# Transportation Costs (or Trucker's Dilemma)

Math 1050 College Algebra Project

Group 15

Names of Participants Isaac Martin - Part I
Kristina Ainge - Part II
Collin Welch - Part III
Misty Larsen - Part IV

Instructions: One group member should fill in sheet using dark pencil or ink, showing steps in the provided work space and answers in answer spaces. Group members must work together to assure correct solutions. The final work shown should be split among group members with each group member providing the work and solution for part of the project. Participants' initials should appear to the right of their work/solutions.

**Problem: A truck driving 260 miles over a flat interstate at a constant rate of 50 miles per hour gets 7 miles to the gallon. Fuel costs $3.50 per gallon. For each mile per hour increase in speed, the truck loses a tenth of a mile per gallon in its mileage. Drivers get $27.50 per hour in wages and fixed costs for running the truck amount to $11.33 per hour. What constant speed (between 50 mph and the speed limit of 65 mph) should the truck drive to minimize the total cost of the trip?**

I made an excel spreadsheet with the calculations shown. I hope my calculations are correct. I wrote how I calculated each one where the initials I

$ 201.92 Total driver wage

| fuel$(gal) | Distance in miles | speed MPH | MPG | Gal fuel burned | trip cost | hrs | Driver wages per hour labor | driver wage for running truck cost | Total driver Wage | Total Cost of Trip |
|---|---|---|---|---|---|---|---|---|---|---|
| $ 3.50 | 260 | 50 | 7.00 | 37.14 | $ 130.00 | 5.20 | $ 27.50 | $ 11.33 | $ 201.92 | $ 331.92 |
| $ 3.50 | 260 | 51 | 6.90 | 37.68 | $ 131.88 | 5.10 | $ 27.50 | $ 11.33 | $ 197.96 | $ 329.84 |
| $ 3.50 | 260 | 52 | 6.80 | 38.24 | $ 133.82 | 5.00 | $ 27.50 | $ 11.33 | $ 194.15 | $ 327.97 |
| $ 3.50 | 260 | 53 | 6.70 | 38.81 | $ 135.82 | 4.91 | $ 27.50 | $ 11.33 | $ 190.49 | $ 326.31 |
| $ 3.50 | 260 | 54 | 6.60 | 39.39 | $ 137.88 | 4.81 | $ 27.50 | $ 11.33 | $ 186.96 | $ 324.84 |
| $ 3.50 | 260 | 55 | 6.50 | 40.00 | $ 140.00 | 4.73 | $ 27.50 | $ 11.33 | $ 183.56 | $ 323.56 |
| $ 3.50 | 260 | 56 | 6.40 | 40.63 | $ 142.19 | 4.64 | $ 27.50 | $ 11.33 | $ 180.28 | $ 322.47 |
| $ 3.50 | 260 | 57 | 6.30 | 41.27 | $ 144.44 | 4.56 | $ 27.50 | $ 11.33 | $ 177.12 | $ 321.56 |
| $ 3.50 | 260 | 58 | 6.20 | 41.94 | $ 146.77 | 4.48 | $ 27.50 | $ 11.33 | $ 174.07 | $ 320.84 |
| $ 3.50 | 260 | 59 | 6.10 | 42.62 | $ 149.18 | 4.41 | $ 27.50 | $ 11.33 | $ 171.12 | $ 320.30 |
| $ 3.50 | 260 | 60 | 6.00 | 43.33 | $ 151.67 | 4.33 | $ 27.50 | $ 11.33 | $ 168.26 | $ 319.93 |
| $ 3.50 | 260 | 61 | 5.90 | 44.07 | $ 154.24 | 4.26 | $ 27.50 | $ 11.33 | $ 165.50 | $ 319.74 |
| $ 3.50 | 260 | 62 | 5.80 | 44.83 | $ 156.90 | 4.19 | $ 27.50 | $ 11.33 | $ 162.84 | $ 319.73 |
| $ 3.50 | 260 | 63 | 5.70 | 45.61 | $ 159.65 | 4.13 | $ 27.50 | $ 11.33 | $ 160.25 | $ 319.90 |
| $ 3.50 | 260 | 64 | 5.60 | 46.43 | $ 162.50 | 4.06 | $ 27.50 | $ 11.33 | $ 157.75 | $ 320.25 |
| $ 3.50 | 260 | 65 | 5.50 | 47.27 | $ 165.45 | 4.00 | $ 27.50 | $ 11.33 | $ 155.32 | $ 320.77 |

A. Let's start out by finding how long the trip will take.

5.20

The length of time required for the trip is _____. (Do not round.)

IM: this is calculated by dividing the distance of 260 miles by 50 miles per hour

B. Now, with this time known, how much will it cost to pay the driver and run the truck?

Isaac Martin

$ 201.92

The amount needed to pay the driver and run the truck is _____. (Round to nearest cent.)

