SPSS: Stats Practically Short and Simple

Sidney Tyrrell

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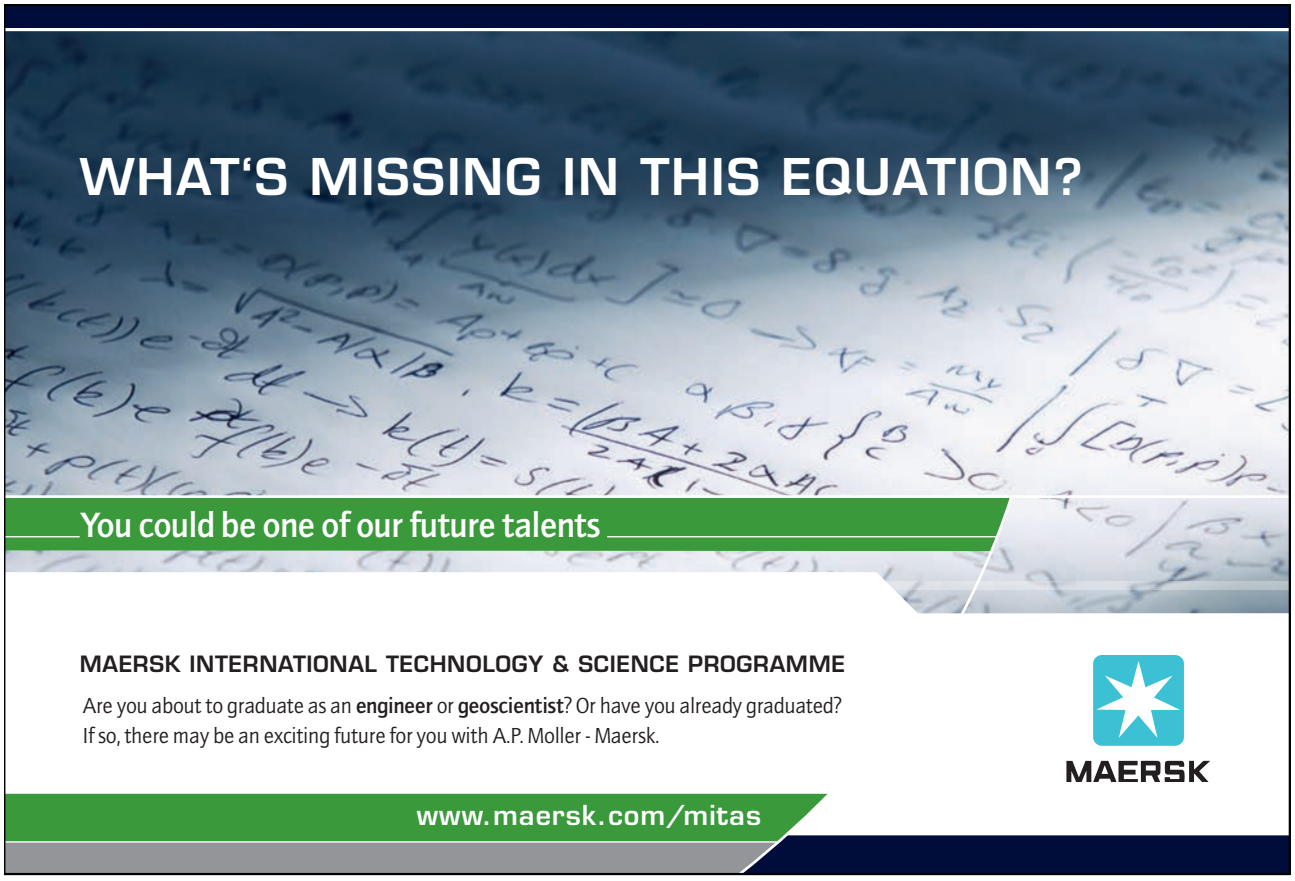

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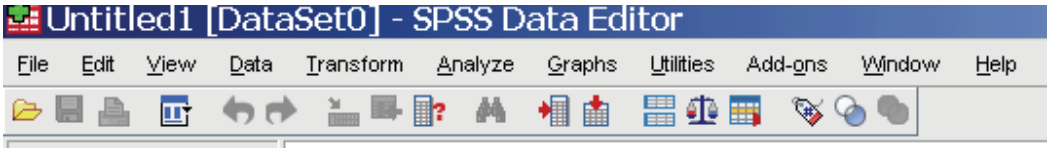
1. An Overview

Getting In

Having opened SPSS you will get a dialogue box which you can cancel the first time you enter SPSS. Enlarge the window.

SPSS is like a spreadsheet **but it does** not update calculations, tables or charts if you change the data.

At the top of the screen are a series of menus which can be used to instruct SPSS to do something.

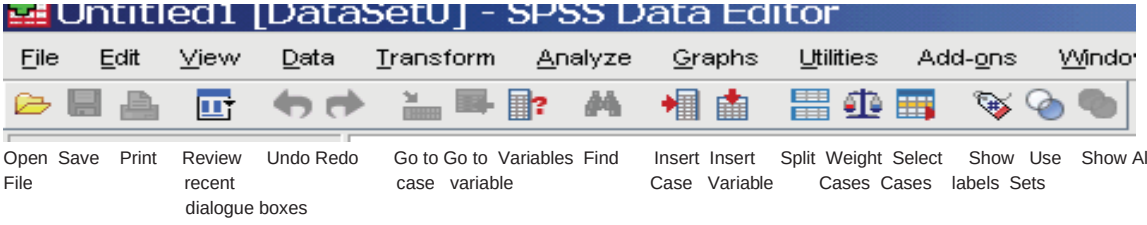


SPSS uses 2 windows: The Data Editor, which is what you are looking at and which has 2 tabs at the bottom, and the Viewer.

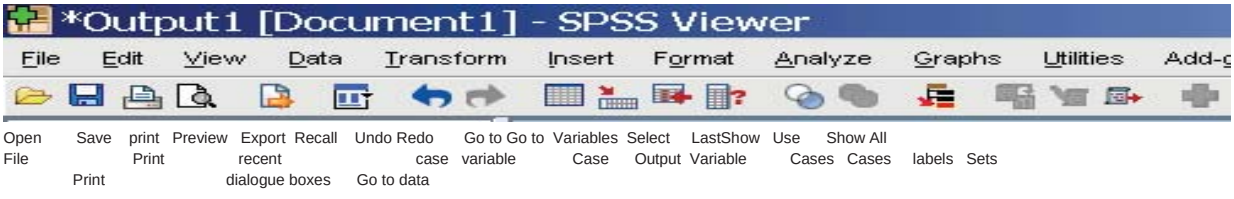
The Viewer is not visible yet, but opens automatically as soon as you open a file or run a command that produces output, such as statistics, tables and charts.

The menus are the same in each window but the icons are different. To switch between the two windows use the tabs at the bottom of the screen.

The Data Editor window:



The Output window:



SPSS comes with a large number of sample data files, which this book will use. If you do not have access to these, use any data set you have access to.

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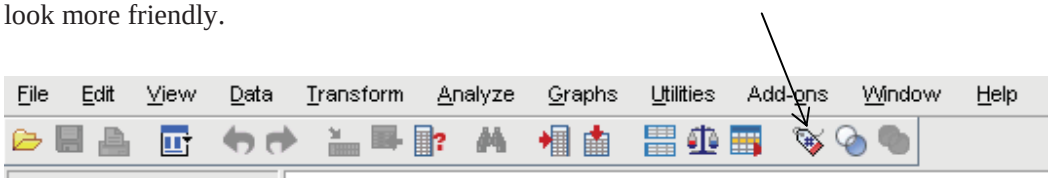
To open the data file **1991 U.S. General Social Survey.sav**
use F**ile** > O**pen** > **D**a**ta**

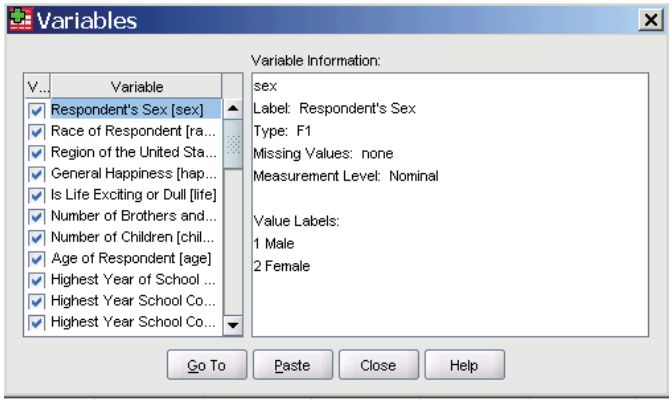
- Double click on the appropriate directories to open each
- Double click on the file **1991 U.S. General Social Survey.sav**

At first you will probably be faced by a mass of seemingly meaningless numbers.

If you look along the toolbar you will find the Value labels icon . Click on this and the output should look more friendly.



- Click on the Variables icon to get an overview of each variable.



Exercise:

- How many Regions of the United States are represented?

Frequencies

- Let's start simply. All that data looks a bit overwhelming so we need to get a handle on it and pick out the main messages.
- First of all how many men and women are there in this group?

For a simple count, and for percentages use

Analyze > Descriptive Statistics > Frequencies .

SPSS uses Dialogue boxes for the selection of variables and options.

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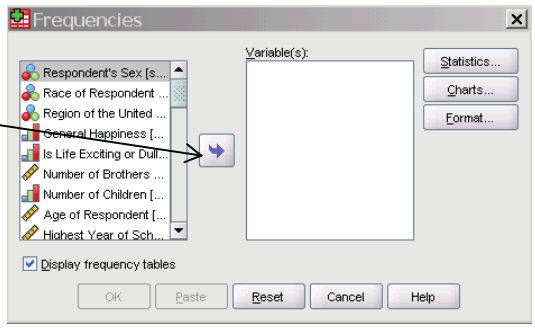
The source list contains the list of variables, with icons as before indicating data types.

- Your dialogue box may have only listed the variable **names**, e.g. ***sex***, rather than the variable **labels** such as 'Respondent's sex'. It is more helpful in analysis to see these labels.
- If they are not shown use **Edit > Options**
- Select the **General** tab and at the top under **Variable Lists click on the circle Display Labels**.

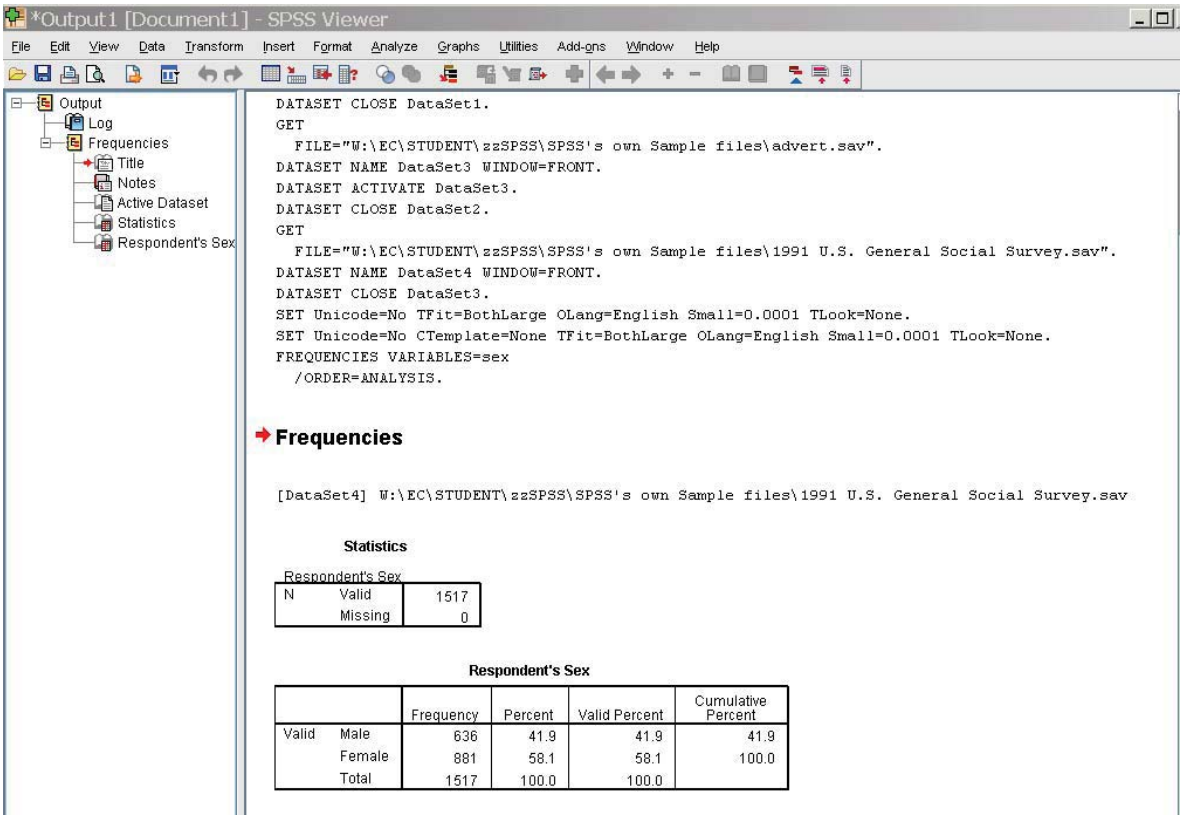
Use the arrow button to move a variable to the target list – the Variable(s) box on the right.

Place *Respondent's sex* in the **Variable(s)** box

then click on **OK**

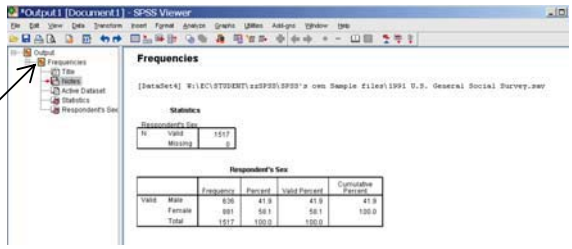


The resulting output introduces us to the Viewer window, and shows that 636 respondents, or 42%, were men. **Maximise the Viewer window.**



- There is a lot of clutter here.
- Tip: Always delete unnecessary Output, and annotate the rest as you go.
- Click on all the text at the top of the screen and press Delete on your keyboard.

The left hand pane contains the outline view. To go directly to an item click on it; very useful when you have masses of output. If you don't need it all for the moment you can hide it by clicking on the minus signs that appear in the left hand frame.

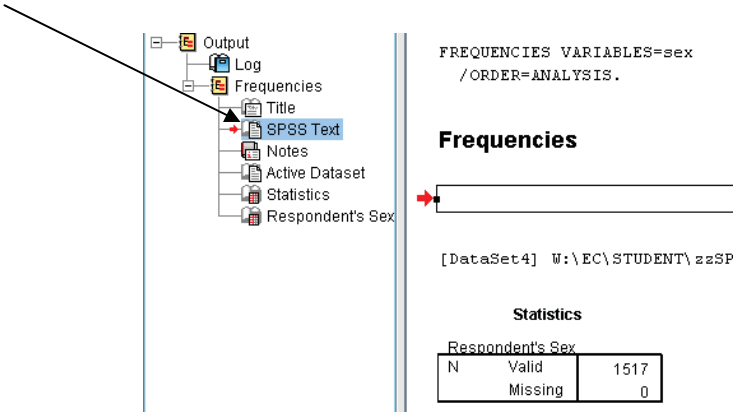


To hide one item, click on the minus sign. This is useful if you only want to print a small selection, as only what is shown is printed.

