Introduction to Microsoft Excel

Microsoft Office
Excel 2003/2007

Naming cells in Excel

Columns

Rows

	A	B	C
1	A1	B1	C1
2	A2	B2	C2
3	A3	B3	C3
4	A4	B4	C4

this column is B1:B4

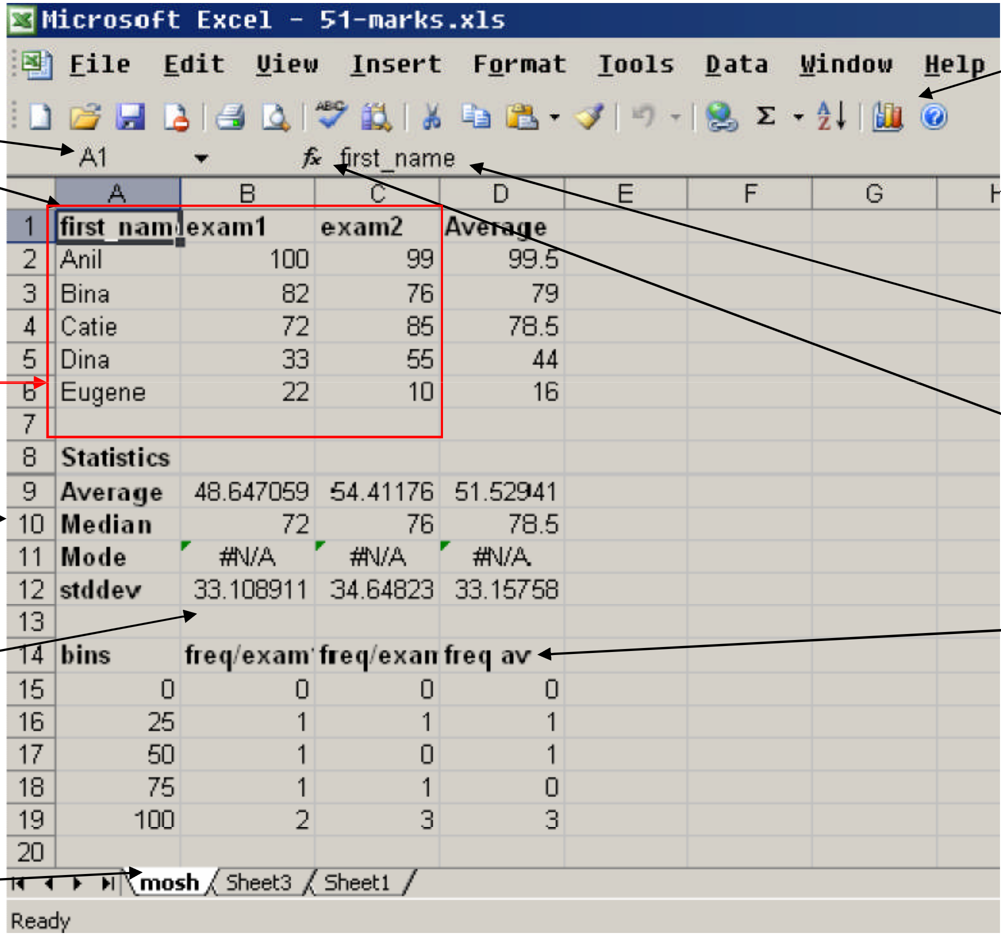
This cell is C4

Example of Excel data

Cell A1

Charts

Columns



	A	B	C	D
1	first_nam	exam1	exam2	Average
2	Anil	100	99	99.5
3	Bina	82	76	79
4	Catie	72	85	78.5
5	Dina	33	55	44
6	Eugene	22	10	16
7				
8	Statistics			
9	Average	48.647059	54.41176	51.52941
10	Median	72	76	78.5
11	Mode	#N/A	#N/A	#N/A
12	stddev	33.108911	34.64823	33.15758
13				
14	bins	freq/exam	freq/exan	freq av
15	0	0	0	0
16	25	1	1	1
17	50	1	0	1
18	75	1	1	0
19	100	2	3	3
20				

value of cell A1

Data entered

Formulas

Rows

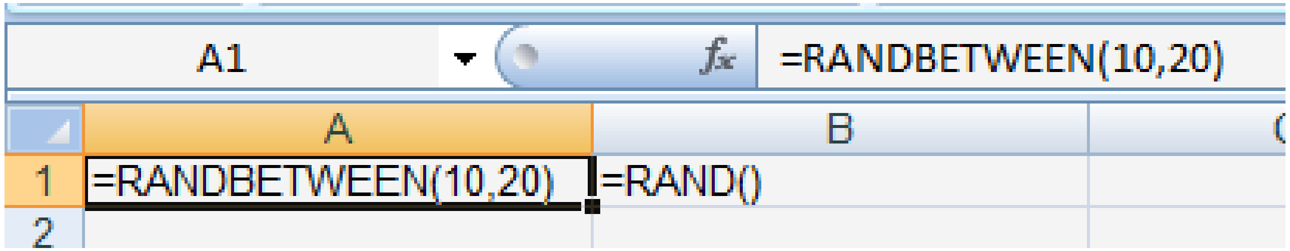
Data computed using a formula by excel

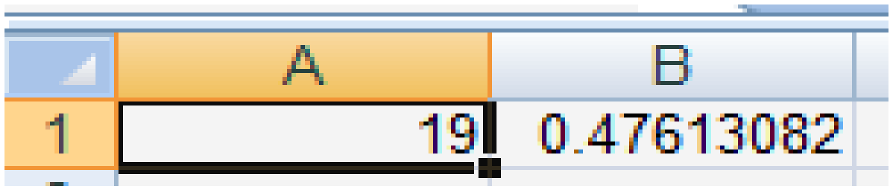
Each cell can contain text or number or formula

sheets

Random numbers with =Rand( ) and =RandBetween(x, y)

1. Type these two formulas in A1 and B1 and
2. press Control-backquote/tilde [C-`] or [C ~] to see the formula

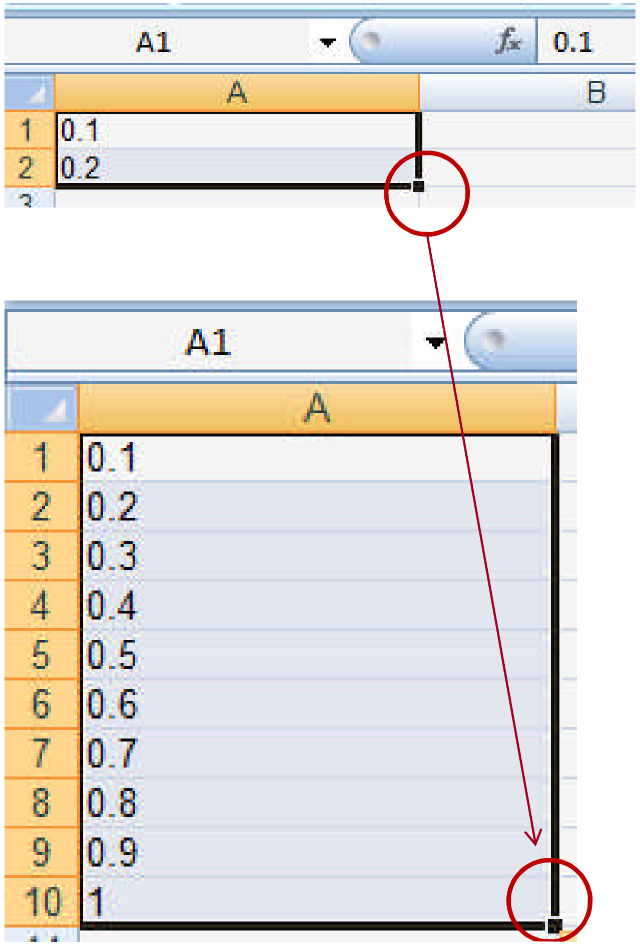




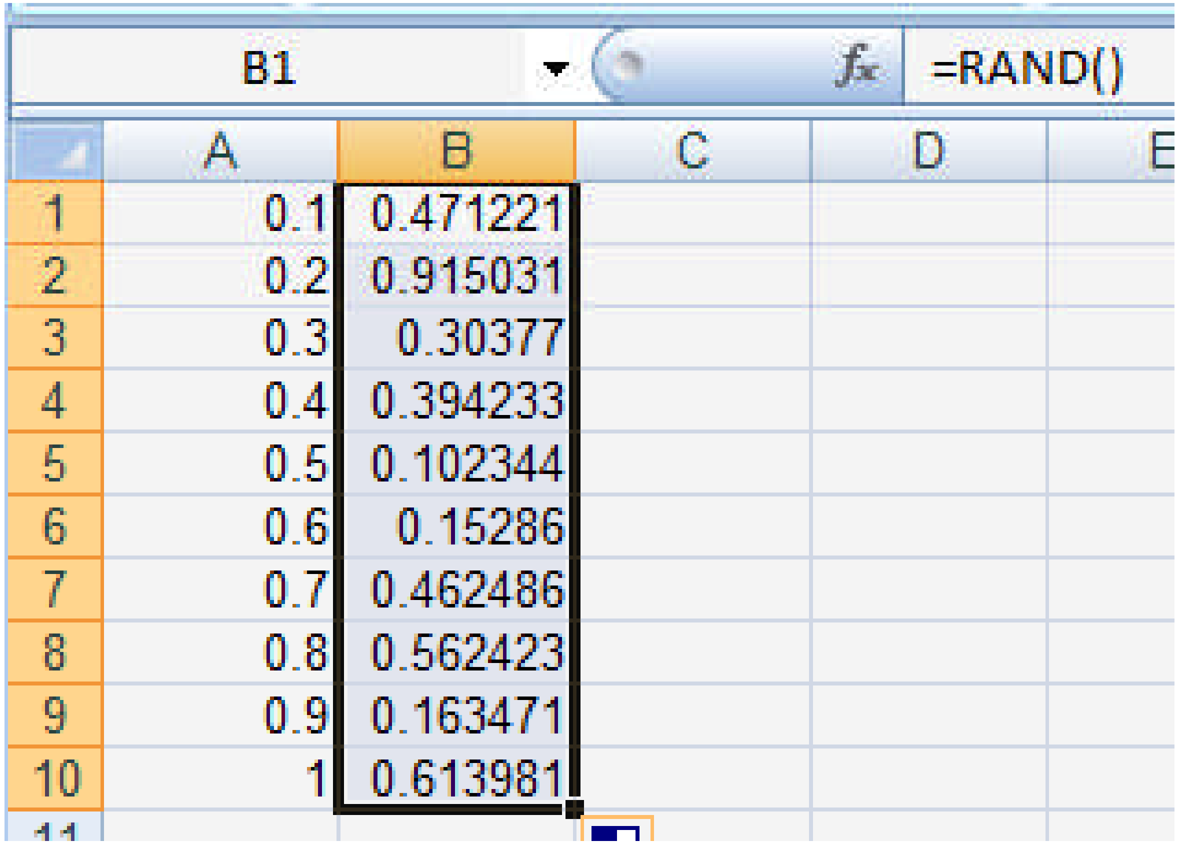
Exercise: On new sheet create numbers 0.1 to 1.0

1. Type A1=0.1, A2=0.2
2. Select A1 and A2 with Shift-click
3. Drag black dot to A10.

OR you can DOUBLE-CLICK on the black dot to fill the whole column



Exercise: In B1 type =Rand(), and then drag the black dot down to make 10 Random Numbers

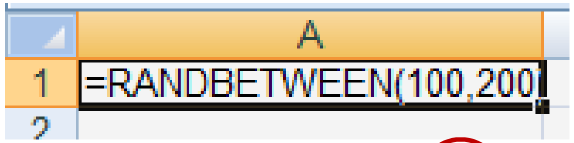

B1 | =RAND()

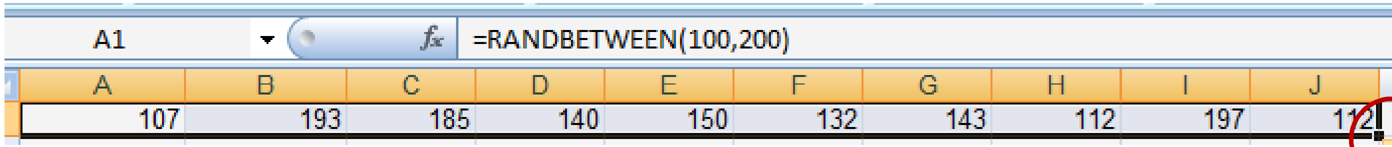
	A	B	C	D	E
1	0.1	0.471221			
2	0.2	0.915031			
3	0.3	0.30377			
4	0.4	0.394233			
5	0.5	0.102344			
6	0.6	0.15286			
7	0.7	0.462486			
8	0.8	0.562423			
9	0.9	0.163471			
10	1	0.613981			

Exercise: Create 100 randoms

Create: 100 random numbers between 100 .. 200 with

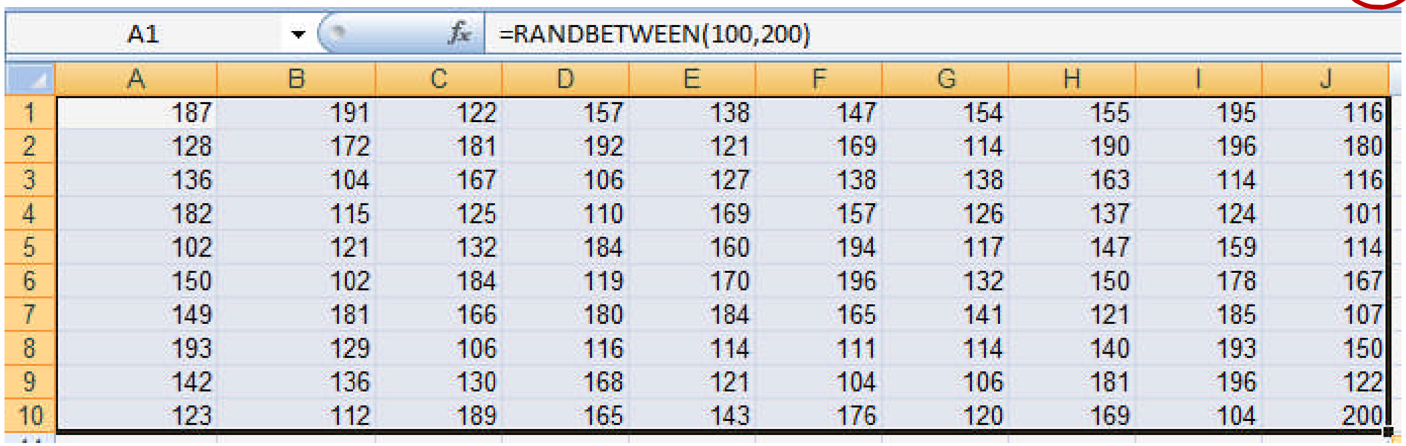
1. In A1 type =**`randomBetween(100,200)`**),
2. drag the black-dot to J1
3. Select the Row 1 with Shift-Mouse-Click
4. Drag the black dot to J10





A1 =RANDBETWEEN(100,200)

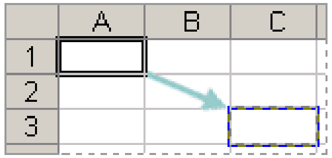
A	B	C	D	E	F	G	H	I	J
107	193	185	140	150	132	143	112	197	112



A1 =RANDBETWEEN(100,200)

	A	B	C	D	E	F	G	H	I	J
1	187	191	122	157	138	147	154	155	195	116
2	128	172	181	192	121	169	114	190	196	180
3	136	104	167	106	127	138	138	163	114	116
4	182	115	125	110	169	157	126	137	124	101
5	102	121	132	184	160	194	117	147	159	114
6	150	102	184	119	170	196	132	150	178	167
7	149	181	166	180	184	165	141	121	185	107
8	193	129	106	116	114	111	114	140	193	150
9	142	136	130	168	121	104	106	181	196	122
10	123	112	189	165	143	176	120	169	104	200

Absolute versus Relative Cell

FOR A FORMULA BEING COPIED:	IF THE REFERENCE IS:	IT CHANGES TO:
	$A$1 (absolute column and absolute row)	$A$1 (the reference is absolute)
	A$1 (relative column and absolute row)	C$1 (the reference is mixed)
	$A1 (absolute column and relative row)	$A3 (the reference is mixed)
	A1 (relative column and relative row)	C3 (the reference is relative)

Exercise: Make a Multiplication Table

	A	B	C	D	E
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25
6	6	12	18	24	30
7	7	14	21	28	35
8	8	16	24	32	40
9	9	18	27	36	45
10	10	20	30	40	50

Hint: In B2 type = $A2 * B$1, and drag the DOT to copy the formula.

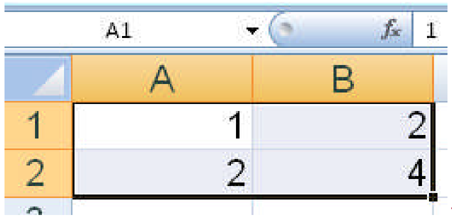
Multiplication Table: Solution

B2 f_x =$A2*B$1

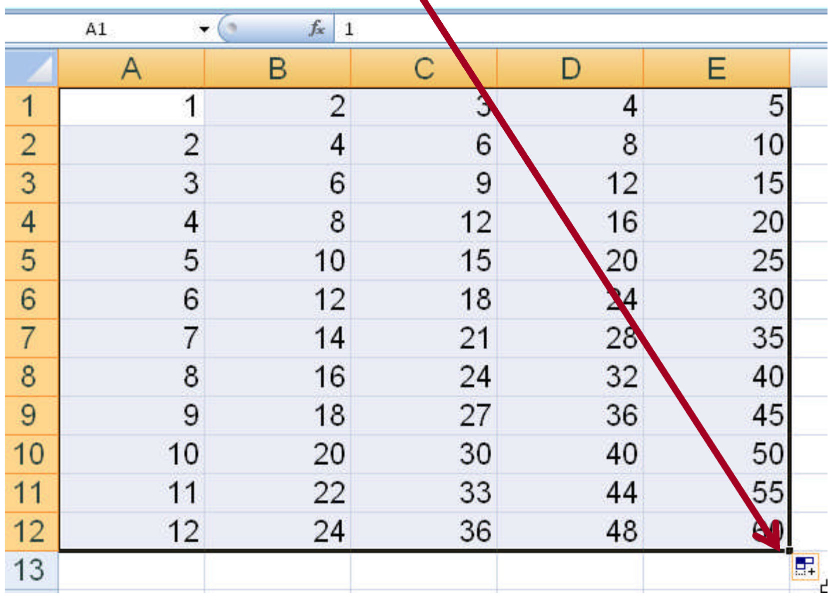
	A	B	C	D
1	1	2	3	4
2	2	=$A2*B$1	=$A2*C$1	=$A2*D$1
3	3	=$A3*B$1	=$A3*C$1	=$A3*D$1
4	4	=$A4*B$1	=$A4*C$1	=$A4*D$1
5	5	=$A5*B$1	=$A5*C$1	=$A5*D$1
6	6	=$A6*B$1	=$A6*C$1	=$A6*D$1
7	7	=$A7*B$1	=$A7*C$1	=$A7*D$1

Multiplication table easy way

- Make 2x2 table
- Pull the Black Dot down
- Excel will guess the numbers are increasing in multiplication order.



	A	B
1	1	2
2	2	4



	A	B	C	D	E
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25
6	6	12	18	24	30
7	7	14	21	28	35
8	8	16	24	32	40
9	9	18	27	36	45
10	10	20	30	40	50
11	11	22	33	44	55
12	12	24	36	48	60
13					

Exercise: Make the Addition Table

	A	B	C	D	E	F	G	H	I	J
1	1	2	3	4	5	6	7	8	9	10
2	2	4	5	6	7	8	9	10	11	12
3	3	5	6	7	8	9	10	11	12	13
4	4	6	7	8	9	10	11	12	13	14
5	5	7	8	9	10	11	12	13	14	15
6	6	8	9	10	11	12	13	14	15	16
7	7	9	10	11	12	13	14	15	16	17
8	8	10	11	12	13	14	15	16	17	18
9	9	11	12	13	14	15	16	17	18	19
10	10	12	13	14	15	16	17	18	19	20

Hint: B2 = $A2 + B$1, and drag the DOT to copy the formula.

Exercise: Solution for AdditionTable

B2 | f_x | =$A2+B$1

	A	B	C	D	E	F	G	H	I	J
1	1	2	3	4	5	6	7	8	9	10
2	2	4	5	6	7	8	9	10	11	12
3	3	5	6	7	8	9	10	11	12	13
4	4	6	7	8	9	10	11	12	13	14
5	5	7	8	9	10	11	12	13	14	15
6	6	8	9	10	11	12	13	14	15	16
7	7	9	10	11	12	13	14	15	16	17
8	8	10	11	12	13	14	15	16	17	18
9	9	11	12	13	14	15	16	17	18	19
10	10	12	13	14	15	16	17	18	19	20

Microsoft Office
Excel 2003/2007

Printing from Microsoft Excel

Compact Printing

- File > page setup

> Page > fit to 1 page

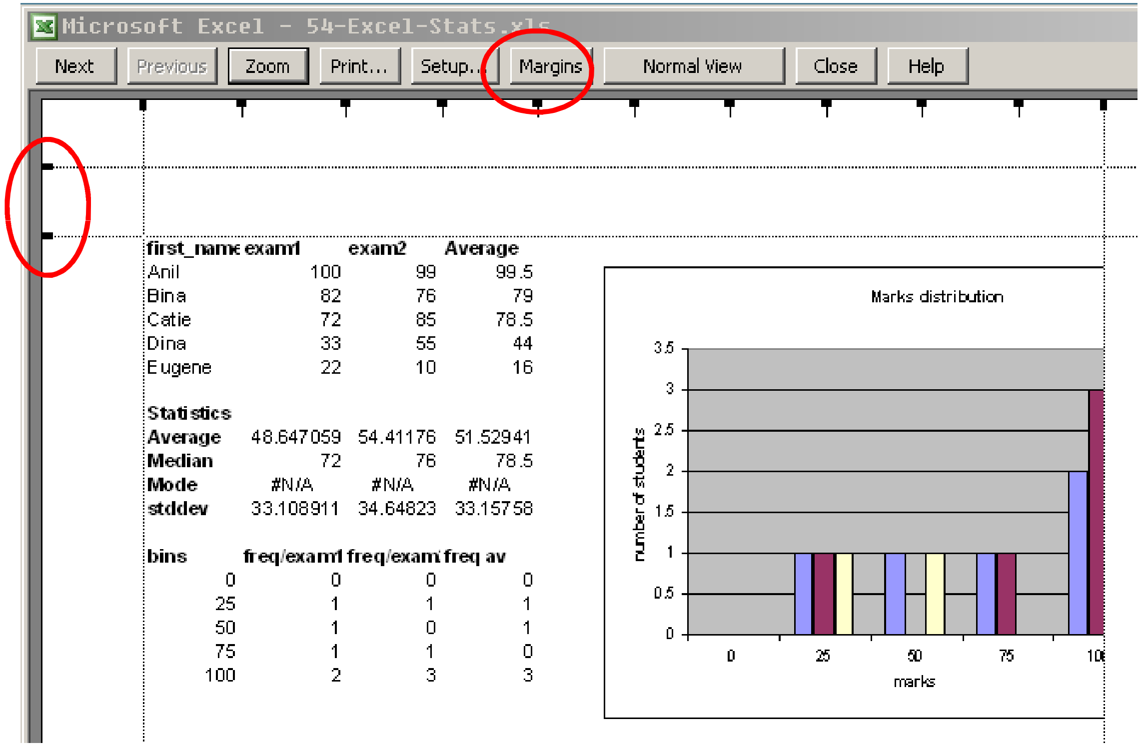
  > Paper size A4 (depending on printer).

> margins > Reduce margins to 0.1 inch.

> sheet > select [Gridlines]

- Finally click on [Print Preview] to see it.
- [Install from Google *doPdf virtual pdf printer* driver].
- Always exchange pdf files for easier printing on different computers.

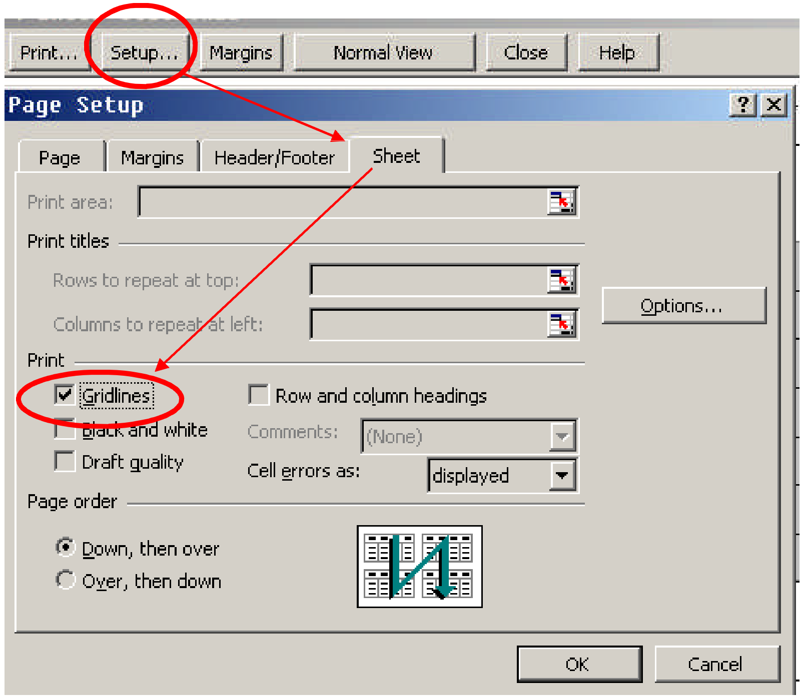
File > Print Preview



- Drag the black dots to adjust margin

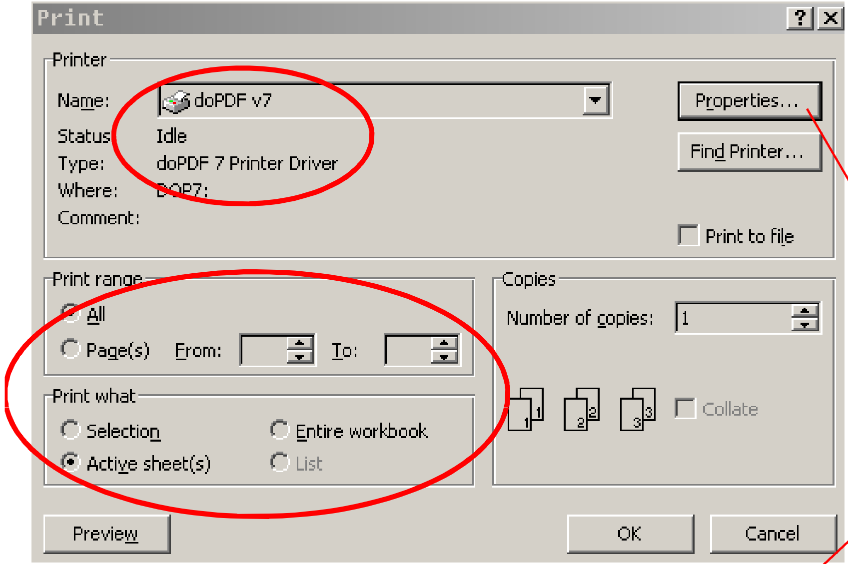
Add Grid lines

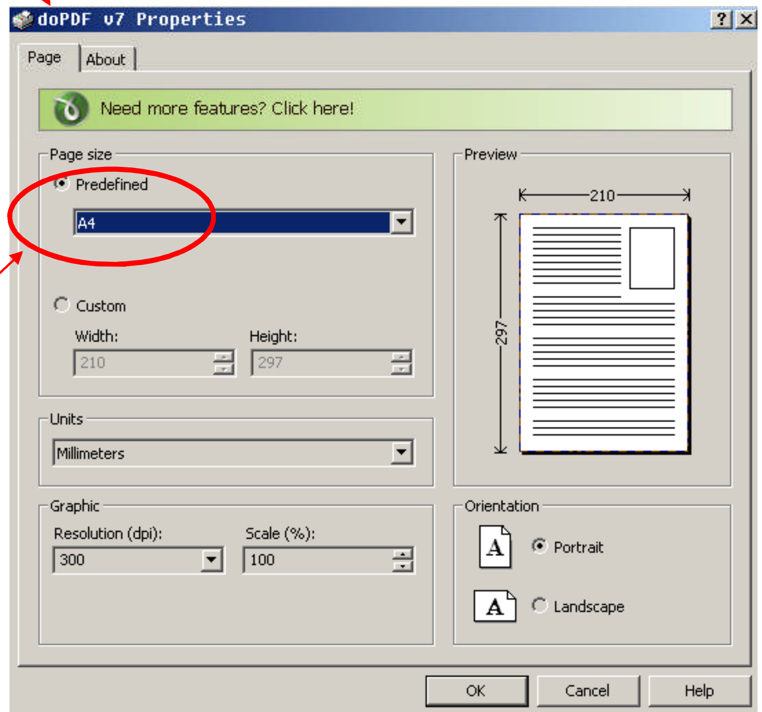
- File > Print Preview > Setup > Sheet > Gridlines



first_name	exam1	exam2	Average
Anil	100	99	99.5
Bina	82	76	79
Catie	72	85	78.5
Dina	33	55	44
Eugene	22	10	16
Statistics			
Average	48.647059	54.41176	51.52941
Median	72	76	78.5
Mode	#N/A	#N/A	#N/A
stddev	33.108911	34.64823	33.15758
bins	**freq/exam1**	**freq/exam**	**freq av**
0	0	0	0
25	1	1	1
50	1	0	1
75	1	1	0
100	2	3	3

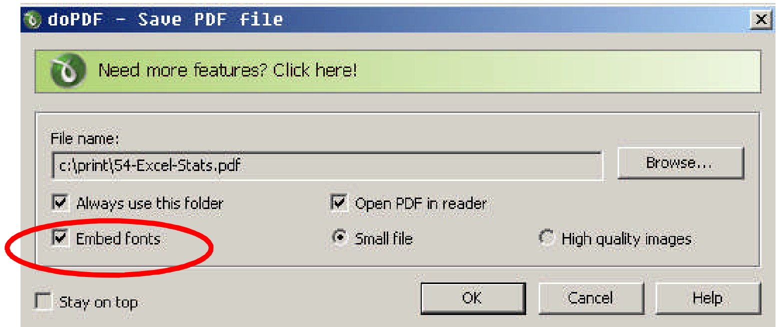
File > Print

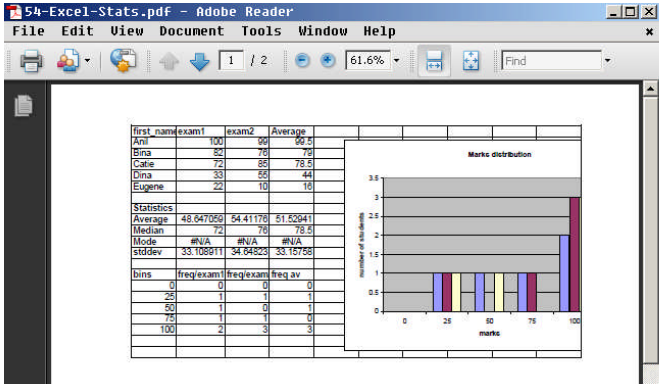




- A4 paper (India)
- Letter paper (US)

Install doPdf virtual Printer





Save as CSV file (for Email, SPSS, R, Excel)

1. To freeze the formula and only save the numbers use csv (comma separated values) or tsv (tab separated values) in a text file):

   `file > save-as > csv (file.csv)`

2. If you are giving an xls file to someone having only Excel 2003, do this:

   `file > save-as > excel 2003`

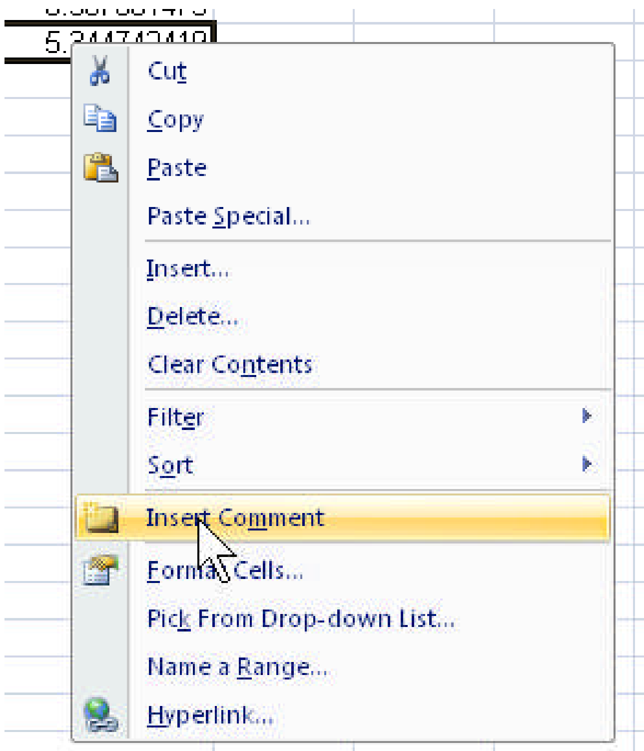
Commenting / Name

1. Add notes in a blank cell as plain text, works for csv also.
2. Right click on a cell and add comment
3. =Formula + N("my comment")

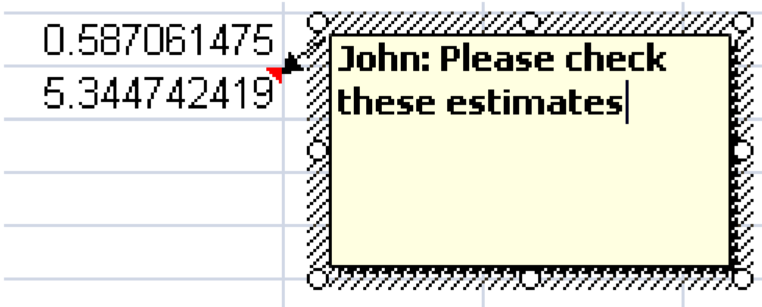
   (value of N("string") is zero).
4. Name the cells.

2. Excel comments

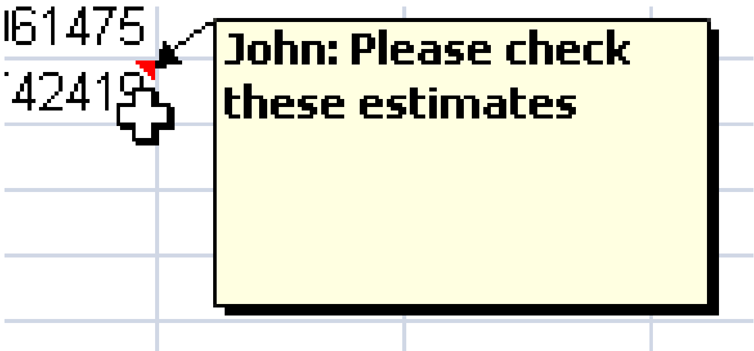
1. Right click cell > Insert Comment



2. Type the comment

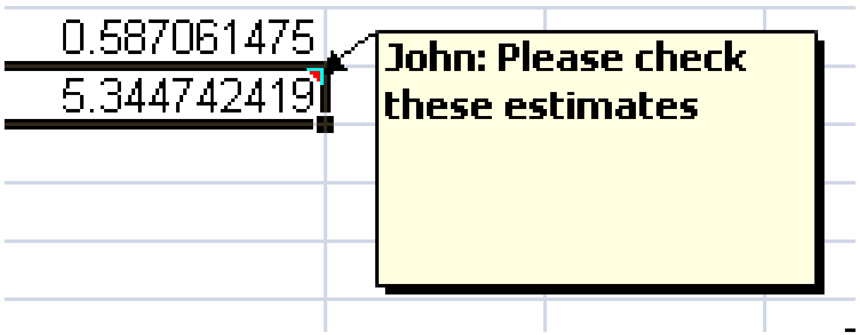


3. Hover on red triangle to see comment

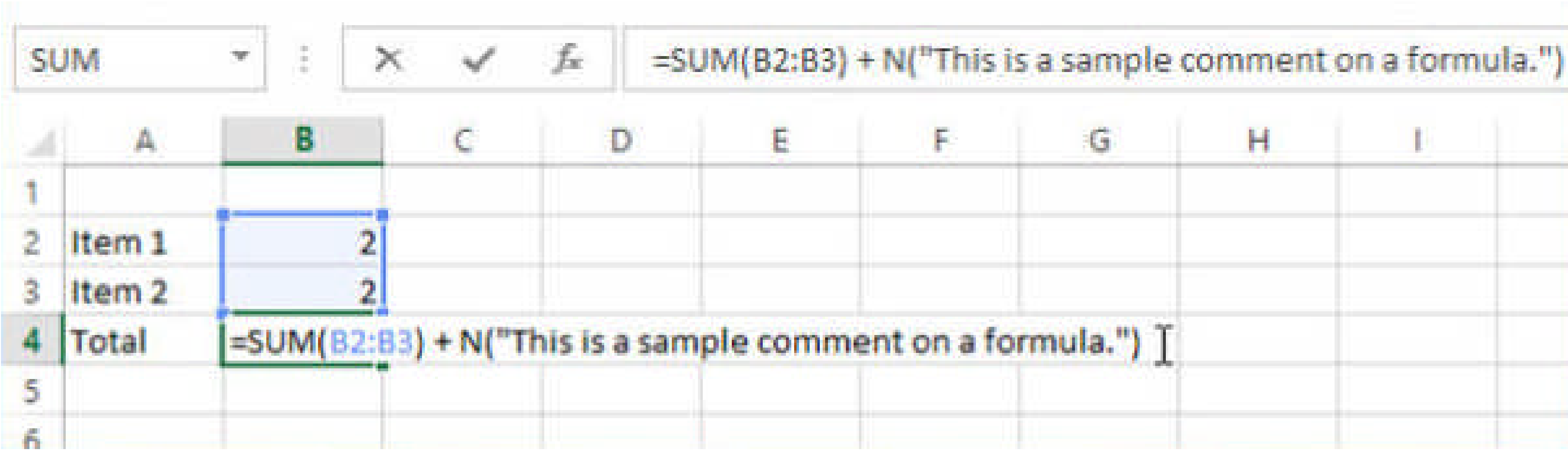


2. Viewing comments

1. Right click cell > Show/hide/edit/delete comments

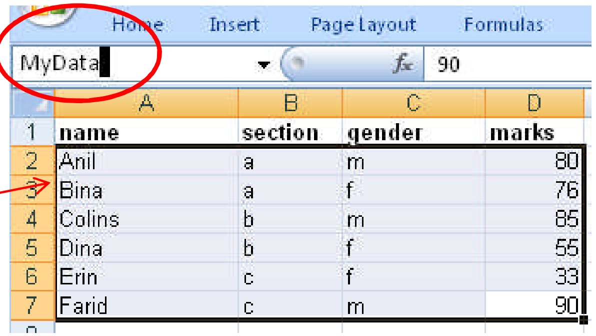


3. Formula + N("Comment")



4. Name the cells

- Select block of cells (cell/column/row/matrix),
- e.g. A2:D7 is named "MyData"
- You can then use "MyData" instead of A2:D7



Full name of it is:

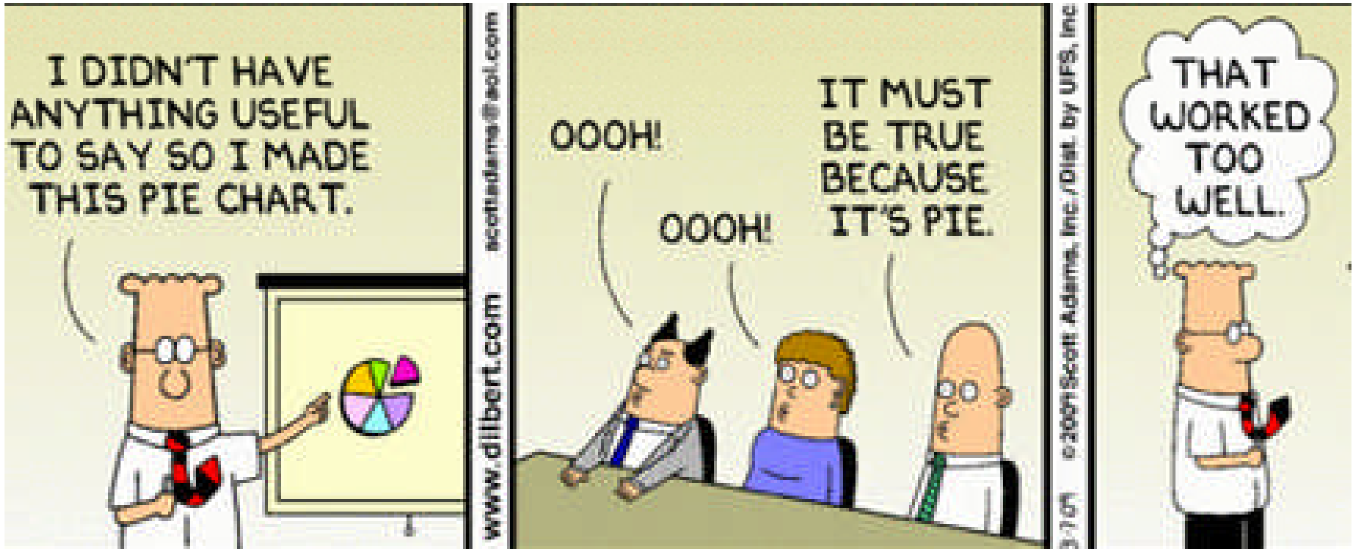
'sheetname':MyData and

'[filename.xls]sheetname'!MyData

Graphing with Microsoft Excel

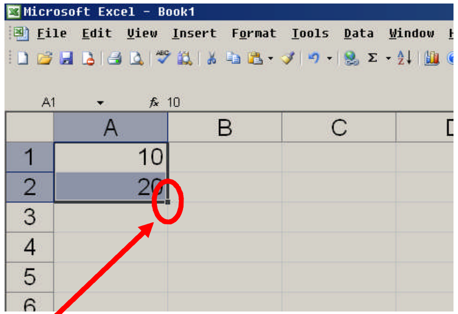
Microsoft Office
Excel 2003/2007

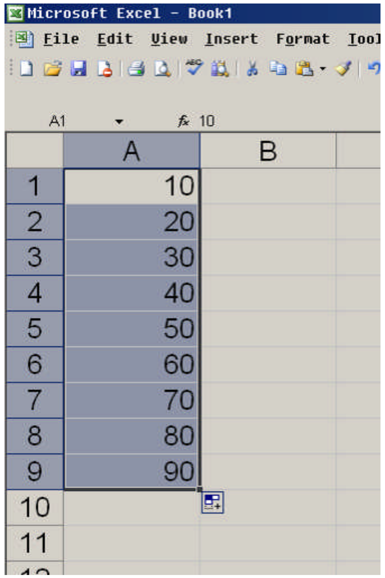
Dilbert on Graphs in Presentations



Create the x-data to be plotted

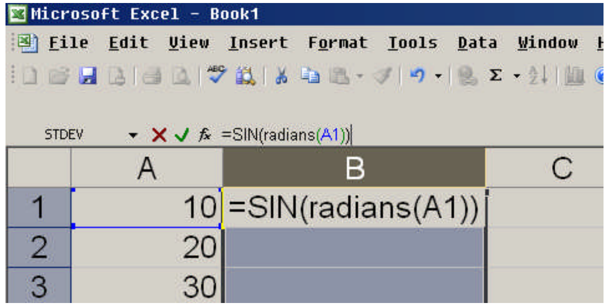
- In Excel, column A, type 10, 20
- Select A1 and A2 with Shift-mouse-click
- Drag the small dot in A2 to A9, to generate remaining x3,...x9 values

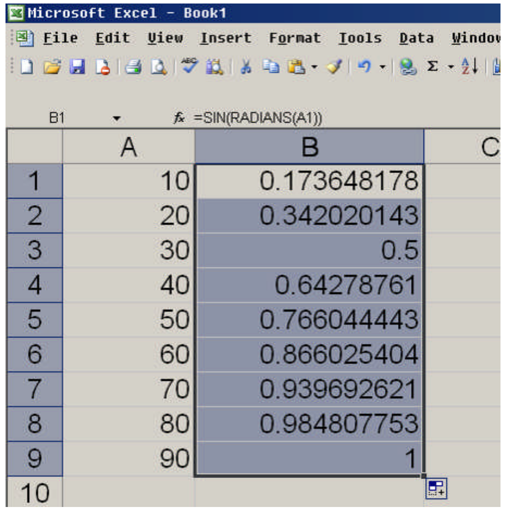




Create the y-data, e.g. y=sin(x)

- In Cell B1, type **fx=sin(radians(A1))**
- Drag the black dot in bottom-right corner of B1 to fill B2..B9 with y1..y9.





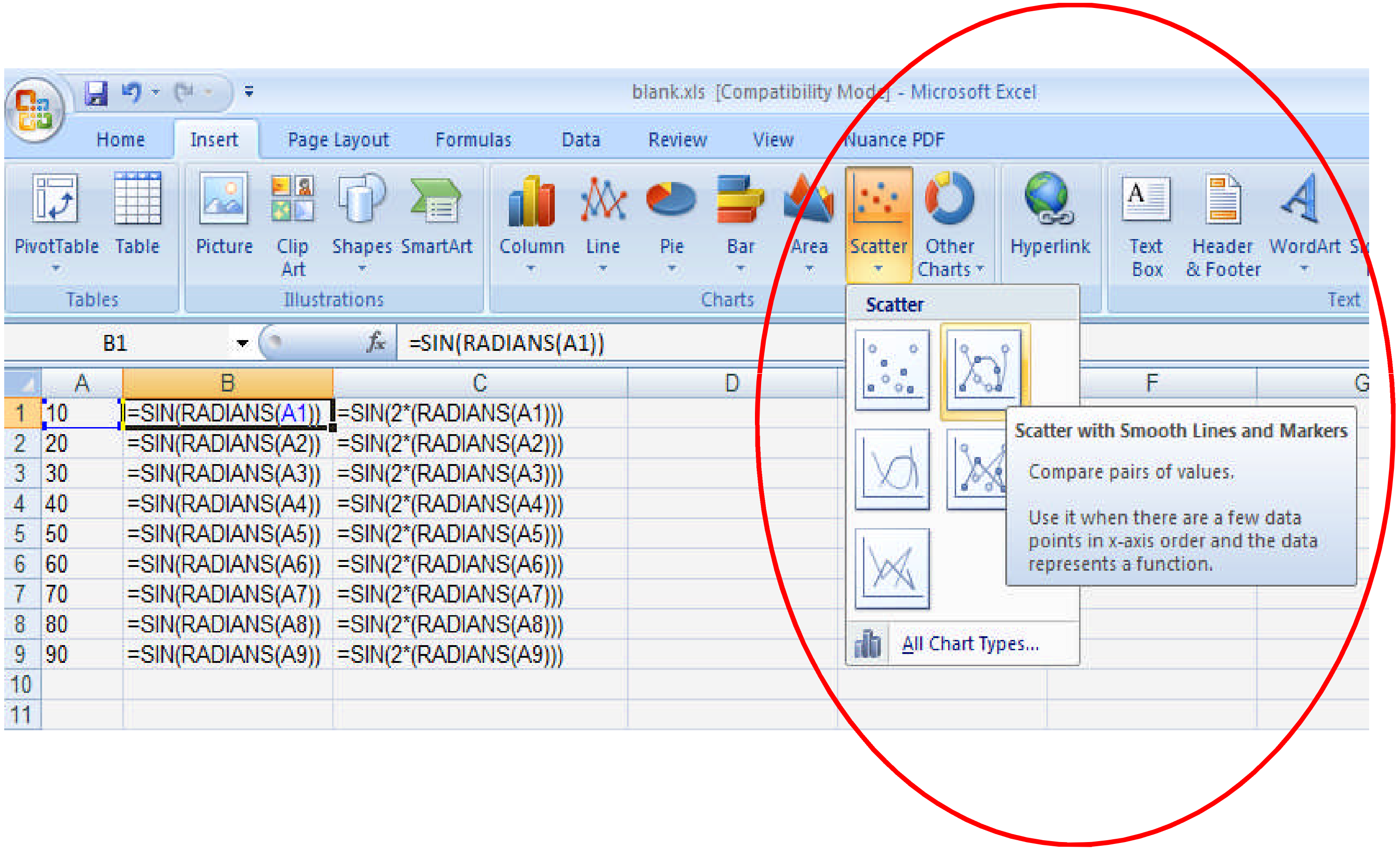
	A	B
1	10	0.173648178
2	20	0.342020143
3	30	0.5
4	40	0.64278761
5	50	0.766044443
6	60	0.866025404
7	70	0.939692621
8	80	0.984807753
9	90	1
10		

Exercise: Make this table

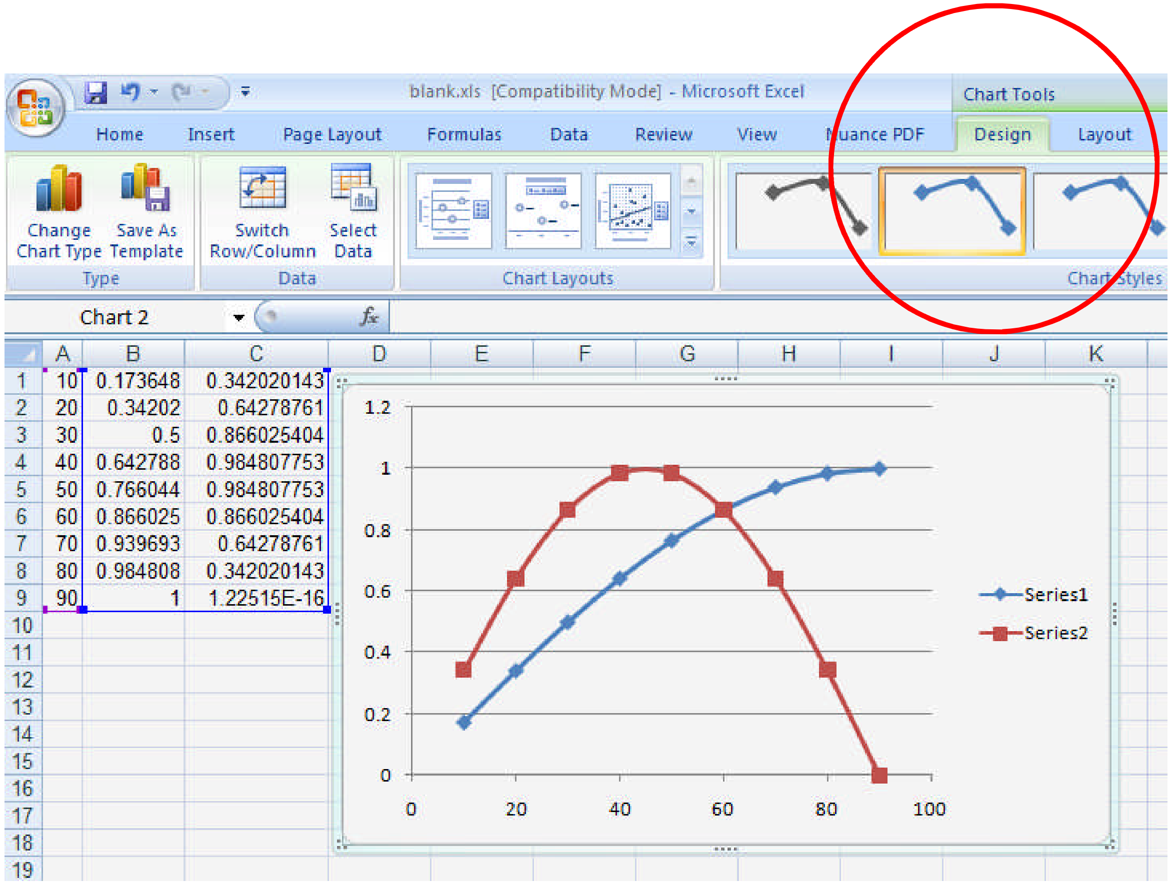
B1 f_x =SIN(RADIANS(A1))

	A	B	C
1	10	=SIN(RADIANS(A1))	=SIN(2*(RADIANS(A1)))
2	20	=SIN(RADIANS(A2))	=SIN(2*(RADIANS(A2)))
3	30	=SIN(RADIANS(A3))	=SIN(2*(RADIANS(A3)))
4	40	=SIN(RADIANS(A4))	=SIN(2*(RADIANS(A4)))
5	50	=SIN(RADIANS(A5))	=SIN(2*(RADIANS(A5)))
6	60	=SIN(RADIANS(A6))	=SIN(2*(RADIANS(A6)))
7	70	=SIN(RADIANS(A7))	=SIN(2*(RADIANS(A7)))
8	80	=SIN(RADIANS(A8))	=SIN(2*(RADIANS(A8)))
9	90	=SIN(RADIANS(A9))	=SIN(2*(RADIANS(A9)))

Exercise: Plot sin(x) and sin(2x)

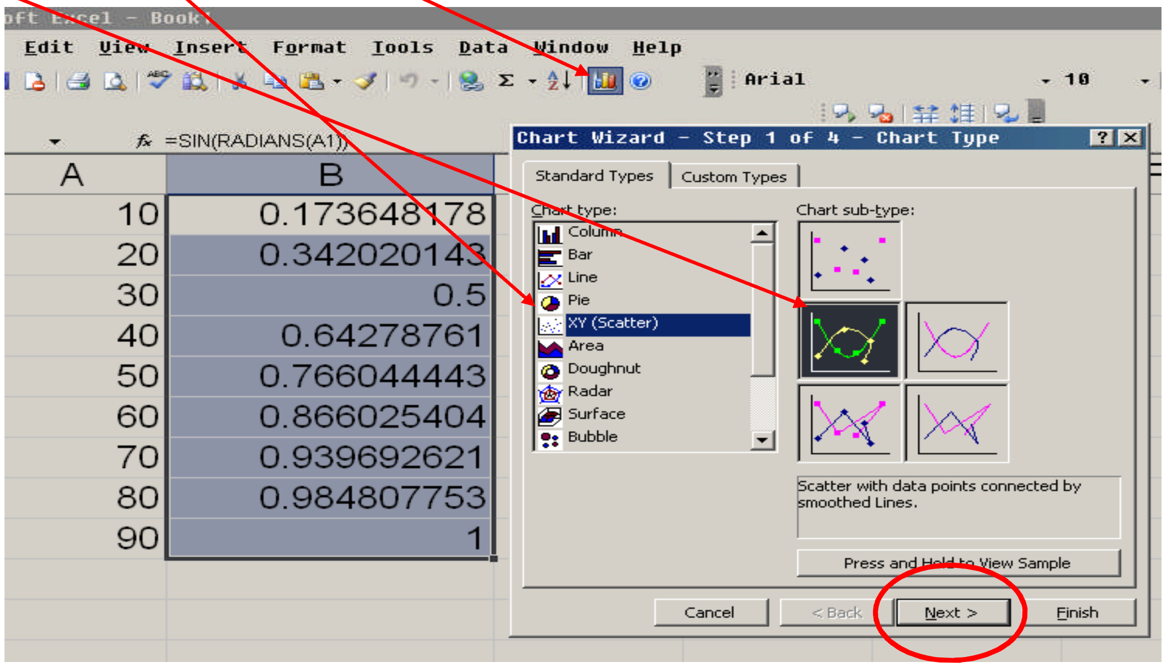


Graphs of sin(x) and sin(2x)

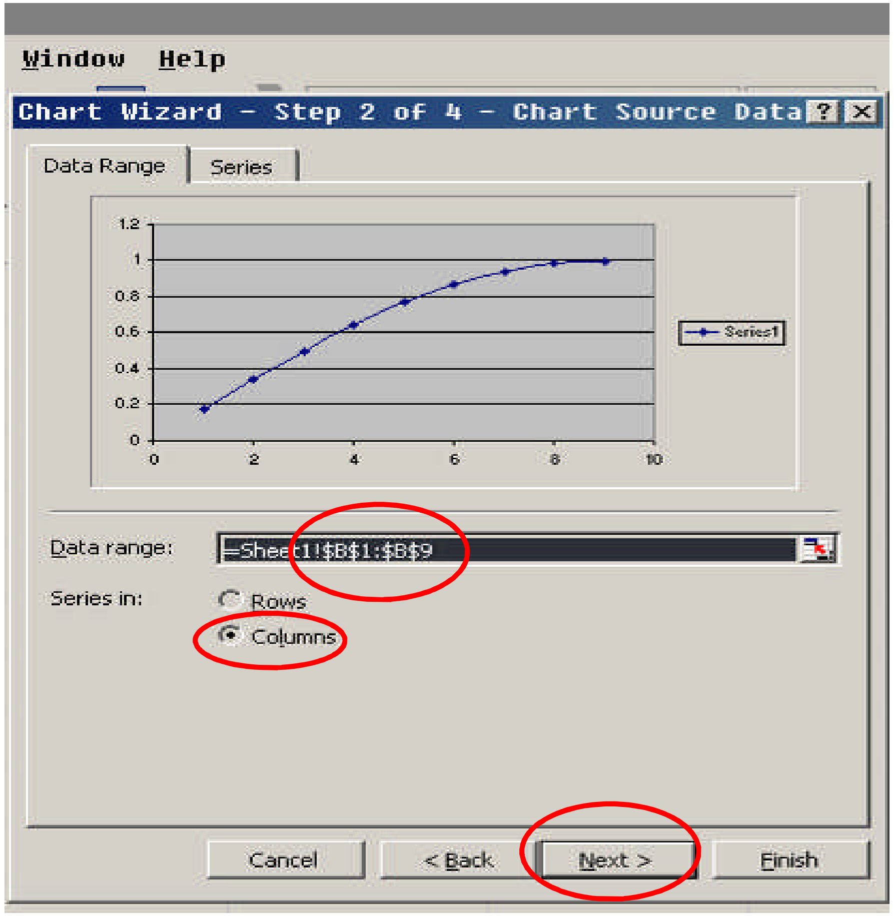


Excel 2003: Graph the xy-data (chart scatter)

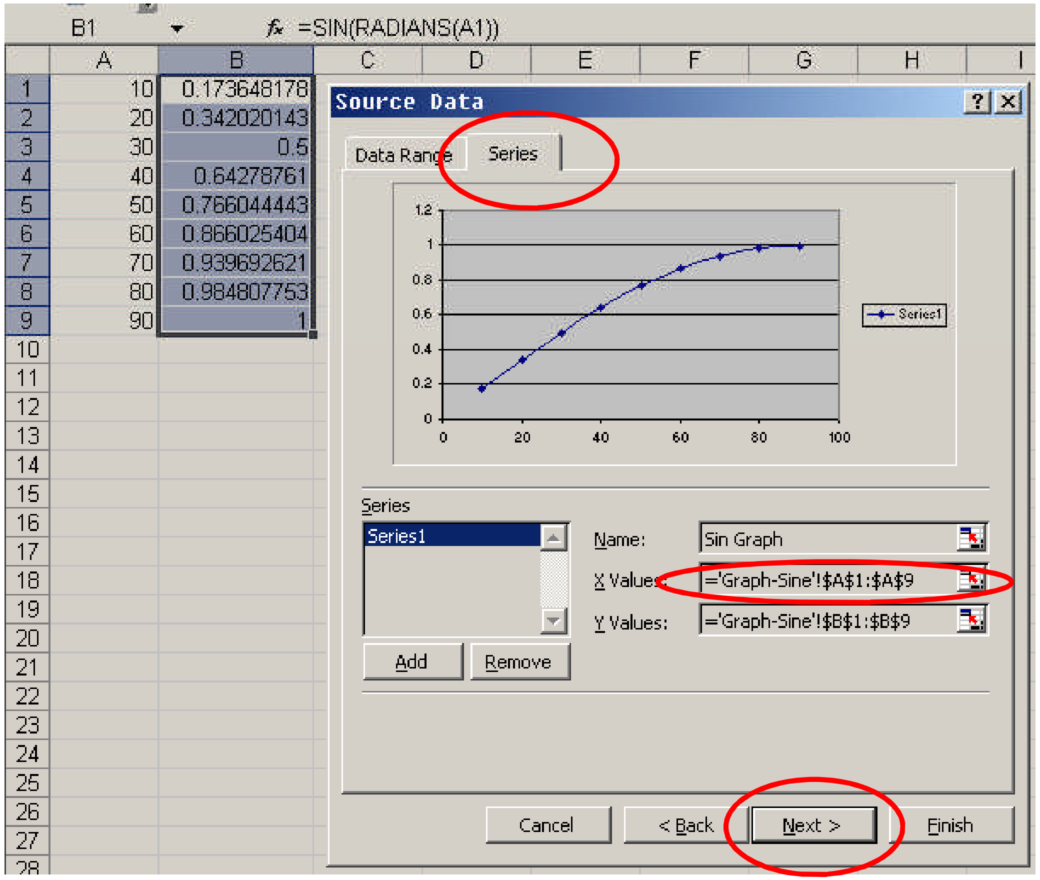
Select Chart >
XY (Scatter) >
connected by smooth lines



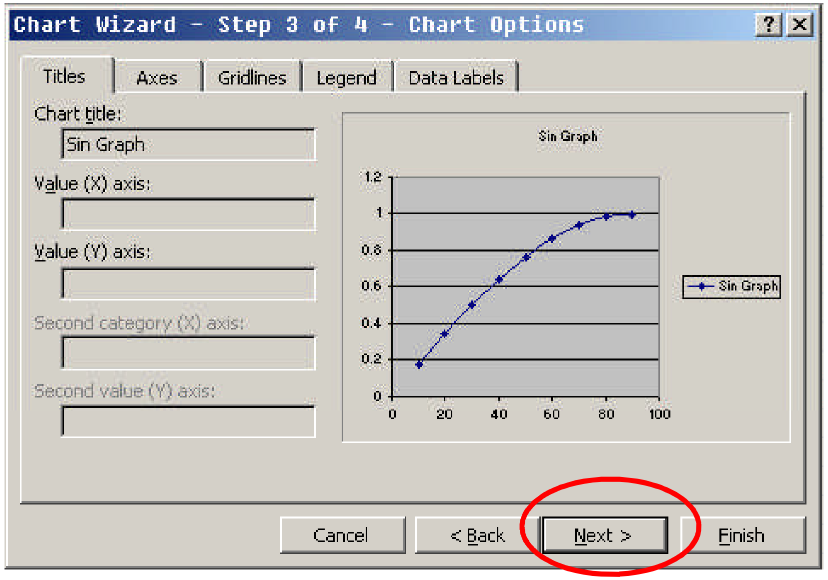
Next > data range is B1 .. B9

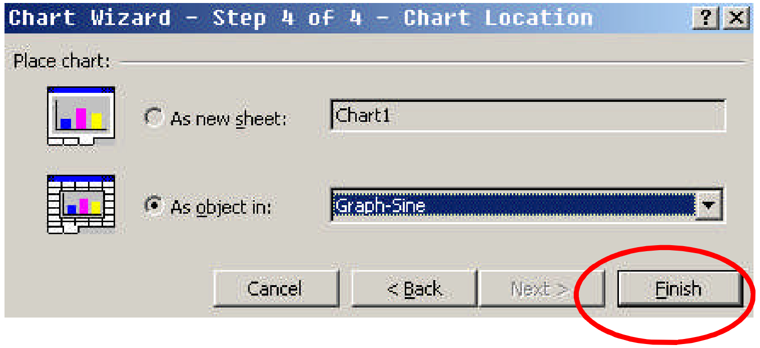


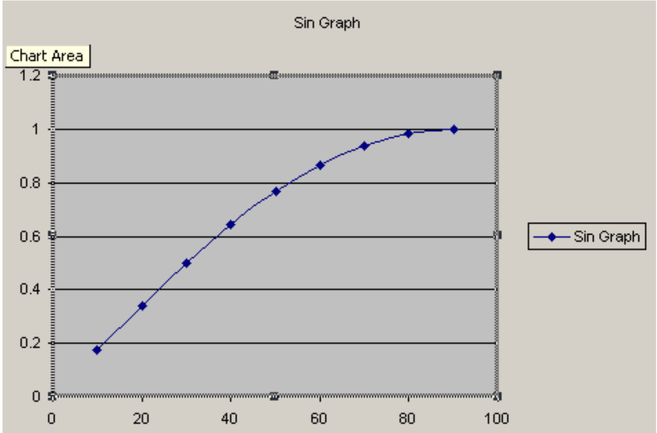
Put x values for the series



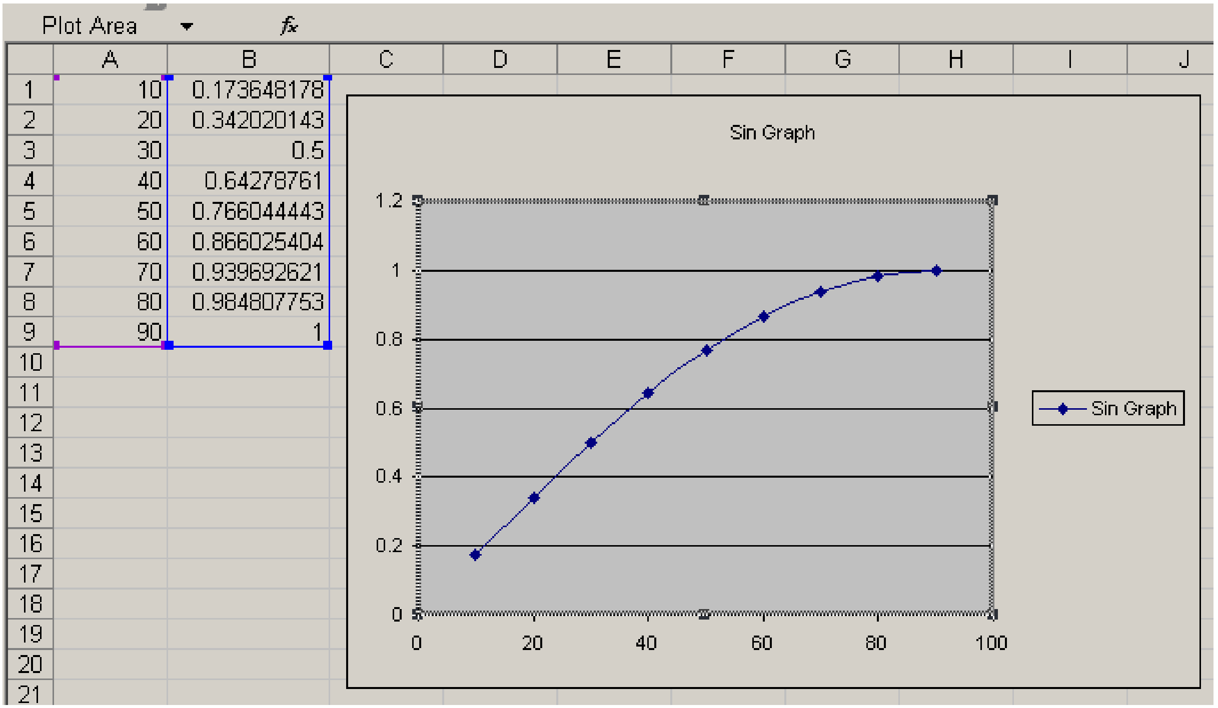
Next > next > finish





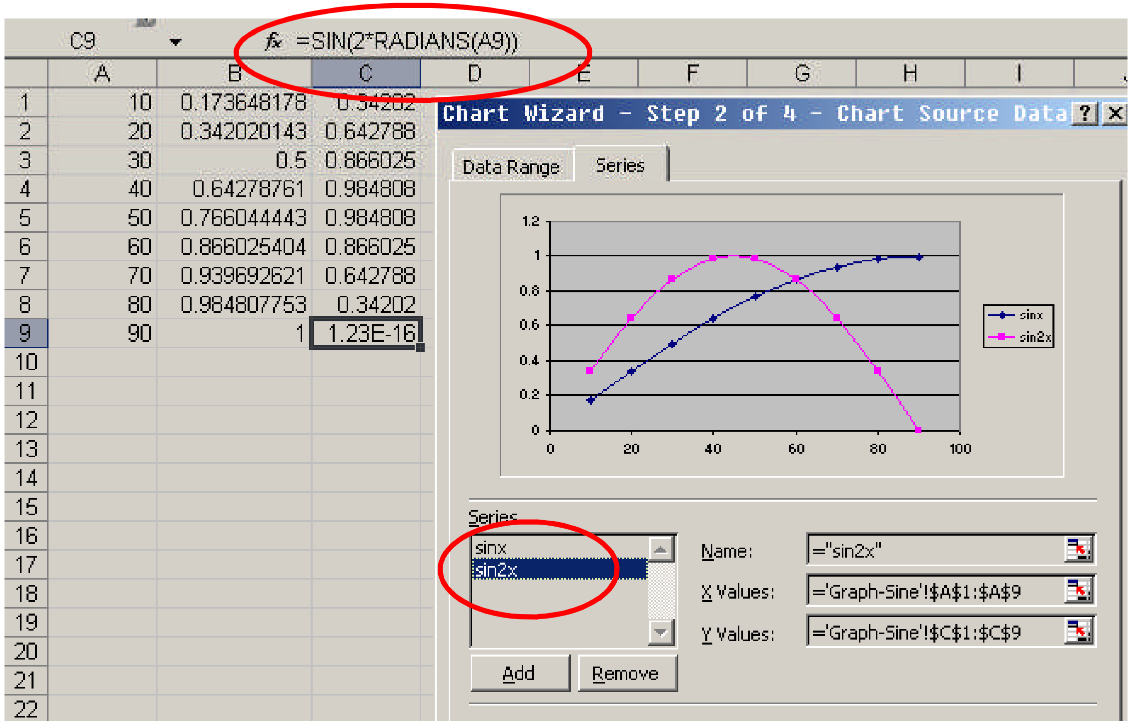


Next > Finish to see the graph.