IM: this is calculated by first understanding what the driver gets paid for.... Which is **first, the $27.50** for wages and **Second** the **$11.30** for running the truck. So we would times the number of hours it took to drive (5.20) by ($27.50)
Which is $143. Then times (5.20) by ($11.33) which is $58.92 and add both of them together
Which will equal $201.92

C. Next determine, at 7 miles per hour for 260 miles, how much gas will be required.

37.14 **Notice it wants it in a fraction, I will leave it in decimal form for excel**

The amount of gas required is _____260/7_____. (Do not round. Leave as proper fraction.)

IM: this is calculated by dividing the distance (260) by the MPG(7)

D. With the amount of gas known, how much will the gas cost to make the 260 miles?

$ 130.00

The cost of the gas is _____. (Round to nearest cent.)

IM: this is calculated by multiplying MPG (7) by the cost per gollon of gas ($3.50)

E. Finally we can find the TOTAL cost.

$ 331.92

The total cost for the trip is _____. (Round to nearest cent.)

IM: this is calculated by getting the drivers total wage ($201.92) and adding the fuel cost for the trip ($130.00)

Part II: The preceding process should have illuminated the basic procedure we will use to find the total cost of a trip. Next we will find the total cost if the truck is driven at 65 miles per hour. As in Part I, include the correct units with each value.

Kristina Ainge

A. Let's find how long the trip will take.

260 miles
65 MPH

The length of time required for the trip is 4 hours. *(Do not round.)*

B. Now, with this time known, how much will it cost to pay the driver and the fixed costs for running the truck?

$(27.50 \times 4)(11.33 \times 4) = (110 + 45.32)$

The amount needed to pay the driver and the fixed costs is $155.32. *(Round to nearest cent.)*

C. Next, to begin determining the gas cost, we need to find the mileage (miles per gallon of gas) when the truck is travelling at 65 miles per hour.

mileage $= 7 - ((65 - 50) \times \frac{1}{10})$

$7 - (15 \times \frac{1}{10})$

$7 - (\frac{15}{10})$

$7 - \frac{3}{2}$

$= 5.5$

The mileage at 65 miles per hour is 5.5 mpg. *(Do not round.)*

D. With the gas mileage known, how much gas will be needed for the 260 miles?

$\frac{260 \text{ miles}}{5\frac{1}{2} \text{ mpg}}$ $\frac{260}{11/2}$ $\frac{520}{11}$

The amount of gas required is $\frac{520}{11}$ mpg. *(Do not round. Leave as proper fraction.)*

E. With the amount of gas known, how much will the gas cost to make the 260 miles?

$\frac{520}{11} \times 3.50$

$47.27 \times 3.50$

The cost of the gas is $165.45. *(Round to nearest cent.)*

F. Finally we can find the TOTAL cost.

155.32 (pay Driver + fix truck) + 165.45 (fue

The total cost for the trip is $320.77. *(Round to nearest cent.)*

CW Part III. We should now have a good process for determining the total cost of a trip for any rate of speed greater than or equal to 50 miles per hour. Next is to create a Total Cost function using X as the unknown rate in miles per hour. Simplify your answers and remember to include units. *As you work through each step, test your answers by plugging in 50 mph and then 65 mph and comparing with results from parts I and II.*

A. Let's find how long the trip will take.

$t = \frac{d}{r}$ $t(x) = \frac{260}{x}$

$t(50) = \frac{260}{50} = 5.2 \text{ hr}$

$t(65) = \frac{260}{65} = 4 \text{ hr}$

The length of time required for the trip is $\frac{260}{x}$.

B. Now with this time known, how much will it cost to pay the driver and the fixed costs for running the truck?

$C(x) = \frac{260}{x}(27.50 + 11.33)$

$= \frac{7150}{x} + \frac{2945.8}{x}$

$= \frac{10095.8}{x}$

$C(50) = \frac{10095.8}{50} = 201.916$

$C(65) = \frac{10095.8}{65} = 155.32$

The amount of money needed to pay the driver and the fixed costs is $\frac{10095.8}{x}$.

C. Next, to begin determining the gas cost, we need to find the mileage (miles per gallon of gas) when the truck is travelling at X miles per hour.

50 mph = 7 mpg - $\frac{1}{10}$ for each mph increase

$7 - \frac{1}{10}(x - 50)$

$7 - \left(\frac{x}{10} - \frac{50}{10}\right)$

$7 - \left(\frac{x}{10} - 5\right)$

$7 - \frac{x}{10} + 5$

$\frac{12}{10} - \frac{x}{10} = \frac{120 - x}{10}$

$A(50) = \frac{120 - 50}{10} = \frac{70}{10} = 7$

$A(65) = \frac{120 - 65}{10} = \frac{55}{10} = 5.5$

The mileage at X miles per hour is $A(x) = \frac{120 - x}{10}$.

