

The Need for Speed

Time:

1 class period

**Suggested grade
levels: 6-7**

Math Objectives:

Create and interpret scatter plots, Determine relationships between variables

Science Objectives:

Calculate velocity, Represent motion graphically



Materials:

TI-73 Explorer™, Radio controlled car, Stop watches (3), Tape measure, Scale

OVERVIEW

Nowadays, any adventure-seeking person can experience the thrill of driving a real race car. Racing schools allow them to drive with professional drivers who teach racing skills and tactics, as well as safety. Modern car races are won by hundredths of a second, often using cameras to determine which car actually crossed the finish line first.

In this adventure, students will run a radio controlled car at several different weights recording the time of each run. They will calculate the speed for each run, and use graphs to determine the relationship between speed, time, and weight.

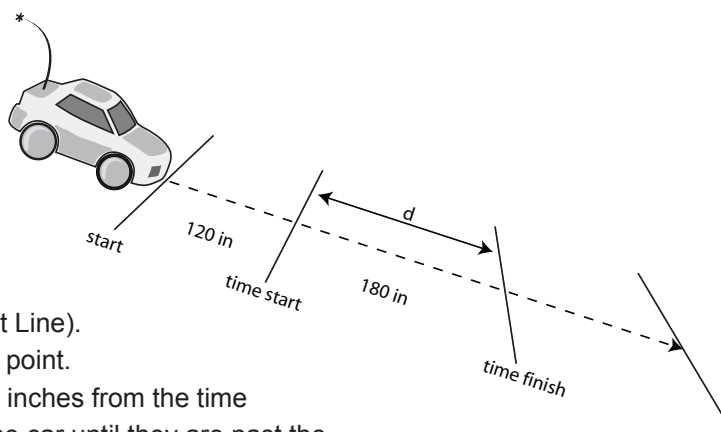


NOTE The measurements shown are suggested measurements, and can be adjusted to meet size constraints of your classroom or hallway.



SETUP

1. For each test run, there needs to be a driver, three timers, and a data recorder.
2. From START, measure approximately 120 inches and mark with tape. This is the line at which timers start their watches (the time Start Line). The car should be “up to speed” by this point.
3. Mark the Finish Line approximately 180 inches from the time Start Line. Instruct drivers to not slow the car until they are past the Finish Line.
4. Find weights to add to the car. The weights can be washers taped to the car or soda bottles with water.





DATA COLLECTION

1. Have three timers time each test run.
2. Increase the weight of the vehicle for each run.
3. Record the weights and times for each run in the table on your worksheet.



DATA ANALYSIS

Calculate and Store Average Times for Each Run

1. Press **[LIST]**. Under L1, enter the three times for run 1. Under L2 enter the three times for run 2. Repeat this step until all three times for each run are entered. **See Figure 1.**
2. Press **[2nd][QUIT]** to return to the home screen.
3. Find the average time for run 1. Press **[2nd][STAT] [▶] [▶] [3]** to choose the mean function. Then press **[2nd][STAT][ENTER][ENTER]** to choose list 1. **See Figure 2.** Enter the average time on your worksheet.
4. Repeat these steps to find the average times for runs 2 through 6.
5. On the home screen, press **[▲]** to scroll up to previous entries and highlight the average for L1. Press **[ENTER]** to place that number at the bottom of the home screen.
6. Press **[STO▶][2nd][TEXT][ENTER][▲][ENTER][ENTER]**. This makes the variable A equal to the average for L1. Repeat to store the averages for L2 through L6 selecting B, C, D, E, and F respectively. **See Figure 3.**

L1	L2	L3	3
2.5	3.1	3.59	
2.47	3.09	3.64	
2.42	3.14	3.69	

L3(4) =			

Figure 1

mean(L1
2.463333333

Figure 2

mean(L5	4.533333333
mean(L6	6.406666667
mean(L6	12.52
2.463333333+8	2.463333333
2.463333333	

Figure 3

Calculate the Speed of Each Car

1. Press **[2nd][MEM][6][ENTER]** to clear all the lists.
2. Enter the six weights in L1.
3. Enter the stored average times in L2. To enter A, press **[2nd][TEXT][ENTER][▲][ENTER][ENTER]**. To enter B, press **[2nd][TEXT][▶][ENTER][▲][ENTER][ENTER]**. Continue these steps to enter C, D, E, and F.

NOTE Remind students that speed (or rate) is distance divided by time. The suggested distance in this activity was 180 inches. If you used a different distance, be sure students use that value in step 4.

4. Highlight the title of L3 and press **180 ÷ [2nd][STAT][▼][ENTER][ENTER]**. The speed of the car for each run is now in L3. **See Figures 4a-b.**

Find a Relationship Between Time and Weight

1. Press **[2nd][PLOT]** and select Plot 1 by pressing **[ENTER]**. Turn Plot 1 On.
2. Press **[▼]** and select the scatter plot. Press **[ENTER]**. Select L1 for XList and L2 for YList. **See Figure 5.**

L1	L2	L3	3
22	2.4633	-----	
37.7	3.11		
55.4	3.64		
79	4.5333		
93.4	6.4067		
109.8	12.52		

L3=180/L2			

Figure 4a

L1	L2	L3	3
22	2.4633	73.07185	
37.7	3.11	57.878	
55.4	3.64	49.451	
79	4.5333	39.706	
93.4	6.4067	28.098	
109.8	12.52	14.377	

L3(4) = 73.0717185...			

