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Math 102 Students
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Dear Calculus Students:

Smithers told me that he outsourced to you the investigation into whether converting Sector 7G of my nuclear power plant into a donut factory would be profitable. Your conclusions were quite convincing, and as a result, the conversion is underway. This process brings with it, of course, many decisions. Usually I have no difficulty figuring out how best to save and make the most money, but one question has arisen that is stumping me.

We're going to give a single distributor exclusive rights to sell our donuts, and we need to decide which of two distributors – Moe's Tavern Ltd or Kwik-E-Mart – that should be. While you might think that a Kwik-E-Mart might be more likely to sell large quantities of donuts than a bar, our sales projections all seem to show that we'll sell the same number of cases of donuts no matter which distributor we use. I need to decide between the two somehow. Since the donut factory is responsible for the costs of moving the donuts to the distributor's warehouses, I'm going to choose between Moe's and Kwik-E-Mart based on the transportation costs of getting the donuts from the factory to the warehouses. (They'll of course pay for any shipping costs that occur after the donuts are on their property.) These two companies each have two warehouses (in fact, they share one of them), and have both proposed moving the donuts by underground conveyor belt to their two warehouses.

Both companies have submitted bids of \$15,000 to install these conveyor belts. As I'm sure you know, such bids are just estimates: sometimes they are over-estimates of the cost, while most times they are under-estimates. It goes without saying that if one company comes in under-bid, I would only pay them their actual costs. I'd like to know which one is going to actually cost me the least amount of money, if they build the conveyor belt in the most efficient manner. You can be sure that if I know the most efficient way for them to build, they *will* build it that way. And this is where I

need your help – I need to know whether these two bids are over- or under-estimates, what the best possible routes for the conveyor belts would be in each case, and exactly how much building the conveyor belt to either pair of warehouses will cost me.

As I mentioned, each has two warehouses to which we would be moving the donuts. I have enclosed a scale map showing the location of the factory and the warehouses. Our donut factory (*Burns' Atomic Donuts*) is located at the northwest corner of Springfield Reservoir. Moe's and Kwik-E-Mart share a warehouse at the northwest corner of Jebediah Island. They each also have a warehouse on the southwest shore of the lake, 1/2 mile apart.

Each company already has experience installing underground conveyor belts and they included their under-water and on-land rates in their bids. This seems like information you will need, so I include it here:

	Cost of Installation:	
	On Land	Underwater
Moe's	\$3,300/mi	\$6,100/mi
Kwik-E-Mart	\$2,000/mi	\$7,200/mi

I have verified that both firms have stuck to their advertised rates on past projects.

I'm hoping that you can use these exact rates and the scale map to find the cheapest possible routes each company could choose, because I don't trust them to be looking out for *my* profit line. I'm expecting you to give me exact results. Smithers volunteered to do something with zooming in on a graph, but I thought that technique sounded too rough a method for this finicky a situation. After all, every penny saved is important. For each company, I have two questions: how accurate are their bids, and which one could do it most cheaply, if they chose the absolute cheapest route possible for laying their conveyor belts.

Since your responses will be used to choose whether to hire Kwik-E-Mart or Moe's Tavern Ltd., please explain your results as clearly as possible. I need to hear back from you by April 11th at the latest!

Sincerely yours,
Montgomery Burns

