

Inclined Motion Rail Lab Analysis with the Casio CFX-9850Ga Plus

Purpose: To plot the position vs. time data of a ball rolling down a ramp, modify the data and find the mathematical model of the data.

Calculator menus: LIST and STAT

| <u>Data:</u> | <u>Position (cm)</u> | <u>Average Time (s)</u> |
|--------------|----------------------|-------------------------|
| | 0 | 0 |
| | 20 | .697 |
| | 40 | 1.044 |
| | 60 | 1.282 |
| | 80 | 1.572 |
| | 100 | 1.701 |

Plot Position on the Y axis and Average Time on the X axis.

Procedure:

1. In the LIST Menu, place the cursor in row 1 column 1 of List 1. Enter the first time value (for the **Xaxis**). Press EXE key. Repeat process until all X axis data are entered.
2. Place the cursor in row 1 column 1 of List 2. Enter the position values for the **Y axis**. Repeat until all Y axis data are entered.
3. Choose MENU and use the < button to go to the STAT Menu. Press EXE key.
4. Choose GRAPH (F1).
5. Choose the SET option (press F6).
6. Check the settings. You can store the graph in either GRPH 1, 2 or 3. Check the XList and YList to make certain it matches the List columns you entered. To change an option use the direction buttons and highlight the row. Then check the bottom of the screen and use the appropriate 'F' button to change the option.

Example: To change the XList to List3, first highlight the XList row then press F3. Note that the XList now reads ':List3' instead of ':List1'.

7. Press EXIT. You should now see the List values.
8. Choose SEL (F4). Make sure the StatGraph1 (or 2 or 3) is 'On'. Use the F1 or F2 button to turn the appropriate graph On or Off. (Remember to highlight the statgraph you want to turn on or off **BEFORE** pressing 'F1' or 'F2'.)
9. Press EXIT. You should now see the List values.

10. Choose the GRPH option (press F1 key).
11. Choose either GPH1 or GPH2 or GPH3 (press F1 or F2 or F3). If you choose 2 or 3 make certain that the SET option agrees!
12. The graph should now be on the screen. It should appear as a top-opening parabola.
13. To test whether this is a squared relationship (position is proportional to the square of the time) modify the X data by squaring it. The following procedure assumes that the X data are in List 1 and that the X squared data will go in List 3. Do this as follows:
 - a. Press EXIT.
 - b. Use the direction arrows and select the List 3 heading (there should be nothing in this column).
 - c. Press OPTN.
 - d. Choose LIST (Press F1). Choose List (Press F1 again).
 - e. The blinking cursor will appear after the word 'List'. Type in '1' . Press x^2 .
 - f. Press EXE. You should now see the squared x values in List 3.
14. Press EXIT. Press EXIT again. The GRPH option should now be visible above the F1 button.
15. Press F1. Choose SET (Press F6). To store the new graph as GPH2, press F2. This should now make the highlighted line at the top of the screen read 'StatGraph2'.
16. Use the direction buttons and go down to XList. Change to List3 by pressing F3. The new graph will now plot List 2 vs. List 3.
17. Press EXE.
18. Choose SEL by pressing F4. Turn 'on' StatGraph 2 by pressing F1. Turn 'off' any other graphs.
19. Choose DRAW by pressing F6.
20. Press F1(is shown by an 'x') to get linear regression information. (If you use the data above then the slope of the regression line is 33.1740193 and the y intercept is 2.53984354).
21. Since the data for the X axis were squared then the mathematical model would now be $s = (33.2 \text{ cm/s}^2)t^2 + 2.54 \text{ cm}$ where s = position and t = time.

*Side note: If the equation for the regression line is to be kept, it is possible to save it as a graphical equation by two methods.

- Have the students manually enter the equation from step 21
This is recommended if the students do not have experience with linear regression.
- Use the copy command to have the calculator store it.

- a. Select the copy command (F5)
- b. Choose the memory location to store the equation in.
- c. Press the EXE key to store the equation. You will be returned to the regression window.

To see the stored equation, press the MENU key and select the GRAPH mode.

The equation in the location you selected should be:

$$Y1=57.4939554X+-10.3$$