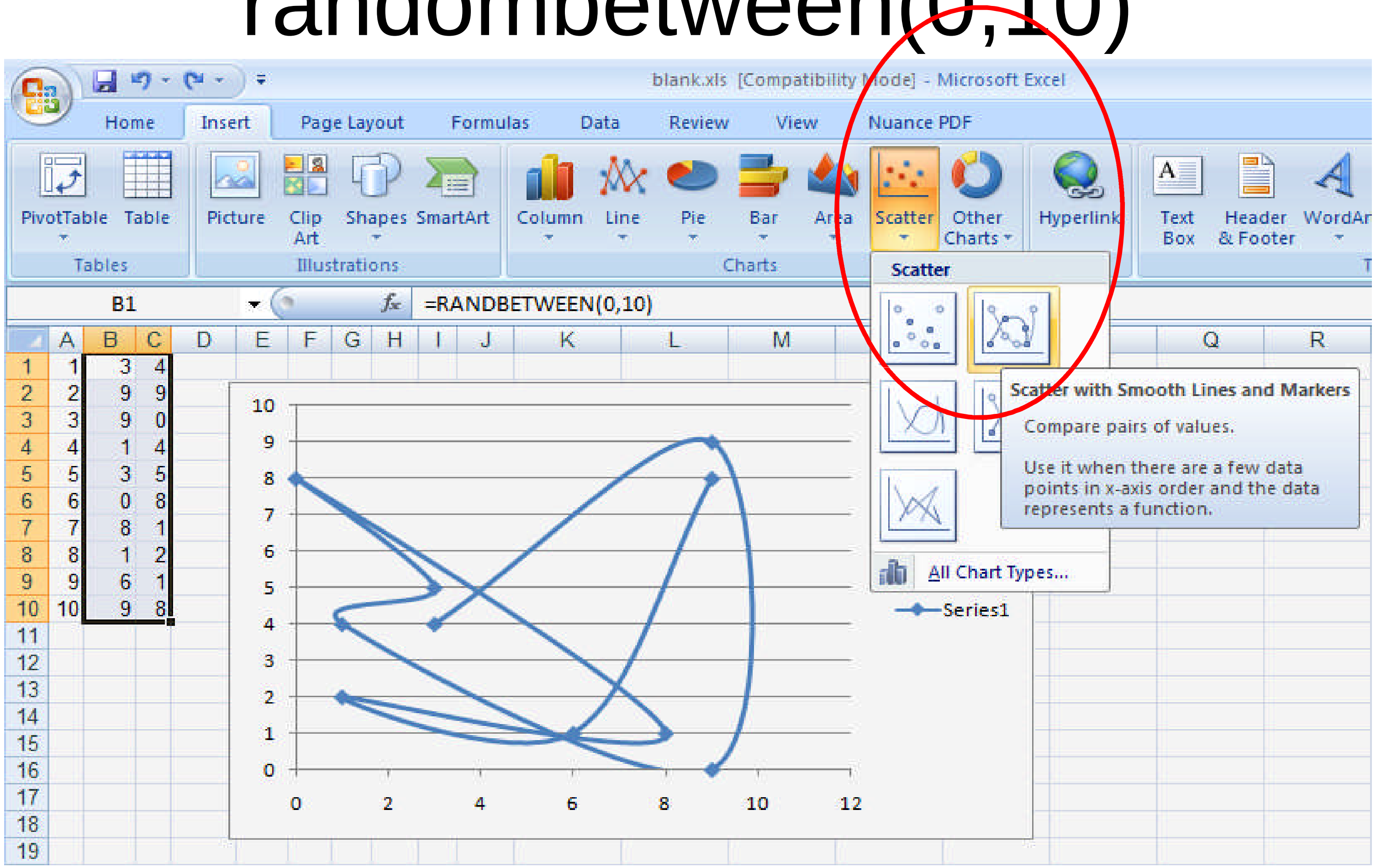


Plot sin(x) and sin(2x) together

- Add to column C1, fx= sin(2*Radian(A1)) and drag the black-dot down to c9.
- Repeat graph procedure with two series



Exercise: Make the plot of randombetween(0,10)

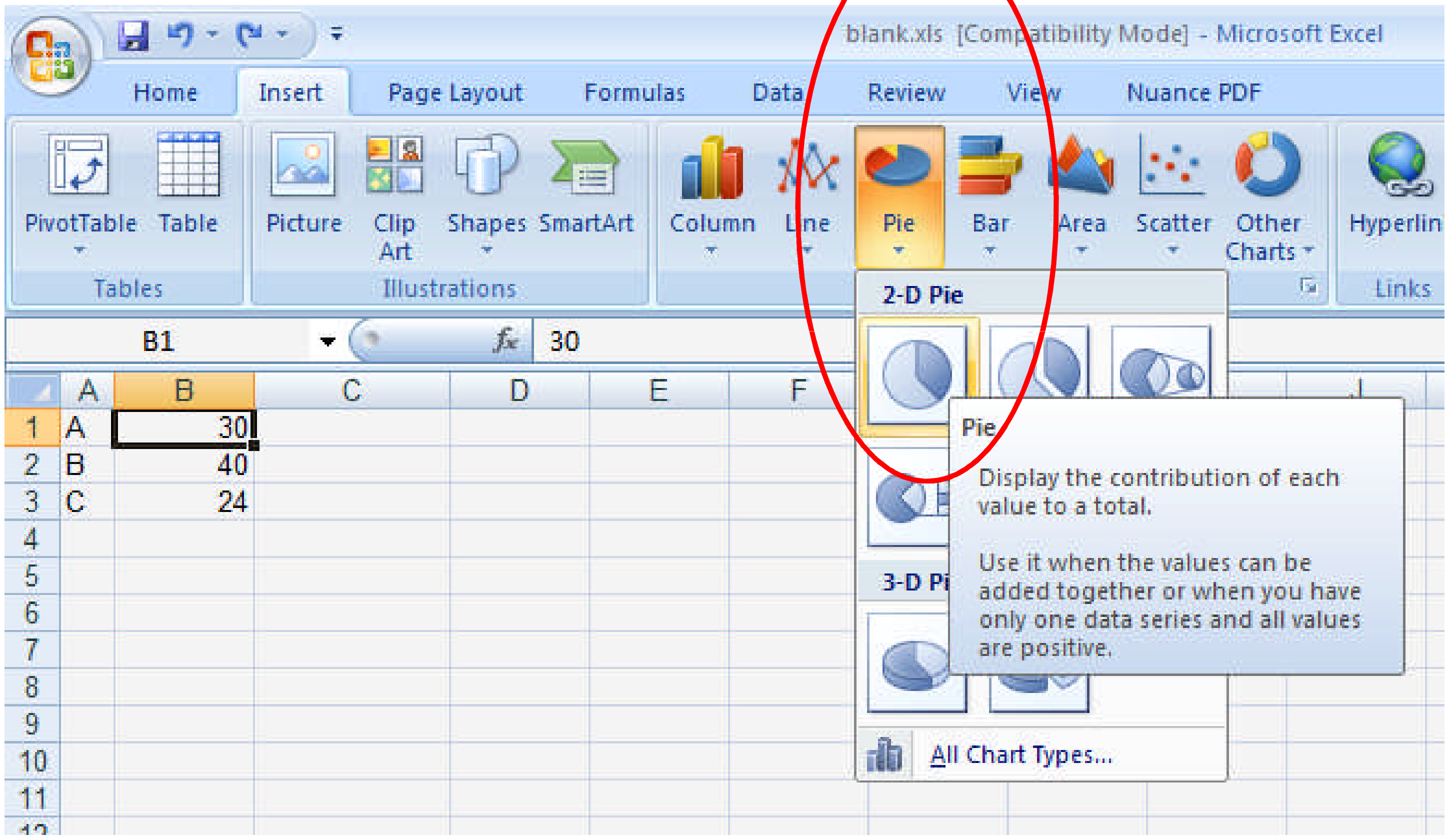


Exercise: create this table, and make a pie chart out of it.

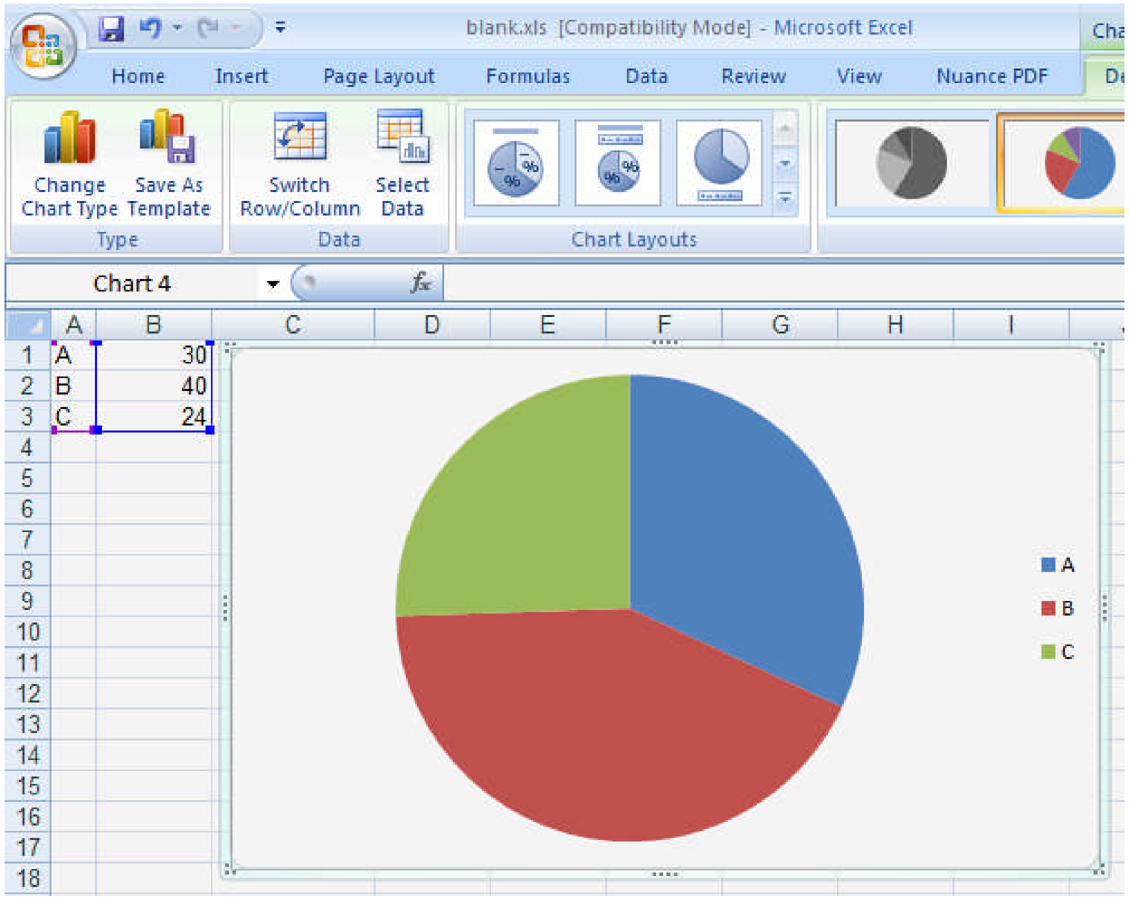
B1

	A	B
1	A	30
2	B	40
3	C	24
4		

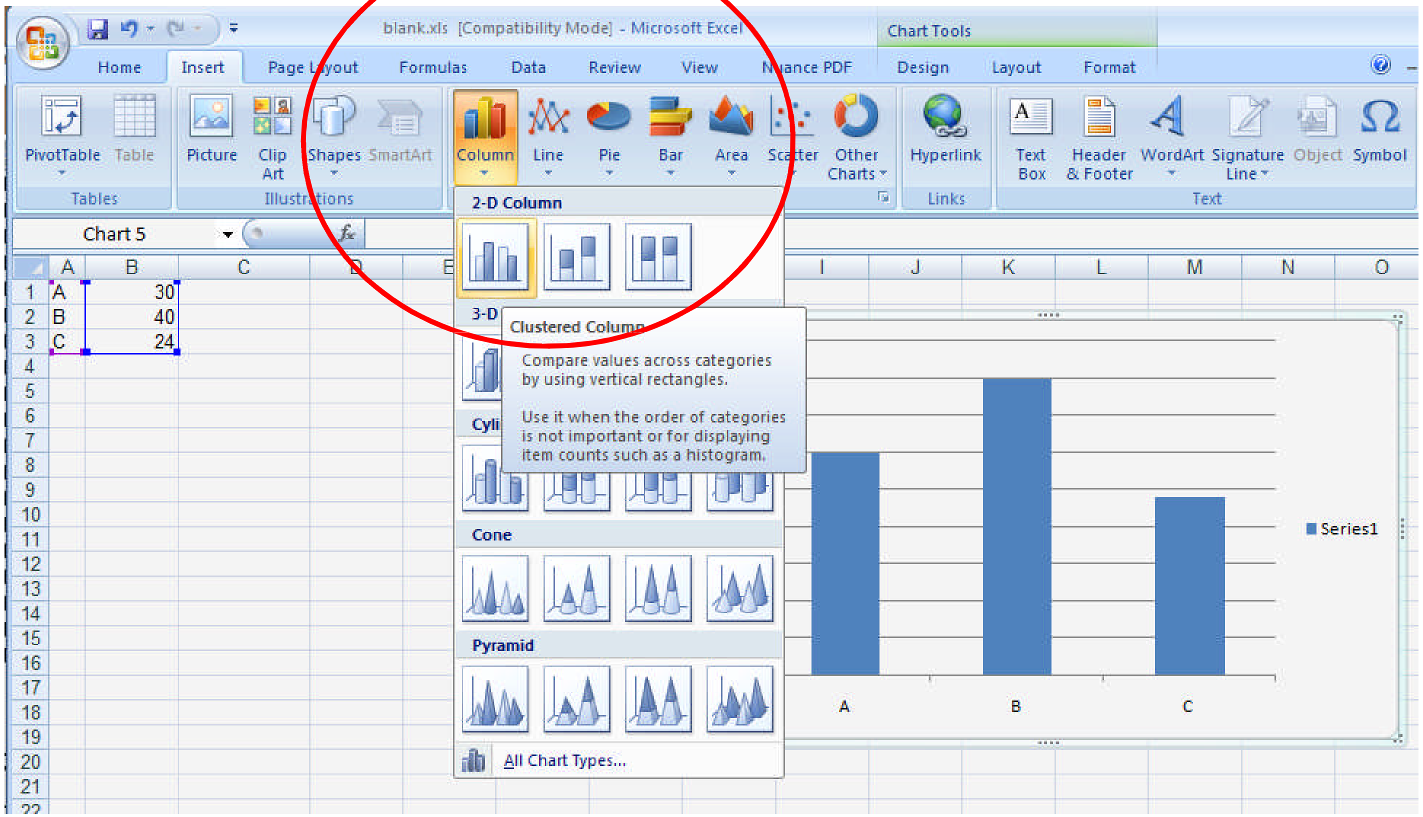
Pie chart


blank.xls [Compatibility Mode] - Microsoft Excel
Home
Insert
Page Layout
Formulas
Data
Review
View
Nuance PDF
PivotTable
Table
Tables
Picture
Clip Art
Shapes
SmartArt
Illustrations
Column
Line
Pie
Bar
Area
Scatter
Other Charts
Hyperlin
Links
B1
30
2-D Pie
3-D Pi
Pie
Display the contribution of each value to a total.
Use it when the values can be added together or when you have only one data series and all values are positive.
All Chart Types...
A 30
B 40
C 24

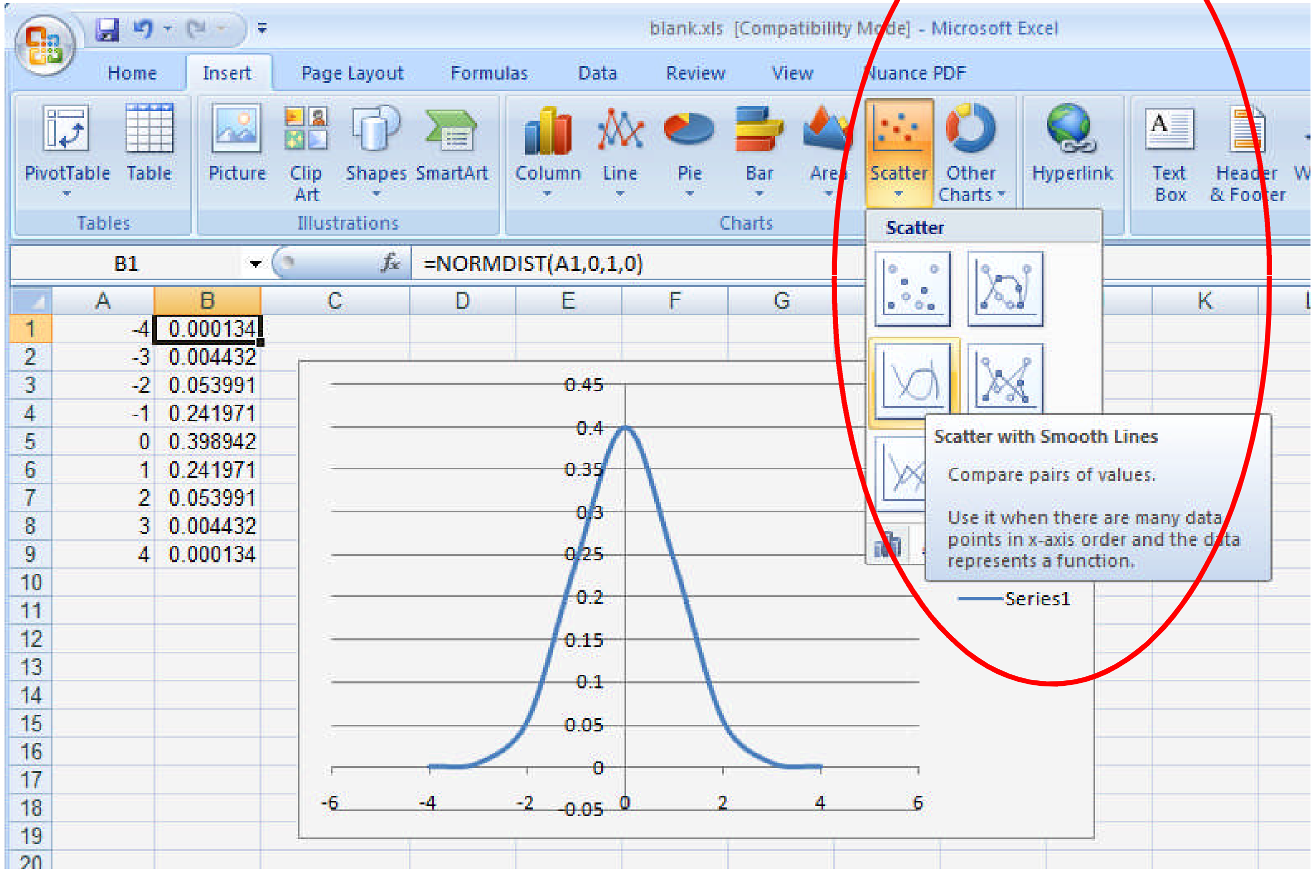
Exercise: make this pie chart



Make this bar chart



Exercise: Draw the graph of Std Normal Distribution with: A1:A9=-4,-3,...,4 B1=normdist(A1,0,1,0)

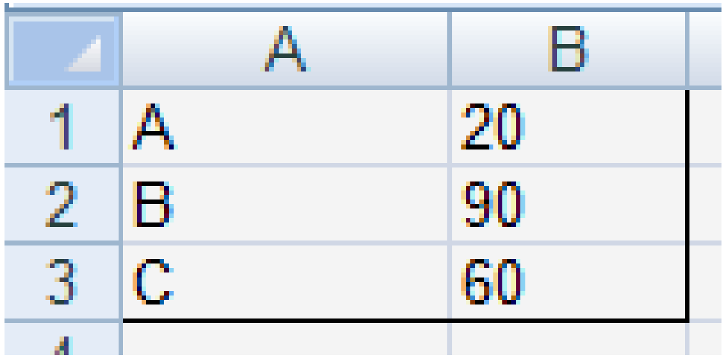


Managing Data with Microsoft Excel

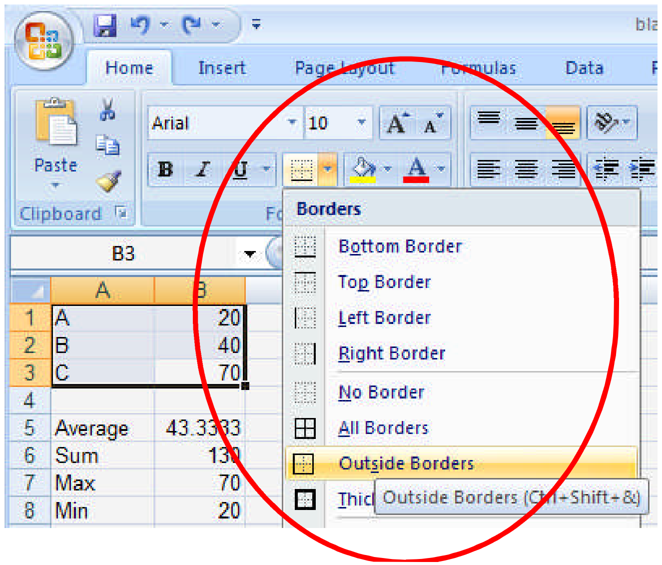
Microsoft Office
Excel 2003/2007

Border around the data

- Type this data on a new sheet

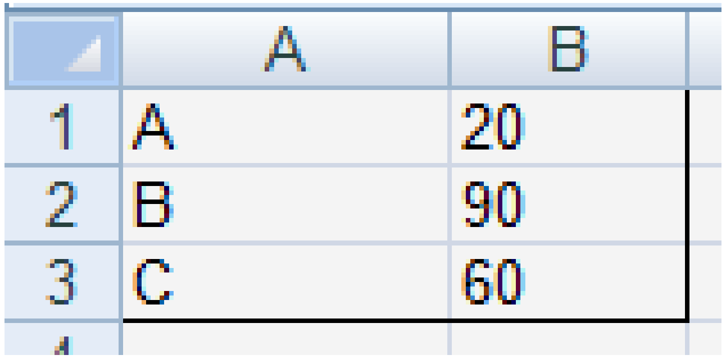


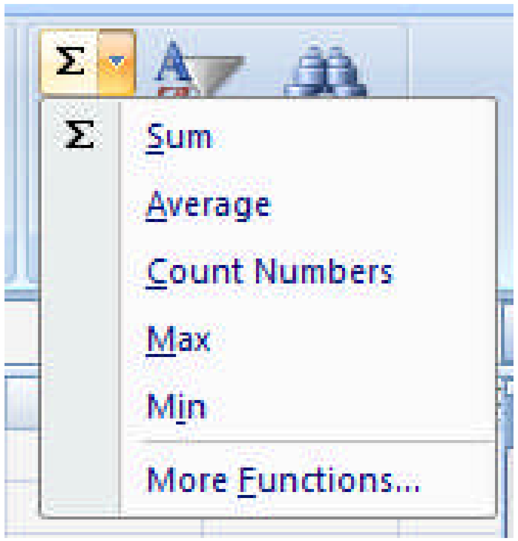
- Put a border around the data



Useful Functions

- Type this data on a new sheet
- Select the block A1:B3
- Click on Sigma sign to see some useful function





Exercise: Compute Average, Sum, Max, Min, Stdev

	A	B
1	A	20
2	B	90
3	C	60
4		
5	Average	56.667
6	Sum	170
7	Max	90
8	Min	20
9	Stdev	35.119

Solution: Average, Sum, Max, Min, Stdev

	A	B
1	A	20
2	B	90
3	C	60
4		
5	Average	=AVERAGE($B$1:$B$3)
6	Sum	=SUM($B$1:$B$3)
7	Max	=MAX($B$1:$B$3)
8	Min	=MIN($B$1:$B$3)
9	Stdev	=STDEV($B$1:$B$3)

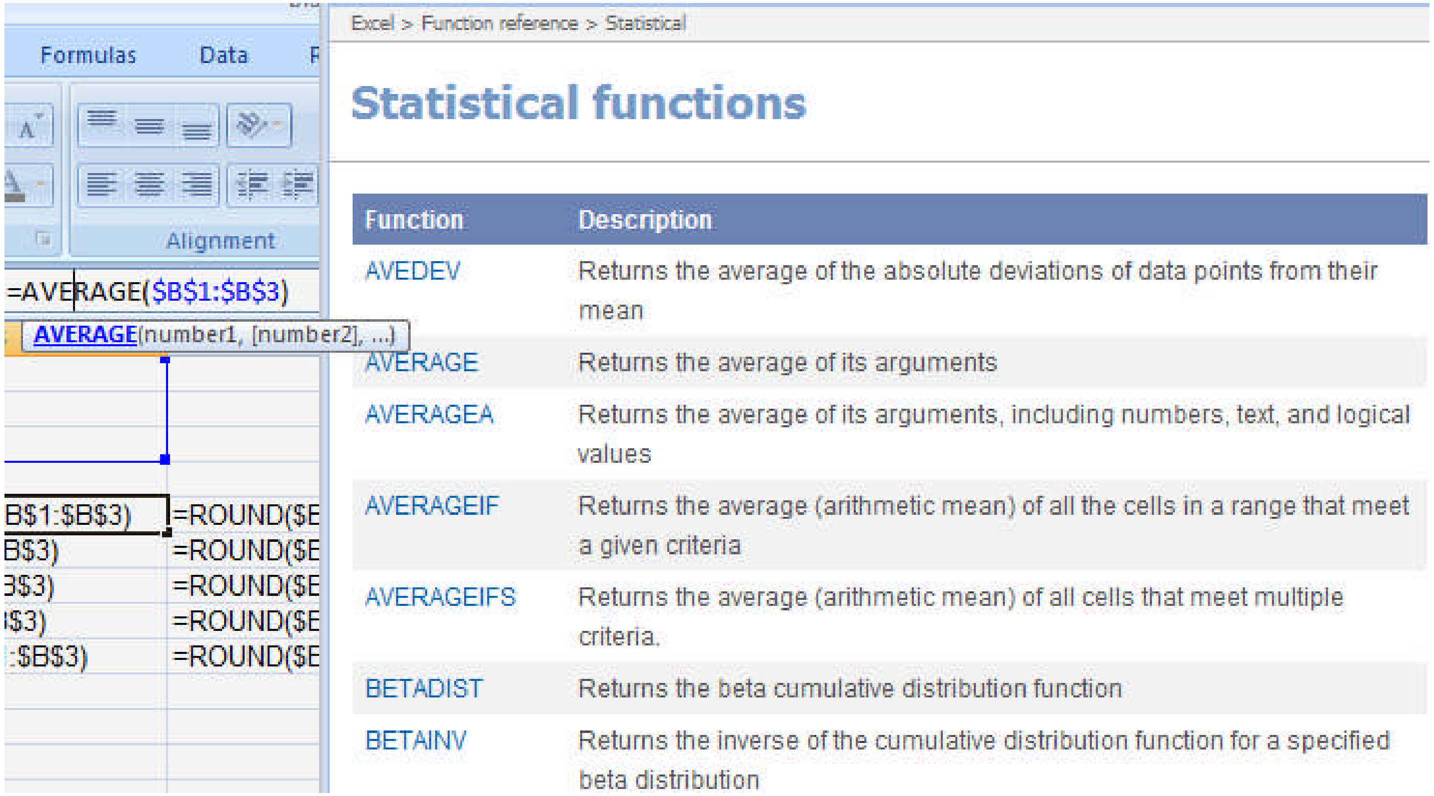
Rounding numbers

	A	B	C
1	A	20	
2	B	90	
3	C	60	
4			
5	Avera	56.6666667	56.67
6	Sum	170	170
7	Max	90	90
8	Min	20	20
9	Stde	35.1188458	35.12
10			

Rounding numbers with =round(value,digits)

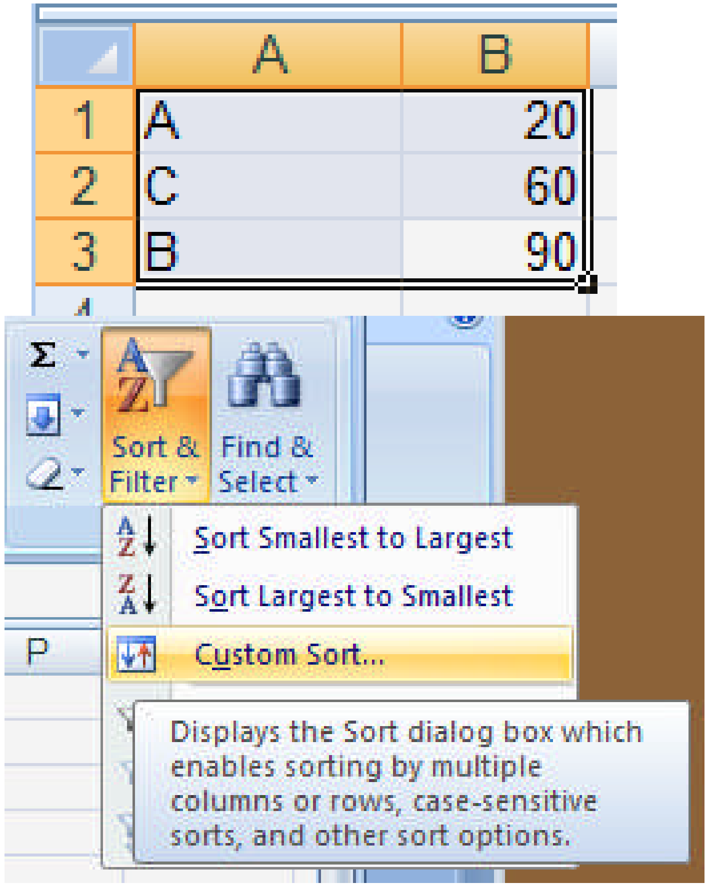
	A	B	C
1	A	20	
2	B	90	
3	C	60	
4			
5	Average	=AVERAGE($B$1:$B$3)	=ROUND($B5,2)
6	Sum	=SUM($B$1:$B$3)	=ROUND($B6,2)
7	Max	=MAX($B$1:$B$3)	=ROUND($B7,2)
8	Min	=MIN($B$1:$B$3)	=ROUND($B8,2)
9	Stdev	=STDEV($B$1:$B$3)	=ROUND($B9,2)
10			

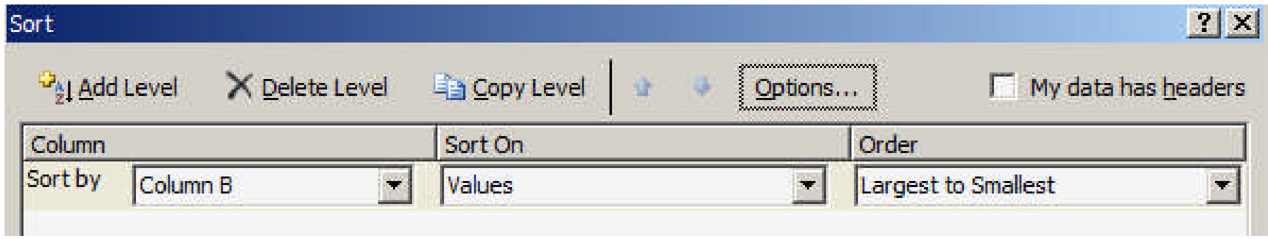
More functions: click on the blue function name to get help



Sort the table

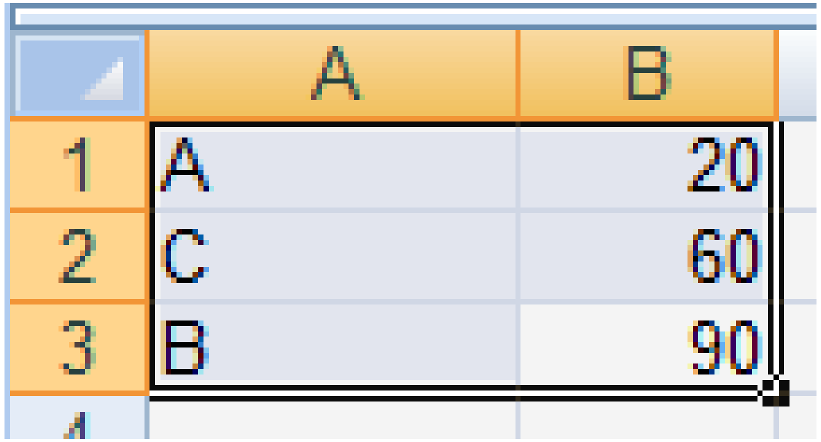
- Select the block A1:B3 and click [Custom Sort]
- Sort by column B

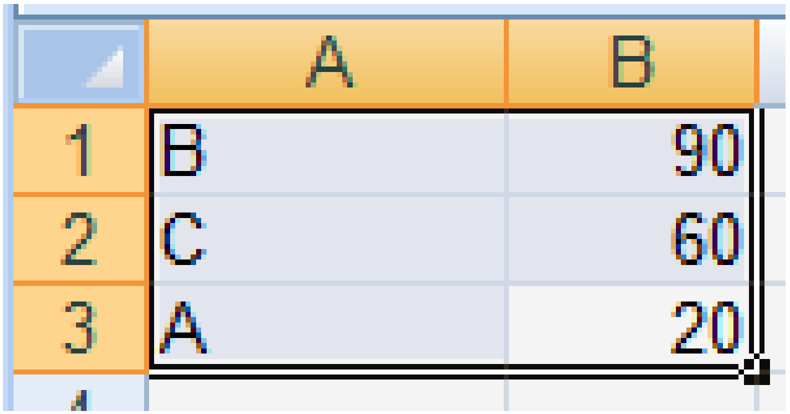




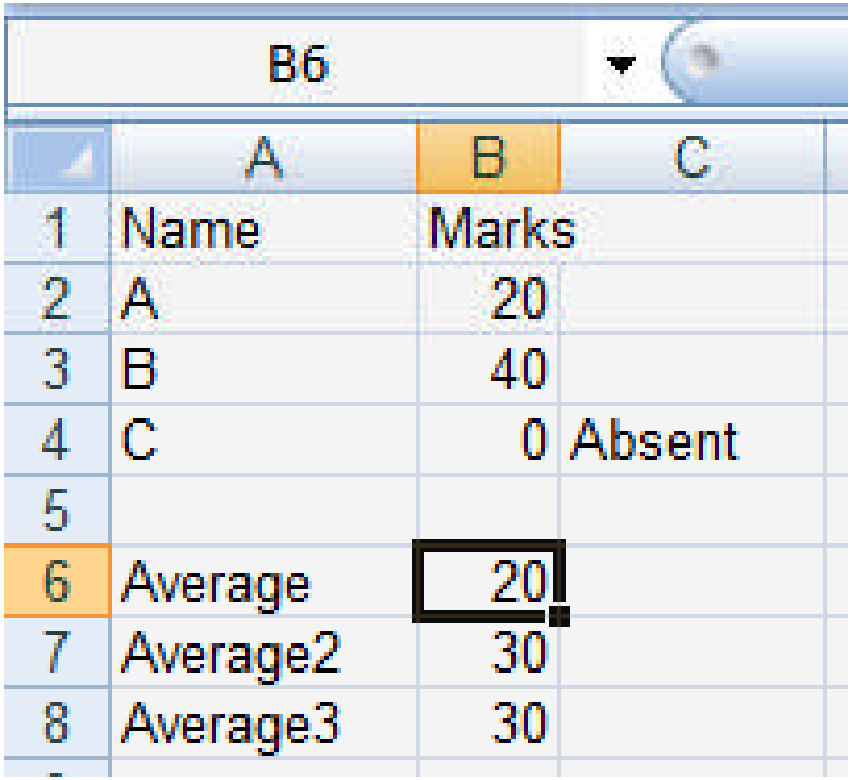
Sort the table

- Select the block A1:B3 and click [Custom Sort]
- Sort by column B





What is the Class Average?



B6

	A	B	C
1	Name	Marks	
2	A	20	
3	B	40	
4	C	0	Absent
5			
6	Average	20	
7	Average2	30	
8	Average3	30	

Exercise: Compute the average marks

Class average ignoring ‘0’

B7 {=AVERAGE(IF(B2:B4<>0,B2:B4))}

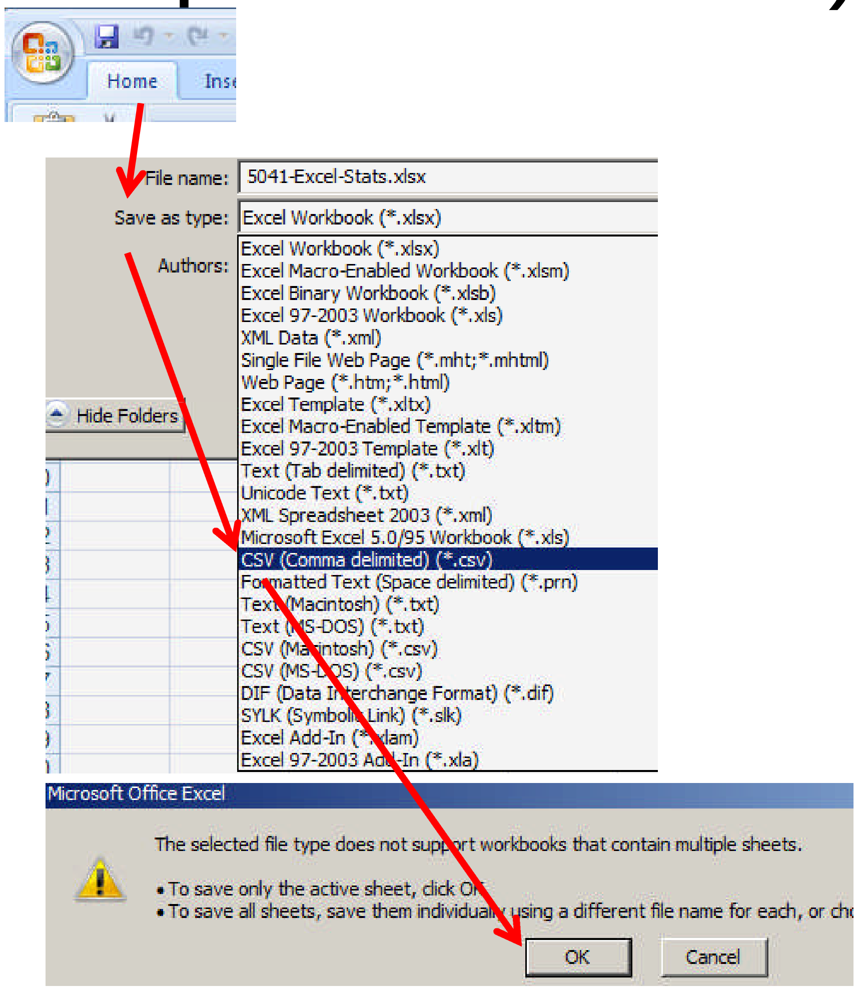
	A	B
1	Name	Marks
2	A	20
3	B	40
4	C	0
5		
6	Average	=AVERAGE(B2:B4)
7	Average2	=AVERAGE(IF(B2:B4<>0,B2:B4))
8	Average3	= SUM(B2:B4) / COUNTIF(B2:B4,"<>0")
9		

In B7, type ‘=average(IF(B2:B4<>0,B2:B4)’ and press Control-Shift-Enter, to make it into an {array}

In B8, type ‘=SUM(B2:B4)/COUNTIF(B2:B4,"<>0")’

Export data as
CSV (comma separated values)

- To freeze the formulas as data. Export it as a CSV file.
- Office Button> Save As> Other formats> csv file> Ok to warnings

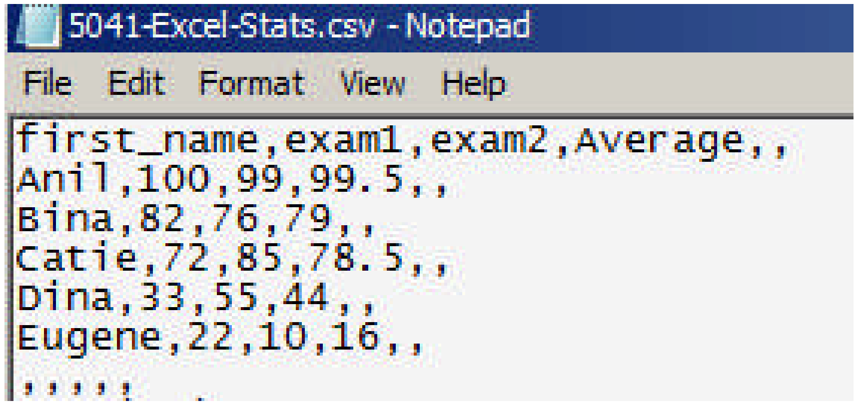


Open the saved CSV file in notepad

This CSV file can be used in R, SPSS, Excel, etc.

Find the CSV file on the desktop >

[right-click-mouse] > [open with] > notepad.

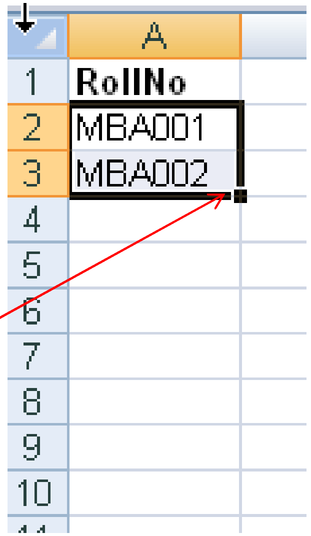


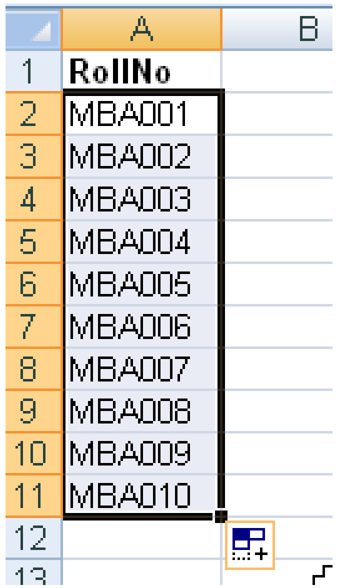
Exercise:
Shuffle Data with Microsoft Excel

Microsoft Office
Excel 2003/2007

Exercise: Shuffle Student List

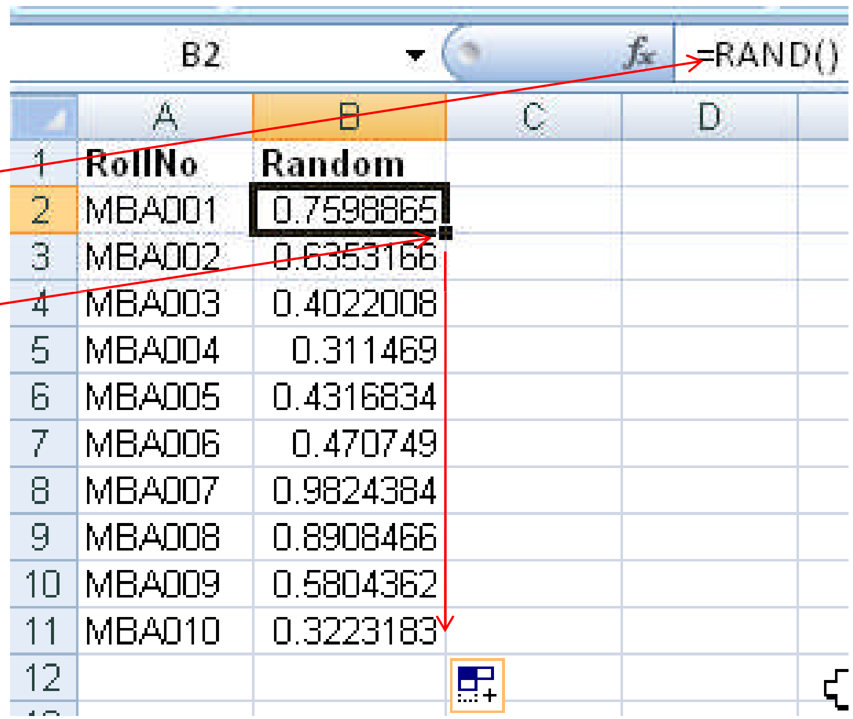
1. New sheet
2. Type 2 roll numbers
3. Select A2,A3
4. Drag BlackDot to A11 or Double-Click on the BlackDot





Exercise: Shuffle Student List

1. In B1 type Random.
2. In B2, write =Rand( ).
3. Drag the BlackDot to B11 or DoubleClick on it.

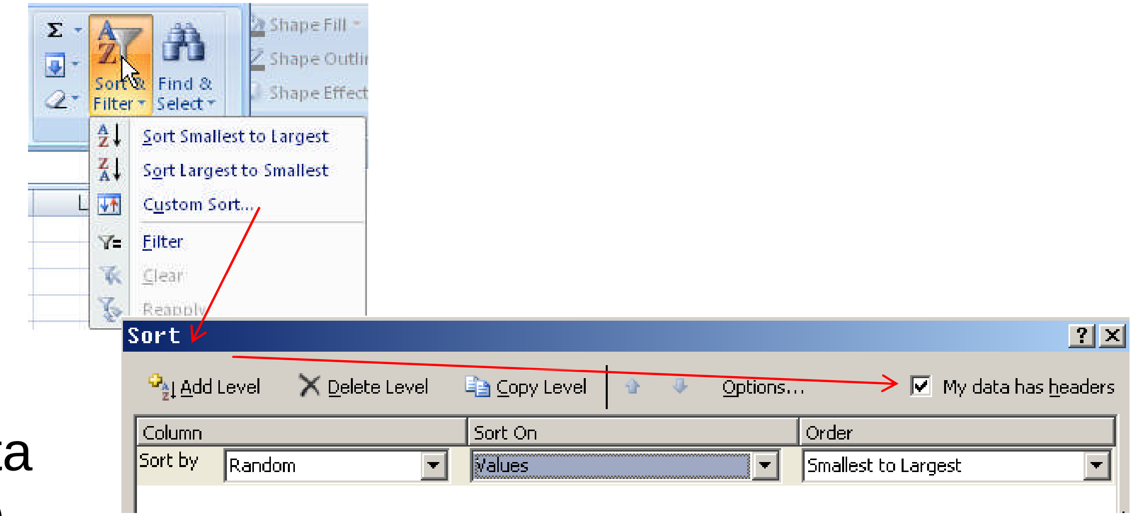


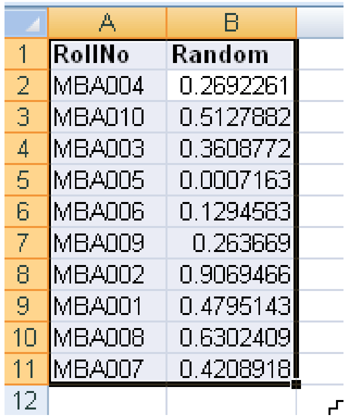
B2 | =RAND()

	A	B	C	D
1	**RollNo**	**Random**		
2	MBA001	0.7598865		
3	MBA002	0.6353166		
4	MBA003	0.4022008		
5	MBA004	0.311469		
6	MBA005	0.4316834		
7	MBA006	0.470749		
8	MBA007	0.9824384		
9	MBA008	0.8908466		
10	MBA009	0.5804362		
11	MBA010	0.3223183		
12				

Exercise: Shuffle Student List

1. Control-A to select All
2. Sort
3. Custom Sort
4. Sort on Random (data has headers)
5. You get students shuffled

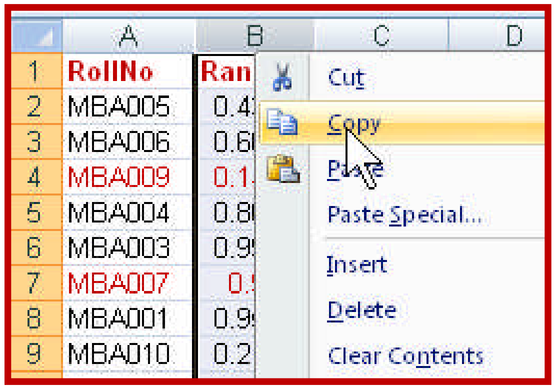


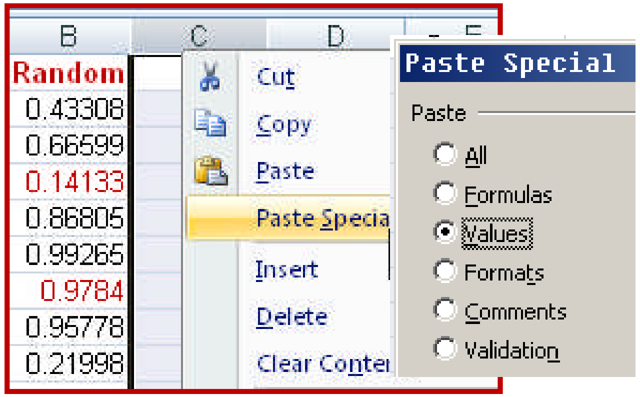


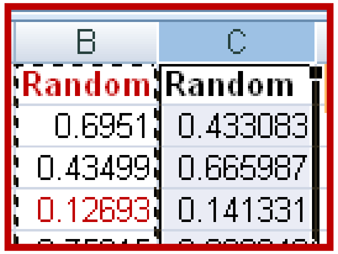
	A	B
1	RollNo	Random
2	MBA004	0.2692261
3	MBA010	0.5127882
4	MBA003	0.3608772
5	MBA005	0.0007163
6	MBA006	0.1294583
7	MBA009	0.263669
8	MBA002	0.9069466
9	MBA001	0.4795143
10	MBA008	0.6302409
11	MBA007	0.4208918
12		

Freezing the data (change formula to numbers)

- Everytime you sort by data, the random numbers keep changing.
- To keep the numbers fixed. Right click on column B > Copy > Goto Column C > Paste Special > Values.







Freezing the data (change formula to numbers)

- Everytime you sort by data, the random numbers keep changing.
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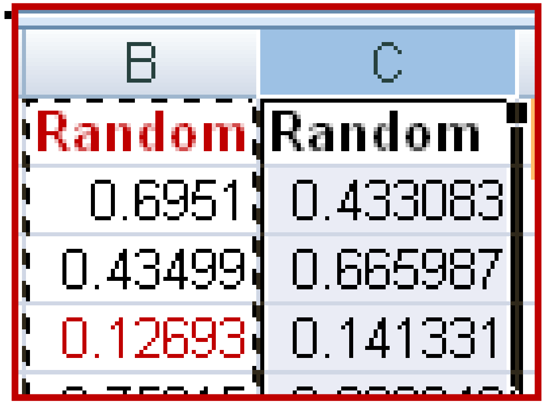
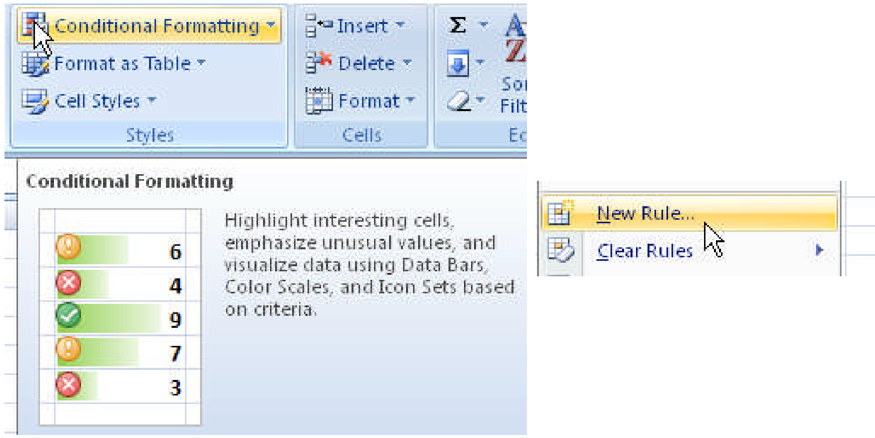
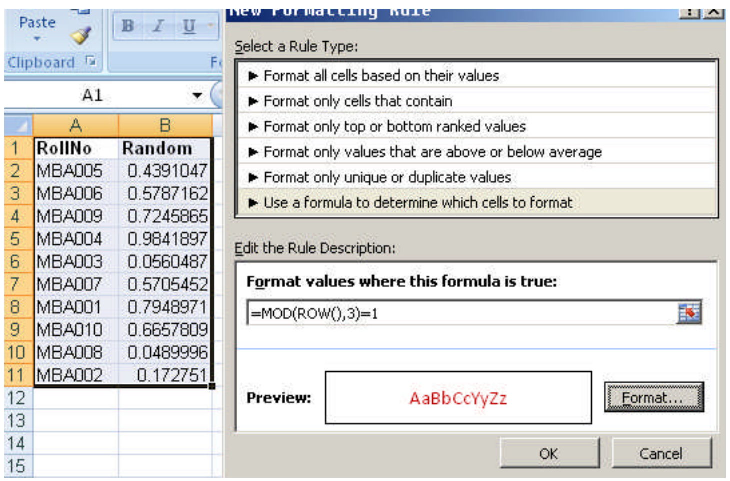
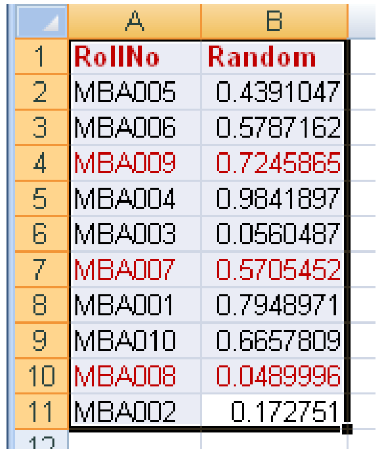


Exercise: Shuffle into Groups

1. Home
2. Select All (Control-A)
3. Conditional Formatting
4. New Rule
5. Formula
6. =Mod(ROW(),3)=1







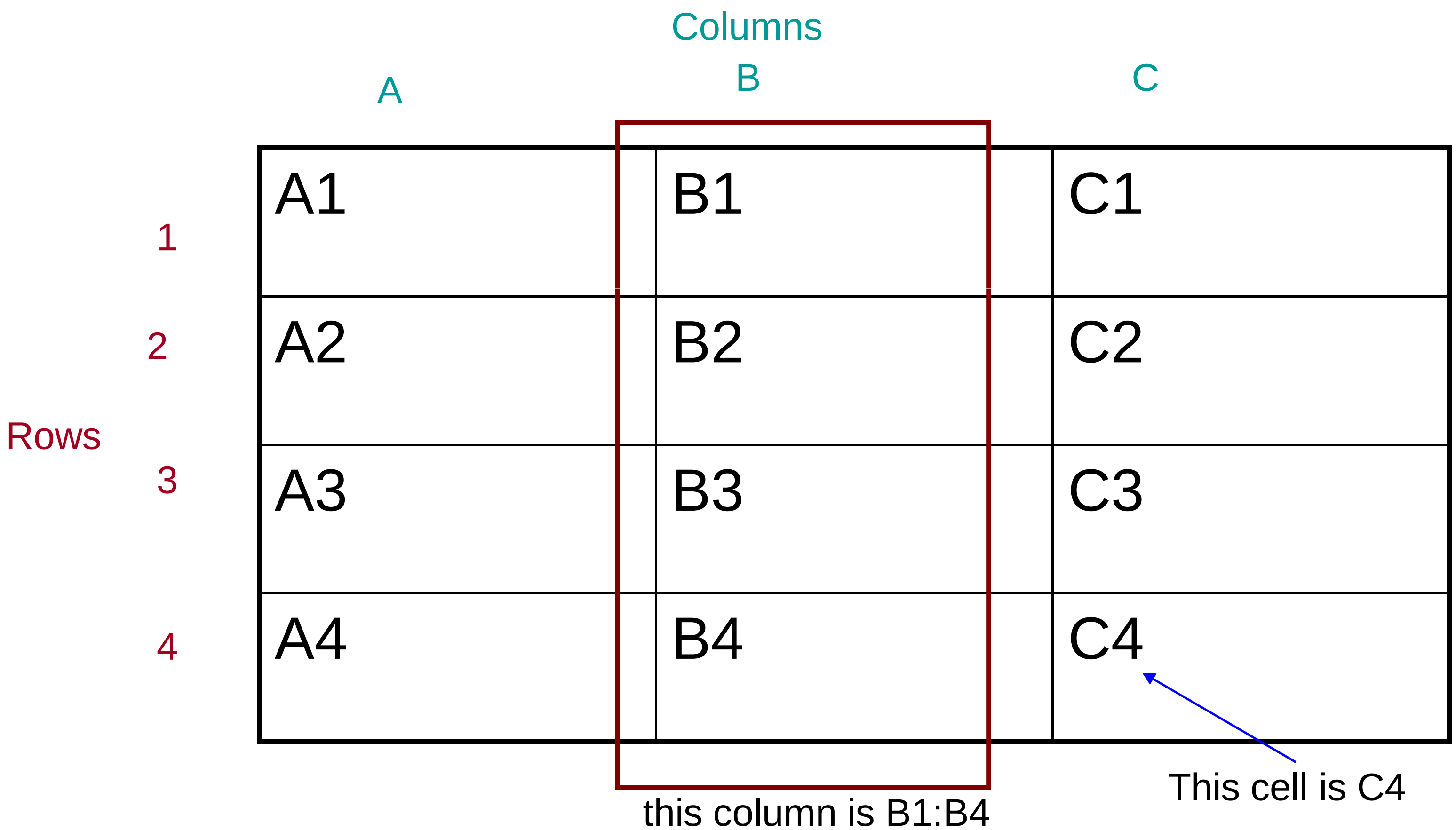
Microsoft Office
Excel 2003/2007

Data Analysis with Microsoft Excel

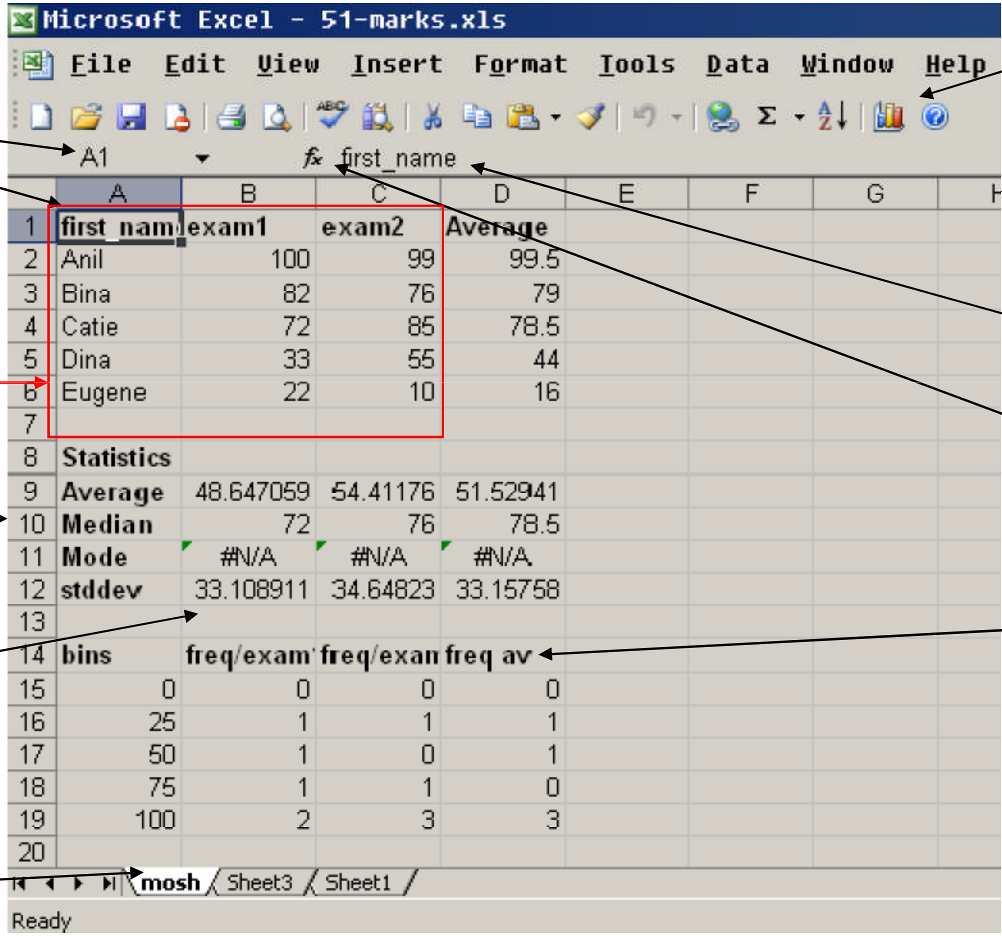
Agenda

1. Sort column
2. Average of 2 columns
3. Stddev of a column
4. Descriptive statistics
5. Histogram of average with a chart
6. Frequency computation

Naming cells in Excel



Example of Excel data



	A	B	C	D
1	first_nam	exam1	exam2	Average
2	Anil	100	99	99.5
3	Bina	82	76	79
4	Catie	72	85	78.5
5	Dina	33	55	44
6	Eugene	22	10	16
7				
8	Statistics			
9	Average	48.647059	54.41176	51.52941
10	Median	72	76	78.5
11	Mode	#N/A	#N/A	#N/A
12	stddev	33.108911	34.64823	33.15758
13				
14	bins	freq/exam	freq/exan	freq av
15	0	0	0	0
16	25	1	1	1
17	50	1	0	1
18	75	1	1	0
19	100	2	3	3
20				

Cell A1

Data entered

Rows

Data computed using a formula by excel

sheets

Charts

Columns

value of cell A1

Formulas

Each cell can contain text or number or formula

Create some data in Excel

Start > Excel > Enter data as below

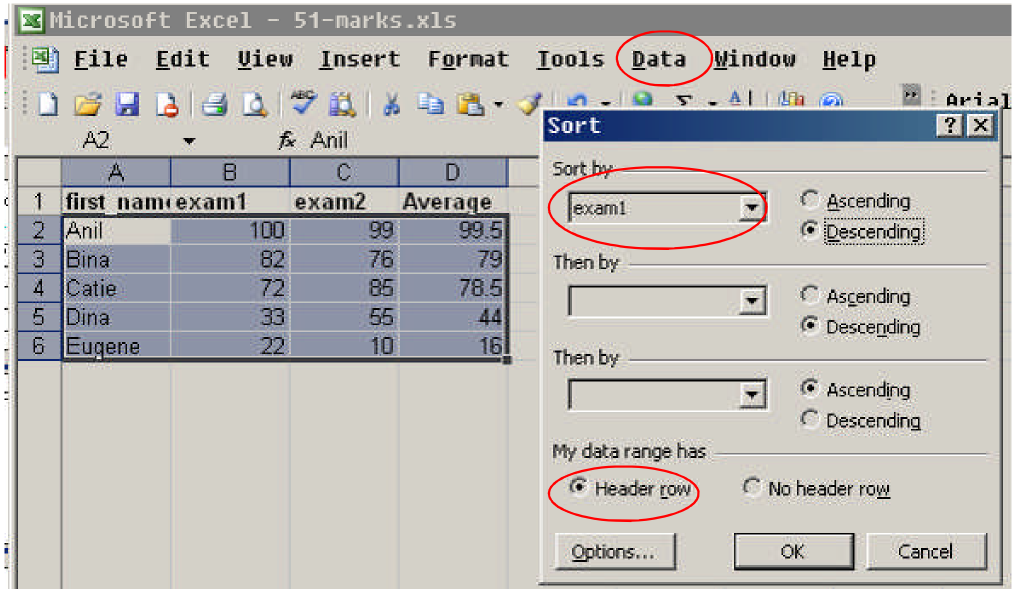
Columns

	A	B	C
1	Name	exam1	exam2
2	Anil	10	15
3	Bina	70	80
4	Catie	90	60

Rows

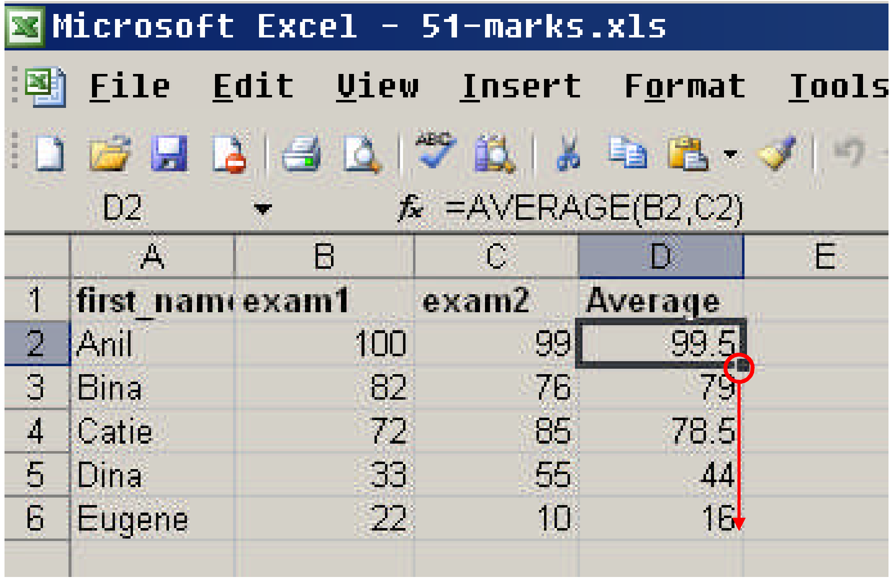
Sort data by exam1

- Select cells [A1..D6]
- Menu > Data > Sort



Average of two columns in 3rd column (exam1 and exam2)

- Put cursor in D2
- fx=Average(B2,C2)
- Drag black dot from D2 to D6 with mouse.



