



# New Hampshire Chase Activity

STEM Lesson for TI-Nspire™ Technology

**Objective:** Students will create scatter plots given data in a table. Students will then create lines of best fit to analyze and interpret the data.

**About the Lesson:** New Hampshire Motor Speedway is only 80 miles from downtown Boston and only three times that far to Times Square in New York City. Built in 1960 as Bryar Motorsport Park, a 1.6 mile road course, the track was rebuilt in 1989 as a paved 1.058 mile relatively low (12 degrees) banked oval. During the New Hampshire race, the decay lap times (increase due to tire wear) was an important parameter. In this activity students will compare the lap times of Kasey Kahne and Jeff Gordon while each were in the lead during the race and predict a winner.

**Materials:** Student Worksheet

**Prerequisite skills:** The students need have a basic understanding of scatter plots.

**Analysis:**

## Using TI-Nspire Technology

1. Open the file named ***NH\_Chase\_Activity.tns***.
2. Move to page **1.2**.
3. The data in the spreadsheet shows the lap times for Kasey Kahne and Jeff Gordon for 30 of their laps led during the race. Lap times increase each lap due to tire wear.

	lapsled	kaseyk	jeffg
1	1	29.8037	29.5783
2	2	29.8491	29.643
3	3	29.872	29.7219
4	4	30.3079	29.6781
5	5		29.72

**Teacher Tip:** There are some gaps in the data. This should not be 0 and should be left blank.

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4. Move to page 1.3 to create a scatter plot of lap times vs. laps led for each driver.
5. What is the independent variable?

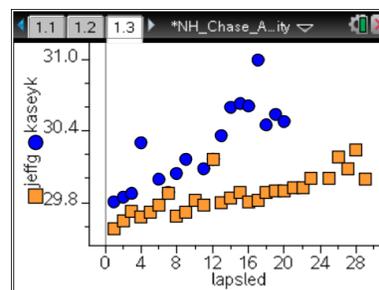
**Answer: Number of Laps Led**

6. What is the dependent variable?

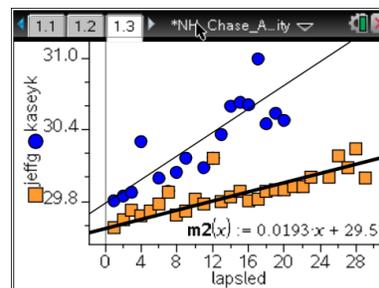
**Answer: Lap Times**

**Navigator Tip:** Quick Poll the students for their answers to #5 and #6 and show the results to make sure the students know which variable goes on which axis.

7. Move the cursor to the bottom of the screen where it says, “Click to add variable,” and press .
8. Choose the independent variable.
9. Move the cursor to the right side of the screen until a rectangle appears and press .
10. Choose the dependent variable.
11. While still at the right side of the screen press   then **Add Y Variable**. Choose the other driver.



12. Press  then choose **Analyze > Add Movable Line**. Grab the line at each end and move it until it best fits the points. Repeat this step for the second set of points.



13. What is the equation for each driver’s line of best fit?

**Answer: Answers will vary but the student should get the equation by clicking on the line.**

**Navigator Tip:** Quick Poll the students for their answers to #13 and show the results to start a good discussion about lines of best fit.

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14. What is the slope of the line for Kasey Kahne?

**Answer: Answers will depend on student equation. It should be the coefficient of  $x$ .**

15. What is the slope of the line for Jeff Gordon?

**Answer: Answers will depend on student equation. It should be the coefficient of  $x$ .**

The slopes of these lines are actually called decay rates even though they are positive and the lines increase. In racing the lowest time is the best time.

16. Who has the best lap times?

**Answer: Jeff Gordon**

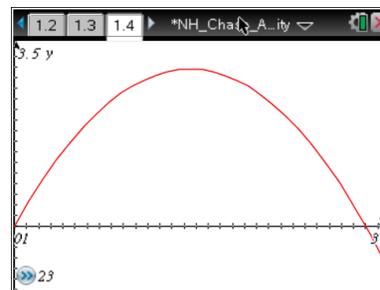
Although both drivers were in the lead at some point in the race, one of the drivers was faster while he led. We can use the data to predict who will come out in the lead on the last lap.

