

Graphical presentation of research results: How to place accurate LSD bars in graphs

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Introduction

Statistical methods are generally accepted as a valid tool for decision making in scientific research. Numerous statistical methods are available for differing kind of inference; these methods have their strengths, weaknesses and basic assumptions. Some commonly used methods include the F-test, the T-test, Chi-square test and the summary statistics measures of central tendencies viz., mean, median, mode and measures of dispersion such as variance, standard deviation, standard error, coefficient of variation etc.

In presentation of research results either in a tabular or graphical form, the mean is presented with either standard deviation or standard error. Furthermore, the magnitude of difference between the treatments means need to be shown with the use of mean separation tools that are appropriate to the experimental design. Presentation of experimental data with mean separation in table format is easily achieved, while many researchers still struggle to show accurate mean separation in

graphical form.

The commonly used mean separation tools give their results either in numerical value e.g. Fisher least significant difference (LSD) or in alphabetical form e.g. the Duncan multiple range test. The alphabetical results can easily be indicated on graphs by inserting borderless text boxes at the appropriate data point and typing in the right letters. While the numerical methods are best shown with bars that are accurately measured, to visually indicate differences among plotted bars or data points in line graphs.

Some authors have erroneously used the Standard error (SE) method found in graphical software as Microsoft Excel to depict mean separation. This often creates confusion as SE is more of a measure of dispersion among individual values that are averaged to derive the mean than a mean separation tool. The bars in this case are either sunk into the graph in equal halves or shown as half of the SE value on individual bar or data point in a line graph. This ultimately will not indicate the minimum difference that could exist between individual treatment mean for them to be regarded as significantly

different from one another.

Thus, devising a clear and accurate way to show graphical mean separation is vital to proper communication of research result. The aim of this write up is to graphically show few steps that could be taken to insert accurate LSD bars or other numerical mean separation values in a graph using MS Excel software. This will address the most commonly used mean separation methods and software.

Steps to get it done.

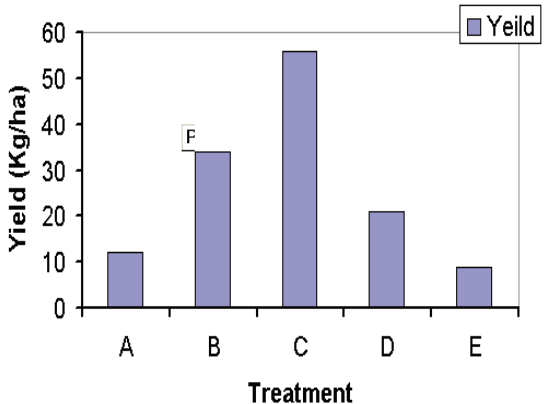
Two version of Microsoft Excel are commonly used by researchers, Excel 97-2003 and the Excel 2007. The steps vary a little between the two versions, therefore they are presented separately in this article.

MS Excel 97-2003

Step 1

Plot your graph. Note that The

	A	B	C	D	E	F	G	H	I	J	K
1	Treat	Yeild									
2	A	12									
3	B	34									
4	C	56									
5	D	21									
6	E	9									
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											



graph can also be a time line graph where ABCDE constitute the treatment and data are collected at different intervals.

