Tutorial: Plotting Data

Putting data into a graph can significantly help understand how two quantities relate to each other.

Step 1: Plan the Graph

Decide what quantities you want to assign to the graph.

Sub-steps

1. Decide your *dependent variable* (the quantity you want to observe).
   a. This will go on the *y-axis*.
2. Decide your *independent variable* (the quantity that changes the dependent variable).
   a. This will go on the *x-axis*.

Example

"I want to see how *voltage* changes with *time*."

- Voltage is the dependent variable (y-axis)
- Time is the independent variable (x-axis)

Step 2: Format Output to the Serial Monitor

Use the *Serial Monitor* to output the data in CSV format (*comma separated values*).

Sub-steps

1. Create your *independent* and *dependent* variables in a LaunchPad program.
    a. If you expect your data to have decimal points, use the *float* data type.
2. Use a *for loop* to create a specific number of data points.
    a. A data point is an x-value paired with its y-value, i.e. (x,y)
3. Output the data in CSV format, using `Serial.print()` statements.
    a. There should be *one* data point per line.

Example

```
void setup() {
  Serial.begin(9600);

  float y; // dependent variable
  float x; // independent variable

  // This for loop will make 100 data points
  for (int i = 0; i < 100; i++) {
    // Get data point
    x = i * 0.1;
    y = sin(x);

    // Send data point to Serial Monitor using CSV format:
    // "(x), (y)"
    Serial.print(x);
    Serial.print(", ");
    Serial.print(y);
    Serial.println();
  }
}

void loop() {
}
```

Step 3: Copy data into a CSV text file.

After you run your program, you should have your data in CSV format in your Serial Monitor. Copy this text into a CSV file.

Sub-steps

1. Open a new blank text file (on Windows, the program *Notepad* works well).
2. Copy the text in the *Serial Monitor* and paste the text into the blank text file.
   a. In the Serial Monitor, only the copy shortcut works (Ctrl+C)
3. Save the text file as a CSV document in a location that you can remember.
   a. Be sure to use the file extension ".csv" (not ".txt")
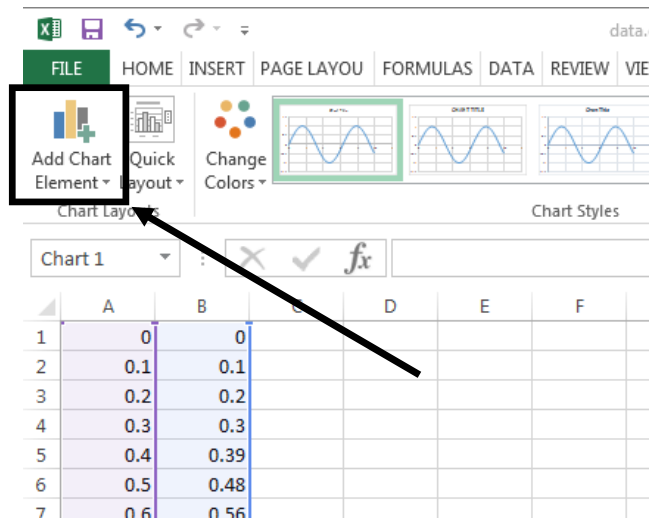
Example
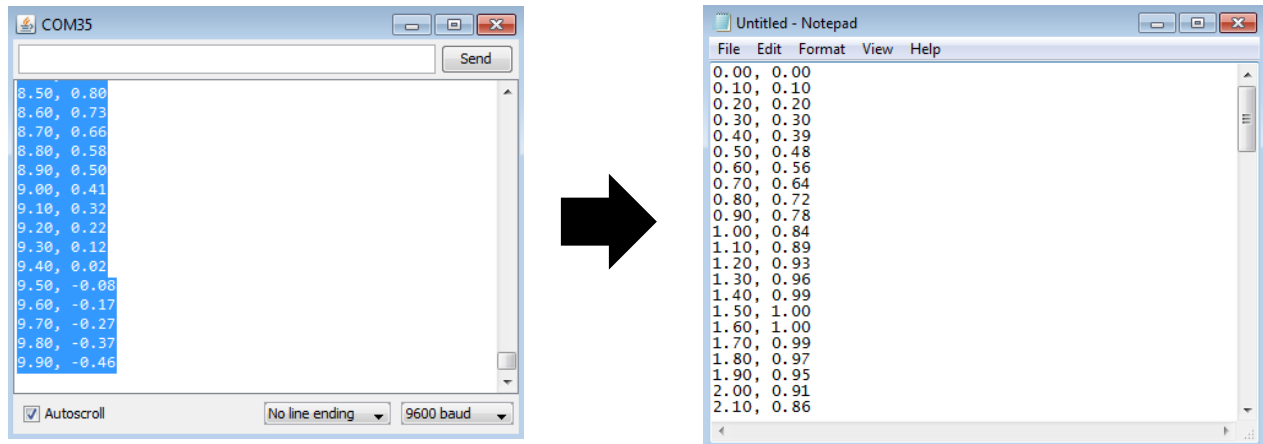
## Step 4: Use Excel to plot the data

Plot your data using Excel.