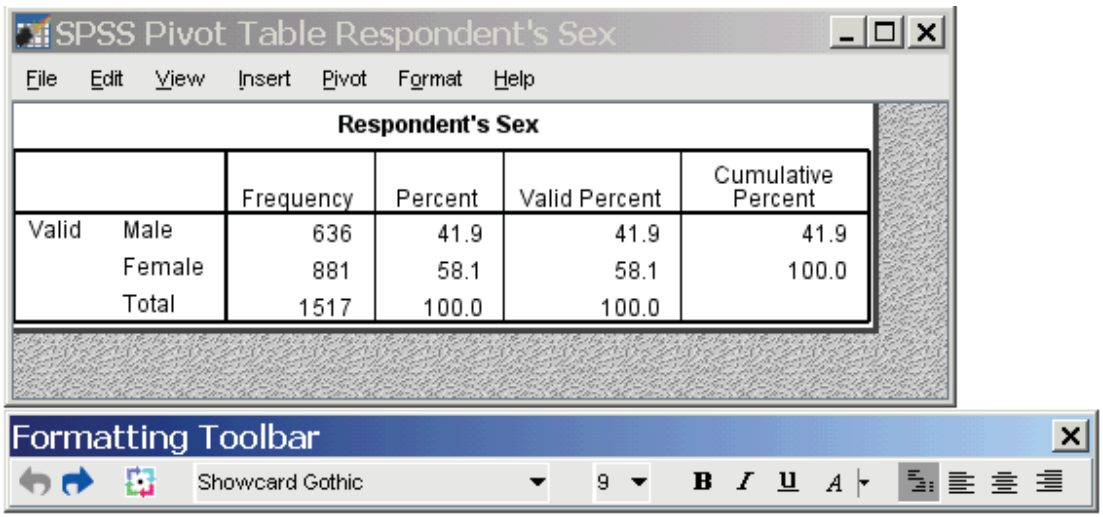
To change the order in which the items are displayed, drag and drop in the left hand pane. Try it.

To delete an item, click on it and press delete.

- **Tip: Never do any analysis without interpreting it.**
- To annotate your output use **Insert > New Text which** provides a text box in which you can write a comment.
- It appears on the left hand side of the screen with a red arrow at first
- Click on it and the box will open in the right hand pane for you to write in.



- Back to the output: itself; t**his can be edited.**
- **Double click** on the table to bring up the Formatting Toolbar.
- If it does not appear use **View>Toolbar**



- Click on any text to change its format and use the Formatting Toolbar to do so.
- Double click to rewrite the text itself.
- When you have finished close the Editing window by clicking on the X

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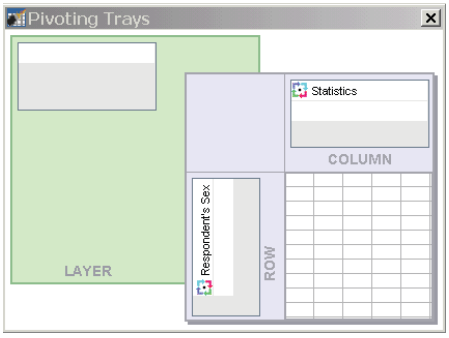
The Formatting Toolbar also gives Pivoting Control (!).

Pivoting control is a useful device, which enables you to change the look of your tables.

Click on the icon to bring up the Pivoting Tray, if it is not already shown.



Clicking on each of the icons at the edges tells you what they represent.

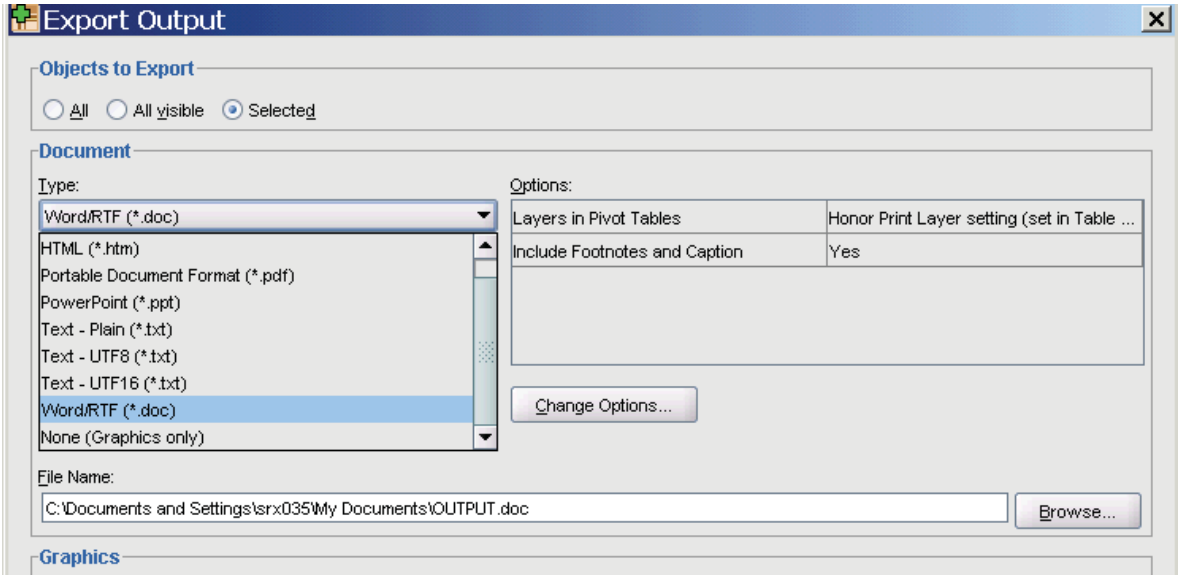
Here the columns are Statistics, and the Rows are Respondent's Sex.

Drag the Statistics icon on to the Row bar so that the 2 are side by side, to see how the table changes; drag it back before proceeding.

- You can copy Output into Word by clicking on it and using **Edit > Copy**
- In Word use **Edit > Paste**.

Exporting your Output to Word

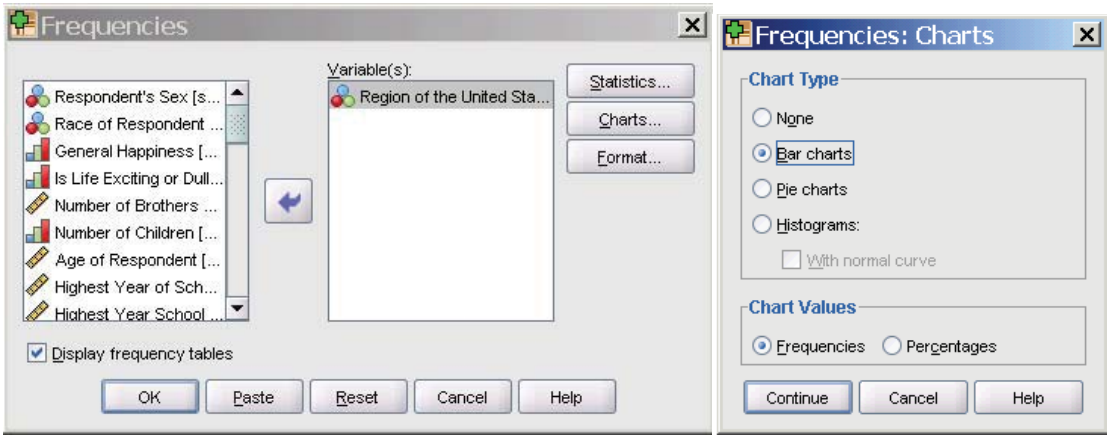
- Output can be exported as a Word RTF file or Text file
- Use **File > Export** and select the appropriate entry under Type.



Drawing charts

This requires a chapter to itself but the easy way for simple charts is to use
Analyze > Descriptive Statistics > Frequencies

Then click the chart button and select an appropriate chart.
Try it for Region of the United States and draw a bar chart.
The dialogue boxes are shown on the next page.



In the same way try drawing a histogram for Age of Respondent.

Exercise

Do not spend too long doing this – the aim is to show you it is much easier drawing charts using Frequencies!

Try drawing the same 2 charts using the Graphs menu and either the Chart Builder or Legacy Dialogs.

After all that … To return to the data window click on the icon in the toolbar or click on the tab at the foot of the screen, or use the **Window** menu.

The SPSS Tutorial is an extremely useful feature of SPSS

- Click on **Help > Tutorial**
- Click on the **Introduction** book and take it from there.

Now take a look at the other very useful help: **The Statistics Coach**.

Click on **Help > Statistics Coach**.

As an example, follow the default settings, and click **Next** each time.

- Summarize, describe or present data **Next**
- Data in categories **Next**
- Tables and Numbers **Next**
- Counts or percentages by category **Finish OK**

Moving Around

You will be glad to know that the usual short cut keys work here.

Home	takes you to the first cell of the row you are in
End	takes you to the last cell of the row you are in
Ctrl Home	takes you to the first cell of your data
Ctrl End	takes you to the last cell of your data.

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2. Entering Data

Introduction

This is a chapter for anyone faced with the long and tedious task of entering data. Spend a little time planning this. Wherever possible use numbers rather than text for answers as you can add labels later.

With questionnaires one usually has a separate column for each question, but if you have a question such as:

“Rate each of the following on a score of 1 to 10 according to importance for the community:

Adequate housing
Good schools
Cultural facilities
Sports facilities.”

You will need a separate column for each category.

Data can be entered directly or imported from an existing SPSS file, spreadsheet or text file, and we shall cover each of these.

Opening an existing SPSS file.

Use **File > Open > Data**

Entering Data directly

Entering numbers and text.

The Data Editor Window looks suspiciously like a spreadsheet, and numbers and text can be entered directly.

Be warned, though it looks like a spreadsheet it does not behave like one. Your charts and output will **not** automatically update if you should change the original data, and you cannot enter formulae directly into a cell, though you can do calculations using a different facility.

- Open a new data sheet. Try **Ctrl n**; this is the shortcut key to open a new file.
- Or use **File > New > Data**

- Try entering some numbers in the first column.
- Type what you want in each cell; press the return key or a cursor key.
- If you make a mistake retype the entry.

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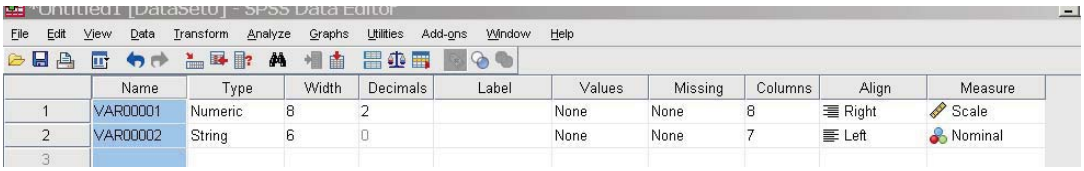
- Now try to put some text into the same column.
- Can you? You can type it in but when you press Enter it disappears.
- This is because SPSS has identified the column as a numeric one and won't allow any text.

- Put some names of countries in the next column to the right including Australia.
- What happens? Most probably it is cut short.
- Try entering numbers in this column – you can but you will not be able to do any calculations with them as SPSS thinks they are text.
- Your new variables have been given the names VAR00001 and VAR00002 which we will now change.

Defining Variables

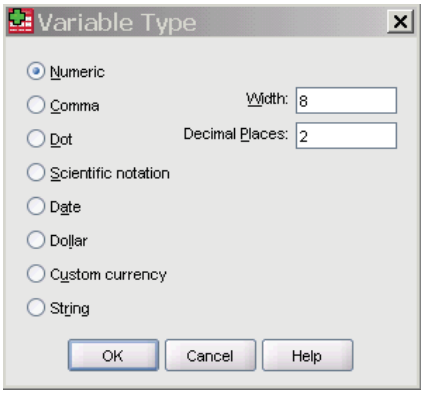
At the foot of the screen are two tabs. Click on Variable View to get the following screen.



Overtype VAR00001 and VAR00002 with the names of your new variables: **numbers** and **countries** will do.

Click in the cell under Type to get a grey square.

Click on that to bring up a **Variable Type** box which you can use to define your variable, control the number of decimal places shown, column width etc.



Adjusting the width

You can adjust the width of your countries column to 18.

Annoyingly when you return to Data View you will still not find Australia displayed, though when you type it in again it will appear.

Variable names

- They must start with a letter but can now be 64bytes long.
- They can contain numerals e.g. abc12
- But cannot contain spaces or % sign.
- Keep them short.

It is important to keep variable names short so that you can see as much as possible of your data on the screen. It is quite an art to write short names that still give you an idea of what the column is all about. Resist the temptation to write Q1, Q2 etc.

You can enter longer descriptive variable labels to explain what the columns are, and these labels will appear on all output.

Tip: It is better to enter most data as numerical codes and then provide labels explaining what the codes represent. Adding Variable and Value Labels will be explained after you have loaded the spreadsheet.

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Inés Aréizaga Esteva (Spain), 25 years old
Education: Chemical Engineer

– You have to be proactive and open-minded as a newcomer and make it clear to your colleagues what you are able to cope. The pharmaceutical field is new to me. But busy as they are, most of my colleagues find the time to teach me, and they also trust me. Even though it was a bit hard at first, I can feel over time that I am beginning to be taken seriously and that my contribution is appreciated.

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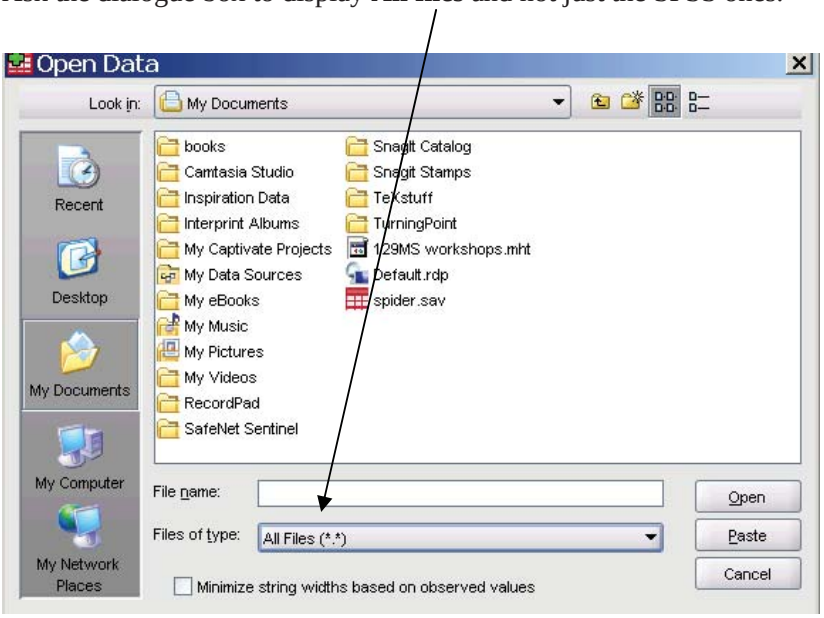
Entering data via a spreadsheet

Excel spreadsheets can be opened in SPSS with the variable names.

One can also simply copy and paste the data cells from Excel into SPSS but you will have to label the columns.

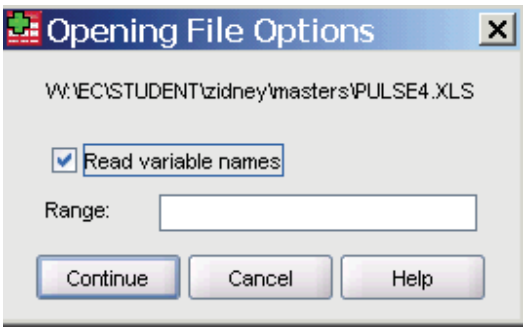
- To open a spreadsheet use **File > Open > Data**
- Ask the dialogue box to display **All files** and not just the SPSS ones.
- 

Find the spreadsheet to open.

SPSS will recognise the format and automatically give this dialogue box.

Tick **Read variable names.**

Click **OK.**



Adding Variable Labels

To keep your sheet manageable it is advisable to have short column names.

Variable labels can explain more fully the nature of the variable – you have 256 characters for the description.

- In Variable View of the Data Editor.
- Click on the cell under the **Label** column and type in a suitable label.

To give an example I might have the variable **exgrp**, short for exercise group.

The Variable Label for this would then be **exercise group**.

Adding Value Labels

Value Labels explain numerical codes.

To insert a **Value Label**

- Click in the cell under the Values column and a small grey square appears.
- Click on this to bring up the Define Variable box.

Enter a value in the Value box, here it is 1

Type an appropriate label in the Value Label box, e.g. ***smokes regularly***
Click on **Add**

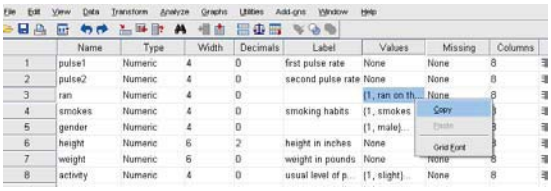
Enter the value 2, and a label, e.g. ***non-smoker***

Add

When all the values have been entered use **Add** for the final value, then click on **OK**

A very useful tip for lots of identical value labels for different variables:

- E.g. if you are entering. 0 = No and 1 = Yes,
- Enter them for one variable.
- Then right click on the cell
- Select Copy
- Go to a new variable and use Paste under the Value column.
- This is a huge time saver!