Step 2

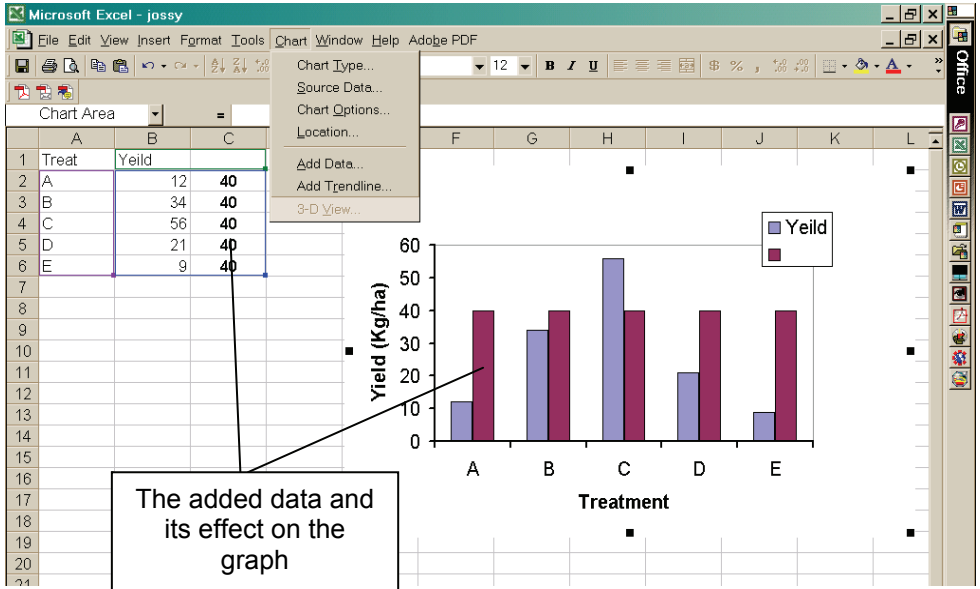
Revert back to your data and create a column, fit the column with values that correspond to the location on the Y-axis where you want the bars to be.

Then click on chart and select add data to include the values in the new location. A quick way is to highlight your graph and drag the blue boundary on your data to include the new data.

Step 3

Convert the added bar into a line graph by clicking on the newly added bar; the bars will be highlighted. Then right click the bars. A dialogue box will open on which you will select *chart type*, which will open another dialogue box where you will

Step 1



Step 2

select *line graph*.

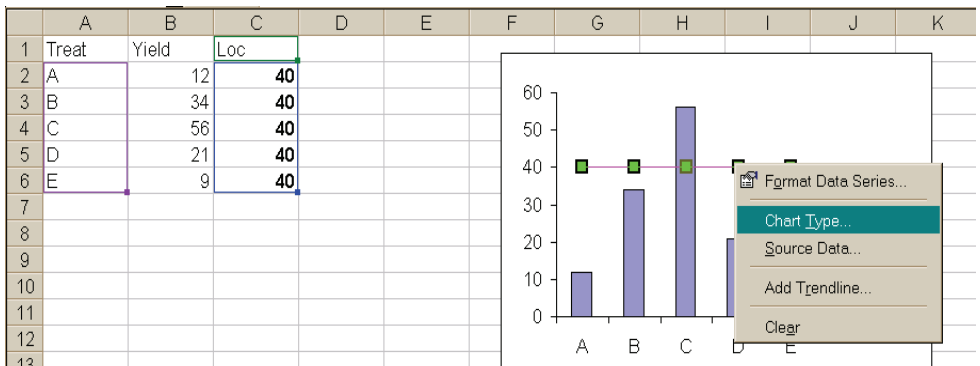
Step 4

Add another column to the data area. This is where you type in your LSD value. The value you entered into this column should be your LSD value divided by 2, as the bar you will insert will have the top and bottom cut off i.e. double sided. It will

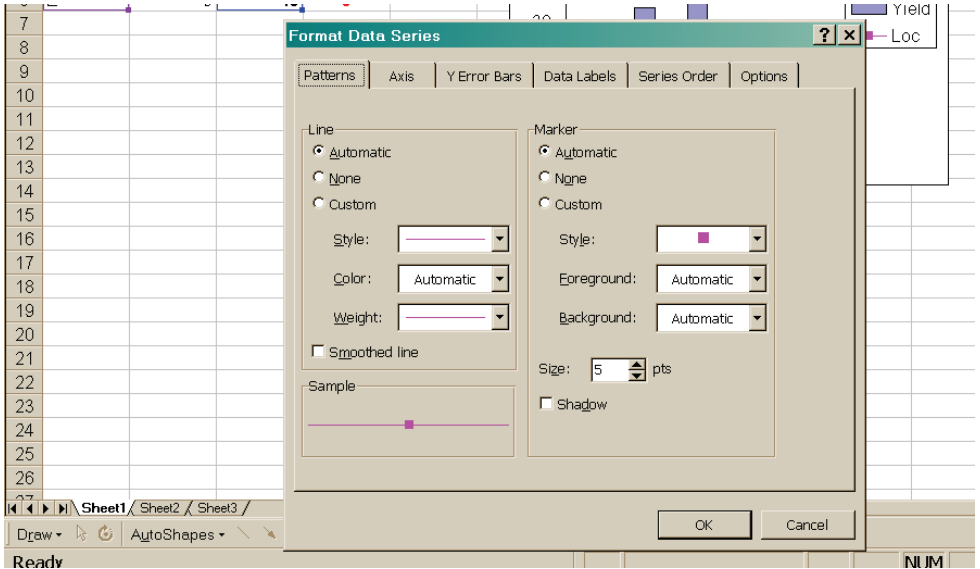
double the value if you enter the actual LSD value. Then right click on the new line graph, a dialogue box will show up, on it highlight format data series.