Three ways to find Average

	A	B
1	name	marks
2	Anil	20
3	Ball	40
4	Cat	0

Average1	=AVERAGE(B2:B4)	20
Average2	=AVERAGE(IF(B2:B4<>0,B2:B4))	30
Average3	=SUM(B2:B4)/COUNTIF(B2:B4,"<>0")	30

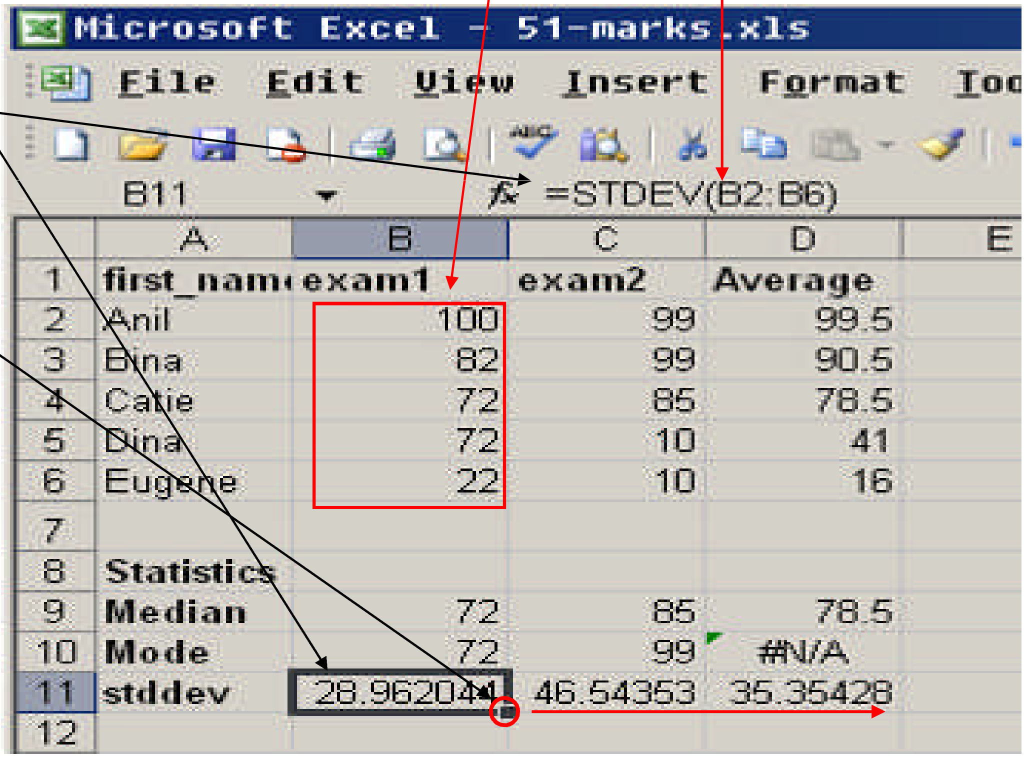
Column Statistics: standard deviation (stddev)

1. Select B11

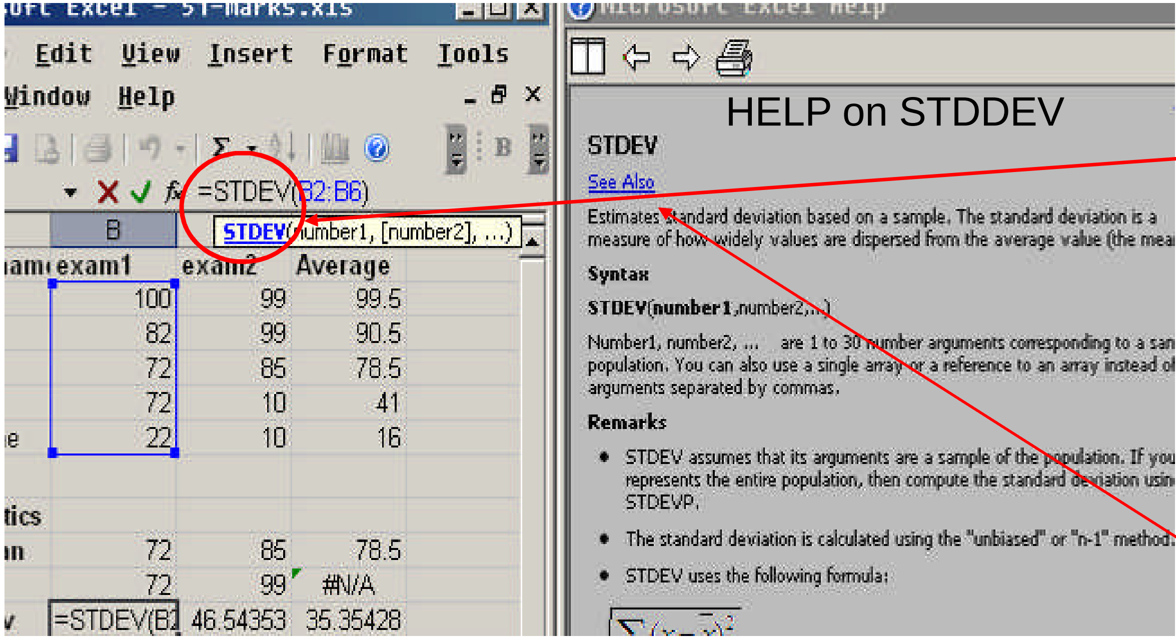
2. After fx=, type: STDDEV(B2:B6)

3. Drag black square in B11 to D11, to get stddev of each column

Refer to the 2nd column as B2:B6



Help on the statistical functions



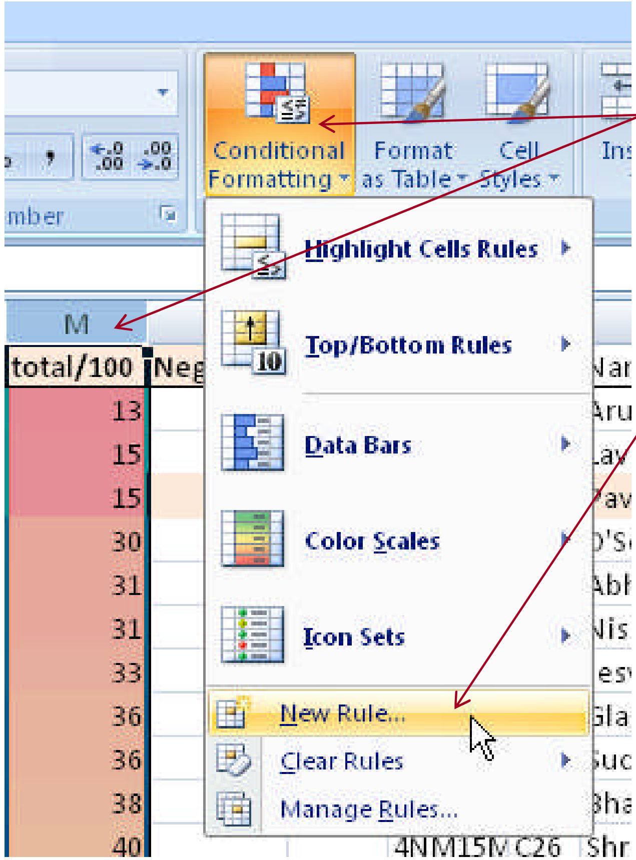
Click here to see the selected cells B2:B6 and help on function STDDEV

Click on See Also to get help on all other functions

Excel 2007

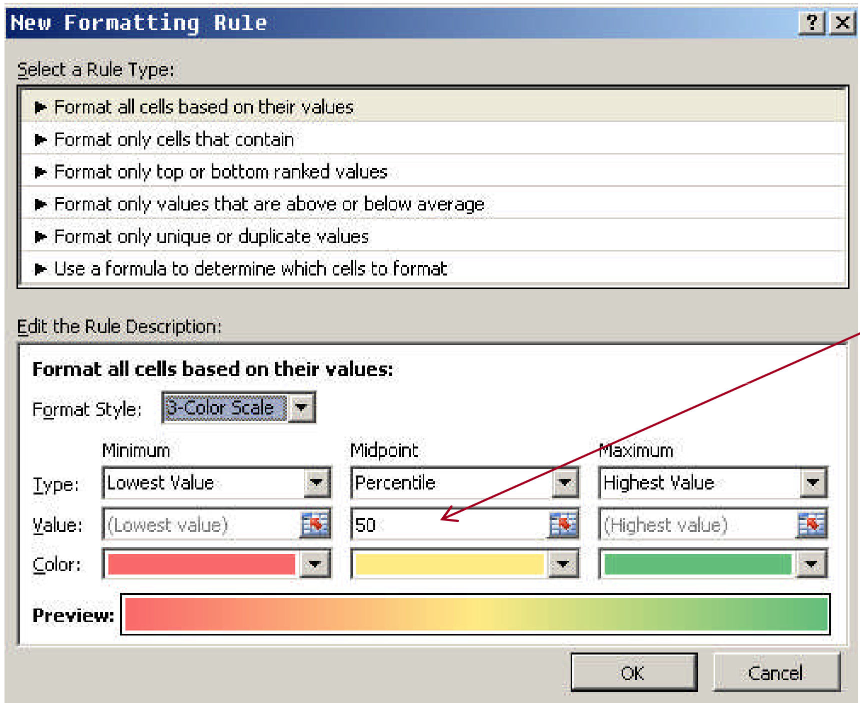
Grading in Excel

Coloring the marks



1. Select Marks Column
2. Home > Conditional Formatting
3. New Formatting Rule

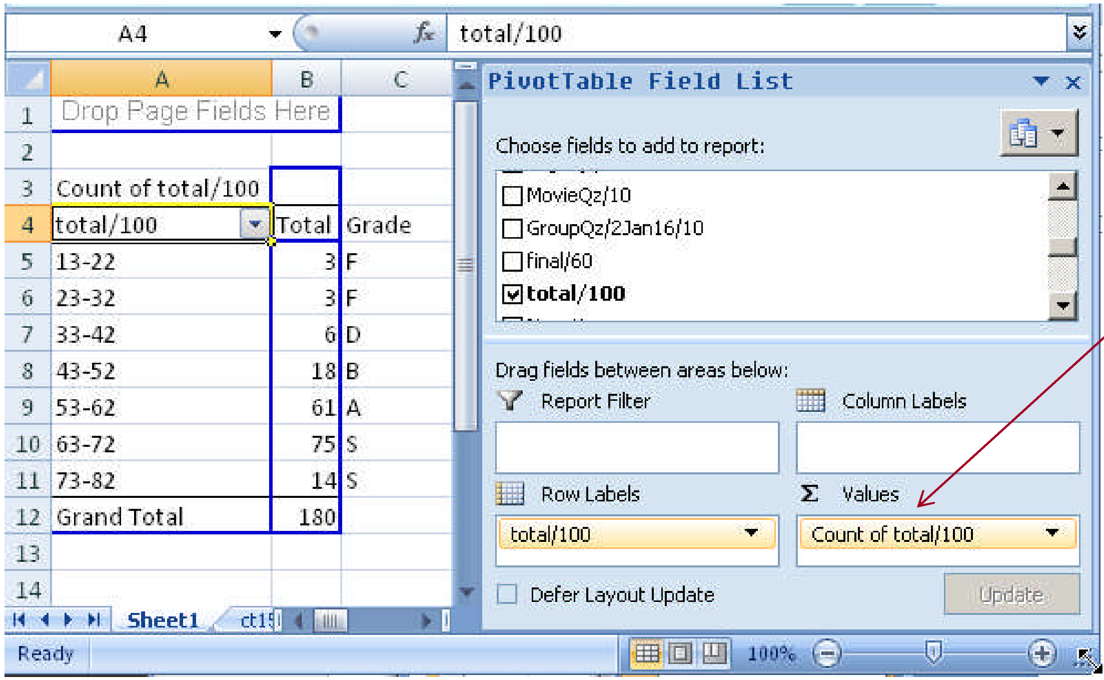
Coloring the marks



1. Select Marks Column
2. Home > Conditional Formatting
3. New Formatting Rule
4. "3 color scale"
   Red: Lowest,
   Yellow: 50% percentile,
   Green: Highest

Advanced: Calculate =PERCENTILE($B$3:$B$20,0.25), then use a formula to determine which cells to color   B3 <=PERCENTILE($B$3:$B$20,0.25)
See http://www.dummies.com/how-to/content/how-to-highlight-data-based-on-percentile-rank-in-.html

Insert Pivot Table

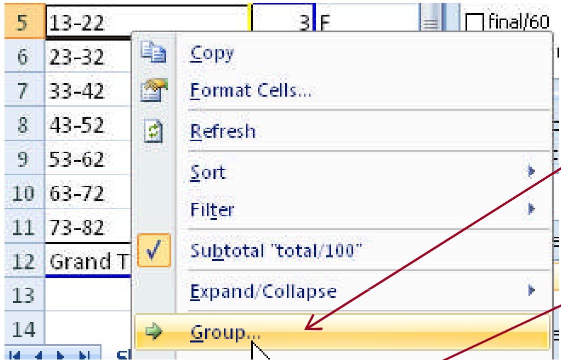


1. Insert Pivot Table

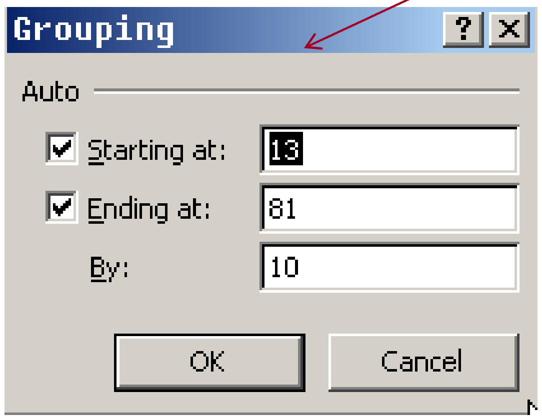
2. Select
RowLabels=Marks
Sigma Values=
Count of Marks

Freq/Count Histogram

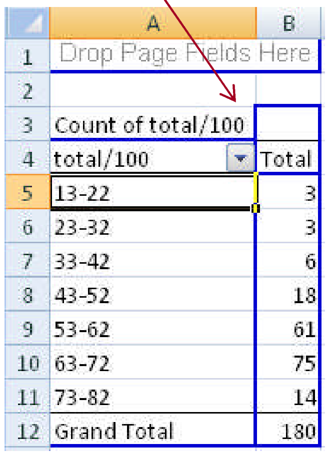
Right click on any row, and click on "Group"



Grouping from Lowest to Highest, with delta



You get this table:

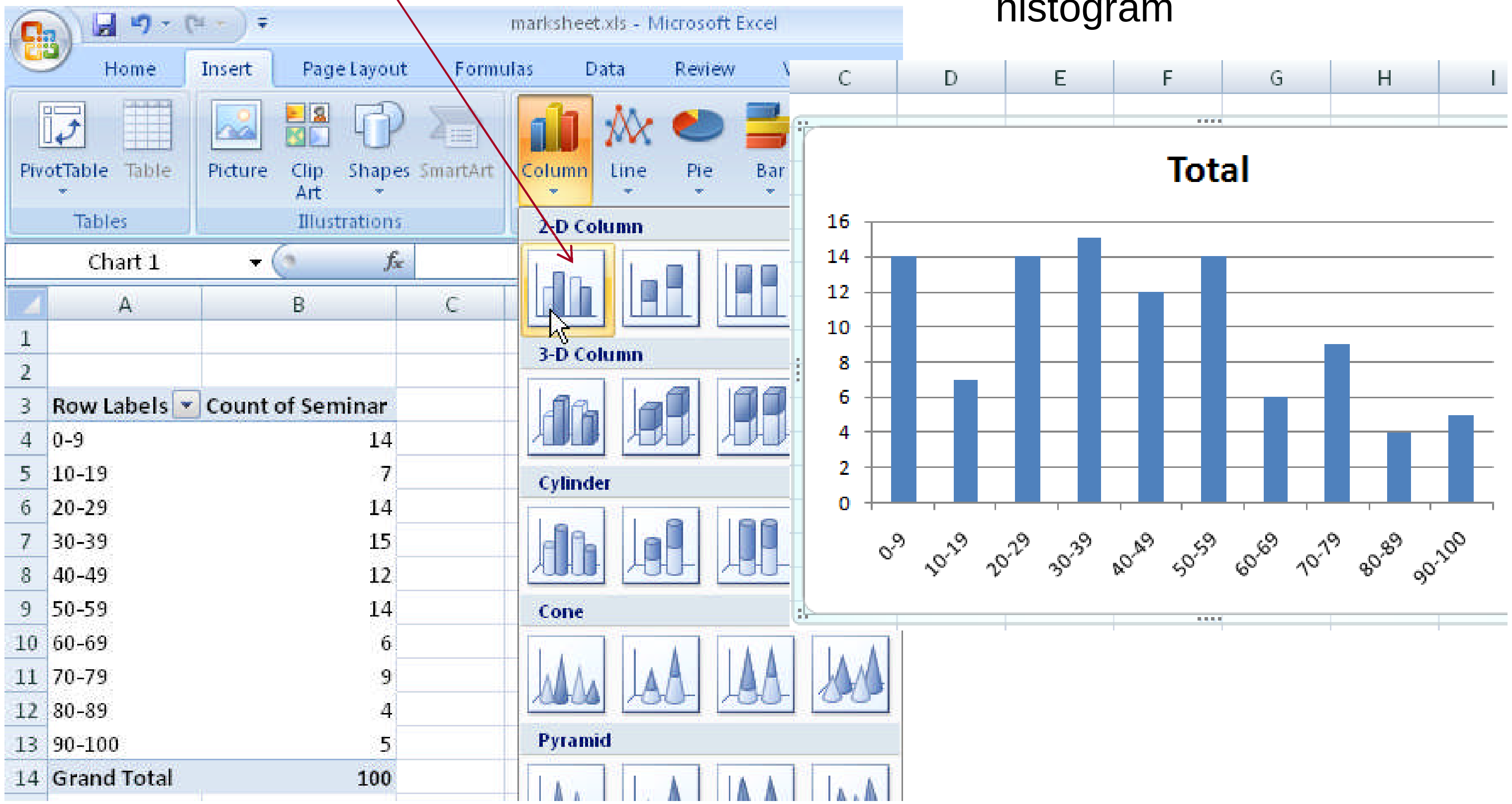


	A	B
1	Drop Page Fields Here	
2		
3	Count of total/100	
4	total/100	Total
5	13-22	3
6	23-32	3
7	33-42	6
8	43-52	18
9	53-62	61
10	63-72	75
11	73-82	14
12	Grand Total	180

Freq/Count Histogram

Insert > Column Chart

You get this mark distribution histogram



Summing marks

We had 3 quiz of 10, 5, 15 marks.

With weightage {30, 50, 20} out of total=100.

Suppose a student got q1,q2,q3 marks in those quizzes, then we get weighted total % for each student as:

total = int(q1/10 * 30 + q2/5 * 50 + q3 / 15 * 20)

Re-Scaling

Marks Range = a .. b

Want Range = c .. d

Rescale student marks=m to new with:

new = int((m – a)*(d-c)/(b-a)+c)

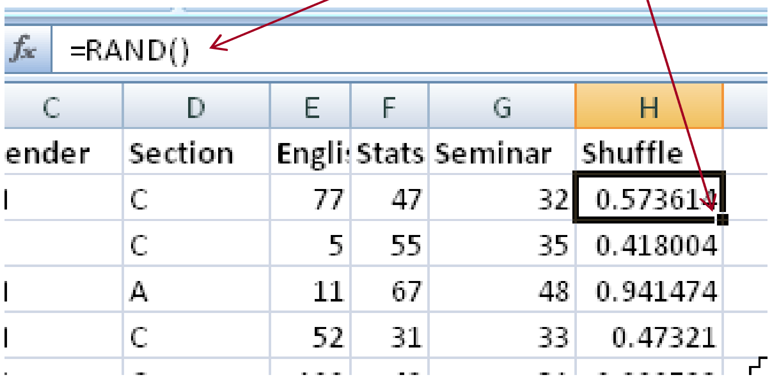
E.g. Students got marks in range: 7 to 81

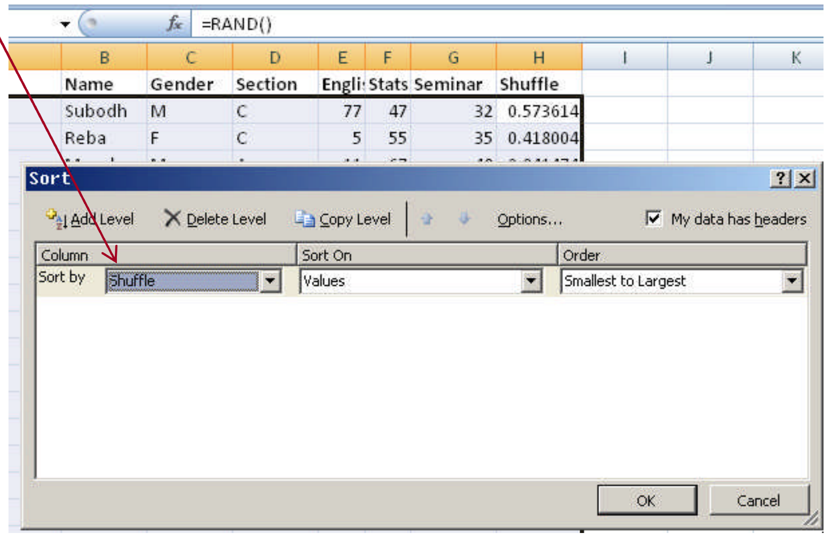
We want to give marks in range: 40 to 100

new = int ((m – 7)*(100-40)/(81-7)+40)

Random shuffling

- Add a column Shuffle, =Rand( ),
- drag Black Dot to all the rows.
- Sort by column shuffle.





Random Grouping of size=3

- Shuffle the rows (last slide).
- Add a column Groups, = int((row() - 2)/3+1)
- Drag Black Dot down to all rows
- You get group numbers, each group size is 3.

=INT((ROW()-2)/3+1)

	E	F	G	H	I
ct	Engli	Stats	Seminar	Shuffle	Groups
	100	42	31	0.0186	1
	67	52	42	0.351	1
	43	100	3	0.8449	1
	22	74	35	0.7817	2
	65	42	25	0.5725	2
	53	32	56	0.1405	2
	38	30	64	0.9974	3

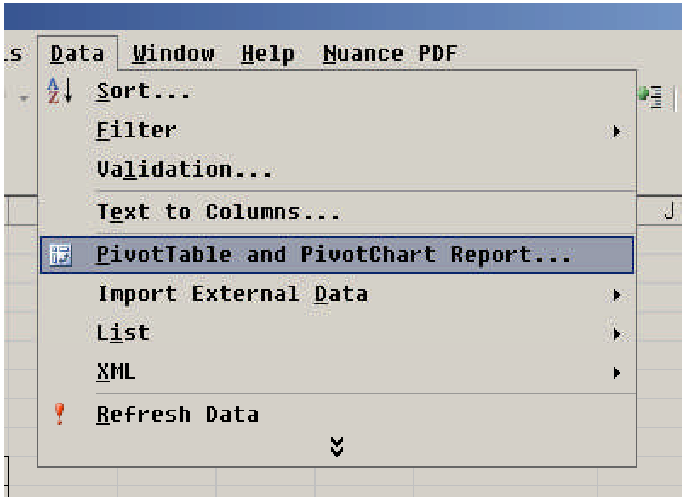
Pivot table in Excel

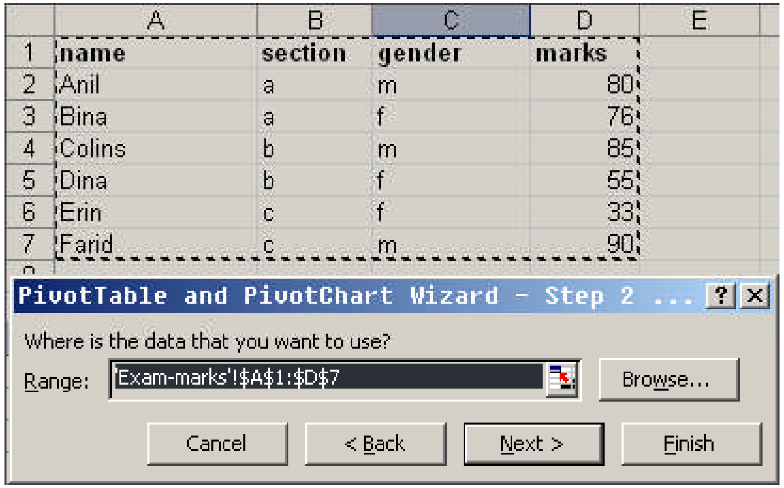
Example data of class marks

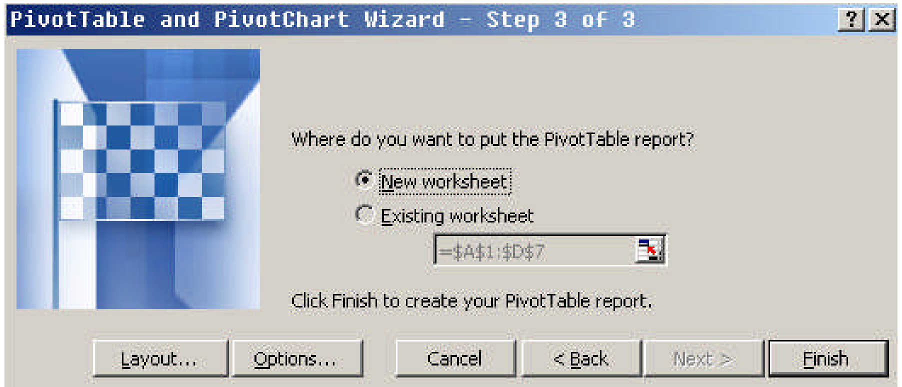
- We want to find out the average for each section, and average for the gender.
- Pivot table does this for us.

	A	B	C	D
1	**name**	**section**	**gender**	**marks**
2	Anil	a	m	80
3	Bina	a	f	76
4	Colins	b	m	85
5	Dina	b	f	55
6	Erin	c	f	33
7	Farid	c	m	90

Data > Pivot table

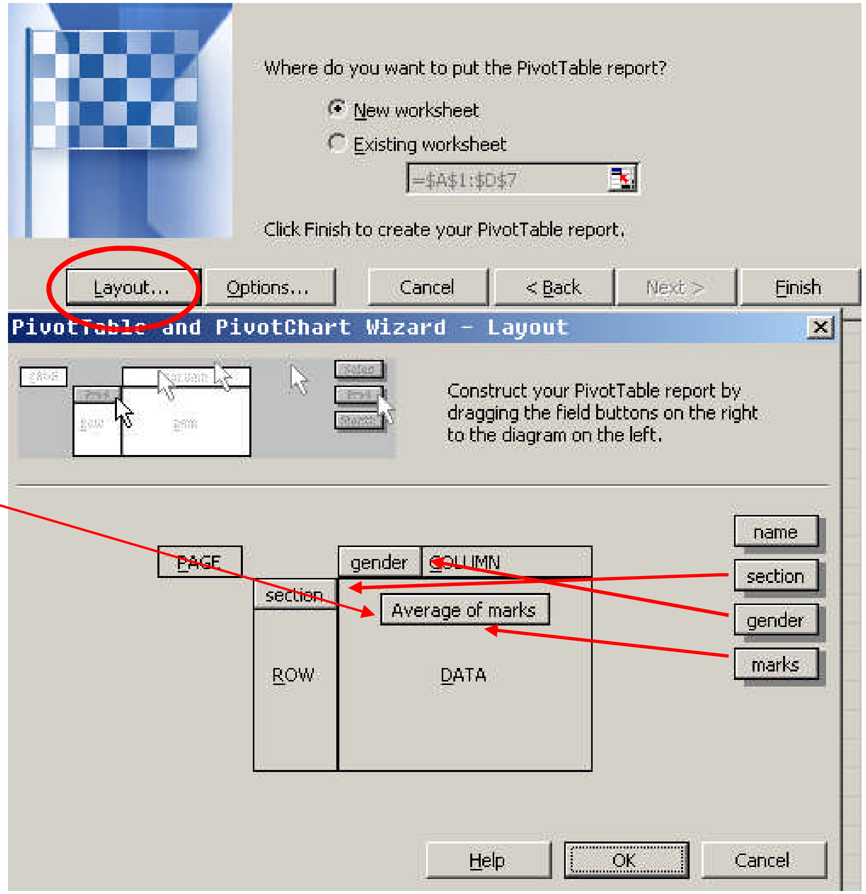




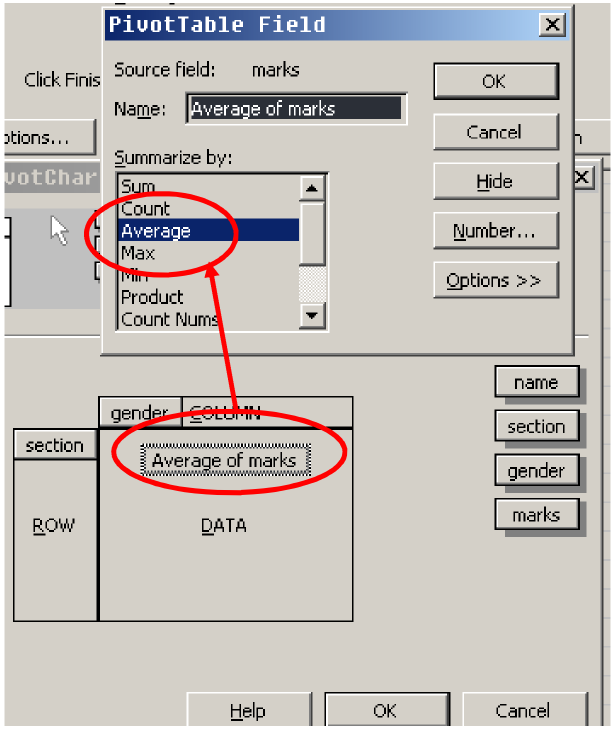


Layout

- Drag “section” “gender” and “marks” in the layout form.
- Click on “marks” and select average.



- Click on “marks” and select average.



Result

- We get average of each section and for each gender.

	A	B	C	D
1				
2				
3	Average of mark:	gender		
4	section	f	m	Average
5	a	76	80	78
6	b	55	85	70
7	c	33	90	61.5
8	Average	54.66667	85	69.833
9				

Excel 2007

Pivot Table in Excel

Example data of class marks

- We want to find out the average for each section, and average for the gender.
- Pivot table does this for us automatically

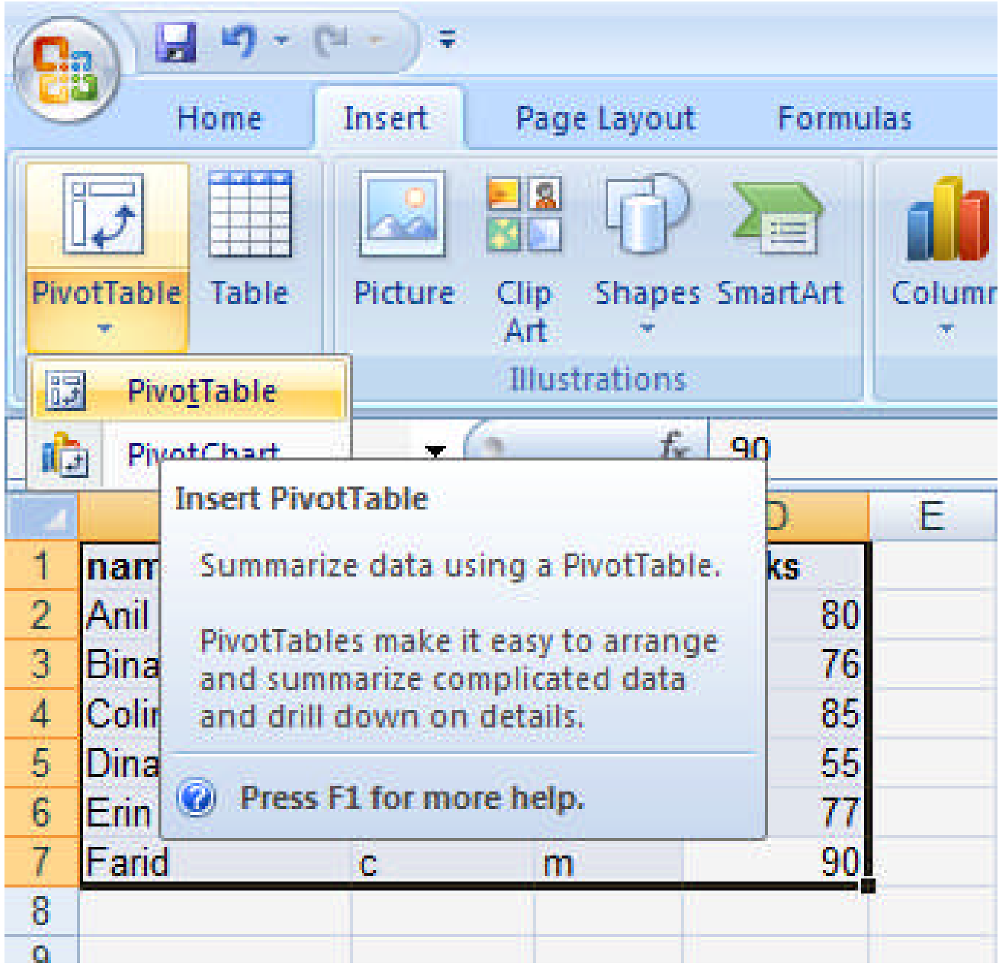
	A	B	C	D
1	**name**	**section**	**gender**	**marks**
2	Anil	a	m	80
3	Bina	a	f	76
4	Colins	b	m	85
5	Dina	b	f	55
6	Erin	c	f	77
7	Farid	c	m	90

Excel 2007 Pivot table

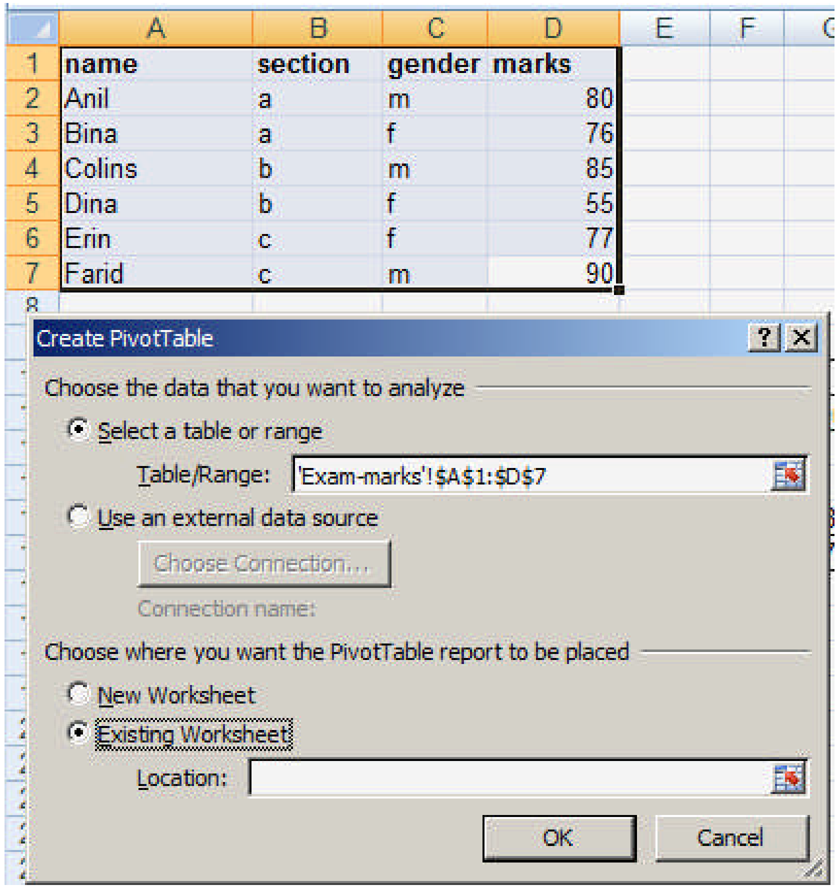
Exercise: Enter this data

	A	B	C	D
1	**name**	**section**	**gender**	**marks**
2	Anil	a	m	80
3	Bina	a	f	76
4	Colins	b	m	85
5	Dina	b	f	55
6	Erin	c	f	77
7	Farid	c	m	90

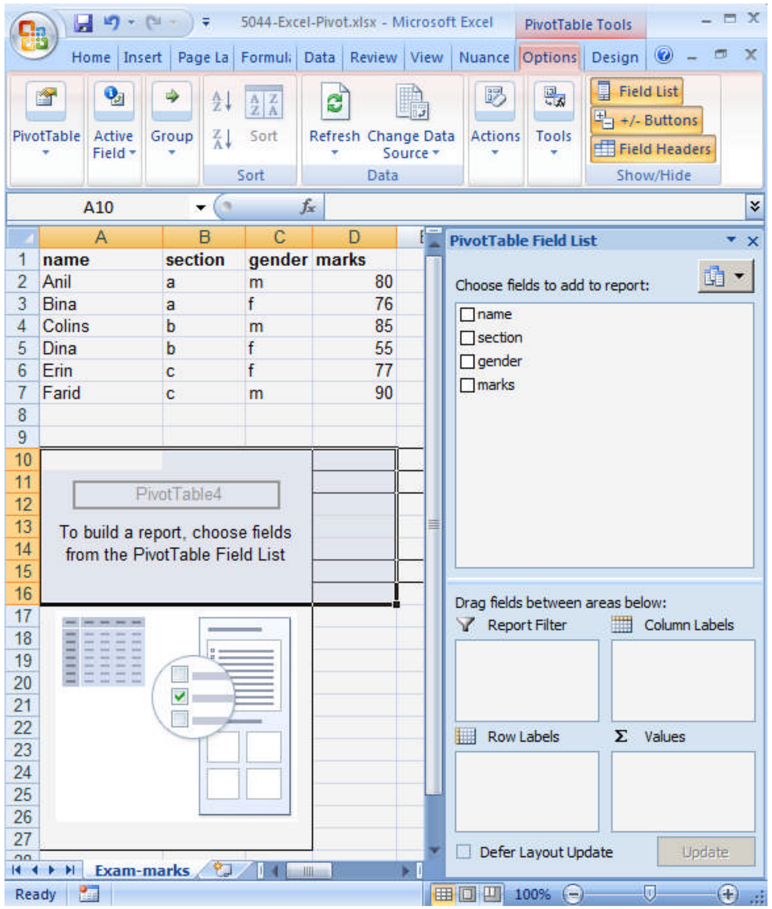
Select data and Insert > Pivot Table



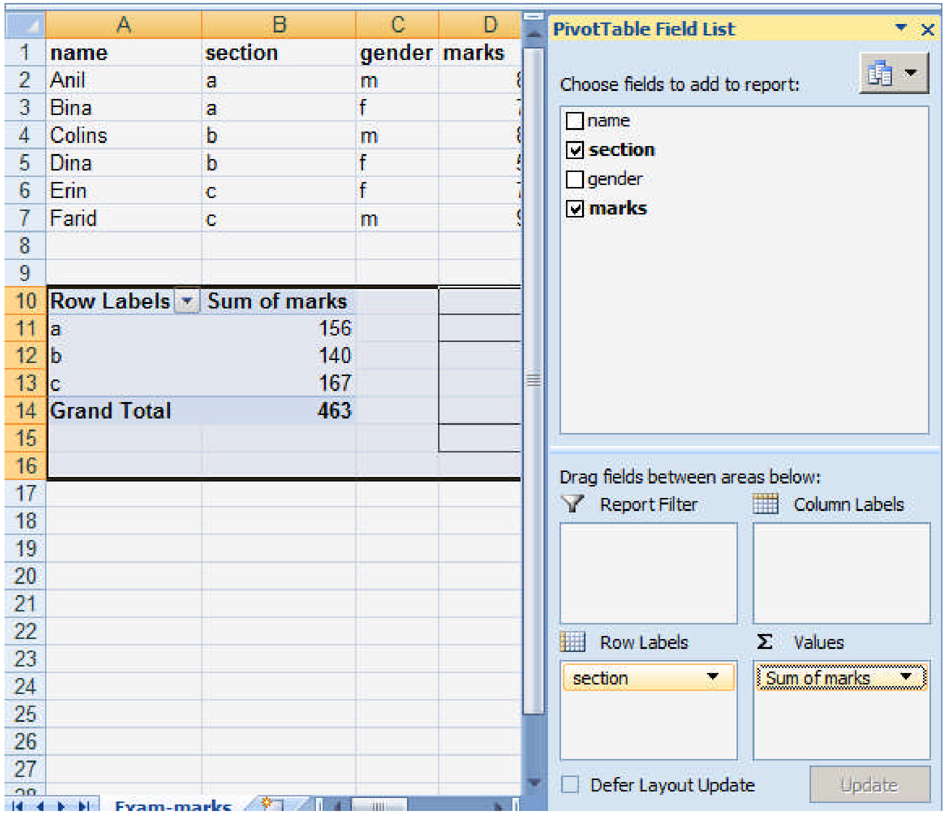
Create Pivot Table



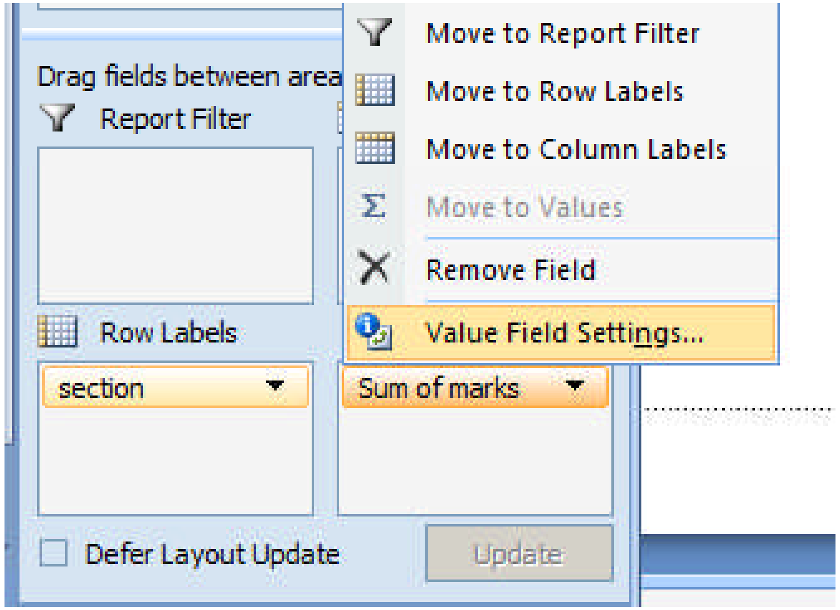
Blank Pivot table

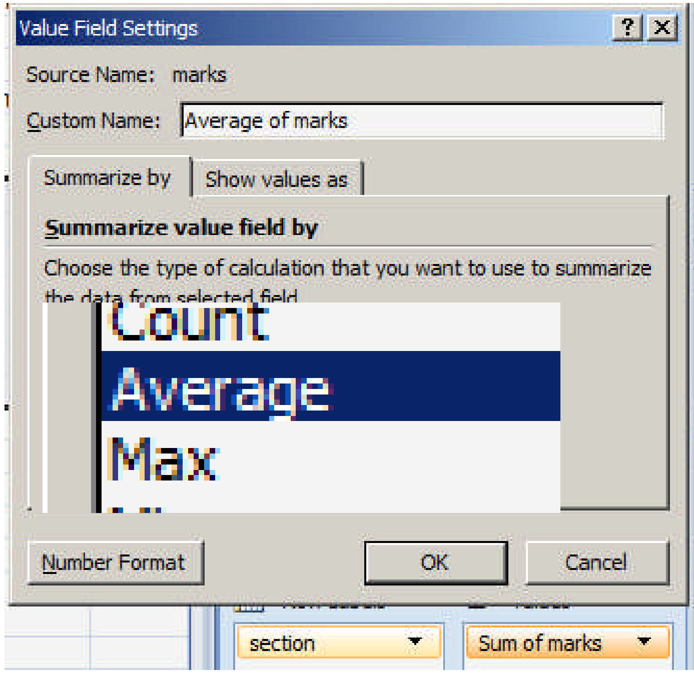


Select Section and Gender

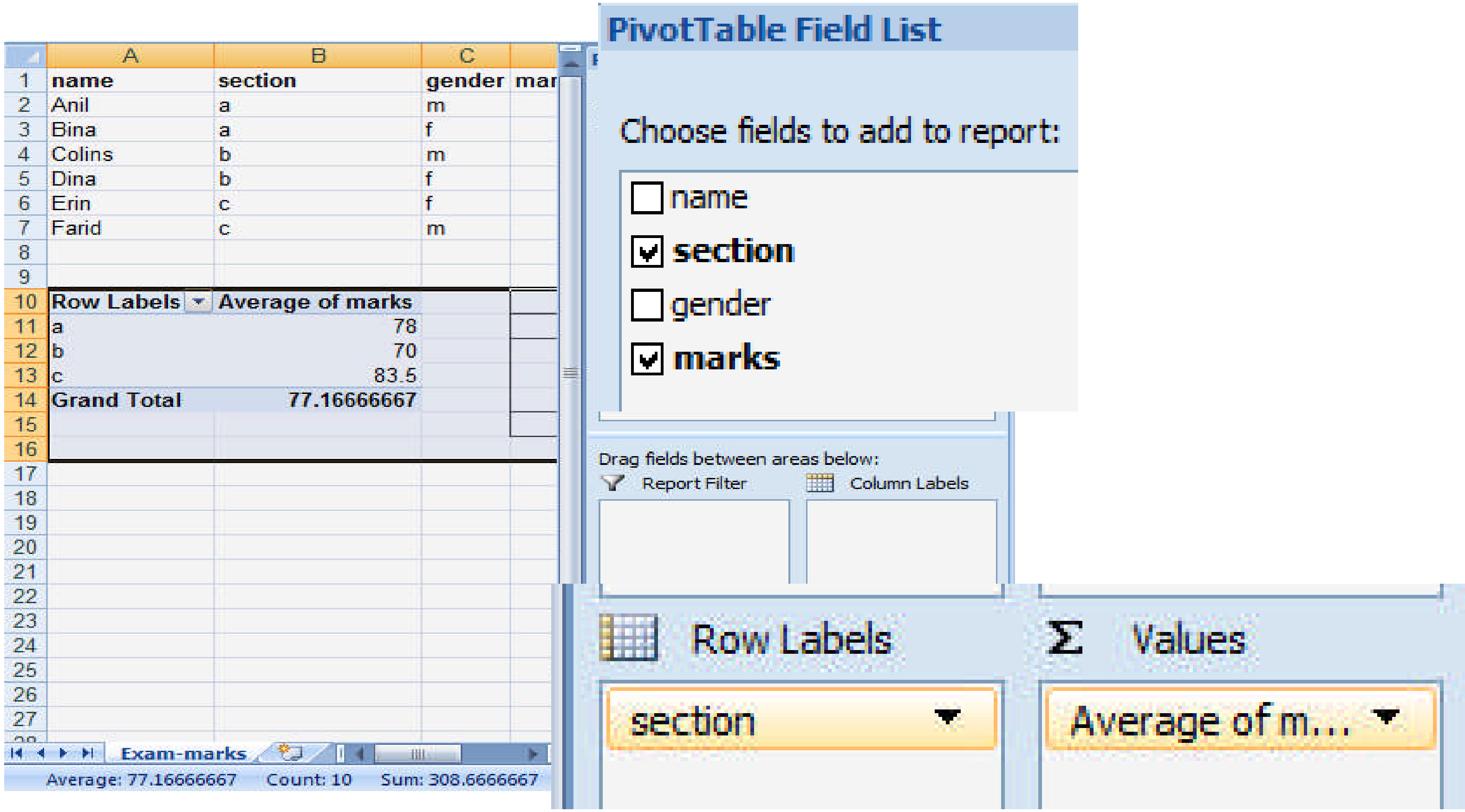


Change “sum of marks” > value field settings > change ‘sum’ to ‘Average’

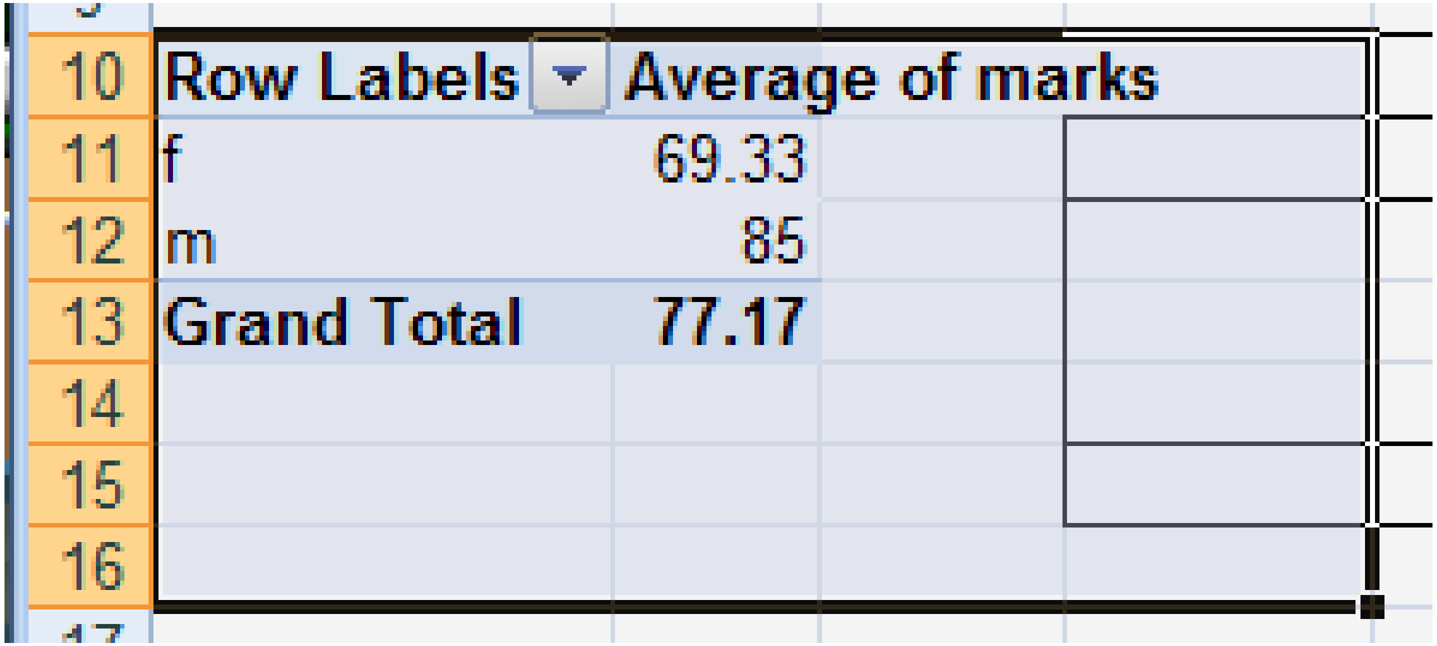




Pivot table for average marks by section



Exercise: Make the pivot table for average by gender



Row Labels	Average of marks
f	69.33
m	85
Grand Total	**77.17**

Excel 2007

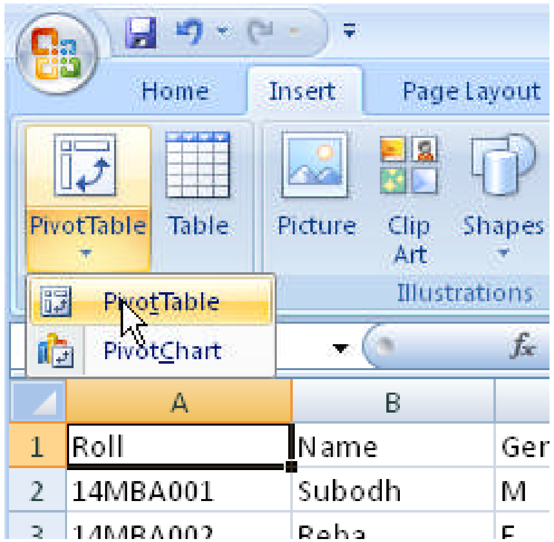
Histogram of Marksheet using Pivot Table

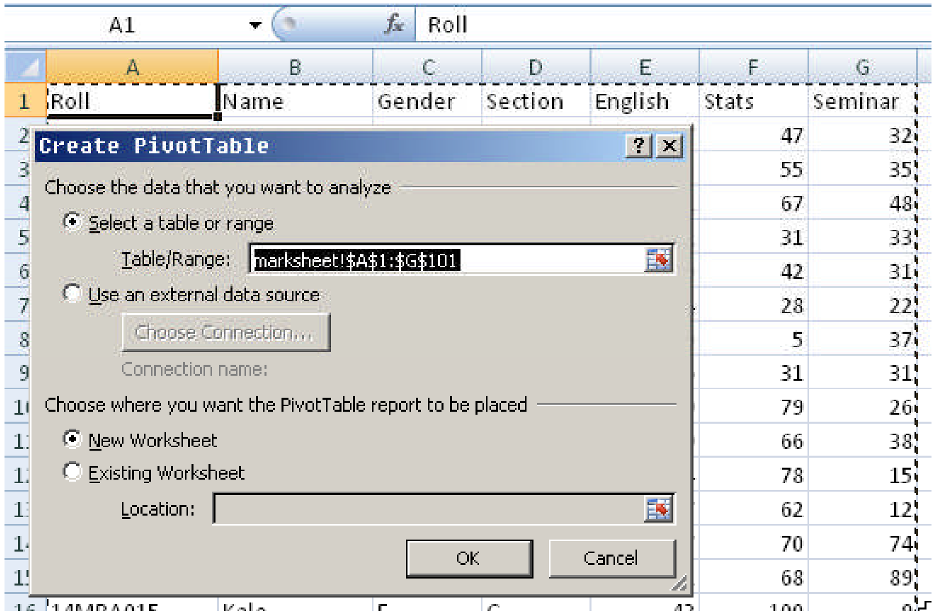
Histogram

1. File > open > marksheet.csv

	A	B	C	D	E	F	G
1	Roll	Name	Gender	Section	English	Stats	Seminar
2	14MBA001	Subodh	M	C	77	47	32
3	14MBA002	Reba	F	C	5	55	35
4	14MBA003	Mayekar	M	A	11	67	48
5	14MBA004	Kushwaha	M	C	52	31	33
6	14MBA005	Narain	M	C	100	42	31
7	14MBA006	Bhadriraju	M	C	64	28	22
8	14MBA007	Magesh	M	C	50	5	37
9	14MBA008	Naimish	M	C	46	31	31
10	14MBA009	Preetish	F	C	39	79	26
11	14MBA010	Karanam	M	B	39	66	38
12	14MBA011	Lal	F	C	34	78	15

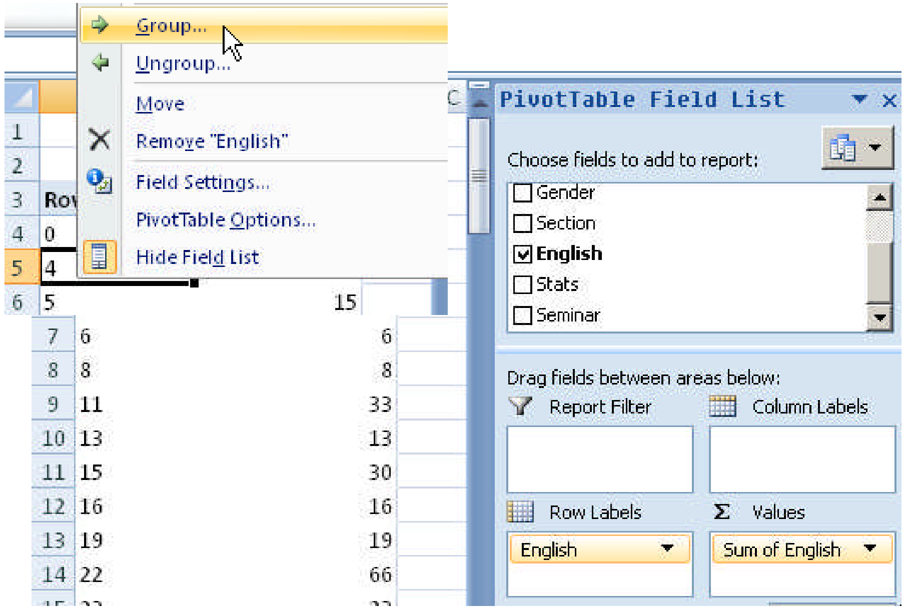
Insert > Pivot Table

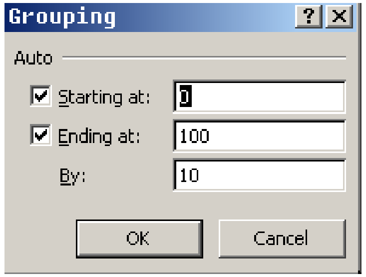




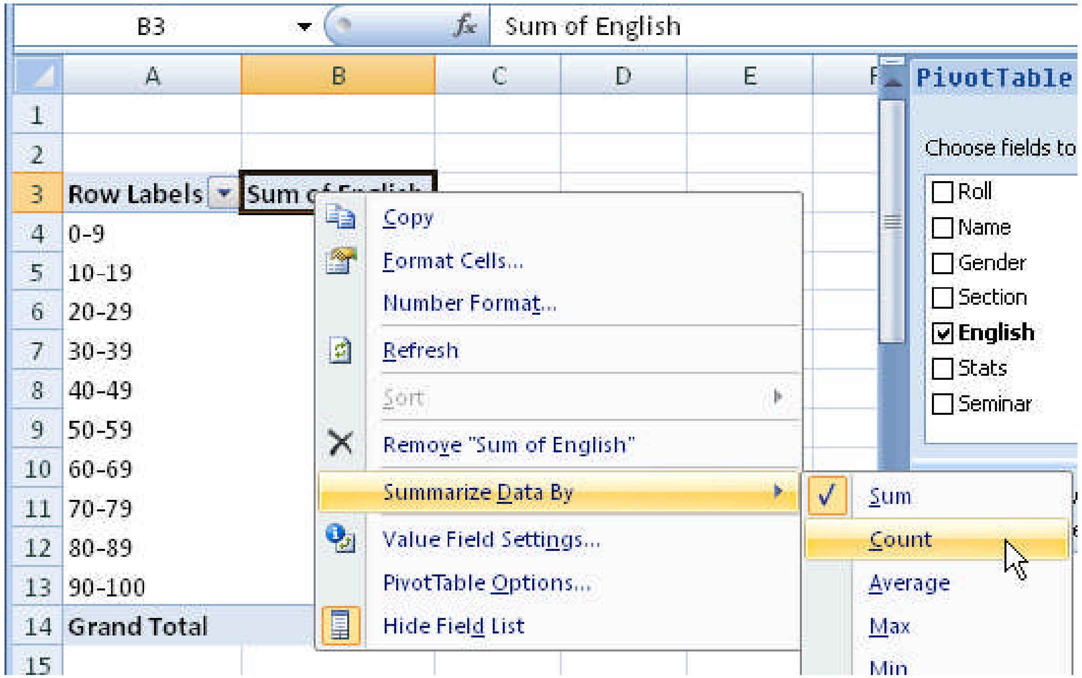
Group the data into Histogram

1. Select English & Sum English(for row values and Sum), you get a table.
2 In the table on any row, Right click > Group
3. Grouping 0 to 100, by 10 (se we get 0,10,20,30,..,100).