Sub-steps

1. Using *File Explorer*, navigate to where you saved the .csv file, and double-click the file.
    a. If you cannot open the file, right-click on the .csv file and select *Open with* ➜ *Excel*
2. Now you should see your data populated in a Microsoft Excel spreadsheet.
    a. Plot this data in a *Scatterplot* chart.
        i. Highlight the data with your mouse.
        ii. Go to the **Charts** tab. Select the *Scatter* chart type.
        iii. Be sure to format your chart
            1. Click on your chart to bring up the chart ribbon.
            2. Select the *Add Chart Element* tab (see figure below)

            3. Add a label for the x-axis and y-axis.
    b. Now you can use this chart as a figure in a report.
        i. See example on next page.

Example
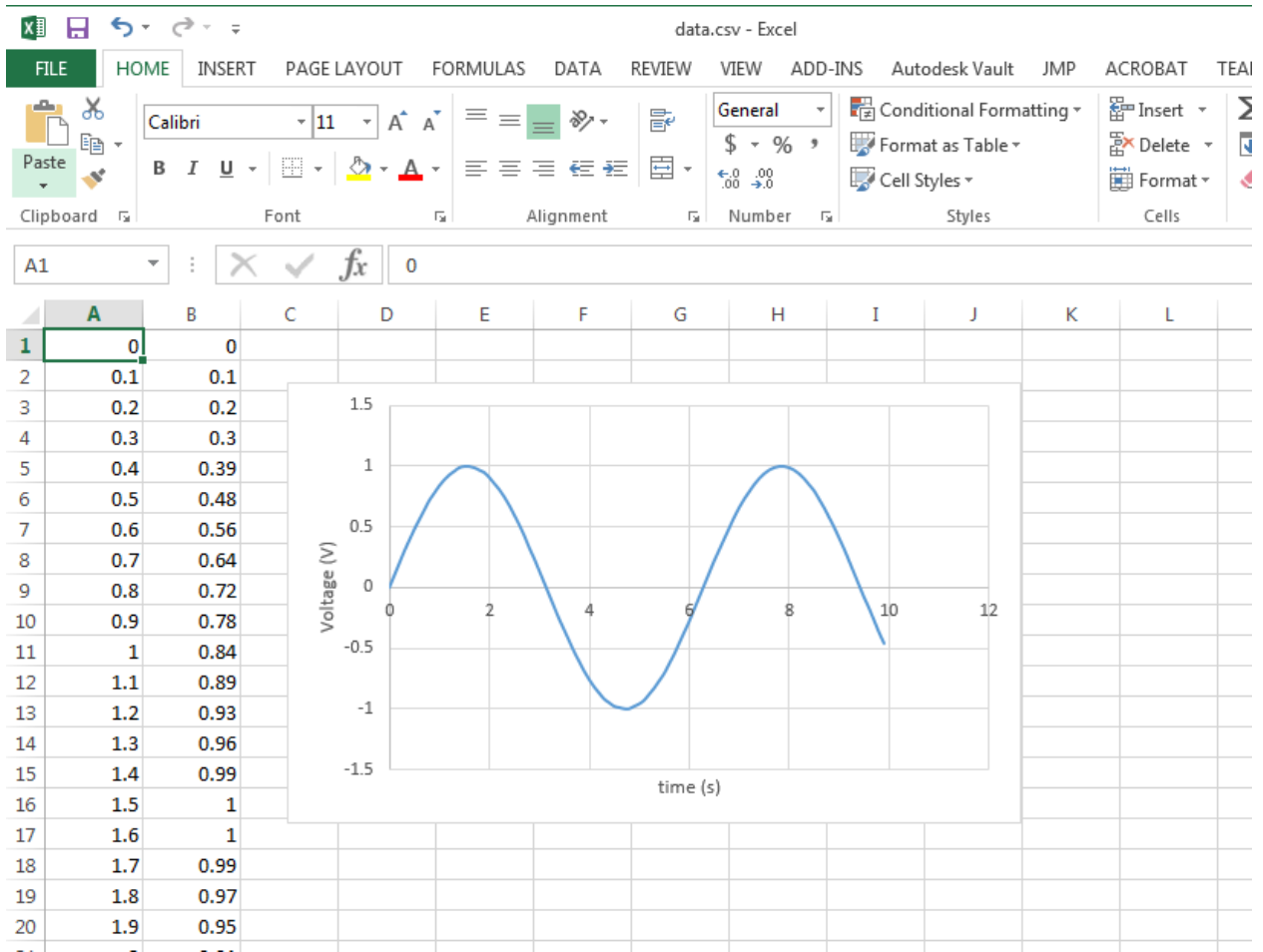
Review

Steps

1. Decide what you want to graph.
2. Design your program to output data in CSV format.
3. Copy the text from Serial Monitor into a text file. Save with a ".csv" file extension.
4. Open the CSV document with Excel, and create the graph.