Brown Mathematical Contest for Modeling Solution due Sunday, November 6th at 10am

Choose <u>one</u> of the two problems proposed below. Submit your model report and anything else that the problem might ask for in a zip file to <u>bmcm@brown.edu</u> by **Sunday**, **November 6th at 10** am. Reports received after this time will not be considered.

Your report should start with a cover sheet page 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 <u>not</u> include your team members' names. Remember to reference your sources at the end of the report.

Problem 1: Elementary Primary

The United States presidential election is coming up very soon, and the two major parties are battling it out for control over the White House. Currently, the states of Iowa and New Hampshire are the first to host primaries in both parties. Candidates who perform poorly drop out after the first few primaries.

There are complaints that the first few states of the current system are not representative of the general population, and the results in these states may determine strong candidates (who would otherwise win in a general election) to drop out. On the other hand, the current system allows lesser-known candidates to be competitive against the more established ones.

Consider a list of only 10 states with primaries for the national election: Iowa, New Hampshire, South Carolina, North Carolina, Florida, Colorado, Alabama, Texas, Massachusetts and California; furthermore, consider only the two major (Democratic or Republican) parties. You have 41 hours to determine a metric for the optimal order of states that a party may use in hosting a primary such that the candidate most likely to win in the national election (i.e. all 50 states) will be selected. Apply your metric to these states and explain your results.

Keep in mind:

- The candidate predicted by your metric should be the most likely candidate to win the general election for that particular party.
- Candidates start out with various amount of support, and money. Starting with a large state would greatly favor a more established candidate. A smaller state would allow a more equal playing field.
- Residents of current swing states (i.e. North Carolina, Florida) do not enjoy being bombarded with advertisements. If one were to start with these, some of the residents might be jaded up to the point of not voting.
- The role of minorities, Catholics or other large voting blocs is different in each state, and may show different voting trends.

On top of your model report, write a half page op-ed piece to the New York Times on why your ordering should be adopted instead of the status quo.

The US census bureau runs a website with many statistics that might be pertinent to this problem.

Note: while this topic is inherently political, please treat this as unbiased as possible. Mathematicians sometimes have to model situations which they might object to.

Problem 2: Providence Pokémon Po

With the overwhelming popularity of Niantic's Pokémon Go! app, multiple game developers are jumping at the opportunity to cash in on the success. The Providence, Providence Pokémon Po, is now being beta tested, and you have been tasked with some of the algorithm development. The game is played on a coordinate grid and has many features similar to the Pokémon Go! Game.

Poké appear at random locations on the map at intervals of (on average) 30 minutes. The Poké stay there for a fixed amount of time (15 minutes) and then disappear. Each Poké has a point value associated with it, ranging from 1 to 20 points. The lower valued Poké are fairly common, but the high point valued ones are quite rare.

Your goal is to develop an algorithm to move around the map to collect as many points as possible in a 12 hour period. You have 41 hours to accomplish this, as well as to give an estimate for the expected number of points your algorithm can earn you in a typical 12 hour period.

At first glance this problem may seem like a "Traveling Salesperson Problem", but don't be fooled! Since we never know where or when the next Poké will show up, decisions need to be made based on imperfect information that changes over time. Make sure you discuss strengths and weaknesses of your model in your report.

The dataset "Providence_Pokemon.xlsx" contains data from the last 42 days of Poké appearances in a 4 mile by 4 mile downtown grid (broken into a 10 by 10 grid). You can use this data to build and test your model. Just like the Pokémon Go! game, Providence Pokémon Po is meant to be played by people who walk from location to location. Be sure to consider this in your model. Also note that the grid is meant to represent the layout of streets in a downtown-type area with buildings, businesses, restaurants, pedestrian traffic, and residents (so no cutting diagonally across).

Besides your model report, your supervisor required that you write a half-page non-technical summary of your approach and predictions to be shared with the team.