Right click and Summarize change *Sum* to *Count*



You get a histogram of distribution of English marks

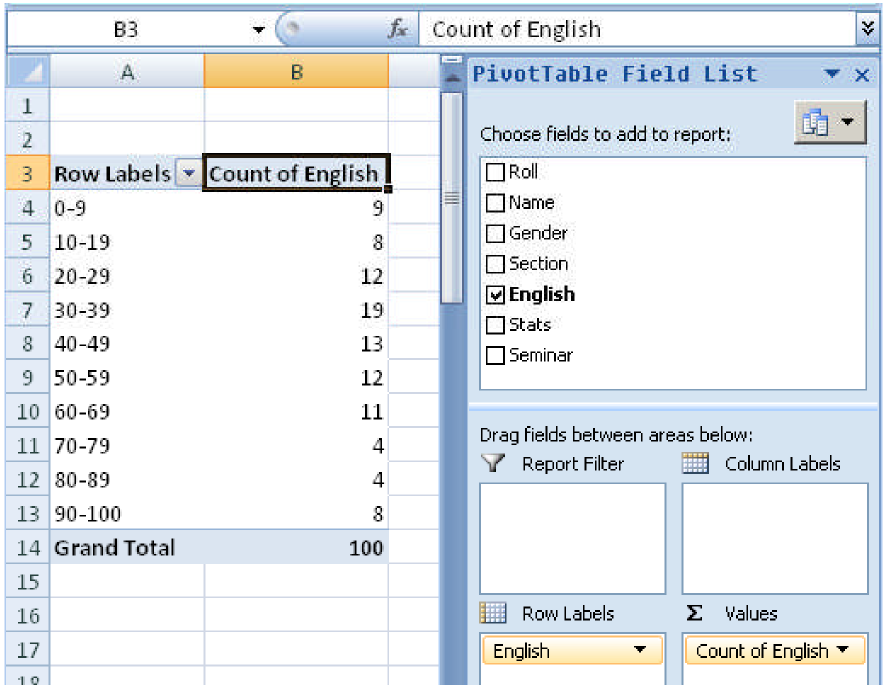
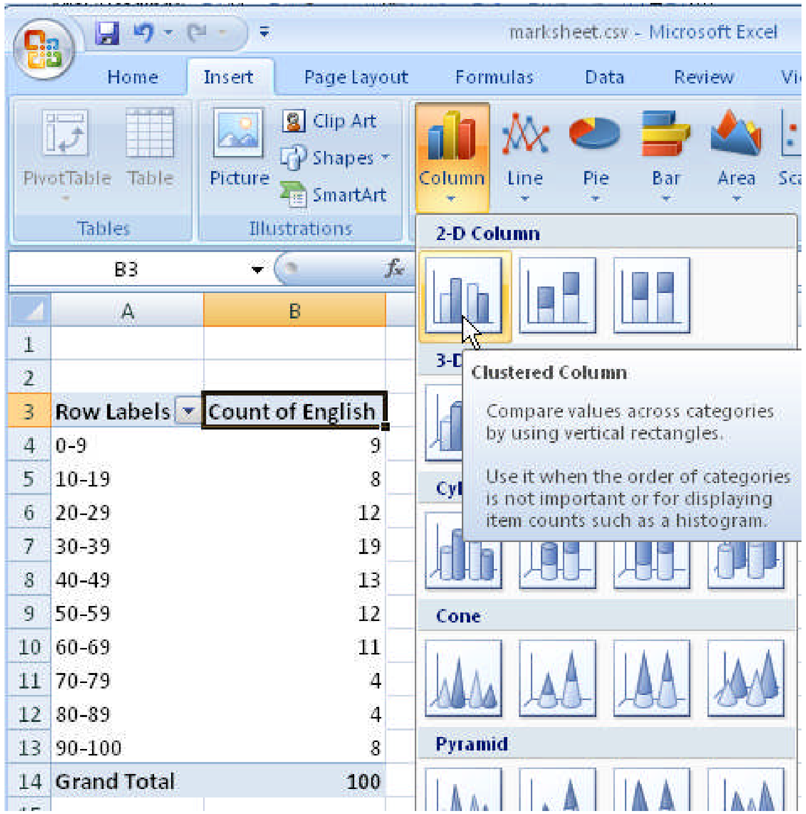
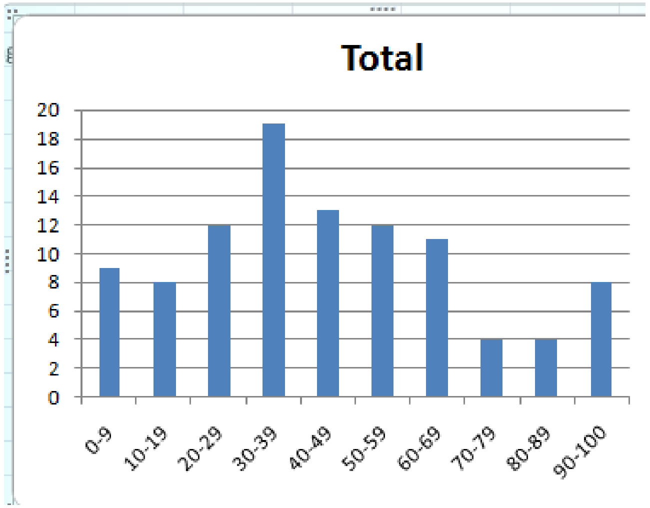


Table to Histogram
Insert > Column > 2D Column





Exercise: Find Averages for each section and gender

D4 | Average of Seminar

Row Labels	Average of English	Average of Stats	Average of Seminar
A	**51.44**	**68.96**	**48.96**
F	65.78571429	66.64285714	60.21428571
M	33.18181818	71.90909091	34.63636364
B	**31.62962963**	**51.85185185**	**55.44444444**
F	26.14285714	32.71428571	78.78571429
M	37.53846154	72.46153846	30.30769231
C	**48.72916667**	**53.41666667**	**30.8125**
F	29.08695652	81.60869565	31.65217391
M	66.8	27.48	30.04
Grand Total	**44.79**	**56.88**	**42**

PivotTable Field List

Choose fields to add to report:

- ☐ Roll
- ☐ Name
- ☑ **Gender**
- ☑ **Section**
- ☑ **English**
- ☑ **Stats**
- ☑ **Seminar**

Drag fields between areas below:

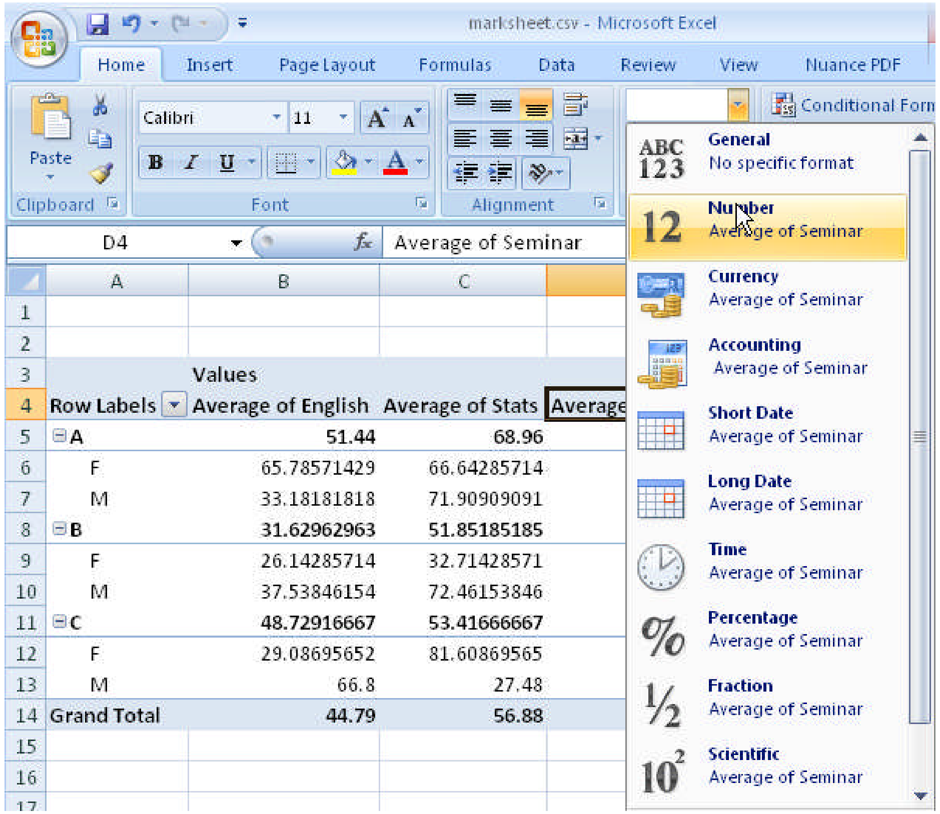
Report Filter

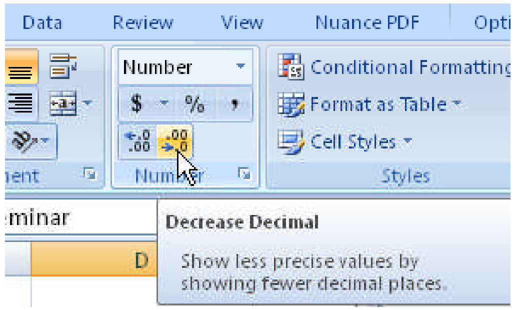
Column Labels: Σ Values

Row Labels: Section, Gender

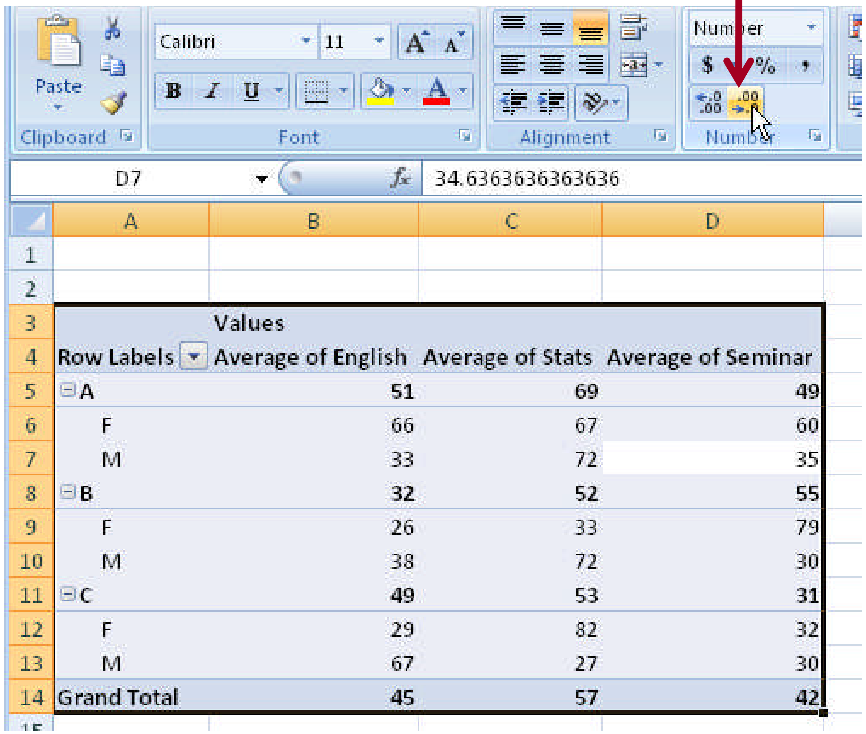
Σ Values: Average of English, Average of Stats, Average of Seminar

Make numbers easier to read





Select All (C-a) and
click on >.00 till
all the decimals vanish



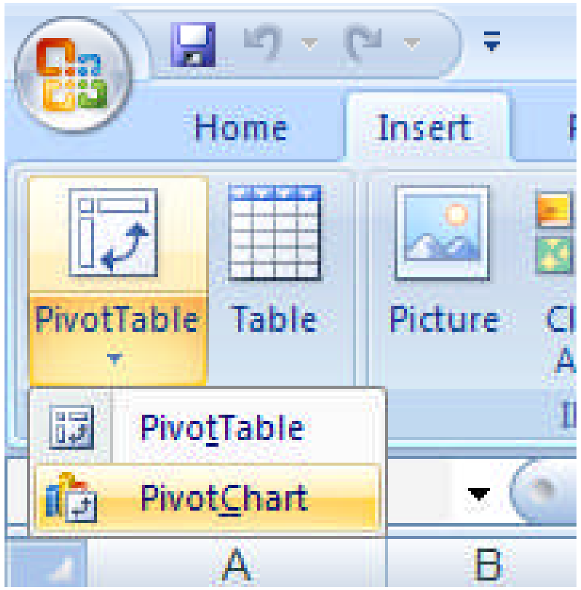
	A	B	C	D
1				
2				
3		Values		
4	Row Labels	Average of English	Average of Stats	Average of Seminar
5	⊟A	51	69	49
6	F	66	67	60
7	M	33	72	35
8	⊟B	32	52	55
9	F	26	33	79
10	M	38	72	30
11	⊟C	49	53	31
12	F	29	82	32
13	M	67	27	30
14	Grand Total	45	57	42

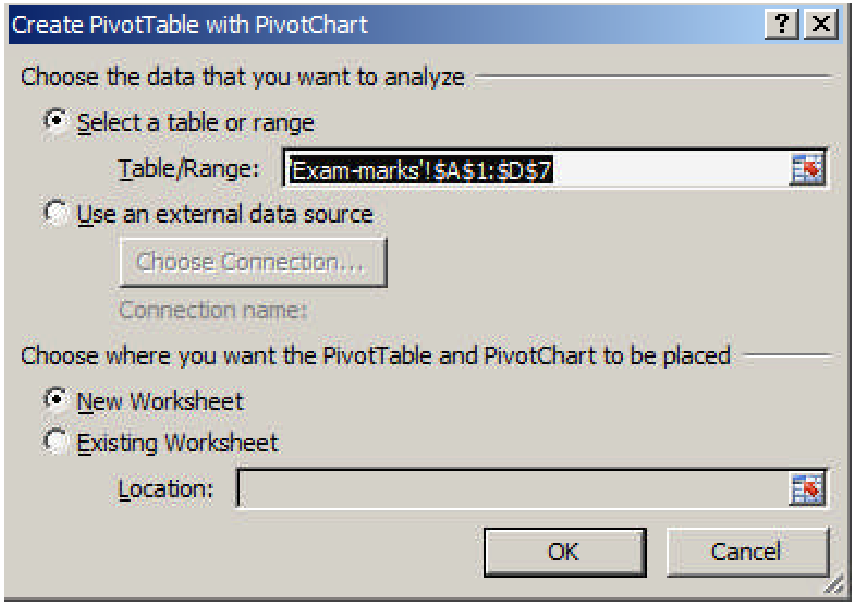
Excel 2007

Pivot Chart
in Excel

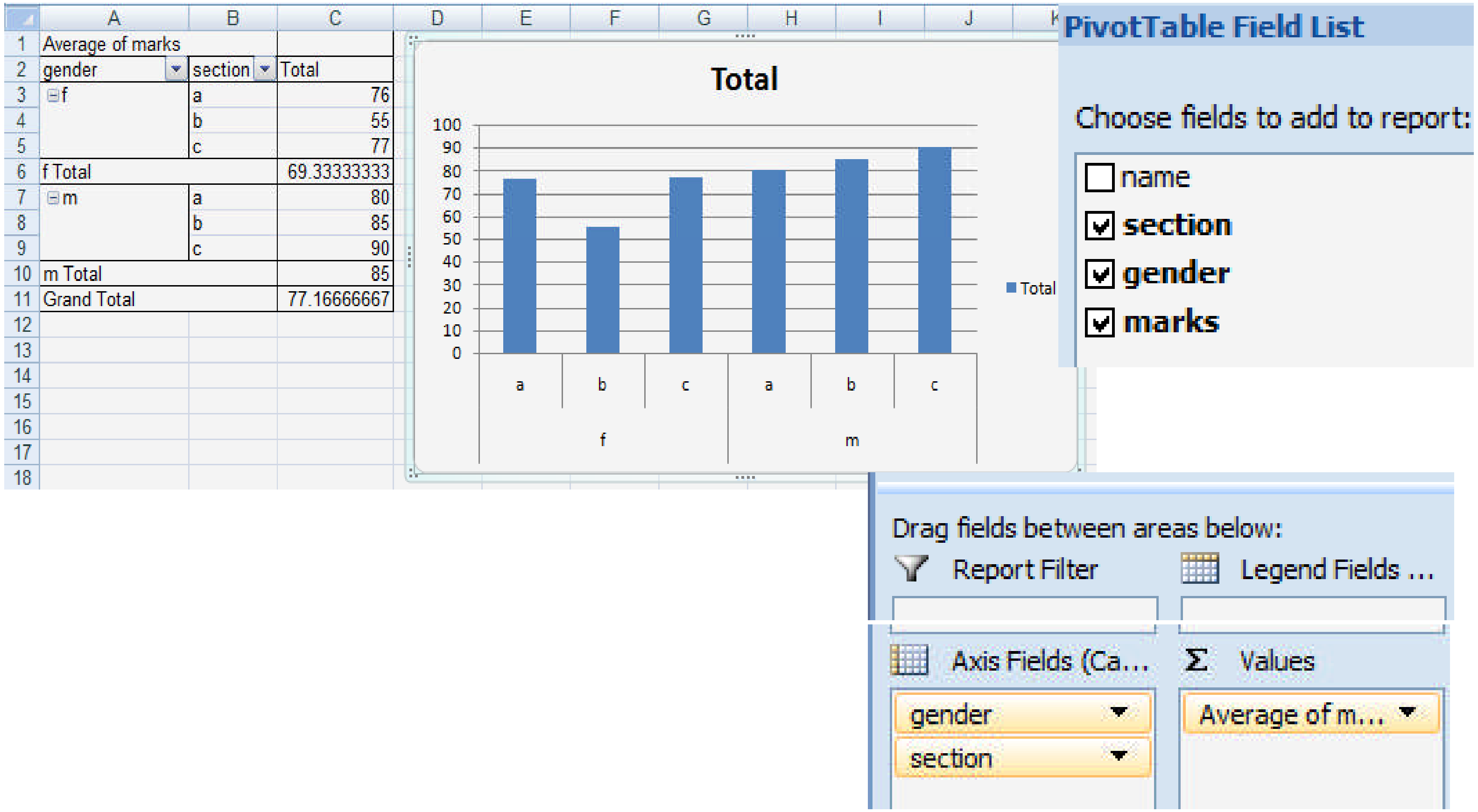
Pivot Chart

Select Data > Insert > Pivot > PivotChart > NewWorksheet > OK





Pivot Chart to Make



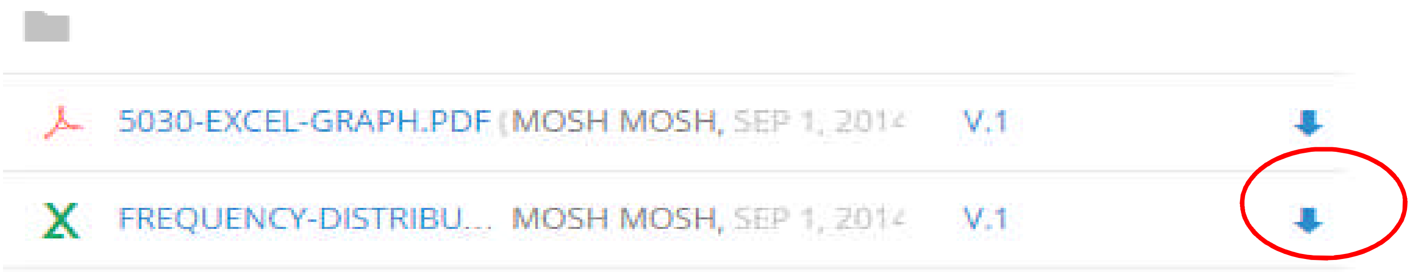
Pivot table for sales data

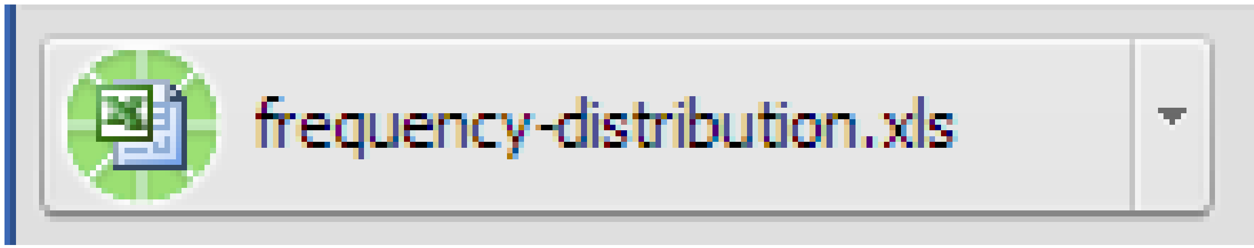
- Google > JKSHIM Critical Thinking

Download the xls file

https://sites.google.com/site/jkshimcriticalthinking/excel

download the xls file, and open it in excel

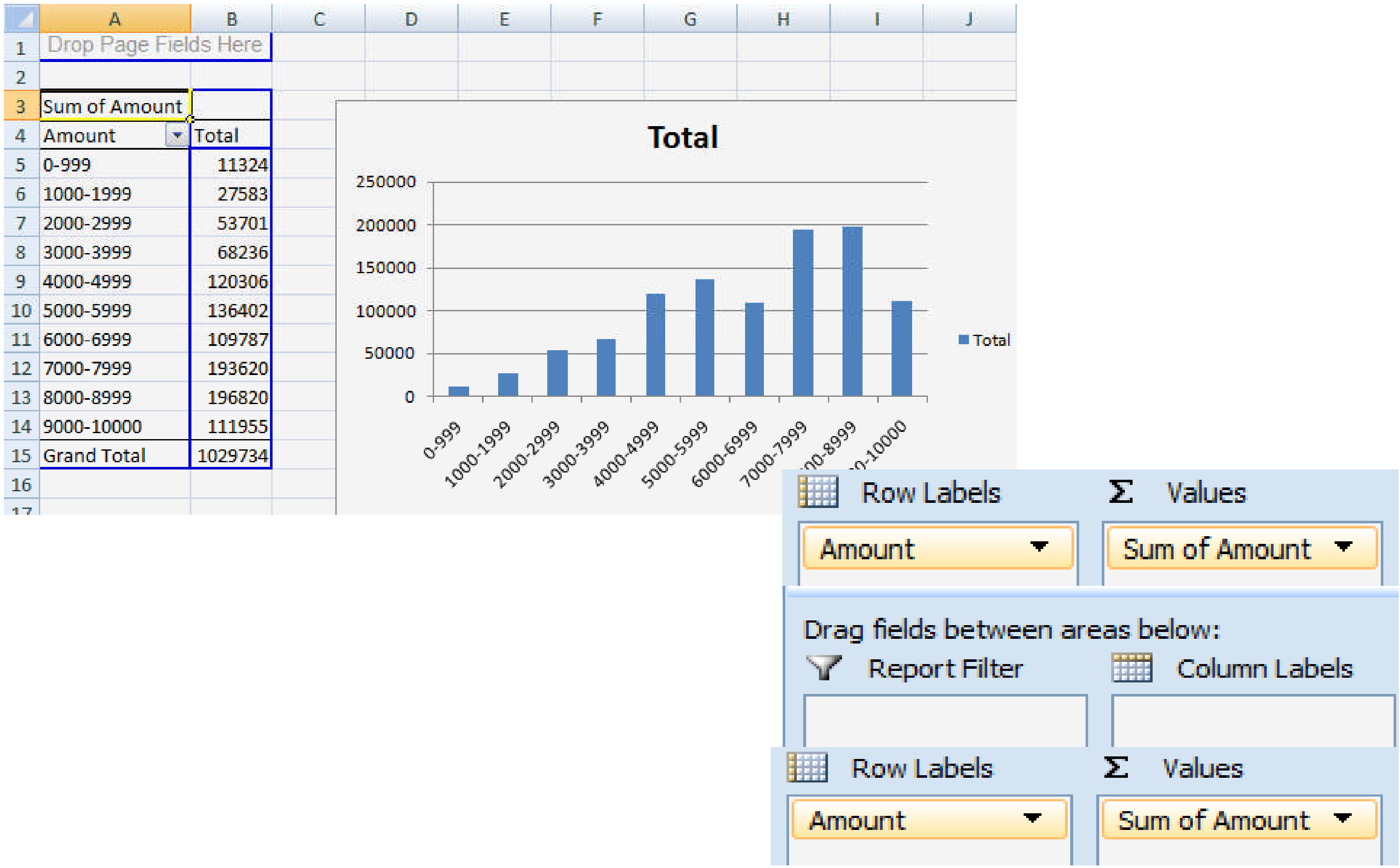




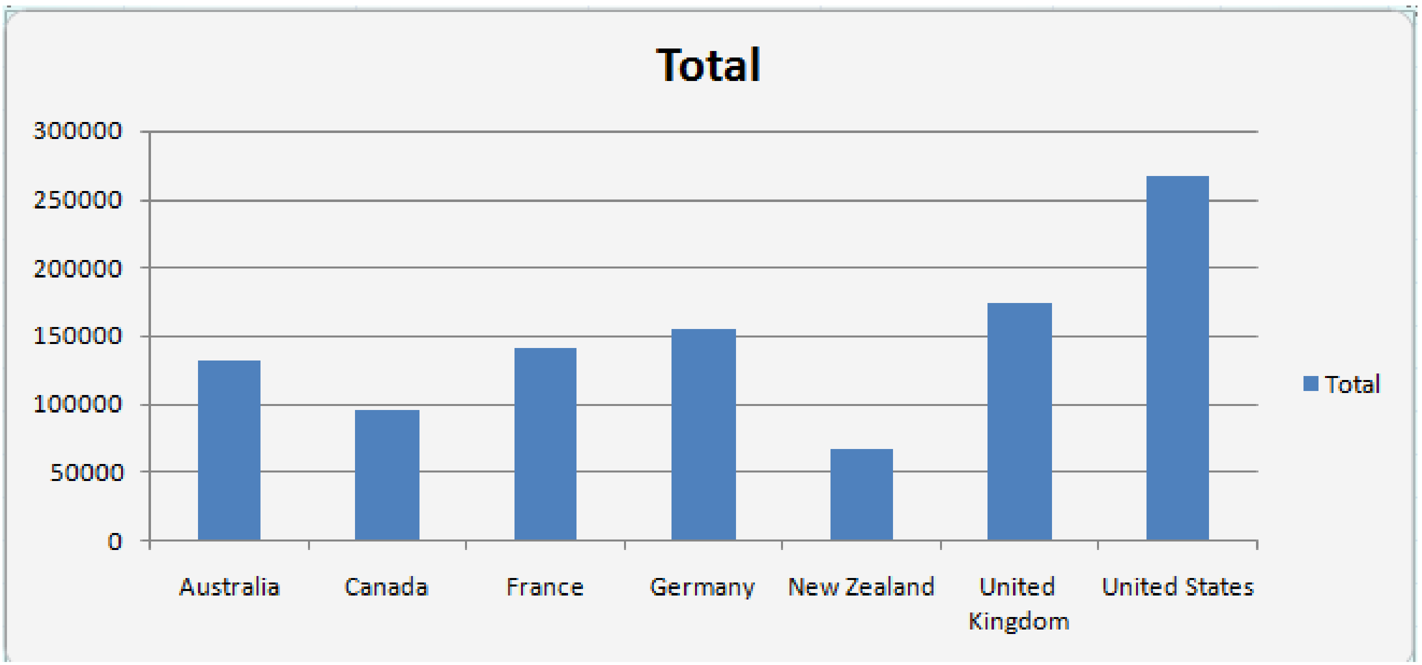
Open the pivot-table sheet

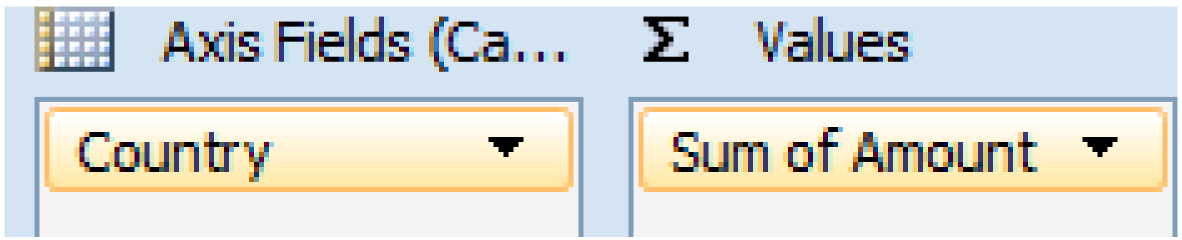
Order ID	Product	Category	Amount	Date	Country
1	Carrots	Vegetables	$4,270	1/6/2012	United States
2	Broccoli	Vegetables	$8,239	1/7/2012	United Kingdom
3	Banana	Fruit	$617	1/8/2012	United States
4	Banana	Fruit	$8,384	1/10/2012	Canada
5	Beans	Vegetables	$2,626	1/10/2012	Germany
6	Orange	Fruit	$3,610	1/11/2012	United States
7	Broccoli	Vegetables	$9,062	1/11/2012	Australia
8	Banana	Fruit	$6,906	1/16/2012	New Zealand
9	Apple	Fruit	$2,417	1/16/2012	France
10	Apple	Fruit	$7,431	1/16/2012	Canada
11	Banana	Fruit	$8,250	1/16/2012	Germany

Pivot chart 1

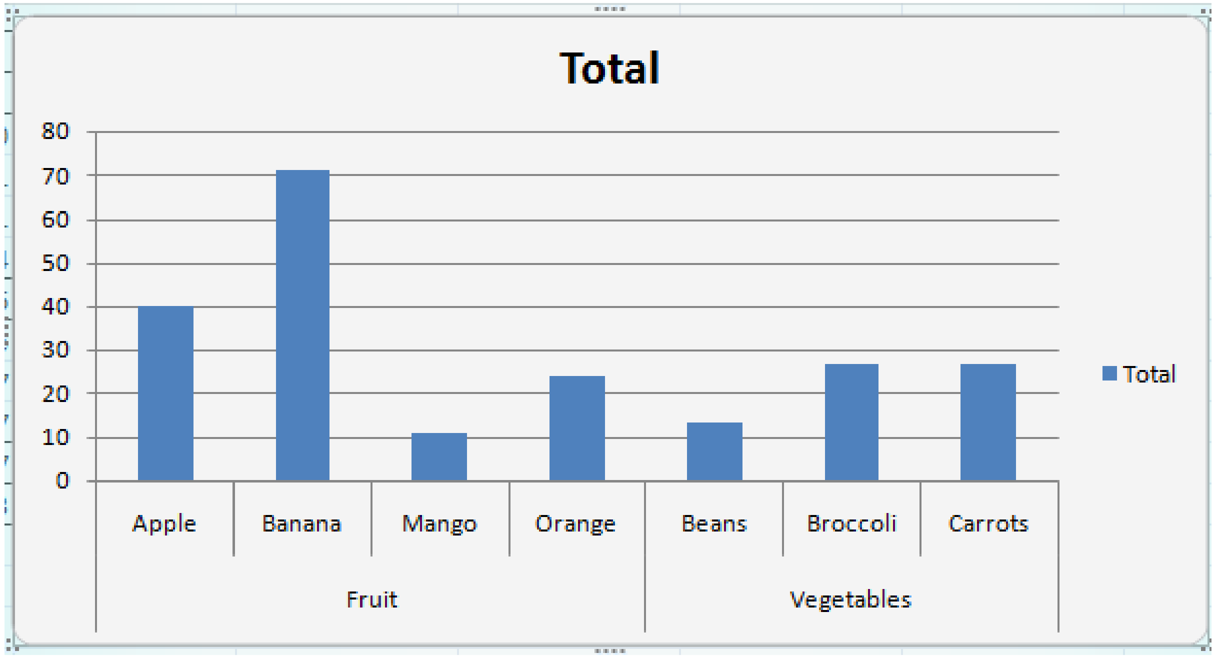


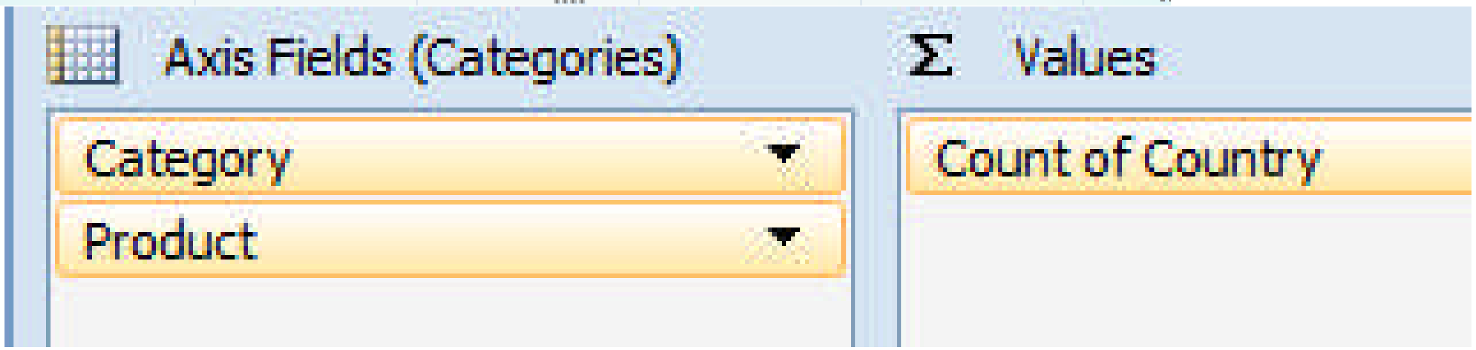
Make this pivot chart 2



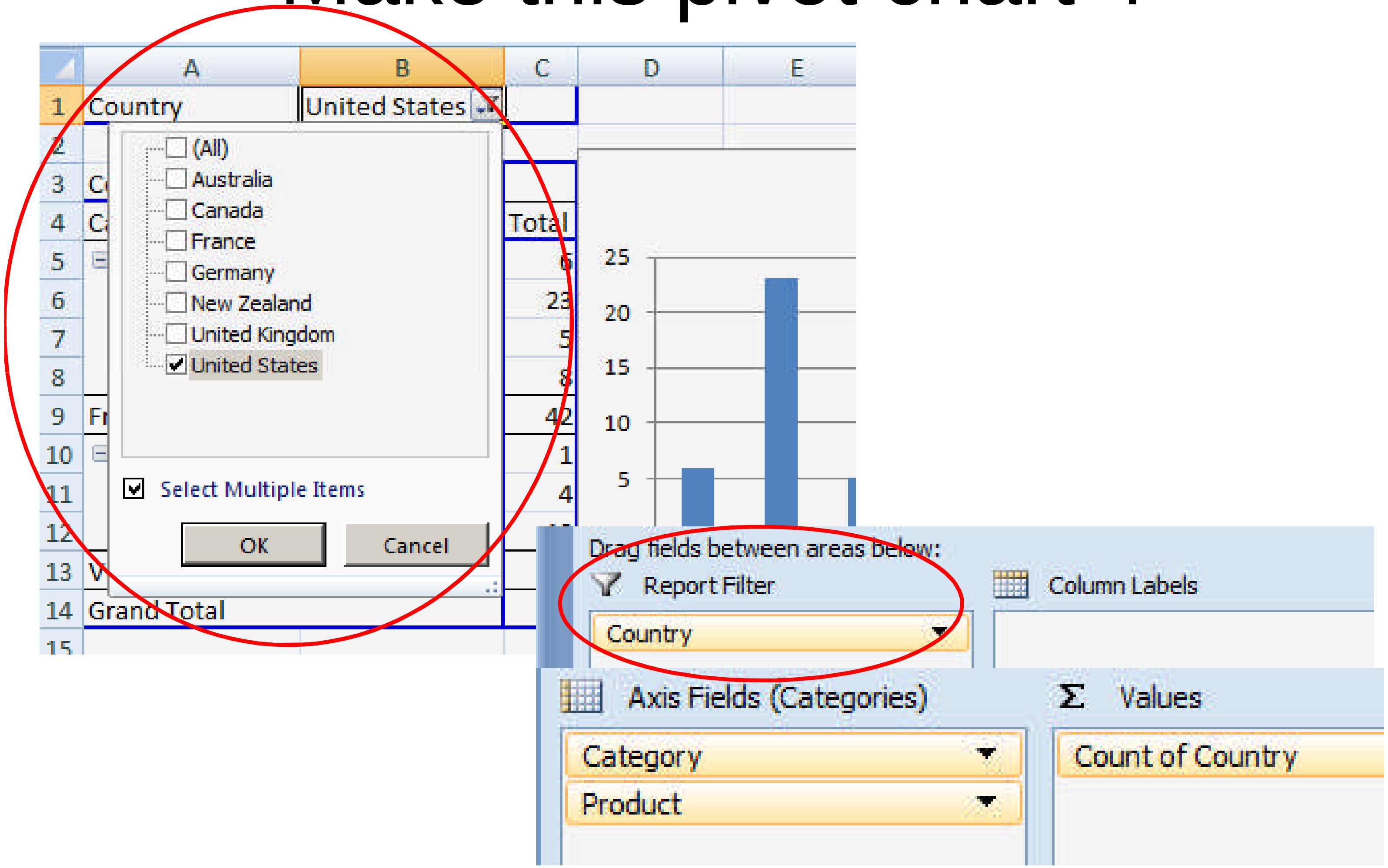


Make this pivot chart 3





Make this pivot chart 4

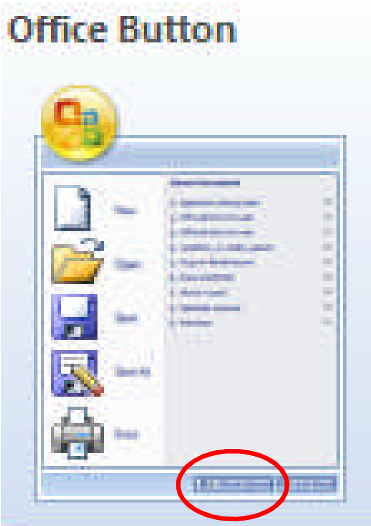


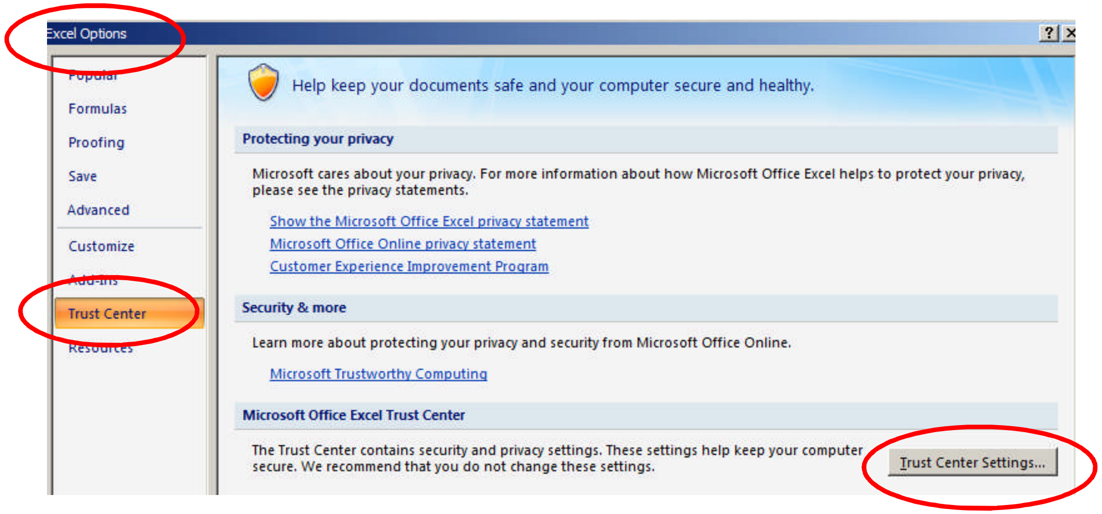
Microsoft Office
Excel 2007

Excel Macros

Macros

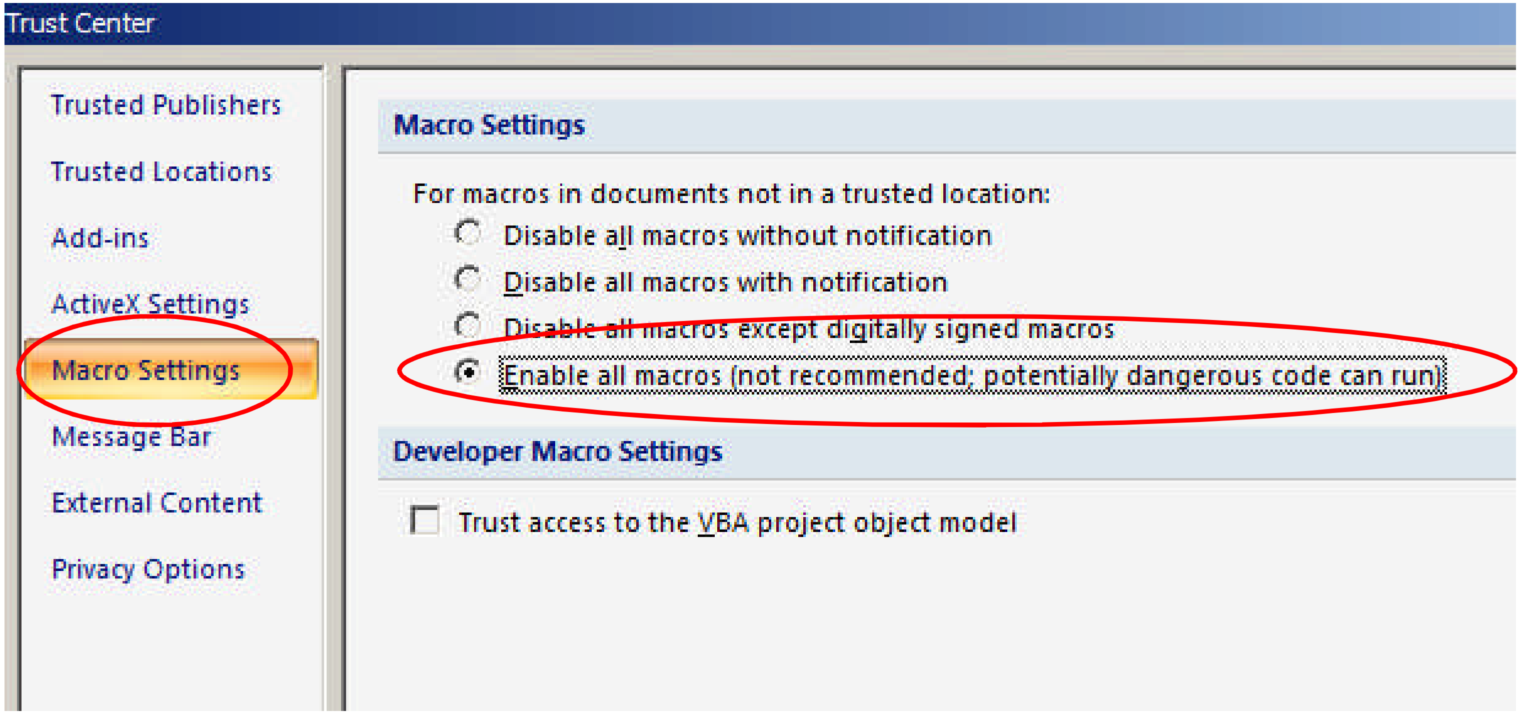
- Macros are disabled because of viruses can get into Excel.
- Office > Excel Options > Trust center > Trust center settings.





Enabling macros

- Office > options > Trust Center > Trust Center Settings > Macro settings

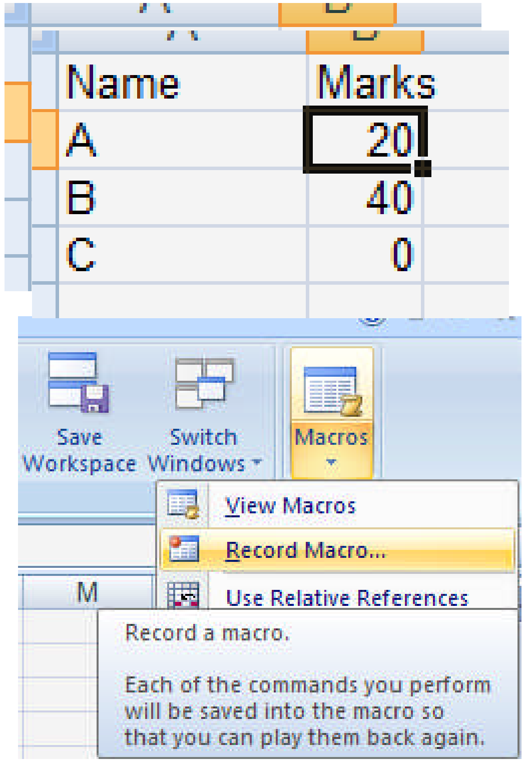


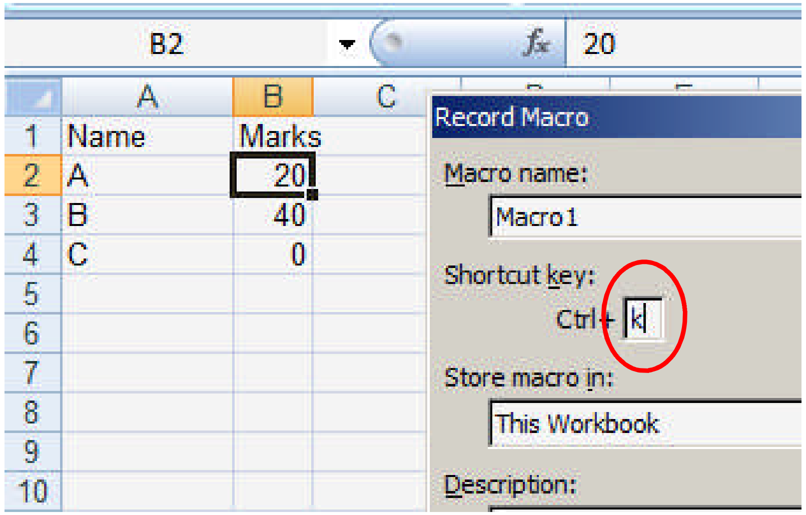
Create some data

	A	B
1	Name	Marks
2	A	20
3	B	40
4	C	0

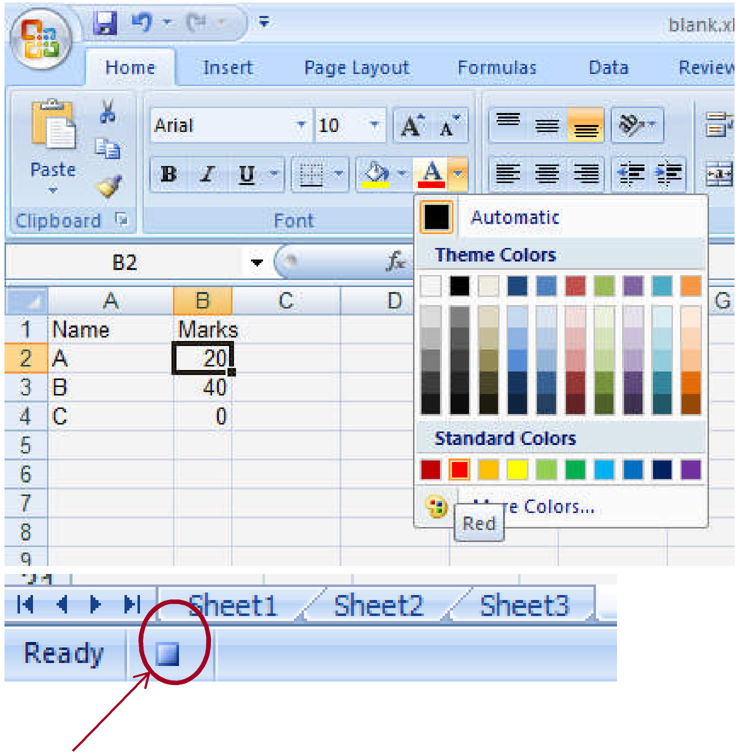
View > Macro > Record Macro

Select a cell to edit and record a macro:
Specify [Control-K] as the shortcut key to run this macro.





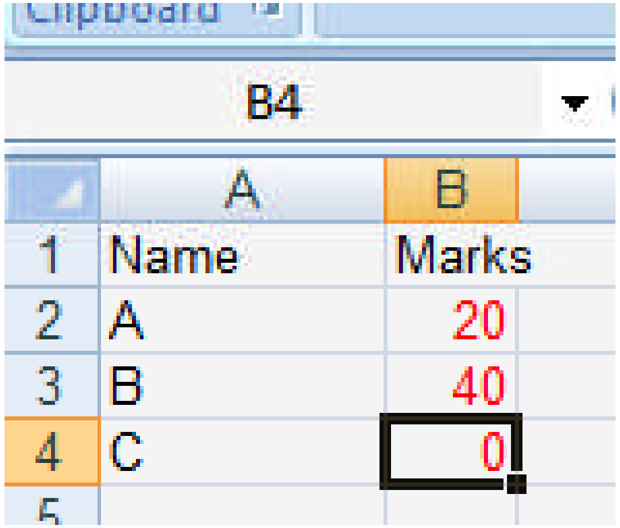
Make a number "RED" and then stop recording



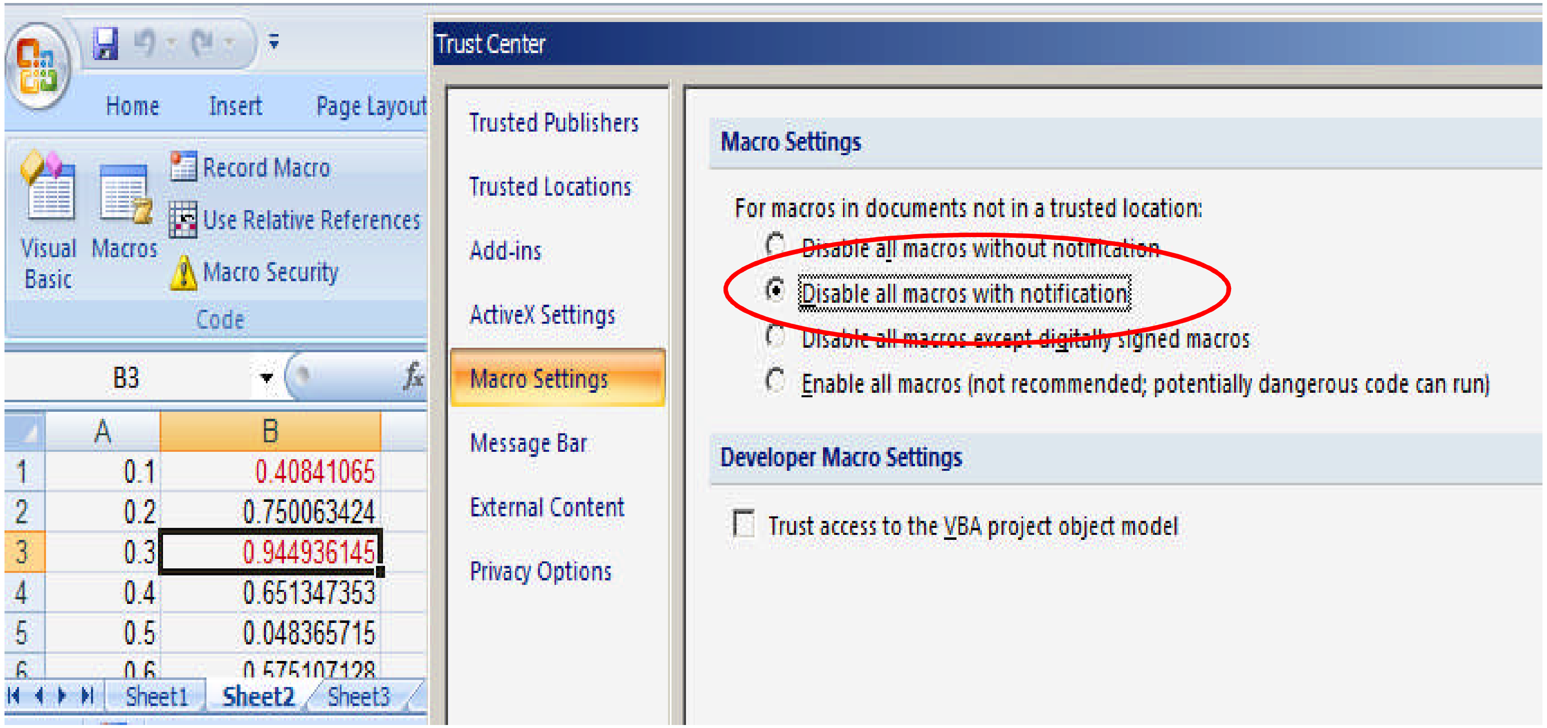
Macro "Stop Recording button"

Use the macro

- Go to another cell and press Control-K, it should also become Red



view > Macro Settings > Disable all macros with notification (to prevent viruses)



Microsoft Office
Excel 2003/2007

Excel Extra Topics
VLookUp

Vertical Lookup across tables

Exercise: create this data

	A	B
1	name	marks
2	Anil	90
3	Ball	40
4	Cat	0

vlookup syntax

=vlookup(key, matrix, value_col, exact)

- Finds *key* in column 0 of matrix and returns corresponding value from matrix.
- e.g. Finds *matrix[0][key]* using *exact* match and returns *matrix[value_col][key]*
- Limitations: key column must be before value column. Otherwise modify matrix columns.
- Better if Excel would let us specify both columns numbers: key and value:

  =vlookup(key, matrix, key_col, val_col, exact)

  Not possible in Excel, so use R

Example: vlookup Anil’s marks

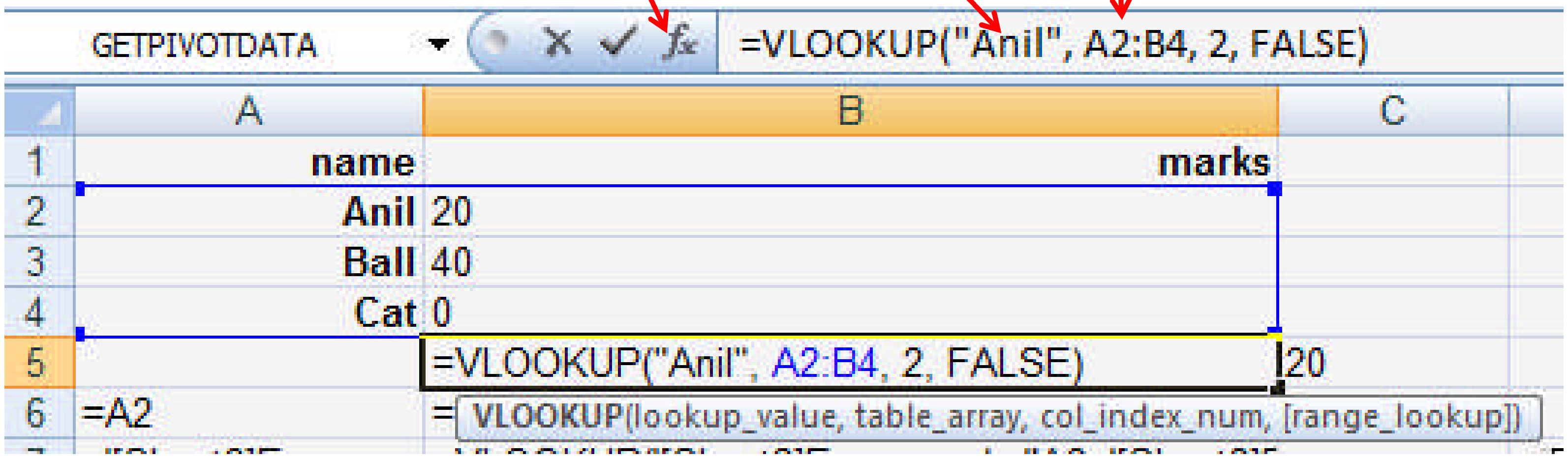
In B5, click on fx and type

‘=vlookup(“Anil”, A2:B4, 2, FALSE)’

To vlookup marks of "*Anil"* in the matrix *A2:B4*,

get the marks from the 2nd column of matrix

and lastly 'FALSE' for exact match.



Uses of vlookup?

- Merge two sheets by common column
- Example: Copy marks of Subject1 and Subject2 into MarksCard, merge using common roll number in all sheets (sql join):

  e.g. =vlookup(roll2, sheet2!Marks, 2, FALSE)’

Tips

- To vlookup arg2 in different file: arg2=[file.xls]sheet!cells
- Copy sheet into sheet with vlookup
- Copy and paste 'special values' to convert formula into numbers across files.

Another example: hourly rate

Hourly Pay:

	A	B
1	**Employee Name**	**Hourly Rate**
2	Atkins, James	$35.50
3	Benn, Carol	$25.00
4	Benson, Paul	$32.00
5	Cooper, David	$28.50
6	Daley, Ann	$41.00
7	Dawson, Helen	$32.00
8	⋮	⋮

Sales Team Hours Worked:

	A	B	C	D
1	**Employee Name**	**Hours Worked**	**Hourly Rate**	**Payment Due**
2	Benson, Paul	37.5		
3	Cooper, David	40		
4	Dawson, Helen	39		
5	Evans, Robin	25		
6	Gee, Louise	38		
7	Jones, Michael	20		
8	⋮	⋮		

Sales Team Hours Worked with Vlookup Functions:

	A	B	C	D	E
1	**Employee Name**	**Hours Worked**	**Hourly Rate**	**Payment Due**	
2	Benson, Paul	37.5	=VLOOKUP(A2, 'Hourly Pay'!A:B, 2, FALSE)		
3	Cooper, David	40	=VLOOKUP(A3, 'Hourly Pay'!A:B, 2, FALSE)		
4	Dawson, Helen	39	=VLOOKUP(A4, 'Hourly Pay'!A:B, 2, FALSE)		
5	⋮	⋮	⋮		

Vlookup Example Explained

The first call to the Vlookup function, in C2 is:

=VLOOKUP(A2, 'Hourly Pay'!A:B, 2, FALSE)

The table below explains the arguments that are supplied to this function:

A2	-	Cell A2 is the lookup_value (i.e. the value to be searched for). The lookup_value is therefore the text string "Benson, Paul".
'Hourly Pay'!A:B	-	The table_array is made up of columns A-B of the "Hourly Pay" spreadsheet. The Vlookup function will search down the leftmost column (i.e. column A) of this array, when searching for the text string "Benson, Paul".
2	-	This argument tells the function that the value to be returned should be taken from column 2 of the supplied table_array (i.e. from column B of the "Hourly Pay" spreadsheet).
FALSE	-	This tells the Vlookup function that we require an exact match to the lookup_value. If an exact match is not found, then the Vlookup function should return an error.

From: http://www.excelfunctions.net/Vlookup-Example-Closest-Match.html

Nearest match example

Interest Rates:

	A	B	C
1	**Lower Balance**	**Upper Balance**	**Interest Rate**
2	$0.00	$999.99	2%
3	$1,000.00	$4,999.99	3%
4	$5,000.00	$19,999.99	4%
5	$20,000.00		5%

1 2 3

Bank Accounts:

	A	B	C
1	**Bank Account**	**Balance**	**Interest Rate**
2	ABC-12345678	$5.69	
3	DEF-23456789	$55,220.00	
4	GHI-34567890	$4,500.00	
5	⋮	⋮	

Bank Accounts spreadsheet with Vlookup functions:

	A	B	C	D	E	F
1	**Bank Account**	**Balance**	**Interest Rate**			
2	ABC-12345678	$5.69	=VLOOKUP(B2, 'Interest Rates'!A2:C5, 3, TRUE)			
3	DEF-23456789	$55,220.00	=VLOOKUP(B3, 'Interest Rates'!A2:C5, 3, TRUE)			
4	GHI-34567890	$4,500.00	=VLOOKUP(B4, 'Interest Rates'!A2:C5, 3, TRUE)			
5	⋮	⋮	⋮			

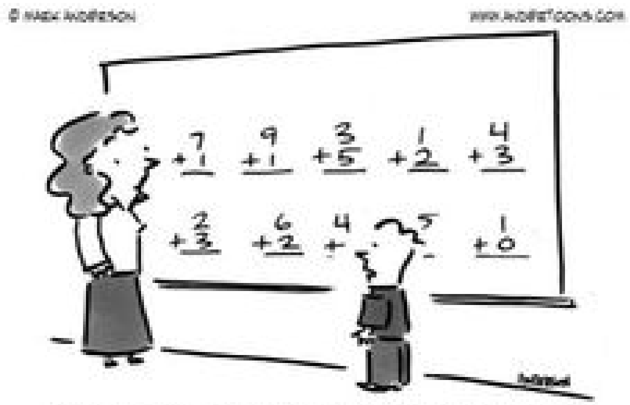
TRUE - Tells the Vlookup function that we require a closest match to the lookup_value.

I.e. if an exact match is not found, then use the closest value below the lookup_value.

Note that this value could have been omitted from the above formula as, by default, it takes on the value TRUE.

Microsoft Office
Excel 2003/2007

Advanced Statistics with Microsoft Excel



"All I'm saying is we plug these into Excel, let it do its thing, and then we can all play until lunch!"

Agenda

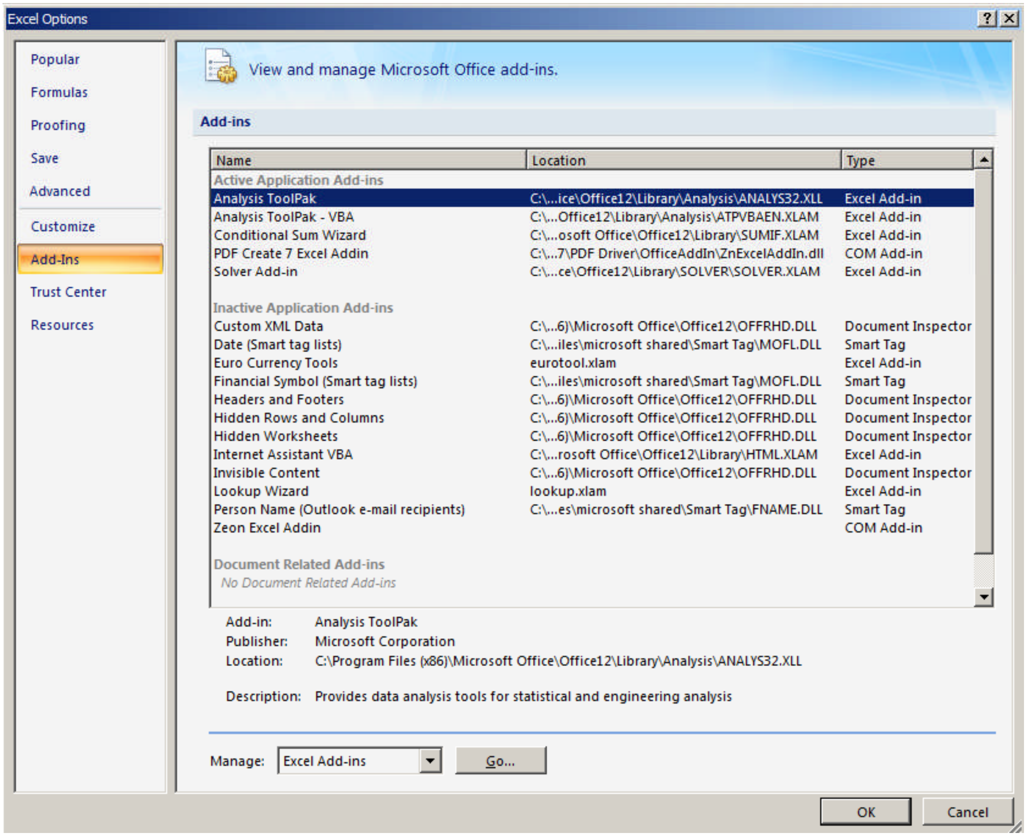
1. Install Addins
2. Descriptive statistics
3. Histogram of average with a chart
4. Frequency computation

Excel 2007: Install Addins

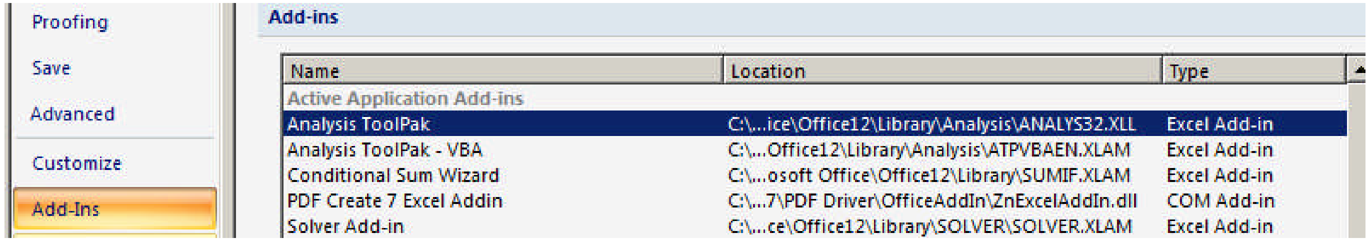
Office

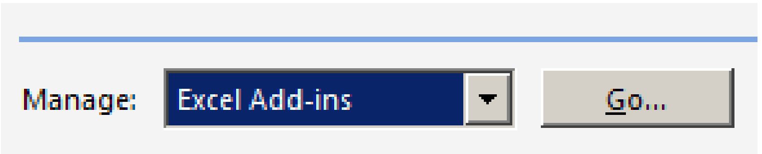
> Excel
  Options

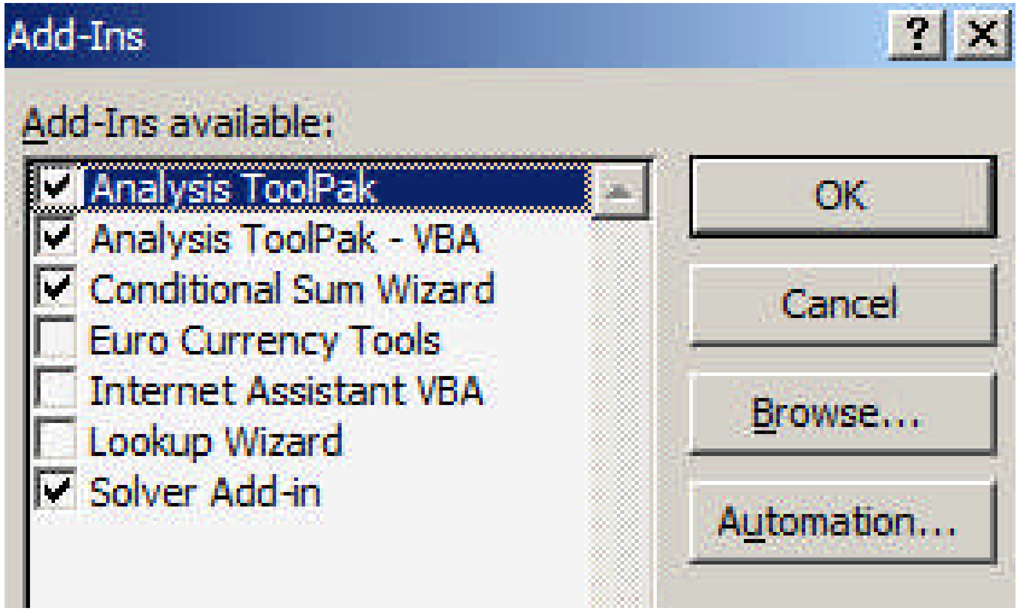
> Addins



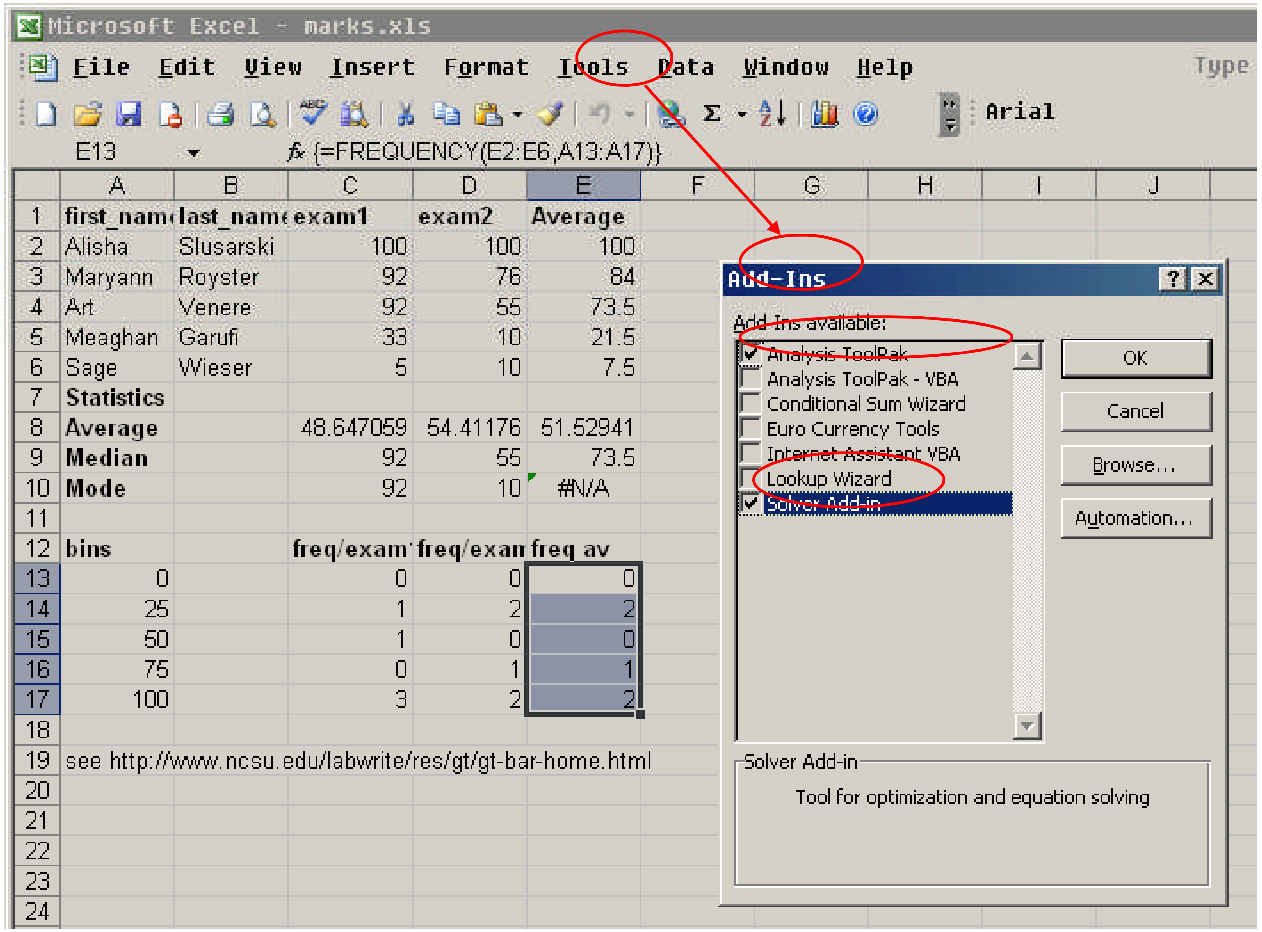
Addins to Install



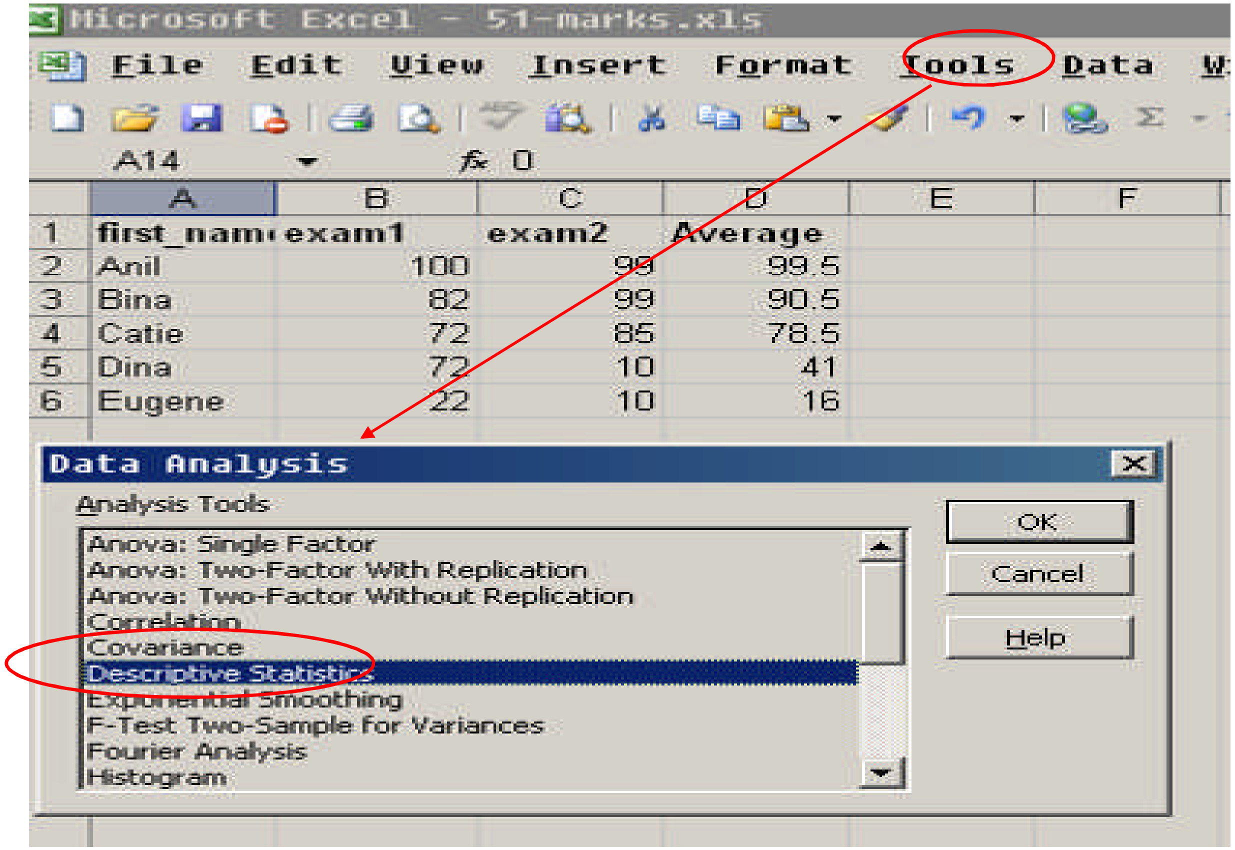




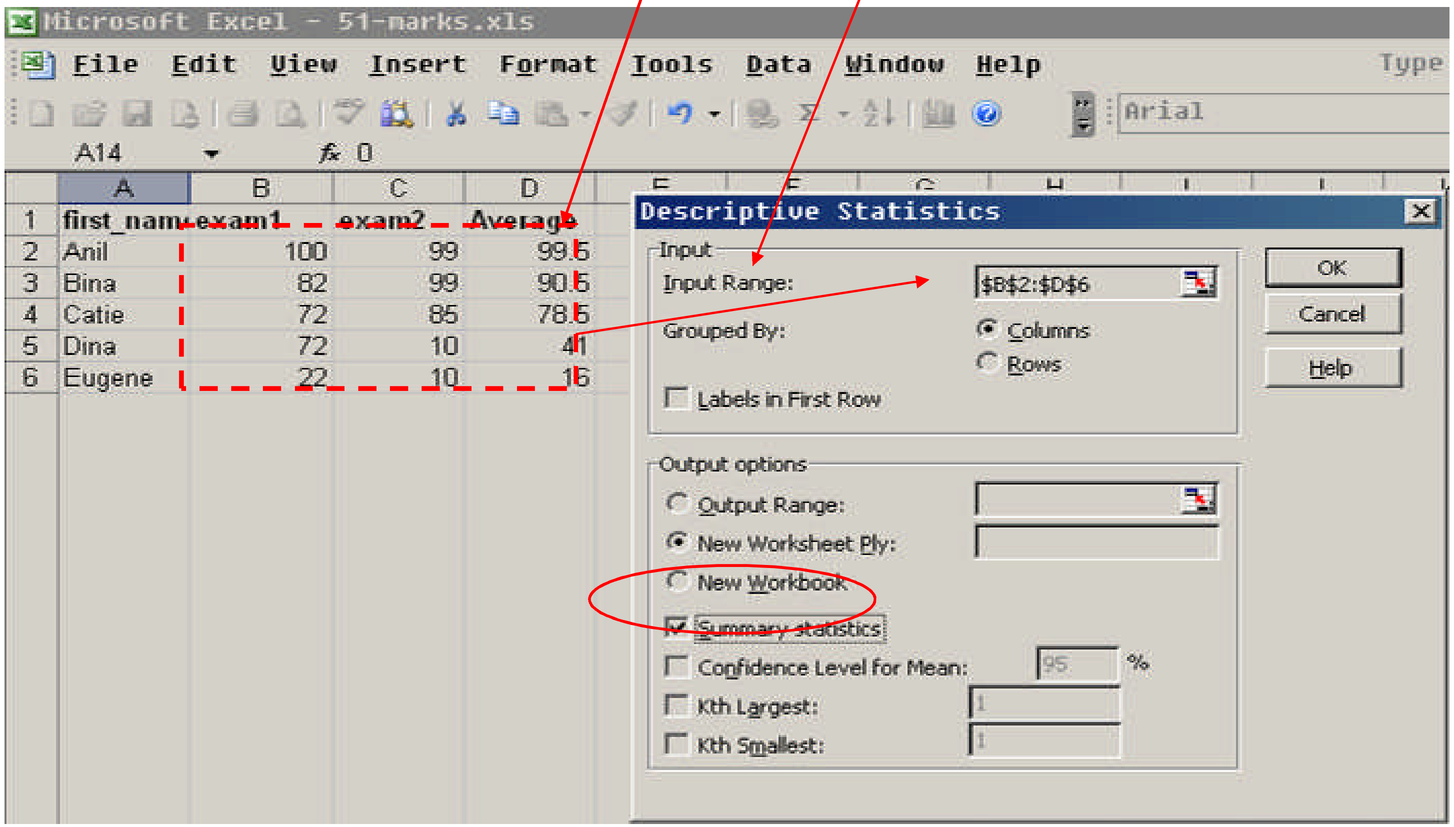
Excel 2003: Install: Tools > Add-Ins > Analysis & Solver ..



