Course-taking Patterns of Community College Students Beginning in STEM: Using Data Mining Techniques to Reveal Viable STEM Transfer Pathways

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Study's purpose

- **Explore and identify patterns of course-taking that are common to those students who successfully transfer in STEM versus other transfer outcomes**

Data Source and Study Sample

- Beginning Postsecondary Students Longitudinal Study (BPS:04/09) and Postsecondary Education Transcript Study (PETS:09)

- Sample restricted to beginning postsecondary students at community colleges who were enrolled in at least one non-remedial STEM course during the first year of postsecondary attendance, ≈2,810

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Data Preparation and Formulation

- The first step was to extract all postsecondary records of each individual student
- (a) "likely transferrable" STEM courses; (b) "likely terminal" STEM courses; (c) mathematics—courses within CIP 27 category, except for those designated as remedial math; (d) English—courses within CIP 23 category, except for those designated as remedial English; (e) remedial courses; and (f) other.
- The main "outcome" measure indicates upward transfer among STEM-aspiring students beginning at community colleges. This measure was coded into three possible outcome scenarios:
  - (a) upward transfer in STEM, if, over the 6-year period, students' transcript data indicate transfer into a baccalaureate program in the STEM CIP codes as indicated above (i.e., CIP 01, 03, 11, 14, 15, 26, 27, 40, 41, and 47);
  - (b) upward transfer into non-STEM fields; and
  - (c) did not transfer into a baccalaureate institution.

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Data Analyses: Several data mining techniques

- Apriori algorithm: Frequent pattern/association rule
  - A pattern indicating that an itemset A occurrence implies that another itemset B also occurred, i.e., A⟹B (if A then B)
  - Provide insight into sequence of course-taking
- Decision List Algorithm
  - Added advantage of combining binary, categorical, or continuous predictor variables as the antecedent or consequent variables.
- Decision tree (or classification rules) data mining
  - Student demographic data fields were joined to the course dataset to help examine the relationship between student characteristics and course-taking behavior
  - Multi-dimensional association rules mining to examine whether course-taking pathways to STEM transfer differ among racial and gender groups

Selected results

- During the study's 6-year observation window, after appropriate weighting:
  - roughly 3.7% of the STEM-aspiring students beginning at community colleges transferred into a 4-year STEM major
  - 23.2% transferred into a 4-year non-STEM major
  - 73.1% did not transfer to a 4-year institution.
- Among STEM transfer students
  - 55.5% were male students and 44.5% were females
  - Relative to their share in the total sample (28.1%), underrepresented minority students reported a lower percentage of transfer outcomes in both STEM (18.6%) and non-STEM areas (24.8%)
  - Similar disparities were observed, indicating that students who were single-parents, first-generation, non-traditional age (i.e., age 24 and above), or with low high school GPAs were less likely to transfer upward into STEM or other areas of study.

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Selected results: Apriori algorithm

- In general, "antecedent" course-taking patterns that result in transfer in STEM as a "consequent" involve a combination of "likely transferrable" STEM courses and math courses in the earlier terms of students' community college attendance.

Consequent (Transfer Outcome)	Antecedent
STEM	SP04: Tr. STEM & FA04: Tr. STEM, Math & SP05: Tr. STEM, Math
STEM	SP04: Tr. STEM, Other & FA04: Tr. STEM, Math & SP05: Math
STEM	SP04: Tr. STEM & FA04: Math & SP05: Tr. STEM, Math
STEM	SP04: Tr. STEM & FA04: Tr. STEM, Math & SP05: Math
STEM	FA03: English & FA04: Tr. STEM, Math & SP05: Tr. STEM, Math
STEM	FA03: Tr. STEM & SP04: Math, Other & SP05: Tr. STEM, Math
STEM	FA03: Tr. STEM & FA04: Math, Other & SP04: Tr. STEM, Other
STEM	FA03: English & SP04: Tr. STEM, Other & FA04: Tr. STEM, Math & SP05: Tr. STEM