If both cars came out after a pit stop together with 30 laps of racing to go after the green flag and the 4 car driven by Kahne starts with a 29.53 second lap and Gordon starts with a 29.65 lap, who will win with the given decay rates (increase) of 0.46 sec/lap for Kahne and 0.0177 sec/lap increase for Gordon?

17. Kasey Kahne's accumulated time can be modeled as  $f(x) = 0.023x^2 + 29.53x$  and Jeff Gordon's accumulated time can be modeled as  $f(x) = 0.00885x^2 + 29.65x$ . Calculate the difference between the two functions.

**Answer:  $(0.00885x^2 + 29.64x) - (0.023x^2 + 29.23x) = -0.01415x^2 + 0.41x$**

18. Move to page 1.4 and graph the difference between the two functions.



When the graph is positive, Kasey Kahne is  $y$  seconds ahead of Jeff Gordon. When the graph is negative, Kasey Kahne is  $y$  seconds behind Jeff Gordon.

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19. According to your graph who is the winner (the one in the lead) after the last 30 laps of the race?

**Answer: Jeff Gordon**

**Navigator Tip:** Quick Poll the students for their answers to #19 to check student understanding.

**Using spreadsheet software**

Number of Laps Led	Kasey Kahne	Jeff Gordon
1	29.80375	29.57832
2	29.84906	29.643
3	29.872	29.72188
4	30.30795	29.67811
5		29.72003
6	29.99811	29.77905
7	29.88302	29.87294
8	30.04188	29.68598
9	30.15892	29.71701
10		29.81098
11	30.08697	29.77905
12	30.16704	30.16561
13	30.35892	29.79489
14	30.5999	29.832
15	30.62795	29.87997
16	30.61195	29.80398
17	30.99811	29.81612
18	30.45189	29.8849
19	30.54395	29.89193
20	30.47893	29.89193
21		29.92904
22		29.92904
23		30.00804
24		
25		30.00591
26		30.18497
27		30.08008
28		30.24297
29		29.99811
30		

1. Enter the data from the table into spreadsheet software. Do not put zeros in the blank spaces. This is where there is no data for that lap or the car wasn't in the lead.
2. Use the chart wizard to create a scatter plot of *lap time* vs. *laps led* for each driver. Chart type will be XY(Scatter). Click **Next**.

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3. What is the independent variable?

**Answer: Number of Laps Led**

4. What is the dependent variable?

**Answer: Lap Time**

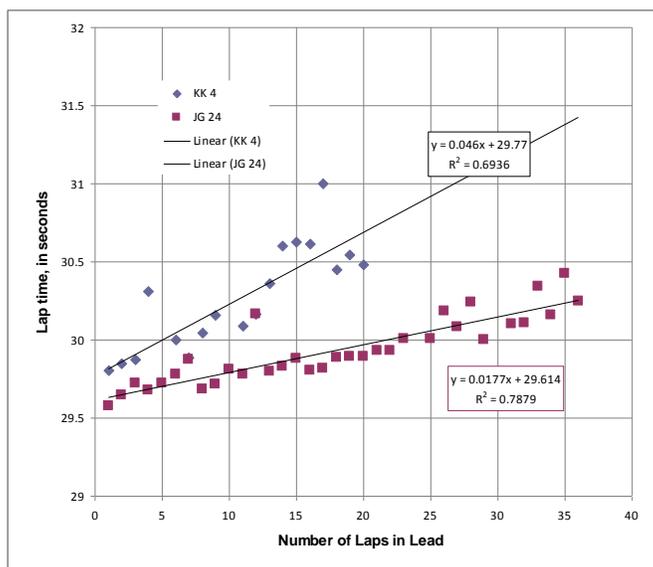
5. You will have to click on the **Series** tab to make sure the correct data is on the correct axis. If the wrong data is there, click in the box for the x values then highlight the data for the independent variable.

6. Repeat step 5 for the y values. Click **Next**.

7. Create titles for the chart and each axis. You can also click the other tabs to change the appearance of your graph. Click **Next**.