Tools > Data Analysis > Descriptive Statistics



Put cursor in Input Range and Select the rectangle of data



Result sheet of "Descriptive statistics"

	A	B	C	D	E	F
1	*Column1*		*Column2*		*Column3*	
2						
3	Mean	69.6	Mean	60.6	Mean	65.1
4	Standard E	12.95222	Standard E	20.8149	Standard E	15.81091
5	Median	72	Median	85	Median	78.5
6	Mode	72	Mode	99	Mode	#N/A
7	Standard D	28.96204	Standard D	46.54353	Standard D	35.35428
8	Sample Va	838.8	Sample Va	2166.3	Sample Va	1249.925
9	Kurtosis	2.680026	Kurtosis	-3.25502	Kurtosis	-1.6007
10	Skewness	-1.33475	Skewness	-0.54274	Skewness	-0.68706
11	Range	78	Range	89	Range	83.5
12	Minimum	22	Minimum	10	Minimum	16
13	Maximum	100	Maximum	99	Maximum	99.5
14	Sum	348	Sum	303	Sum	325.5
15	Count	5	Count	5	Count	5

Sheet2 | mosh | Sheet3 | Sheet1

Range of data

- Range is a measure of dispersion. It is simple the difference between the largest and smallest value
- = max(RANGE) – min(RANGE).

Median

- The median is another measure of central tendency. To get the median you have to order the data from lowest to highest. The median is the number in the middle.
- If the number of cases is odd the median is the single value, for an even number of cases the median is the average of the two numbers in the middle.
- Excel: =MEDIAN(RANGE)

Mode

- The mode refers to the most frequent, repeated or common number in the data. By age there are more students 19 years old in the sample than any other group. If all values are unique, there is no mode: #N/A.
- Excel: =MODE(RANGE)

Sample Variance (SV)

- The sample variance measures the dispersion of the data from the mean. It is the simple mean of the squared distance from the mean:
- SV = sum(sqr(X-mean of X)) / (N-1)
- Excel: VAR(RANGE)

Standard deviation (SD)

- The standard deviation is the squared root of the variance. Indicates how far-spread the data is from the mean.
- In a normal distribution, 68% of the values are within 1 sd from the mean, 95% within 2 sd and 99% within 3 sd.
- Excel =STDEV(range of cells with the values of interest)

Skewness

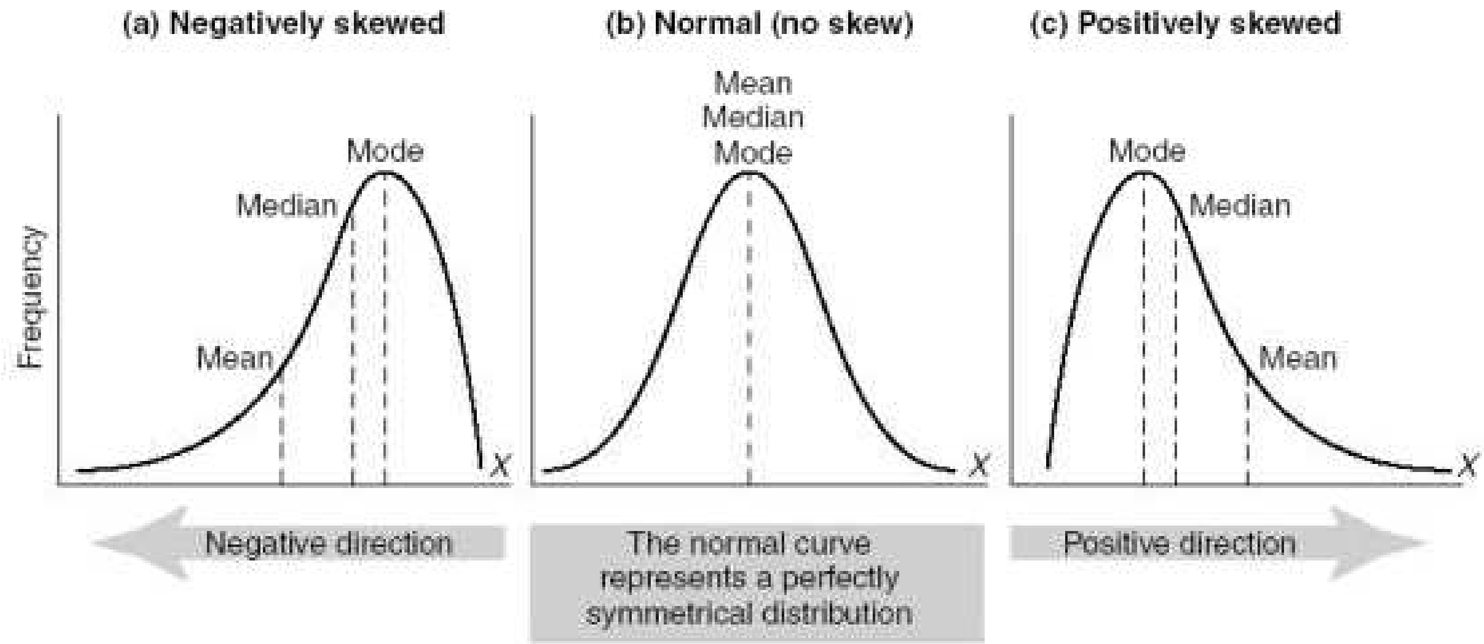


FIGURE 15.6 Examples of normal and skewed distributions

Skewness

- Skewness measures the asymmetry of the data, when in an otherwise normal curve one of the tails is longer than the other.
  - Skew = 0, is a normal distribution.
  - Skew > 0, if there is more data on the left side of the curve (right skewed, the median and the mode are lower than the mean).
  - Skew < 0, indicates that the mass of the data is concentrated on the right of the curve (left tail is longer, left skewed, the median and the mode are higher than the mean).
- Excel: =SKEW(RANGE)

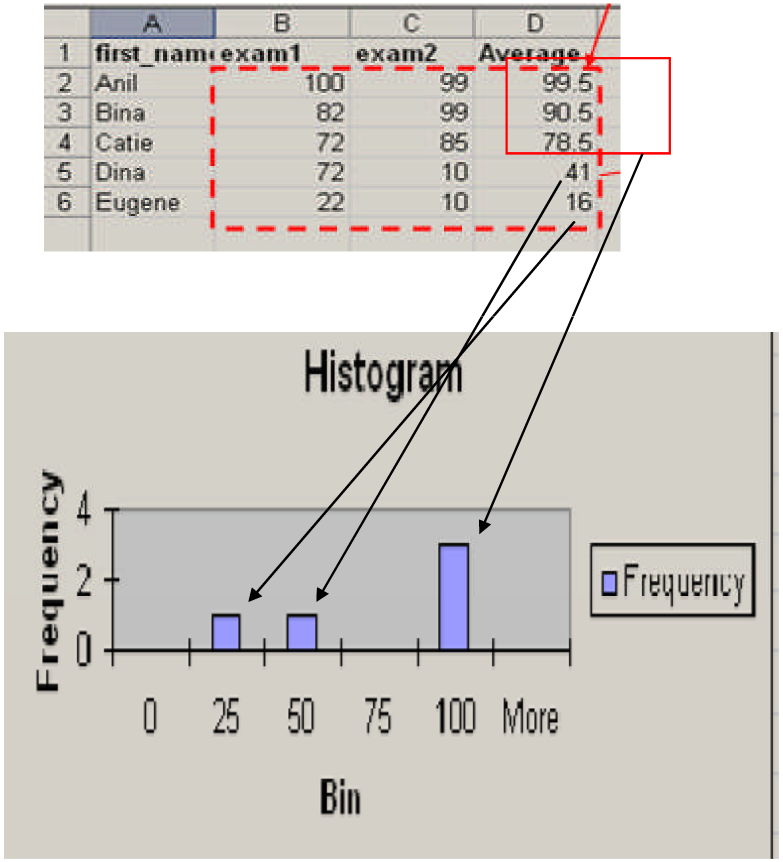
Kurtosis

- Kurtosis measures the peak of the distribution. It is also an indicator of normality.
  - Positive kurtosis indicates too few cases in the tails or a tall distribution (leptokurtic),
  - Negative kurtosis too many cases in the tails or a flat distribution (platykurtic).
  - A normal distribution has a kurtosis of 0 (given a correction of -3, otherwise it will have a kurtosis of 3).
- Excel =KURT(RANGE).

Histogram of Frequency Distribution in Excel

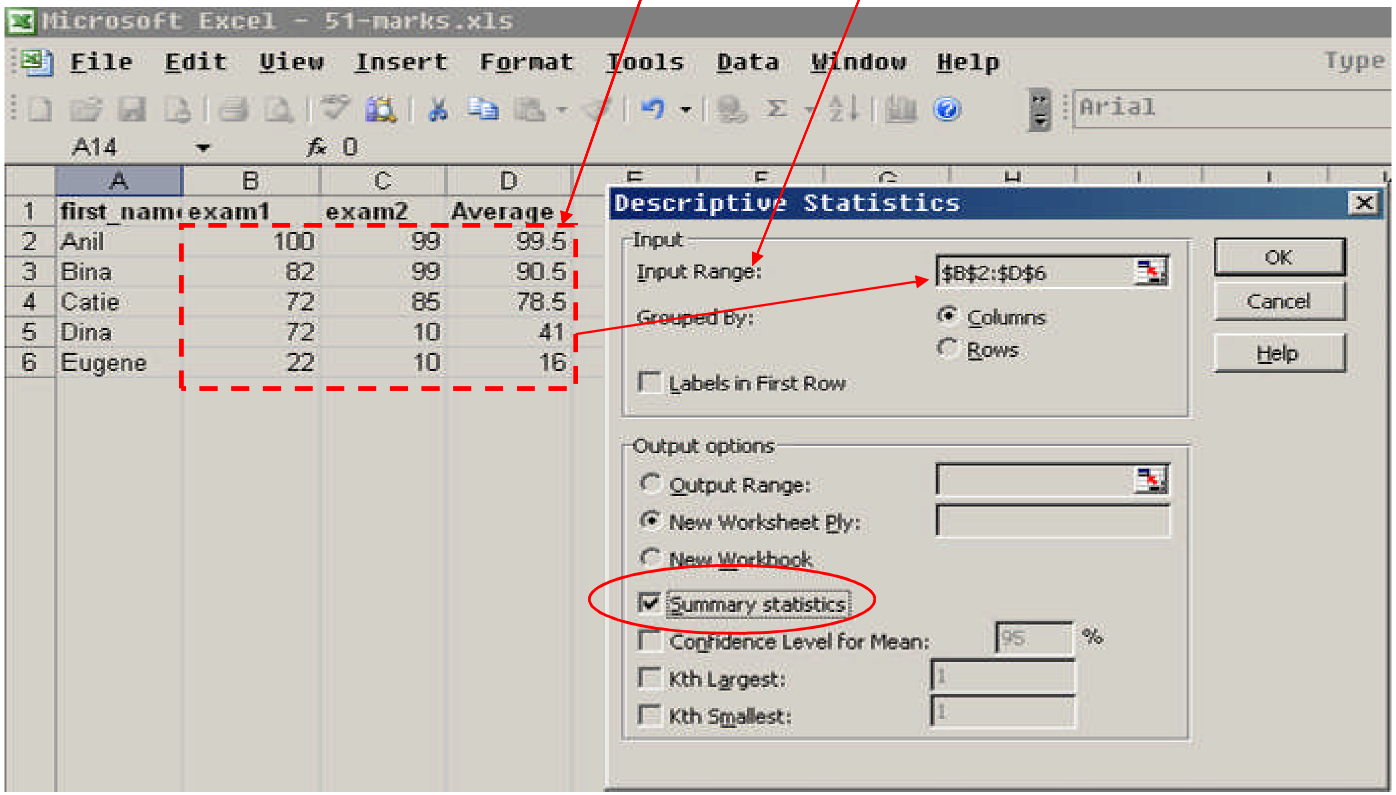
Histogram example

- Here Histogram shows how the average marks were distributed:
  - 3 people got marks in 75-100 range.
  - 1 person got between 25-50.
  - 1 person got between 0-25 range.

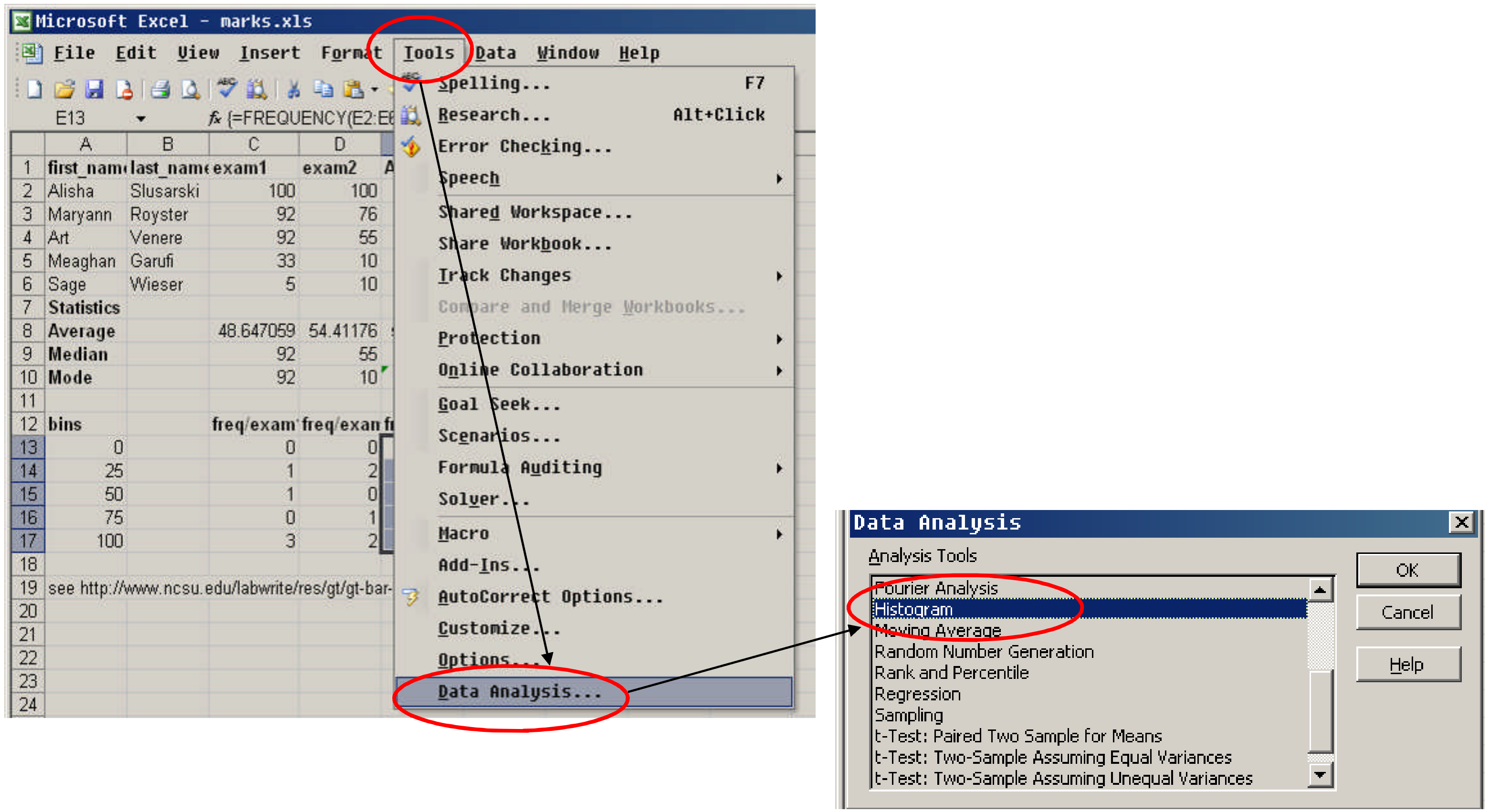


	A	B	C	D
1	first_nam	exam1	exam2	Average
2	Anil	100	99	99.5
3	Bina	82	99	90.5
4	Catie	72	85	78.5
5	Dina	72	10	41
6	Eugene	22	10	16

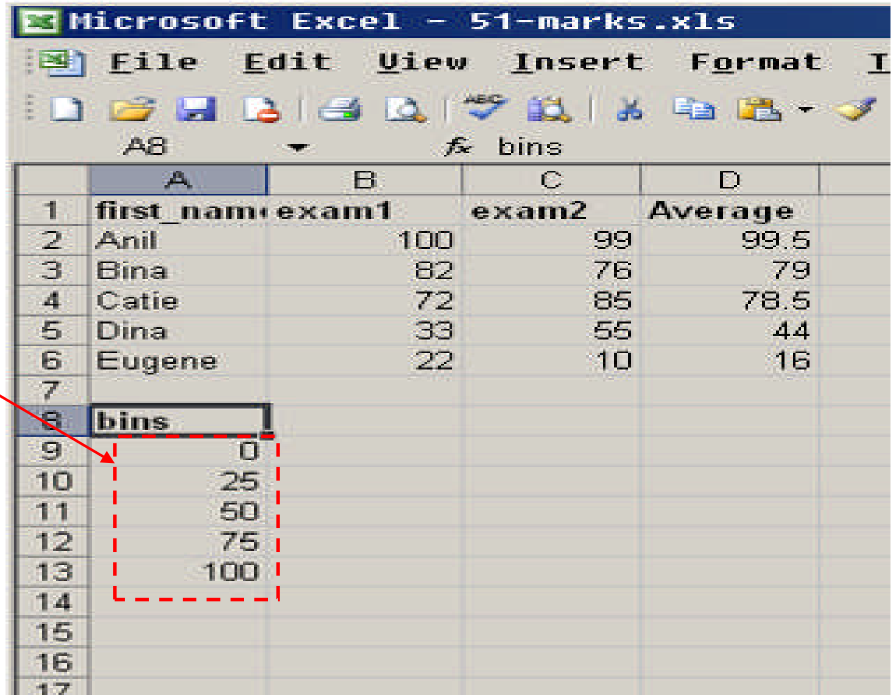
Put cursor in Input Range and Select the rectangle of data



Tools > Data Analysis > Histogram



Create bins for histogram



Microsoft Excel - 51-marks.xls

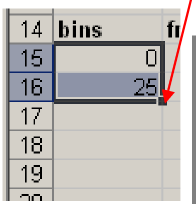
File Edit View Insert Format

A8 fx bins

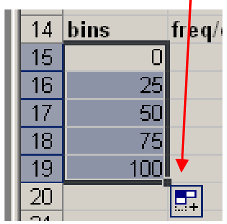
	A	B	C	D
1	first_nam	exam1	exam2	Average
2	Anil	100	99	99.5
3	Bina	82	76	79
4	Catie	72	85	78.5
5	Dina	33	55	44
6	Eugene	22	10	16
7				
8	bins			
9	0			
10	25			
11	50			
12	75			
13	100			
14				
15				
16				

Type into (A9:A13) =
[0,25,50,75,100]
OR

1. Type 0, 25,
2. Shift select both
3. Drag the black dot



14	bins
15	0
16	25
17	
18	
19	



14	bins	freq/
15	0	
16	25	
17	50	
18	75	
19	100	
20		

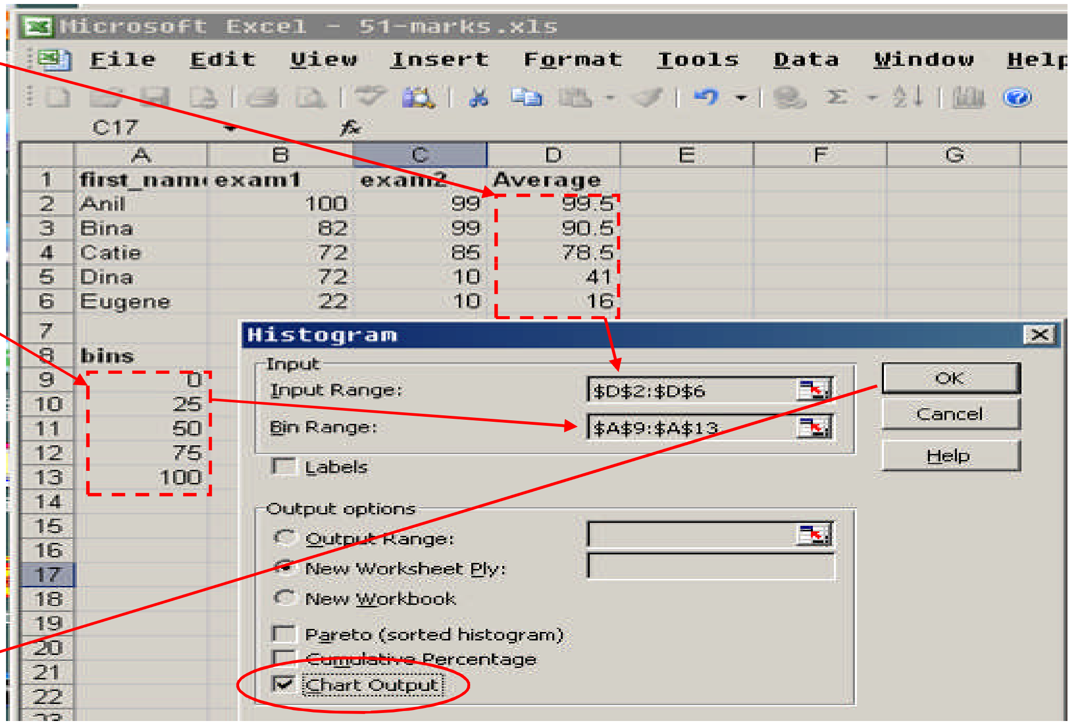
Example of bins for Sorting things

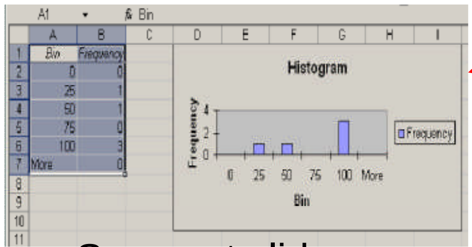
Create the histogram

Select D2 to D6 as
input range

Type into (A9:A13) =
[0,25,50,75,100] and

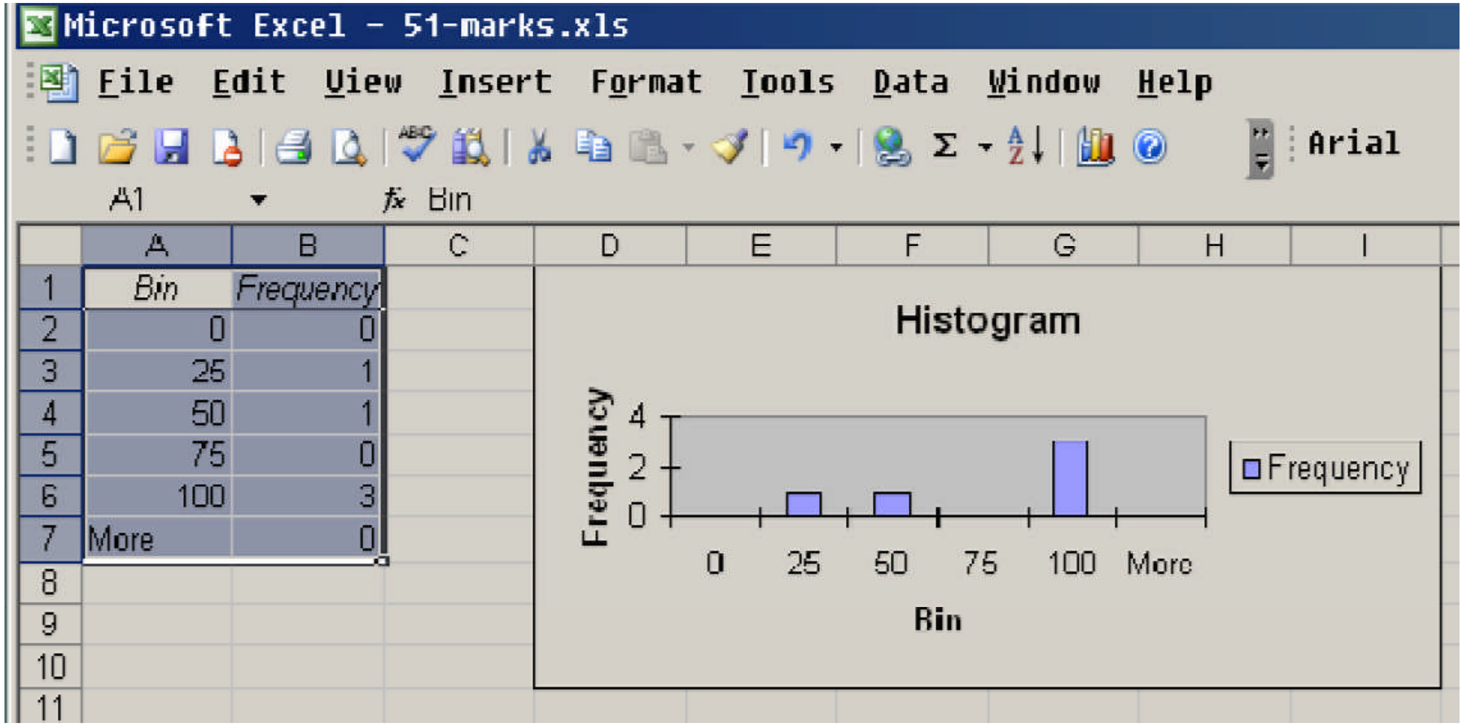
Select it as "Bin Range"





See next slide

Result of histogram of average column



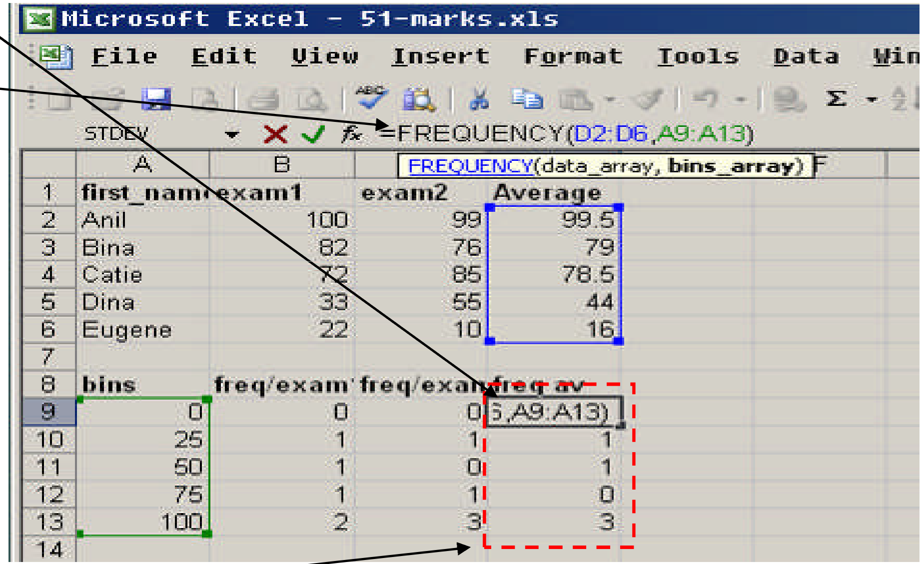
Array computation

- Example of using a function that returns an Array as it's result.

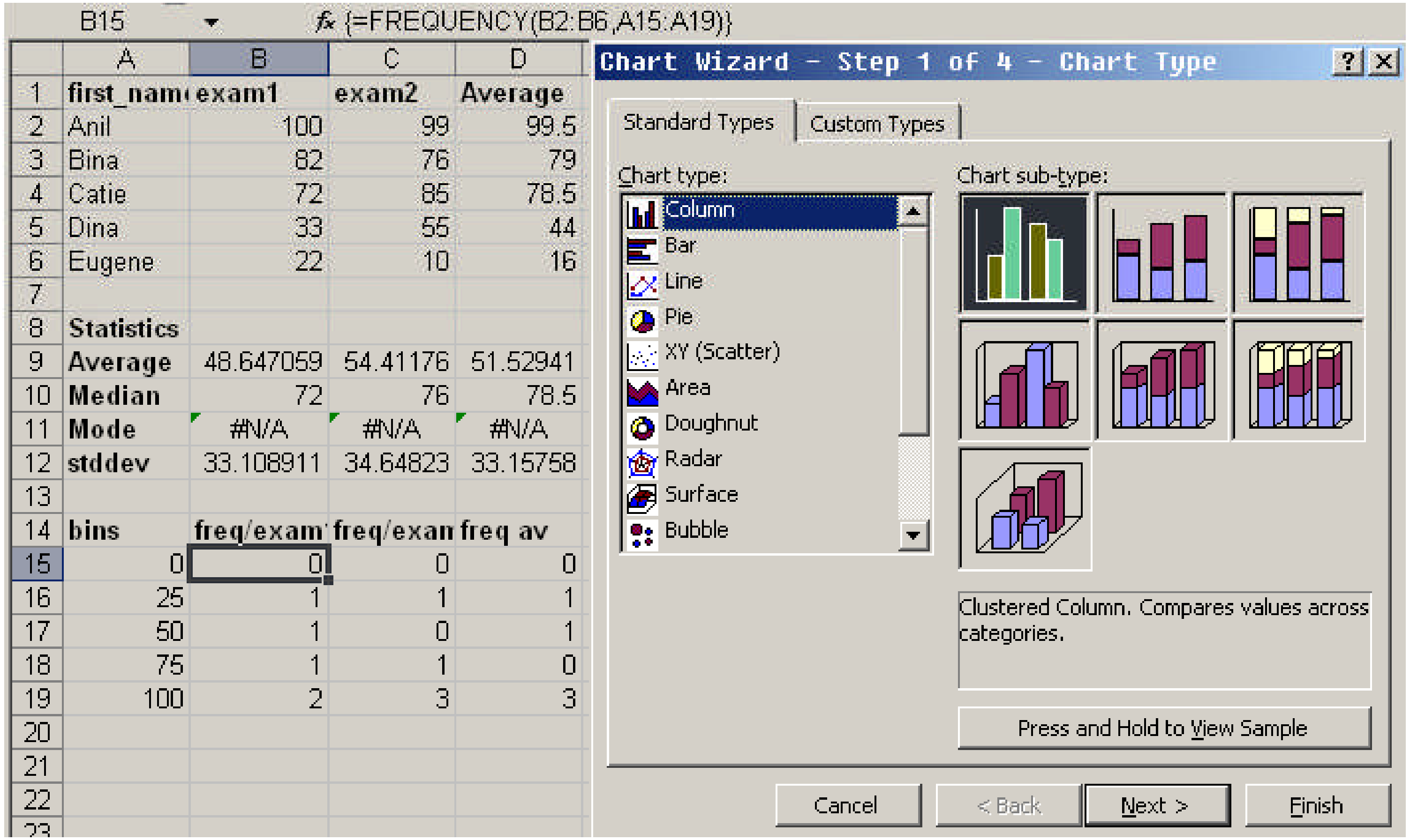
Frequency computation

1. Select cell D9, to compute Fx=Frequency(D2:D6, A9:13)

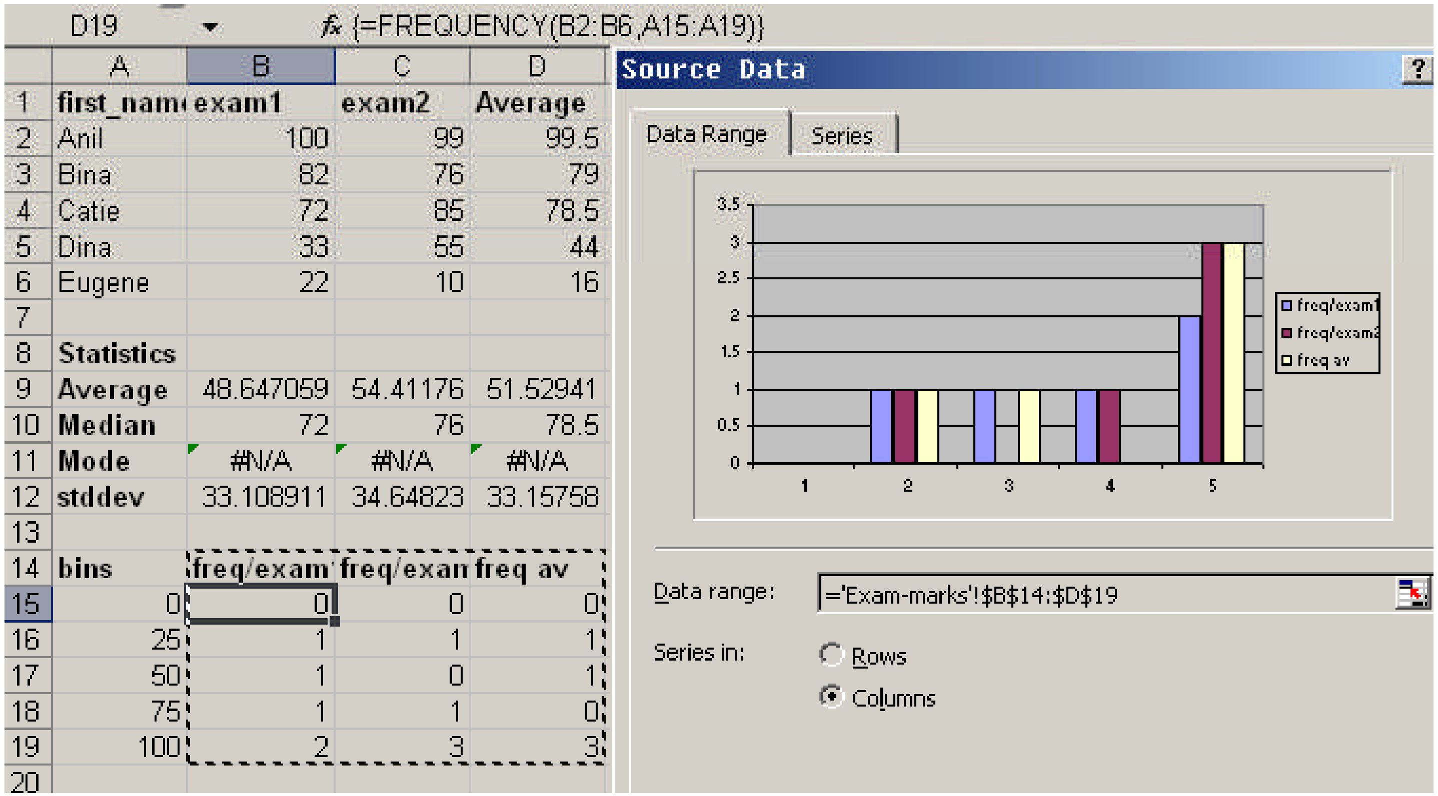
2. Press [Control-Shift-Enter] to compute {D9:D12} automatically



Plot the data



Select the data to plot



Add the X axis in Series

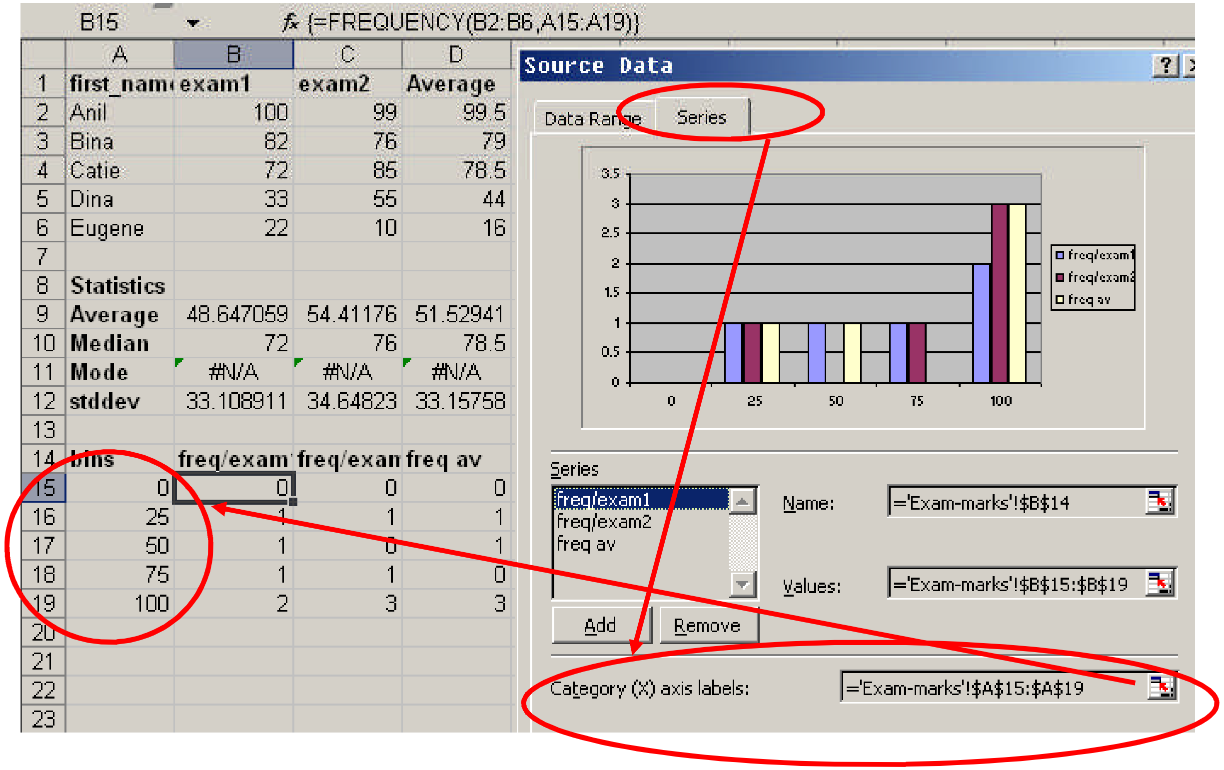
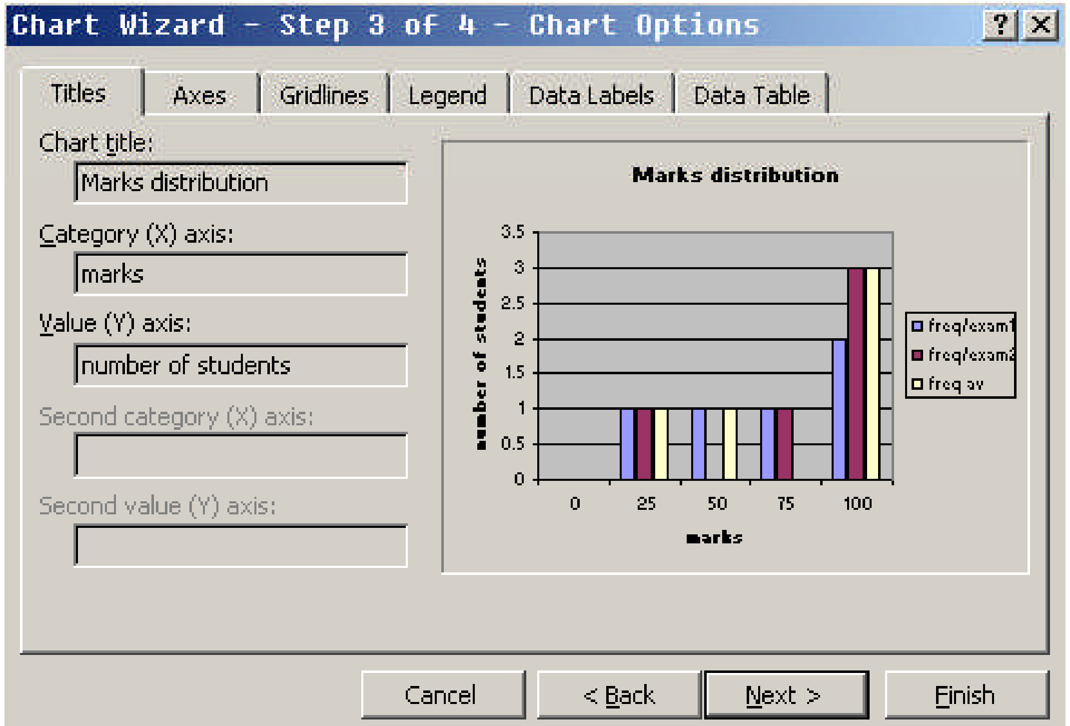


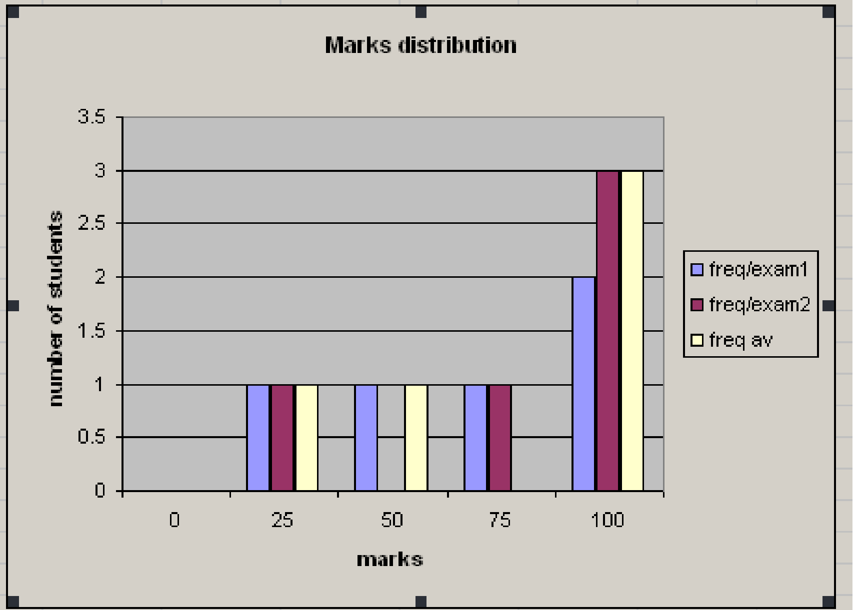
Chart wizard



Final Marks distribution

Chart 7 fx

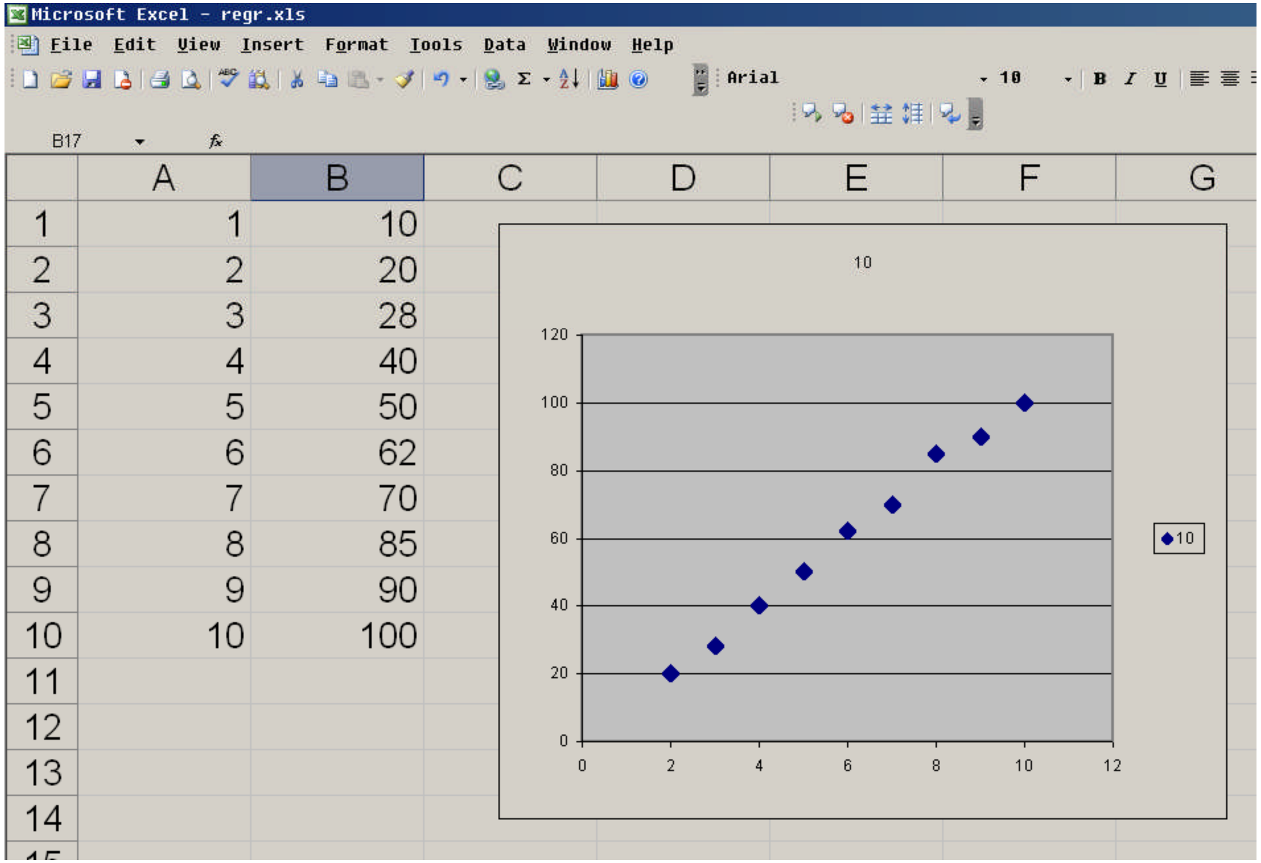
	A	B	C	D
1	**first_nam**	**exam1**	**exam2**	**Average**
2	Anil	100	99	99.5
3	Bina	82	76	79
4	Catie	72	85	78.5
5	Dina	33	55	44
6	Eugene	22	10	16
7				
8	**Statistics**			
9	**Average**	48.647059	54.41176	51.52941
10	**Median**	72	76	78.5
11	**Mode**	#N/A	#N/A	#N/A
12	**stddev**	33.108911	34.64823	33.15758
13				
14	**bins**	**freq/exam**	**freq/exan**	**freq av**
15	0	0	0	0
16	25	1	1	1
17	50	1	0	1
18	75	1	1	0
19	100	2	3	3
20				
21				



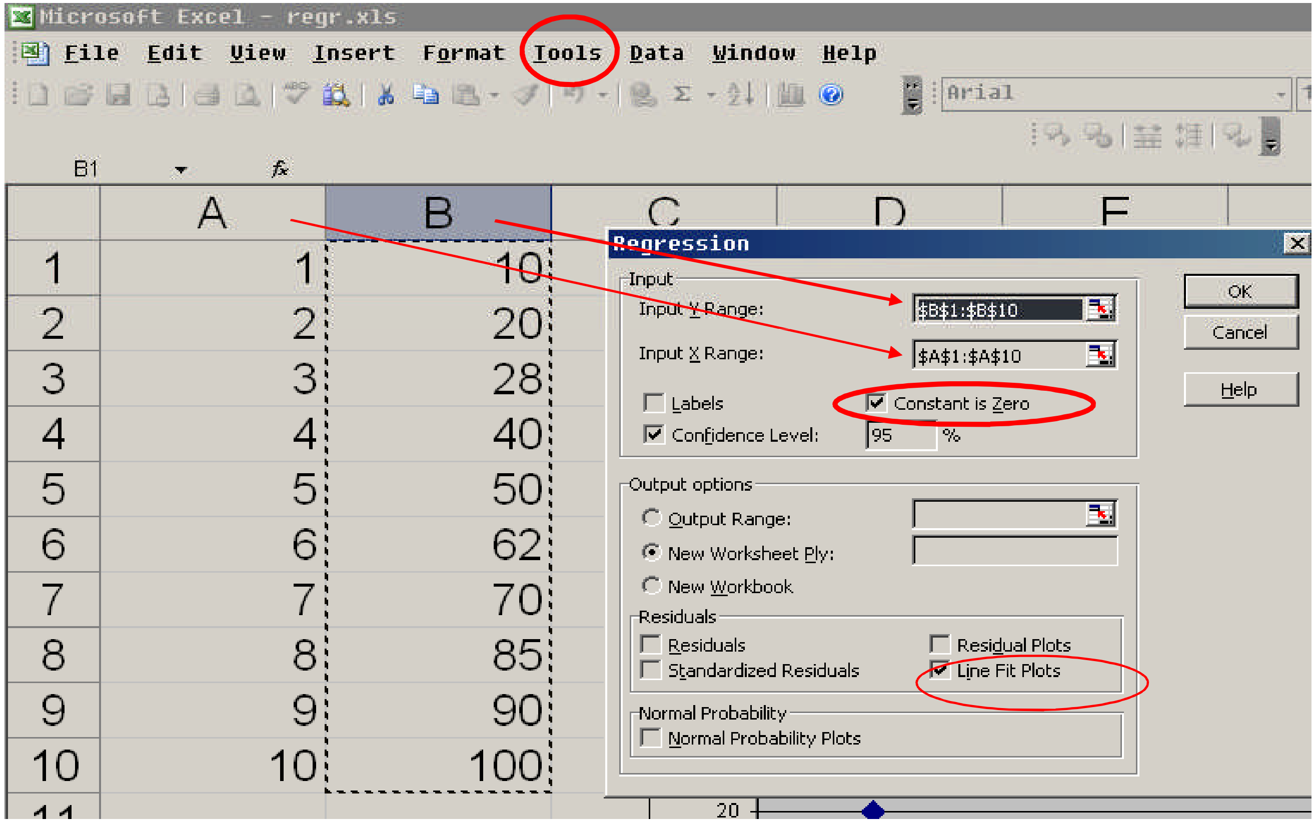
Regression
with Microsoft Excel

Microsoft Office
Excel 2003

Create some XY-Data (e.g.)



Tools > Data Analysis > Regression



Regression output sheet

Microsoft Excel - regr.xls

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.999651374
R Square	0.999302869
Adjusted R Square	0.888191758
Standard Error	1.748138569
Observations	10

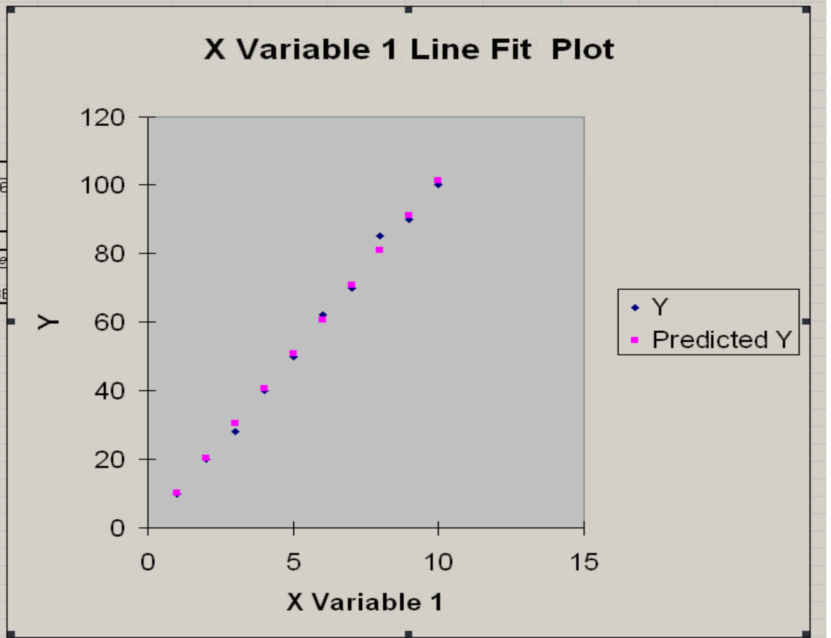
ANOVA

	df	*SS*	*MS*	*F*
Regression	1	39425.4961	39425.4961	12901.06
Residual	9	27.5038961	3.055988456	
Total	10	39453		

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	0	#N/A	#N/A	#N/A
X Variable 1	10.11948052	0.089093391	113.5828414	1.61368E

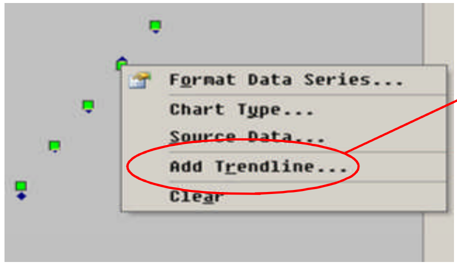
RESIDUAL OUTPUT

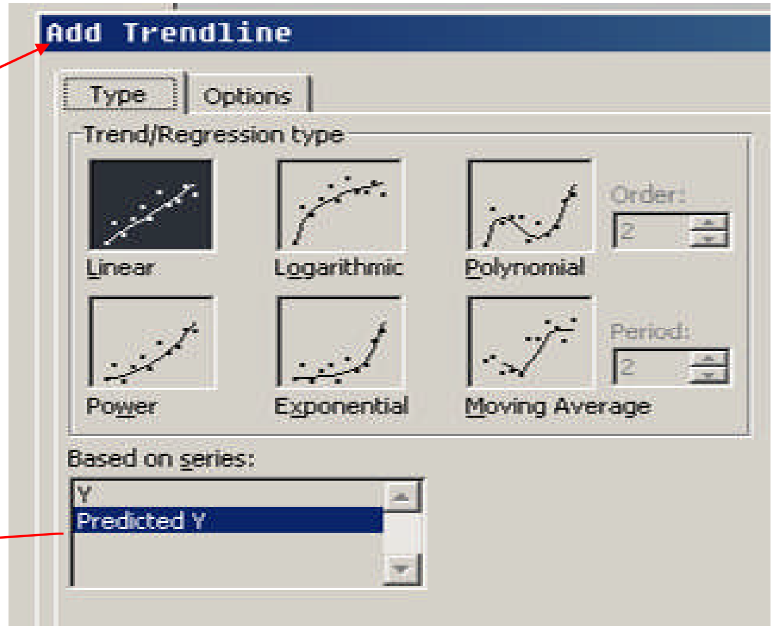
Observation	*Predicted Y*	*Residuals*
1	10.11948052	-0.119480519
2	20.23896104	-0.238961039
3	30.35844156	-2.358441558
4	40.47792208	-0.477922078
5	50.5974026	-0.597402597
6	60.71688312	1.283116883
7	70.83636364	-0.836363636
8	80.95584416	4.044155844
9	91.07532468	-1.075324675
10	101.1948052	-1.194805195

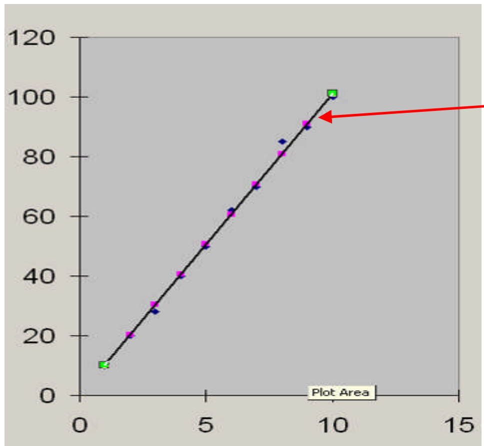


Trendline

Right mouse click on graph, and add "Trendline"

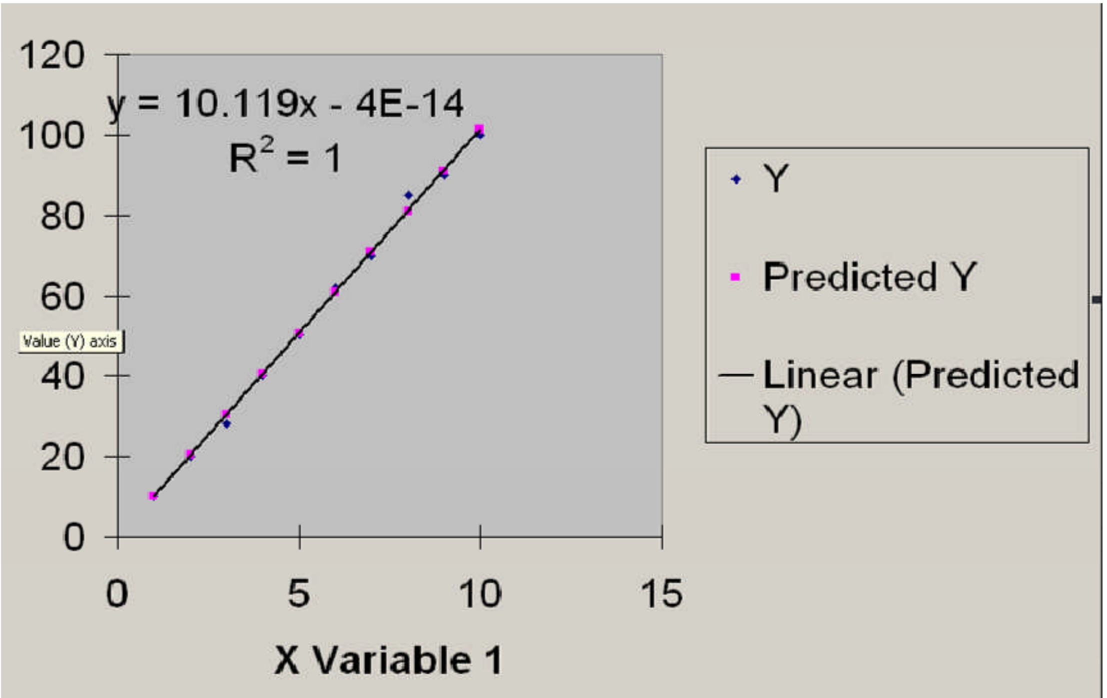






Trendline options > show equation and R square

R2 is a measure of the error between the data points and the predicted values.
Its values vary between 0 = no relationship, and 1 = a perfect relationship.



Forecast (interpolate, extrapolate)

To find the value of Y at X=9.5,

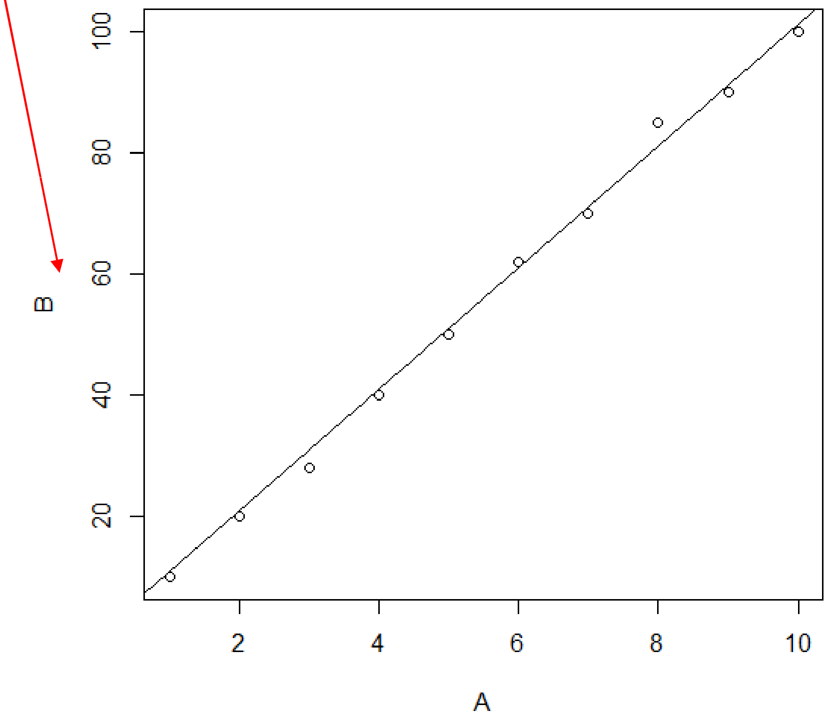
- Go to the empty cell A12, and type:
- fx=Forecast(9.5,B1:B10,A1:A10)
- and you should get the value 96.39.

To do the inverse forecast, back from Y to X, do

- =FORECAST(96.39,A1:A10, B1:B10)
- and you should get 9.48

Regression with R

```
> A <-  c(1:10)    # c(1,2,3,4,5,6,7,8,9,10)
> B <-
    c(10,20,28,40,50,62,70,85,90,100)
> plot(A,B);
> abline(A,B)
> cor(A,B)  # Correlation of A and B is:
  [1] 0.9984757
> fit <- lm(A ~ B) ; fit

Call: lm(formula = A ~ B),
Coefficients:
    (Intercept)   B
    0.08826      0.09751
> summary(fit)
    ...lot of details...
```



Anova

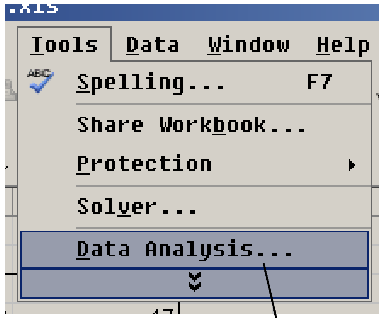
Compare four tyre brands, which brand is better?

