

Chapter 4.5: A Bit More Optimization and also Proportionality

Calculus I

College of the Atlantic. Fall 2014

1. A student's stress level is inversely proportional to the square of the time remaining before the end of the term and proportional to the amount of caffeine she has consumed.
 - (a) Write a formula for the student's stress.
 - (b) If the student doubles her caffeine consumption, what happens to her stress?
 - (c) How much more stressed is she on Thursday of week 10 compared to Wednesday of week 10?
2. The power delivered by a wind turbine is proportional to the cube of the windspeed.
 - (a) Write a formula for the turbine's power.
 - (b) If the wind speed doubles, by how much does the power increase?
 - (c) If the windspeed increased by 20%, by how much does the power increase?
3. You are trying to raise funds to help start an organic alpaca farm. To do so, you have purchased 45 t-shirts. Your plan is to sell them for 10 dollars each. However, ~~a huge~~ extensive market research indicates that you could probably sell them for a little more, but you might sell a few less t-shirts. In particular, for every dollar by which you raise the prices, you sell three less shirts. To maximize your revenue,¹ how should you price the shirts? How many will you sell? How much revenue will you get?
4. Now it is time to build an enclosure for the alpacas. You opt for a rectangle. Due to a strange easement that has been placed on your land, two of the sides of the enclosure need to be made of a material that costs 3 dollars per meter, while the other two sides can be made from material that costs 1 dollar per meter. The expensive sides are opposite each other. You would like to build as large an enclosure as possible for your alpaca, but funds are limited. The t-shirt sale didn't work out as well as you had hoped. You have only 144 to spend on fencing. What dimensions should you choose? How much area do the alpacas end up getting?

¹You want to buy as much fencing material as possible. Then you can make sure that your alpacas have sufficient space, avoiding an intervention by the Alpaca Liberation Front.