Scheduling for Engineering Advising - ENGRG 1050 Matching Tool

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Introduction

Background:

- ENGRG 1050: Engineering Seminar is a 1-credit class that Freshman engineering students take to learn about Cornell's engineering curriculum, explore career paths, and connect with a faculty advisor

- Scheduling students and advisors for ENGRG 1050 courses is not ideal: takes around 25 hours for the Engineering Advising office to match manually, and historically, only 80% of students are matched with their first choice advisor

Sections created by hand using a hand-drawn calendar and post-it notes

Objectives:

- Optimize the section scheduling and student-to-advisor matching process by formulating an Integer Linear Program

- Increase students' and advisors' likelihood of being matched to their preferred major sections, and generate gender- and ethnicity-balanced sections that do not isolate minority students

New Survey Design:

To minimize time spent on processing the data before inputting into our model, we created a new advisor survey that significantly reduces room for free responses and substitutes it with drop-down menus and checkboxes while constraining response data types

Model Formulation

Objective function:

- Maximize the number of students assigned to an advisor's preferred major weighted by the number of allocated points

$$\text{Max} \sum_{i \in Students} \sum_{j \in Advisors} \sum_{k \in Majors} (\frac{points_{ik}}{max\_points_i})^2 * P_{ijk} + (\frac{points_{ik}}{max\_points_i})^2 * S_{ijk} * \frac{1}{10} - 1000x - 1000y$$
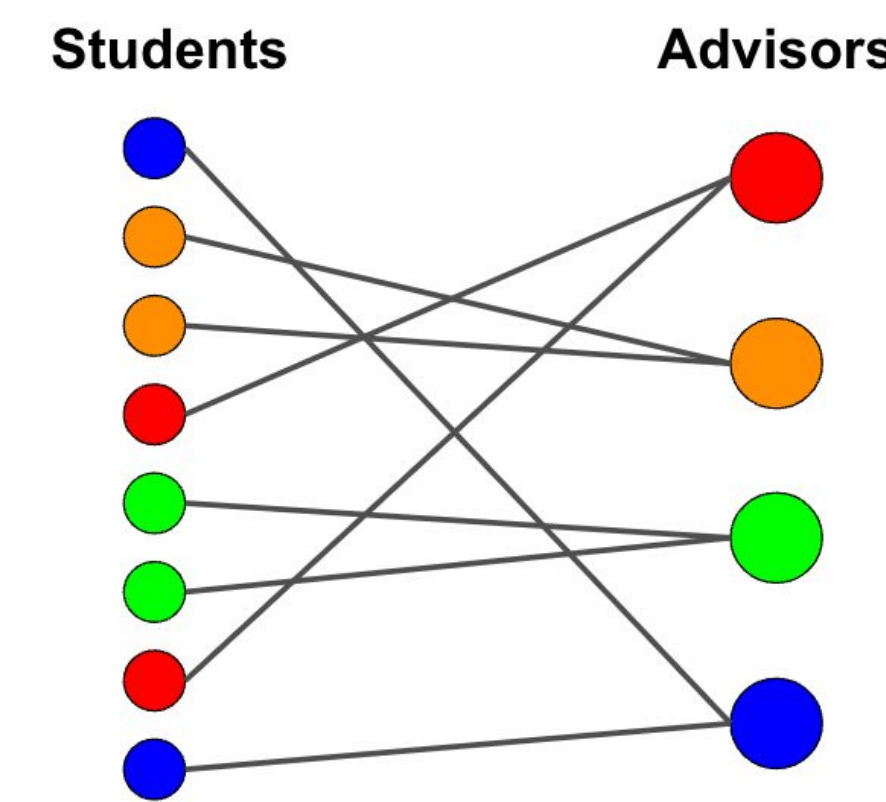
Students   **Advisors**

- *Matching ~750 students to ~45 advisors based on their preferences*
- *Different colors represent different preferred majors*

Constraints:

- <u>Student Constraint</u> Each student is assigned only to one advisor with a major they allocated at least one point to during a time slot that does not conflict with a major-required classes

- <u>Advisor Constraint</u> Each advisor is matched to exactly one time slot they have listed as available and with a major they have listed in their preferences or with a major similar to their home department; advisors can also request to be paired with a specific advisor (i.e., assigned to the same time slot)

