

# Standard Deviation and Error Bar

*Example Software Version: Microsoft® Excel 2007 in Windows® 7*

## 1. Why need standard Deviation?

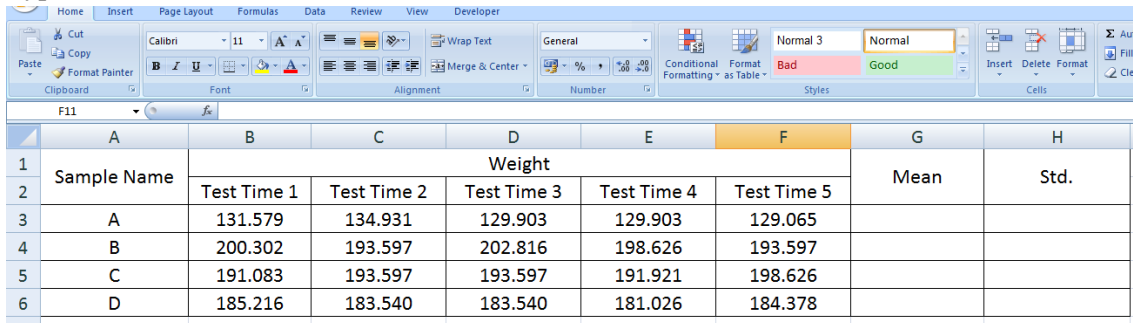
Standard deviation is a widely used measurement of variability or diversity used in statistics and probability theory. It shows how much variation or "dispersion" there is from the average (mean, or expected value). A low standard deviation indicates that the data points tend to be very close to the mean, whereas high standard deviation indicates that the data are spread out over a large range of values.

In science, researchers commonly report the standard deviation of experimental data, and only effects that fall far outside the range of standard deviation are considered statistically significant – normal random error or variation in the measurements is in this way distinguished from causal variation.

## 2. How to add standard Deviation?

### Step 1. Type in Experiment Data into Excel Sheet

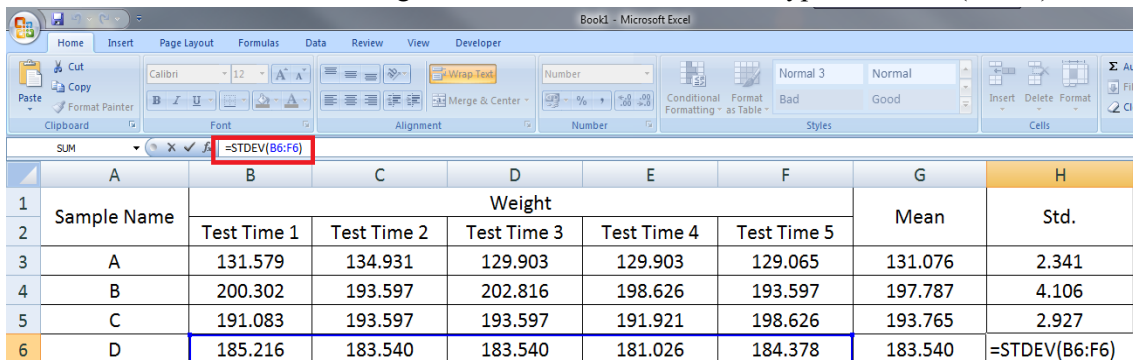
Type in data into Excel sheet:



	A	B	C	D	E	F	G	H
1	Sample Name	Weight					Mean	Std.
2		Test Time 1	Test Time 2	Test Time 3	Test Time 4	Test Time 5		
3	A	131.579	134.931	129.903	129.903	129.065		
4	B	200.302	193.597	202.816	198.626	193.597		
5	C	191.083	193.597	193.597	191.921	198.626		
6	D	185.216	183.540	183.540	181.026	184.378		

### Step 2. Calculate Standard Deviation

Calculate standard deviation using excel formula: in formula bar, type in “=stdev(B3:F3)”



