

Dover Chase Activity

STEM Lesson for TI-Nspire™ Technology

Objective: Students will create a bar graph given data in a table. Students will then use the graph to analyze the data and make predictions.

About the Lesson: Dover is a 1 mile concrete track banked at 24° with interesting transitions at the exits of the turns, Turn 2 in particular, as it has a roller coaster effect but not so dramatic as to having the cars actually take flight. (See Figure 2) As a car exits the turn it runs up the track to make the largest possible radius turn as shown in Figure 1 allowing the car to go faster. Then in the transition from 24° banking to the relatively flat 9° slope of the straightaway the track drops away, and the car heads down hill which can produce the roller coaster effect.

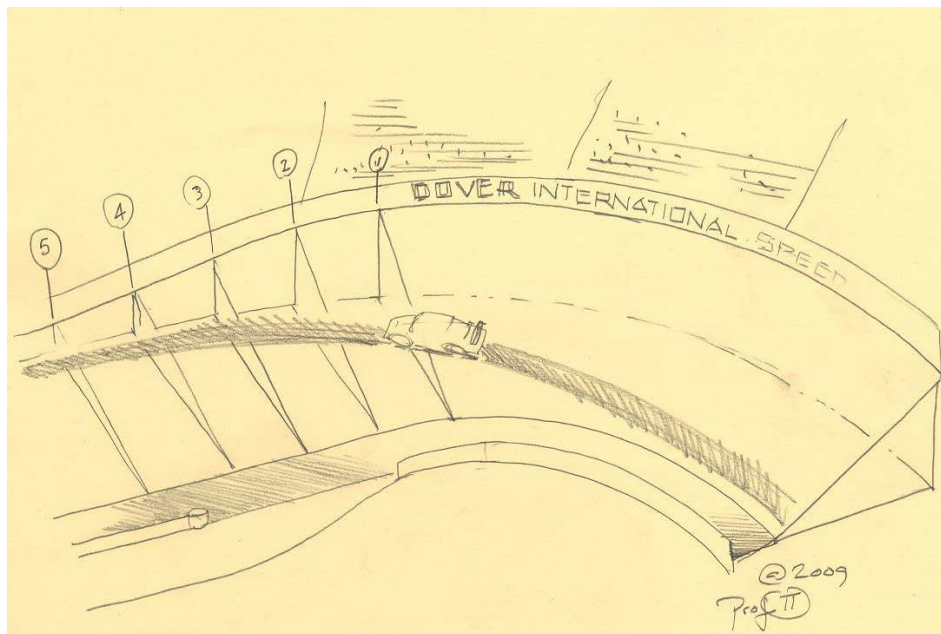


Figure 1

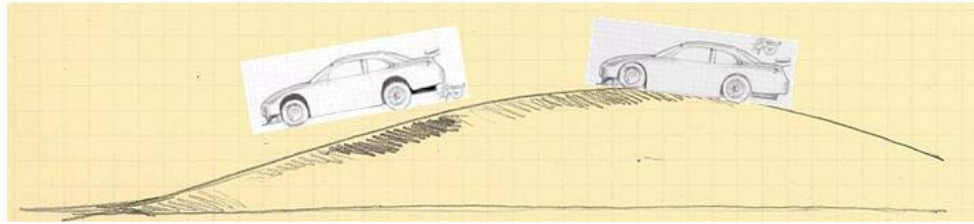


Figure 2

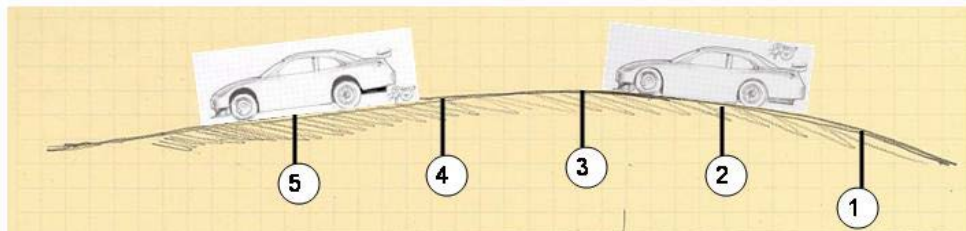


Figure 3

Numbers correspond to numbers in Figure 1.