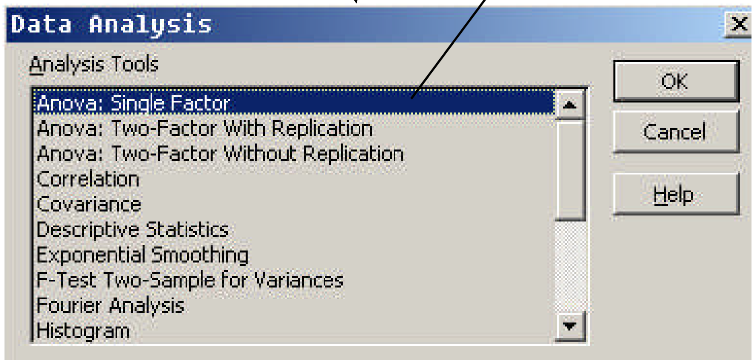
	A	B	C	D	E	F	
1							
2	**Brands**	**Brand 1**	**Brand 2**	**Brand 3**	**Brand 4**	**Totals**	
3		20	19	21	15		
4		23	15	19	17		
5		18	17	20	16		
6		17	20	17	18		
7			16	16			
8	**Totals**	=SUM(B3:B7)	=SUM(C3:C7)	=SUM(D3:D7)	=SUM(E3:E7)	=SUM(B8:E8)	**G**
9	**sqr(T_i)**	=B8*B8	=C8*C8	=D8*D8	=E8*E8		
10	**n_i**	=COUNTIF(B3:B7	=COUNTIF(C3:C7,">0")	=COUNTIF(D3:D7,">0")	=COUNTIF(E3:E7,">0")	=SUM(B10:E10)	
11	**sum(sq(B_i))**	=SUMSQ(B3:B7)	=SUMSQ(C3:C7)	=SUMSQ(D3:D7)	=SUMSQ(E3:E7)	=SUM(B11:E11)	
12	**BSS+CF=sqr(T_i)/n_i**	=B9/B10	=C9/C10	=D9/D10	=E9/E10	=SUM(B12:E12)	
13	**CF=sqr(G)/n**	=G*G/18					
14	**TSS=RSS-CF**	=RSS-CF					
15	**BSS**	=BSS1-CF					
16	**WSS=TSS-BSS**	=TSS-BSS2					
17	**Anova**	**DOF**	**dof**	**ss**	**mean(ss)**	**var/F**	
18	**b/brands**	k-1	3	21.6	=D18/3	=7.2/4.31	
19	**error**	n-1	14	60.4	=D19/14		
20	**total**	n-k	17	82			
21					**Finv(.01,3,14)**	=FINV(0.01,3,14)	
22	**H0**	=1.67<5.56	Tires are same	**Accept**			
23	**H1**		Tires are diff				

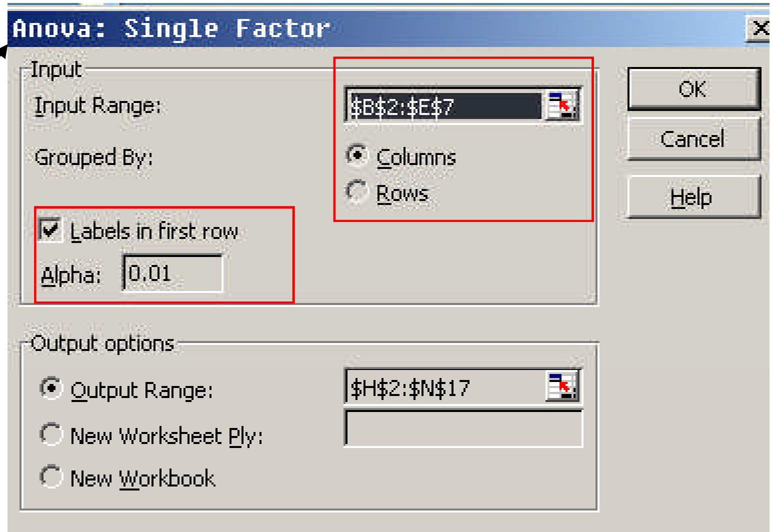
Anova, accept H0, alpha=0.01

	A	B	C	D	E	F
1						
2	**Brands**	**Brand 1**	**Brand 2**	**Brand 3**	**Brand 4**	**Totals**
3		20	19	21	15	
4		23	15	19	17	
5		18	17	20	16	
6		17	20	17	18	
7			16	16		
8	**Totals**	78	87	93	66	324 G
9	**sqr(T_i)**	6084	7569	8649	4356	
10	**n_i**	4	5	5	4	18
11	**sum(sq(B_i))**	1542	1531	1747	1094	5914
12	**BSS+CF=sqr(T_i)/n_i**	1521	1513.8	1729.8	1089	5853.6
13	**CF=sqr(G)/n**	5832				
14	**TSS=RSS-CF**	82				
15	**BSS**	21.6				
16	**WSS=TSS-BSS**	60.4				
17	**Anova**	**DOF**	**dof**	**ss**	**mean(ss)**	**var/F**
18	**b/brands**	k-1	3	21.6	7.2	1.670534
19	**error**	n-1	14	60.4	4.314286	
20	**total**	n-k	17	82		
21					**Finv(.01,3**	5.563886
22	**H0**	TRUE	Tires are sam	**Accept**		
23	**H1**		Tires are diff			

Excel > tools > data analysis > Anova single factor







Brand 1	Brand 2	Brand 3	Brand 4	Totals
20	19	21	15	
23	15	19	17	
18	17	20	16	
17	20	17	18	
	16	16		

Excel does Anova

25	Anova: Single Factor						
26							
27	SUMMARY						
28	*Groups*	*Count*	*Sum*	*Average*	*Variance*		
29	Brand 1	4	78	19.5	7		
30	Brand 2	5	87	17.4	4.3		
31	Brand 3	5	93	18.6	4.3		
32	Brand 4	4	66	16.5	1.666666667		
33							
34							
35	ANOVA						
36	*rce of Varia*	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
37	Between G	21.6	3	7.2	1.668874172	0.2191	5.563885843
38	Within Grou	60.4	14	4.3142857			
39							
40	Total	82	17				

Compare with calculator

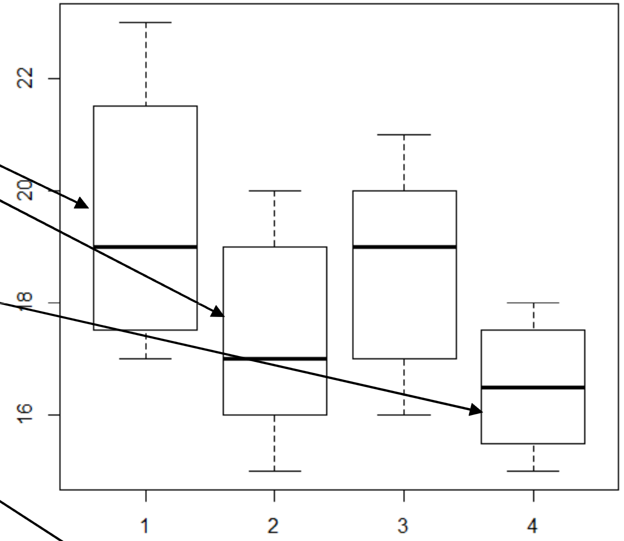
2	**Brands**	**Brand 1**	**Brand 2**	**Brand 3**	**Brand 4**	**Totals**
3		20	19	21	15	
4		23	15	19	17	
5		18	17	20	16	
6		17	20	17	18	
7			16	16		
8	**Totals**	78	87	93	66	324
9	**sqr(T_i)**	6084	7569	8649	4356	
10	**n_i**	4	5	5	4	18
11	**sum(sq(B_**	1542	1531	1747	1094	5914
12	**BSS+CF=s**	1521	1513.8	1729.8	1089	5853.6
13	**CF=sqr(G)/**	5832				
14	**TSS=RSS-**	82				
15	**BSS**	21.6				
16	**WSS=TSS**	60.4				
17	**Anova**	**DOF**	**dof**	**ss**	**mean(ss)**	**var/F**
18	**b/brands**	k-1	3	21.6	7.2	1.67053
19	**error**	n-1	14	60.4	4.314285714	
20	**total**	n-k	17	82		
21					Finv(1%,3,14)=	5.56389

Chi Square

	A	B	C	D	E	F
1	**Month**	**O**	**E=100/10**	**O-E**	**sqr(O-E)**	**sqr(O-E)/E**
2	1	12	10	2	4	0.4
3	2	8	10	-2	4	0.4
4	3	20	10	10	100	10
5	4	2	10	-8	64	6.4
6	5	14	10	4	16	1.6
7	6	10	10	0	0	0
8	7	15	10	5	25	2.5
9	8	6	10	-4	16	1.6
10	9	9	10	-1	1	0.1
11	10	4	10	-6	36	3.6
12						**chisq**
13	**sum**	100	100	0	266	26.6
14	**dof**	9				
15	**chiInv(9,5**	16.91898	<26.6			
16	**H0**	FALSE				
17	**chisq**	0.001628	>0.05?			

Anova in R

```
# The data
> x1 = c( 20, 23, 18, 17)
> x2 = c( 19, 15, 17, 20, 16)
> x3 = c( 21, 19, 20, 17, 16)
> x4 = c( 15, 17, 16, 18)
> boxplot(x1,x2,x3,x4)
> all.scores = c(x1,x2,x3,x4)
> grp = c("x1","x2","x3","x4")
> n = c(4, 5, 5, 4)
> groups = rep(grp, n)
```



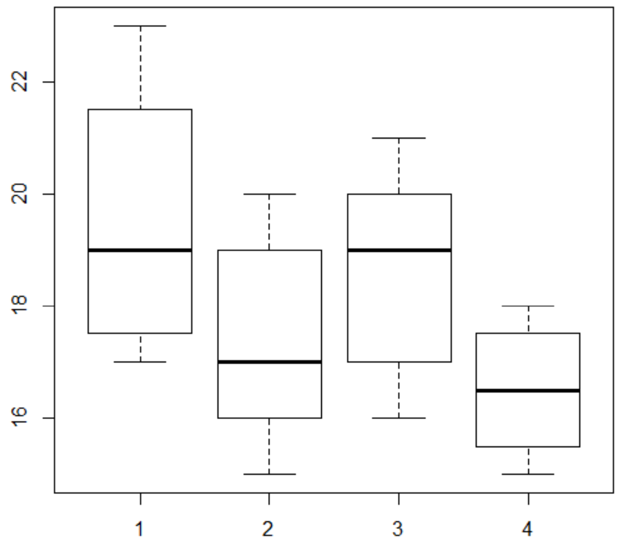
Box plot of the data

Continued ...

Anova in R, continued

```
> results = aov(all.scores ~
   factor(groups))
> summary(results)
factor(groups)
  Df Sum Sq Mean Sq  F value
   Pr(>F)
  3   21.6   7.200   1.669
   0.219
Residuals
  1        4   60.4   4.314
```

```
# Compute the f critical at 1% for dof1=3
   and dof2=14
> qf(.99, df1=3, df2=14)
  [1] 5.563886
```



Box plot of the data

Hypothesis Testing

Statistics of sampling

- We have a population N.
- We measure only a small sample of it, of size n.
- Is our measurement valid for the whole population?

- Example: We ask some people (n=100) who they will vote for, then we can predict how the whole country (N=1000,000,000) will vote.
- Example: We check a few packets of rice, and if they are ok, we assume the whole lot is good.

Tolerance to Accept or Reject.

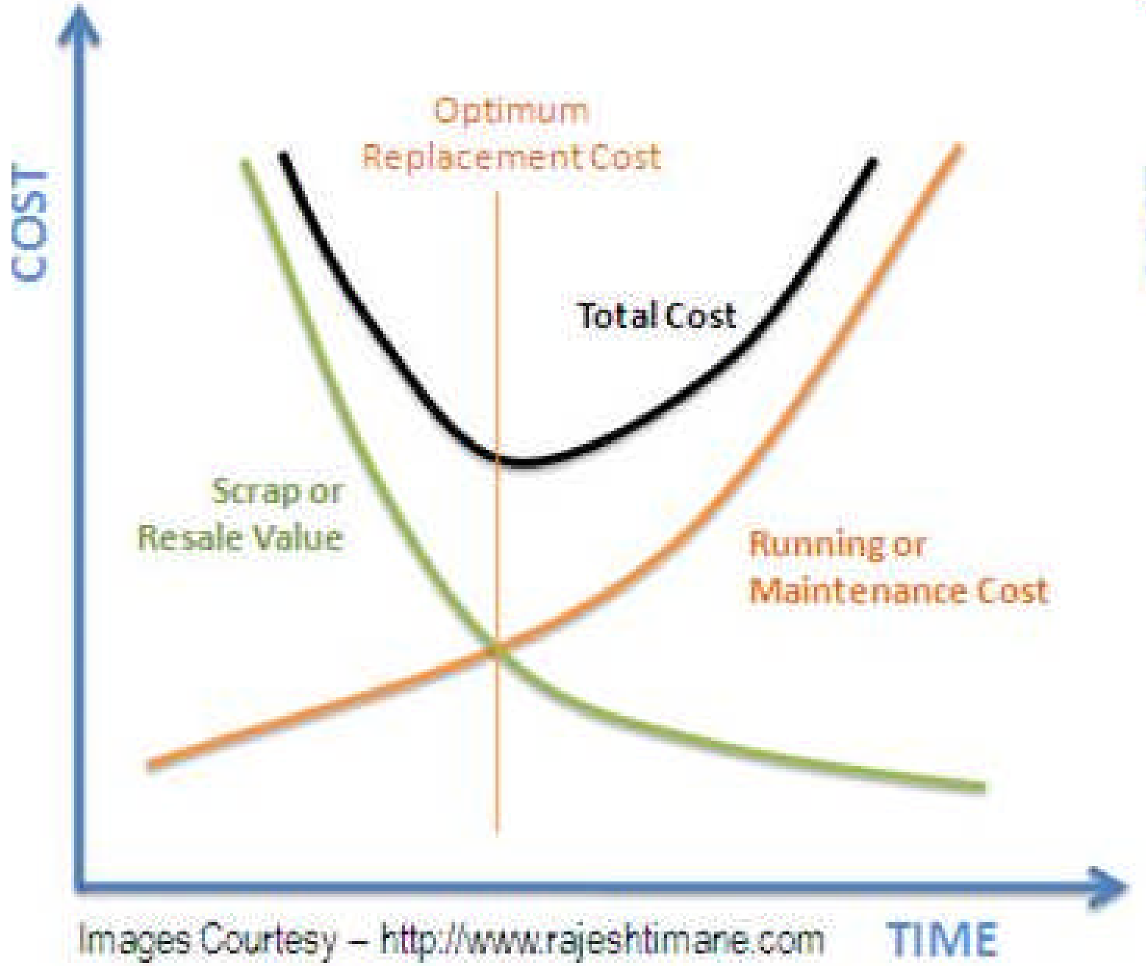
- Example: We say a bus takes 100 minutes to go from Mangalore to NITTE.
- A bus taking 104 minutes is acceptable if we tolerate 5% variation,
- (104-100)=(4/100)< 5%(=5/100)
- If we tolerate only 1% variation, then 104 minutes bus timing will be rejected.

Null Hypothesis (H0, H1).

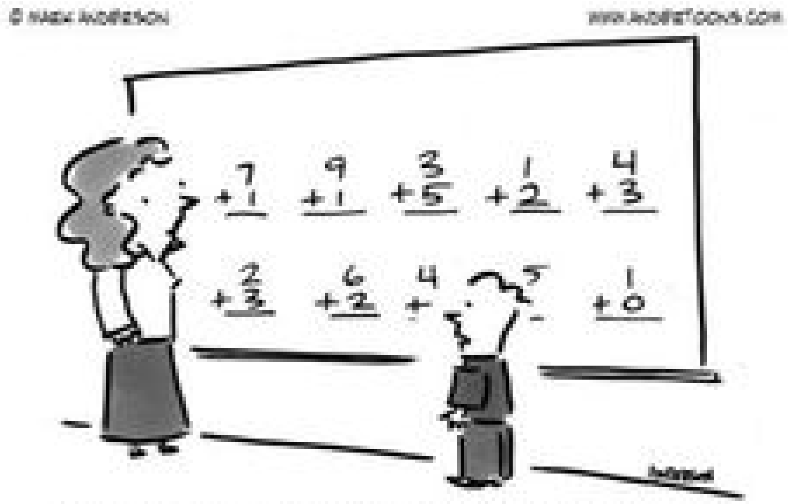
- We make a guess about the population, call it null-hypothesis H0, and the alternative of H0 is called H1.
- We measure a sample.
- We pick a tolerance of 1% or 5%.
- We calculate a “test-statistic” of the sample.
- We look up the tabulated value for the tolerance in the statistics tables.
- We compare the measured with the expected value.
- If the difference < tolerance, we accept the null hypothesis.
- If difference > tolerance, we reject the guess, and accept the alternate hypothesis H1.

Replacement Theory

Replacement cost over time



Solving LP with MS Excel



"All I'm saying is we plug these into Excel, let it do its thing, and then we can all play until lunch!"

Excel Grid

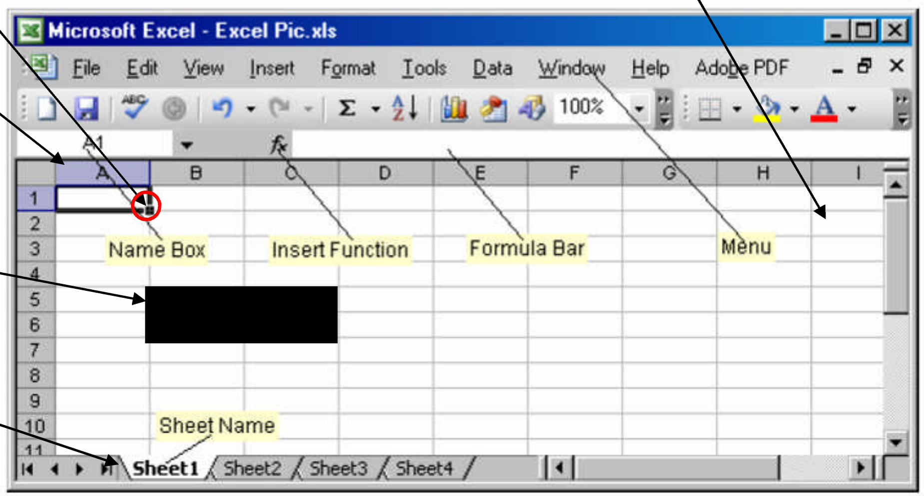
- Excel file have extension .xls or .xlsx (2007).
- Work book is a 2D matrix/grid of CELLs containing data
- Cells are then named by Column+Row, e.g. A1, B5, I2
- Draggable corner to copy cells

Columns are: A,B,C,D

Rows are: 1,2,3,4,…

Matrix: B5:B6;C5:C6

Sheets: 1,2,…



LP example to help a farmer

We have following linear constraints:

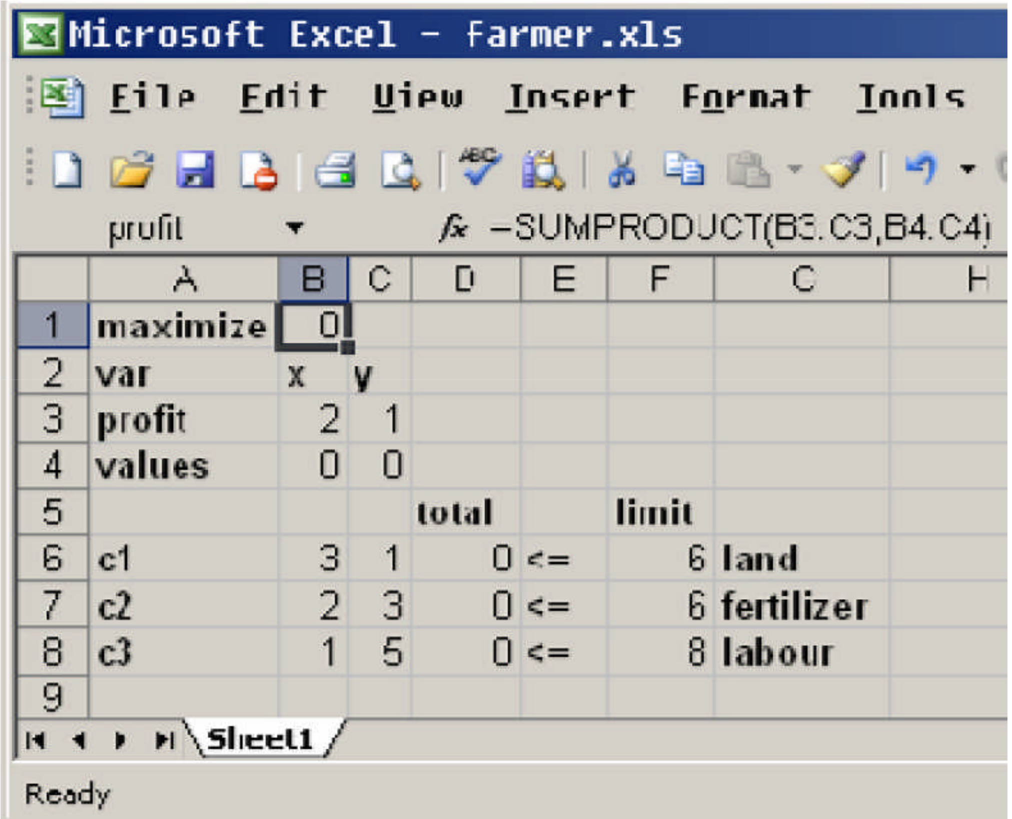
- 6 acres of land: $3x + y \le 6$
- 6 tons of fertilizer: $2x + 3y \le 6$
- 8 hour work day: $x + 5y \le 8$
- Apples sell for twice as much as oranges
- We want to maximize profit: $z = 2x + y$
- Production is positive: $x \ge 0$, $y \ge 0$

Enter the data into Excel

x : apple
y : orange
Price apple = 2 price orange
maximize profit: $z = 2x + y$

Constraints:
6 acres of land: $3x + y \leq 6$
6 tons of fertilizer: $2x + 3y \leq 6$
8 hour work day: $x + 5y \leq 8$

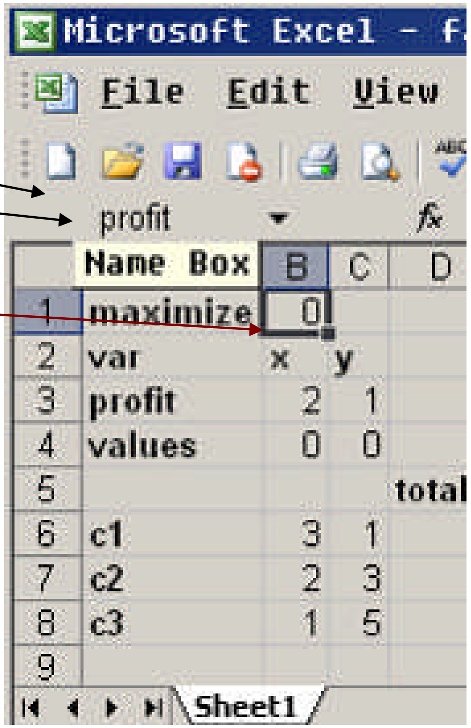
Production is positive: $x \geq 0$, $y \geq 0$



Naming a cell

- Select B1
- Click on "*name box*",
- Type *"profit"*,
- Press *"Control-Shift-Enter"*

  to name B1 profit.



Input the objective function, (equation for profit)

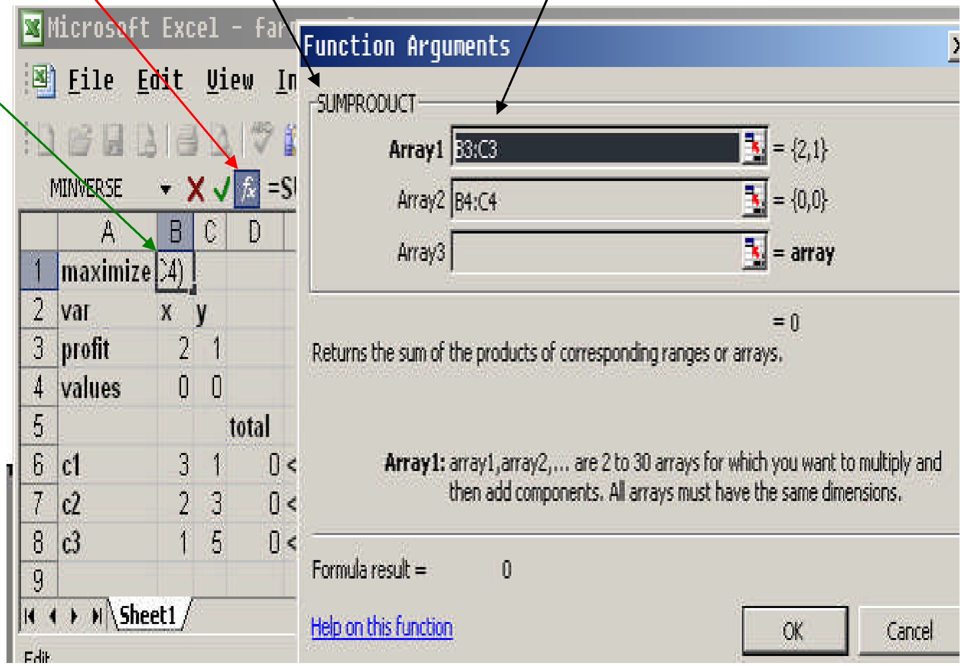
Select cell B1, Click on ***fx***, Select *sumproduct*, Array1=B3:C3

Array2=B4:C4

So profit is

z = 2 * x + 1 * y

B1 = B3 * B4 + C3 * C4



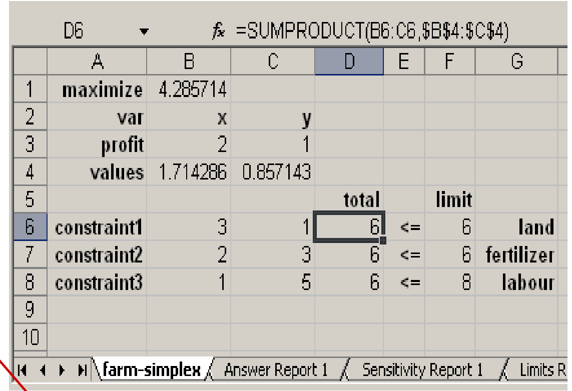
Enter the formula for constraints

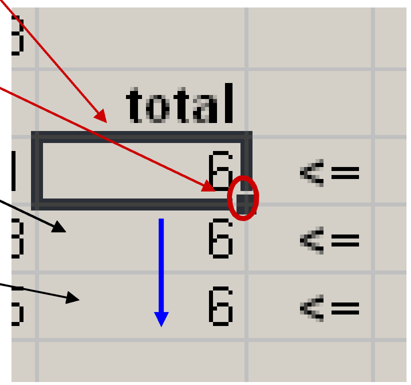
Type formula for D6

- D6=SUMPRODUCT(B6:C6,$B$4:$C$4)

Drag the black dot over D7 and D8 to fill these:

- D7=SUMPRODUCT(B7:C7,$B$4:$C$4)
- D8=SUMPRODUCT(B8:C8,$B$4:$C$4)

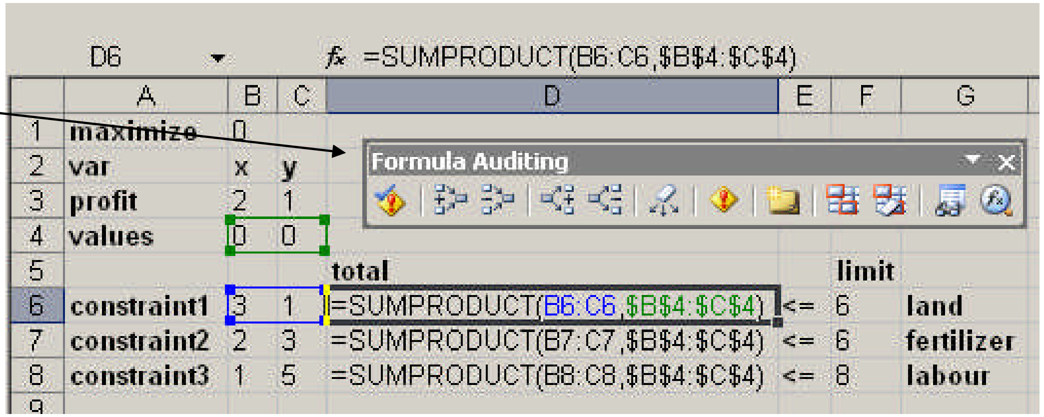




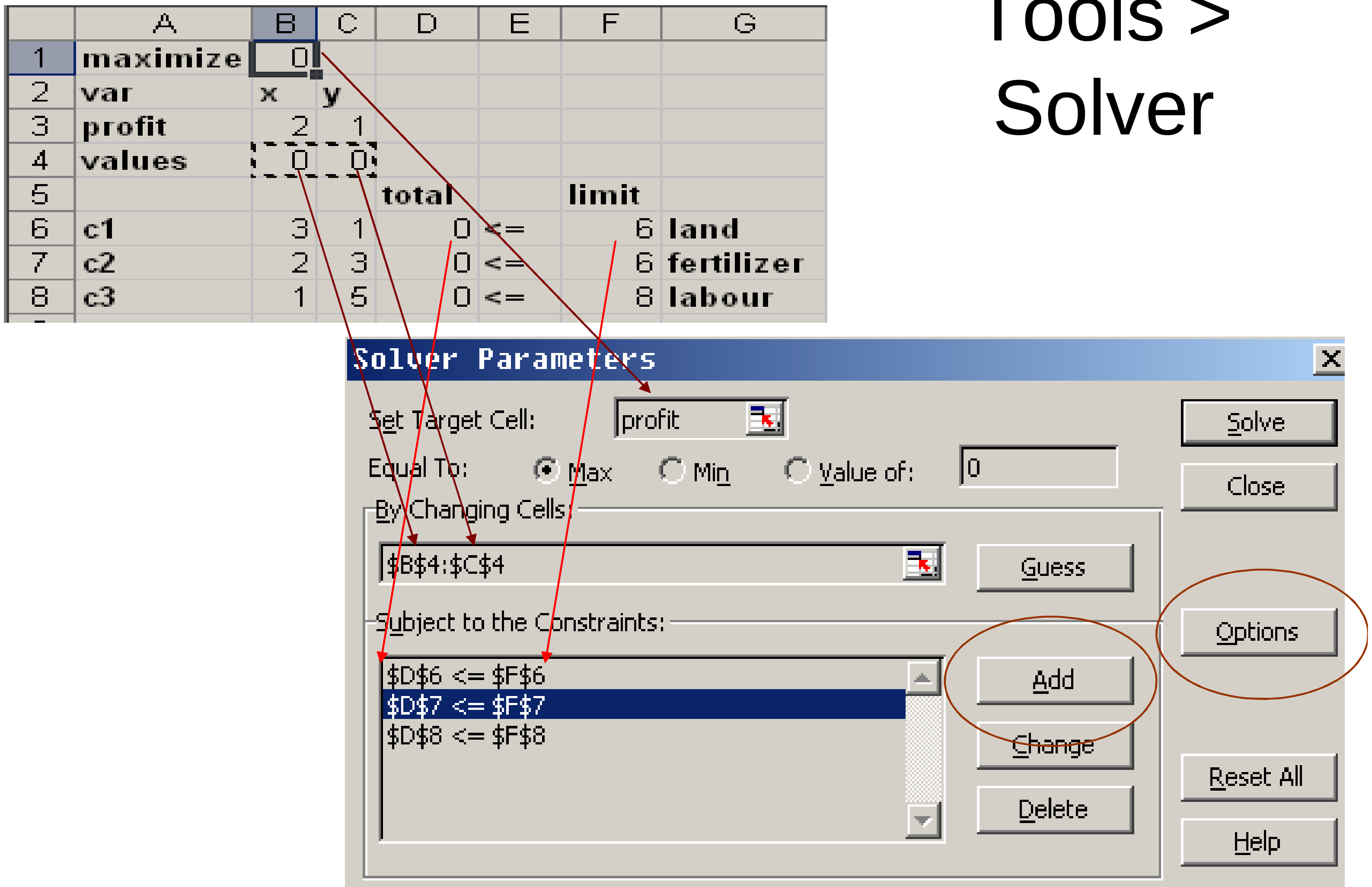
Formulas Auditing toolbar

- Press CTRL+` (backquote below tilde ~): To switch between results and formulas; Or use the
- Menu: Tools > [Formula Auditing] > [Formula Auditing Mode]
- Use F9 to recalculate formulas and update the sheet.

Formula editing toolbar

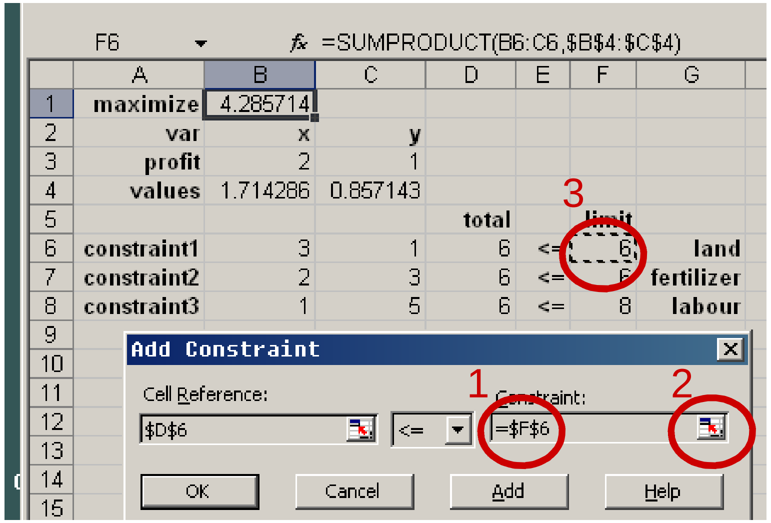


Tools > Solver



Adding solver constraints by clicking on cells

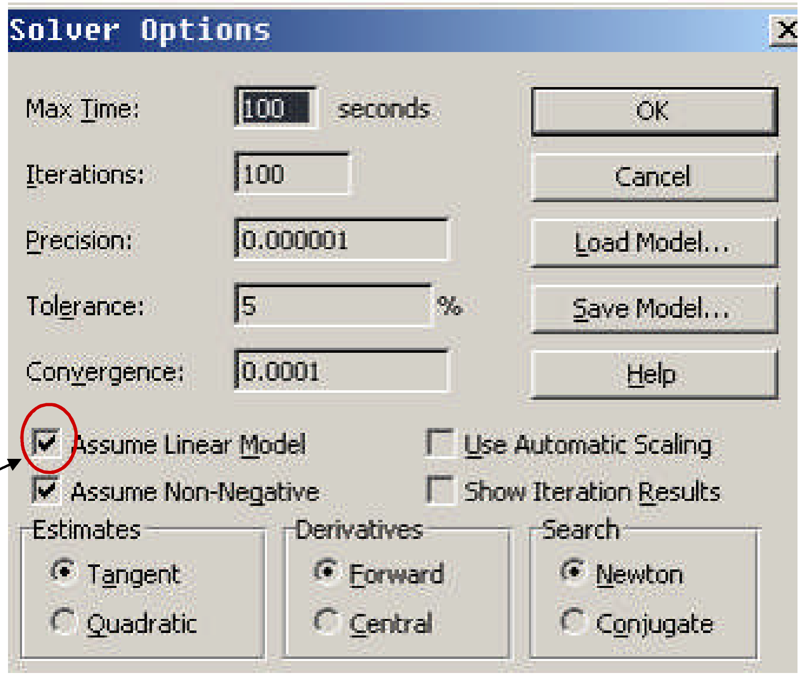
- Solver > Add constraints > Add
- Then click on icon and cells, example is numbered below, Excel will fill in the cell numbers details based on your clicks



Solver > Options

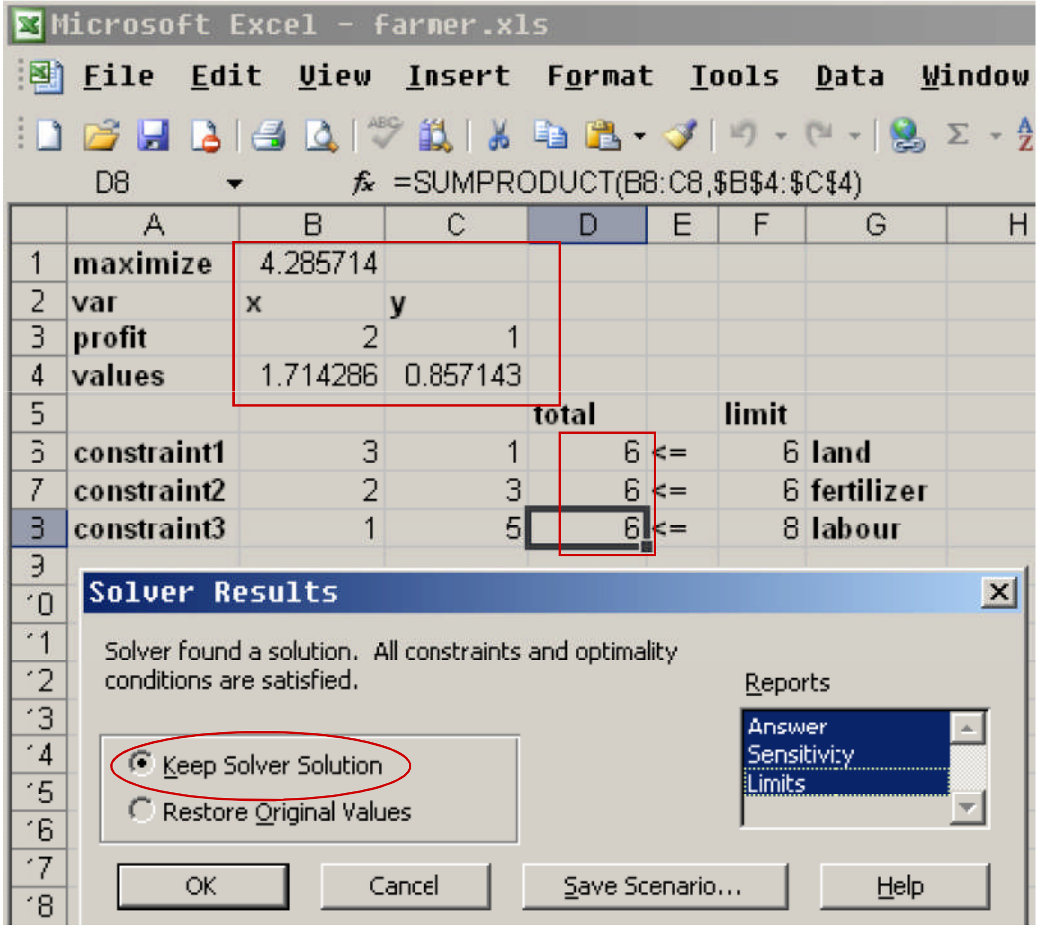
- The default solver options are good.

Simplex

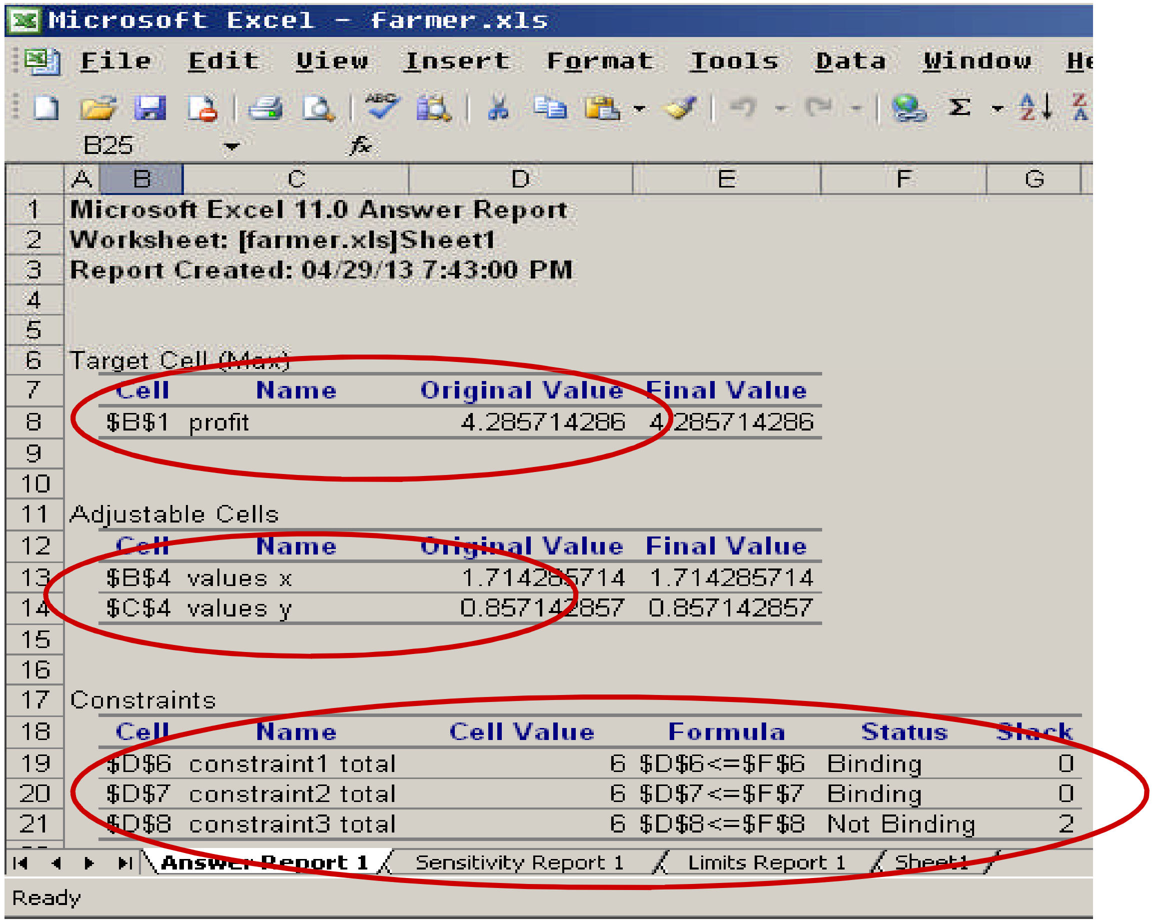


Solved (in 1 click and 1 second)

- x=1.714
- y=0.857
- z = 4.28



Answer report


Microsoft Excel - farmer.xls

File Edit View Insert Format Tools Data Window He

B25

Microsoft Excel 11.0 Answer Report

Worksheet: [farmer.xls]Sheet1

Report Created: 04/29/13 7:43:00 PM

Target Cell (Max)

Cell	Name	Original Value	Final Value
$B$1	profit	4.285714286	4.285714286

Adjustable Cells

Cell	Name	Original Value	Final Value
$B$4	values x	1.714285714	1.714285714
$C$4	values y	0.857142857	0.857142857

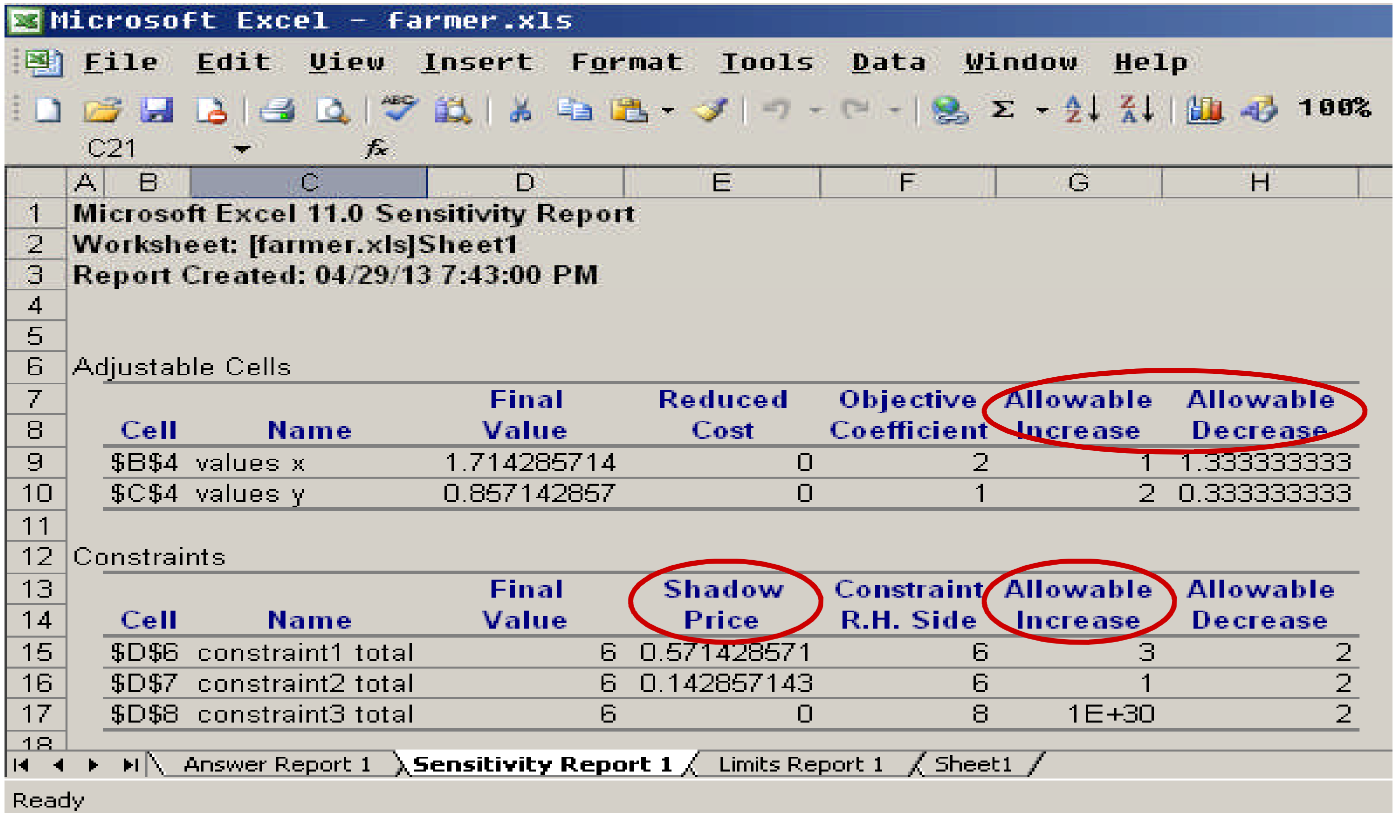
Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$D$6	constraint1 total	6	$D$6<=$F$6	Binding	0
$D$7	constraint2 total	6	$D$7<=$F$7	Binding	0
$D$8	constraint3 total	6	$D$8<=$F$8	Not Binding	2

Answer Report 1 / Sensitivity Report 1 / Limits Report 1 / Sheet1

Ready

Sensitivity report



Microsoft Excel - farmer.xls

Microsoft Excel 11.0 Sensitivity Report
Worksheet: [farmer.xls]Sheet1
Report Created: 04/29/13 7:43:00 PM

Adjustable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$B$4	values x	1.714285714	0	2	1	1.333333333
$C$4	values y	0.857142857	0	1	2	0.333333333

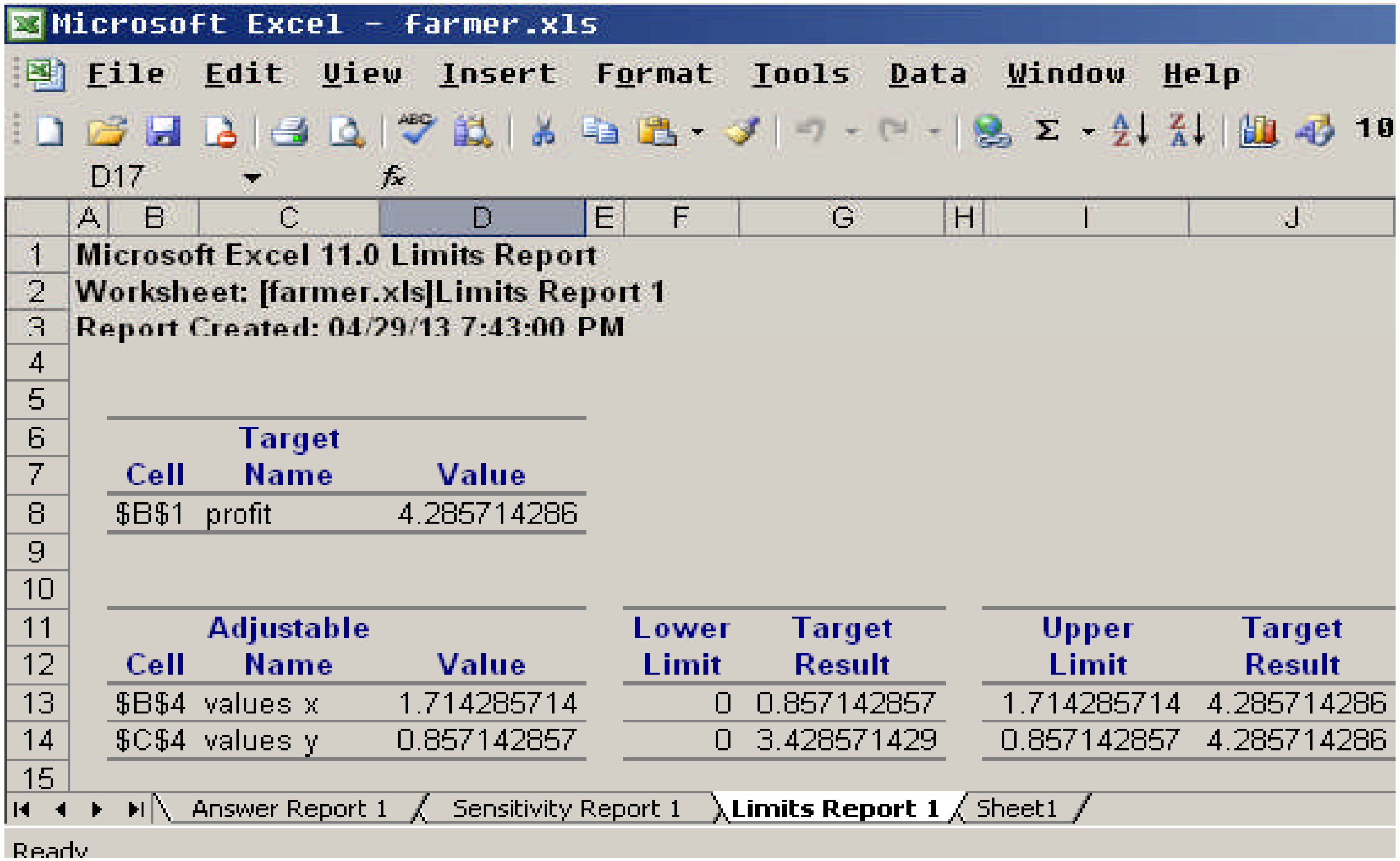
Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$D$6	constraint1 total	6	0.571428571	6	3	2
$D$7	constraint2 total	6	0.142857143	6	1	2
$D$8	constraint3 total	6	0	8	1E+30	2

Answer Report 1 | Sensitivity Report 1 | Limits Report 1 | Sheet1

Ready

Limits Report



Microsoft Excel - farmer.xls

Microsoft Excel 11.0 Limits Report
Worksheet: [farmer.xls]Limits Report 1
Report Created: 04/29/13 7:43:00 PM

Cell	Target Name	Value
$B$1	profit	4.285714286

Cell	Adjustable Name	Value	Lower Limit	Target Result	Upper Limit	Target Result
$B$4	values x	1.714285714	0	0.857142857	1.714285714	4.285714286
$C$4	values y	0.857142857	0	3.428571429	0.857142857	4.285714286

Answer Report 1 / Sensitivity Report 1 / Limits Report 1 / Sheet1

Ready

Farm Problem in Excel

- Use the attached xls file

Microsoft
Excel Worksheet

R 4 MBA

Statistical Programming Language

(slides merged into R-Intro and R-details)

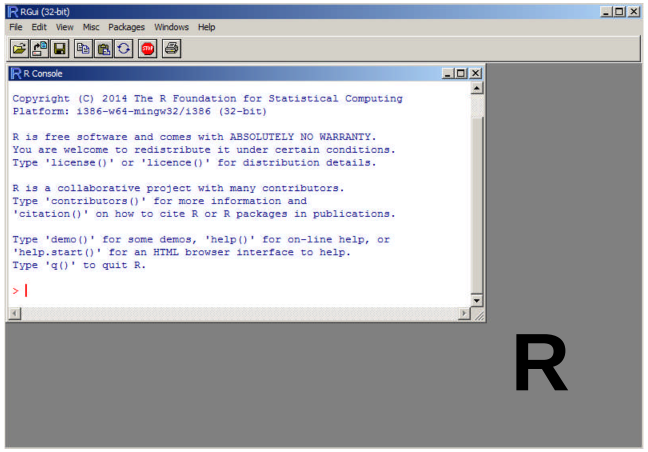
Presented by Kavya, Nishita, Nikita,
Jovita, Meet, Laxmi for
TechBugs, JKSHIM, 12/8/2014.

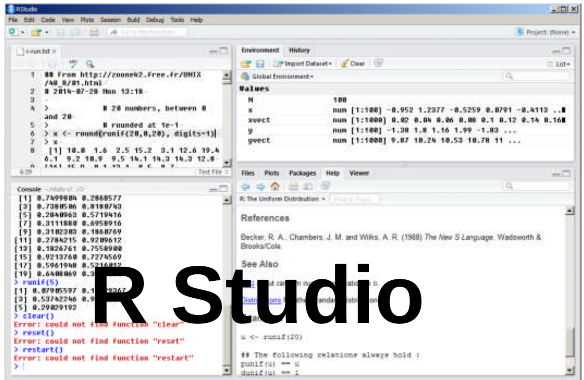
History of R

- Ross Ihaka and Robert Gentleman created R in 1993, in University of Auckland, New Zealand.
- R language is the programming language that you write your commands and run in.
- R is the successor to the S, the statistics language from Bell Labs in 1976.

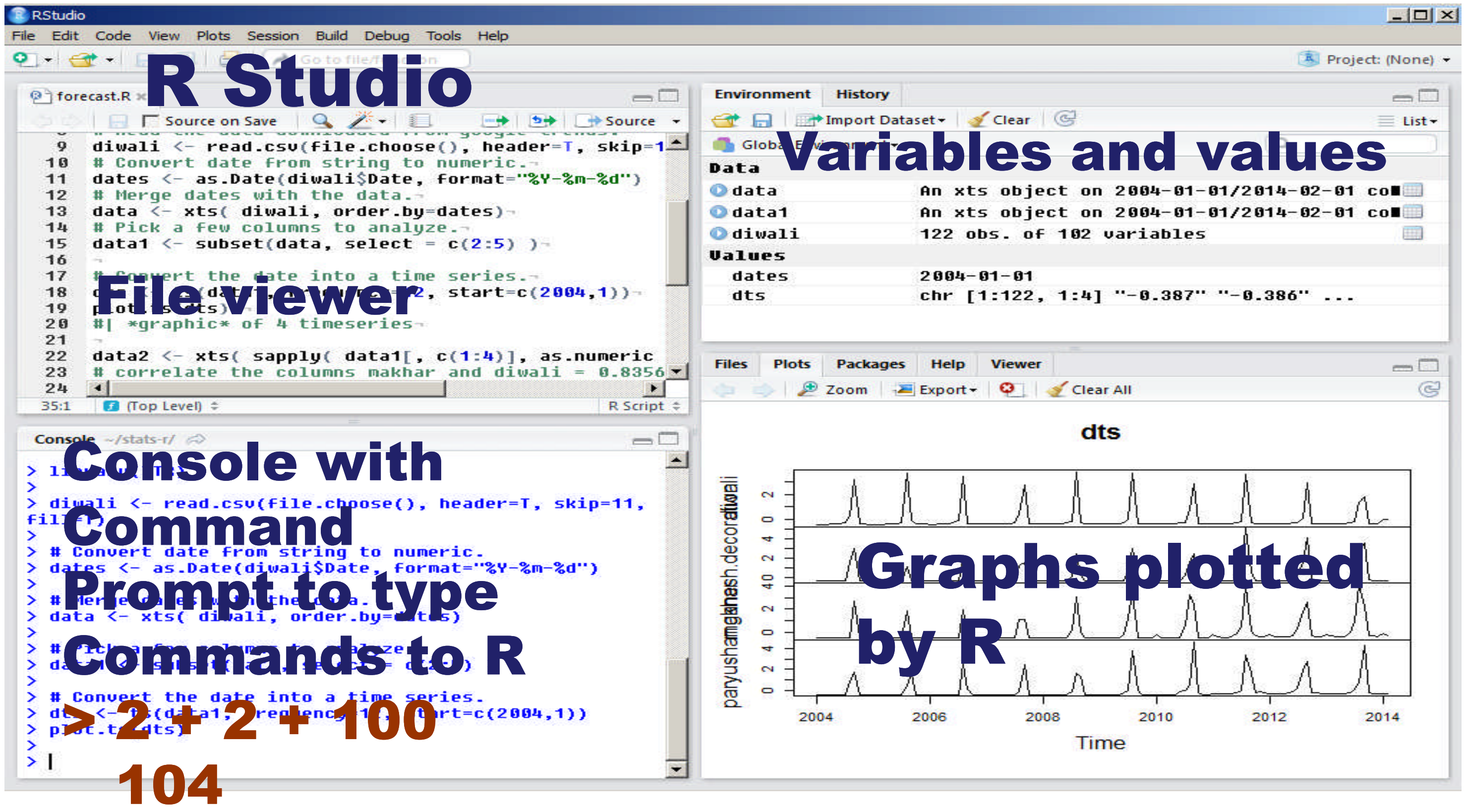
Installing R

- Google “R stats windows download”
- Download R and R-Studio
- Install R and R-Studio
- Start R by clicking on it





R Studio

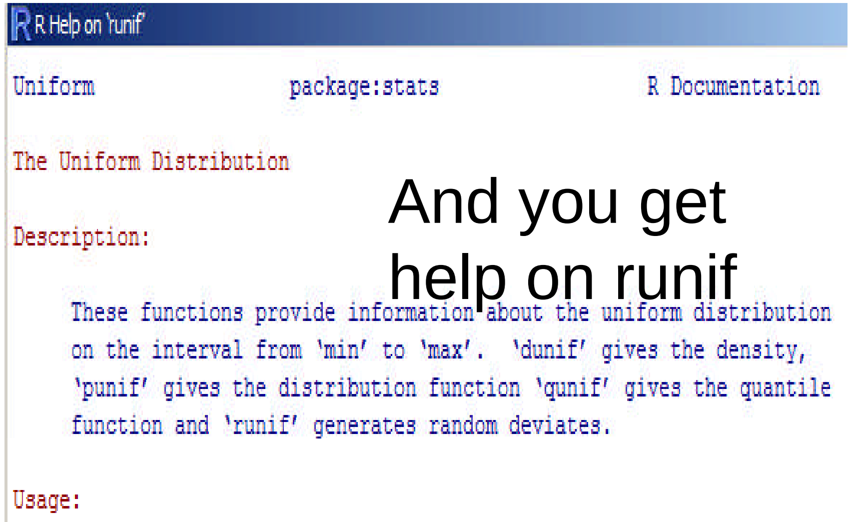

R Studio
File viewer
Variables and values
Console with Command Prompt to type Commands to R
> 2 + 2 + 100
104
Graphs plotted by R

Workflow in R

1. Read Data into R
2. Analyze Data
3. Visualize Data
4. Make Conclusions from Data

Help in R Studio

> ?runif


R Help on 'runif'

Uniform package:stats R Documentation

The Uniform Distribution

Description:

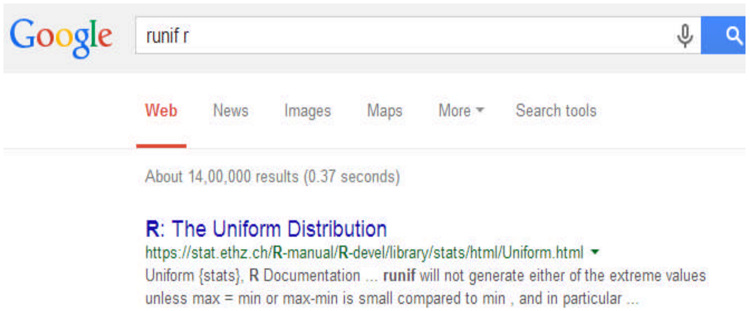
These functions provide information about the uniform distribution on the interval from 'min' to 'max'. 'dunif' gives the density, 'punif' gives the distribution function 'qunif' gives the quantile function and 'runif' generates random deviates.