	A	B	C	D	E	F	G	H
1	Sample Name	Weight					Mean	Std.
2		Test Time 1	Test Time 2	Test Time 3	Test Time 4	Test Time 5		
3	A	131.579	134.931	129.903	129.903	129.065	131.076	2.341
4	B	200.302	193.597	202.816	198.626	193.597	197.787	4.106
5	C	191.083	193.597	193.597	191.921	198.626	193.765	2.927
6	D	185.216	183.540	183.540	181.026	184.378	183.540	=STDEV(B6:F6)

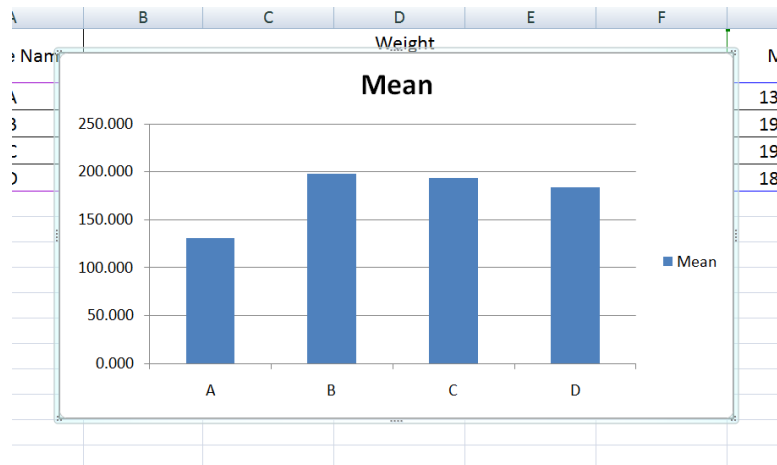
### 3. Why Need Error Bar in figure?


Error bars are used on graphs to indicate the error, or uncertainty in a reported measurement. They give a general idea of how accurate a measurement is, or conversely, how far from the reported value the true (error free) value might be. Error bars often indicate one standard deviation of uncertainty, but may also indicate the standard error. These quantities are not the same and so the measure selected should be stated explicitly in the graph or supporting text.

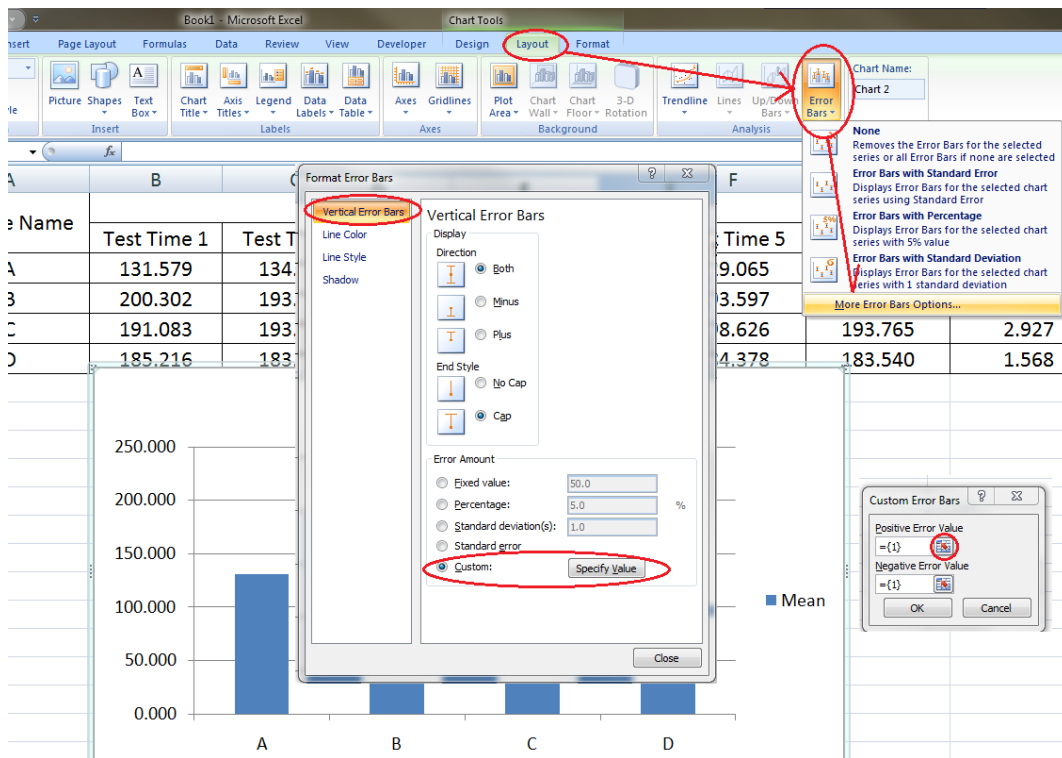
Error bars can be used to compare visually two quantities if various other conditions hold. This can determine whether differences are statistically significant. Error bars can also show how good a statistical fit the data has to a given function. Scientific papers in the experimental sciences are expected to include error bars on all graphs, though the practice differs somewhat between sciences, and each journal will have its own house style.