During television broadcasts long camera shots of the cars exiting Turn 2 will make it appear as if the back end of some cars suddenly jump sideways, but in reality they don't jump. Due to unloading the wheels, there is less traction; and the cars suddenly tend to go straight. The illusion that the car jumps sideways is caused by the fact that the wall of the track is curved so the space between the car and wall suddenly diminishes. Unloading the back wheels in a turn can cause a driver to over-steer which causes the back of the car to slide towards the wall. If the driver does not correct the over-steer quickly, a wreck will occur. This activity will investigate where most wrecks occur at Dover.

Analysis:

Wreck	Where Wreck Occurred
1	T 2
2	T1
3	T2
4	T4
5	T2
6	T4

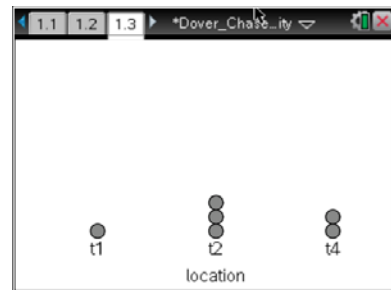
Using TI-Nspire Technology

1. Open the file named **Dover_Chase_Activity.tns**.
2. Move to page **1.2**.
3. Enter the data from the table in the columns provided.

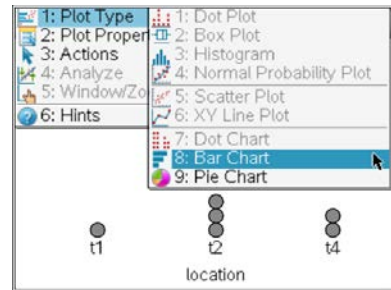
wrecks	location
3	t2
4	t4
5	t2
6	t4

Let's look at where the wrecks occurred.

4. Move to page **1.3** to graph a bar graph showing how many times a wreck occurred in each turn.
5. Move the cursor to the bottom of the screen where it says, "Click to add variable," and press . Choose **location**.



6. Press and choose **Plot Type > Bar Chart**.



7. Hover over each bar. What percentage of the wrecks occurred in each turn.

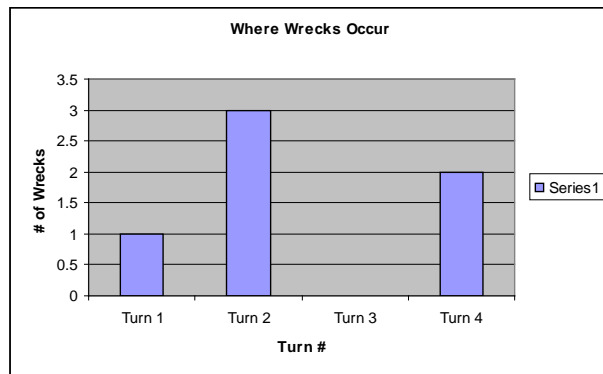


Using spreadsheet software

1. Enter the table above into spreadsheet software.

Let's look at where the wrecks occurred.

2. Create another table with each turn in one column (Turn 1, Turn 2, etc.) and the number of times a wreck occurred for each term in another column.
3. Use the chart wizard to create a bar graph. Choose Column under chart type. Click Next.
4. Since this is a frequency graph, you only have to select all of the data. Make sure the category (X) data is the turn labels. Click **Next**.
5. Create titles for the chart and each axis. You can also click the other tabs to change the appearance of your graph. Click **Next**.
6. 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.



7. Which turn did the most wrecks occur?
8. Based on the graph, what conjecture can you make about where wrecks will occur at Dover International Speedway?

