

MT 1800 – Calculus 1

WS 1.1b Introduction to Mathematica - Fitting linear functions to data

Name:

Name:

Due date:

Purpose: In this worksheet we find a mathematical model to predict the gold winning time/height/length for the event you chose in WS1.3a and compare this prediction to the prediction that you made initially, and to the actual result. We will use Mathematica and the table of data you used initially to make your prediction.

Instructions:

1. Log into your MT 1800 account.

2. Open Mathematica

Double click on the Mathematica 6 icon on your desktop, a blank Mathematica notebook will appear.

3. Create a new input cell

To create a new input cell hit the **enter key on the alphabetical keypad**.

4. Create a text cell to enter your names

Type in your names (they should appear in black). To convert this cell into a text cell, select the cell (bracket on the right) and then go to the **Format** option on the menu bar, select **Style** followed by **Text** or **Press Alt-7**.

5. Basic input palette

Check to see if the BasicInput Palette is active. If it does not appear, go to the **File** menu and select **Palettes**, followed by **BasicInput**.

6. Save and name a notebook

Go to the **File** menu and select **Save As**, search for your **MT1800** folder on the **Isabel** server and save this notebook using the file name **LinearModel_Name1_Name2**.

Example: LinearModel_Brandt_Guadarrama

It is easy to identify files if you follow this format whenever you save files on Isabel.

Modeling process

First, you will input in Mathematica the table of data you used in order to make your prediction.

7. Create a table in your Mathematica notebook

- a. Create a new input cell.
- b. Decide the name of the table.
In this case type: `eventData=`
- c. Immediately after the equal sign hold down **Insert** from the menu bar, select **Table/Matrix, New...**
- d. When the Table window appears select:
 - Make: Table
 - Number of rows: __ (input the number of rows you need)
 - Number of columns: 2
- e. To make the table easier to read, use the mouse cursor to put a checkmark in each of the following boxes:
 - Draw lines between rows
 - Draw lines between columns
 - Draw frame
- f. Enter the data into your table **without the headings for the columns**.
- g. **To input your table**, place the cursor on the right of it and **press the numerical enter key**. A list of ordered pairs should appear.
- h. View your data by typing `eventData` and pressing the numerical enter key.

8. Draw a plot of the data

- a. Create a new input cell.
- b. Decide on a name for the graph of your data plot.
In this case type: `dataGraph=`
- c. Immediately after the equal sign enter the Mathematica command:
`ListPlot[eventData]`

The line should look like this:

```
dataGraph= ListPlot[eventData]
```

Mathematica reads it as: create a graph called “**dataGraph**” by plotting the table (list) called “**eventData**”.

- d. Execute the command by pressing the **numerical enter key**.
- e. If you need to make the dots bigger you can specify the size adding to the command on the right hand side as follows:

```
ListPlot[eventData, PlotStyle->PointSize[.03]]
```
- f. View the graph of your data by typing **dataGraph** and pressing the enter key.

9. Do the data suggest a linear model? Enter a text cell and explain.

10. Look at the plot of the data and, by hand, find an equation of the line that you think best models the data, write it in slope intercept form i.e. $f(x)=mx+b$.

11. Open a text cell, type in your model, and interpret the slope and vertical intercept in terms of the context. Do they make any practical sense? Explain in detail.

12. Define the function

- a. Create a new input cell.
- b. Define the linear function you found above (your model).
To define a function in Mathematica type **$f[x_]:=$** followed by the function.

As an example, if we were to define the function $f(x)=3x+5$ we would type the following command:

```
f[x_]:=3x+5
```

- c. Execute the command by pressing the **numerical enter key**. It should show you the right hand side of the function you inputted.

13. Graph a function

- To graph a function in Mathematica we need to specify the domain for the independent variable. Think about what is a reasonable domain for your independent variable given the data you are modeling. (Hint: think years!)
- Create a new input cell.
- Decide on a name for the graph of your function.
In this case type: `modelGraph=`
- Immediately after the equal sign type: `Plot[f[x], {x, a, b}]` replacing **a** and **b** by the endpoints of the interval on which you will graph the function.

For example, to graph the function $f(x)=3x+5$ from above, which we called $f[x]$, with values of x going from -2 to 2 , we type:

```
modelGraph= Plot[f[x], {x, -2, 2}]
```

Mathematica reads it as: create a graph called “**modelGraph**” by plotting the function “**f[x]**” on the interval $[-2,2]$.

- Execute the command by pressing the **numerical enter key**. You should see the graph of your function.
- View the graph of your model by typing `modelGraph` and pressing the enter key.

14. Show the graphs together and review your model by comparing it with the data

- Create a new input cell.
- Show the graphs together by typing:**

`Show[dataGraph, modelGraph]`
- Execute the command by pressing the **numerical enter key**. Did you do a good job of modeling?

15. Make adjustments to your model if necessary, then open a text cell and answer the following questions:

- a. How well does the linear model fit the data?
- b. What does your model predict as the gold winning time/height/length for Beijing 2008?
- c. How does your model prediction compare to your guess prediction and the actual result?
- d. What are the shortcomings of your model?
- e. How could your model be improved?
- f. What did you learn in this worksheet about data and predictions in general?