Gas Station Summary

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Problem: Because gas prices fluctuate widely from week to week, it is essential for commuters to know where to purchase gasoline: the more expensive gas station on the way to work or the less expensive gas station further from their route. Is it worth driving further to purchase cheaper gas, or is it more cost effective in the long run to buy from the more expensive gas on the way to work?

Solution: If the difference in price of gasoline between the two stations does not exceed 10 cents per gallon, it is generally more cost effective to purchase gasoline at the closest gas station.

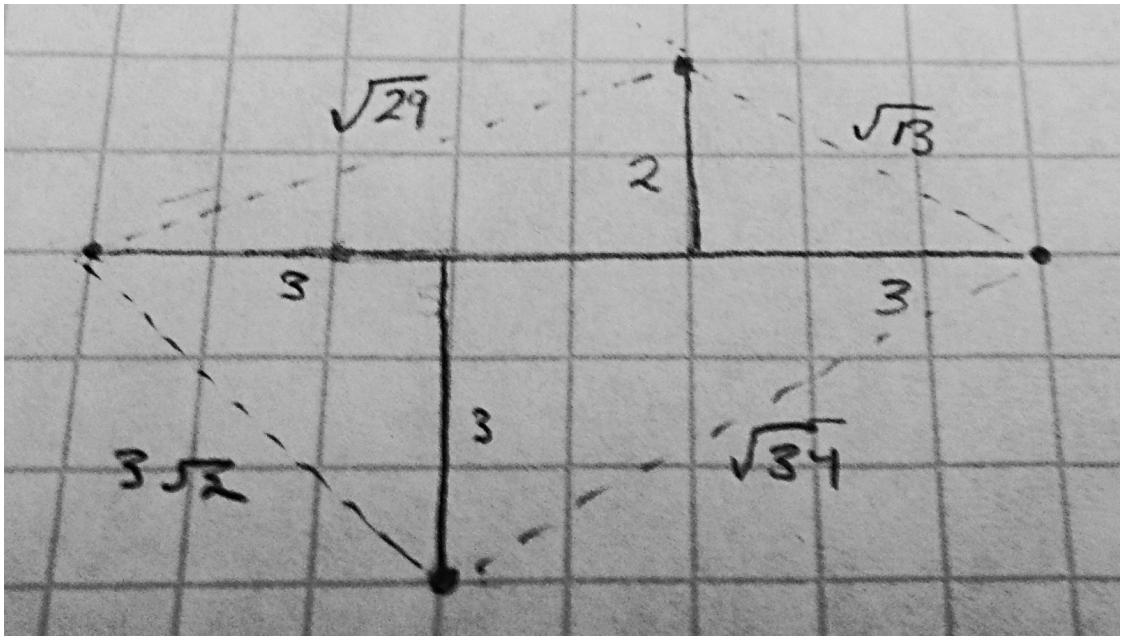
Overview:

Givens / Assumptions:

- There is a direct route from the driver's house to their work, on which the more expensive gas station lies
- A different diagonal route runs directly from the driver's house to the cheapest gas station
- Only the exact amount of gas that is needed to go to work and back is purchased each time a gas station is visited.

Methodology:

- First we identified two points for the location of the home and work.
- Then we generated random points as possible locations for the gas stations. Point 1 (P1) was not always further than Point 2 (P2) because the points were generated randomly. We discarded the data if P1 was further than P2.



[1] Massachusetts Academy of Math and Science at WPI (http://www.massacademy.org)

- The distance formula was used to determine the miles travelled for each trip to work, to the gas station, and home again. This was calculated for two possible routes: a direct diagonal from home to the gas station and to work, and a road from home to work with a perpendicular route to the gas station.
- We calculated the cost of gas for each route by dividing by the mileage and multiplying by the cost of gas per gallon.
- An estimate was used for the price of gas and we used a fifteen cent difference to compare the close, expensive gas station to the further, cheaper gas station. A route was calculated for each gas station as well as an alternative route, giving four possible routes per case.
- Finally we took the price for each route and compared to see which option was the most efficient.

***Generalizations**:* We used exact values for the distance commuted, the price of gas, and the average gas mileage. We could generalize these values so that one could use a more specific case. There are two ways to generalize the problem: when we consider the car to travel directly to the graph and when the car travels along horizontal and vertical lines.

(0,0) - Position of Starting Point
(d,0) - Position of Final Point, where d is the distance from the final point to the starting point
(x1, y1) - Position of gas station 1, where x1 is between 0 and d
(x2, y2) - Position of gas station 2, where x2 is between 0 and d
m_g - miles per gallon of car
p_g - price of gas per gallon

Equation 1: $Price = \left(\sqrt{(x)^2 + (y)^2} + \sqrt{(d-x)^2 + (0-y)^2} + d \right) / m_g * p_g$

Equation 2: $Price = (x + 2 * y + (d-x) + d) / m_g * p_g$

Where x and y can be x1 or x2 and y1 or y2, respectively. We can compare the values of Price for gas station 1 and 2 to see whether it is cheaper to buy gas from gas station 1 or 2.

