# Lab: An Introduction to Mathematical Modeling

**Motivation:** Mathematical modeling is often a messy and iterative process. Usually a simple model is developed with clearly stated assumptions and then more complexity can be added into the model.

**Objectives:** Students will try to answer an ill-posed question by developing a mathematical model. Students will also become familiar with the process of mathematical modeling and learn how to communicate the answer using precise and mathematical language.

## When is using Uber or Lyft less expensive than owning a car?

In this assignment, your group will construct a mathematical model to answer the question above. This question is purposefully vague or, to use mathematical language, *ill-posed*. Ill-posed problems are typically what engineers and scientists deal with when solving problems in real life. With an ill-posed question, you must make certain assumptions.

**General modeling principles**

* It is usually easier to develop useful models by starting with a simplified version of a situation than with one that is closer to reality. The first model is rarely the final model.
* Pay attention to what you “want.” If you need a number, make up a value, but note what you did. That number may become a variable later.
* Be conscious of decisions/assumptions.
* Ask, “What if?” What would happen if (pick a number or assumption) changed?
* Ask, “What question are we trying to answer? How can I ‘measure’ that?”
1. Make sure that someone in your group has the Uber or Lyft app downloaded on a mobile device. If you don’t have either of the apps, you might want to download one yourself. Decide if your group is going to use Uber or Lyft as a comparison.
2. With your group, discuss the question above. What assumptions do you need to make? What do you need to measure or estimate? What is the variable (or variables) in this problem? Write down notes on your discussion. Make sure you write down all assumptions.
3. As a group, decide on a car that you will use for comparison and a typical day for the driver. Consider choosing a car that is similar to what someone in your group currently drives. What information will you need to gather? What costs are associated with owning and driving a car?
4. Prepare a 5-minute presentation to answer the question. Be sure to include any information that will justify your mathematical argument. You may want to use charts or graphics to illustrate a point. You should clearly articulate your mathematical model, what assumptions you have made, and your final solution to the problem.