Step 5

On the *format data series* dialogue box, open *y-error bar* and select the *custom* tab. Click on the icon with



Step 3

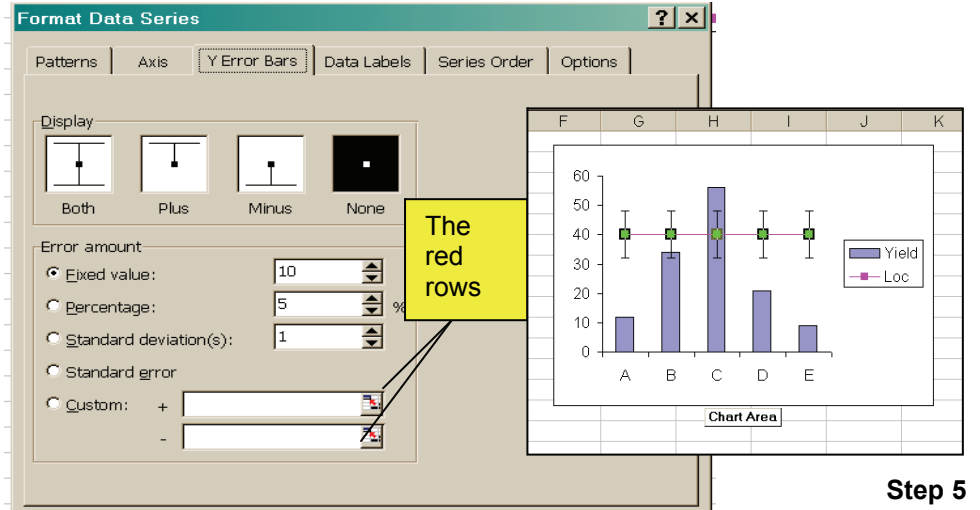


Step 4

the red arrow on the row with the positive sign and it will display. Then highlight the added LSD data and click the red arrow again. Repeat the same for the row with the negative sign. On the display buttons select *both* and click *ok*.

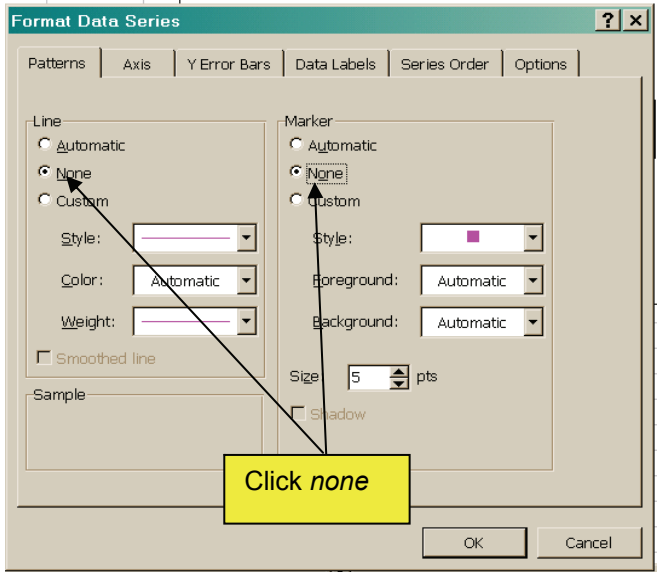
Step 6

Right click to open the *format data series* again and open *patterns* then click *none* under line and marker dialogue boxes



Step 5

Step 6



Step 7

From the original data area, delete the data from where you don't want LSD bars to appear.

