Montana Mathematical
Modeling Challenge
2017

Electoral *Community* College

Every four years the Electoral College (EC) elects the U.S. President. In all but two states (Nebraska and Maine) the vote cast by each Elector is expected to be consistent with the winner of the plurality vote of the state they represent.

Because of the EC, presidential candidates typically focus their campaign resources on states where the vote is predicted to be close (commonly referred to as a "battleground" state). A commentary published soon after the 2016 election noted the following[1]:

"...53 percent of campaign events for Trump, Hillary Clinton, Mike Pence and Tim Kaine in the two months before the November election were in only four states: Florida, Pennsylvania, North Carolina and Ohio. During that time, 87 percent of campaign visits by the four candidates were in 12 battleground states, and none of the four candidates ever went to 27 states…"

Another result of this state-by-state "winner-takes-all" approach to allocating EC votes is that a candidate can win the presidency without winning the national popular vote, causing Americans to question the value of the EC system. In fact, since the ratification of the Constitution, there have been at least 700 proposed amendments to modify or abolish the EC - more than any other subject of Constitutional reform.

Consider the following proposals for changing the EC:
- **The Proportional Plan** divides each state's electoral vote to mirror its popular vote.
- **The District Plan** awards two electoral votes to the state's popular vote leader and the others to the winner in each congressional district.
- **The Bonus Plan** retains the current Electoral College system, but also awards an extra 102 electoral votes (two for every state and two for Washington DC) to the winner of the popular vote.

For each, develop a mathematical model that will provide a campaign with a plan for how to allocate campaign resources in the event that EC rules change.

The following links may help you get started:
- 538.com's article *The Last 10 Weeks Of 2016 Campaign Stops In One Handy Gif* (https://fivethirtyeight.com/features/the-last-10-weeks-of-2016-campaign-stops-in-one-handy-gif/)
- Use this web-based app (http://nj-travel-tracker.herokuapp.com/) to find the number of visits presidential candidates made to different U.S. cities while on the campaign trail.

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[1] http://www.newsweek.com/arguments-favor-electoral-college-wrong-522439

A Song of Fire and Glaciers

Glacier National Park is a popular tourist destination for hikers and campers in the summer. Many of the campsites in the park are accessible only on foot, and most require a substantial amount of hiking and/or climbing to reach. While this can be idyllic for outdoor enthusiasts, it can also be hazardous during drought summers. On August 10, 2017, a forest fire was spotted burning near Lake McDonald in the southwestern portion of the park. On August 12, 2017, another fire started near Logging Lake in the northwest part of the park. To date these fires have burned more than 20,000 acres, causing the evacuation and closure of at least 8 back-country campgrounds and numerous trails.

This poses an interesting challenge for park officials. During late August, all back-country campgrounds are filled to near capacity. Since there is little cell coverage in the park, there is virtually no way to contact campground occupants apart from visiting them in person. Federal law (and local trail conditions) prohibits the use of wheeled or motorized vehicles in the back-country. In the event of a fire, all back-country campers need to be evacuated from the park, presumably by hiking to a location where they can be transported by bus to safety. What is the best way to facilitate the evacuation of campgrounds that are only accessible by foot? How long should an evacuation be expected to take? From which of the ranger stations should evacuation teams be dispatched in order to vacate each campground?

Your task in this problem is to propose an evacuation plan for each of the park regions in the event of a fire. Assume that rescue teams can be dispatched from each of the five backcountry permit offices (Apgar, Two Medicine, Many Glacier, St. Mary, and Polebridge). You should specify which ranger station(s) should dispatch which team(s) and provide estimates on how many evacuation crews should be dispatched and how long evacuation will take.
Remember:
- the National Park Service does not have unlimited resources.
- in rough terrain, there are limits as to how far hikers can be expected to travel in a single day.

The following links may help you get started:

https://www.nps.gov/glac/planyourvisit/upload/Backcountry-Map-Web.pdf
https://www.nps.gov/glac/planyourvisit/backcountry.htm