

Tips and a Systematic Procedure for Solving Optimization (Applied Max-Min) Problems

Math 111

- Read and understand the problem.

- **Diagram:** Draw and label the diagram for the problem. (Try to imagine a few extreme cases here in order to give you a sense of the possible options.)

- **Variables:** Assign appropriate variables to key quantities. Write them down.

- **Equation(s) relating variables:**
 - Write an equation relating the variables based on the given fixed information. This is the equation that represents some restricted relationship between the variables.

 - Write an equation for the quantity to be maximized or minimized in terms of one or more of the variables.

 - Use the first fixed equation, representing the given restricted conditions of the problem, to eliminate all but one of these variables in the second equation and thereby express the desired quantity as a function of a single variable.

 - Determine the set of possible values for this single variable. These values can often determine a closed interval for the function's domain; we can think about them as *common sense choices* for the variable.

- **Maximize/Minimize:** Use calculus techniques and max-min theory to find the desired absolute maximum or minimum value.
 - Differentiate and find the critical numbers (where the quantity's derivative equals zero or is undefined).

 - Identify the extrema. You can use sign-testing and the First Derivative Test for Absolute Extreme Values in Section 3.7, or use the Closed Interval Method if you have a closed interval for the domain. Make sure that you actually investigate whether you have an absolute maximum or minimum value.

- **Answer:** Answer the question posed in the original problem. Interpret your results and give a detailed answer to the original question. Check if your answer satisfies the conditions in the initial word problem.