**OPTIMIZATION APPLICATIONS**

**Optimize**-Find the maximum or minimum of something.

 **Primary Equation** –The equation to be optimized

 **Secondary Equation**- The equation used to replace one of the variables in the primary equation.

“THINK OF SYSTEMS OF EQUATIONS FROM MATH 1”

(Class example #1) y = x + 4 (Class example #2) y = x + 2

 2x + 3y = -8 y = 3x + 10

STEPS TO SOLVING

* Read the question/scenario and draw a picture (if possible)
* Determine your primary equation
* Determine your secondary equation
* Solve for a variable in the secondary equation (usually “y” so we have “f(x)”)
* Replace a variable (usually “y”) in the primary equation so that you have one variable “f(x)”
* Use the 1st or 2nd derivative test to determine the max or min.
* Check the domain of the primary equation to see if your answer is in the domain
* Answer the question asked.
* Check your answer using your primary and secondary equations, or your picture to ensure it makes sense

Example 1 (from handout)

Primary equation is P = 2x + y Secondary Equation is A = xy

 So 180,000 = xy

 therefore $\frac{180,000}{x}$ = y

The Primary Equation as a function of x is P(x) = 2x + $\frac{180,000}{x}$ or P(x) = 2x + 180,000$x^{-1}$

Find the derivative P’(x)

P’(x) = 2 – 180,000$x^{-2}$

Perform the 1st derivative test 2 -180,000$x^{-2}$= 0

So P’(x) = $\frac{2}{1}$ - $\frac{180,000}{x^{2}}$ = 0 (get a common denominator to solve)

Therefore $\frac{x^{2}}{x^{2}}$ $\frac{2}{1}$ - $\frac{180,000}{x^{2}}$ = 0 thus $\frac{2x^{2}-180,000}{x^{2}}$ = 0, so we know that $2x^{2}$- 180,000 = 0 and x = $\mp $300

We know that -300 is not in the domain because distance can’t be negative. Therefore x must equal 300 in this situation

Complete the process of the 1st derivative test to determine if max or min (using a sign line)

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P’(1) = - 300 P’(500) = + Therefore we have a minimum at x = 300

If we used the 2nd derivative test we would have P’’(x) = 360,000$x^{-3}$ or Therefore P’’(300) = + therefore indicating concave up thus a min.

By using the Primary and Secondary equation (or our picture) we have the width (x) as 300 and the length (y) as 600