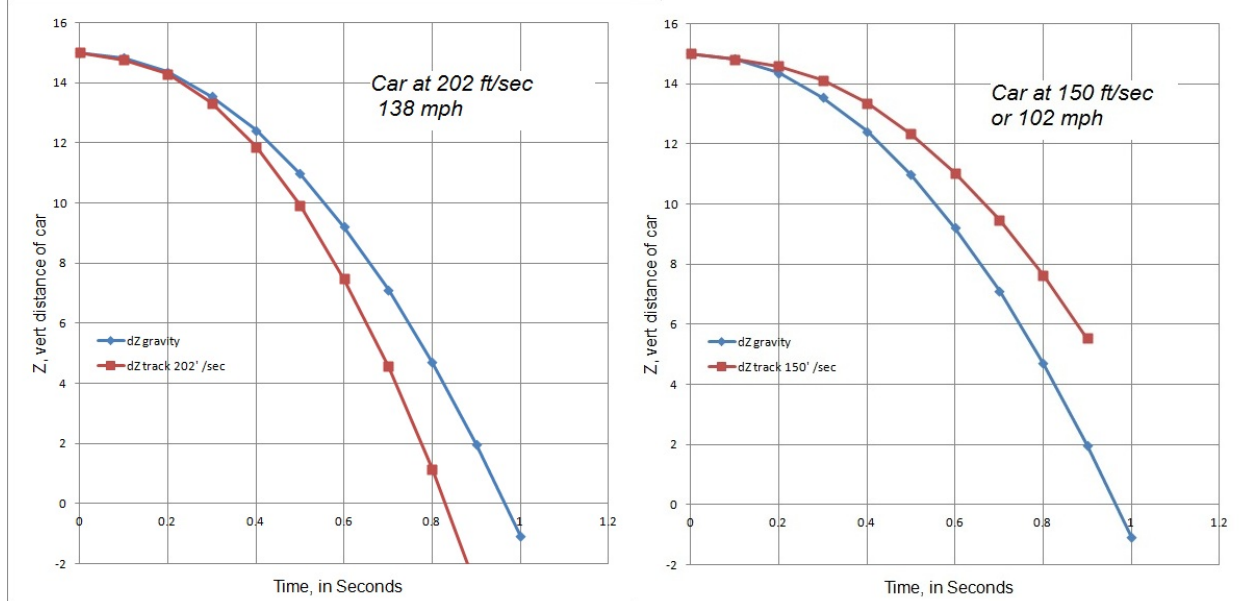
Extension:

The "roller coaster" feel of the Dover track, particularly exiting Turn 2 was best described by Elliott Sadler, former driver of the 19 car in the Sprint Cup Series and current driver of the 2 car in the Nationwide Series, who accurately characterized the sensation but didn't have the math/science to explain the effect.

If one goes over a hill slowly there's little or no "roller coaster" or fast Ferris wheel sensation. The feeling in question is when one goes over a hill and due to the speed of the vehicle the road or path drops away at a rate that starts to be a significant portion of the free-fall rate. If the road drops away at precisely the rate of free-fall then the sensation is being completely weightless; you're not but weightless but in free-fall you're not pulled down in your seat by gravity, now you and the seat are going down at the same rate.

If the speed of the vehicle is even faster then the car actually leaves the ground and flies through the air.

The curve of the road is physically the same irrespective of vehicle speed, but at higher speeds the road, relative to the car, drops away more quickly.



Note in both graphs the free-fall line is the same, the forward speed of the car determines the rate at which the road "falls away" from the vehicle. The car in the left side graph is air-borne, while the one on the right is still in contact with the pavement but the wheels are unloaded--this is what happens at Dover if the driver takes the wrong drive path in exiting Turn 2. The preferred drive line is shown in this Google map view of Dover.

Ten80 Student Racing Challenge: NASCAR STEM Initiative