To return to the data click on the **Data View** tab at the bottom of the screen.

Important note

When selecting data, defining groups, obtaining multiple response sets you will need to use the numeric value entered in a column and not the text label.

In these circumstances always check what the original data has entered by clicking on the icon first.

Finally

It is very easy to make a mistake when entering data.

When it is all entered use **Analyze > Descriptive Statistics > Frequencies** for each column which will help you spot the most glaring errors .e. 11 instead of 1

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3. Editing and Handling Data

- Open any SPSS file e.g. **1991 U.S. General Social Survey.sav**
- Try each of the following.
- It doesn't matter if you change the data, as long as you don’t save the changes.

Correcting entries

Any entry can be over-typed.
Click on the cell, type in the correct entry and press Enter.
Try changing the value in any cell now.

Deleting entries

- To delete an entry for a cell, click in the cell and press delete.
- Complete columns and rows can be deleted by clicking on the grey cell at the top or side and pressing the **Delete** key on the keyboard.
- Remember the useful Undo icon!

Copying cells, columns and rows

- Cells, columns and rows can be copied by first highlighting them then using the **Edit Copy** menu, or **Ctrl C**.
- Move to where you want them copied and use **Edit > Paste** or **Ctrl V**.

Inserting a variable (a column)

- Click on the top of the column to the right of where you want the new column to appear, i.e. the new column will appear on the left
- Use the **Insert Column icon**
  or
- **Right Click** at the top of the column to the right of where you want the new column to appear, and use **Insert Variable**
  or
- Use **Edit > Insert Variable**

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Inserting a case (a row)

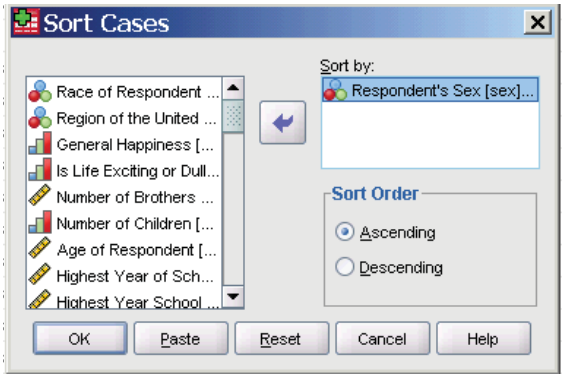
- Click at the side of the row below where you want the new row to appear.
- Use the Insert Row Icon
  or
- **Right Click** at the side of the row below where you want the new row to appear, and use **Insert Cases**.
  or
- **Edit > Insert Cases**

Moving columns

You can drag and drop columns to wherever you like – highlight them first.

Sorting data

SPSS can sort the data, e.g. by Respondent's Sex **Data > Sort Cases**.



In the dialog box highlight Respondent's Sex (sex)

Click on the arrow

to transfer it to the **Sort by** box

OK

Sorting can be Ascending or Descending.

Saving data and output

- Data and output have to be saved **separately**.
- Use **File > Save** in the appropriate window.
- Charts are saved as part of the Output in a **.spv** file; data is saved as a **.sav** file.
- You **need to save your Output** before it can be exported in another format or printed out.
- Be warned Output from SPSS v15 cannot be opened in V16.

Exporting Output

- **Once you have saved** your Output it can also be exported as a Word RTF (Rich Text File) which contains graphics.
- Use **File > Export** and choose Word/RTF from the drop down box.

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- Similarly it can exported as a pdf file.

- **It is an excellent rule to save frequently.**

Saving Data as an Excel file

- SPSS data can be saved as an Excel File.
- Use **Save Data As** and from the drop down box select the appropriate Excel format.
- There are a wide variety of other formats to choose from including csv, dat and SAS.

Copying tables and charts into Word

- In the Viewer window click on what you want to transfer to Word, either a table or chart.
- Use **Edit > Copy** and in Word use **Edit > Paste**, or **Ctrl c** and **Ctrl V**.

Printing from SPSS

- Remember that you need to save your Output first.
- You can print directly from the Viewer window using **File > Print**, but
- **use Print Preview first** to make sure you have what you want.
- To print just one specific thing click on it first to select it.
- Output that you don't want can be hidden by clicking on the icons in the left hand pane.

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Recoding into groups

- You will find it very useful to be able to recode data.
- The **1991 U.S. General Social Survey.sav** data includes the number of brothers and sisters each respondent has in the column headed **siblings**.
- Use Analyze> Descriptive Statistics >Frequencies
  to get an idea of what this data looks like.

Number of Brothers and Sisters

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	74	4.9	4.9	4.9
	1	236	15.6	15.7	20.6
	2	276	18.2	18.3	38.9
	3	236	15.6	15.7	54.6
	4	209	13.8	13.9	68.5
	5	118	7.8	7.8	76.3
	6	80	5.3	5.3	81.7
	7	81	5.3	5.4	87.0
	8	58	3.8	3.9	90.9
	9	47	3.1	3.1	94.0
	10	34	2.2	2.3	96.3
	11	22	1.5	1.5	97.7
	12	11	.7	.7	98.5
	13	9	.6	.6	99.1
	14	5	.3	.3	99.4
	15	3	.2	.2	99.6
	16	1	.1	.1	99.7
	17	2	.1	.1	99.8
	18	1	.1	.1	99.9
	21	1	.1	.1	99.9
	26	1	.1	.1	100.0
	Total	1505	99.2	100.0	
Missing	DK	4	.3		
	NA	8	.5		
	Total	12	.8		
Total		1517	100.0		

- It might be useful to regroup the data into subgroups and give each group a numerical code.

- As an example I suggest recoding the students into 3 groups:

Those with no brothers or sisters	Group 1
Those with 1, 2 or 3 brothers or sisters	Group 2
Those with 4 or more brothers or sisters	Group 3

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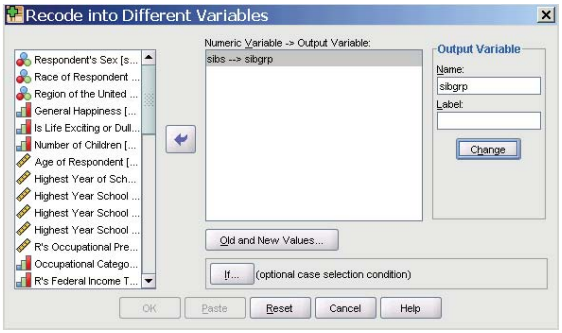
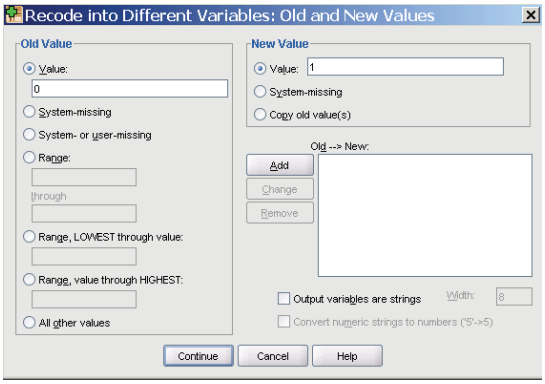
Use
Transform
Recode Into Different Variables



Place ***Number of brothers and Sisters (sibs)*** in the large box.
Name the new variable ***sibgrp*** in the right hand box.

Click on **Change**
Type in the Label **sibling groups**

Click on **Old and New Values** to get the next dialogue box:



On the left hand side under Old Value
Click next to Value and enter 0 in the box.

On the right hand side, as shown
Type 1 in the Value box

Click **Add.**

Recode the other groups as follows:

Group 2 1, 2, or 3 brothers or sisters
For Old Value use ***Range 1 through 3*** **and for the new Value 2**
Don't forget to click on **Add**

Group 3 4 or more brothers or sisters
For Old Value use ***Range, value through highest 4*** **and for the new Value 3**
Add

Having completed the recoding use Continue OK

You should now have a new column on the right of your data sheet headed sibgrp

Revision exercise

- Provide **labels for** the new variable **sibgrp** to explain what the numbers represent.

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Doing Calculations on Variables

Calculations can easily be done in **SPSS using Transform > Compute Variable**

As an example, in the data **1991 U.S. General Social Survey.sav**, we shall calculate a new column to measure age in months.

- Use **Transform > Compute Variable**
- fill out the dialogue box as shown then **OK**

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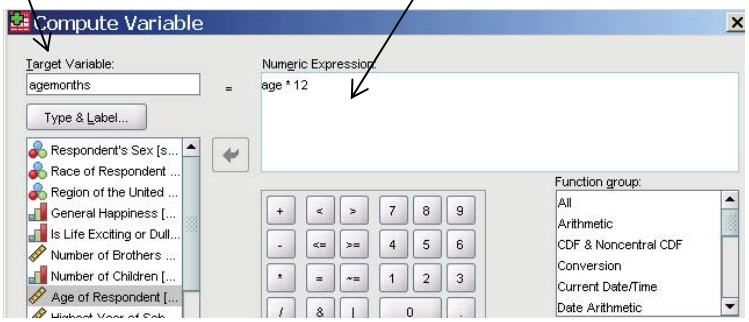
A new variable **agemonths** has been created.

The age in years has been multiplied (*) by 12



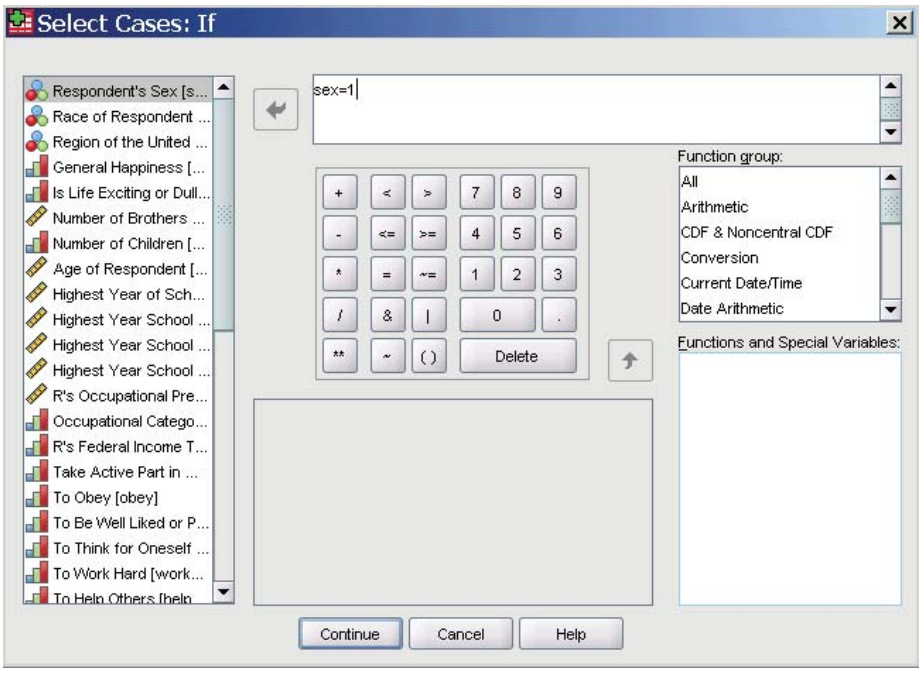
Type in the Numeric Expression ‘long-hand' or use the keypad.

The list of functions can be useful for your calculations.

Selecting a subset

During your investigations you may want to look only at the data for the males, or females.

- SPSS enables us to select just these cases using
- **Data > Select Cases > If condition is satisfied *(click in the circle next to this)***
- Click on the **If** … button under **If condition is satisfied**
  (the **If button** will not be available if you have not clicked in the circle)
- Enter the appropriate condition, e.g. the example shows what has to be filled in for selecting males.
- **Notice you have to put sex =1 not sex = “males”**
- **This is because the data entered into SPSS in the sex column was numeric**



Continue select **Filter out unselected cases** **OK**
(Tip: Do not delete the other cases as they will be lost for good.)

If you scroll down the data sheet you will notice that the females are crossed out on the left, and are now ignored in any operation. Try a frequency table for Respondent's sex and see what you get.

To **restore all the data** use **Data > Select Cases > All cases** **OK**

Be warned: this is all too easily overlooked when you have been working on only part of the data, and then decide to analyse what you think is the complete data set.

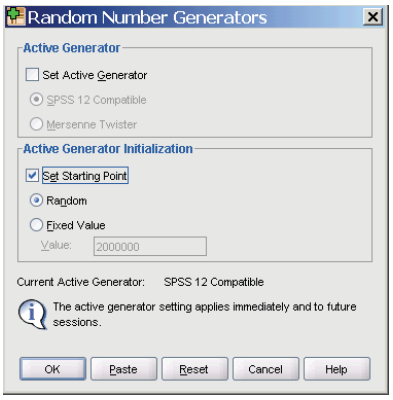
Selecting a Random Sample

This is a two stage process:

- First we set the starting point and type of random number generation.
- Then we select the actual sample.

To select the starting point and type of number generator:

- Use **Transform > Random Number Generators**



- Select **Set Active Generator**
- There are two ways in which SPSS version 16 generates random numbers. The current active random number generator is displayed.
- **You should use Mersenne** Twister unless you want to reproduce results generated in SPSS version 12.

- Select **Set Starting Point**.
- Choosing **Random** allows a different start point for the random selection each time you enter SPSS.
- Entering a Fixed Value (which can be any number) allows a random selection to be reproduced.

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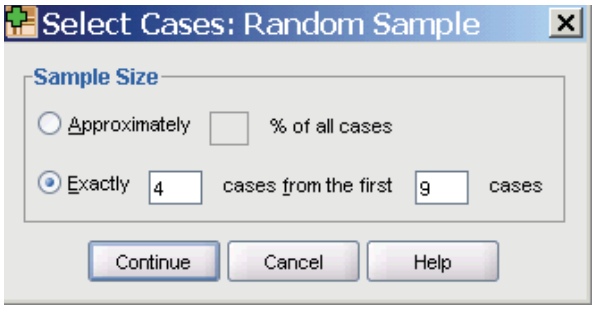
- Try them both in the next example and see what happens.
- If you do not set a starting point you will get the same random selection each time you enter SPSS.
- Click OK following your selection.
- **Any settings you make will remain in force for future sessions**

To select the actual sample:

- Use: Data > **Select Cases** > **Random Sample of Cases**
- Click on the **Sample** button
- Fill out the dialogue box appropriately.

Suppose you wanted to selected a random sample of 4 from the first 9 cases, the box would be set out as follows:



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Merging Files

- Sometimes you will have two data files relating to the same people, or two files with similar data but with different people.
- Using Merge Files you can add Variables or Cases to an existing file.

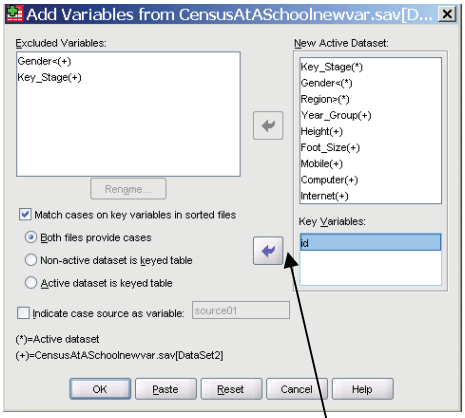
Adding Variables

- Open the first file
- Open the second file which will relate to the same people or objects but with different variables.
- **Always open using File Open – do not double click from Windows Explorer as this will often open another running of SPSS.**

- To merge the two files so that you have all the variables in one:
- **You must have a key variable which identifies each case, and you must have sorted the files so that the key variable is in the same order in each.**

- Use **Data > Merge Files > Add Variables.**
- Choose the first file from the list under **An open dataset** and click **Continue**

The dialogue box shows an example where the id is the key variable:



Click Match cases on key variables in sorted files and
Both files provide cases
Highlight the id in the left hand box and click on the arrow to paste it into the Key Variable box.
Click on OK and OK again at the warning message and the files will merge.

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Adding cases

- Open your first file to which you want to add more cases.
- Use **Data > Merge Files > Add Cases**
- Select **An external SPSS data file** and click the **Browse** button, then select your second file.
- Click on **Open**
- There should be no unpaired variables.
- Click on **OK**.
- You should now have a file with all your cases.

