

Lab 0 –Excel Practice

Equipment

- Computer with Excel software

Note on a grade: A grade for this report is optional but if a student decides to go for it, a grade for the Intro Lab will replace a lowest non-zero Data report grade. To receive a grade for the Intro Lab, a student must complete first 3 exercises of the Intro Lab and submit an Excel file complete work with imbedded formulas **before the midnight of Lab #1 scheduled date.**

Exercise 1: Data Entry and Data Summaries

Typically in data tables, we place the units with the column or row heading, in parentheses. The numerical values of the quantities don't have units written next to them. Some methods of summarizing data are to give the average, standard deviation, change, etc.

1. **Enter the data and headings** from the table into Excel. Notice that the data columns are labeled, and that the units are placed in the label in parentheses.
 - **Excel Note:** Don't include units with the numbers! Only the numbers should be in the data cells. Because of this, labels (with units) are always required above or at the left of a data series.

	A	B	C	D
1		t (s)	d (m)	d/t (m/s)
2		16	1.7	
3		13	2.4	
4		6.3	4.6	
5		1.1	6.1	
6		-2	6.9	
7		-7.9	8.8	
8				
9	Averages:			
10	Standard Devs:			
11	Final - Initial:			
12				
13	$\Delta d/\Delta t$ (m/s):			

Table 1. Sample data set to be entered into Excel. The labels are provided for you. Don't type in the grey headings; Excel shows them above and to the left of your spreadsheet.

2. **Calculate the ratios:** Here you will calculate the ratios of distance divided by time. Computers are great at repeating calculations without much effort. The “Fill handle” is a key to getting these calculations done easily.
 - **Enter the first formula** to calculate the ratio of d/t in the first blank cell of column D. Click on Cell D2, press “=” to start the formula, click on the top of the fraction (cell C2), type “/” for the division symbol, then click on the bottom of the fraction (cell B2). You could type the whole formula, but clicking reduces mistakes.
 - **Copy the formula down** by dragging the “fill handle” of cell D2 downward. The “Fill Handle” is a solid black dot at the bottom corner of the current cell. To see it, click once (not twice!) to select the cell you want to copy. Move your mouse cursor to the lower-right corner so that it turns into a plus sign (+). Drag the fill handle down, up, or across the cells that you want to fill.
 - **Excel Note:** Formulas start with an equals sign (=). Use formulas with cell references (e.g. “B2”) as much as possible. Don’t retype data values. That only gives you the opportunity to make a mistake. You may want to use your calculator to check the results, but don’t type in the results from your calculator.
3. **Calculate the averages** of all three data sets (Column B, C, D) by using the built-in average function. On the “Average” row, in cell B9 type “=average (B2 : B7)”. Use the fill handle to copy the formula across for series C and D.
4. **Calculate the Standard Deviations:** Use the standard deviation function in cells B10 thru D10. The first one should look something like “=stdev (B2 : B7) ”.
5. **Calculate the Change in each Quantity.** In B11, calculate “Delta t”, which is just “=B7–B2”.
 - **Excel Note:** To get the Δ , you can use Insert-Symbol in Excel, or just Google for “Unicode Math Symbols” and copy-and-paste what you need. Alternatively, you can just use the word “Delta”.
6. **Calculate a mediocre approximation of the slope.** In B13, divide Delta d by Delta t to produce $\Delta d/\Delta t$.

Exercise 2: Graphing

Using the MS Excel features, make two scatter plot graph using the above set of data points. Note that for most scientific graphs you will need to use **the scatter plot option** (click “insert” tab and look for “scatter plot” on upper bar).

- **Graph 1**, scatter plot of d vs. t . This one is easy because the data is in the right order.
- **Graph 2**, scatter plot of t vs. d . The data series are “backwards” for this graph. There are two ways to deal with this:
 - **Method 1:** Make another copy of the data table in a blank area of the spreadsheet, with the columns in the “right order”. I call this a “**helper table**”. Simply use copy-and-paste, one column at a time. (Advanced version: use the Paste Special feature to paste a link, and the helper table will update if you have to fix your data.)
 - **Method 2:** Create a blank graph and use the Select Data option within the graph and manually choose the x and y data series. This is cumbersome but works well if you can figure it out.

