LAB 33

Collecting and Modeling Data

In this lab, you will use a CBR-2 to collect real-world bivariate data and perform a regression to develop a mathematical model. Then you will use your model to make a prediction.

Collecting and Modeling Data

1. Decide what type of bivariate data you will collect and prepare the necessary tools and materials.
2. Collect the data.
3. Examine the data and decide what types of functions might be good models for the data.
4. Develop a model.
5. Use the model to make a prediction.

STEP 1 Decide what type of bivariate data you will collect and prepare the necessary tools and materials.

EXAMPLE You can use your graphing calculator and a CBR-2 to collect motion data. Set up a long ramp and use the CBR-2 with the EasyData application to gather time and distance data for a ball rolling down the ramp.

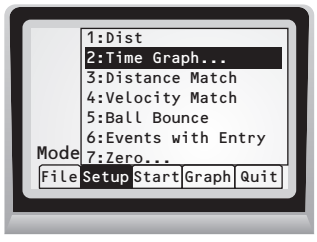
a. What type of data will you collect?

b. What are the two variables?

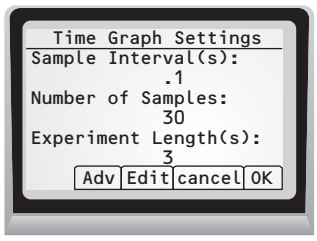
c. What type of correlation, if any, do you expect to see in your bivariate data?

STEP 2 Collect the data.

EXAMPLE Press APPS on your calculator and choose **EasyData**. From the **Setup** menu, choose **Time Graph**. Then enter 0.1 for the time (in seconds) between samples and 30 for the number of samples, so that the data collection lasts 3 seconds. Select **Next** until you see a summary of the settings and then select **OK**.



Hold the CBR-2 at least 15 centimeters behind the ball at the top of the ramp. Choose **Start** on the CBR-2 menu to begin collecting data and then immediately release the ball.

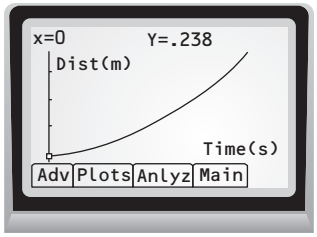


a. What is the interval between samples for your data-collection experiment? How many samples will you collect? How long does your experiment last?

b. What steps can you take to ensure that the data are collected as accurately as possible?

STEP 3 Examine the data and decide what types of functions might be good models for the data.

EXAMPLE When data collection stops, the CBR-2 transfers the data to the calculator and the calculator displays a graph. The upward-curving graph shows that the ball picked up speed as it went down the ramp. The data appear to be either quadratic or exponential.



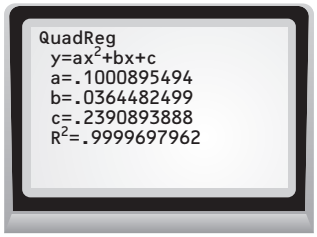
a. What general conclusions can you make based on the shape of the graph of your data?

b. What types of functions might be good models for your data? Why?

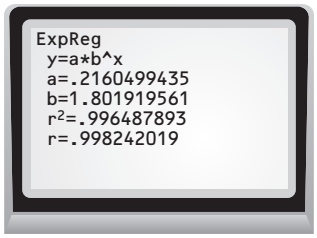
c. Do your data contain outliers? If so, what might account for these values?

STEP 4 Develop a model.

EXAMPLE The CBR-2 transfers the time data to list L1 of the calculator and the distance data to list L6. Exit **EasyData**, press **STAT**, and then go to the **CALC** menu to perform a quadratic regression and an exponential regression on the data in lists L1 and L6.



A measure of the goodness of fit for each regression model is given by the coefficient of determination, which is denoted R^2 for the quadratic model and r^2 for the exponential model. The coefficient of determination is a number between 0 and 1, and the closer it is to 1, the better the fit. Comparing the values of R^2 and r^2 shows that both models are good fits for the data, but that the quadratic model is a better fit. The quadratic model is $y \approx 0.1x^2 + 0.04x + 0.24$.



a. Which model fits your data best? Why?

b. How good a fit is the model for your data? Explain.

STEP 5 Use the model to make a prediction.

EXAMPLE The quadratic model is $y \approx 0.1x^2 + 0.04x + 0.24$. At the start ($x = 0$), the ball was 0.24 meter from the CBR-2. After 10 seconds, the ball would be $0.1(10)^2 + 0.04(10) + 0.24 = 10.64$ meters from the CBR-2. Since $10.64 - 0.24 = 10.4$, you can predict that the ball would travel about 10.4 meters in 10 seconds, assuming the ramp were long enough.

a. What predictions can you make using your model? What assumptions, if any, are part of your prediction?

b. Can you use your model to make predictions with any value of the independent variable? Explain.

What Do You Think?

1. Was your correlation prediction from Step 1(c) correct? Explain.

2. Describe a variation of your experiment (such as changing the angle of the ramp) and discuss how you think this would affect the data.