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4. Descriptive Statistics

The **Analyze** function in SPSS enables us to summarise our data in a number of ways.

The confusion is what to use when, especially as there is often more than one way of doing things in SPSS.

This section provides a guide to what to use, and a brief look at the functions in turn.
Remember this is a book on SPSS not on statistics.

A 'Very Rough Guide' as to what is appropriate to use when:

All the functions are found under **Analyze** **Descriptive Statistics** except where stated.

Task	SPSS function	Comments
Counts	Frequencies (offers charts too) Crosstabs	Use %'s as well as counts. %'s are used for comparisons. Round %'s to the nearest whole number in reports.
Averages and Measures of spread	Frequencies with the Statistics option; Descriptives.	Make sure you use a sensible measure, e.g. the mean gender is meaningless.
Comparing sets of data	Explore (offers charts too) Crosstabs Analyze > Custom Tables	Beware of using boxplots for inappropriate data, eg nominal. Crosstab tables can look untidy, so think carefully about the number of levels and the information required in them. Use for multiple responses. All tables can be modified.
Looking for relationships	Tables: Crosstabs Scatterplots (see Scatter/Dot in the Graphs menu)	Plots and tables give a visual impression of possible relationships: the eyeball test. You may then need to follow this up with the appropriate statistical test.

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The Functions

What follows is a brief description of the following functions:

Frequencies, Descriptives, Explore, Crosstabs and a brief look at other Tables.

Frequencies: **Analyze > Descriptive Statistics > Frequencies**

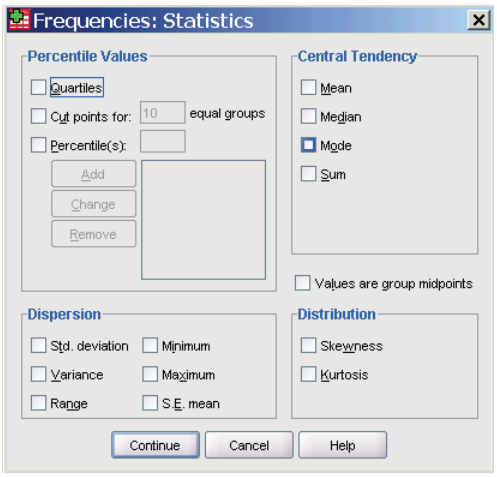
This is the best function for overall summaries

Frequencies are used when you want to know how many of something you have.

However, additional statistics available via the **Statistics** button makes it **far more useful** than just counting.

The **Charts** button is particularly useful; automatically producing charts of your data.

The **Statistics** button brings up the following dialogue box:



These statistics would be helpful for age but don't be tempted to use them for gender!

Example:

Using the **1991 U.S.General Social Survey.sav** data

- Use Frequencies to find the summary statistics for age.
- Draw a histogram of the data.

- Start with **Analyze > Descriptive Statistics > Frequencies**
- Fill out the dialogue box as shown.
- Click on the **Statistics** button

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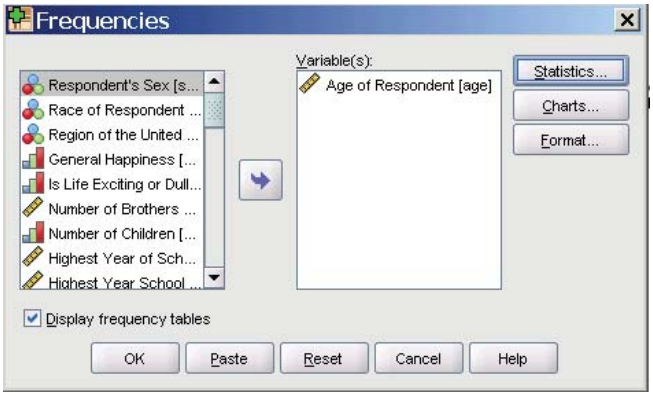

- We can ask for the Mean, Median, Std deviation, Minimum and Maximum
- Click **Continue**
- Click on the **Chart** button
- Select **Histograms**
- **Continue** **OK**

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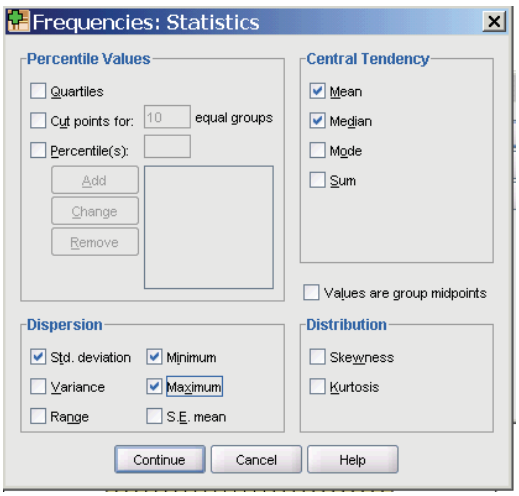
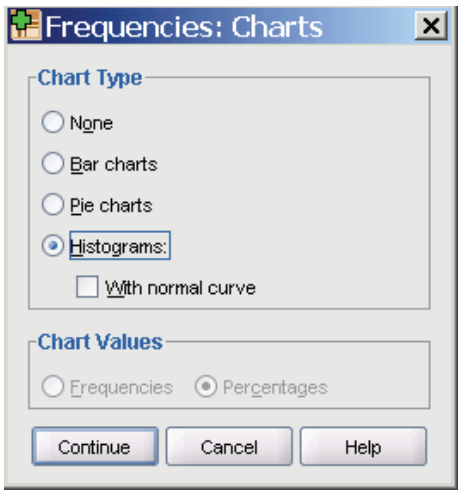


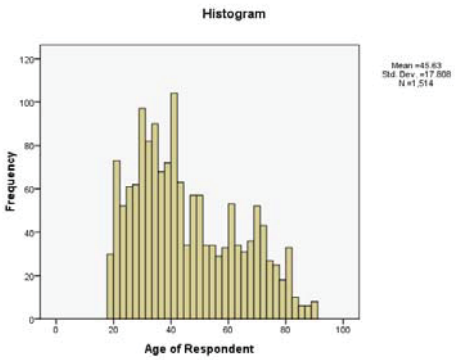


- The Output should look like this.
- No-one would pretend that the histogram is well formatted at this stage but that can be corrected. (See the chapter on charts).
- Believe me, it is by far the quickest way to draw a histogram of age.

Statistics

Age of Respondent

N	Valid	1514
	Missing	3
	Mean	45.63
	Median	41.00
	Std. Deviation	17.808
	Minimum	18
	Maximum	89

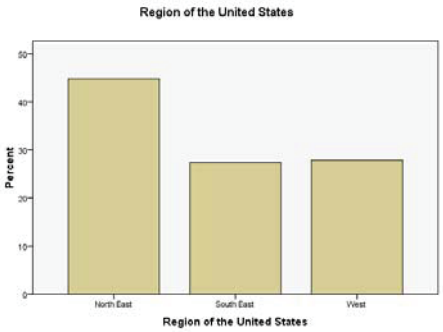


Exercise:

Use Frequencies to find the % of respondents living in each of the different regions.
Draw a % bar chart to represent this.

Region of the United States

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	North East	679	44.8	44.8	44.8
	South East	415	27.4	27.4	72.1
	West	423	27.9	27.9	100.0
	Total	1517	100.0	100.0	



Finding Frequencies for Multiple Response Variables

When you write a questionnaire you often include a question where the respondent can tick more than one response.

In the data file **1991 U.S.General Social Survey.sav** there are several questions relating to health, e.g.

Are you ill enough to go to a doctor?
Have you received counselling for mental problems?
Infertility, are you unable to have a baby?
Do you have a drinking problem?

Using frequencies we could obtain a separate table for each but SPSS can combine these multiple responses into one table for you.

Use **Analyse > Tables > Multiple Response Sets.**

- First we need to define our Multiple Response set.
- Fill out the dialogue box as shown, with the various health related questions in the Variables box
- Dichotomies Counted value 1 (because there is a 1 in the column when a respondent has that problem)
- Set Name: **problems**
- Click on **Add** then **OK**

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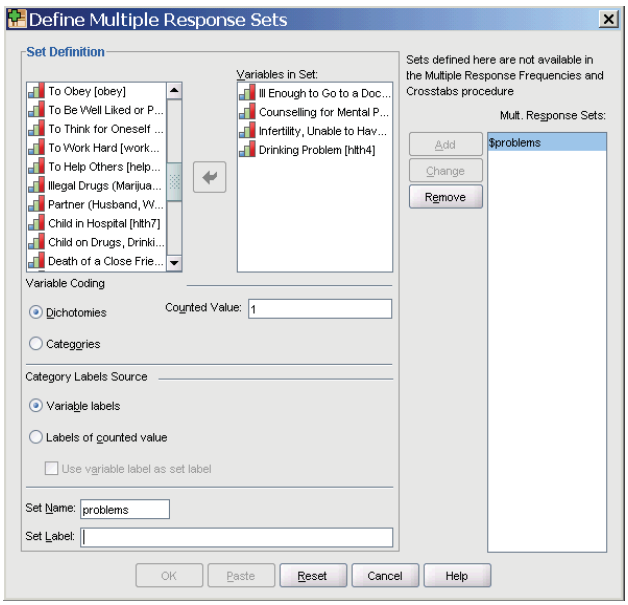
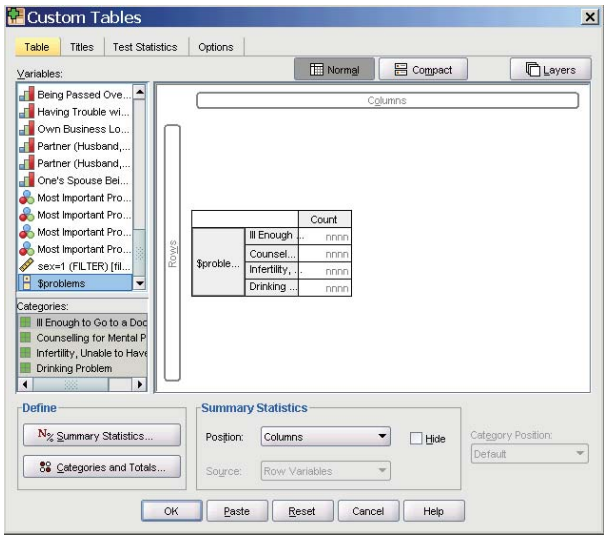


You do not get a table as output but this

Multiple Response Sets

Name	Coded As	Counted Value	Data Type	Elementary Variables
$problems	Dichotomies	1	Numeric	Ill Enough to Go to a Doctor Counselling for Mental Problems Infertility, Unable to Have a Baby Drinking Problem

- Now use **Analyze > Tables > Custom Tables**
- Your variable **problems** should now appear at the bottom of the Table dialogue box.
- Place it in the Rows and Click **OK**.

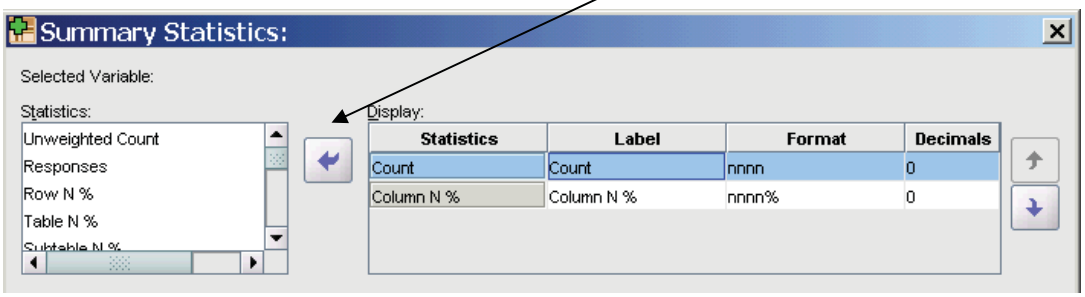


You should get:

Table 1

		Count
$problems	Ill Enough to Go to a Doctor	559
	Counselling for Mental Problems	58
	Infertility, Unable to Have a Baby	35
	Drinking Problem	17

- For percentages use **the N%Summary Statistics** button.
- Use **Column N%**
- Take out the counts by highlighting them and using the back arrow.
- **Apply to Selection > OK**



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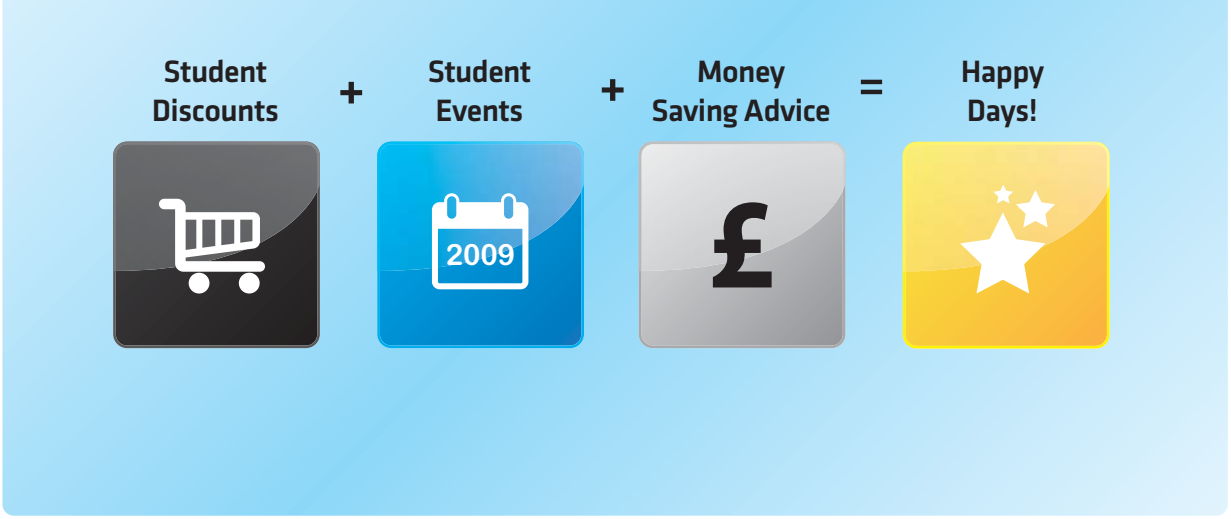

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This should give you:

Table 1

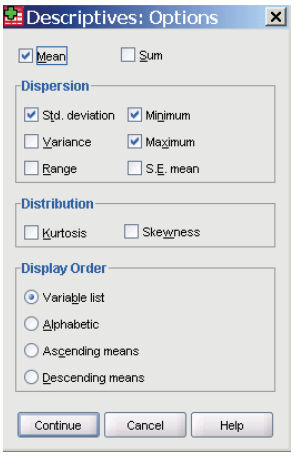
		Column N %
$problems	Ill Enough to Go to a Doctor	96%
	Counselling for Mental Problems	10%
	Infertility, Unable to Have a Baby	6%
	Drinking Problem	3%

Descriptives**: Analyze > Descriptive Statistics > Descriptives**

Analyze > Descriptive Statistics > Descriptives

Click on **Options**
This brings up the following dialogue box:

Descriptives offers much less than Frequencies - only giving a mean for averages, and the standard deviation and range for spread.



Explore: **Analyze > Descriptive Statistics > Explore**

This is an extremely useful command when you need to compare two sets of data, e.g. ages of males and females. It explores the differences.

The example shows the dialogue box set up to compare the ages of men and women in **the 1991 U.S.General Social Survey.sav** data file.

SPSS has been asked to display both statistics and charts, the latter being boxplots and stem and leaf plots - again a very useful automatic facility.

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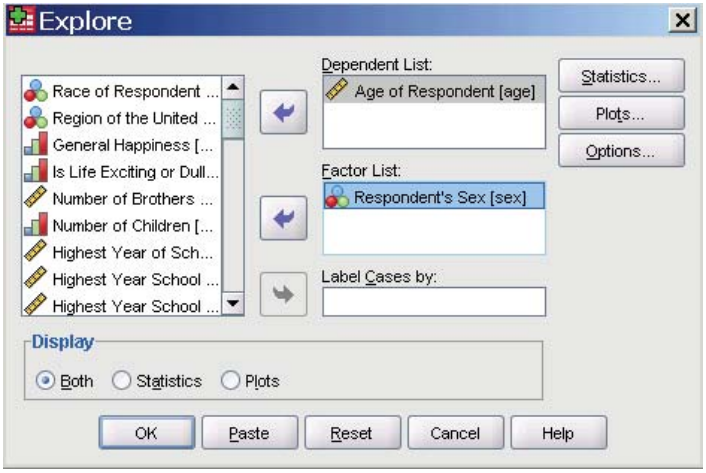

Boxplots are a useful way of comparing two or more data sets. They are as the name implies a box whose length represents the inter-quartile range of the data.

