The Gas Station Problem

By: A. Yang[1] , N. Kale[1], A. Sun[1]

[1]Corresponding Author

Problem

At what point is it more worth it to go the extra distance for cheaper gas?

In the problem, a driver wants to fuel up their car, but wants to do so in the cheapest way possible.

Assumptions

- We assumed that the driver at home, and needs to fuel the car.
- He/she has the option to either fill up the car at a nearby gas station, or at a gas station that is cheaper but farther away.
  - The driver would need to go to the gas station, then come back home.
- You must drive the car to the station and back – no walking
- There is enough gas to reach every station
- There is no traffic (MPG is constant)
- You have infinite time to spare

A: Closer but more expensive

B: Farther but cheaper

The Process

1. Identify Constants and Variables

Constants

- Fuel tank capacity (gallons)
- Fuel economy (miles per gallon)

Variables (per station)

- Distance (mi)
- Cost of gas ($ per gallon)

2. Develop Equations

A: Closer but more expensive

B: Farther but cheaper

$$Price_A = Distance_A * \frac{gallons}{miles} * Price_A + GasAmount_A * Price_A$$

$$Price_B = Distance_B * \frac{gallons}{miles} * Price_B + GasAmount_B * Price_B$$

3. Mathematica!

- 3D Plot?
  - Each point represents a station
  - 3 axes: distance to station, cost at station, total cost
- Deemed ineffective due to time constraints.

4. Java

- Convert equations to code
- Generate fuel capacities and miles per gallon incrementally
- Auto-generate gas station distances and prices
  - Values can be found on Google Maps in real life
- Take each scenario and print the cheapest option

Solution

- Our group used the previously mentioned equations and used Java to generate thousands of test cases to see at what points it would be more worthwhile to go the farther distance.
- The test cases were generated by combining data points (e.g. MPG, prices) within a reasonable range, and then identifying which station is the cheaper option
- Code

Cool Discoveries!

GasStationData

- Cool Trends
  - MPG and Capacity Matters!
  - They are dependent on each other!

- Normal Expected Trends
  - Longer distances favored the closer but more expensive station
  - If the difference in miles in the same, then winner stays the same, but by how much increases