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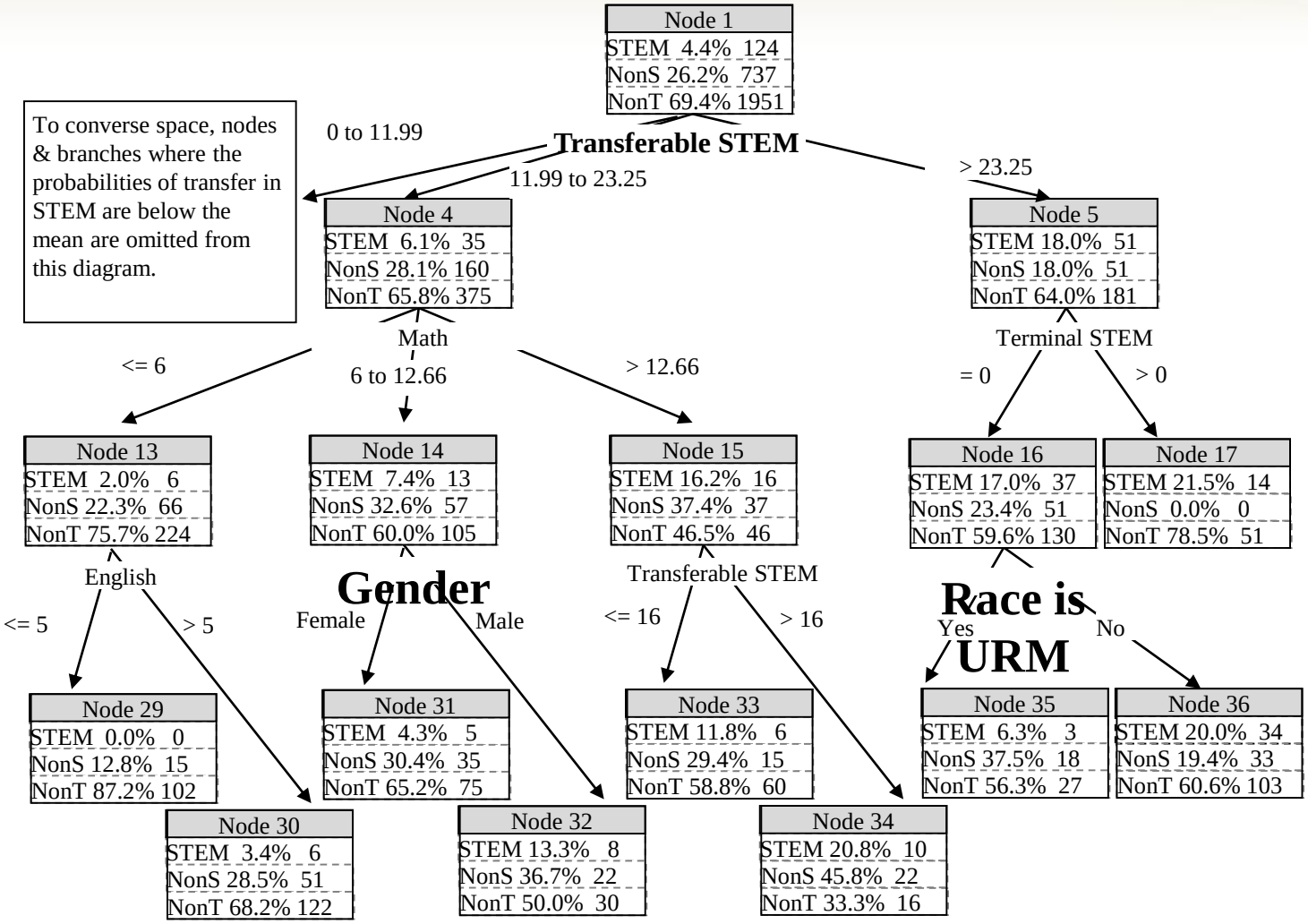
Selected results: Decision List

- Complete at least four likely transferrable STEM credits; beyond that, the greater the "dosage" of STEM courses, the more likely that students transfer in STEM. To accompany "likely transferable" STEM courses, three to four credits in math seem optimal.

Outcome = Transfer to 4-year STEM	
All Cases	
FA03: Tr. STEM > 4 & SP04: Math > 3	
SP05: Tr. STEM > 5, Math > 3	
SP04: 3 < Math ≤ 4, Tr. STEM > 3	
SP04: Tr. STEM > 4.67 & FA04: Tr. STEM > 3	
SP05: Tr. STEM > 5	

Selected results: Decision Tree



Implications

- Curricular and programmatic design that aims to facilitate transfer in STEM must feature a coherent, well-scaffolded sequence combining transferrable STEM and math courses.
- The persistent gender and racial gap in access to STEM programs of study warrants continued research and policy interventions.
- It is critical to further involve analysis of transcript data, as transcripts form the map of a student's engagement with the community college

Thank You!

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