The lower edge of the box is at the lower quartile of the data, and the upper edge at the upper quartile. A horizontal line indicates the median.

'Whiskers' are drawn to the minimum and maximum values within 1.5 box-lengths of each end of the box. Outliers are indicated by o. Values outside 3 box-lengths are indicated by *

Crosstabs: **Analyze > Descriptive Statistics > Crosstabs**

If you want a table use Crosstabs.

The Tables function is in my opinion only for advanced users of SPSS.

The Crosstabs function produces slightly complex tables, but these can be edited to look tidier.

It has the useful additional facility of doing a Chi-Squared test (and others) if asked - use the **Statistics** button. The **Cells** button enables one to choose Column %'s, Row %'s and Total %'s, but it is advisable to ask for only one at a time, for clarity.

- Using the **1991 U.S.General Social Survey.sav** data file.
- The example shows the dialogue box set up to produce a table of **General Happiness** by **Respondent's Sex**.

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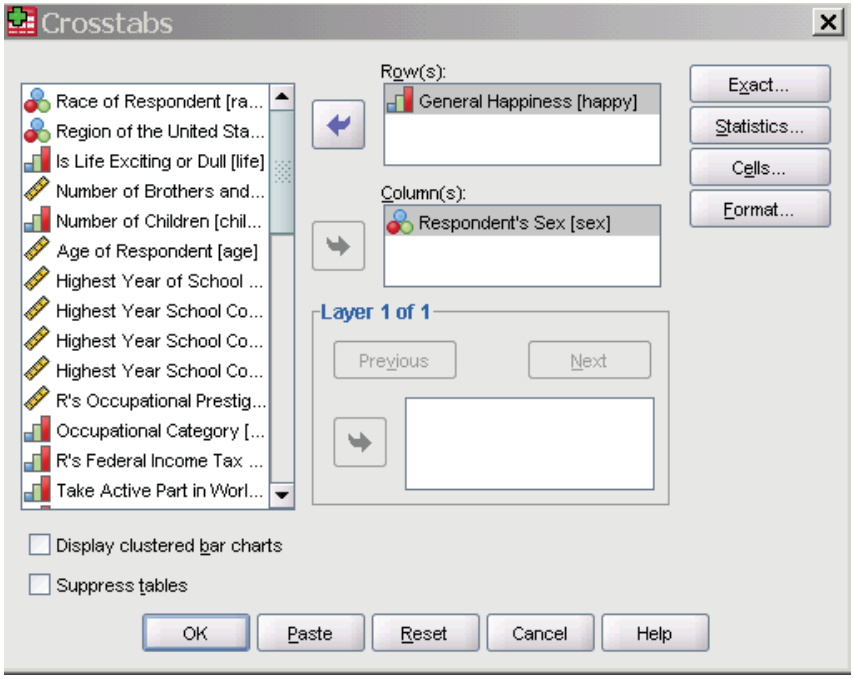

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Which gives:

General Happiness * Respondent's Sex Crosstabulation

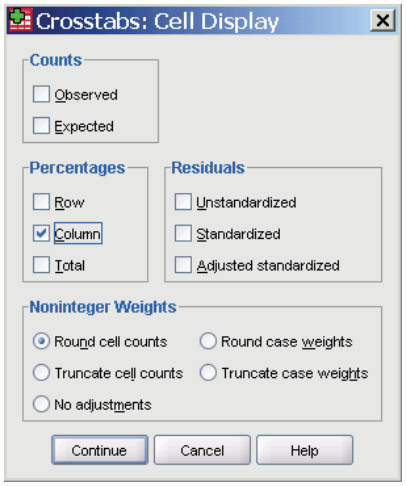
Count

		Respondent's Sex		
		Male	Female	Total
General Happiness	Very Happy	206	261	467
	Pretty Happy	374	498	872
	Not Too Happy	53	112	165
	Total	633	871	1504

It would be more helpful to give column %'s here to compare the relative happiness of men and women.

- To do this click on the **Cells** button:

And fill out the box as shown:



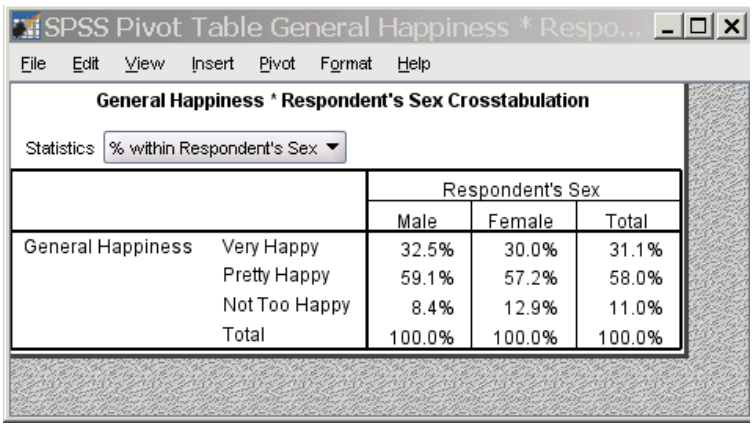
To give

General Happiness * Respondent's Sex Crosstabulation

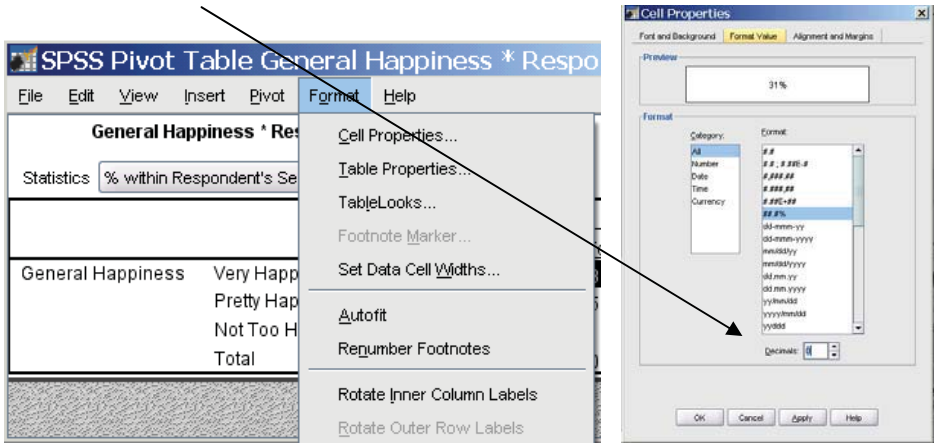
% within Respondent's Sex

		Respondent's Sex		
		Male	Female	Total
General Happiness	Very Happy	32.5%	30.0%	31.1%
	Pretty Happy	59.1%	57.2%	58.0%
	Not Too Happy	8.4%	12.9%	11.0%
	Total	100.0%	100.0%	100.0%

- This table needs formatting to give the %'s as whole numbers.
- Double click on the table To bring up the Pivot Table box



- Highlight the cells in the table
- Click on **Format > Cell Properties**
- Under the **Format Value** tab
- Change **Decimals** to **0**.



NB Producing a table with a variable taking many different values, e.g. age, is not a good idea.

Tables are tricky!

Look at these 2 tables and answer the following questions:

		Male	Female	Total
General Happiness	Very Happy	44%	56%	100%
	Pretty Happy	43%	57%	100%
	Not Too Happy	32%	68%	100%
	Total	42%	58%	100%

		Male	Female	Total
General Happiness	Very Happy	33%	30%	31%
	Pretty Happy	59%	57%	58%
	Not Too Happy	8%	13%	11%
	Total	100%	100%	100%

- What % of females were very happy?
- Of those who were very happy, what % were female?

- The answers are 30% of females were very happy and 56% of those who were very happy were female.
- You may well have got it the wrong way round.

- This is the biggest problem students have – wrongly interpreting %'s in tables.

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The tip is to do both column and row %'s and have them in front of you so that you can see the difference.

- Crosstabs should produce adequate tables for all your needs, but there are other Tables functions in SPSS.
- My advice is to ignore these unless you feel very confident.
- Plenty of help on Tables is available under the SPSS Help function.

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5. Charts

Introduction

SPSS provides a wide variety of charts to choose from including bar charts, histograms, pie charts, scatterplots, and boxplots.
These are accessed via **Graphs> Chart Builder**
Or by Charts > Legacy Dialogs

Charts should convey a message;
They should help the reader to understand the data, and not confuse.

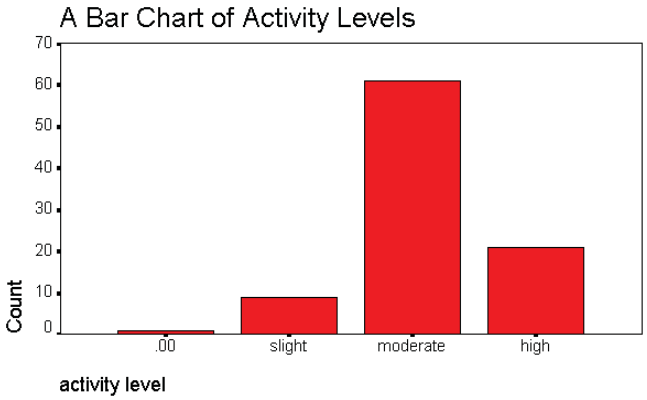
Try to use as little 'ink' as possible – cluttered charts are not easy to understand.

Drawing appropriate charts is not as easy as it looks, so if you feel daunted use the **Charts** options under **Frequencies**.
For boxplots use Explore.
These two commands will do most of the thinking for you.

In general there are a 2 simple rules which will help:

Decide what your message is and find a chart that conveys it clearly.
Label everything, but don't swamp the chart with words - adjust the font size.

Here are 2 examples



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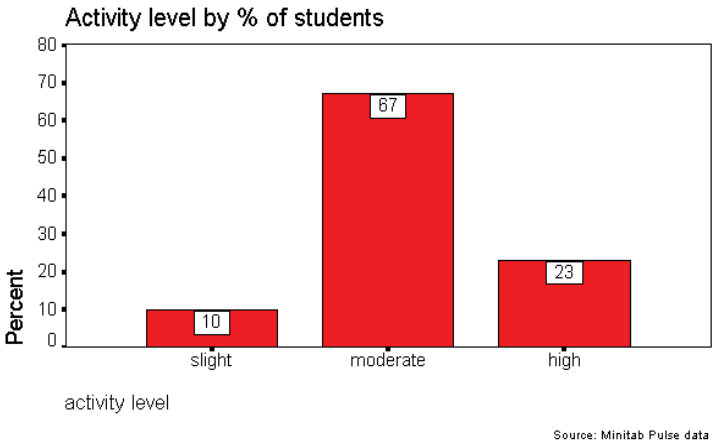


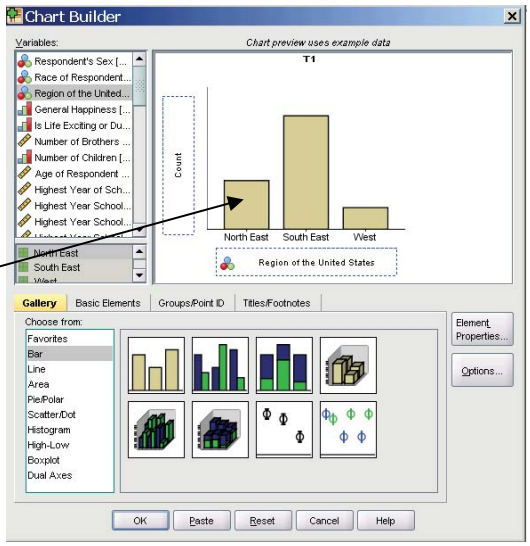
Spot the differences and decide which is more helpful.

A Simple Bar Chart

Using the **1991 U.S.General Social Survey.sav** data

We shall start by drawing a bar chart of the regions.

Use Graphs > Chart Builder



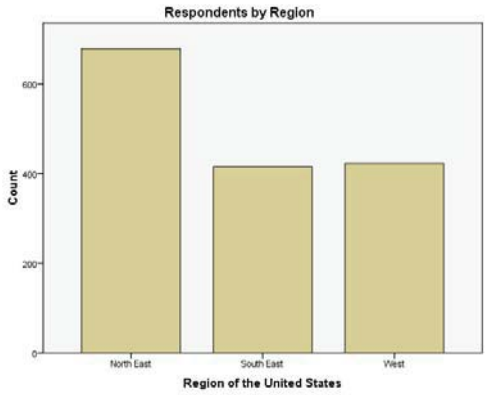
Drag the left hand Bar Chart into the main window

Drag **Region of the uNited States** into the X axis box.

Under Titles/Footnotes
Click Title 1 and enter **Respondents by Region**
Click **Apply**

Click on **OK**

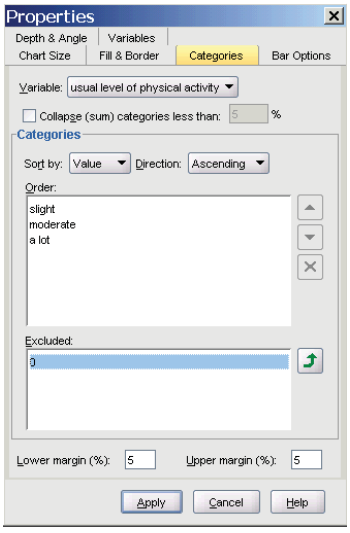
You should get this.



To edit the chart double click on it.

The Chart Editor appears.
Depending where you double click on the chart a Properties box should appear with different tabs.

- Double click on a bar;
- Under the **Fill & Border** tab
- Change the colour;
- Apply.



- To change the colour of a single bar click once on one bar;
- it alone will be selected.
- Double click on it
- apply colour as before.

- Under Depth and Angle do NOT be tempted to apply shadow or 3-D.

- To remove a category

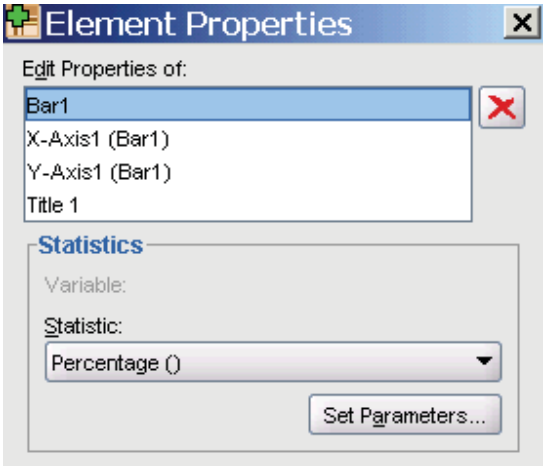
- Double click on the x axis labels , e.g. North East
- Click on the Categories Tab
- Highlight **North East**
- Click on the red cross,
- **Apply.**

Percentage Bar Chart

As before use Graphs > Chart Builder

- In the **Element Properties** box (only the top half is shown)
- Select Percentage ()
- Apply

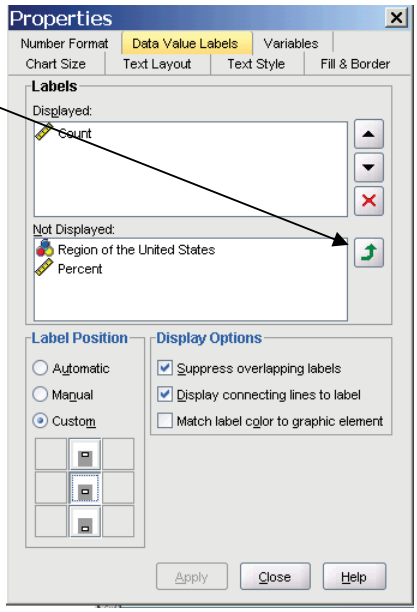
- OK



- Double click to edit this chart.
- Click once on a bar to select them all

Then on the Show Data Labels Icon

- Click on Percent
- Transfer to the top box using the arrow
- Apply.