- <u>Diversity Constraint</u> Each section has 1 advisor and between 14 and 21 students without disadvantaging any minority or gender group (30-70% female students and no minority or Hispanic student is singled out in a section)

- <u>Number of Majors Constraint</u> Number of majors to be 2 or 3 if the section only has 14 students

- <u>Room Capacity Constraint</u> Only 3 sections can be scheduled during morning time slots and 5 sections can be scheduled in the afternoon times
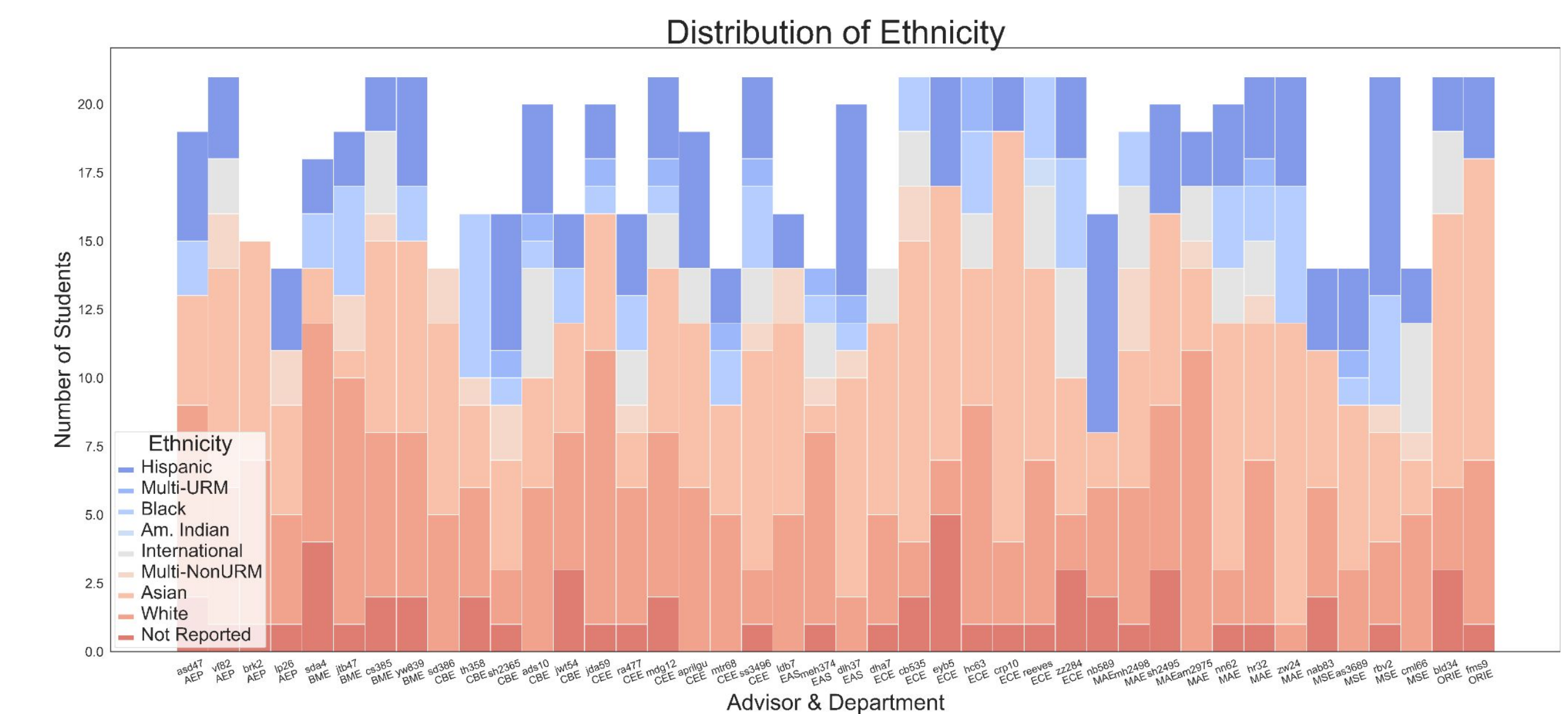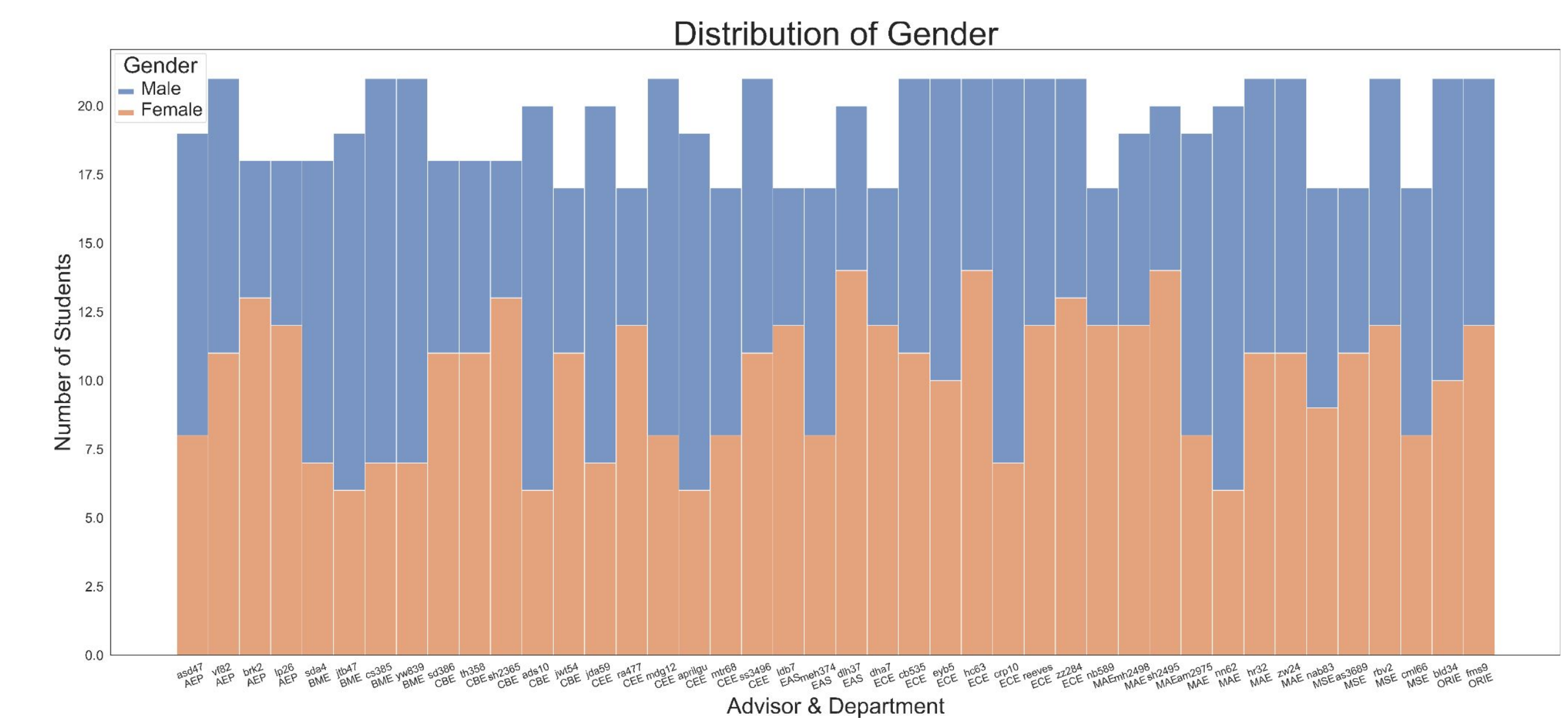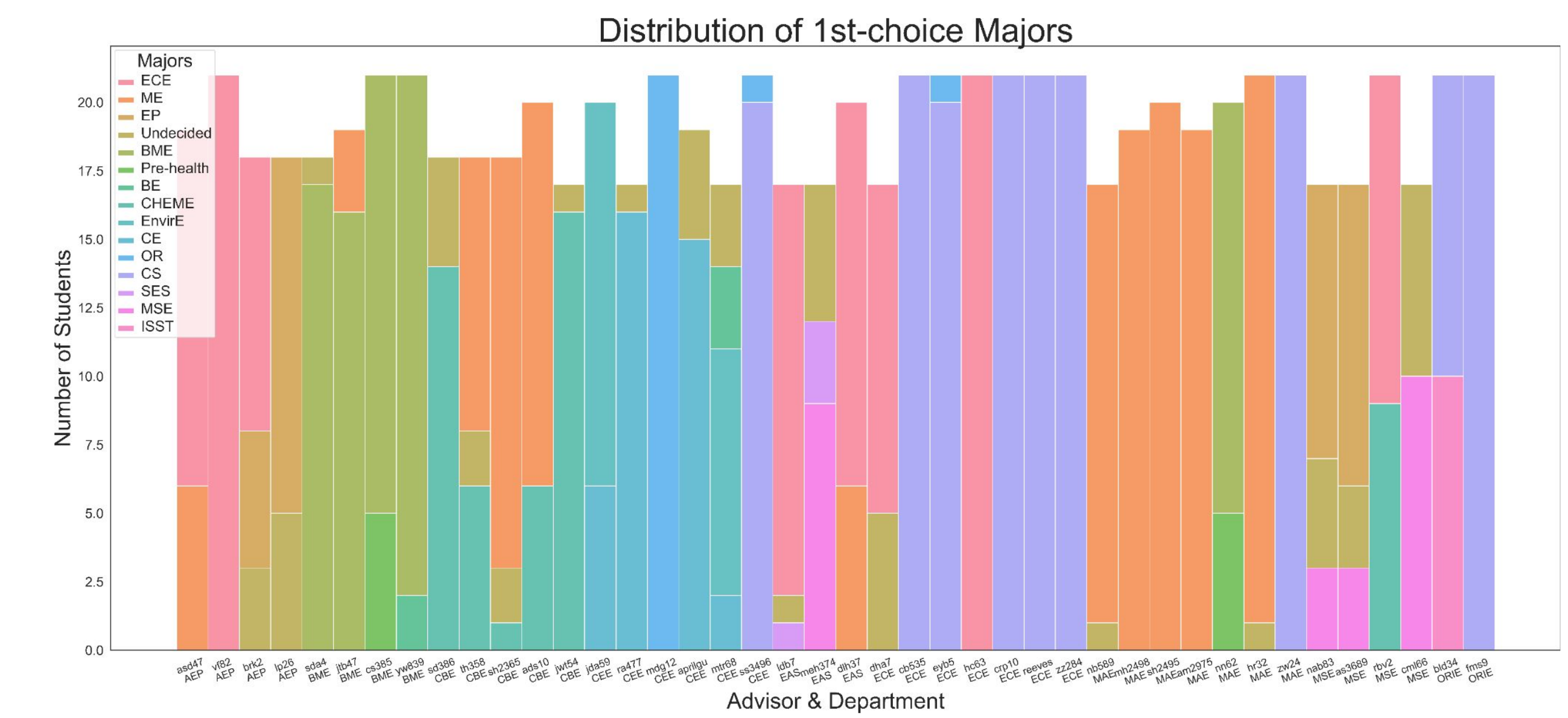
Times	1050 Section	Notes