Usage:

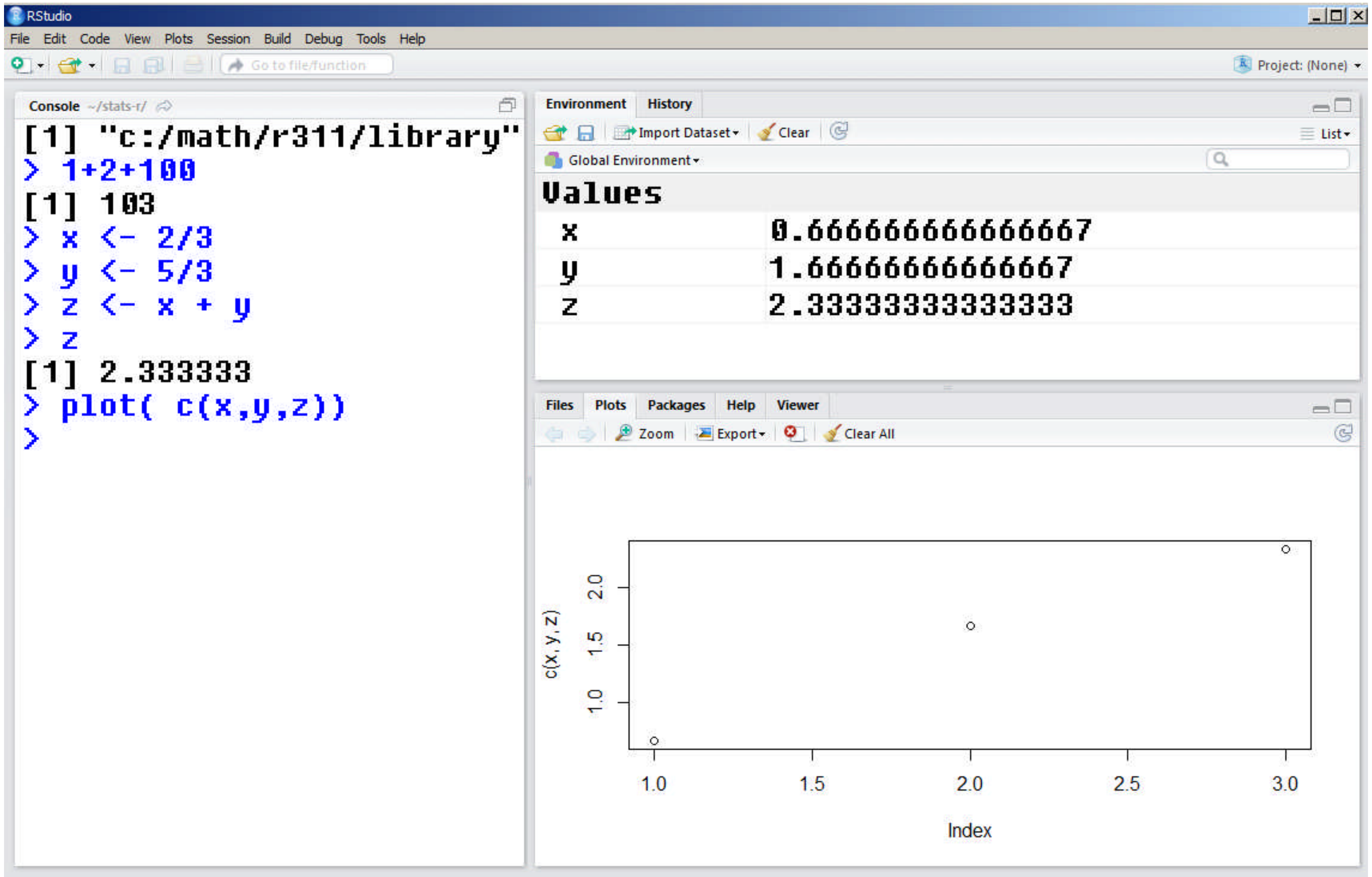
And you get help on runif

Or google

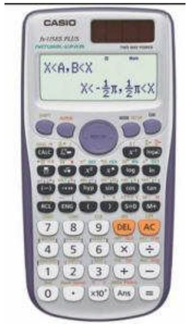
R statistics runif



R as a calculator



R as a Scientific calculator




```
> 1+1/2+1/3+2/3
[1]    2.5

> 1/0               # undefined to divide by zero
[1] Inf             # Infinite

> 0/0
[1] NaN             # undefined, not-a-number

> sqrt(2i)          # Complex numbers
[1] 1+1i
```

R Command Prompt

1. Start R by clicking on its icon

```
>  # Comment lines are  ignored by R

> 2+2    # You type commands at the R prompt.
[1]   4      # Result '4' printed by R, ignore [1].

> 1+1/2+1/3+2/3
[1]    2.5
```

Vector of numbers

```
# Sequence of numbers from 1 : to 10
> 1:10
[1]  1  2  3  4  5  6  7  8  9 10

# Create 4 numbers and save the
# vector in variable named u.
> u   <-   c(1, 4, 0, -2)
```

Sequence, vector

```
> 1:5                  #   1 2 3 4 5
> c(1,2,3,4,5)         #   1 2 3 4 5
> seq( 0, 4, len=3)    #   0 2 4
> seq( 0, 4, by=2)     #   0 2 4

> c(a=1, b=5, c=10)  # Named vector
  a   b   c
  1   5   10
```

summary(data)

```
> u  <-  c(1, 4, 0, -2)
> summary(u)
Min.    1Q.    Median  Mean   3Q.   Max.
-2      -0.5    0.5     0.75   1.75   4
```

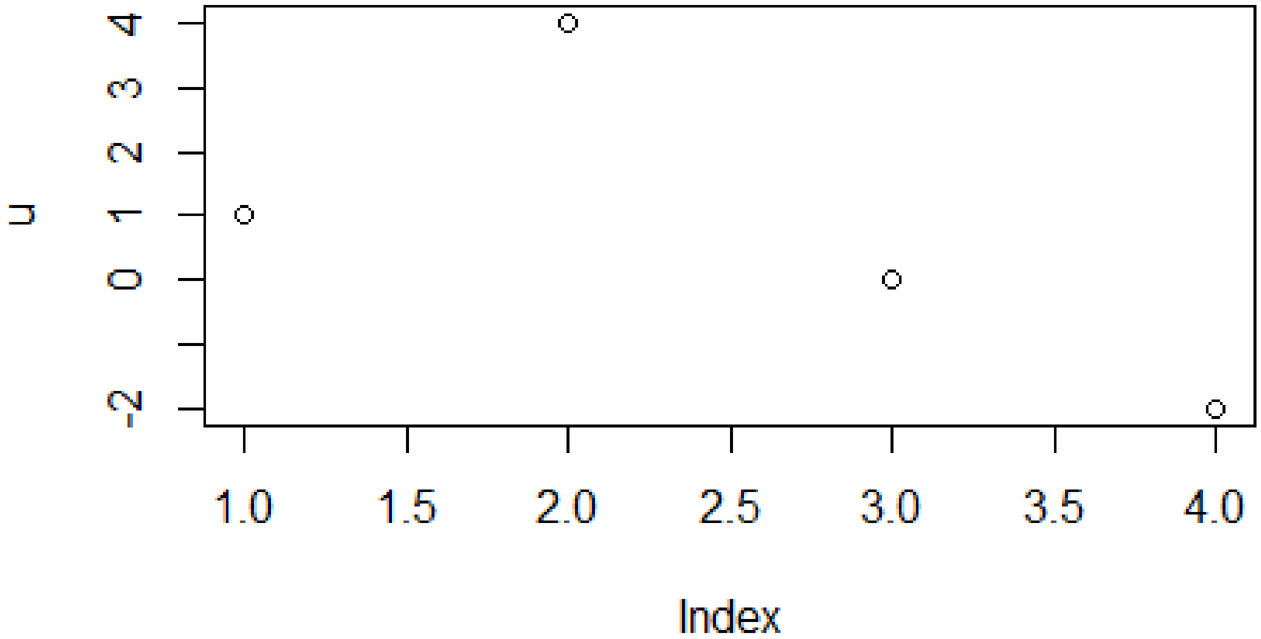
quantile(data)

```
> u   <-   c(1, 4, 0, -2)
> quantile(u)
  0%     25%    50%   75% 100%
 -2     -0.5    0.5   1.75  4

> quantile(u, c(0,.33,.66,1))
   0%    33%  66% 100%
  -2    -0.02  0.98  4
```

plot(data)

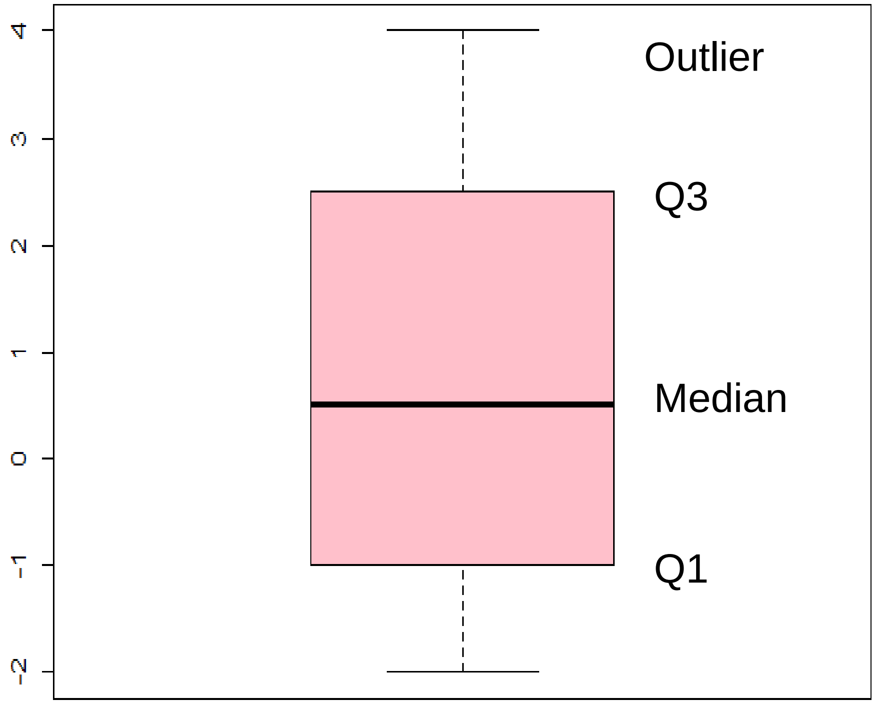
> u <- c(1, 4, 0, -2)

> plot(u)



boxplot(data)

```
> u   <-   c(1, 4, 0, -2)
> boxplot(u)
```

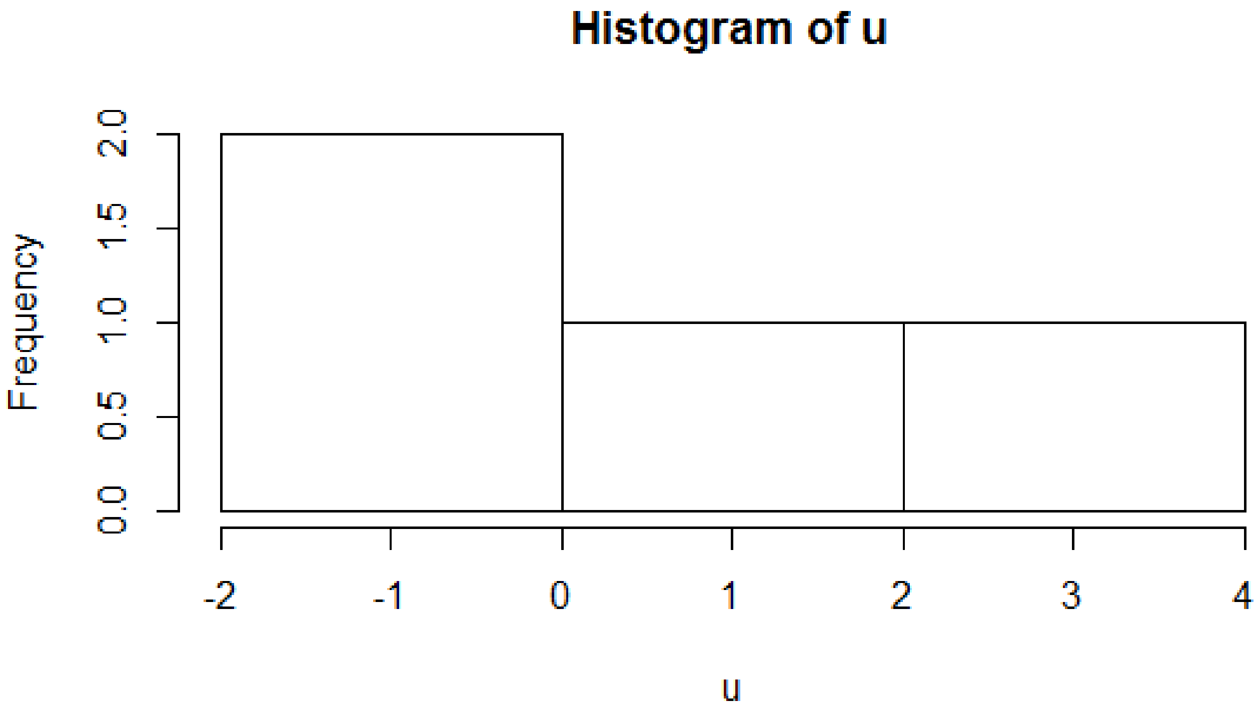



```
> median(u)
0.5
```

```
> summary(u)
   Min.   1Q.    Median Mean  3Q.    Max.
   -2     -0.5    0.5     0.75  1.75   4
```

histogram(data)

```
> u  <-  c(1, 4, 0, -2)
> hist(u)
```



Statistical functions

```
> u   <-   c(1, 4, 0, -2)
> mean(u)
  0.75
> sd(u); max(u); min(u); median(u); var(u)
   2.5,     4,        -2,         0.5,          6.25
> sum(u) ; length(u)
  3,           4,
```

Not Available: NA and NaN

```
> str( log ( c(-1,   0,    1,   2,     NA ) ) )
            NaN  -Inf   0  0.693   NA
Warning ..  NaNs produced

> is.finite(  log(c(-1, 0, 1, 2, NA))  )
                  F F  T  T  F
```

Dealing with Missing Values

```
> x <- c(1,5,9,NA,2)
> mean(x)
  NA     # NA = Not Available

# Find mean after removing NA
> mean(x, na.rm=T)
 4.25

# Find NA in x
> is.na(x)
F F F T F
```

Make some random numbers

```
# Make 3 random uniform numbers
> runif(3)
   0.428   0.142    0.877

# Make 3 numbers between 5 to 10
> runif(3, 5,10)
    6.749    8.611    8.108
```

Random numbers

```
# Generate 3 random numbers in
# the range 5 to10,
# round them to 1 decimal digit.

> round( runif(3, 5, 10), digits=1)
[1]   5.5   9.7    9.5
```

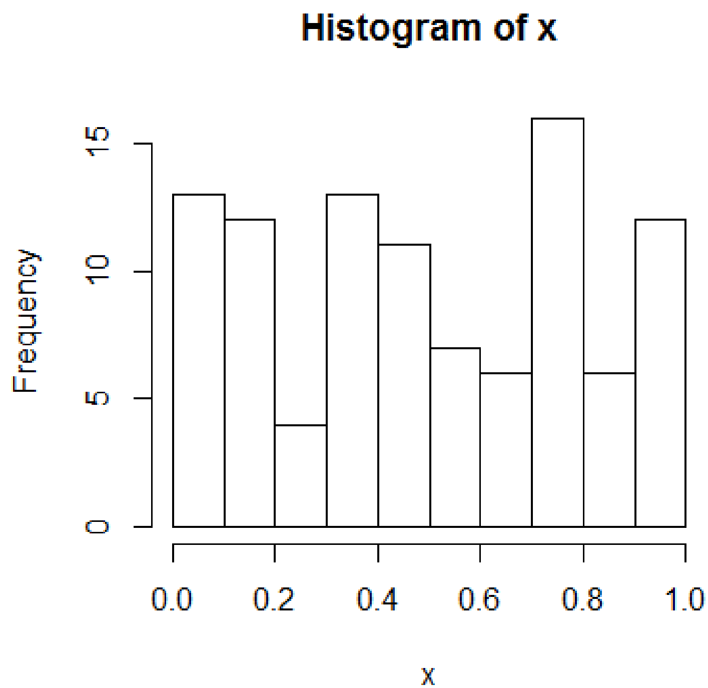
Save the numbers in variable y

```
# Save 3 numbers in a variable named y
>    y <- runif(3)
# See what's in y
>    y
[1]  0.179  0.384   0.176
```

Histogram

Save100 numbers in a
variable named x
\> x <- runif(100)

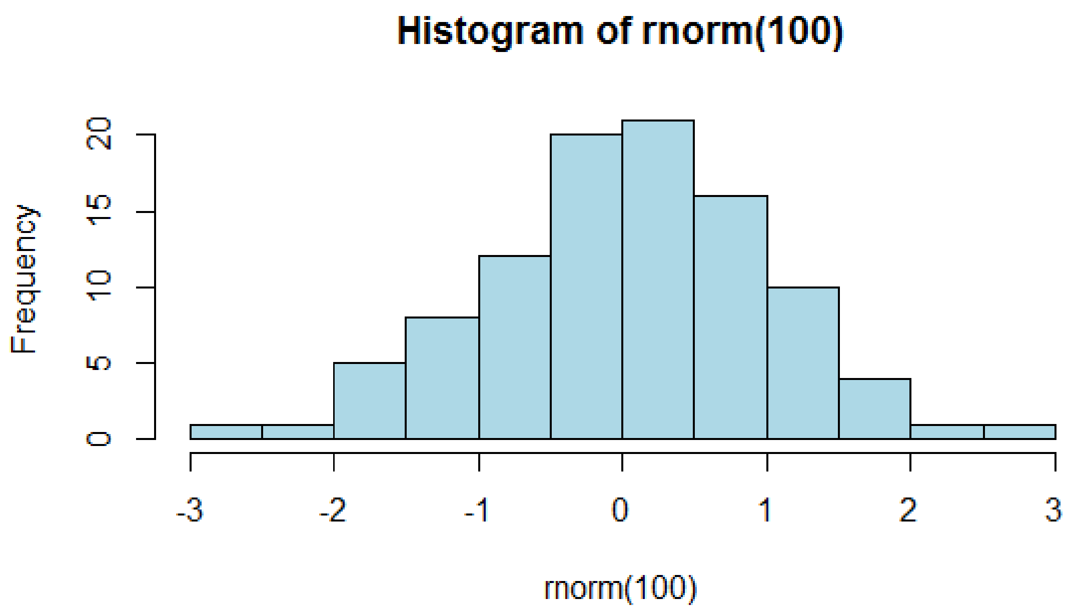
Plot the histogram
\> hist(x)



Histogram of normal random numbers in blue color

100 normal distributed random numbers

> hist(rnorm(100), col="light blue“)



To roll a Dice (Die) 10 times.

```
> sample(1:6, 1)  # one throw
  2
```

```
# Throw dice 10 times
> sample( 1:6, 10, replace=T)
    5 6 3 2 5 5 3 4 1 6
```

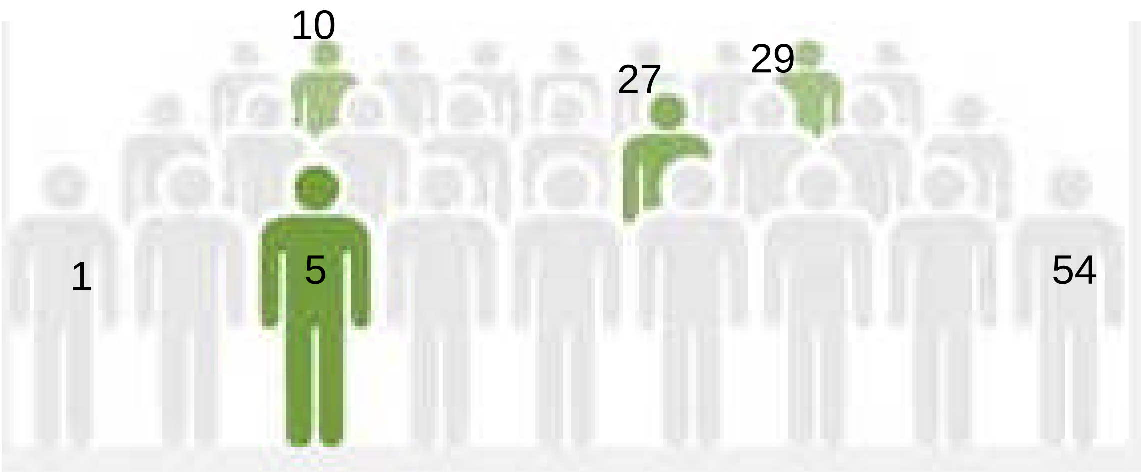
Replace=T means, the same number can repeat.
Replace=F means, each number can appear only once.

Toss a coin 10 times.

```
> sample(c("H","T"),10,replace=TRUE)
  "T" "H" "H" "H" "T" "H" "T" "H" "T" "T"
```

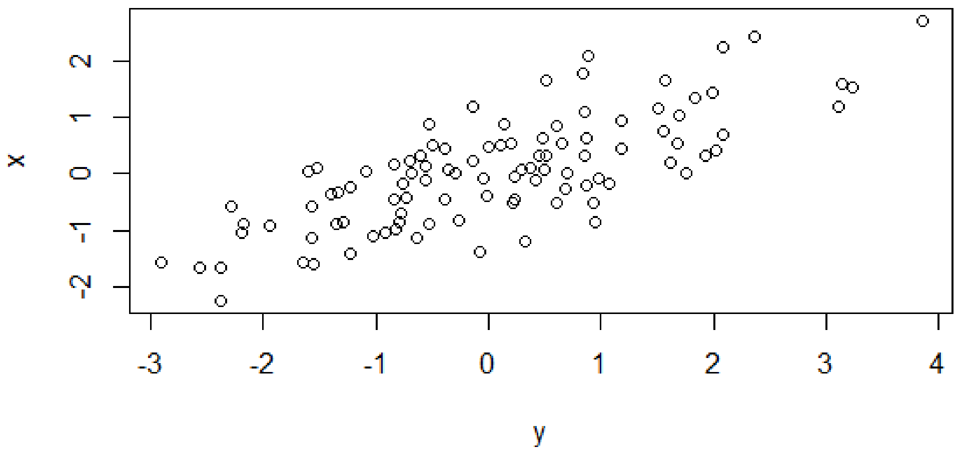
Select 4 different students from a class of 54 students

```
> sample(1:54, 4)  # default is no replacement
[1] 27  5 10 29
```



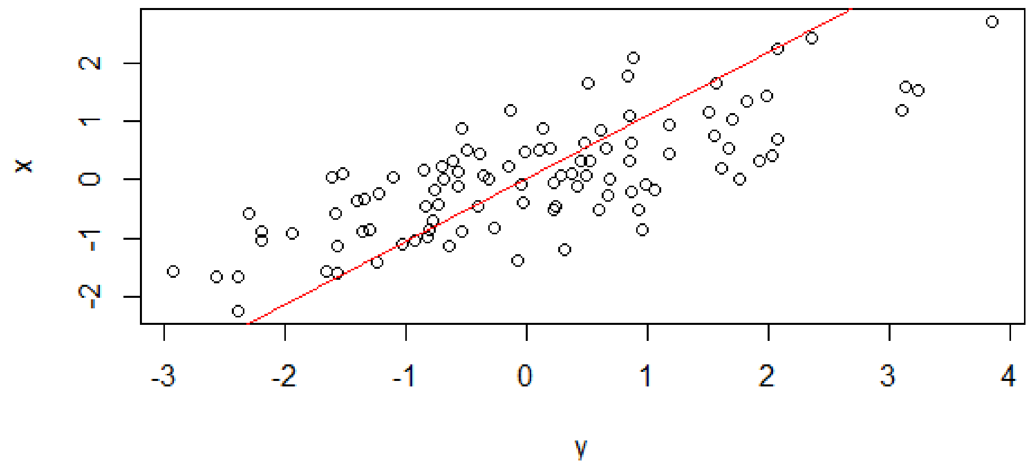
Scatter plot of two variables

```
> x <- rnorm(100)
> y <- x + rnorm(100)
> plot( x ~ y)
```



Add a Regression Line

```
> x <- rnorm(100)
> y <- x + rnorm(100)
> plot( x ~ y)
> abline( lm(y ~ x), col = "red" )
```



Sharing Data with Excel

Data sharing with Excel, SPSS

```
# Reading excel csv data files
sales <- read.csv( file.choose() )
prices <- read.csv(“prices-2012.csv”)

# Load the foreign package
library(foreign)
# Import the spss data file
read.spss("newData.sav")
```

Data frame (excel sheet)

```
# 3 columns: a, b c
> x <- data.frame(a=1:3, b=5:7,
  c=11:13 )
> x
    a b c
1   1 5 11
2   2 6 12
3   3 7 13
```

> x$a   # Get column ‘a’ of x, same as x[[‘a’]]
  1 2 3

Columns of a data frame

```
> x$c <- NULL      # delete column c.
> x$d <- 21:23     # add new column d.
> x
    a  b  d
1   1  5  21
2   2  6  22
3   3  7  23
```

cbind to Combine two sheets

```
> y <- 31:33
> cbind( x, y)
  a b d  y
1 1 5 21 31
2 2 6 22 32
3 3 7 23 33
```

Omit rows with NA data

```
> x <- c(1,2,NA,4)
> d <- data.frame(x, y=rev(x))
> d
   x  y
1  1  4
2  2 NA
3 NA  2
4  4  1
> na.omit(d)    # Remove rows with NA
1  1  4
2  4  1
```

Matrix

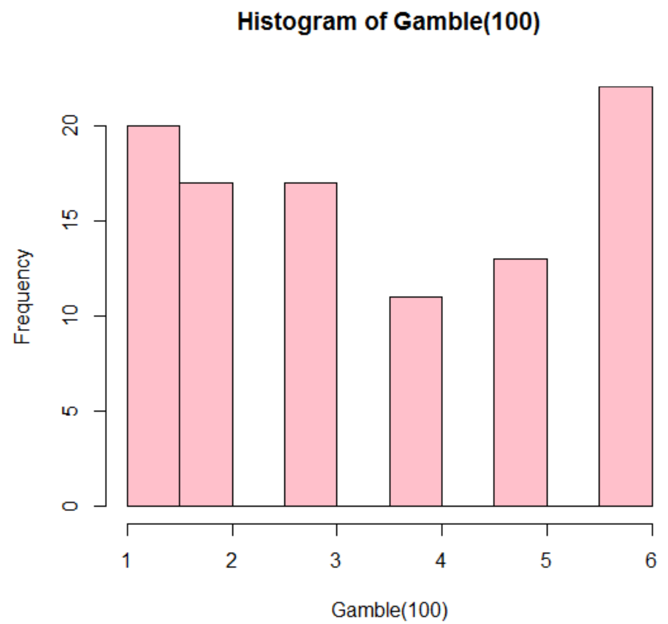
```
> m <- matrix( c(1,2,3,4), nrow=2)
> m
      [,1]  [,2]
[1,]   1     3        # Row 1
[2,]   2     4        # Row 2

> det(m)   # Determinant of m=1x4-2x4
 -2
```

Define your own function

Create a function.
> Gamble = function(n)
sample(1:6, n, replace=T)

Call Gamble with n=4
> Gamble(4)
[1] 3 4 3 6

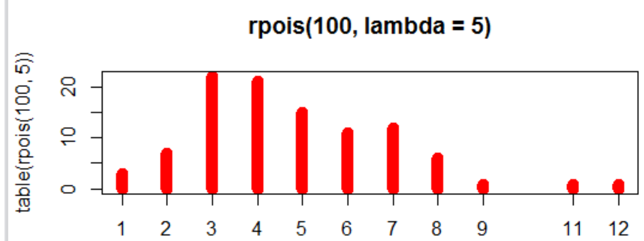
Plot Gamble
> hist(Gamble(100),
col="pink")



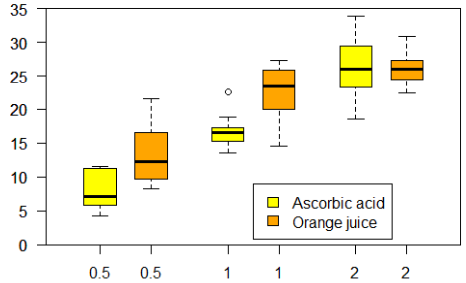
Builtin Examples

Try these examples in R

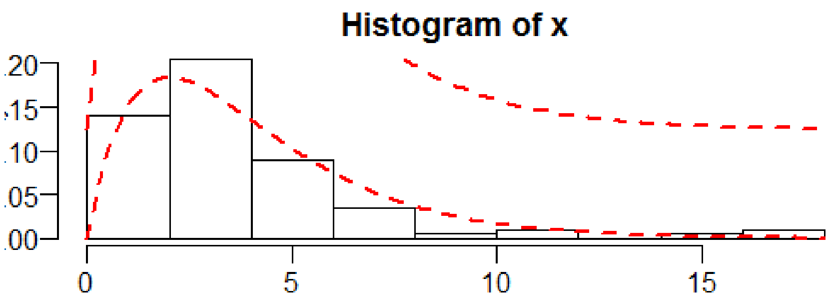
> example(plot)



> example(boxplot)



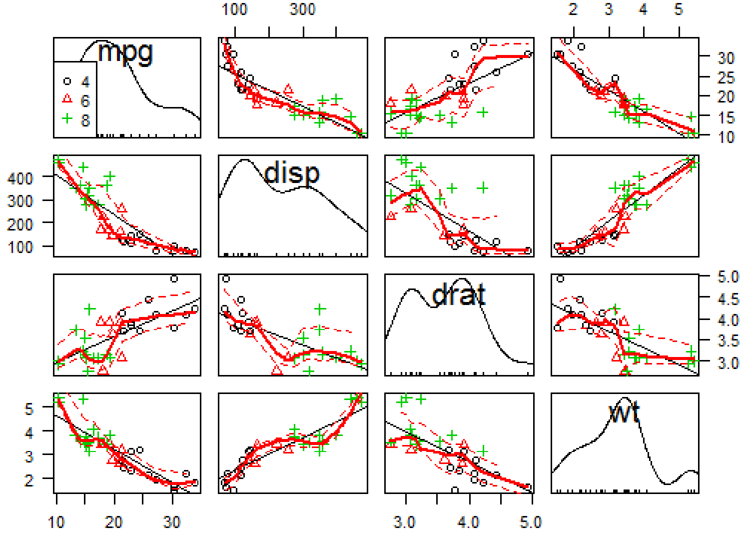
> example(hist)



Playing with Builtin Data

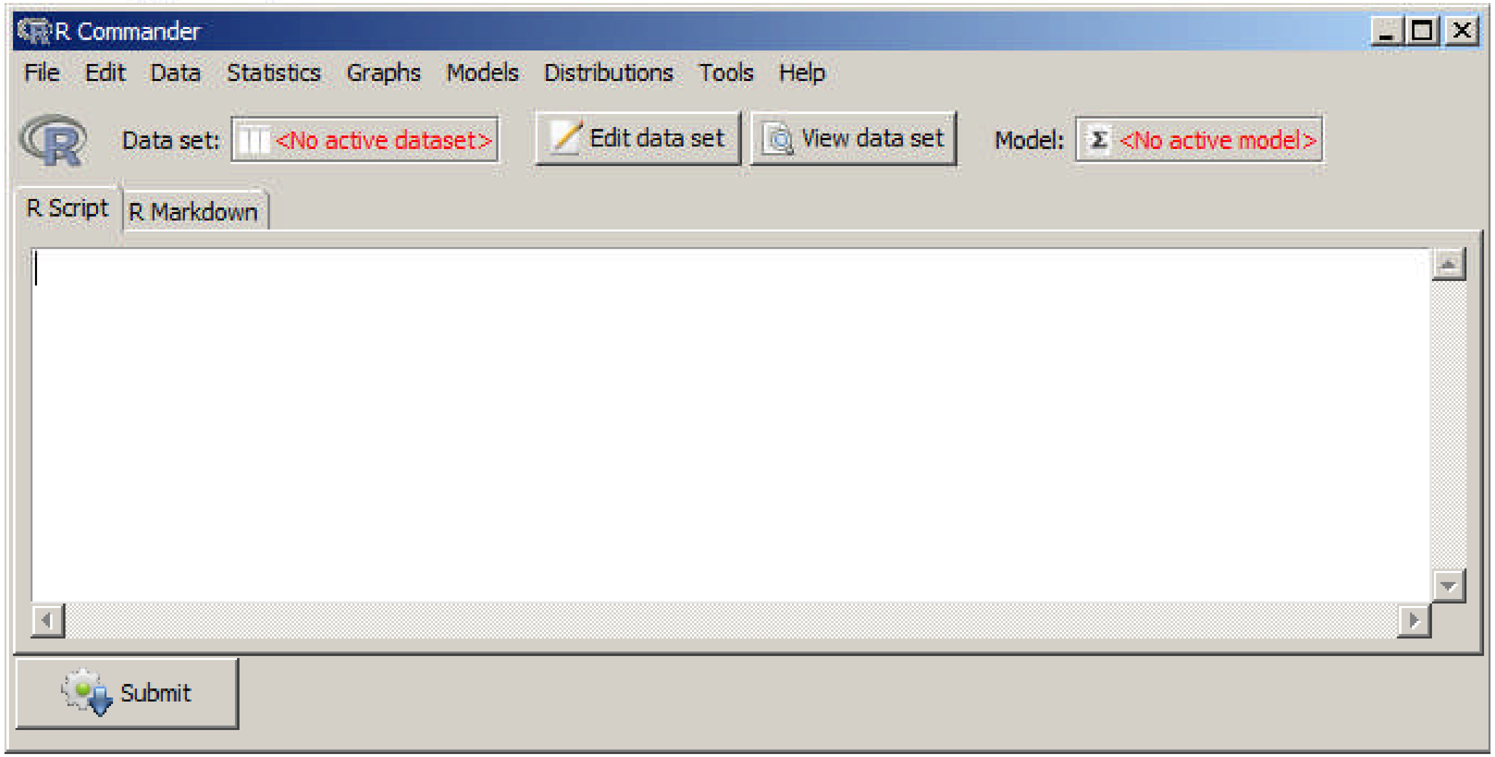
Scatterplot Matrices from the car Package

```
> library(car)
> scatterplotMatrix( ~mpg +disp +drat +wt |cyl,
     data=mtcars)
```



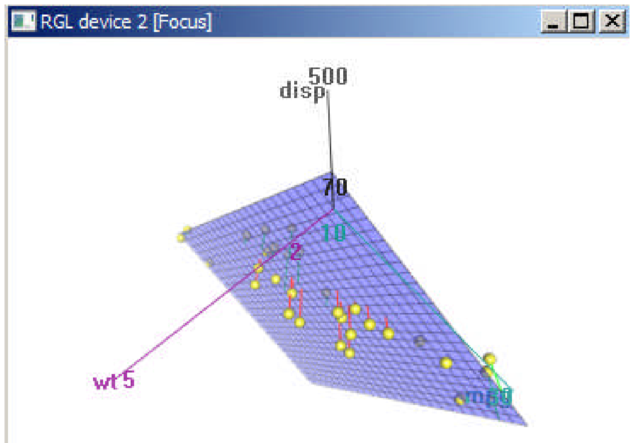
R Commander: Rcmdr

```
> library(Rcmdr)
```



3D graphs

```
> library(Rcmdr)
> attach(mtcars)          # see ?mtcars
> scatter3d(wt, disp, mpg)
```



References

1. Intro to R, Venables and Smith, http://cran.r-project.org/doc/manuals/R-intro.pdf http://cran.r-project.org/manuals.html
2. Basic Statistics tests in R, http://www.statmethods.net/stats/index.html
3. Advanced Probability/Statistics in R, http://zoonek2.free.fr/UNIX/48_R/all.html
4. More Statistics tests in R, http://www.ats.ucla.edu/stat/r/whatstat/whatstat.htm
5. 7 lectures on Financial Trading with R, http://www.rfortraders.com/

R 4 MBA
Introduction to R

R is Statistical Programming Language

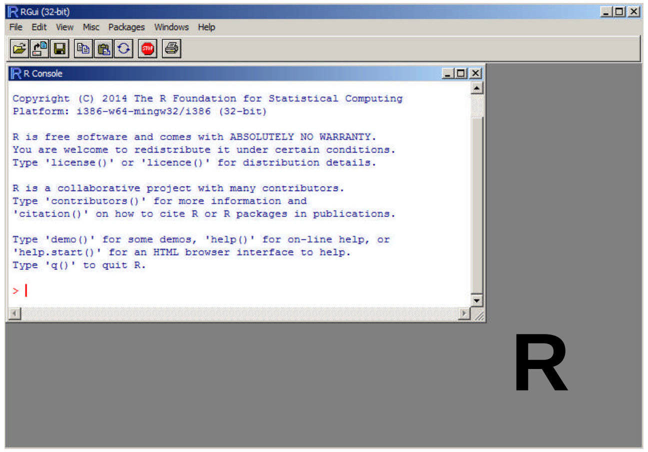
Moshahmed@gmail.com
JKSHIM, 16/4/16.

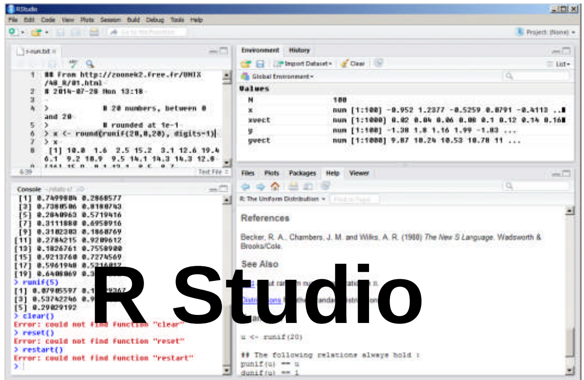
History of R

- Ross Ihaka and Robert Gentleman created R in 1993, in University of Auckland, New Zealand.
- R language is the programming language that you write your commands and run in.
- R is the successor to the S, the statistics language from Bell Labs in 1976.

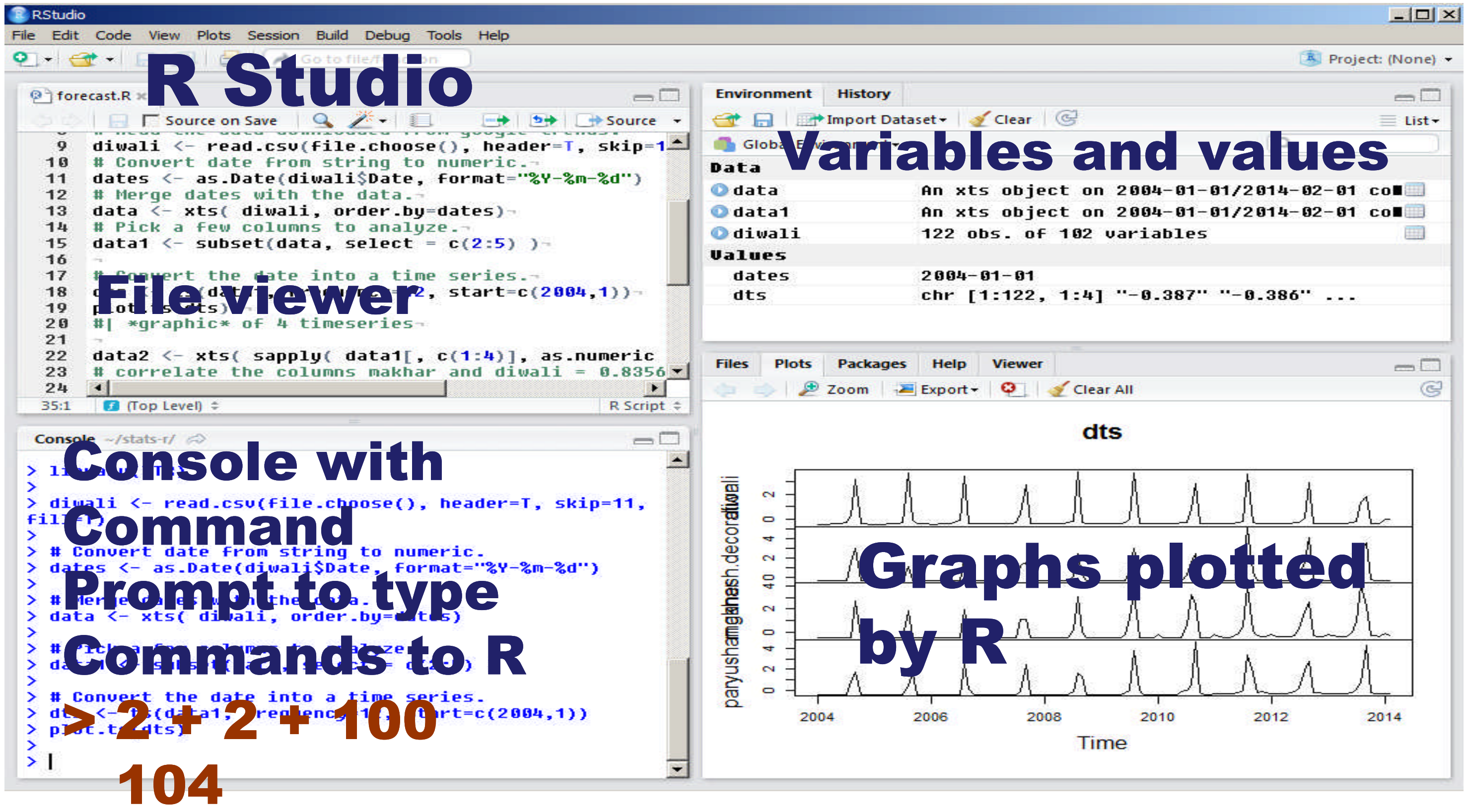
Installing R

- Google “R stats windows download”
- Download R and R-Studio
- Install R and R-Studio
- Start R by clicking on it





R Studio

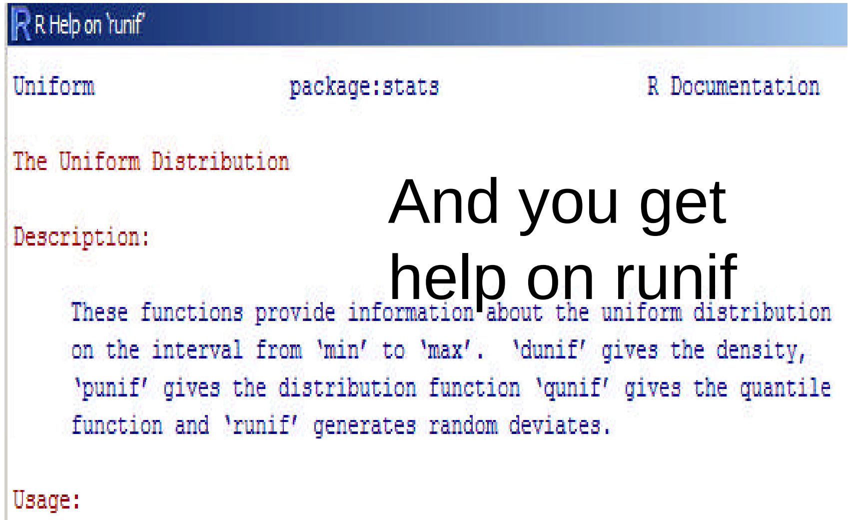

R Studio
File viewer
Variables and values
Console with Command Prompt to type Commands to R
> 2 + 2 + 100
104
Graphs plotted by R

Workflow in R

1. Read Data into R
2. Analyze Data
3. Visualize Data
4. Make Conclusions from Data

Help in R Studio

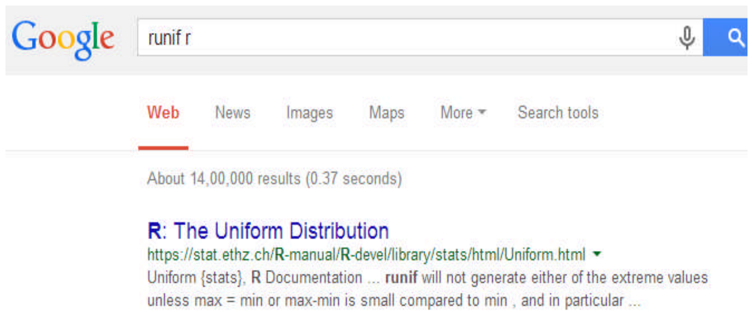
> ?runif



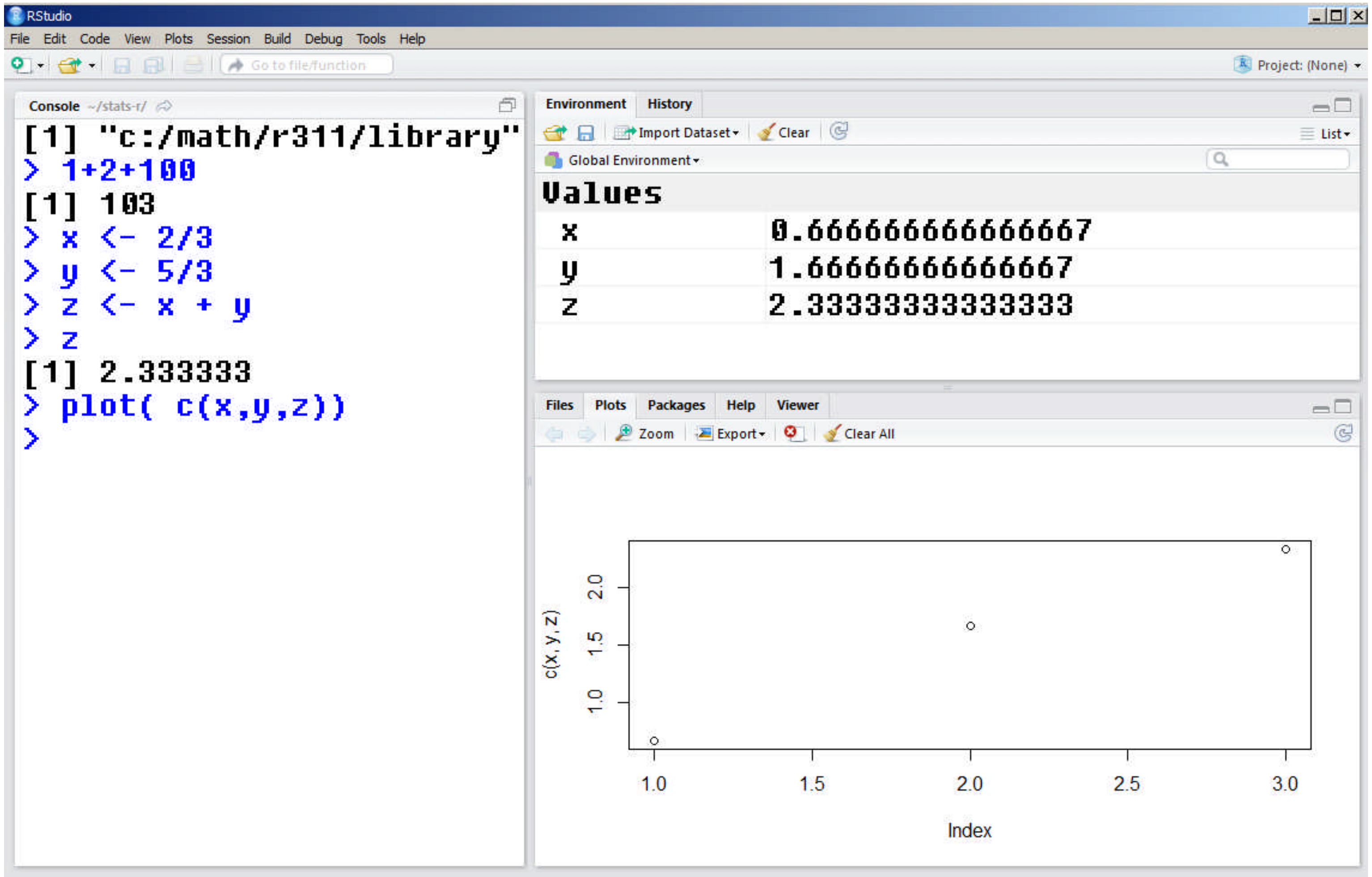
And you get help on runif

Or google

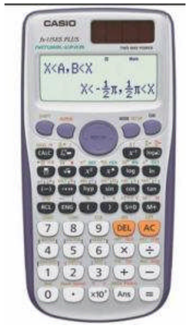
R statistics runif



R as a calculator



R as a Scientific calculator



```
> 1+1/2+1/3+2/3
[1]   2.5

> 1/0                # undefined to divide by zero
[1] Inf              # Infinite

> 0/0
[1] NaN              # undefined, not-a-number

> sqrt(2i)           # Complex numbers
[1] 1+1i
```

R Command Prompt

1. Start R by clicking on its icon

```
>   # Comment lines are  ignored by R

> 2+2    # You type commands at the R prompt.
[1]   4       # Result '4' printed by R, ignore [1].

> 1+1/2+1/3+2/3
[1]    2.5
```

Vector of numbers

```
# Sequence of numbers from 1 : to 10
> 1:10
[1]  1  2  3  4  5  6  7  8  9 10

# Create 4 numbers and save the
# vector in variable named u.
> u   <-   c(1, 4, 0, -2)
```

Sequence, vector

```
> 1:5                      #   1 2 3 4 5
> c(1,2,3,4,5)             #   1 2 3 4 5
> seq( 0, 4, len=3)        #   0 2 4
> seq( 0, 4, by=2)         #   0 2 4

> c(a=1, b=5, c=10)  # Named vector
  a    b    c
  1    5   10
```

summary(data)

```
> u   <-   c(1, 4, 0, -2)
> summary(u)
Min.     1Q.     Median  Mean    3Q.    Max.
-2       -0.5     0.5        0.75    1.75    4
```

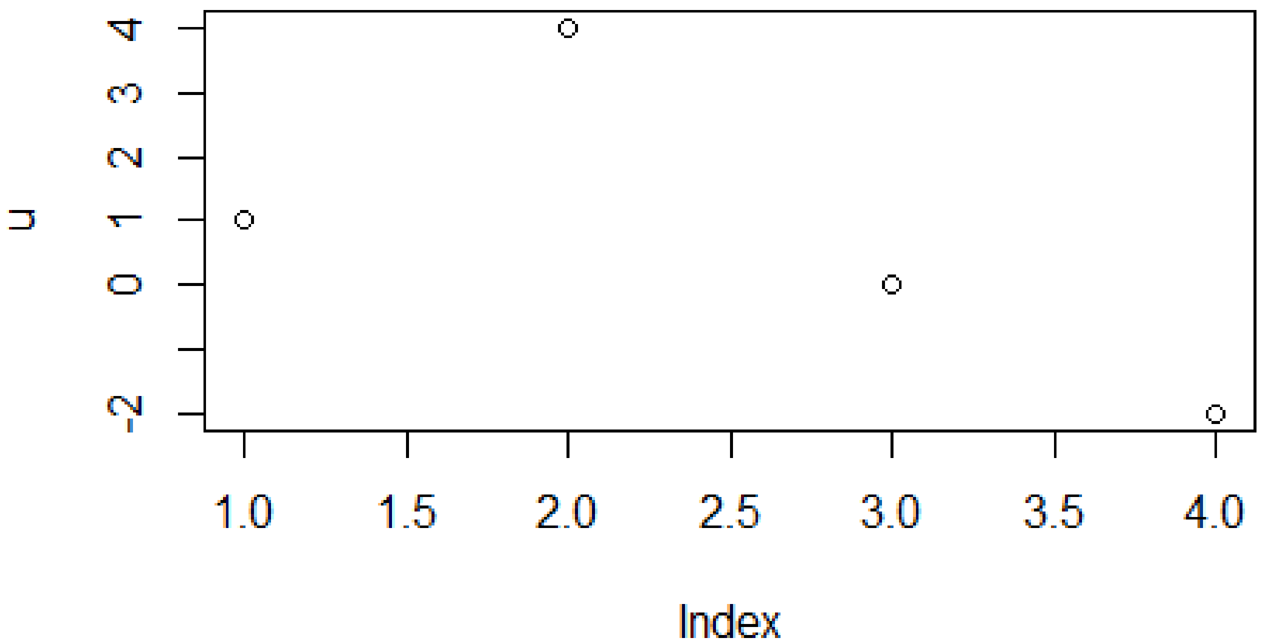
quantile(data)

```
> u   <-   c(1, 4, 0, -2)
> quantile(u)
  0%     25%    50%   75% 100%
 -2     -0.5    0.5   1.75  4

> quantile(u, c(0,.33,.66,1))
   0%    33%   66% 100%
  -2    -0.02  0.98  4
```

plot(data)

> u <- c(1, 4, 0, -2)

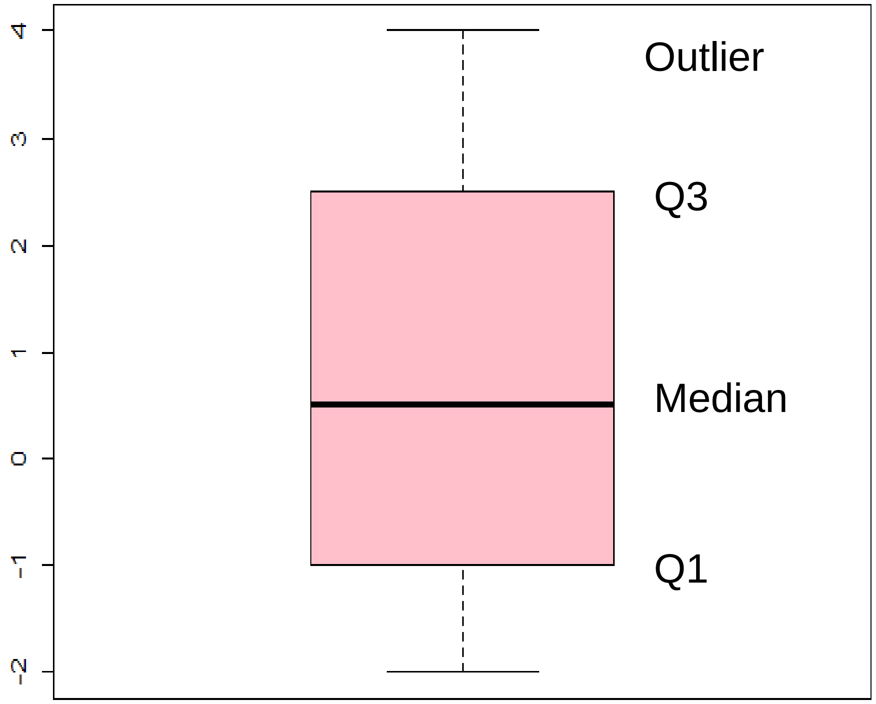
> plot(u)



boxplot(data)

> u <- c(1, 4, 0, -2)

> boxplot(u)



> median(u)

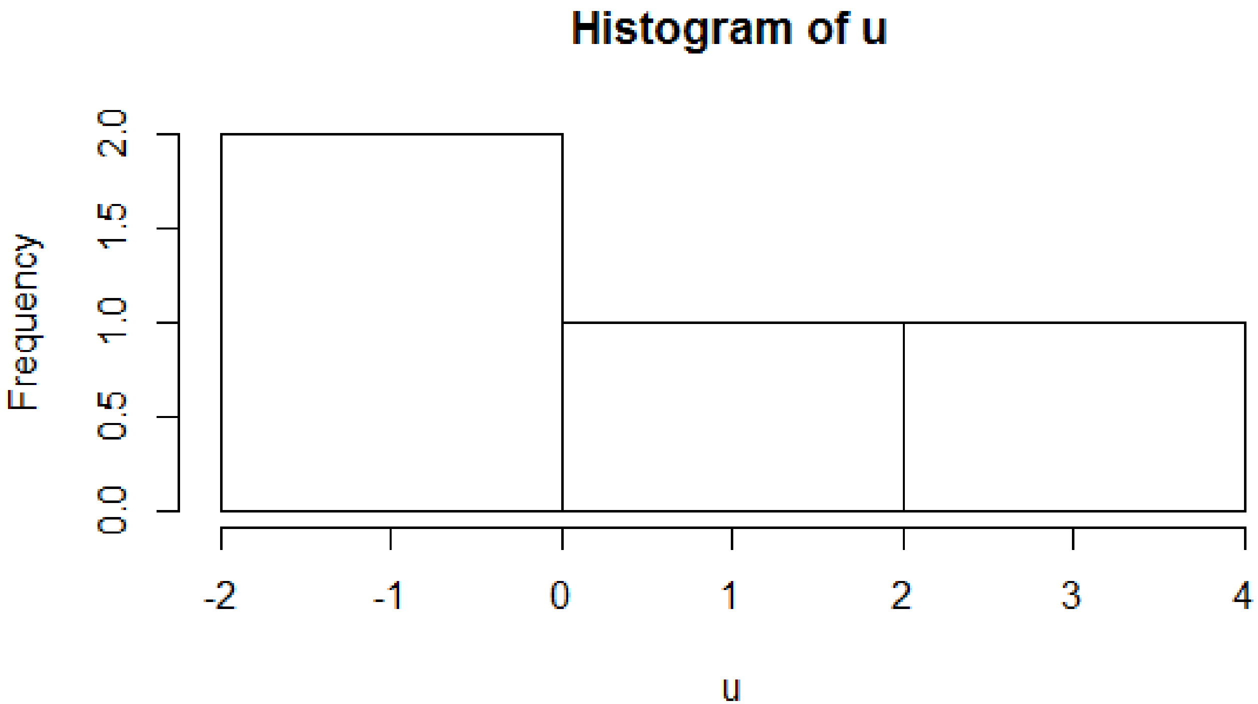
0.5

> summary(u)

Min.	1Q.	Median	Mean	3Q.	Max.
-2	-0.5	0.5	0.75	1.75	4

histogram(data)

```
> u  <-  c(1, 4, 0, -2)
> hist(u)
```



Statistical functions

```
> u   <-   c(1, 4, 0, -2)
> mean(u)
   0.75
> sd(u); max(u); min(u); median(u); var(u)
    2.5,      4,         -2,          0.5,            6.25
> sum(u) ; length(u)
   3,           4,
```

Not Available: NA and NaN

```
> str( log ( c(-1,   0,    1,   2,     NA ) ) )
             NaN  -Inf   0  0.693   NA
Warning ..  NaNs produced

> is.finite(  log(c(-1, 0, 1, 2, NA))  )
                      F F  T  T  F
```

Dealing with Missing Values

```
> x <- c(1,5,9,NA,2)
> mean(x)
  NA     # NA = Not Available

# Find mean after removing NA
> mean(x, na.rm=T)
 4.25

# Find NA in x
> is.na(x)
F F F T F
```

Make some random numbers

```
# Make 3 random uniform numbers
> runif(3)
   0.428   0.142    0.877

# Make 3 numbers between 5 to 10
> runif(3, 5,10)
    6.749    8.611    8.108
```

Random numbers

```
# Generate 3 random numbers in
# the range 5 to10,
# round them to 1 decimal digit.

> round( runif(3, 5, 10), digits=1)
[1]   5.5   9.7    9.5
```

Save the numbers in variable y

```
# Save 3 numbers in a variable named y
>    y <- runif(3)
# See what's in y
>     y
[1]   0.179   0.384    0.176
```

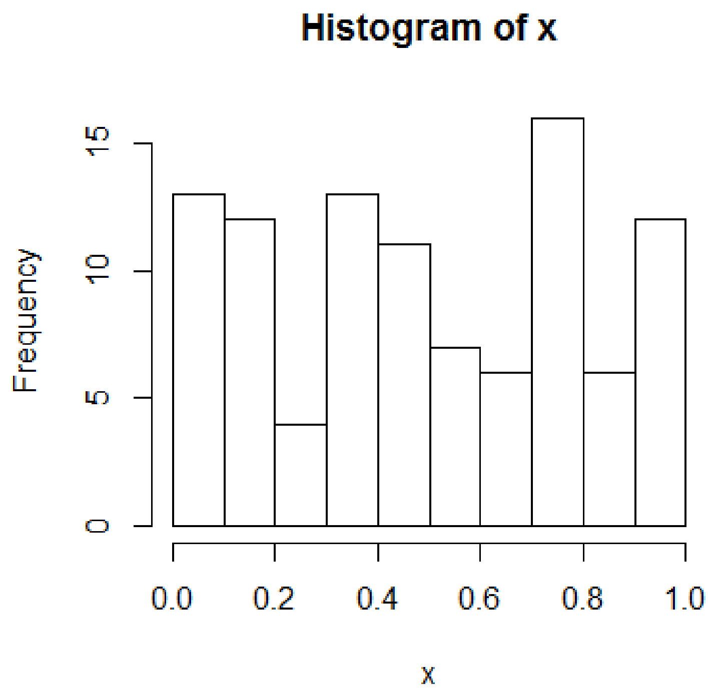
Histogram

Save100 numbers in a
variable named x

```
>    x <- runif(100)
```

Plot the histogram

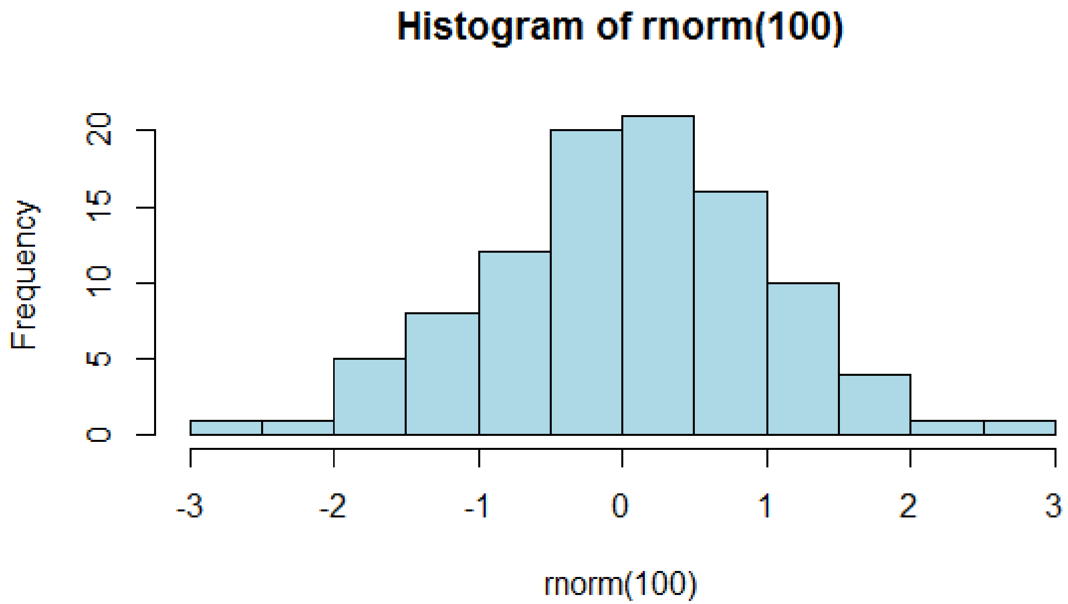
```
>   hist( x )
```



Histogram of normal random numbers in blue color

100 normal distributed random numbers

> hist(rnorm(100), col="light blue“)



To roll a Dice (Die) 10 times.

```
> sample(1:6, 1)  # one throw
  2

# Throw dice 10 times
> sample( 1:6, 10, replace=T)
   5 6 3 2 5 5 3 4 1 6
```

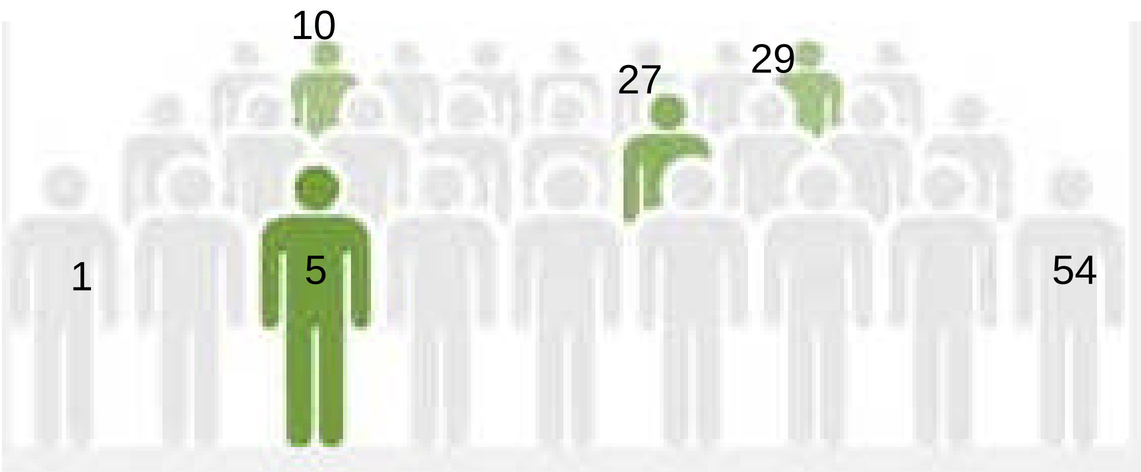
Replace=T means, the same number can repeat.
Replace=F means, each number can appear only once.

Toss a coin 10 times.

```
> sample(c("H","T"),10,replace=TRUE)
  "T" "H" "H" "H" "T" "H" "T" "H" "T" "T"
```

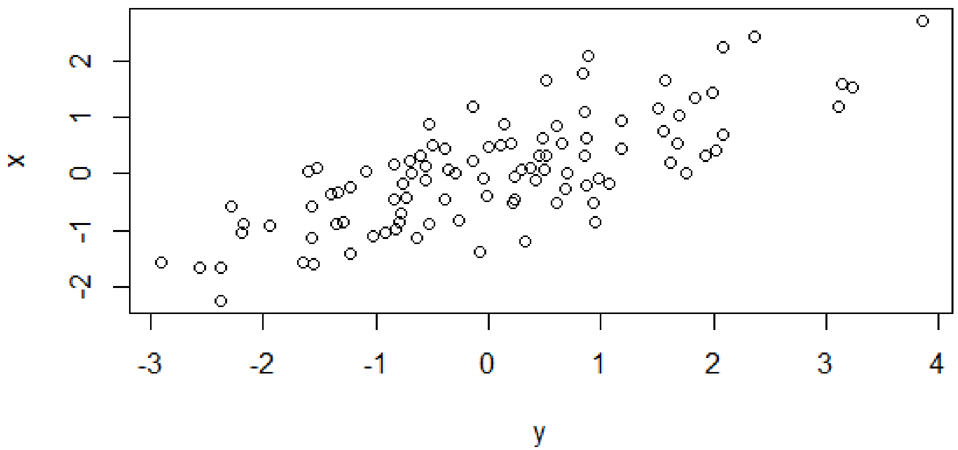
Select 4 different students from a class of 54 students

```
> sample(1:54, 4)  # default is no replacement
[1] 27  5 10 29
```



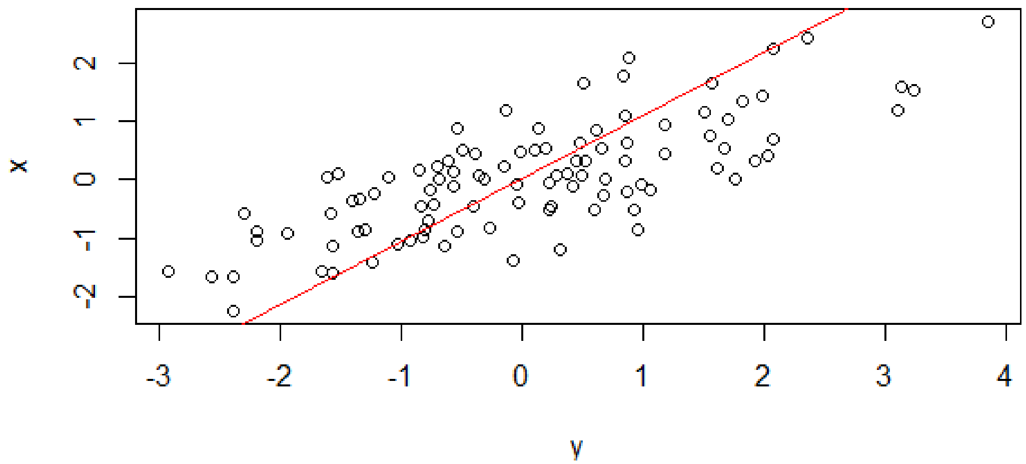
Scatter plot of two variables

```
> x <- rnorm(100)
> y <- x + rnorm(100)
> plot( x ~ y)
```



Add a Regression Line

```
> x <- rnorm(100)
> y <- x + rnorm(100)
> plot( x ~ y)
> abline( lm(y ~ x), col = "red" )
```



Sharing Data with Excel

Data sharing with Excel, SPSS

```
# Reading excel csv data files
sales <- read.csv( file.choose() )
prices <- read.csv(“prices-2012.csv”)

# Load the foreign package
library(foreign)
# Import the spss data file
read.spss("newData.sav")
```

Data frame (excel sheet)

```
# 3 columns: a, b c
> x <- data.frame(a=1:3, b=5:7,
  c=11:13 )
> x
    a b c
1   1 5 11
2   2 6 12
3   3 7 13
```

> x$a   # Get column ‘a’ of x, same as x[[‘a’]]

1 2 3

Columns of a data frame

```
> x$c <- NULL     # delete column c.
> x$d <- 21:23    # add new column d.
> x
    a  b  d
1   1  5  21
2   2  6  22
3   3  7  23
```

cbind to Combine two sheets

```
> y <- 31:33
> cbind( x, y)
  a b d  y
1 1 5 21 31
2 2 6 22 32
3 3 7 23 33
```

Omit rows with NA data

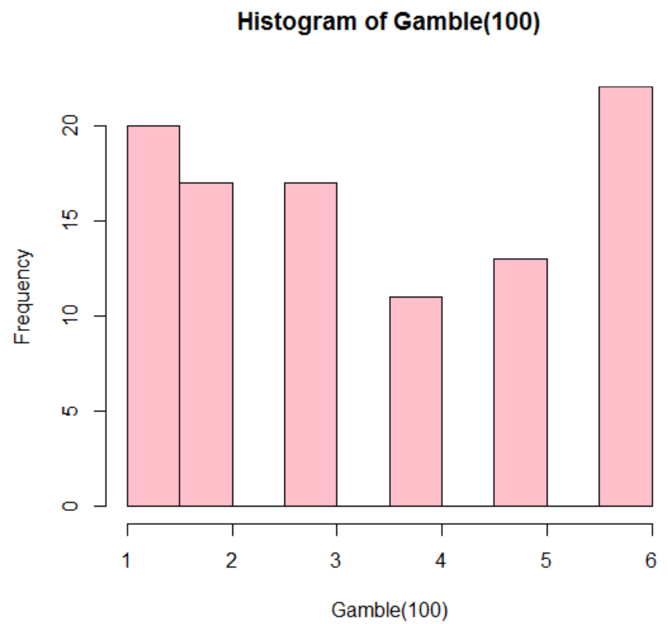
```
> x <- c(1,2,NA,4)
> d <- data.frame(x, y=rev(x))
> d
   x   y
1  1   4
2  2  NA
3 NA   2
4  4   1
> na.omit(d)       # Remove rows with NA
1    1   4
2    4   1
```

Matrix

```
> m <- matrix( c(1,2,3,4), nrow=2)
> m
        [,1]   [,2]
[1,]     1      3          # Row 1
[2,]     2      4          # Row 2

> det(m)   # Determinant of m=1x4-2x4
  -2
```

Define your own function

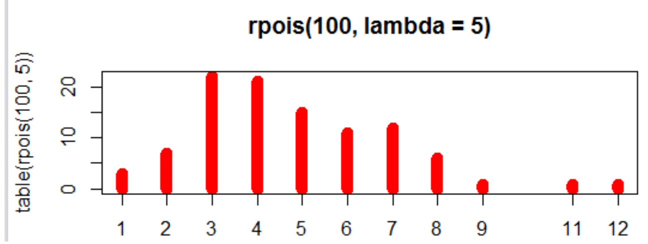
```
# Create a function.
> Gamble = function(n)
sample(1:6, n, replace=T)

# Call Gamble with n=4
> Gamble(4)
[1] 3 4 3 6

# Plot Gamble
> hist(  Gamble(100),
         col="pink")
```



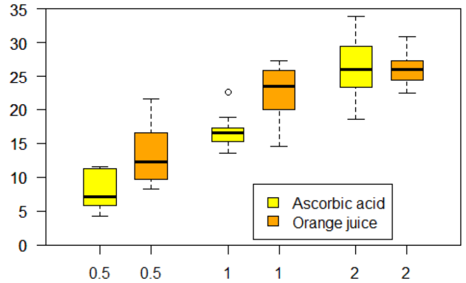
Builtin Examples

Try these examples in R

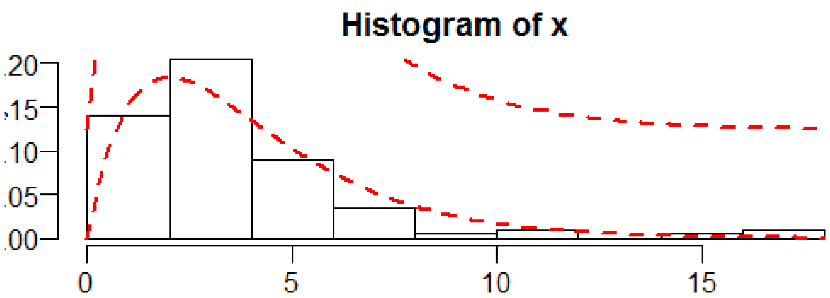
> example(plot)



> example(boxplot)



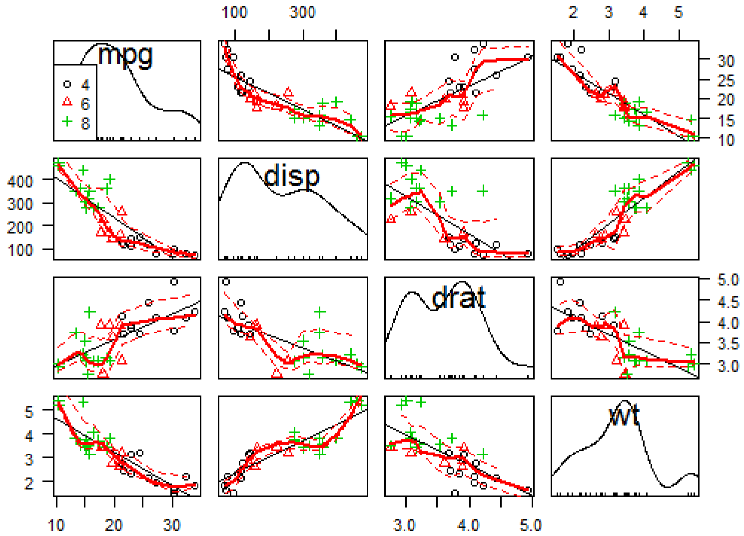
> example(hist)



Playing with Builtin Data

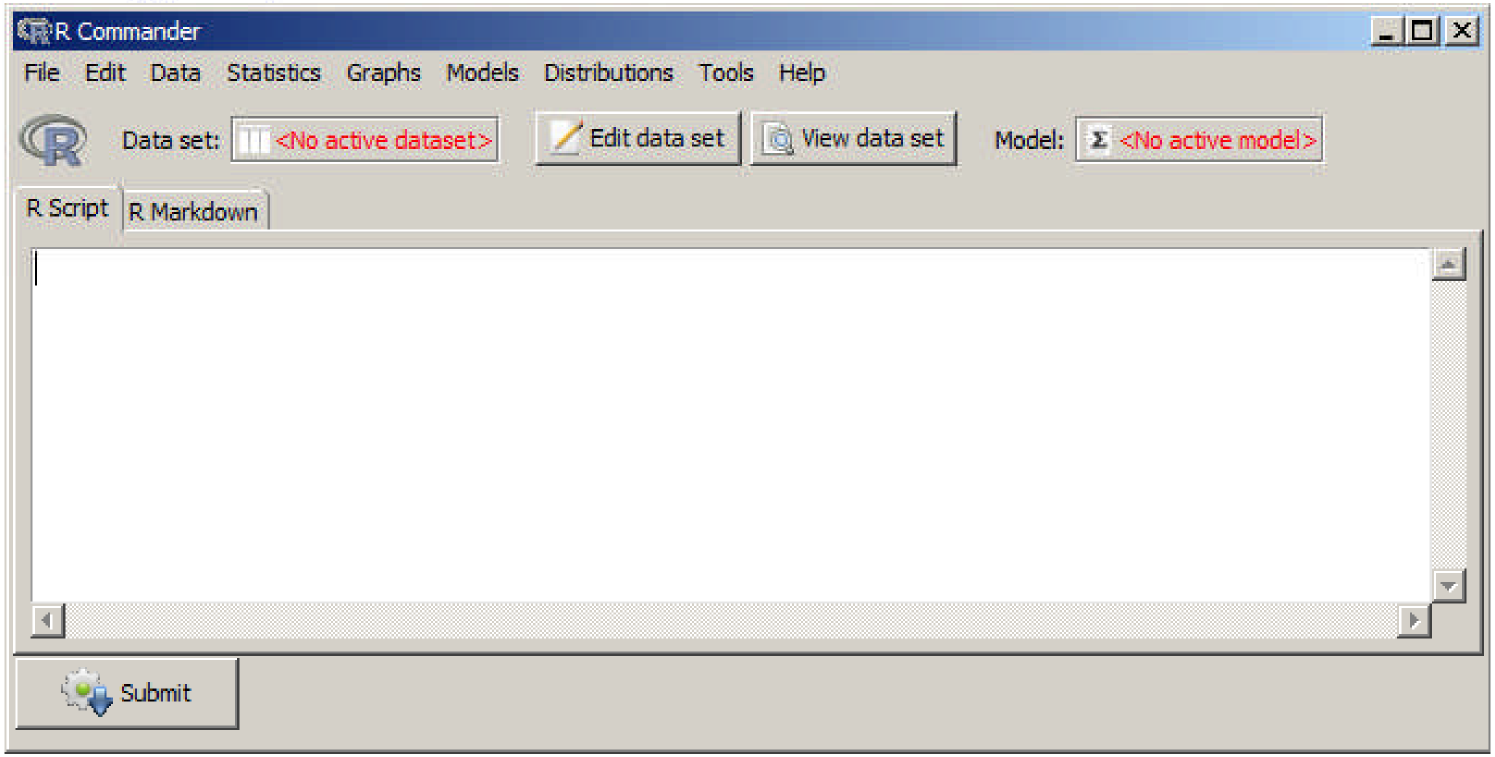
Scatterplot Matrices from the car Package

```
> library(car)
> scatterplotMatrix( ~mpg +disp +drat +wt |cyl,
      data=mtcars)
```



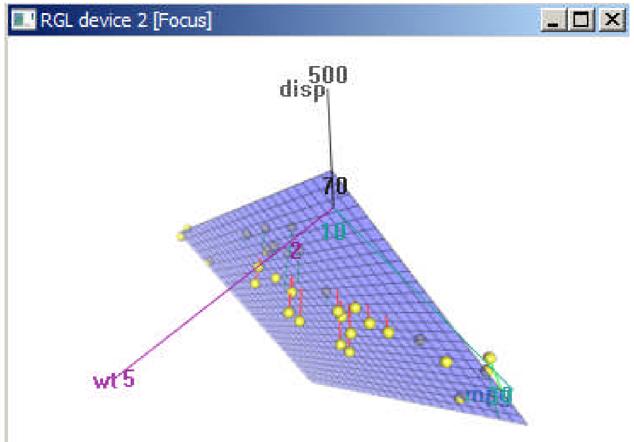
R Commander: Rcmdr

```
> library(Rcmdr)
```



3D graphs

```
> library(Rcmdr)
> attach(mtcars)              # see ?mtcars
> scatter3d(wt, disp, mpg)
```



References

1. Intro to R, Venables and Smith, http://cran.r-project.org/doc/manuals/R-intro.pdf http://cran.r-project.org/manuals.html
2. Basic Statistics tests in R, http://www.statmethods.net/stats/index.html
3. Advanced Probability/Statistics in R, http://zoonek2.free.fr/UNIX/48_R/all.html
4. More Statistics tests in R, http://www.ats.ucla.edu/stat/r/whatstat/whatstat.htm
5. 7 lectures on Financial Trading with R, http://www.rfortraders.com/

Section: __ Roll Number: ____
Or Name: ______, Date 2014/03/__
Course: Creative Thinking,
First do all the questions alone in your notebook and Excel. If you have doubts work in group.