Figure 4b

WINDOW
Xmin=-1
Xmax=110
ΔX=1.180851063...
Xscl=1
Ymin=-1
Ymax=15
Yscl=1

Figure 5

3. Have students determine an appropriate scale for the axes. Press **WINDOW** and adjust the values. The sample data uses $X_{min} = -1$, $X_{max} = 110$, $Y_{min} = -1$, $Y_{max} = 15$. **See Figure 6.**
4. Press **GRAPH**. You will see a graph of time with respect to weight. Sketch this plot on the axes on your worksheet. **See Figure 7.**

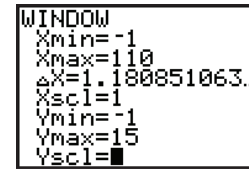


Figure 6

Find a Relationship Between Speed and Weight

1. Press **2nd**[PLOT]. Turn Plot 1 Off. Select Plot 2 and turn it On.
2. Press **↓** and select the scatter plot. Press **ENTER**. Select L1 for XList and L3 for YList. (To insert L3, press **2nd**[STAT]**↓****↓****ENTER**.)
3. Have students determine an appropriate scale for the axes. Press **WINDOW** and adjust the values. The sample data uses $X_{min} = -1$, $X_{max} = 115$, $Y_{min} = -1$, $Y_{max} = 100$.
4. Press **GRAPH**. You will see a plot of speed with respect to weight. Sketch this plot on the axes on your worksheet. **See Figure 8.**

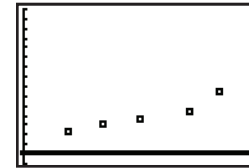


Figure 7



Figure 8



EXTENSION ACTIVITY

1. Test a point on the graph to see if it matches reality. Start by adding a trend line to the speed and weight graph. Press **2nd**[STAT]**↓****5****2nd**[STAT]**.****ENTER****2nd**[STAT]**↓****↓****ENTER****ENTER** to see the equation of the trend line. Then press **Y=****2nd**[VARS]**3****↓****↓****ENTER** to paste the equation into the Y= editor. Press **GRAPH** to see the trend line on the scatter plot.

★ **NOTE** You can have students first manually draw a trend line. See Appendix A for help with Manual Fit.

2. Press **TRACE** to see values on the line. Pick a weight you have not tried and test it to see if it attains the speed you predicted with your model. **See Figure 9.**

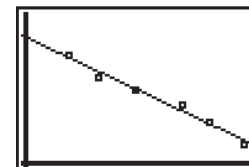


Figure 9

DISCUSSION NOTES

Discuss independent and dependent variables. The independent variable is what changes on each run (the weight). Independent variables are always represented on a graph on the x -axis. The dependent variables (time and speed) are shown on the y -axis. Stress the relationship by saying “The time/speed depended on the weight of the car.”

After each scatter plot is drawn, have students discuss its shape. On their worksheets, it may help them if they label the x - and y -axes with the words time, weight, and speed. To help them understand their plot, have them pick a point and explain what it represents.

For students who performed the extension, explain that trend lines are models that help predict what should occur in real life. The more data they collect, and the better they control the variables, the better their model will become.

WORKSHEET ANSWERS

Data in the chart will vary.

1. Plots will vary.
2. Weight is on the x -axis and time is on the y -axis.
3. As weight increased, time increased.
4. Plots will vary.
5. Weight is on the x -axis and speed is on the y -axis.
6. As weight increased, speed decreased.
7. The speed would be 0. (The car would not move.)



TI-NAVIGATOR™ EXTENSION ACTIVITY

1. Load the **scatplot1.act** activity settings file. A scatter plot, and a red and green X on the x -axis, will appear in Activity Center. The activity settings files can be found on the CD located in the back of the book.
2. Ask students to imagine a trend line going through the blue points. Have one student move their cursor to the position where they think the trend line will be above the red X. Repeat with another student for the green X. See if the rest of the class agrees. Clear the data and have other students mark the points if they think they should be elsewhere.
3. Repeat with **scatplot2.act** and **scatplot3.act**.
4. For any of the scatter plots, you can also have the entire class move their cursors to form the trend line.

ADVENTURE

2

The Need for Speed Worksheet

Math Objectives:

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Materials:

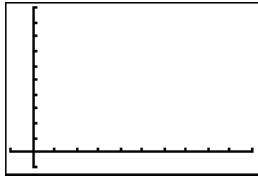
TI-73 Explorer™, Radio controlled car, Stop watches (3), Tape measure, Scale

In this adventure, you will run a radio controlled car at several different weights recording the time of each run.

	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
Vehicle Weight in oz.						
Timer #1						
Timer #2						
Timer #3						
Time Average in sec.						
Speed $\left(\frac{d}{t}\right)$ (in./sec)						

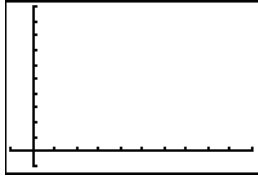
Adventure 2: The Need for Speed

1. Sketch the plot of time with respect to weight.



2. What is represented on the x-axis? the y-axis?

3. Fill in the blank: As weight increased, time _____.



4. Sketch the plot of speed with respect to weight.

5. What is represented on the x-axis? the y-axis?

6. Fill in the blank: As weight increased, speed _____.

7. What would happen if you made the car ridiculously heavy?

EXTENSION

Pick some weight you have not tried and test it to see if it attains the speed you predicted with your model.

Chosen weight _____

Predicted speed _____

Actual speed _____