***Self-Assessment**:* From doing this problem, we learned that managing time is very important in order to stay sane. However, our group did work very diligently on the problem, finishing within a few days and only working on the Mathematica document after that. We used outside resources on commuting distances and the price of gas, but other than that, we did not use any outside research.

xhome	yhome		x1	y1	x2	y2		gas1turn	gas1diag	gas2turn	gas2diag		cost1turn	cost1diag	cost2turn	cost2diag
6	10		14	12	9	7		20.00	18.25	22.00	18.07		$ 2.00	$ 1.82	$ 2.09	$ 1.72
			9	14	5	16		24.00	19.40	28.00	24.90		$ 2.40	$ 1.94	$ 2.66	$ 2.37
xwork	ywork		18	2	20	12		32.00	31.37	20.00	28.47		$ 3.20	$ 3.14	$ 1.90	$ 2.70
14	10		14	15	14	20		26.00	22.43	36.00	30.81		$ 2.60	$ 2.24	$ 3.42	$ 2.93
			4	18	16	13		32.00	29.05	22.00	22.05		$ 3.20	$ 2.91	$ 2.09	$ 2.09
price1	price2		16	0	17	1		36.00	32.34	34.00	31.70		$ 3.60	$ 3.23	$ 3.23	$ 3.01
$ 3.00	$ 2.85		20	13	10	7		22.00	29.03	22.00	18.00		$ 2.20	$ 2.90	$ 2.09	$ 1.71
			6	5	7	0		26.00	22.43	36.00	30.26		$ 2.60	$ 2.24	$ 3.42	$ 2.87
mpg	30		13	3	19	11		30.00	24.97	18.00	26.14		$ 3.00	$ 2.50	$ 1.71	$ 2.48
			5	4	4	14		28.00	24.90	24.00	23.24		$ 2.80	$ 2.49	$ 2.28	$ 2.21
			7	11	0	18		18.00	16.49	32.00	34.12		$ 1.80	$ 1.65	$ 3.04	$ 3.24
			1	6	2	2		24.00	28.00	32.00	31.37		$ 2.40	$ 2.80	$ 3.04	$ 2.98
			17	9	1	5		18.00	22.21	26.00	29.00		$ 1.80	$ 2.22	$ 2.47	$ 2.75
			15	19	9	6		34.00	29.78	24.00	19.40		$ 3.40	$ 2.98	$ 2.28	$ 1.84
			12	20	18	4		36.00	29.86	28.00	28.63		$ 3.60	$ 2.99	$ 2.66	$ 2.72
			8	1	12	9		34.00	28.04	18.00	16.32		$ 3.40	$ 2.80	$ 1.71	$ 1.55
			2	12	11	3		20.00	24.64	30.00	24.22		$ 2.00	$ 2.46	$ 2.85	$ 2.30
			10	7	3	10		22.00	18.00	16.00	22.00		$ 2.20	$ 1.80	$ 1.52	$ 2.09
			0	8	13	17		20.00	28.47	30.00	24.97		$ 2.00	$ 2.85	$ 2.85	$ 2.37
			3	16	15	8		28.00	27.24	20.00	19.46		$ 2.80	$ 2.72	$ 1.90	$ 1.85
			19	17	6	15		30.00	31.37	26.00	22.43		$ 3.00	$ 3.14	$ 2.47	$ 2.13

difturn	difdiag		cheapest	which				if		if
2.00	-0.17		$ 1.72	4	**4**	**gas2diag**		Further		N/A
4.00	5.50		$ 1.94	2	**3**	**gas2turn**		Closer		Closer
-12.00	-2.90		$ 1.90	3	**2**	**gas1diag**		Closer		N/A
10.00	8.37		$ 2.24	2	**1**	**gas1turn**		Closer		Closer
-10.00	-7.01		$ 2.09	3				Closer		N/A
-2.00	-0.64		$ 3.01	4				Closer		N/A
0.00	-11.03		$ 1.71	4				Closer		N/A
10.00	7.82		$ 2.24	2				Closer		Closer
-12.00	1.17		$ 1.71	3				Closer		N/A
-4.00	-1.66		$ 2.21	4				Closer		N/A
14.00	17.64		$ 1.65	2				Closer		Closer
8.00	3.36		$ 2.40	1				Closer		Closer
8.00	6.79		$ 1.80	1				Closer		Closer
-10.00	-10.38		$ 1.84	4				Closer		N/A
-8.00	-1.23		$ 2.66	3				Closer		N/A
-16.00	-11.72		$ 1.55	4				Closer		N/A
10.00	-0.42		$ 2.00	1				Closer		N/A
-6.00	4.00		$ 1.52	3				Closer		N/A
10.00	-3.50		$ 2.00	1				Closer		N/A
-8.00	-7.78		$ 1.85	4				Closer		N/A
-4.00	-8.93		$ 2.13	4				Closer		N/A

Positive difference means gas2 is further than gas1 (IDEAL)

Negative difference means gas1 is further than gas2 (NOT IDEAL)