9:05	CEE	Error: conflicts with MATH 1910, a requirement for CEE majors
10:10	MechE BioE ORIE Material Science	Error: Cannot have more than 3 classes in morning slots for student convenience
11:20	BioMedE	Pending
12:25	ChemE CS	Error: conflicts with Intro to Chemical Engineering, a class that most ChemEs will take
1:15	EAS ECE	Pending
2:20	Physics ISST	Pending

Times	1050 Section	Notes
9:05	ORIE MechE	Approved
10:10	PHYS CEE	Approved
11:20	BioMedE Material Science	Approved
12:25	ECE CS	Approved
1:15	EAS ChemE	Approved
2:20	Physics ISST	Approved

An initial schedule, with errors as labeled

A sample schedule with resolved conflicts

Results

Distribution of 1st-choice Majors

Distribution of Gender

Distribution of Ethnicity

- The model provides visualizations that allow staffs from Engineering Advising to decide between different matching schedules (see sample outputs above)

- Most advisors are matched to their preferred major sections

- We ensured diversity in the sections by balancing gender and ethnicity ratios

Future Work

- Continue the transfer of the tool from Excel + AMPL to Jupyter Notebook entirely
- Reconstruct the raw data input by designing new advisor survey
- Coordinate with Engineering Advising to refine model objective, constraints, and visualizations