Making Professional Graphs and Tables

Professional quality graphs follow many rules. Here are some rules you should ALWAYS use:

1. Use descriptive titles for your graphs. Useless titles such as "Distance vs. Time" are unacceptable. (The title is "useless" because anyone looking at the graph can see that the axes are distance and time without you telling them again in the title.) A good title would be something like "Motion of a Neutrino between CERN and Italy" or perhaps "Possible Faster than Light Motion by a Neutrino" or maybe "Neutrino Velocity and the Failure of General Relativity." Even better would be a two or three sentence caption describing the reason these data and this chart are important.

2. Not always a rule, but usually true. Actual data should be plotted with data point markers only and no lines connecting the points. Mathematical fits and theoretical calculations are plotted with lines only and thus no markers. The exception to this is when the data points from many separate runs are somewhat jumbled together and hard to visually isolate on the graph, in these cases you can go ahead and plot connecting lines.

3. Axes must have labels and units. The units are placed in parentheses. For example: "Distance (m)" or "*D* (m)" if it is clear what the variable means. When in doubt, spell it out.

4. Variables are set in an italic font. Written out words and units are set in a normal font.

5. Beware of Excel. It was never really intended for scientific use as Microsoft sees a bigger market in the business community. The XY graphs have a "Line" and "Scatter" option. Line graphs might be important to businesses but for scientific use you want to use the so-called scatter plots. Scatter plots result in a uniform x-axis, line plots do not.

6. Generally, your lines and markers should be black, not color or grey. Color looks nice but most publications are in black and white. Get used to it. Make sure your markers are sized to be easily seen but small enough to not overlap.

7. Unless you change it, Older versions of Excel default to a plot with a grey background. Make sure you change that to white.

8. You should use most of your plot area. That means that most of the time your axes will not start at zero. Scale your axes so that the major and minor tic marks are "round" numbers. When in doubt look through some of your textbooks and see how they do their graphs. Use common sense though, if your data run from 1 to 9 then plot with axes that run from 0 to 10.

9. Most of the time your axes should be at the left and bottom edges. If you are plotting negative numbers or log graphs make sure you shift the axes to the edges not in the middle of the graph. There are lots of exceptions to this though, check the journals in your field.

10. If you are plotting more than one set of data on a single graph make sure that you have a clear legend or annotate the graph with text boxes and/or arrows to distinguish which data points are related to each set.

11. If there are important features to a plot, you will often want to annotate that with an arrow and text to emphasize your discussion points.

12. If you are fitting your data to a line (straight or curved) and if you can include error bars on your graphs, you probably should plot the error bars.

Professional data tables follow specific rules too. Here are a few that yours should always follow.

1. Data tables require descriptive titles or captions. Again, look at your textbooks for examples of how this is done.
2. Variables are in italic font and units are in parentheses in normal font. Often the variable or word (*D* or "distance") is on one line and the units are centered on the next line immediately below it. If there is room, putting the units next to the variable is just fine too.
3. Unless you have a specific and clear reason, do not put boxes and lines around all your data points. A common way to do scientific data tables is to have a horizontal bold line across the top under the column headers and a similar line at the bottom denoting the end of the data table. If you have a lot of data then inserting a blank line after every five or ten rows of data will make it easier to read later. (Note, this can sometimes cause mistakes for plotting in Excel so you will probably want to have two sets of your data inside the spreadsheet, one for plotting and a second for presentation.)
4. Use multipliers or powers of ten prefixes whenever possible. I.e., avoid a column with numbers like 0.000010 A but instead use mA or µA for which the entry would now be either 0.010 or 10 respectively. You can also use 10^{-3} or 10^-3. Avoid using "E-3" type notation like your calculator does.
5. The numbers should line up. Generally, you want to line up the decimal points. This can be tricky in Excel.
6. The data should be roughly centered under the column heading. Be leery of using right or left justified data columns.
7. Data in a given column should usually have the same number of significant figures. That includes any trailing zeros. Thus, don't let Excel list a column with the trailing zeros suppressed. The value "0" is every bit as important as a "9" or "1" value unless it is only being used as a place holder. (Try to avoid that though.)
8. Don't crowd your table. Use a font and font size that is easy to read and have the columns spaced far enough apart to be clear but close enough together that the reader can scan across the column for relationships amongst the data.

Here are two examples of what has been discussed above.

Radioactive Decay of Rn^{220}
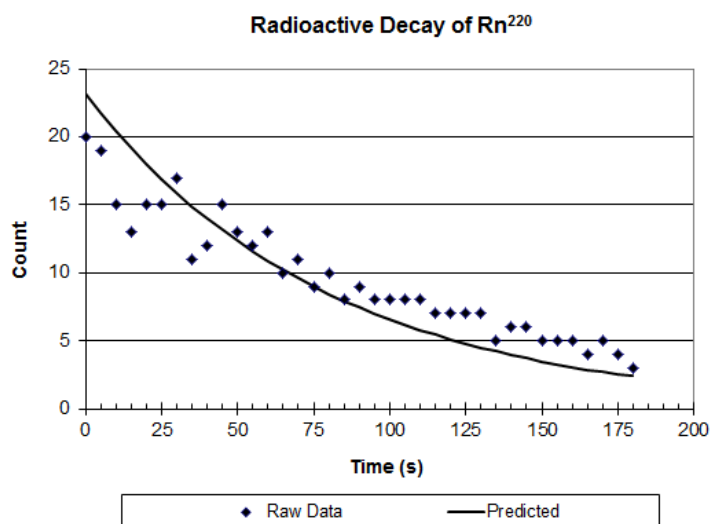
MET (s)	Accel_x (m/s^2)	Accel_y (m/s^2)	Accel_z (m/s^2)	Accel Magnitude (m/s^2)
0.2	-8.8	-12.7	-3.1	15.8
0.3	-1.2	-10.3	-3.8	11.0
0.4	-1.4	-5.4	-1.1	5.7
0.5	-5.1	-6.8	0.2	8.5
0.6	-5.7	-11.3	14.1	18.9
0.7	-9.8	-17.1	-2.2	19.8
0.8	-2.5	-6.4	-1.6	7.1
0.9	-1.2	-3.5	1.1	3.9
1.0	-8.6	-4.9	0.0	9.9