MS Excel 2007

Step 1.

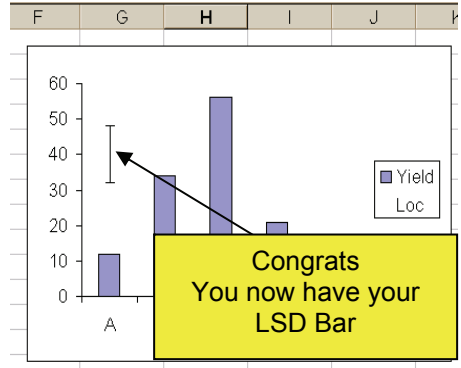
Plot your graph

Step 2

Revert back to your data

B	C	D	E
Id	Loc	LSD	
12	40	8	
34	40	8	
56	40	8	
21	40	8	
9	40	8	

Delete



Step 7

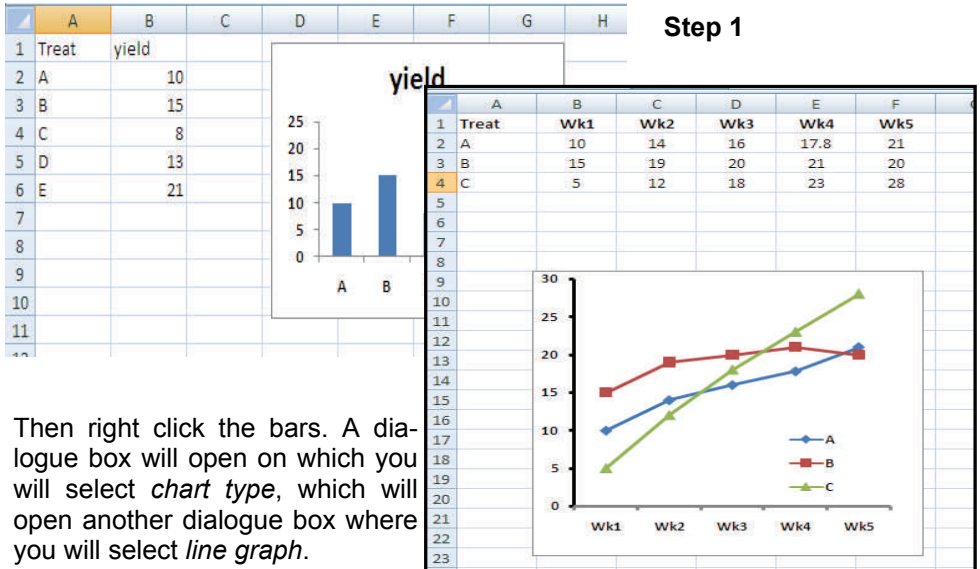
and create a column. Fit the column with values that correspond to the location on the Y-axis where you want the bars to be.

Then click on *chart* and select *add data* to include the values in the new location. A quick way is to highlight your graph and drag the blue

boundary on your data to include the new data.

Step 3

Convert the added bar into a line graph by clicking on the newly added bar; the bars will be highlighted.

