Talladega Chase Activity

STEM Lesson for TI-Nspire™ Technology

Objective: Students will create scatter plots given data in a table. Students will then do regressions to analyze and interpret the data.

About the Lesson: Talladega Superspeedway is strictly aero, all aero, all the time. A standing joke in the engineering circles is that you can put anything (springs, shocks and chassis geometry) under a car for Talladega and it doesn't matter. It's all aero and all luck. Many teams don't even bother to run shaker rig tests on their Talladega cars. The current configuration of a NASCAR Sprint Cup car combined with restrictor plates which limit the power output of an engine results in two car tandems with the second car literally pushing the lead car of the duo. Cars paired up in this manner can run as much as 15 mph faster than a single car and 8 mph faster than a long line of cars with tiny spaces between the cars. You could call it the Talladega Pas de Deux.

Materials: Student Worksheets

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

Teacher Tip: *You could use this activity to introduce quadratic graphs with teacher input during the activity or use it as an advanced activity and let students decide the type of regression to use.*

Analysis:

Using TI-Nspire Technology

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

2. Move to page **1.2**.

3. Input speeds ranging from 140-210 mph in increments of 10 mph in the first column. The other columns show the power associated with each speed for a single car and a two car tandem.

4. Move to page **1.3** to create scatter plots of *single power* vs. *speed* and *duo power* vs. *speed*.

5. What is the independent variable?

    Answer: Speed

6. What is the dependent variable?

    Answer: Power

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.*

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7. Press (var) and choose your independent variable. Press ▾ then (var) and select your dependent variable. Press (enter).

8. Press (menu) then **Window/Zoom > Zoom – Data**.

9. Press (tab) and repeat steps **7** and **8** for the second plot.
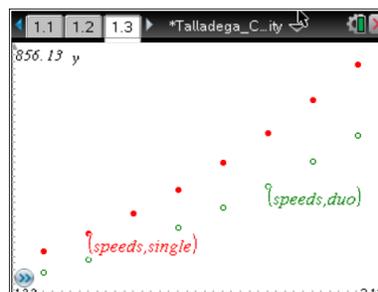
10. When the power is the same between single and duo, what is the difference in speed?

    Answer: 20 mph

11. Move back to page **1.2** and move to column D.

12. Press (menu) then choose **Statistics > Stat Calc > Quadratic Regression**.
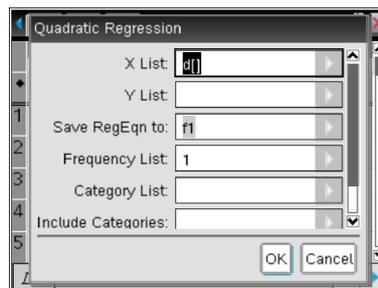
13. Click on the arrow to the right of X List and choose *speeds* and click the arrow to the right of Y List and choose *single*.

14. Scroll to the very bottom and make sure the 1st Result Column is e[ ] and click **OK**.

15. Move to column G and repeat steps **12-14** for *duo*.

16. Move to page **1.3**.

17. Press (menu) **> Graph Type > Function**. The function bar will appear at the bottom of the screen. Press ▲ to see *f1*(*x*) and press (enter). Your curve for single power should appear.

18. Press (tab) then ▲ to see *f2*(*x*) and press (enter) to see your curve for duo power.

19. Grab and drag any text to make the graph more visible. You can also adjust the window settings to investigate the graphs.
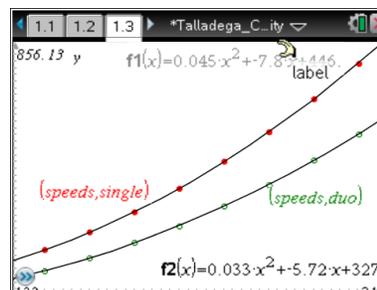
Navigator Tip: *Do a screen capture of student handhelds to make sure everyone is on the right track.*

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20. Press (menu) **> Graph > Graph Trace** to trace the graphs. Press ▲▼ to switch graphs.

21. Predict the power single and duo powers at the following speeds:

     a. 165 mph   **single = 382 hp, duo = 283**

     b. 185 mph   **single = 544 hp, duo = 399 hp**

     c. 100 mph   **single = 116 hp , duo = 85.2 hp**

     Answers may vary by some.

22. Make a conjecture about single car laps and the two-car tandem.

> **Answers will vary.**

Using spreadsheet software

1. Create 3 columns in your spreadsheet software. Title them *Speeds, Single Car Power,* and *Duo Car Power*.

2. Input speeds ranging from 140-210 mph in increments of 10 mph in the first column.

3. In the second column input the equation =500*(**A2**/**A6**)^3 where **A2** is your 1st speed and **A6** is the average speed of 180 mph. Copy the equation down for all speeds. Adjust each equation so the numerator changes cells for each one and the denominator stays **A6**.

4. In the third column input the equation = 500*0.733*(**A2**/**A6**)^3 where **A2** is your 1st speed and **A6** is the average speed of 180 mph. Copy the equation down for all speeds. Adjust each equation so the numerator changes cells for each one and the denominator stays **A6**.

5. Use the chart wizard to create a scatter plot of *single power* vs. *speed* and *duo power* vs. *speed*. Chart type will be XY(Scatter) and choose the one with the data points connected by smoothed lines. Click **Next**.

6. What is the independent variable?

> **Answer: Speed**

7. What is the dependent variable?

> **Answer: Power**

8. 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.

9. Repeat step **8** for the y values. Click **Next**.

10. Create titles for the chart and each axis. You can also click the other tabs to change the appearance of your graph. You might want to adjust the domain and range. Click **Next**.

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11. 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.

The Pas de Deux

Power in hp vs Speed in mph, with Single and Duo curves.
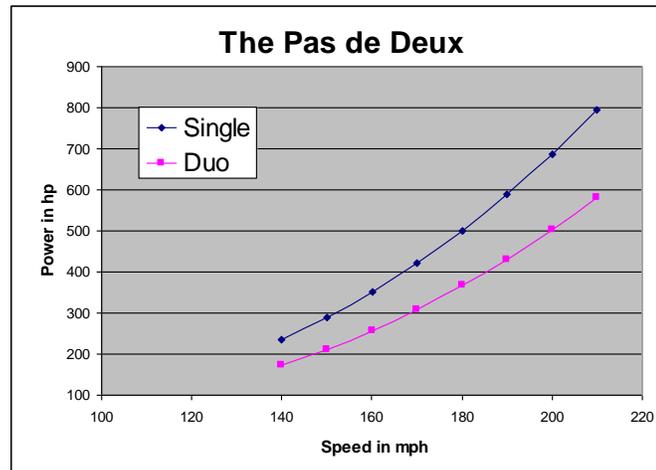
12. When the power is the same between single and duo, what is the difference in speed?

Answer: 20 mph

13. What kind of regression do you think would be?

Answer: Quadratic Regression

14. Predict the power single and duo powers at the following speeds:

   a. 165 mph   **single = 380 hp, duo = 280 hp**

   b. 185 mph   **single = 540 hp, duo = 400 hp**

   Answers are approximate.

15. Make a conjecture about single car laps and the two-car tandem.

   Answers will vary.