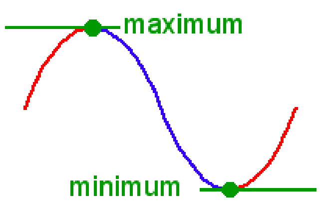
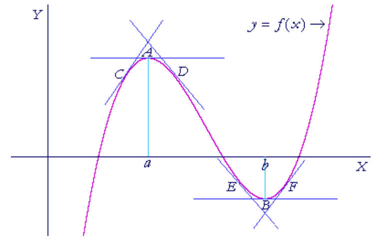


OPTIMIZATION

Application of Derivatives:
(Finding the Best Conditions!)



Optimization problems is one of the most practical applications of Calculus. Essentially optimization involves finding the **maximum** or **minimum** value of a function.

Example situation (don't solve. Just an example situation):

Imagine you are a mountain bike manufacturer and you have concluded that your *profit* is a function of *labor costs* (how many people are working for you) and how many *bikes* you can produce per week.

$$\mathbf{P} = 6.09\mathbf{B} - 23.34\mathbf{L}^2$$

P is profit. **B** is #of bikes produced, and **L** is labor costs.

What number of bikes should you aim to produce? How many staff should you have working to maximize profits?

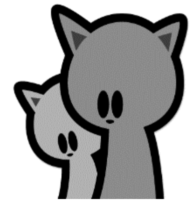
Solving this problem involves finding the **max value** of the function above. We can do this by taking the **derivative of the function**, *setting the derivative to 0* (zero slope). We can use our results to determine value of P and L that will **maximize** profit.

Example situation (don't solve. Just an example situation):

Imagine you work for a company that manufactures tin cans for tuna. If each can must have a volume of $500cm^3$, what should the dimensions of the can be if you want to **minimize** the surface area of the can (reduce your cost of tin)?

We will now apply the methods we used to find ***max and min*** values of functions to find the **optimal values** needed ***for any situation that can be modelled with mathematics!***

Optimization Examples (see solutions):



1. A Kitty Farmer has 40 feet of fence to enclose a rectangular *pen along the side of a barn*. What should the width and length be to maximize the area for the kitties?

Fool Proof Plan for Solving Optimization Problems:

1. **Make a sketch** including all variables you know and don't know

2. Write an equation for the **quantity you want to Optimize**

   (This is call the **"OBJECTIVE EQUATION".** *Know this term*. In the example our objective equation was AREA

3. If your OBJECTIVE equation has more than one variable, you must create a **"Constraint" equation** to eliminate one variable.

   In our example we used *PERIMETER* AS OUR **CONSTRAINT EQUATION.**

4. Sub the constraint equation in to the objective equation so we only have one variable.

5. Differentiate the **objective equation** with respect to a single variable.

6. Set it the Derivative to zero.

7. Solve for **critical points**

8. Use the ***closed interval method*** to determine the optimal value (max or min) you are looking for.

2. Tom Yum Soup just came out with a jumbo 1000ml cylindrical can for its soups what are the best dimensions of the soup to *minimize the amount of metal needed to make it*.

3. Jim Jam's Box Company is designing an open top, square based, rectangular box that will have a volume of 800 ml. What should the box's dimensions be to minimize the about of cardboard to be used