Topic 9 Outline

1. Optimization
   - Solving Optimization Problems

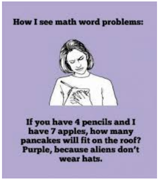
Topic 9 Learning Objectives

1. recall geometric formulas for areas, perimeters, surface areas, volumes, right angle triangles, similar triangles, etc
2. set up optimization based on word problems
3. differentiate equations and locate extreme values
4. solve optimization problems

Optimization Problems

The methods we have learned in the previous chapters for finding extreme values have practical applications in many areas of life. For example, minimizing cost, distance, time, etc., or maximizing profit, area, volume, etc.

The problems we encounter are word problems similar to related rates problems, so our strategy for solving them is similar, only now we want to find the extreme values of our function instead of solving for a missing rate!



Check out this link for a video on optimization!
https://www.educreations.com/lesson/embed/9872053/?ref=app

Strategy

1. Read the problem slowly and carefully.
2. Draw a diagram.
3. Assign symbols to all of the variables involced.
4. Decide which variable is to be maximized/minimized and write an equation that expresses it in terms of the others.
5. Use the info you have been given to eliminate all but 1 of the variables in that equation.
6. State the doamin of that equation.
7. Use the methods from the previous section to find the absolute max or min of that equation.
8. Be sure to finish with a sentance, including units.

Problem 1

A farmer has 2400 ft of fencing and wants to fence off a rectangular field that borders a straight river (so he needs no fence along the river). What are the dimensions of the field he could make that would have the largest area?

The First Derivative Test for Absolute Extreme Values

- If $f'(x) > 0$ for all $x < c$ and $f'(x) < 0$ for all $x > c$, then $f(c)$ is the absolute max of $f(x)$.

- If $f'(x) < 0$ for all $x < c$ and $f'(x) > 0$ for all $x > c$, then $f(c)$ is the absolute min of $f(x)$.

Problem 2

A cylindrical can is to be made to hold 1L or oil. Find the dimensions that will minimize the cost of the metal needed to manufacture the can.

Problem 3

FInd the point on the semi-circle with radius 1 that is closest to the point $(2, 0)$.

Problem 4

We want to construct a box with a square base and we only have 10 m^2 of material to use in construction of the box. Assuming that all the material is used in the construction process determine the maximum volume that the box can have.

Five in Five!

There are 50 apple trees in an orchard, and each tree produces 800 apples. For each additional tree planted in the orchard, the output per tree drops by 10 apples.

1. What is the function that gives the total number of apples in the orchard?
2. State the domain of the function.
3. Differentiate the function that gives the total number of apples in the orchard.
4. What are the critical points of the function?
5. How many trees should be added to the existing orchard in order to maximize the total output of trees?

Flex the Mental Muscle!

Find the area of the largest rectangle that can be inscribed in a semi-circle with radius r.
First use length and width as your variables, and then confirm your answer by solving the problem once more, but this time using the angle from the centre of the base to the top corner as your variable.