Make sure to label each axis (“t (s)” or “d (m)” like the column labels) of each plot properly and display the title of the plot on the chart. If you have difficulties, ask for help from the lab instructor.

Important Note: We refer to any graph by the vertical axis first. For example, in a “ d vs. t ” graph, d is on the y -axis and t is on the x -axis.

Exercise 3: Graph analysis and Linear Fitting

On each graph, obtain the equation of best fit, using Excel’s trendline feature. Go back to the Excel graphs and fit a linear trendline to each graph (right click on one of the graph points and choose Trendline option). To display the equation of the fitting line, select “Display Equation” from “Options”. Use this equation to find out the slope and intercept of the graph. Excel displays the equation using the variables x and y . Of course your variables are different, so you should correct the equation to show the correct variables.

	Graph 1: d vs. t	Graph 2: t vs. d
Displayed Equation		
Corrected Equation		
Slope		
Units of Slope		
y-Intercept		
Units of y-Intercept		

Table 2. Data extracted from the linear fit. Use an empty area of your spreadsheet for this information.

Once you get your results, we’d like you to notice 2 things:

- The slopes are inverses ($1/x$) of each other.
- The slope of d vs. t is not equal to d/t (Cells D2-D7) or even the average d/t (cell D8). It’s close to the rise/run = $\Delta d/\Delta t$ (Cell B13) between the first and last data points.

Exercise 4: Trigonometry Practice.

(This is not required to be submitted with Lab 0. It is here for practice if you need it during Lab 5.)

Excel does all trigonometry in radians. This means you have to frequently convert between degrees and radians. Fortunately, it provides formulas to do this.

<u>You want</u>	<u>Math notation</u>	<u>Excel notation</u>
Sine	$\sin(\theta)$	<code>=sin(radians(c4))</code>
Cosine	$\cos(\theta)$	<code>=cos(radians(c4))</code>
Tangent	$\tan(\theta)$	<code>=tan(radians(c4))</code>
Sine with mult.	$d \sin(\theta)$	<code>=b4*sin(radians(c4))</code>
Inverse Tangent	$\tan^{-1}(y/x)$	<code>=degrees(atan(e5/d5))</code>
	$\text{atan2}(x, y)$	<code>=degrees(atan2(d5, e5))</code>
Square Root	$\sqrt{x^2 + y^2}$	<code>=sqrt(d5^2+e5^2)</code>

Notice that there's a special version of the inverse tangent that takes the x and y values separately, instead of having them divided. This eliminates the need to sometimes add 180° .

Use the spreadsheet to calculate the total displacement for a two-stage trip. Many formulas are given to help you along. Use the "Fill Handle" as much as possible. The math steps in the calculation are:

- Calculate the horizontal and vertical parts of each Leg.
- Add the horizontal and vertical parts separately to get the totals.
- Use the Pythagorean Theorem and inverse tangent to calculate the Distance and Angle of the total.

	A	B	C	D	E
40		d , Distance (m)	θ , Angle (deg)	x , Horiz (m)	y , Vert (m)
41	Leg 1	1	30	$d_1 \cos(\theta_1)$	$d_1 \sin(\theta_1)$
42	Leg 2	2	45	$d_2 \cos(\theta_2)$	$d_2 \sin(\theta_2)$
43	Total	$\sqrt{x_T^2 + y_T^2}$	$\text{atan2}(x_T, y_T)$	$x_1 + x_2$	$y_1 + y_2$

Table 3. Sample data for practice calculations. Some sample formulas are given using math notation. The final results in B43 and C43 should be a distance of 2.977 m at an angle of 40.01° .