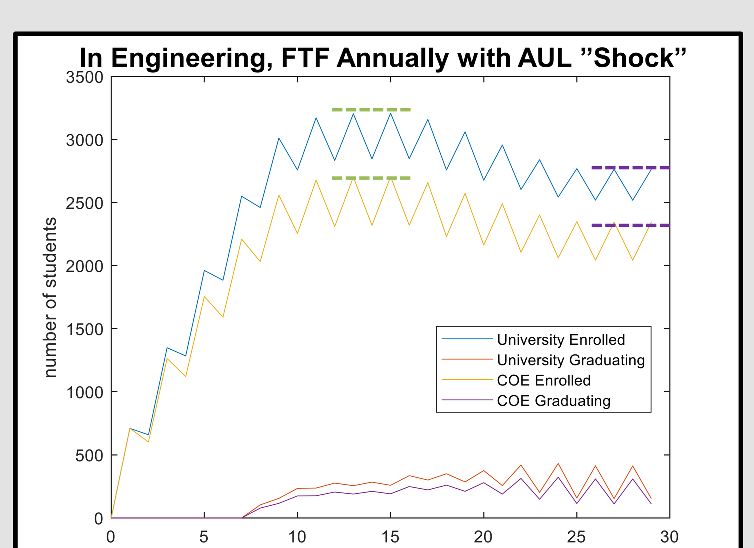


Figure 9. No. of Students with FTF admissions (*n*=710) annually, AUL=12.9 units, until steady-state – then AUL "shock" with (AUL=15)

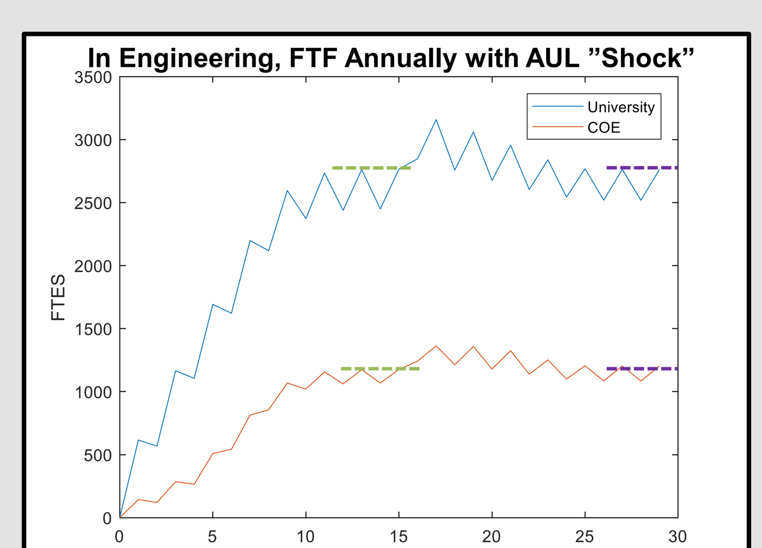


Figure 10. FTES with FTF admissions (*n*=710) annually, AUL=12.9 units, until steady-state – then AUL "shock" with (AUL=15)

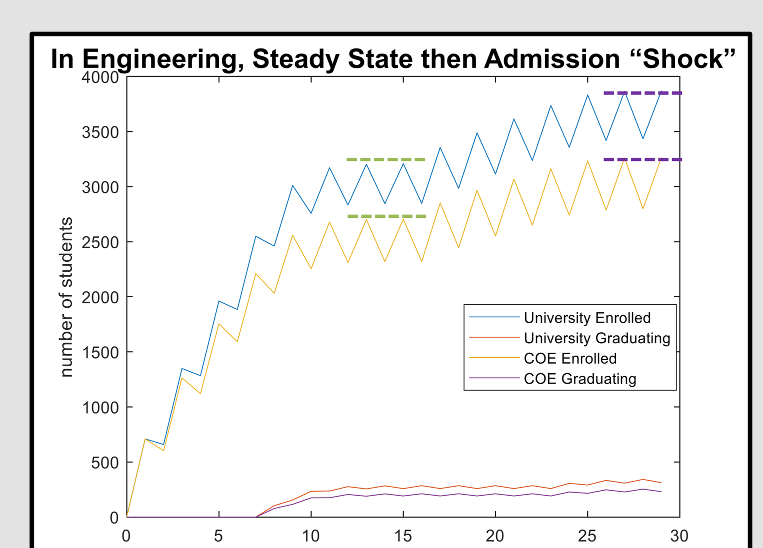


Figure 11. In COE, FTF admissions (*n*=710) annually, AUL=12.9 units, until steady-state – then Admissions "shock" with (*n*=865)

Discussion

- Figures 3 and 6 show the correlation of simulation results to actual COE Data.
- Examining Figures 4 and 7, the curve for 0-29 Curriculum Units 'In Engineering' has a steeper decrease than the corresponding curve for 'In University'. This difference is the result of first-year Major Specific Declaration Requirements and the migration of COE students.
- Figures 5 and 8 demonstrate the differences between units taken in COE and in other colleges. For the first two years, over half of the units are taken outside of COE. This is consistent with Figure 1. Any increase in enrollment is likely to impact COE during semesters 5 to 10.
- Figure 9 shows simulation results for student enrollment with FTF admissions (n=710) occurring each Fall. An Average Units Load (AUL) "shock" occurs at semester 15 and then at 27 semesters reaches a new steady-state.
- Figure 10 shows FTES over time with AUL "shock" occurring at semester 15 when the system is in steady-state. Results show it takes a period of 6 years to stabilize after the shock assuming sufficient resources are available.
- Figure 11 shows an admission 'shock' occurring at semester 15 when the system is in steady-state. *n* is increased from 710 to 865 students. Re-stabilization of enrolled students takes 6 years.

Implications for Action

Although this dynamic model is currently in its initial implementation phase, two areas for possible action are already apparent:

- Further analysis of admission and AUL "shocks" will be used to provide practical information for optimizing future schedule and resource planning.
- There seems to be a correlation at the end of 8 semesters between a high rate of attempted FTES and an increase in D/F/Ws. This should be examined.

Next Steps / Future Directions

- Incorporate transfer cohorts into the model.
- Study the impact of FTF entering with AP or IB credits.
- Utilize model to find steady-state enrollments needed to meet Graduation Initiative 2025 goals.

References

[1] O Duarte and C Márquez, "A Model of Student Flow through the College Curriculum," 14th LACCEI Multi-Conference for Engineering, Education and Technology, 20-22 July 2016, San Jóse, Costa Rica.

[2] RM Saltzman and TM Roeder, "Simulating student flow through a College of Business for policy and structural change analysis," The Journal of the Operational Research Society, Vol. 63, No. 4 (APRIL 2012), pp.511-523.