D. With the gas mileage known, how much gas will be needed for the 260 miles?

$A(x) = \frac{260 \text{ miles}}{\left(\frac{120-x}{10}\right)}$

$A(x) = \frac{2600}{120-x}$

$A(50) = \frac{2600}{120-50} = \frac{2600}{70} = \frac{260}{7}$

$A(65) = \frac{2600}{120-65} = \frac{2600}{55} = \frac{520}{11}$

The amount of gas required is $A(x) = \frac{2600}{120-x}$.

E. With the amount of gas known, how much will the gas cost to make the 260 miles?

Cost of gas $= 3.5\left(\frac{2600}{120-x}\right)$

$g(x) = \frac{9100}{120-x}$

$g(50) = \frac{9100}{120-50} = \frac{9100}{70} = 130$

$g(65) = \frac{9100}{120-65} = \frac{9100}{55} = 165.45$

The cost of the gas is $g(x) = \frac{9100}{120-x}$.

F. Now we can find the TOTAL cost function. Express your function as C(X) =

total cost $= C(x) = \underbrace{\frac{9100}{120-x}}_{\text{cost of gas}} + \underbrace{\frac{10095.8}{x}}_{\text{cost of labor}}$

TOTAL Trip Cost Function is $C(x) = \frac{9100}{120-x} + \frac{10095.8}{x}$

G. The last thing we should do is verify that this is the correct function by evaluating it at 50 mph and 65 mph to see if we get the same values we have previously computed.

$C(50) = \frac{9100}{120-50} + \frac{10095.8}{50}$

$= \frac{9100}{70} + \frac{10095.8}{50}$

$= 130 + 201.916$ (round)

C(50) = $331.92

$C(65) = \frac{9100}{120-65} + \frac{10095.8}{65}$

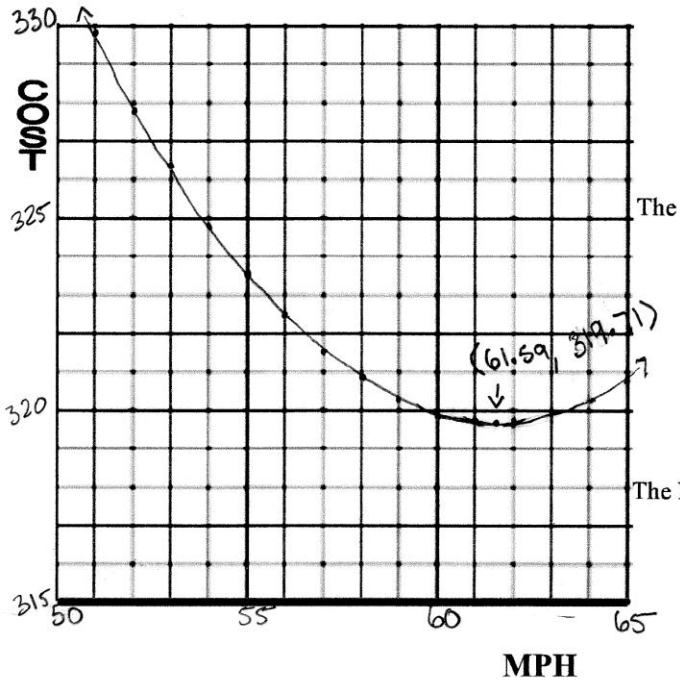
$= \frac{9100}{55} + \frac{10095.8}{65}$

$= 165.45 + 155.32$

C(65) = $320.77

Part IV. Assuming the function is modeling correctly, you need to calculate the minimum cost. Graph the Cost Function and find its minimum point. Sketch your graph here: Have the lower left point represent (50,315). You may use a graphing utility to help you find the minimum point.

$C(x) = \frac{\$10095.8}{x} + \frac{\$9100}{(120-x)}$




The minimum COST for the trip is $319.71

The MPH that minimizes COST is 61.59 MPH.

Reflective Writing: How did this project change the way you think about how math can be applied to the real world? Write one paragraph stating what ideas changed and why. How do you think the math skills in this project will impact other classes you will take in your school career? Try to be specific.

I didn't really have a problem understanding what the problem was asking or figuring it out. This is actually stuff I do a lot because my husband likes to know how much we're spending on gas and what our mileage is. I also already figure out a lot about pay. Sometimes I figure out how much my husband gets paid by the hour because he is doing something and will get paid his hourly rate for the time he does it. I found that this problem combined things that I already do because it was in a different context.

In thinking about the classes I have to take over my school career it is hard to say how these math skills will impact them. The only thing I could come up with is that the skills from this particular problem could be put to use when I drive into Salt Lake for classes. My husband makes a certain amount of money each month and from that I often have a specific amount of money I can spend on gas. Driving into Salt Lake multiple days a week for classes can really start to add up. It also causes us to need to put more money into the car for maintenance. All this starts to add up and we have to minimize the cost of these in order to make our budget work.