Take Count out

- by highlighting **Count**, and
- Using the cross
- **Apply**.

You can amend the format of numbers by selecting the Number Format tab.

- Always show %'s as whole numbers.
- Type 0 in the Decimal Places box.
- **Apply**

- Use the Text Style tab to increase the font size: try 12
- **Apply.**

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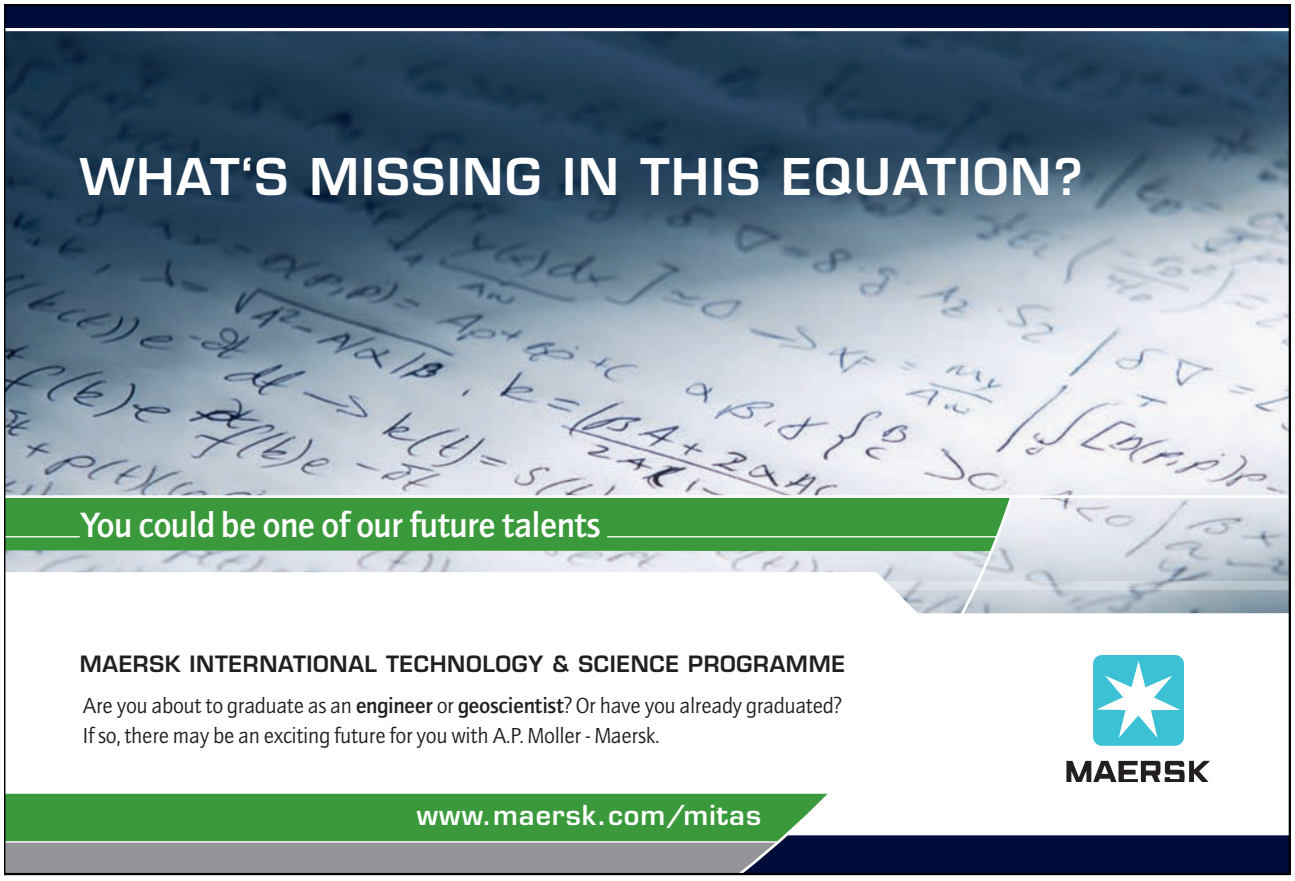

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To change the %'s on the axis to whole numbers

- Click on the y axis once to select it
- Double click to bring up the properties box
- Select the Number Format tab
- Type 0 in the Decimal Places box
- Click **Apply**

Transpose the chart using the Transpose icon

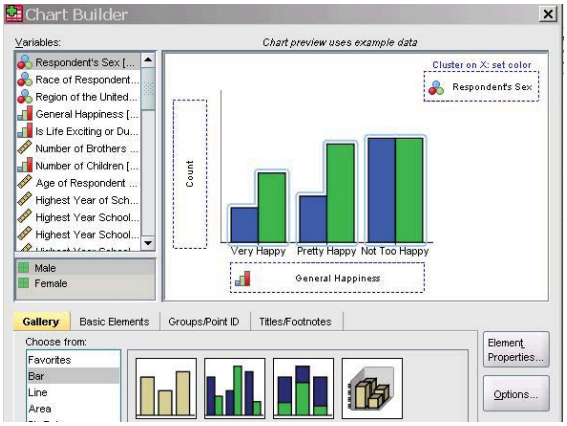
The chart can be copied from Output into a Word document using **Edit > Copy**
When in Word use **Edit > Paste**.

A clustered bar chart

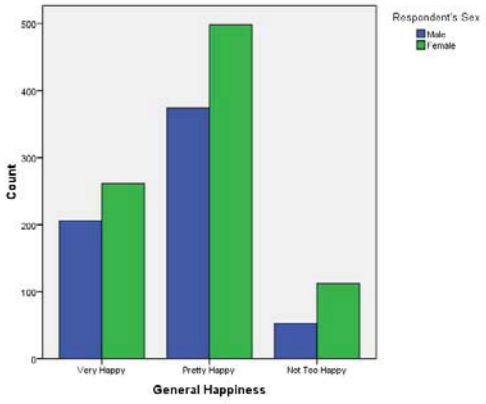
A clustered bar chart is good for comparisons.
Here we shall compare the general happiness of males and females.

Use Graphs > Chart Builder
Reset

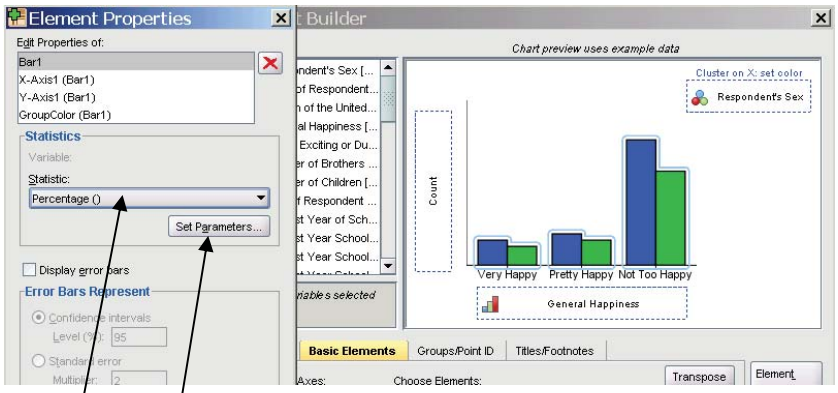
Drag the second bar chart option into the Gallery.
Drag General Happiness into the X axis box
Drag Respondent's Sex in to the Cluster on X **box** in the top right of the Gallery window.



You should get



Percentage Clustered Bar Chart



For a percentage chart use the Element Properties Box with
Bar 1 highlighted
Choose Percentage(0) from the Statistic box
Click on Set Parameters
Choose Total for Each X-Axis Category
Continue > Apply > OK

Warning: if you apply labels to the bars they will give the wrong %'s.

Percentage Clustered Bar Chart using Legacy Dialogs With correct labels!

For some reason %'s on charts in SPSS pose problems; here is another way of drawing the same chart but with correct labels. It uses the Legacy Dialogs option.

Use Graphs > Legacy Dialogs >Bar… > Clustered
Use **Summaries for groups of cases > Define**

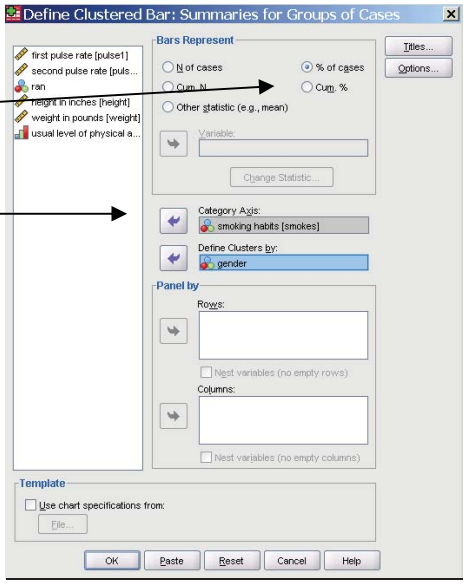
Use % of cases

Place **General Happiness** in the Category Axis

Define Clusters by **Respondent's Sex**

Click on **OK**

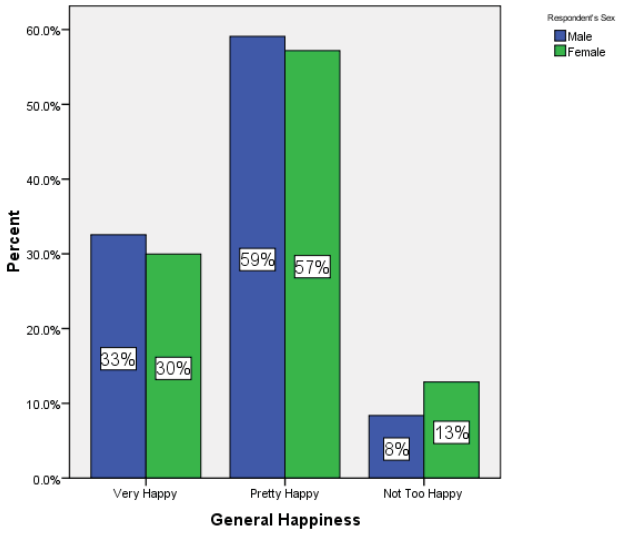
Edit the chart to
add the Bar Labels as before.,
reducing the decimal places to 0
and increasing the font size.



Think of each colour as being a length of ribbon.

All the ribbons are the same length and represent 100% of each category (males and females).

They are then cut up into the different sections.



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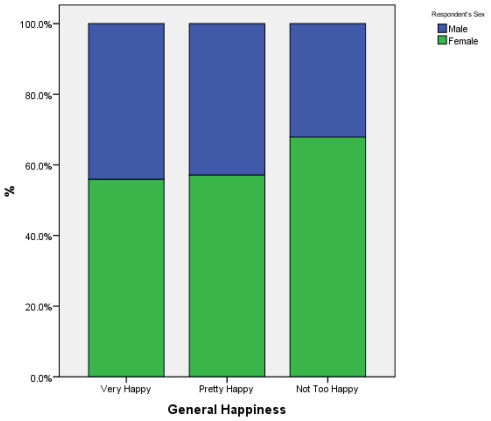
A stacked % bar chart

BEWARE: If you ask SPSS to add labels to this it will give you the **wrong percentages**. Create a table in cross tabs to find what the %s should be and add the labels as text boxes.

Use Graphs > Legacy Dialog > Bar
Select
Stacked > Summaries for groups of cases
Define

Place General Happiness in the Category Axis
and Respondent's Sex in Define Stacks by

Select number of cases **N of cases**
OK



When your chart appears **Edit** it

From the menu bar select **Options**
At the bottom select **Scale to 100%**

Edit the Y axis label to % by clicking on it.
Add text boxes for labels.

Drawing a panel bar chart

This again uses the Legacy Dialogs.

Panel plots are a style of plot in which subgroups of the data are plotted on separate axes alongside or above and below each other, with the scale on the axes kept common. These can be very useful plots for comparing different subgroups.

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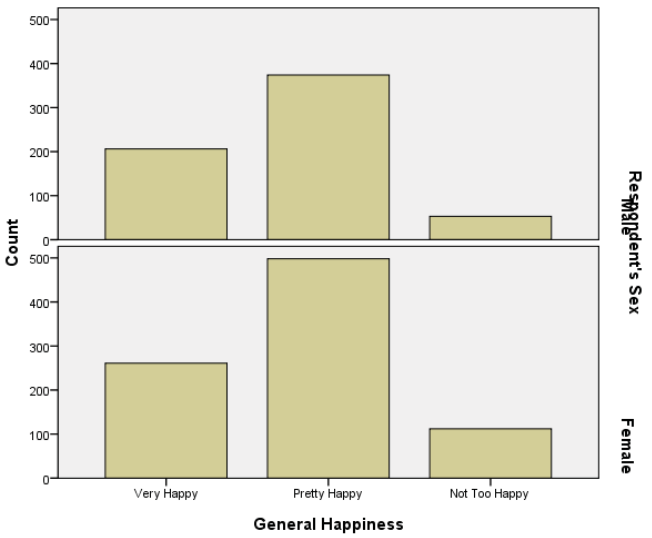
To produce a panel bar chart of physical activity by gender use

Graph > Legacy Dialogs >Bar > Simple,
Put General Happiness in Category Axis and
Respondent's Sex in the **Panel by > Rows** box.

You should get the chart shown.

This clearly needs some editing.
Note: The panel option is available with many of the charts, and can be generated in a similar fashion.



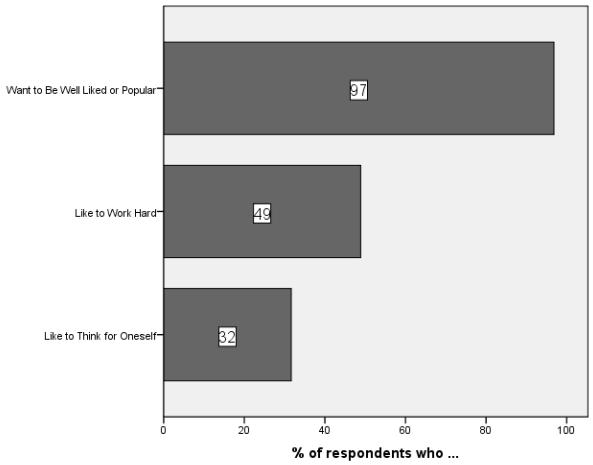
Drawing a bar chart of more than one variable

Here's another type of bar chart.
The difference in this bar chart is that each bar represents a different variable.

You have to be sensible about the variables you will compare.

An example is the % of respondents who
Like to work hard;
Like to think for oneself;
Want to be well liked or popular.

Those who have any of these characteristics are indicated by a 1 in the appropriate column.



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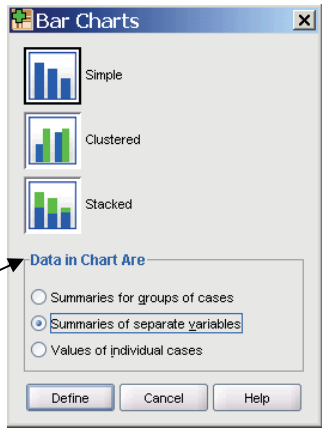
To draw the chart use

Graphs >Legacy Dialogs > Bar …
Simple



Summaries of separate variables

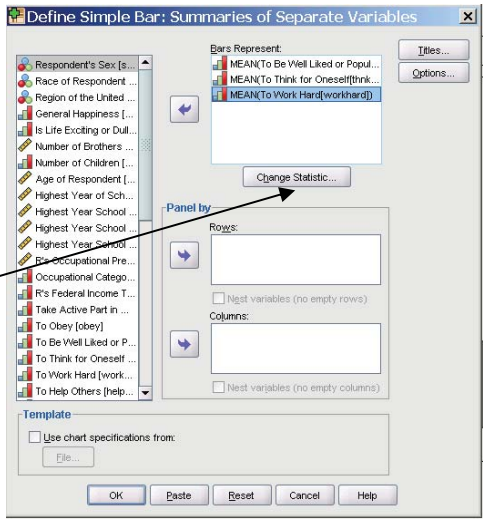
Define

At the next dialogue box place each of the activities in the **Bars Represent** box.

They will show MEAN(…. which we will need to change.

Highlight them all by holding down Ctrl and clicking on each.

