Brown Mathematical Contest for Modeling
Solutions due Saturday, January 16 at 5pm ET

Choose one of the two problems proposed below. Submit your model report (and summary) to rebecca_santorella@brown.edu, angelina_grosso@brown.edu, and kevin_hu@brown.edu by **Saturday, January 16 at 5pm ET**. Reports received after this time will not be considered.

Your report should start with a cover sheet that includes the following information: names of your team members, title of your report, and which problem you chose to solve. The rest of the pages in your report **should not include your team members' names**. Remember to reference your sources at the end of the report.

Problem 1: Why can't I find a spot? Parking on the Brown campus

Parking at Brown is currently controlled by the Transportation Office, and a very common complaint among faculty, staff, and students is that there are never enough parking spaces in convenient places on campus. Parking on campus includes lots and street parking, but the general public also uses much of the street parking. Employees, emeriti, graduate students, medical students, and a limited number of junior and senior undergraduates are allowed to purchase parking permits. Permits for visitors and contractors are also available based on availability.

You are tasked with helping the Transportation Office figure out how to best allocate parking spaces. **Devise a strategy to allocate parking spaces to different classes of parking pass holders. This strategy should seek to maximize both profit and the number of occupied parking spaces.** While devising your strategy, remember to keep in mind

- How the location influences the demand of individual parking spaces.
- Which groups of people are interested in individual parking spaces.
- How the time of day and/or season may influence the demand for certain parking spaces.

You may use a simplified model of Brown University and the surrounding parts of Providence while devising your strategy. As public behavior has been vastly influenced by the circumstances of COVID-19, you may assume this strategy will be implemented post-pandemic. In other words, your strategy should assume activity is not hindered by lock-downs, restricted movement, or reduced personnel on campus.

If your results suggest that additional parking spaces are needed to accommodate usual (post-pandemic) use, make a recommendation as to how many and where these spots should be added. Be sure to justify why the benefit of adding these extra parking spaces would outweigh any cost required to add those spaces.

In addition to your full report, write a maximum one page summary to President Paxson and the directors of the Transportation Office outlining your findings and clearly stating your recommendations to reform Brown University parking.

Problem 2: Random Assignment of Cases

In the United States, federal court cases are supposed to be randomly assigned to judges within a district. The majority of courts claim to use some form of random drawing for assignment; however, in practice, such random assignment often does not occur. For example, in the Southern District of New York, one judge was responsible for seeing nearly all stop-and-frisk cases due to the local "related cases" rule, which allows judges to accept new cases related to ones already on their docket. Judges can also be assigned non-randomly due to geographical constraints such as where the case was filed or may be recused from cases due to potential conflicts of interest or scheduling conflicts.

Recently, Ciocanel *et al.* compiled a data set of criminal sentencing decisions made in federal district courts from 2001-2019. This data set contains defendant demographic information, sentencing details, judge information, district information, and more. The full data set as well as a codebook and further descriptions can be found here.

The Rhode Island state government is concerned that their process may not be randomly assigning judges, so they have tasked you with coming up with a new method. **Specifically, you must**

(a) Devise a strategy for random assignment of cases to judges in a district. Clearly specify what factors you are considering in the random assignment.

(b) Propose clear measures that can be used to assess whether cases in a district have been randomly assigned or not.

(c) Use your method to check if cases have been randomly assigned or not in Rhode Island by using the JUSTFAIR data set. Consider checking at least one other district of your choosing.

As you work on this task, you should keep the following in mind:

- There are legitimate reasons that a judge should not be assigned to a case.
- Factors to consider include (but are not limited to) defendant race, gender, nationality, age, criminal history, education level.
- The JUSTFAIR dataset accounts for only around half of all federal criminal cases in the United States.

Write a detailed technical report to explain your model and findings to the Attorney General's office. In addition to this report, write a short letter to Attorney General Neronha informing him of your recommendation on strategies for assigning judges and explaining the main results of your analysis.

See the next page for some notes on the JUSTFAIR data set

Data Set Notes

The JUSTFAIR data set is quite large, so here is a quick guide to some important variables (with full details in the data dictionary). To reduce the amount of data, you may want to restrict to one district through the CIRCDIST variable then save this new data set. CIRCDIST = 6 corresponds to Rhode Island, and the full list can be found in the USSC codebook in Appendix A-1. Table 1 contains more variables that may be of use.

Variable	Description
AGE	Identifies the age of the defendant at the time of sentencing.
CIRCDIST	Districts in the order in which they appear in the Commission's Sourcebook of Federal Sentencing Statistics.
CITIZEN	Identifies the nature of defendant's citizenship with respect to the United States.
CRIMHIST	Indication as to whether the defendant has any criminal history or law enforcement contacts, including behavior that is not eligible for the application of criminal history points (ex. arrests).
CRIMPTS	Subtotal of criminal history points applied, based on the contributions of one, two, and three point offenses.
judge	Judge name as extracted from Wikipedia court district pages.
NEWEDUC	Highest level of education for offender.
NEWRACE	Race of defendant
MONSEX	Indicates the offender's gender.
OFFICE	The code of the district office where the case was located.
PRISTOT	The total prison time for all offenses of which the defendant was convicted and prison time was imposed.
PROBATN	Total probation ordered, in months.
SENTDATE	The date on which the defendant was sentenced. Field not on datafiles after FY2004.
SENTMON	Sentencing month. Field not on datafiles prior to FY2005.
SNETYR	Sentencing year. Field not on datafiles prior to FY2005.

Table 1: A (non-exhaustive) list of helpful variables in the JUSTFAIR data set.