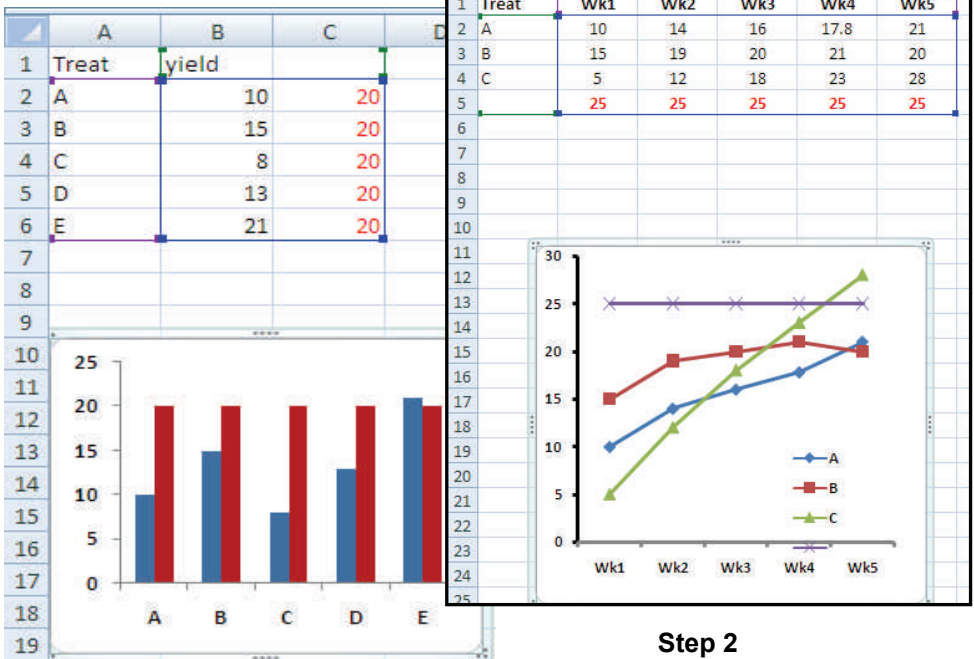


Then right click the bars. A dialogue box will open on which you will select *chart type*, which will open another dialogue box where you will select *line graph*.

Step 4

Add another column to the data area. This is where you type in your LSD value. The value you entered

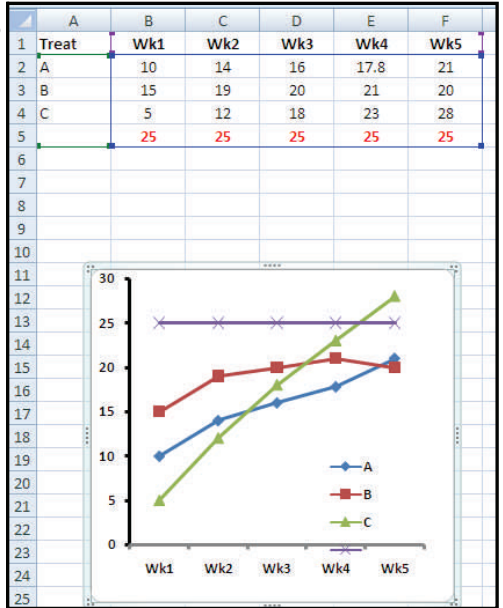
into this column should be your LSD value divided by 2, as the bar you will insert will have the top and bot-



Step 2

	A	B	C	D
1	Treat	yield		
2	A	10	20	
3	B	15	20	
4	C	8	20	
5	D	13	20	
6	E	21	20	
7				
8				
9				

Step 3



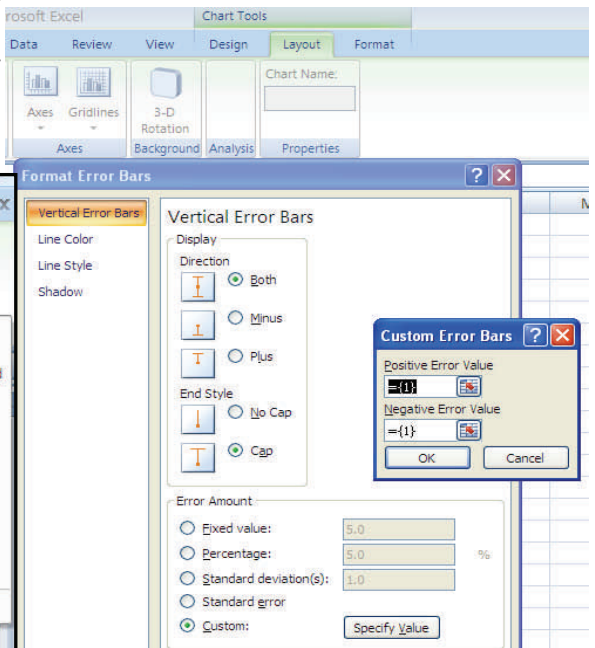
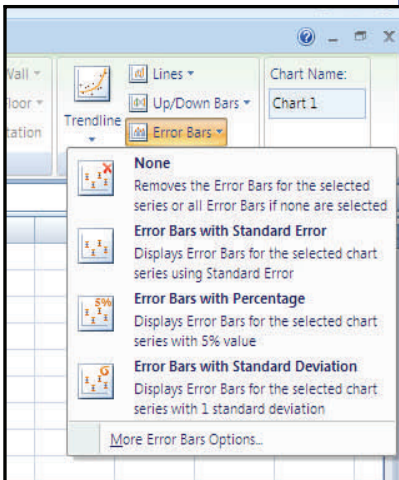
tom cut off i.e. double sided. It will double the value if you enter the actual LSD value