Draw the graphs for following and shade the region if any:
----
1. x == 1 & y == 1
2. x < 1 & y < 2
3. x > 1 & x < 2
4. x < 2 & x > 1 & y < 3 & y > 2
--------------------.
5. x + y = 0
6. x + y < 0
7. x + y > 0
8. x + y > 2
----
9. x – y = 0
10. x – y = 2
11. x – y > 2
12. x – y < 2
13. x < y
14. x > y & x > 0.
15. y < x & x > 1 & y > 1.

First list the slope and intercept of the graph, and then draw the graph and shade the region for inequalities:
----
16. y = 2 x
17. y > 2 x
18. 2 y > 4 x
19. 2 y > x
20. y = 2 x + 1
21. y = 3 x + 1
22. y = 1 – x
23. y = 1 – 2 x
24. x + y = 10
25. 2 x + 3 y = 10
26. 3 x – 2x = 7.
27. 3 x – 3 y = 0
----
28. x > 1 or y > 1.
29. x + y > 1 or x + y < – 1
30. 2 x + 2 y > 2 or 2x – 2y < 2

Using Excel

Q31. Write this as an LP optimization problem: A store sells three brands of stereo systems: brands A, B, and C.
It can sell a total of 100 stereo systems per month.

Brands A, B, and C take up, respectively, 5, 4, and 4 cubic feet of warehouse space and a maximum of 480 cubic feet of warehouse space is available.
Brands A, B, and C generate sales commissions of Rs40, Rs20, and Rs30, respectively, and Rs3200 is available to pay the sale commissions.

The profit generated from the sale of each brand is Rs70, Rs210, and Rs140, respectively. How many of each brand of stereo system should be sold to maximize profit?
A. What are the variables?
B. What are we optimizing (give equation for the objective function)?
C. What are the constraints (give the equations)?
D. Type Q31 in Excel. And solve it.

Q32. Farmer wants to grow Apples, Banana, Chiko. He wrote the equations below to describe his situation.

Now help him use Excel to maximize his profit: z = 3 *A + B + 2*C;
With these constraints:

A + B + 3*C =< 30;
2*A + 2*B + 5*C =< 24;
4*A + B + 2*C =< 36;
All variables are non negative.

Q33. Farmer wants to grow x apples and y oranges; he has following linear constraints:

6 acres of land: 3x + y =< 6
6 tons of fertilizer: 2x + 3y =< 6
8 hour work day: x + 5y =< 8

Apples sell for twice as much as oranges
Production is positive: x >= 0, y >= 0.
Maximize his profit using Excel.

Q 34. Help Samson, formulate this as an LP and solve using Excel.
Samson TV has to decide on the number of x1 and x2 sets to be produced at one of its factories. Market research indicates that at most 40 of the x1 sets and 10 of the x2 sets can be sold per month. The maximum number of work-hours available is 500 per month.

A x1 set requires 20 work-hours and a x2 set requires 10 work-hours. Each x1 set sold produces a profit of $120 and each x2 set produces a profit of $80.

Q 35 Help Gotiya save money, by solving his problem with excel:

Gotiya has a goat farm. He is trying to decide what to feed his goats. He is considering using a combination of goat feeds available from local suppliers.

He would like to feed the goats at minimum cost while also making sure each goat receives an adequate supply of calories and vitamins.

The cost, calorie content, and vitamin content of each feed are given in the table below.

Contents	Feed A	Feed B
Calories/kg	800	1000
Vitamins unit/Kg	140	70
Cost/kg Rs	0.40	0.80

Each goat requires at least 8,000 calories per day and at least 700 units of vitamins. A further constraint is that no more than one-third of the diet (by weight) can consist of Feed A.

Q36. A dietitian is asked to design a special diet supplement using two different foods X and Y containing:

	X	Y	Requirement
Calcium	20	10	300
Iron	15	10	150
Vitamin B	10	20	20
Cost Rs/Kg	111	99	Total Cost
How much?			

Q. What are the variables? What are we optimizing, write the equation. What are the constraints, write the equations. Use Excel to solve it.

--- COCONUT BRAND ----
Q 37. Jackie.Shine is opening a coconut drink shop. There are 3 popular brands: A, B, C (L-neer, Cocosip, Cocojal).

The costs of A,B,C is Rs. 10, 12, 15. She can sell them at Rs 20, 23, 26. The municipal charges Rs 1 to dispose coconut shell.

From market survey, she estimates maximum demand at 500, 400, 300 coconuts per month. There are some loyal student customers, who want 60 of each brand every month.

She has balance Rs 15,000 for paying the suppliers in advance. She can stock 1000 coconuts per month in the small shop.

How many of each should she order every month to maximize her profits and keep all the customers happy?

Q38 . She decides to increases profit by increasing price to Rs 25, 28, 35. But that means the demand will fall to maximum 200, 200, 100 per month.

Should she raise the price? What is the new profit?

Q39. It is summer time, the demand may increase to 400, 400, 600, if she reduces the prices to 18, 22, 25. Should she lower the price? What is the profit now?

Q40. Going back to the original excel sheet in Q37. The brand C has a lockout in their plant for a month (no supplies from C), and Brand A, B take advantage and raise cost price by Rs 10 each because of labour shortage.

What is the new optimal? What should be done?

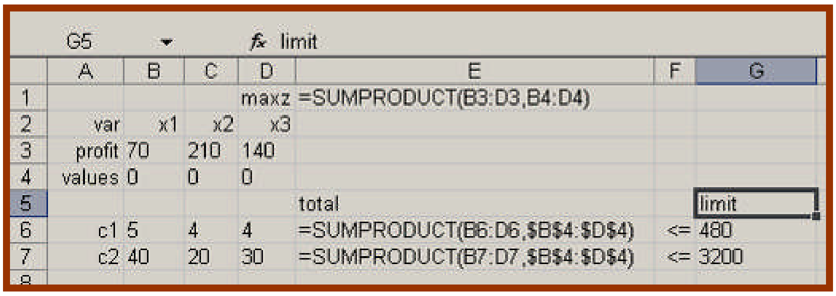
Solutions

Q31. Write this as an LP optimization problem: A store sells three brands of stereo systems: brands A, B, and C. It can sell a total of 100 stereo systems per month.

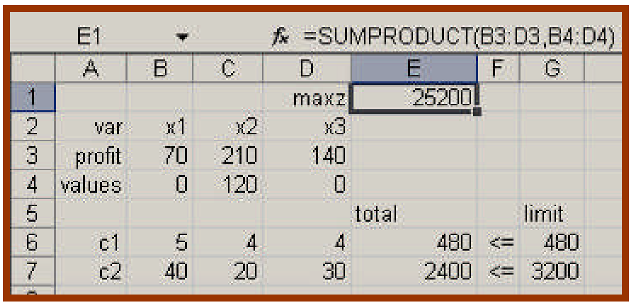
Brands A, B, and C take up, respectively, 5, 4, and 4 cubic feet of warehouse space and a maximum of 480 cubic feet of warehouse space is available.
Brands A, B, and C generate sales commissions of Rs40, Rs20, and Rs30, respectively, and Rs3200 is available to pay the sale commissions.

The profit generated from the sale of each brand is Rs70, Rs210, and Rs140, respectively.
How many of each brand of stereo system should be sold to maximize profit?
A. What are the variables?
B. What are we optimizing (give equation for the objective function)?
C. What are the constraints (give the equations)?
D. Type Q31 in Excel. And solve it.

A31. Variables are (x1,x2,x3) quantity of A,B,C sold. maximizing profit = 25200, with (x1,x2,x3)=(0,120,0).


G5 = limit

	A	B	C	D	E	F	G
1				maxz	=SUMPRODUCT(B3:D3,B4:D4)		
2	var	x1	x2	x3			
3	profit	70	210	140			
4	values	0	0	0			
5					total		limit
6	c1	5	4	4	=SUMPRODUCT(B6:D6,$B$4:$D$4)	<=	480
7	c2	40	20	30	=SUMPRODUCT(B7:D7,$B$4:$D$4)	<=	3200


E1 = =SUMPRODUCT(B3:D3,B4:D4)

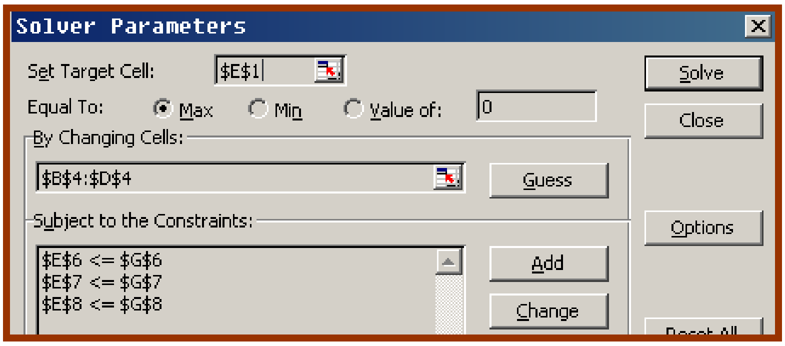
	A	B	C	D	E	F	G
1				maxz	25200		
2	var	x1	x2	x3			
3	profit	70	210	140			
4	values	0	120	0			
5					total		limit
6	c1	5	4	4	480	<=	480
7	c2	40	20	30	2400	<=	3200

Q32. **Farmer** wants to grow Apples, Banana, Chiko. He wrote the equations below to describe his situation.
Now help him use Excel to maximize his profit: z = 3 *A + B + 2*C; With these constraints:

A + B + 3*C =< 30;
2*A + 2*B + 5*C =< 24;
4*A + B + 2*C =< 36;
All variables are non negative.

A32.

	A	B	C	D	E	F	G
1				maxz	=SUMPRODUCT($B$3:$D$3,$B$4:$D$4)		
2	var	x1	x2	x3			
3	profit	3	1	2			
4	values	0	0	0			
5					total		limit
6	c1	1	1	3	=SUMPRODUCT(B6:D6,$B$4:$D$4)	<=	30
7	c2	2	2	5	=SUMPRODUCT(B7:D7,$B$4:$D$4)	<=	24
8	c3	4	1	2	=SUMPRODUCT(B8:D8,$B$4:$D$4)	<=	36
9							



	A	B	C	D	E	F	G
1				maxz	28		
2	var	x1	x2	x3			
3	ofit	3	1	2			
4	ues	8	4	0			
5					total		limit
6	c1	1	1	3	12	=	30
7	c2	2	2	5	24	=	24
8	c3	4	1	2	36	=	36

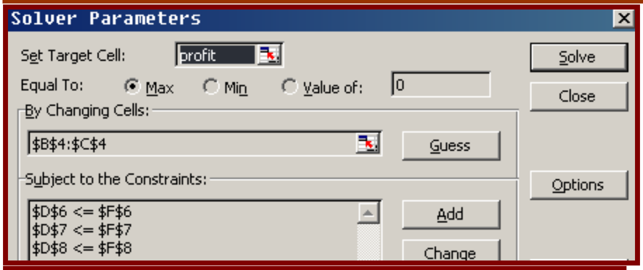
Q33. **Farmer** wants to grow x apples and y oranges; he has following linear constraints:

6 acres of land: $3x + y =< 6$
6 tons of fertilizer: $2x + 3y =< 6$
8 hour work day: $x + 5y =< 8$

Apples sell for twice as much as oranges
Production is positive: $x >= 0$, $y >= 0$.
Maximize his profit using Excel.

A33

	A	B	C	D	E	F
1			max	=SUMPRODUCT(B3:C3,B4:C4)		
2	var	x	y			
3	profit	2	1			
4	values	0	0			
5				total		limit
6	c1	3	1	=SUMPRODUCT(B6:C6,$B$4:$C$4)	<=	6
7	c2	2	3	=SUMPRODUCT(B7:C7,$B$4:$C$4)	<=	6
8	c3	1	5	=SUMPRODUCT(B8:C8,$B$4:$C$4)	<=	8



profit =SUMPRODUCT(B3:C3,B4:C4)

	A	B	C	D	E	F	G
1	maxz	4.286					
2	var	x	y				
3	profit	2	1				
4	values	1.714	0.85714				
5				total		limit	
6	c1	3	1	6	<=	6	
7	c2	2	3	6	<=	6	
8	c3	1	5	6	<=	8	

Q 34. Help Samson, formulate this as an LP and solve using Excel.
Samson TV has to decide on the number of x1 and x2 sets to be produced at one of its factories. Market research indicates that at most 40 of the x1 sets and 10 of the x2 sets can be sold per month. The maximum number of work-hours available is 500 per month.

A x1 set requires 20 work-hours and a x2 set requires 10 work-hours. Each x1 set sold produces a profit of $120 and each x2 set produces a profit of $80.

A34

	A	B	C	D	E	F
1			maxz	=SUMPRODUCT($B$3:$C$3,$B$4:$C$4)		
2	var	x1	x2			
3	profit	120	80			
4	values	0	0			
5				total		limit
6	c1	1	0	=SUMPRODUCT(B6:C6,$B$4:$C$4)	<=	40
7	c2	0	1	=SUMPRODUCT(B7:C7,$B$4:$C$4)	<=	10
8	c3	20	10	=SUMPRODUCT(B8:C8,$B$4:$C$4)	<=	500

	A	B	C	D	E	F
1			maxz	3200		
2	var	x1	x2			
3	profit	120	80			
4	values	20	10			
5				total		limit
6	c1	1	0	20	<=	40
7	c2	0	1	10	<=	10
8	c3	20	10	500	<=	500

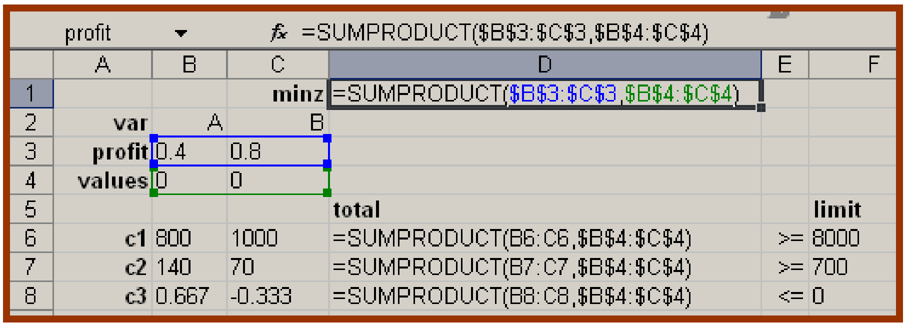
Q 35 Help Gotiya save money, by solving his problem with excel:

Gotiya has a goat farm. He is trying to decide what to feed his goats. He is considering using a combination of goat feeds available from local suppliers.
He would like to feed the goats at minimum cost while also making sure each goat receives an adequate supply of calories and vitamins.
The cost, calorie content, and vitamin content of each feed are given in the table below.

Contents	Feed A	Feed B	Min Required		
Calories/kg	800	1000	8000		
Vitamins unit/Kg	140	70	700		
Cost/kg Rs	0.40	0.80			

Each goat requires at least 8,000 calories per day and at least 700 units of vitamins.
A further constraint is that no more than one-third of the diet (by weight) can consist of Feed A.
That is, constraint $A \leq 1/3\ (A+B)$, which reduces to $2/3\ A - 1/3\ B \leq 0$.

A35



profit | =SUMPRODUCT($B$3:$C$3,$B$4:$C$4)

	A	B	C	D	E	F
1			minz	=SUMPRODUCT($B$3:$C$3,$B$4:$C$4)		
2	var	A	B			
3	profit	0.4	0.8			
4	values	0	0			
5				total		limit
6	c1	800	1000	=SUMPRODUCT(B6:C6,$B$4:$C$4)	>=	8000
7	c2	140	70	=SUMPRODUCT(B7:C7,$B$4:$C$4)	>=	700
8	c3	0.667	-0.333	=SUMPRODUCT(B8:C8,$B$4:$C$4)	<=	0

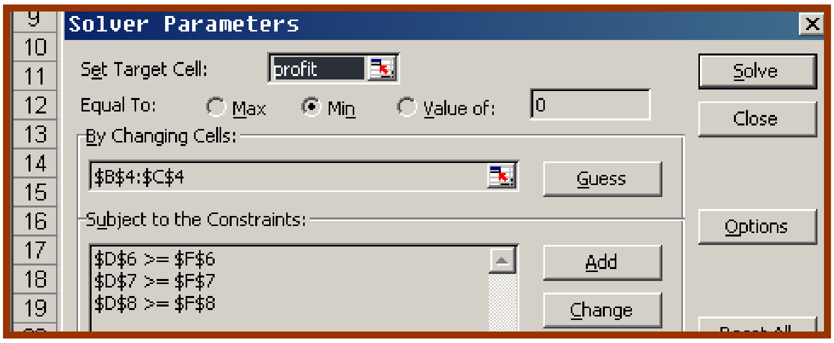
Q36. A dietitian is asked to design a special diet supplement using two different foods X and Y containing:

	X	Y	Requirement
Calcium	20	10	300
Iron	15	10	150
Vitamin B	10	20	20
Cost Rs/Kg	111	99	Total Cost
How much?			

Q. What are the variables? What are we optimizing, write the equation. What are the constraints, write the equations. Use Excel to solve it.

A36.

	Name Box	B	C	D	E	F
1			minz	=SUMPRODUCT($B$3:$C$3,$B$4:$C$4)		
2	var	x	y			
3	profit	111	99			
4	values	0	0			
5				total		limit
6	c1	20	10	=SUMPRODUCT(B6:C6,$B$4:$C$4)	>=	300
7	c2	15	10	=SUMPRODUCT(B7:C7,$B$4:$C$4)	>=	150
8	c3	10	20	=SUMPRODUCT(B8:C8,$B$4:$C$4)	>=	20



	A	B	C	D	E	F
1			minz	1665		
2	var	x	y			
3	rofit	111	99			
4	lues	15	0			
5				total		limit
6	c1	20	10	300	=	300
7	c2	15	10	225	=	150
8	c3	10	20	150	=	20

Q 37. Jackie.Shine is opening a coconut drink shop. There are 3 popular brands: A, B, C (L-neer, Cocosip, Cocojal).

The costs of A,B,C is Rs. 10, 12, 15. She can sell them at Rs 20, 23, 26. The municipal charges Rs 1 to dispose coconut shell.
From market survey, she estimates maximum demand at 500, 400, 300 coconuts per month. There are some loyal student customers, who want 60 of each brand every month.
She has balance Rs 15,000 for paying the suppliers in advance. She can stock 1000 coconuts per month in the small shop.
How many of each should she order every month to maximize her profits and keep all the customers happy?

A37.

B1 fx =SUMPRODUCT(B6:D6,B7:D7)

	A	B	C	D	E	F	G
1	maximize	=SUMPRODUC					
2	var	A	B	C			
3	Sell price	20	23	26			
4	Cost	10	12	15			
5	Disposal	1	1	1			
6	profit	=B3-B4-B5	=C3-C4-C5	=D3-D4-D5			
7	values	0	0	0			
8							
9	A	B	C	total		limit	
10	1	0	0	=SUMPRODUCT(A10:C10,$B$7:$D$7)	<=	500	demand
11	0	1	0	=SUMPRODUCT(A11:C11,$B$7:$D$7)	<=	400	
12	0	0	1	=SUMPRODUCT(A12:C12,$B$7:$D$7)	<=	300	
13	1	0	0	=SUMPRODUCT(A13:C13,$B$7:$D$7)	>=	60	Loyal
14	0	1	0	=SUMPRODUCT(A14:C14,$B$7:$D$7)	>=	60	
15	0	0	1	=SUMPRODUCT(A15:C15,$B$7:$D$7)	>=	60	
16	10	12	15	=SUMPRODUCT(A16:C16,$B$7:$D$7)	<=	15000	Cash
17	1	1	1	=SUMPRODUCT(A17:C17,$B$7:$D$7)	<=	1000	Space

Solver Parameters

Set Target Cell: $B$1

Equal To: (•) Max ( ) Min ( ) Value of:

By Changing Cells:

$B$7:$D$7

Subject to the Constraints:

$D$10 <= $F$10
$D$11 <= $F$11
$D$12 <= $F$12
$D$13 >= $F$13
$D$14 >= $F$14
$D$15 >= $F$15

and some more constraints

$D$16 <= $F$16
$D$17 <= $F$17

	A	B	C	D	E	F	G
1	maximize	9700					
2	var	A	B	C			
3	Sell price	20	23	26			
4	Cost	10	12	15			
5	Disposal	1	1	1			
6	profit	9	10	10			
7	values	300	400	300			
8							
9	A	B	C	total		limit	
10	1	0	0	300	<=	500	demand
11	0	1	0	400	<=	400	
12	0	0	1	300	<=	300	
13	1	0	0	300	>=	60	Loyal
14	0	1	0	400	>=	60	
15	0	0	1	300	>=	60	
16	10	12	15	12300	<=	15000	Cash
17	1	1	1	1000	<=	1000	Space

Q38. She decides to increases profit by increasing price to Rs 25, 28, 35. But that means the demand will fall to maximum 200, 200, 100 per month. Should she raise the price? What is the new profit?

A38

profit ▾ fx =SUMPRODUCT(B6:D6,B7:D7)

	A	B	C	D	E	F	G
1	maximiz	7700					
2	var	A	B	C			
3	Sell price	25	28	35			
4	Cost	10	12	15			
5	Disposal	1	1	1			
6	profit	14	15	19			
7	values	200	200	100			
8							
9	A	B	C	total		limit	
10	1	0	0	200	<=	200	demand
11	0	1	0	200	<=	200	
12	0	0	1	100	<=	100	
13	1	0	0	200	>=	60	Loyal
14	0	1	0	200	>=	60	
15	0	0	1	100	>=	60	
16	10	12	15	5900	<=	15000	Cash
17	1	1	1	500	<=	1000	Space

Q39. It is summer time, the demand may increase to 400, 400, 600, if she reduces the prices to 18, 22, 25. Should she lower the price? What is the profit now?

A39.

profit ▾ fx =SUMPRODUCT(B6:D6,B7:D7)

	A	B	C	D	E	F	G
1	maximize	8880					
2	var	A	B	C			
3	Sell price	18	22	25			
4	Cost	10	12	15			
5	Disposal	1	1	1			
6	profit	7	9	9			
7	values	60	400	540			
8							
9	A	B	C	total		limit	
10	1	0	0	60	<=	500	demand
11	0	1	0	400	<=	400	
12	0	0	1	540	<=	600	
13	1	0	0	60	>=	60	Loyal
14	0	1	0	400	>=	60	
15	0	0	1	540	>=	60	
16	10	12	15	13500	<=	15000	Cash
17	1	1	1	1000	<=	1000	Space

Q40. Going back to the original excel sheet in Q37. The brand C has a lockout in their plant for a month (no supplies from C), and Brand A, B take advantage and raise cost price by Rs 10 each because of labour shortage. What is the new optimal? What should be done?

A40.

B1 =SUMPRODUCT(B6:D6,B7:D7)

	A	B	C	D	E	F	G
1	maximize	0					
2	var	A	B	C			
3	Sell price	20	23	26			
4	Cost	10	12	15			
5	Disposal	1	1	1			
6	profit	9	10	10			
7	values	0	0	0			
8							
9	A	B	C	total		limit	
10	1	0	0	0	<=	500	demand
11	0	1	0	0	<=	400	
12	0	0	1	0	<=	0	lockout
13	1	0	0	0	>=	60	Loyal
14	0	1	0	0	>=	60	
15	0	0	1	0	>=	0	lockout
16	10	12	15	0	<=	15000	Cash
17	1	1	1	0	<=	1000	Space

B1 =SUMPRODUCT(B6:D6,B7:D7)

	A	B	C	D	E	F	G
1	maximize	8500					
2	var	A	B	C			
3	Sell price	20	23	26			
4	Cost	10	12	15			
5	Disposal	1	1	1			
6	profit	9	10	10			
7	values	500	400	-2.72905E-10			
8							
9	A	B	C	total		limit	
10	1	0	0	500	<=	500	demand
11	0	1	0	400	<=	400	
12	0	0	1	-2.72905E-10	<=	0	
13	1	0	0	500	>=	60	Loyal
14	0	1	0	400	>=	60	
15	0	0	1	-2.72905E-10	>=	0	
16	10	12	15	9800	<=	15000	Cash
17	1	1	1	900	<=	1000	Space

Section: __ Roll Number: ____
Or Name: ______, Date 2014/03/__
Course: Creative Thinking,
Do all the question alone in your notebook.

Draw the graph for following and shade the region if any:

----

1. $x == 1$ & $y == 1$
2. $x < 1$ & $y < 2$
3. $x > 1$ & $x < 2$
4. $x < 2$ & $x > 1$ & $y < 3$ & $y > 2$

--------------------.

5. $x + y = 0$
6. $x + y < 0$
7. $x + y > 0$
8. $x + y > 2$

----

9. $x – y = 0$
10. $x – y = 2$
11. $x – y > 2$
12. $x – y < 2$
13. $x < y$
14. $x > y$ & $x > 0$.
15. $y < x$ & $x > 1$ & $y > 1$.

First list the slope and intercept of the graph, and then draw the graph and shade the region for inequalities:

----

16. $y = 2x$
17. $y > 2x$
18. $2y > 4x$
19. $2y > x$
20. $y = 2x + 1$
21. $y = 3x + 1$
22. $y = 1 – x$
23. $y = 1 – 2x$
24. $x + y = 10$
25. $2x + 3y = 10$
26. $3x – 2x = 7$.
27. $3x – 3y = 0$

----

28. $x > 1$ or $y > 1$.
29. $x + y > 1$ or $x + y < – 1$
30. $2x + 2x > 2$ or $2x – 2y < 2$

Q31. Write as LP optimization problem:

A store sells three brands of stereo systems: brands A, B, and C.
It can sell a total of 100 stereo systems per month.
Brands A, B, and C take up, respectively, 5, 4, and 4 cubic feet of warehouse space and a maximum of 480 cubic feet of warehouse space is available.
Brands A, B, and C generate sales commissions of Rs40, Rs20, and Rs30, respectively, and Rs3200 is available to pay the sale commissions.
The profit generated from the sale of each brand is Rs70, Rs210, and Rs140, respectively.
How many of each brand of stereo system should be sold to maximize profit?

A. What are the variables?
B. What are we optimizing (give equation for the objective function)?
C. What are the constraints (give the equations)?

Using Excel:

Q 32. Type Q31 in excel.
Q 33. Solve Q32 in excel

Q34. Farmer wants to grow Apples, Banana, Chiko. He wrote the equations below to describe his situation, Now help him use Excel to maximize his profit: z = 3 *A + B + 2*C;
with these constraints:
A + B + 3*C <= 30;
2*A + 2*B + 5*C <= 24;
4*A + B + 2*C <= 36;

All variables are non negative.

Q 35. Help Samson, formulate this as an LP and solve using Excel.
Samson TV has to decide on the number of x1 and x2 sets to be produced at one of its factories. Market research indicates that at most 40 of the x1 sets and 10 of the x2 sets can be sold per month. The maximum number of work-hours available is 500 per month.

A x1 set requires 20 work-hours and a x2 set requires 10 work-hours. Each x1 set sold produces a profit of $120 and each x2 set produces a profit of $80.

Q 36 Help Gotiya save money, by solving his problem with excel:

Gotiya has a goat farm. He is trying to decide what to feed his goats. He is considering using a combination of goat feeds available from local suppliers. He would like to feed the goats at minimum cost while also making sure each goat receives an adequate supply of calories and vitamins. The cost, calorie content, and vitamin content of each feed are given in the table below.

Contents	Feed A	Feed B
Calories/kg	800	1,000
Vitamins/kg	140 units	70 units
Cost/kg	Rs 0.40	Rs 0.80

Each goat requires at least 8,000 calories per day and at least 700 units of vitamins. A further constraint is that no more than one-third of the diet (by weight) can consist of Feed A.

Q37. A dietitian is asked to design a special diet supplement using two different foods, X costs Rs 111/kg, and Y costs Rs 99/kg.
Each gm of food X contains 20 units of calcium, 15 units of iron, and 10 units of vitamin B.
Each gm of food Y contains 10 units of calcium, 10 units of iron, and 20 units of vitamin B.
The minimum daily requirements in the diet are 300 units of calcium, 150 units of iron, and 20 units of vitamin
A.What are the variables?
B. What are we optimizing, give the equation.
C. What are the constraints, give the equations.

Q41. Nifty Nitte Nitya, a MBA student has debated on “FDI in retail”, read about “Economies of scale in Ballmart” and studied QT. He wants to be an knowledge Entrepreneur.

He finds out there are 2000 coconut vendors in Udupi region, who have never used excel to optimize their profits.

He offers to be the “management consultant”, charging Rs 1000 for month. Of which Rs 300 he must pay as taxes, and Rs 200 is cost of operating his office.

He claims his QT analysis will increase the profit of each shop by Rs 5000 per month.

Analysing the QT data of each shop takes 1 hour (including entering data and talking to the shopkeeper on phone).

Assuming Nitya can work 8 hours a day for 20 days a week.

Q. How many shops can he consult for?

Q. How much will be take home income of Nitya?

Q. How much extra profits will his consulting shop keepers make?

More shopkeepers want his services, but he has no time. So he finds 10 more MBA students who know QT and financial analysis. Since Nitya is expanding his office, he has no time for excel, but 10 new people are doing QT analsysis.

Q. How much is the new profit (after taxes and operating costs)?

Under his profit sharing scheme,

He keeps 40% of the profit, and the rest is divided among his MBA workers.

Q. How much is Nitya's take home income with 20 employees?

Q. How much is take home income of his MBA employees?

Q. How much will Nitya's income be with 10 employees?

Q. What are the constraints on expanding Nitya's business in real life?

Example for Section 3.1

The Apex Television Company has to decide on the number of 27- and 20-inch sets to be produced at one of its factories. Market research indicates that at most 40 of the 27-inch sets and 10 of the 20-inch sets can be sold per month. The maximum number of work-hours available is 500 per month. A 27-inch set requires 20 work-hours and a 20-inch set requires 10 work-hours. Each 27-inch set sold produces a profit of $120 and each 20-inch set produces a profit of $80. A wholesaler has agreed to purchase all the television sets produced if the numbers do not exceed the maxima indicated by the market research.

(a) Formulate a linear programming model for this problem.

The decisions that need to be made are the number of 27-inch and 20-inch TV sets to be produced per month by the Apex Television Company. Therefore, the decision variables for the model are

x_1 = number of 27-inch TV sets to be produced per month,
x_2 = number of 20-inch TV sets to be produced per month.

Also let Z = total profit per month.

The model now can be formulated in terms of these variables as follows.

The total profit per month is $Z = 120\ x_1 + 80\ x_2$.

The resource constraints are:
(1) Number of 27-inch sets sold per month: $x_1 \le 40$
(2) Number of 20-inch sets sold per month: $x_2 \le 10$
(3) Work-hours availability: $20\ x_1 + 10\ x_2 \le 500$.

Nonnegativity constraints on TV sets produced: $x_1 \ge 0$ and $x_2 \ge 0$

With the objective of maximizing the total profit per month, the LP model for this problem is

Maximize $Z = 120\ x_1 + 80\ x_2$,
subject to

$$\begin{aligned} x_1 \qquad\qquad &\le 40 \\ x_2 &\le 10 \\ 20\ x_1 + 10\ x_2 &\le 500 \end{aligned}$$

and

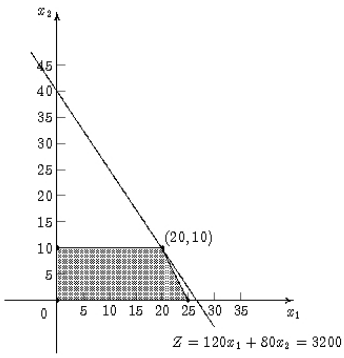
$$x_1 \ge 0, \quad x_2 \ge 0.$$

(b) Use the graphical method to solve this model.

The constraint, $x_1 \le 40$, has a constraint boundary at $x_1 = 40$. Similarly, the constraint, $x_2 \le 10$, has a constraint boundary at $x_2 = 10$.

The constraint boundary for the constraint, $20\ x_1 + 10\ x_2 \le 500$, intercepts the x_1-axis at $20x_1 + 10(0) = 500$, so at $x_1 = 25$. Similarly, this constraint boundary intercepts the x_2-axis at $20(0) + 10x_2 = 500$, so at $x_2 = 50$. This constraint boundary lies well within the constraint boundary for the first constraint, $x_1 \le 40$, so the first constraint is redundant and can be ignored.

For a sample value of Z, say, Z = 2,400, the corresponding objective function line, $Z = 2{,}400 = 120\ x_1 + 80\ x_2$, intercepts the x_1-axis at $120\ x_1 + 80(0) = 2{,}400$, so at $x_1 = 20$. It intercepts the x_2-axis at $120\ (0) + 80\ x_2 = 2{,}400$, so at $x_2 = 30$. The corresponding objective function lines for other values of Z are parallel to this line. Pushing these lines up as much as possible while still passing through a point in the feasible region reveals that the optimal solution is $(x_1, x_2) = (20, 10)$ with Z = 3,200, as depicted in the following graph.



Example for Section 3.4

Dwight is an elementary school teacher who also raises pigs for supplemental income. He is trying to decide what to feed his pigs. He is considering using a combination of pig feeds available from local suppliers. He would like to feed the pigs at minimum cost while also making sure each pig receives an adequate supply of calories and vitamins. The cost, calorie content, and vitamin content of each feed are given in the table below.

Contents	**Feed Type A**	**Feed Type B**
Calories (per pound)	800	1,000
Vitamins (per pound)	140 units	70 units
Cost (per pound)	\$0.40	\$0.80

Each pig requires at least 8,000 calories per day and at least 700 units of vitamins. A further constraint is that no more than one-third of the diet (by weight) can consist of Feed Type A, since it contains an ingredient which is toxic if consumed in too large a quantity.

(a) Formulate a linear programming model for this problem.

Let A and B be the quantity (pounds) of Feed Type A and Feed Type B, respectively, used per day. Also let Z be the total daily cost of the feed per pig. Then, the daily cost is
Z = \$0.4 A + \$0.8 B.

The constraints on the minimum daily requirements of calories and vitamins are

(1) Calories requirement: $800\,A + 1000\,B \geq 8{,}000$.
(2) Vitamins requirement: $140\,A + 70\,B \geq 700$.

Also, Dwight needs to avoid using too much of Feed Type A because of the toxic ingredient in it.

The toxic constraint is $A \leq 1/3\,(A+B)$, which reduces to $2/3\,A - 1/3\,B \leq 0$.

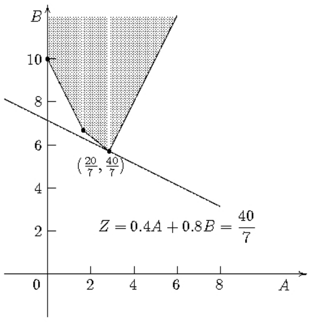
Nonnegativity constraints:
$A \geq 0, \quad B \geq 0$.

The resulting linear programming model for this problem is

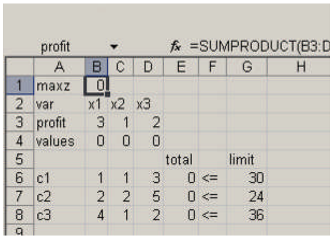
Minimize $Z = 0.4\,A + 0.8\,B$,
subject to $800\,A + 1000\,B \geq 8000$
$140\,A + 70\,B \geq 700$
$2/3\,A - 1/3\,B \leq 0$
And $A \geq 0, \quad B \geq 0$.

(b) Use the graphical method to solve this model. What is the resulting daily cost per pig?

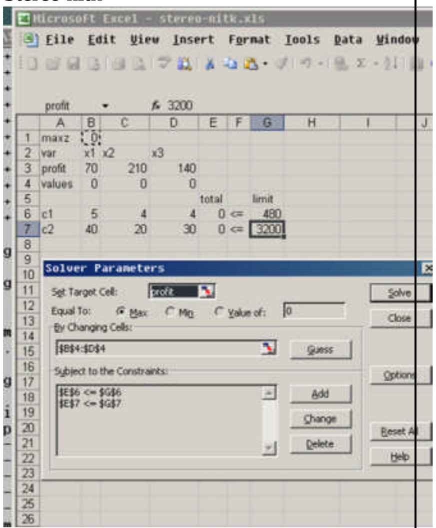
As shown below, the optimal solution is (A, B) = (20/7, 40/7). The resulting daily cost per pig is Z = 40/7 = \$5.71.



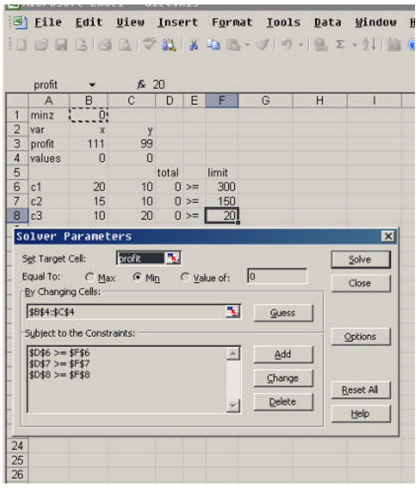
Cormen 29.3



Stereo nitk



Diet



Roll Number/Name: ____ ___________________________

Date 2015/01/13, JKSHIM, NITTE

Q1. A store sells three brands of stereo systems: brands A, B, and C.
It can sell a total of 100 stereo systems per month.

Brands A, B, and C take up, respectively, 5, 4, and 4 cubic feet of warehouse space and a maximum of 480 cubic feet of warehouse space is available.
Brands A, B, and C generate sales commissions of Rs40, Rs20 and Rs30, respectively, and Rs3200 is available to pay the sale commissions.

The profit generated from the sale of each brand is Rs70, Rs210, and Rs140, respectively.
How many of each brand of stereo system should be sold to maximize profit?

Q2. Farmer wants to grow Apples, Banana, Chiko. He wrote the equations below to describe his situation.
Maximize his profit: z = 3 *A + B + 2*C;
with these constraints:
A + B + 3*C =< 30;
2*A + 2*B + 5*C =< 24;
4*A + B + 2*C =< 36;
All variables are non negative.

Q3. Farmer wants to grow x apples and y oranges; he has following linear constraints:

6 acres of land: 3x + y =< 6
6 tons of fertilizer: 2x + 3y =< 6
8 hour work day: x + 5y =< 8

Apples sell for twice as much as oranges
Production is positive: x >= 0, y >= 0.
Maximize his profit.

Q4. Help Samson, formulate this as an LP and solve it using Excel.
Samson TV has to decide on the number of x1 and x2 sets to be produced at one of its factories. Market research indicates that at most 40 of the x1 sets and 10 of the x2 sets can be sold per month. The maximum number of work-hours available is 500 per month.

x1 set requires 20 work-hours and a x2 set requires 10 work-hours. Each x1 set sold produces a profit of $120 and each x2 set produces a profit of $80.

Q 5 Help Gotiya save money, by solving his problem:

Gotiya has a goat farm. He is trying to decide what to feed his goats. He is considering using a combination of goat feeds available from local suppliers.

He would like to feed the goats at minimum cost while also making sure each goat receives an adequate supply of calories and vitamins. Solve it.

The cost, calorie content, and vitamin content of each feed are given in the table below.

Contents	Feed A	Feed
Calories/kg	800	1000
Vitamins unit/K	140	70
Cost/kg Rs	0.40	0.80

Each goat requires at least 8,000 calories per day and at least 700 units of vitamins. A further constraint is that no more than one-third of the diet (by weight) can consist of Feed A.

Q6. A dietitian is asked to design a special diet supplement using two different foods X and Y containing:

	X	Y	Requiremen
Calcium	20	1	300
Iron	15	1	150
Vitamin B	10	2	20
Cost Rs/K	11	9	Total Cost
How much			

Use Excel to find the cheapest solution that satisfies all the requirements.

--- COCONUT BRAND ----
Q7. Jackie Shine is opening a coconut drink shop. There are 3 popular brands: A, B, C (L-neer, Cocosip, Cocojal).

The costs of A,B, C is Rs. 10, 12, 15. She can sell them at Rs 20, 23, 26. The municipal charges Rs 1 to dispose coconut shell.

From market survey, she estimates maximum demand at 500, 400, 300 coconuts per month. There are some loyal student customers, who want 60 of each brand every month.

She has balance Rs 15,000 for paying the suppliers in advance. She can stock 1000 coconuts per month in the small shop.

How many of each should she order every month to maximize her profits and keep all the customers happy?

Q8. She decides to increase profit by increasing price to Rs 25, 28, and 35. But that means the demand will fall to maximum 200, 200, and 100 per month. Should she raise the price? What is the new profit?

Q9. It is summer time, the demand may increase to 400, 400, 600, if she reduces the prices to 18, 22, and 25.
Should she lower the price? What is the profit now?

Q10. Going back to Q7. The brand C has a lockout in their plant for a month (no supplies from C), and Brand A, B take advantage and raise cost price by Rs 10 each because of labour shortage.

What is the new optimal? What should be done?

Solutions

Q1. Write this as an LP optimization problem: A store sells three brands of stereo systems: brands A, B, and C. It can sell a total of 100 stereo systems per month.

Brands A, B, and C take up, respectively, 5, 4, and 4 cubic feet of warehouse space and a maximum of 480 cubic feet of warehouse space is available.
Brands A, B, and C generate sales commissions of Rs40, Rs20, and Rs30, respectively, and Rs3200 is available to pay the sale commissions.

The profit generated from the sale of each brand is Rs70, Rs210, and Rs140, respectively.
How many of each brand of stereo system should be sold to maximize profit?
A. What are the variables?
B. What are we optimizing (give equation for the objective function)?
C. What are the constraints (give the equations)?
D. Type Q31 in Excel. And solve it.
A1. Variables are (x1,x2,x3) quantity of A,B,C sold. maximizing profit = 25200, with (x1,x2,x3)=(0,120,0).

G5 fx limit

	A	B	C	D	E	F	G
1				maxz	=SUMPRODUCT(B3:D3,B4:D4)		
2	var	x1	x2	x3			
3	profit	70	210	140			
4	values	0	0	0			
5					total		limit
6	c1	5	4	4	=SUMPRODUCT(B6:D6,$B$4:$D$4)	<=	480
7	c2	40	20	30	=SUMPRODUCT(B7:D7,$B$4:$D$4)	<=	3200

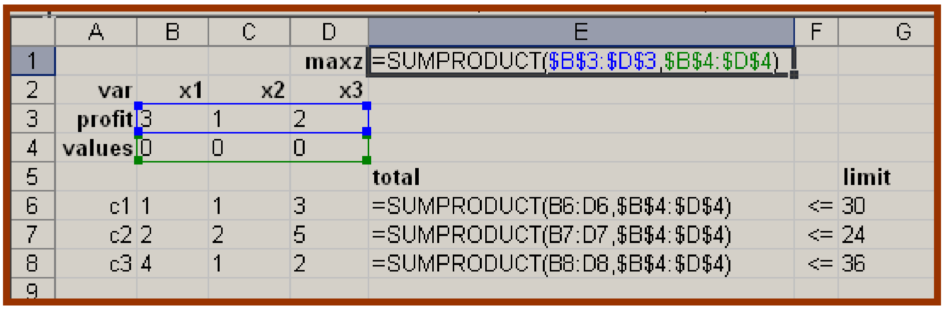
E1 fx =SUMPRODUCT(B3:D3,B4:D4)

	A	B	C	D	E	F	G
1				maxz	25200		
2	var	x1	x2	x3			
3	profit	70	210	140			
4	values	0	120	0			
5					total		limit
6	c1	5	4	4	480	<=	480
7	c2	40	20	30	2400	<=	3200

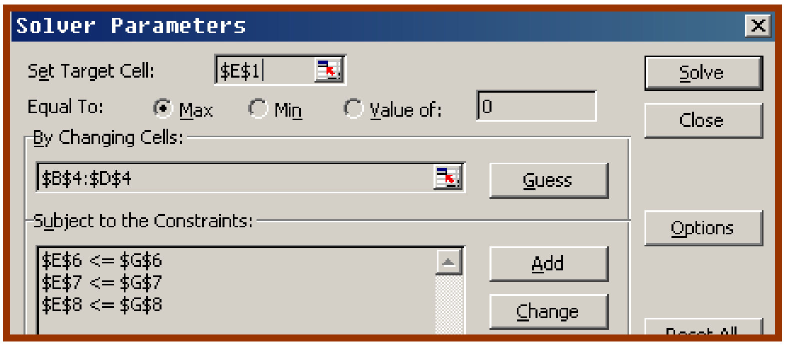
Q32. Farmer wants to grow Apples, Banana, Chiko. He wrote the equations below to describe his situation.
Now help him use Excel to maximize his profit: z = 3 *A + B + 2*C; With these constraints:

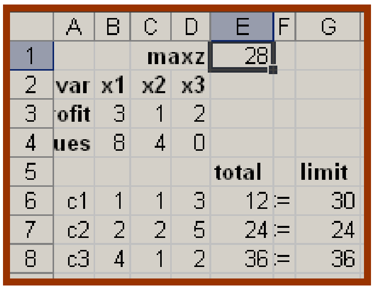
A + B + 3*C =< 30;
2*A + 2*B + 5*C =< 24;
4*A + B + 2*C =< 36;
All variables are non negative.

A2.



	A	B	C	D	E	F	G
1				maxz	=SUMPRODUCT($B$3:$D$3,$B$4:$D$4)		
2	var	x1	x2	x3			
3	profit	3	1	2			
4	values	0	0	0			
5					total		limit
6	c1	1	1	3	=SUMPRODUCT(B6:D6,$B$4:$D$4)	<=	30
7	c2	2	2	5	=SUMPRODUCT(B7:D7,$B$4:$D$4)	<=	24
8	c3	4	1	2	=SUMPRODUCT(B8:D8,$B$4:$D$4)	<=	36
9							





	A	B	C	D	E	F	G
1			maxz		28		
2	var	x1	x2	x3			
3	ofit	3	1	2			
4	ues	8	4	0			
5					total		limit
6	c1	1	1	3	12	:=	30
7	c2	2	2	5	24	:=	24
8	c3	4	1	2	36	:=	36

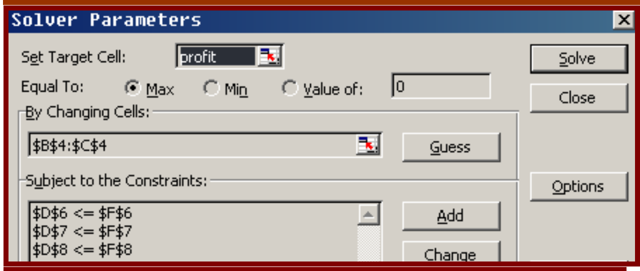
Q3. Farmer wants to grow x apples and y oranges; he has following linear constraints:

6 acres of land: $3x + y \; =< 6$
6 tons of fertilizer: $2x + 3y =< 6$
8 hour work day: $x + 5y \; =< 8$

Apples sell for twice as much as oranges
Production is positive: $x >= 0$, $y >= 0$.
Maximize his profit using Excel.

A33

	A	B	C	D	E	F
1			max	=SUMPRODUCT(B3:C3,B4:C4)		
2	var	x	y			
3	profit	2	1			
4	values	0	0			
5				total		limit
6	c1	3	1	=SUMPRODUCT(B6:C6,$B$4:$C$4)	<=	6
7	c2	2	3	=SUMPRODUCT(B7:C7,$B$4:$C$4)	<=	6
8	c3	1	5	=SUMPRODUCT(B8:C8,$B$4:$C$4)	<=	8



profit fx =SUMPRODUCT(B3:C3,B4:C4)

	A	B	C	D	E	F	G
1	maxz	4.286					
2	var	x	y				
3	profit	2	1				
4	values	1.714	0.85714				
5				total		limit	
6	c1	3	1	6	<=	6	
7	c2	2	3	6	<=	6	
8	c3	1	5	6	<=	8	

Q 4. Help Samson, formulate this as an LP and solve using Excel.
Samson TV has to decide on the number of x1 and x2 sets to be produced at one of its factories. Market research indicates that at most 40 of the x1 sets and 10 of the x2 sets can be sold per month. The maximum number of work-hours available is 500 per month.

A x1 set requires 20 work-hours and a x2 set requires 10 work-hours. Each x1 set sold produces a profit of $120 and each x2 set produces a profit of $80.

A4

	A	B	C	D	E	F
1			naxz	=SUMPRODUCT($B$3:$C$3,$B$4:$C$4)		
2	var	x1	x2			
3	profit	120	80			
4	values	0	0			
5				total		limit
6	c1	1	0	=SUMPRODUCT(B6:C6,$B$4:$C$4)	<=	40
7	c2	0	1	=SUMPRODUCT(B7:C7,$B$4:$C$4)	<=	10
8	c3	20	10	=SUMPRODUCT(B8:C8,$B$4:$C$4)	<=	500

	A	B	C	D	E	F
1			maxz	3200		
2	var	x1	x2			
3	profit	120	80			
4	values	20	10			
5				total		limit
6	c1	1	0	20	<=	40
7	c2	0	1	10	<=	10
8	c3	20	10	500	<=	500

Q5 Help Gotiya save money, by solving his problem with excel:
Gotiya has a goat farm. He is trying to decide what to feed his goats. He is considering using a combination of goat feeds available from local suppliers.
He would like to feed the goats at minimum cost while also making sure each goat receives an adequate supply of calories and vitamins.
The cost, calorie content, and vitamin content of each feed are given in the table below.

Contents	Feed A	Feed B	Min Required		
Calories/kg	800	1000	8000		
Vitamins unit/Kg	140	70	700		
Cost/kg Rs	0.40	0.80			

Each goat requires at least 8,000 calories per day and at least 700 units of vitamins.
A further constraint is that no more than one-third of the diet (by weight) can consist of Feed A.
That is, constraint $A \le 1/3\,(A+B)$, which reduces to $2/3\,A - 1/3\,B \le 0$.

A5

profit f_x =SUMPRODUCT($B$3:$C$3,$B$4:$C$4)

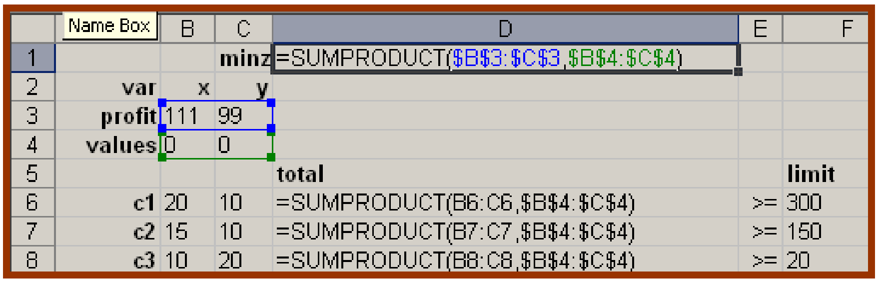
	A	B	C	D	E	F
1			minz	=SUMPRODUCT($B$3:$C$3,$B$4:$C$4)		
2	var	A	B			
3	profit	0.4	0.8			
4	values	0	0			
5				total		limit
6	c1	800	1000	=SUMPRODUCT(B6:C6,$B$4:$C$4)	>=	8000
7	c2	140	70	=SUMPRODUCT(B7:C7,$B$4:$C$4)	>=	700
8	c3	0.667	-0.333	=SUMPRODUCT(B8:C8,$B$4:$C$4)	<=	0

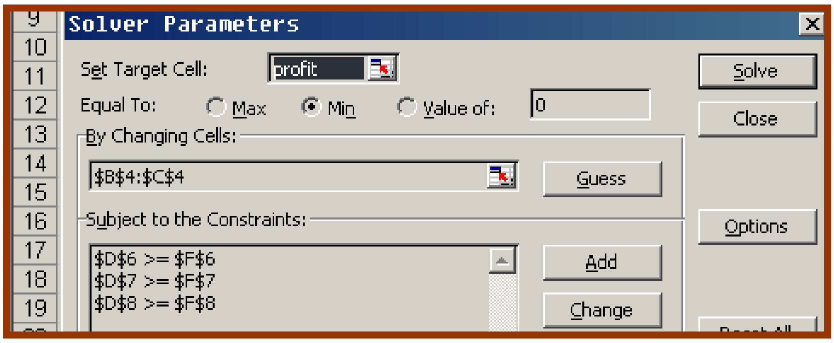
Q6. A dietitian is asked to design a special diet supplement using two different foods X and Y containing:

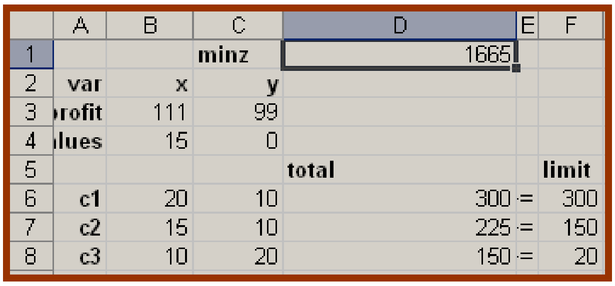
	X	Y	Requirement
Calcium	20	10	300
Iron	15	10	150
Vitamin B	10	20	20
Cost Rs/Kg	111	99	Total Cost
How much?			

Q. What are the variables? What are we optimizing, write the equation. What are the constraints, write the equations. Use Excel to solve it.

A6.







Q 7. Jackie Shine is opening a coconut drink shop. There are 3 popular brands: A, B, C (L-neer, Cocosip, Cocojal).
The costs of A,B,C is Rs. 10, 12, 15. She can sell them at Rs 20, 23, 26. The municipal charges Rs 1 to dispose coconut shell.
From market survey, she estimates maximum demand at 500, 400, 300 coconuts per month. There are some loyal student customers, who want 60 of each brand every month.
She has balance Rs 15,000 for paying the suppliers in advance. She can stock 1000 coconuts per month in the small shop.
How many of each should she order every month to maximize her profits and keep all the customers happy?

A37.

B1 =SUMPRODUCT(B6:D6,B7:D7)

	A	B	C	D	E	F	G
1	maximize	=SUMPRODUC					
2	var	A	B	C			
3	Sell price	20	23	26			
4	Cost	10	12	15			
5	Disposal	1	1	1			
6	profit	=B3-B4-B5	=C3-C4-C5	=D3-D4-D5			
7	values	0	0	0			
8							
9	A	B	C	total		limit	
10	1	0	0	=SUMPRODUCT(A10:C10,$B$7:$D$7)	<=	500	demand
11	0	1	0	=SUMPRODUCT(A11:C11,$B$7:$D$7)	<=	400	
12	0	0	1	=SUMPRODUCT(A12:C12,$B$7:$D$7)	<=	300	
13	1	0	0	=SUMPRODUCT(A13:C13,$B$7:$D$7)	>=	60	Loyal
14	0	1	0	=SUMPRODUCT(A14:C14,$B$7:$D$7)	>=	60	
15	0	0	1	=SUMPRODUCT(A15:C15,$B$7:$D$7)	>=	60	
16	10	12	15	=SUMPRODUCT(A16:C16,$B$7:$D$7)	<=	15000	Cash
17	1	1	1	=SUMPRODUCT(A17:C17,$B$7:$D$7)	<=	1000	Space

Solver Parameters

Set Target Cell: $B$1

Equal To: (•) Max ( ) Min ( ) Value of:

By Changing Cells:

$B$7:$D$7

Subject to the Constraints:

$D$10 <= $F$10
$D$11 <= $F$11
$D$12 <= $F$12
$D$13 >= $F$13
$D$14 >= $F$14
$D$15 >= $F$15

and some more constraints

$D$16 <= $F$16
$D$17 <= $F$17

	A	B	C	D	E	F	G
1	maximize	9700					
2	var	A	B	C			
3	Sell price	20	23	26			
4	Cost	10	12	15			
5	Disposal	1	1	1			
6	profit	9	10	10			
7	values	300	400	300			
8							
9	A	B	C	total		limit	
10	1	0	0	300	<=	500	demand
11	0	1	0	400	<=	400	
12	0	0	1	300	<=	300	
13	1	0	0	300	>=	60	Loyal
14	0	1	0	400	>=	60	
15	0	0	1	300	>=	60	
16	10	12	15	12300	<=	15000	Cash
17	1	1	1	1000	<=	1000	Space

Q8. She decides to increases profit by increasing price to Rs 25, 28, 35. But that means the demand will fall to maximum 200, 200, 100 per month. Should she raise the price? What is the new profit?

A8

profit ▾ fx =SUMPRODUCT(B6:D6,B7:D7)

	A	B	C	D	E	F	G
1	**maximiz**	7700					
2	**var**	**A**	**B**	**C**			
3	**Sell price**	25	28	35			
4	**Cost**	10	12	15			
5	**Disposal**	1	1	1			
6	**profit**	14	15	19			
7	**values**	200	200	100			
8							
9	**A**	**B**	**C**	**total**		**limit**	
10	1	0	0	200	<=	200	**demand**
11	0	1	0	200	<=	200	
12	0	0	1	100	<=	100	
13	1	0	0	200	>=	60	**Loyal**
14	0	1	0	200	>=	60	
15	0	0	1	100	>=	60	
16	10	12	15	5900	<=	15000	**Cash**
17	1	1	1	500	<=	1000	**Space**

Q9. It is summer time, the demand may increase to 400, 400, 600, if she reduces the prices to 18, 22, 25. Should she lower the price? What is the profit now?

A9.

profit ▾ fx =SUMPRODUCT(B6:D6,B7:D7)

	A	B	C	D	E	F	G
1	**maximize**	8880					
2	**var**	**A**	**B**	**C**			
3	**Sell price**	18	22	25			
4	**Cost**	10	12	15			
5	**Disposal**	1	1	1			
6	**profit**	7	9	9			
7	**values**	60	400	540			
8							
9	**A**	**B**	**C**	**total**		**limit**	
10	1	0	0	60	<=	500	**demand**
11	0	1	0	400	<=	400	
12	0	0	1	540	<=	600	
13	1	0	0	60	>=	60	**Loyal**
14	0	1	0	400	>=	60	
15	0	0	1	540	>=	60	
16	10	12	15	13500	<=	15000	**Cash**
17	1	1	1	1000	<=	1000	**Space**

Q10. Going back to the original excel sheet in Q37. The brand C has a lockout in their plant for a month (no supplies from C), and Brand A, B take advantage and raise cost price by Rs 10 each because of labour shortage. What is the new optimal? What should be done?

A10.

B1 =SUMPRODUCT(B6:D6,B7:D7)

	A	B	C	D	E	F	G
1	maximize	0					
2	var	A	B	C			
3	Sell price	20	23	26			
4	Cost	10	12	15			
5	Disposal	1	1	1			
6	profit	9	10	10			
7	values	0	0	0			
8							
9	A	B	C	total		limit	
10	1	0	0	0	<=	500	demand
11	0	1	0	0	<=	400	
12	0	0	1	0	<=	0	lockout
13	1	0	0	0	>=	60	Loyal
14	0	1	0	0	>=	60	
15	0	0	1	0	>=	0	lockout
16	10	12	15	0	<=	15000	Cash
17	1	1	1	0	<=	1000	Space

B1 =SUMPRODUCT(B6:D6,B7:D7)

	A	B	C	D	E	F	G
1	maximize	8500					
2	var	A	B	C			
3	Sell price	20	23	26			
4	Cost	10	12	15			
5	Disposal	1	1	1			
6	profit	9	10	10			
7	values	500	400	-2.72905E-10			
8							
9	A	B	C	total		limit	
10	1	0	0	500	<=	500	demand
11	0	1	0	400	<=	400	
12	0	0	1	-2.72905E-10	<=	0	
13	1	0	0	500	>=	60	Loyal
14	0	1	0	400	>=	60	
15	0	0	1	-2.72905E-10	>=	0	
16	10	12	15	9800	<=	15000	Cash
17	1	1	1	900	<=	1000	Space
18							