Chicago Chase Activity

STEM Lesson for TI-Nspire™ Technology

Objective: Students will investigate non-linear graphs.

About the Lesson: Chicagoland Speedway is a 1.5 mile track with 18 degree banking on a 700' radius turn. The calculated average speed for a lap is 183 mph; however, drivers don't care about average speed of a lap. They only care about lap times. Using historical data one can make a mathematical index which predicts qualifying speed: (0.001*radius of the track in feet)+(length of 1 lap in miles + 3*sine of banking angle). A car should be able to go faster around a curve with a larger radius. During the race the lap times should fall off due to tire wear. Use the given data to investigate speeds and tire wear.

Materials: Student Worksheets

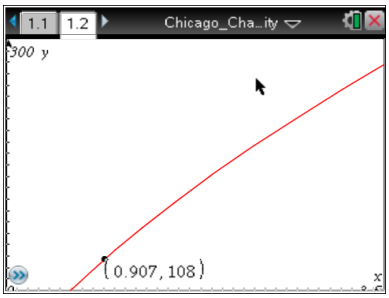
Analysis:

Using TI-Nspire Technology

1. Open the file named ***Chicago_Chase_Activity.tns***.

2. Move to page **1.2**.

3. This graph shows *average qualifying speed* vs. *predictor index*. The index is calculated using the equation mentioned at the beginning of the activity. Drag the point along the line.



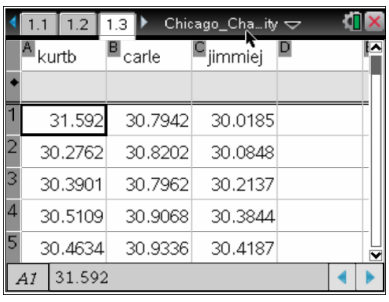
4. What does the *x*-value stand for?

5. What does the *y*-value stand for?

6. Chicagoland Speedway has a predictor index of 1.953. What average qualifying speed do you expect to see at this track?

7. Move to page **1.4**

8. The lap times during a run on one set of tires has been entered into the spreadsheet for three drivers: Kurt Busch, Carl Edwards, and Jimmie Johnson. The names have been abbreviated for easy reading.



9. Move to page **1.5** to create a scatter plot of *lap time* vs. *number of laps* for each driver.

10. What is the independent variable?

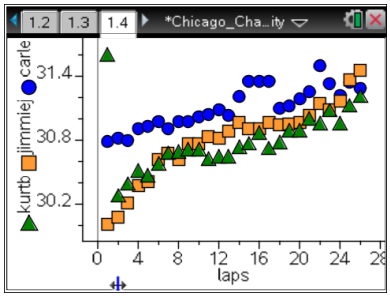
11. What is the dependent variable?

12. Move the cursor to the bottom of the screen where it says, “Click to add variable,” and press .

13. Choose the independent variable.

14. Move the cursor to the right side of the screen until a rectangle appears and press .

15. Choose the dependent variable then press (ctrl) (menu). Choose **Add Y Variable** and choose the correct variable to add each driver.



16. What type of regression would work best for the graph?

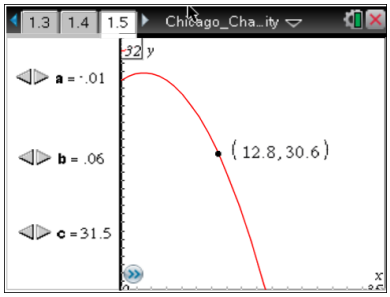
17. According to the graph, which driver has the *best* lap times?

18. According to the graph, which driver has the *worst* lap times?

19. Make a conjecture about lap times as more laps are ran on a set of tires.

It is interesting to compare different drivers and the progression of their lap times while leading. Most lap times have a quadratic trend line and a comparison of coefficients of the equations shows the values for different drivers are close to the same.

20. Move to page **1.5**. This is a graph of *lap time* vs. *number of laps* for one of the leaders during the Chicago race.



21. Grab the point and move it along the curve. What does the *x*-value stand for?

22. What does the *y*-value stand for?

23. On the left of the screen, **a**, **b**, and **c** stand for the coefficients of the quadratic equation shown in the graph. Click the◅ and ▻ to change the coefficients.

24. What happens when you change **a**?

25. What happens when you change **b**?

26. What happens when you change **c**?

Once the race starts, crew chiefs can take the data of the leader for the first laps and model with a quadratic equation like this to predict how fast their driver's lap times will fall off. The crew chiefs want to be able to predict lap times to help make their decision as to when they should call in their driver for new tires.

27. Choose a set of coefficients. Using your new graph, what will the driver's lap time be 15 laps into a run?

Analysis:

Using spreadsheet software

Here are the lap times for the first 26 laps of the 2011 Chicago race for three drivers.

KURT BUSCH	CARL EDWARDS	JIMMIE JOHNSON
31.592	30.79421	30.01852
30.27621	30.82016	30.08478
30.39013	30.79617	30.21371
30.5109	30.90682	30.38442
30.4634	30.93358	30.41869
30.5796	30.97569	30.61812
30.67605	30.91057	30.67801
30.69205	30.98124	30.62187
30.70967	30.98026	30.76647
30.70592	31.01584	30.77202
30.62187	31.04407	30.83779
30.64048	31.0914	30.81836
30.64896	31.03232	30.89034
30.72926	31.20433	30.97014
30.76271	31.35219	30.91335
30.86912	31.3566	30.91416
30.72746	31.35301	30.96198
30.773	31.10054	30.94174
30.88756	31.12502	30.95007
30.89311	31.18997	30.96476
31.00311	31.25199	31.02677
30.95007	31.49581	31.14036
31.07687	31.33081	31.08422
30.95088	30.79421	30.01852
31.12404	30.82016	30.08478
31.20531	30.79617	30.21371

1. Enter the table above into spreadsheet software.

2. Use the chart wizard to create a scatter plot of *lap time* vs. *number of laps* for each driver. Chart type will be XY(Scatter). Click **Next**.

3. What is the independent variable?

4. What is the dependent variable?

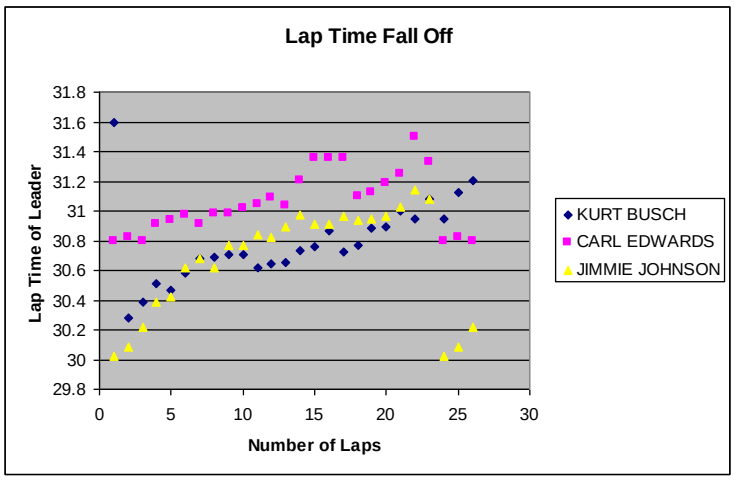
5. You will have to click on the Series tab to select which data goes on which axis. Click in the box for the *x* values then highlight the data for the independent variable.

6. Click the box for the *y* values then highlight the data for the dependent variable. You will have to do this for each series. Click **Next**.

7. Click the box for the name and click on the appropriate driver for each series.

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

9. 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.



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