

Overview -- Reverse Engineering

Requirements

No required CBL or other equipment.

This module is an overview of the spirit of Mathematical Modeling -- **reverse engineering**. We begin with some real world phenomenon and with some tentative ideas (or models) about how that phenomenon might be explained. In this module we begin with the real-world phenomenon of the relationship between the speed of a car's engine (measured in RPM) and the speed of the car (measured in miles per hour). Our tentative explanation for the way in which a car's drive train converts engine speed to the car's speed is based on an analogy with a "10-speed" bicycle. If someone in your group has a "10-speed" bicycle then it would be a good idea to look at it as you work through this module to see how the RPM of the pedals is converted to the MPH of the bicycle. In your own classes, working with a student's bicycle is a one way to make a connection between the classroom and the students' lives.

The next step in mathematical modeling is to try to fit the tentative model to data about the real world phenomenon. In this case, we need to find the car's gear ratios and the times at which its automatic transmission shifts gears. The next step is to test the model's predictions against data. This module has a Java applet that draws a graph showing the relationship between RPM (measured by a tachometer) and MPH (measured by a speedometer) as an imaginary car accelerates. Based on this data, you must determine the gear ratios and the shift points for the transmission. Then you can test your work against the data by clicking a button that draws the predictions of your model. If necessary you can modify your model. This is the **modeling cycle**.

- **Observe the real world and collect data.**
- **Build a model based on theory, analogy, and observation.**
- **Test the model by comparing its predictions to data.**
- **If necessary, modify the model.**

The last two steps are often repeated several times.

For each module your group will be expected to submit your homework to the **HW Bin** on the **MSULink** site. Although you will normally submit homework as a group, for this first module you should submit it individually. Most of these questions are unanswered questions from the module. Your email message **must follow the format below**.

- Name of module. (**Overview -- Reverse Engineering**)
- Names of participants in your group.
- Any questions that your group has for your instructor.
- Answers to the questions in this guide.

There is a list of these questions below. Normally you will receive an answer within a day or two. There is no need to wait for an answer before going on to the next module.

Questions

1. The first set of exercises in this module involves the gears on a bicycle. Be sure to do the problems in this set of exercises including the TI-92 material and the graphs. In your email message to your instructor answer the following question.

If a bicycle has wheels whose diameter is 24 inches, whose front (pedal) gear has 44 teeth, and whose rear gear has 22 teeth what is the ratio between miles per hour and revolutions per minute?

2. What are the shift points and gear ratios for the car simulated by the Java applet in the module? Use the original Java applet as it first comes up.