Click on **Change Statistic.**

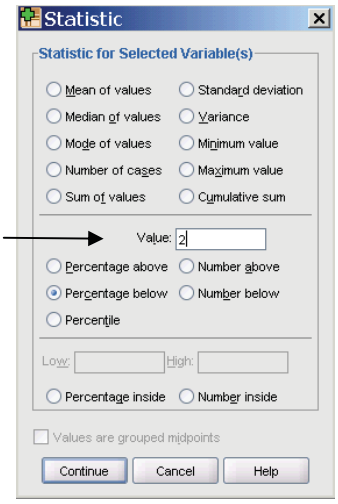


We shall ask SPSS to calculate the % of the entries for each variable less than 2 (since 1 < 2)

Ask for Percentage below
Type **2** in the Value box,
i.e. the % of the numbers in the column < 2

If we had only wanted a count we would have asked for **Number below.**

Continue
OK

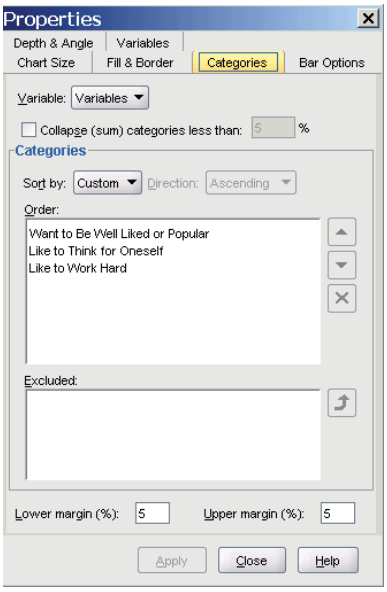


The resulting bar chart doesn't look quite like the one shown earlier.

By double clicking on it you can open up the Chart Editor window and make the necessary alterations.

You can change the order of the bars.
First write down the order you want.

Double click on a bar to open up the **Properties** dialogue box
Select the **Categories** tab
Highlight the item you want to move under **Order**
Click the up or down arrow.
Apply
OK



Drawing a pie chart

Pie charts are used to examine parts of a whole. As an example of drawing one in SPSS we shall draw a pie chart of happiness levels.

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You can use **Analyze > Descriptive Statistics > Frequencies**… and click on the **Charts…** button to ask for a pie chart,

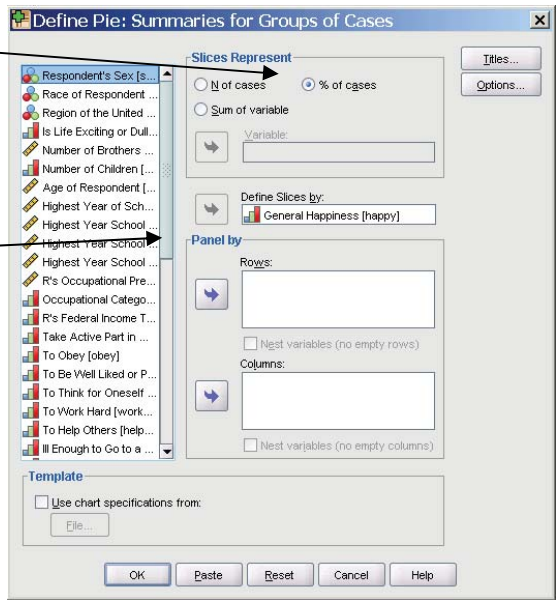
or use **Graphs > Chart Builder** selecting the Pie Option.

Or use Graphs > Legacy Dialogs >Pie… > Summaries for groups of cases > Define

Use % of cases

Define Slices by:
General Happiness

Click on **OK**



Hopefully you have a similar chart to this.

Open the Chart Editing window by double clicking on the chart.

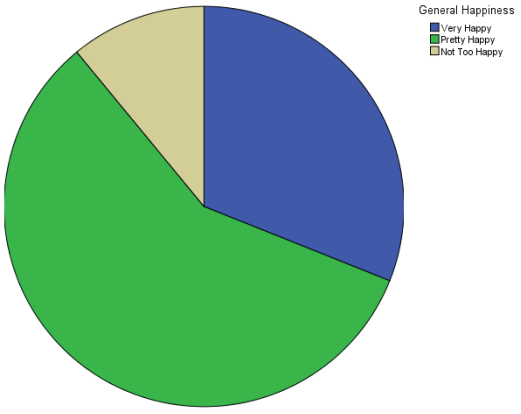
Add labels

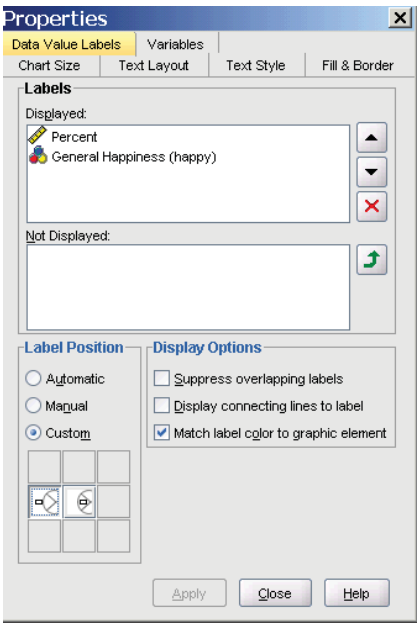
To add % to the labels
Double click on a slice
to bring up the Properties box.

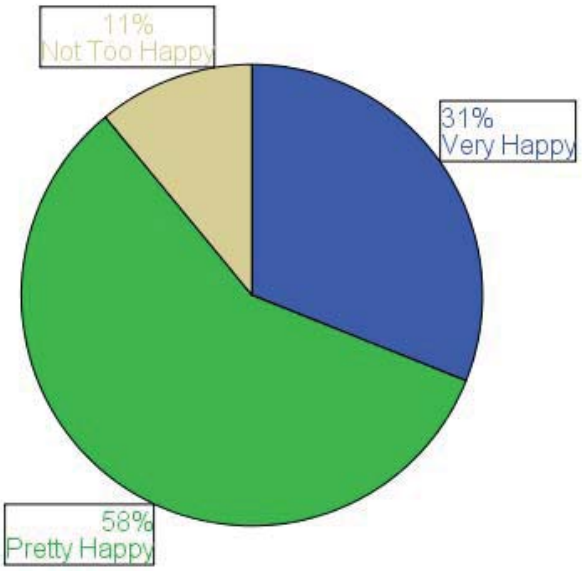
By choosing Percent and General Happiness

and selecting the position of the labels you should be able to get the Pie chart shown on the next page.

See the example dialog box.





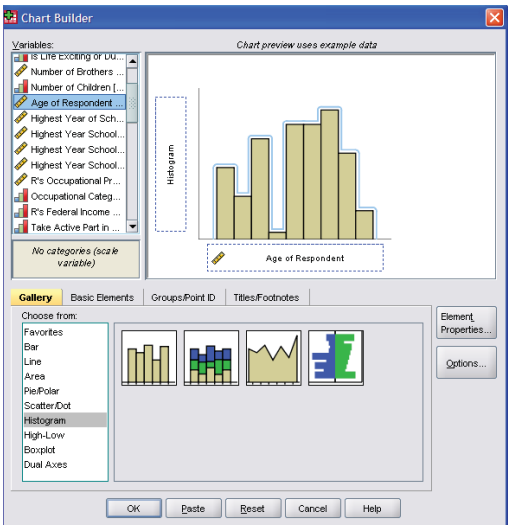


Histogram

Histograms are used for continuous data.

By far the easiest way of drawing a histogram is to use the option under the Chart button in **Analyze > Descriptive Statistics >Frequencies**

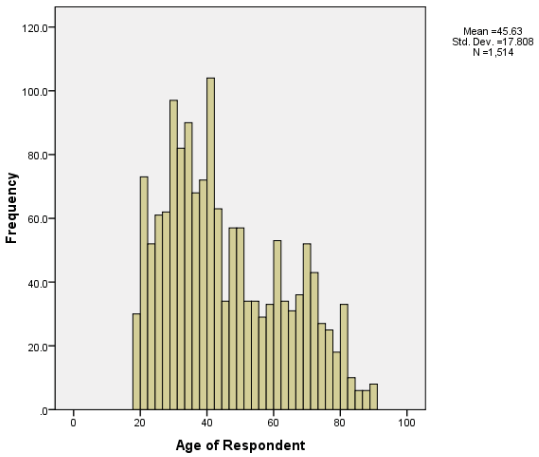
Alternatively use **Graphs >Chart Builder > Histogram**
and drag the first option into the Preview Area.
This example shows **Age of Respondent** dragged on to the X axis.

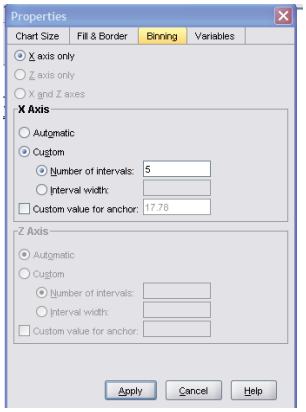


This is not a well formatted Histogram.

Double click on the chart to bring up the Chart Editor.

Double click on a bar for the Properties box.



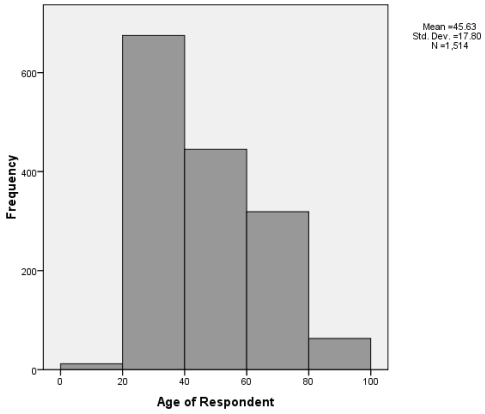


Under the Binning tab

- There is an option of selecting
- either the number of bins
- or the interval width.

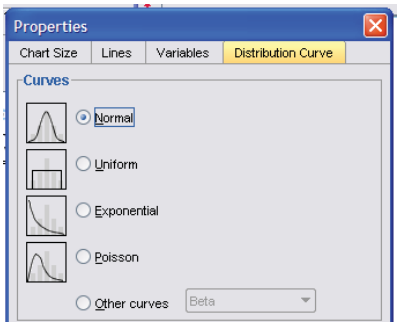
- Select **Custom > Number of Intervals >5**

- **Apply**



Should you wish to you can superimpose a variety of curves on the histogram using the distribution curve icon:

Which brings up the following Properties box:



Boxplots

Boxplots are a useful way of comparing two or more data sets.

They are as the name implies a box, whose length represents the inter-quartile range of the data.

The lower edge of the box is at the lower quartile of the data, and the upper edge at the upper quartile.

A horizontal line indicates the median.

'Whiskers' are drawn to the minimum and maximum values within 1.5 box-lengths of each end of the box. Outliers are indicated by o. Values outside 3 box-lengths are indicated by * (not shown here).

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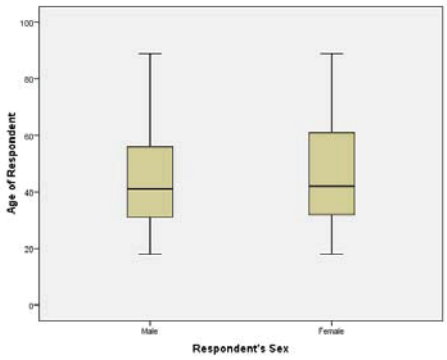
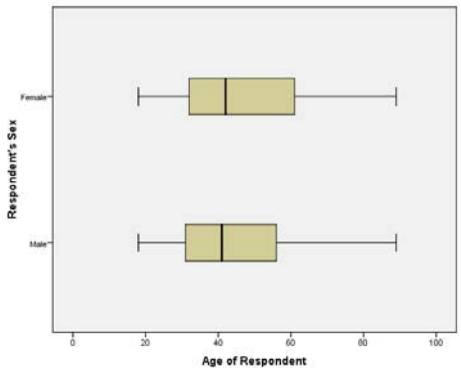


These compare ages by gender.



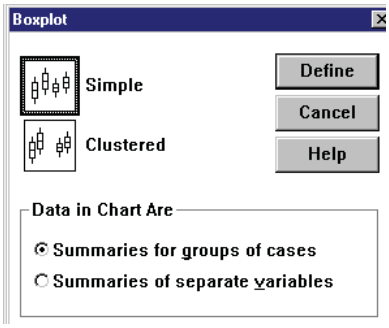
Boxplots can also be horizontal.

Drawing boxplots can get confusing.

It is easiest to use **Explore** under **Analyze** > **Descriptive Statistics,** but here is how to do it using the **Graphs** menu with two examples to illustrate the differences in different types of boxplots.

First we shall draw the boxplots shown above.

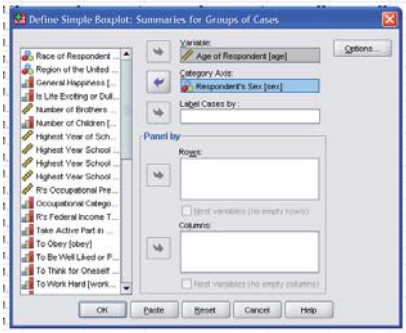
Use **Graphs > Legacy Dialogs> Boxplot**
to obtain the dialogue box.



Select
Simple Summaries for groups of cases

Define.

Set up the next dialogue box as shown



With **Age of Respondent** in the (top) **Variable** box

And **Respondent's Sex** in the Category Axis box

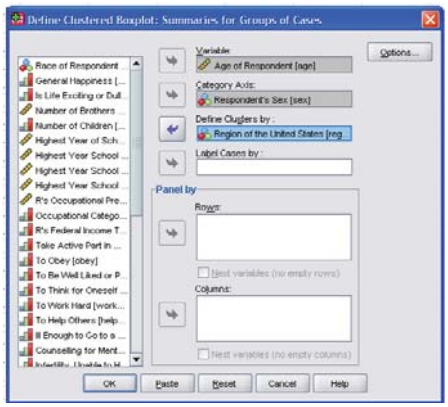
Click **OK** and

you should get the boxplots**.**

The second example is of a clustered box plot which will show the ages, by gender, for each of the Regions.

Use **Graphs > Legacy Dialogs > Boxplot > Clustered**
Summaries for groups of cases
Define.

Complete the dialogue box as follows:
Age of Respondent in the (top) Variable box
Respondent's Sex in the Category Axis box
Region of the United States in the Define Clusters by box.
OK

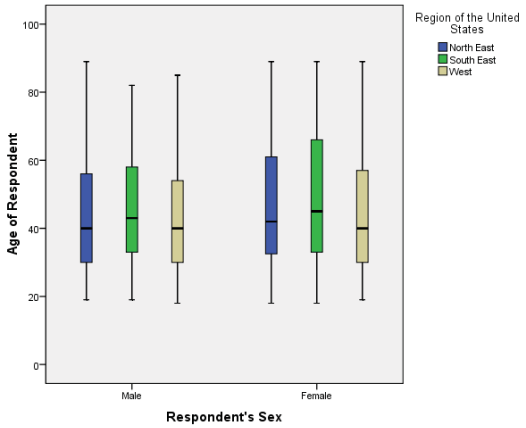


The result will should be:

NB Printing in black and white can lose the detail in coloured charts.

This is a good example of that, if you were to print this chart in black and white it would be hard to find the median bar in some of the boxplots.

So, if you know charts will not be printed in colour, it is a good idea to change the shadings



There is only one way to master chart drawing in SPSS and that is by having plenty of practice - so over to you.

6. Regression and Correlation

Introduction

In statistics when faced with data we attempt to summarise it and then look for patterns. Regression is about patterns; the possible relationship between **two** sets of data, **bivariate** data.

Open the data set **advert.sav** from SPSS's own sample data sets.
This has two columns representing spending on advertising and sales in the same period.
The type of questions we might ask about our two variables are:

- Are the two variables related?
- What sort of relationship is there?
- Can we describe (quantify) the strength of the relationship ?
- Can we predict one variable from the other ?

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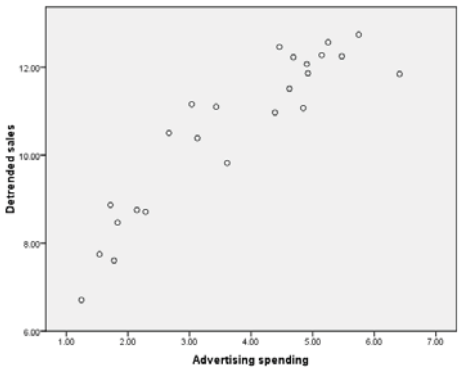
Scatter Diagrams

A visual impression is enormously helpful.