8. Decide if you want the graph to appear in the same window as your table or in a new window. Click **Next** and your graph should appear.

9. Create a line of best fit for your scatter plot by clicking **Insert > Picture > Auto Shapes**. Then choose **Lines** and then **Line Segment**. Draw a line that touches the most points.



10. What is the slope of the line for Kasey Kahne?

**Answer: Answers will depend on the 2 points the students choose. It is approximately 0.05 sec/lap for the line shown.**

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11. What is the slope of the line for Jeff Gordon?

**Answer: Answers will depend on the 2 points the students choose. It is approximately 0.02 sec/lap for the line shown.**

The slopes of these lines are actually called decay rates even though they are positive and the lines increase. In racing the lowest time is the best time.

12. Who has the best lap times?

**Answer: Jeff Gordon**

Although both drivers were in the lead at some point in the race, one of the drivers was faster while he led. We can use the data to predict who will come out in the lead on the last lap.

If both cars came out after a pit stop together with 30 laps of racing to go after the green flag and the 4 car driven by Kahne starts with a 29.53 second lap and Gordon starts with a 29.65 lap, who will win with the given decay rates (increase) of 0.46 sec/lap for Kahne and 0.0177 sec/lap increase for Gordon?

13. Kasey Kahne's accumulated time can be modeled as  $f(x) = 0.023x^2 + 29.53x$  and Jeff Gordon's accumulated time can be modeled as  $f(x) = 0.00885x^2 + 29.65x$ . Calculate the difference between the two functions.

**Answer:  $(0.00885x^2 + 29.64x) - (0.023x^2 + 29.23x) = -0.01415x^2 + 0.41x$**

14. Generate the lead time from your equation for 30 laps. Use the *Laps Led* column that you have already created as the independent variable. Don't forget to type an equal sign before you type your equation. After 2 or 3 cells, you should be able to copy and paste the rest of the column.

15. Use the chart wizard to create a scatter plot of *lead time vs. laps*. Chart type will be XY(Scatter). Click **Next**.

16. What is the independent variable?

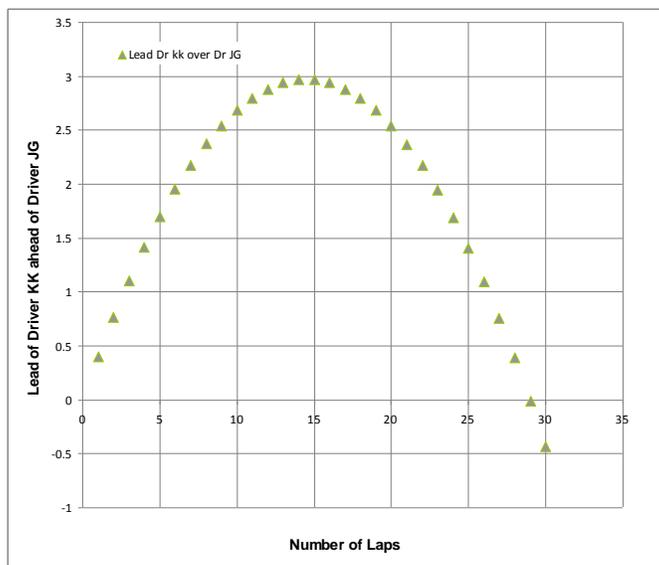
**Answer: Number of Laps**

17. What is the dependent variable?

**Answer: Lead Time**

18. You will have to click on the **Series** tab to make sure the correct data is on the correct axis. If the wrong data is there, click in the box for the x values then highlight the data for the independent variable.

19. Repeat step 5 for the y values. Click **Next**.
20. Create titles for the chart and each axis. You can also click the other tabs to change the appearance of your graph. Click **Next**.
21. Decide if you want the graph to appear in the same window as your table or in a new window. Click **Next** and your graph should appear.



When the graph is positive, Kasey Kahne is  $y$  seconds ahead of Jeff Gordon. When the graph is negative, Kasey Kahne is  $y$  seconds behind Jeff Gordon.

22. According to your graph who is the winner (the one in the lead) after the last 30 laps of the race?

**Answer: Jeff Gordon**