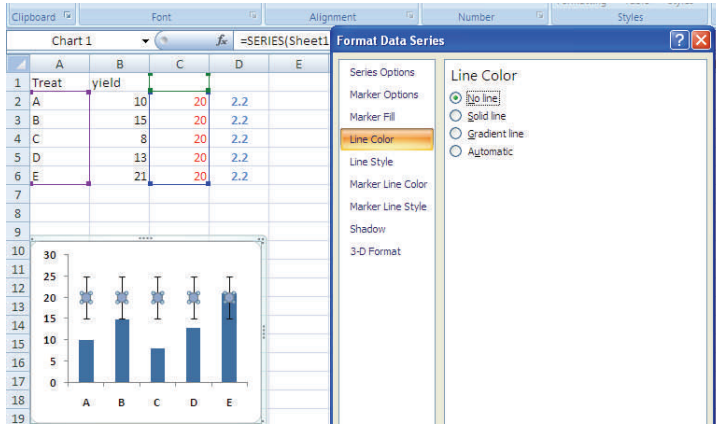
Click your chart, then click *layout* on the quick access tool bar, then go to a box region labelled *analysis* and the *open error bar* dialogue box

option, select *both* at the upper part, *custom* at the lower part and specify value box. A custom error bar dialogue box will appear. Click on the

Click *open more error bar*

Step 4





your preferred colour.

Step 5

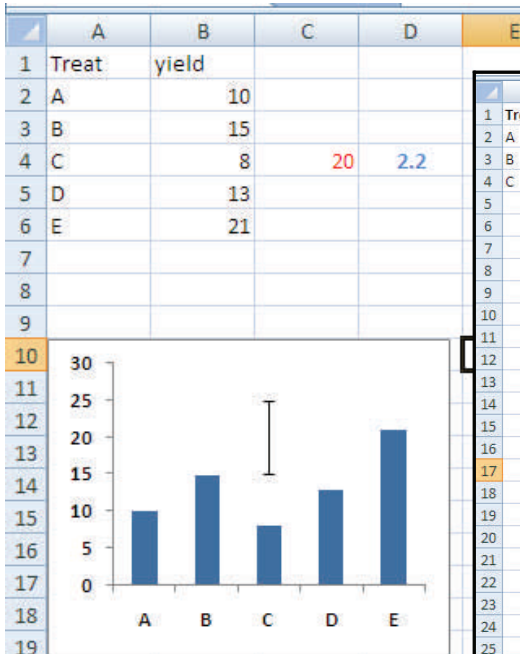
Right click the link lines to your new LSD bars, select format data series, and a dialogue box will open. On the left side, select *line colour* and choose *no line*. Then under *marker fill*, select *no fill* and under *marker option*, select *none*. Close the dialogue box.

red arrow on the positive error value box and revert to highlight the halved LSD values you entered under step 4 above. Once the values are shown in the red arrow box, click the red arrow again. Repeat the step for the negative error value and click OK.

Go back to your data area. You may now delete points where you don't want bars to appear and leave only one where you want data to appear. In case of a line graph where more than one LSD bar is needed you may not need to delete anyone.

Once the value is fixed, click on *line colour* and select *solid line*. Open the dialogue box and select

Go back to your data area. You may now delete points where you don't want bars to appear and leave only one where you want data to appear. In case of a line graph where more than one LSD bar is needed you may not need to delete anyone.



Step 5