### 4. How to Add Error Bar?

Create figures as normal:

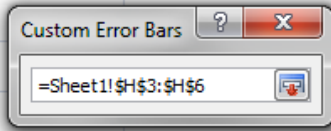


Choose the figure, from the top menu bar, click “Layout”, then “Error Bars”, and then choose “More Error Bars Options”. From the new open windows, choose “Custom”, and click “Specify Value”. From the pop-up menu click the icon  under “Positive Error Value”.

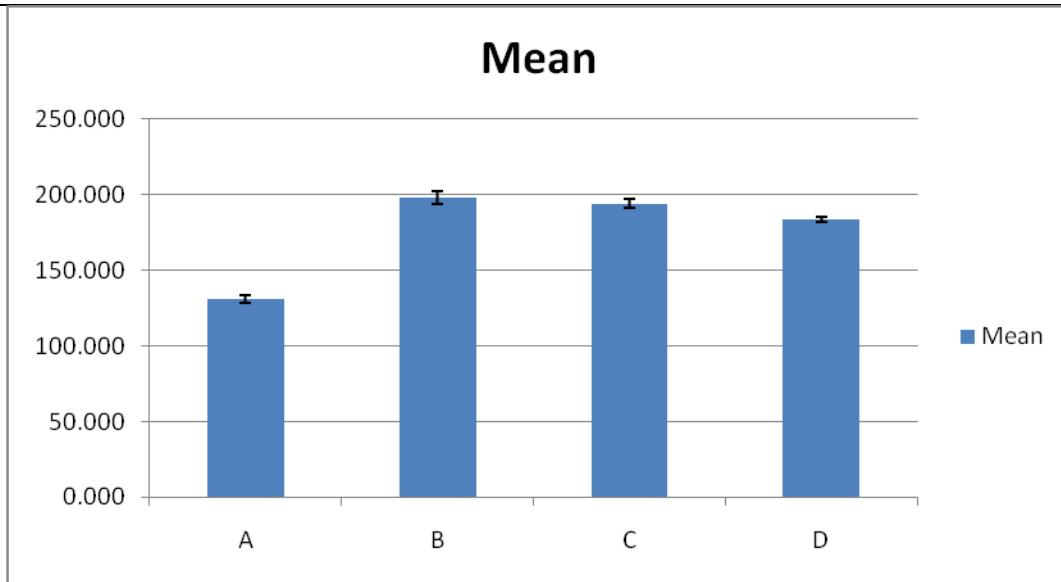


After click the icon , select the cells we have calculated (i.e.: H3:H6), click  again. Do again for "Negative Error Value" (!IMPORTANT). Click OK for each level.

G	H
Mean	Std.
131.076	2.341
197.787	4.106
193.765	2.927
183.540	1.568

Now you have a bar chart figure with error bar:



\*Same method can also be applied to line figures.

**References:**

1. Wikipedia (28 June 2011), Standard Deviation, Retrieved from [http://en.wikipedia.org/wiki/Standard\\_deviation](http://en.wikipedia.org/wiki/Standard_deviation)

2. Wikipedia (9 June 2011), Error Bar, Retrieved from [http://en.wikipedia.org/wiki/Error\\_bar](http://en.wikipedia.org/wiki/Error_bar)

3. Microsoft (15 July 2011), Add, change, or remove error bars in a chart, Retrieved from <http://office.microsoft.com/en-us/excel-help/add-change-or-remove-error-bars-in-a-chart-HP010007462.aspx>