The first thing to do is to plot the data, with the **independent** (x) variable on the **horizontal axis** and the **dependent** (y) variable **vertically.**

Sometimes it isn't obvious which is which. Here it is reasonable to suppose sales depend on advertising.

Plot the data with a Scatter Plot
Graphs > Chart builder > Scatter/Dot



Correlation

Correlation quantifies (puts a number to) the strength of the linear relationship between the two variables and also indicates the direction of the relationship.

The correlation coefficient, r, measures the strength of the linear relationship.
The value of r is between +1 and -1

Values of **r** close to **+1** or **-1** represent a strong linear relation.
A value of **r** close to **0** means that the linear association is very weak.
It could be that there is NO association at all, **or the relationship is non-linear**.

Pearson's product moment correlation coefficient is used where you have variables which represent measurements of some form.
Use **Analyze > Correlate > Bivariate** with the two variables asking for the Pearson coefficient.

Correlations

		Advertising spending	Detrended sales
Advertising spending	Pearson Correlation	1.000	.916**
	Sig. (2-tailed)		.000
	N	24	24
Detrended sales	Pearson Correlation	.916**	1.000
	Sig. (2-tailed)	.000	
	N	24	24

**. Correlation is significant at the 0.01 level (2-tailed).

This shows a correlation coefficient of 0.916 and a significance value of 0.000.

The significance is <0.05 and indicates that if there is no linear relationship between spending on advertising and sales there is a less than 0.05% chance that a random sample of this size would give a value of **r** as extreme as 0.916 .

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Spearman's rank correlation coefficient can also be used. Spearman's coefficient can be used when you have merely ordered variables, e.g. treatments **ranked** as to effectiveness. The printout gives a different value for r having been calculated another way, but the significance value is again <0.05.

Correlations

			Advertising spending	Detrended sales
Spearman's rho	Advertising spending	Correlation Coefficient	1.000	.889**
		Sig. (2-tailed)	.	.000
		N	24	24
	Detrended sales	Correlation Coefficient	.889**	1.000
		Sig. (2-tailed)	.000	.
		N	24	24

**. Correlation is significant at the 0.01 level (2-tailed).

Correlation and Causation

Correlation quantifies the degree of association between two variables- **BUT BEWARE** for although two variables may seem to be related, a change in one may not cause a change in another.

Correlation coefficients **are the most frequently misused statistics** so when interpreting your correlation coefficient remember

- that correlation does not mean causation;
- to use your common sense !

Regression

Having discovered that two variables are correlated the next question might be can we model this data using a straight line?

Can we predict what the sales between and are likely to be from the spending on advertising?

Linear Regression is the technique that is used to find the line that best models the data.
We first have to decide which variable is dependant on the other – here the sales are likely to be dependent on the spending on advertising.

Use **Analyze > Regression > Linear**

Place **Detrended sales** in the Dependent box
and
Advertising spending in the independent box.

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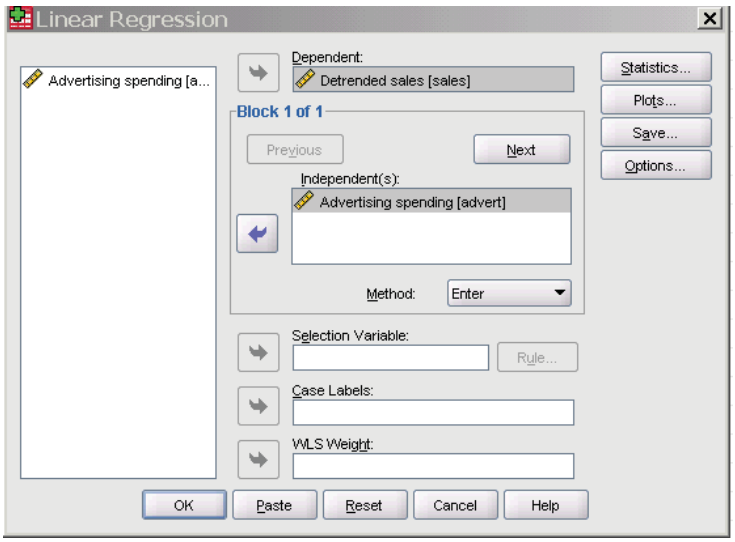

The output is:

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Advertising spending[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Detrended sales

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.916[a]	.839	.832	.73875

a. Predictors: (Constant), Advertising spending

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	62.514	1	62.514	114.548	.000[a]
	Residual	12.006	22	.546		
	Total	74.520	23			

a. Predictors: (Constant), Advertising spending

b. Dependent Variable: Detrended sales

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.584	.402		16.391	.000
	Advertising spending	1.071	.100	.916	10.703	.000

a. Dependent Variable: Detrended sales

The top box showing the variables entered is self explanatory.

The **Model Summary** shows the goodness of fit statistics indicating whether the model is a good fit.

- **R** is the **correlation coefficient** measuring the strength of the linear relationship.
- **R Square** is the **coefficient of determination**, more usually expressed as a percentage. Here it tells us that 89% of the variability in the sales can be explained by the variability in the spending on advertising.

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- The **Std Error of the Estimate** can be thought of as a typical residual; the difference between what is predicted by the model and what is observed.

The **ANOVA** box shows a significance value of .000 This indicates that the regression is significant, i.e. that there is a useful linear model.

The **Coefficients** box tells us that the equation that models the line has a **slope of 1.071** and an **intercept of 6.584**,.

We need to know if the variable is actually significant. This is indicated by the significance column on the right. Sig values > 0 ·05 indicate that the coefficient is not significant. Remember that we are trying to deduce a model to predict price for the population based on a relatively small sample. This means our values for the coefficients of the slope and intercept are only **estimates**.

The t value column has done a t-test to test the probability that the coefficient is zero given the sample data, and the Sig column is the p value for this test.

Here our coefficients are OK so our regression equation would be

sales = 1.071* spending on advertising + 6.584

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Inés Aréizaga Esteva (Spain), 25 years old
Education: Chemical Engineer

– You have to be proactive and open-minded as a newcomer and make it clear to your colleagues what you are able to cope. The pharmaceutical field is new to me. But busy as they are, most of my colleagues find the time to teach me, and they also trust me. Even though it was a bit hard at first, I can feel over time that I am beginning to be taken seriously and that my contribution is appreciated.

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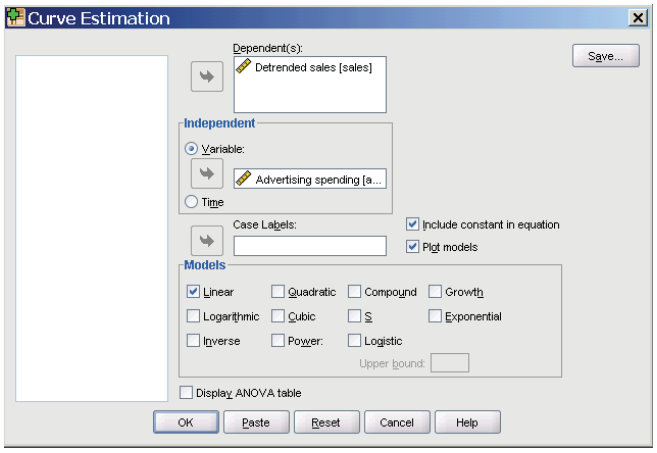
We need to know:

1. Is this line a good fit?
   The answer is given by the goodness of fit statistics. and
2. Is it an appropriate model?
   Here we need to look at the residual plots available under the Plots button

- To obtain a chart showing the regression line use **Analyze > Regression > Curve Estimation**
- filling out the dialogue box as shown.



We have looked at **linear Regression** but there are other models available from the Regression menu.

Multiple Regression

Multiple regression is used where we have more than one variable which might predict the dependent variable.

For a linear model we use the same commands as before: **Analyze > Regression > Linear**

But place more than one variable in the Independents box

This output gives us the values of the coefficients.

Again, we need to know which variables are actually significant.

This is indicated by the significance column on the right.

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Sig values > 0 ·05 indicate that the coefficient is not significant.

Remember that we are trying to deduce a model to predict price for the population based on a relatively small sample. This means our values for the coefficients are only estimates.

The t value column has done a t-test to test the probability that the population coefficient is zero given the sample data, and the Sig column is the p value for this test.

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7. Statistical Tests

Many students and others want to be able to use the statistical tests in SPSS for hypothesis testing. This is not a statistics textbook, but a guide to using SPSS, so no theory is included but it is nevertheless important to stress that you need:

- To be clear about your research question, or the hypothesis you propose to test.
- To be sure that the data you are collecting will actually answer that research question, and
- To collect it from a random sample, to be free from bias.

The procedure is:

- Write your hypothesis and null hypothesis.
- Collect the data.
- Look at the data - what does the evidence of the sample suggest?
- Make a chart if possible.

- It is usual to test the Null Hypothesis which is a statement of no difference; no association.
- Select an appropriate test.
- Check that the requirements for that test have been satisfied; e.g. was the sample a random sample?

- Carry out the test and identify the p value.
- Is the p value >= 0.05, or < 0.05?

Probability	P	Significance	Decision
Less than 1 in 10,000	< .0001	Significant at .01% level	Reject null hypothesis
Less than 1 in 1000	< .001	Significant at .1% level	Reject null hypothesis
Less than 1 in 100	< .01	Significant at 1% level	Reject null hypothesis
Less than 5 in 100	< .05	Significant at 5% level	Reject null hypothesis
More than or equal to 5 in 100	>= .05	Not significant	Don't reject null hypothesis

Table of P Values and Significance

- Decide if the evidence supports the null hypothesis.
- State the decision about the original hypothesis.

In the examples that follow we shall use the **data file 1991 U.S.General Social Survey.sav** .

Confidence Intervals: **Analyze > Descriptive Statistics > Explore**

The requirement for this test is that the sample has been randomly selected.

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Use this to test for a hypothesised value; it will give you the confidence interval for the mean of a population.

E.g. Test the hypothesis that the mean number of brothers and sisters people have is 3.

Using **Analyze > Descriptive Statistics > Explore**

- with **Age of Respondent** in the **Dependent List**
- with no Factor
- asking for Statistics only

The output is:

Descriptives

			Statistic	Std. Error
Number of Brothers and Sisters	Mean		3.93	.079
	95% Confidence Interval for Mean	Lower Bound	3.78	
		Upper Bound	4.09	
	5% Trimmed Mean		3.69	
	Median		3.00	
	Variance		9.282	
	Std. Deviation		3.047	
	Minimum		0	
	Maximum		26	
	Range		26	
	Interquartile Range		3	
	Skewness		1.468	.063
	Kurtosis		3.507	.126

The confidence interval would support any hypothesis which suggested that the population mean was between the Lower Bound of 3.78 and the Upper Bound of 4.09

There is no evidence at the 5% level that the mean number of brothers and sisters is 3.

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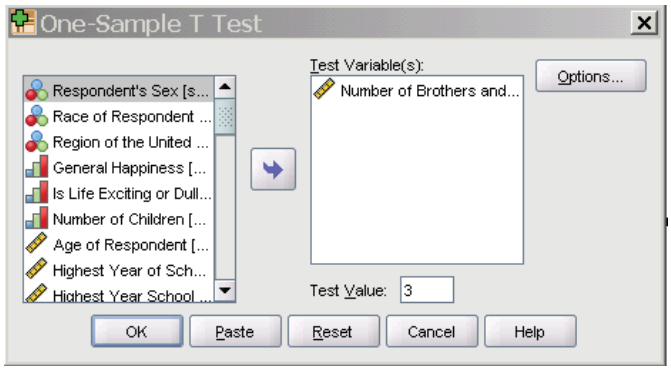
The One-Sample T test

The requirement for this test is that the sample has been randomly selected.

This is an alternative method to using confidence intervals.
Use this to test for a hypothesised value.
E.g. Test the hypothesis that the mean number of brothers and sisters people have is 3.

Use Analyze > **Compare Means** > **One-Sample T test**



Place **Number of Brothers and Sisters** in the **Test Variable** box
And type 3 in the **Test Value** box

The output is:

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Number of Brothers and Sisters	1505	3.93	3.047	.079

One-Sample Test

	Test Value = 3					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Number of Brothers and Sisters	11.862	1504	.000	.932	.78	1.09

The significance value is < 0.000 which shows that there is a significant difference between 3 and the mean number of brothers and sisters of those in the sample.

The Chi-Squared Test for contingency tables

The requirements for this test are that the samples are random and at least 80% of the cells in the table should have expected counts of at least 5 and no cell should have an expected count less than 1.

The question:	Is there an association between happiness and gender?
The Research Hypothesis:	There is an association between happiness and gender.
The Null Hypothesis:	There is no association between happiness and gender.

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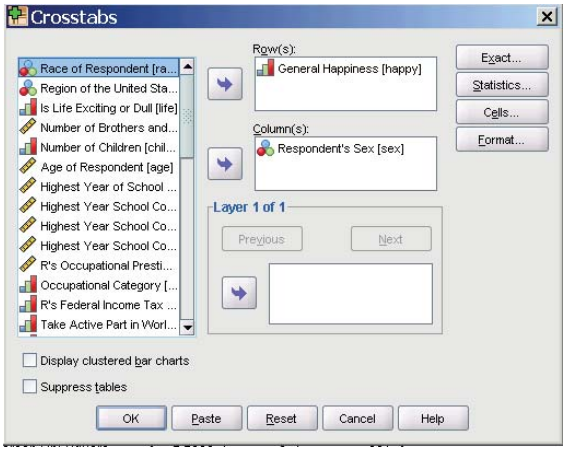
Use **Analyze > Descriptive Statistics > Crosstabs**

Complete the dialogue box as shown



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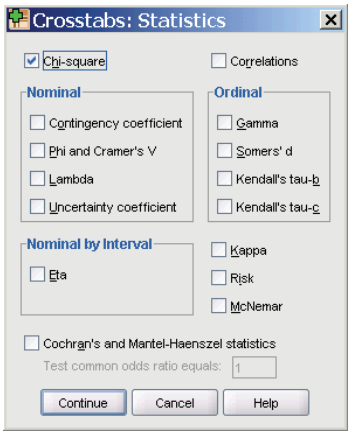
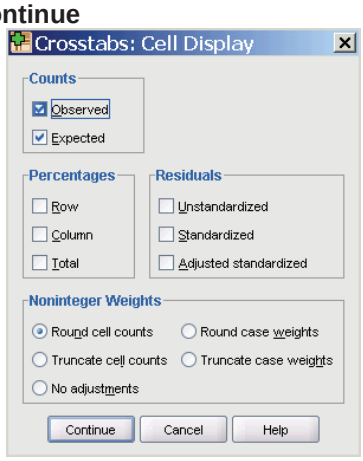
- Click on the **Statistics** button
- Click in **Chi-Squared** (top left box)
- **Continue**



- Click on the **Cells** button
- for **Counts: Observed Expected**
- **Continue**



and then on **OK**

This should bring up the following Output. By looking at the table of expected and observed counts one can see that there are more men who are happy than expected and more women who are Not Too Happy (the eyeball test).

General Happiness * Respondent's Sex Crosstabulation

			Respondent's Sex		
			Male	Female	Total
General Happiness	Very Happy	Count	206	261	467
		Expected Count	196.5	270.5	467.0
	Pretty Happy	Count	374	498	872
		Expected Count	367.0	505.0	872.0
	Not Too Happy	Count	53	112	165
		Expected Count	69.4	95.6	165.0
	Total	Count	633	871	1504
		Expected Count	633.0	871.0	1504.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.739[a]	2	.021
Likelihood Ratio	7.936	2	.019
Linear-by-Linear Association	4.812	1	.028
N of Valid Cases	1504		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 69.44.

So it comes as no great surprise that the value of Chi-squared (7.739) is significant because the p value is 0.021

The null hypothesis is not accepted.

The conclusion is that this sample shows evidence at the %5 level that there is an association between happiness and gender, with men appearing to be happier.

t-test for related samples

The requirement for this test is that the sample is randomly selected. There is no need for the underlying population to be normal provided the sample size is large, i.e. >30.

With related samples we are comparing the differences between **pairs of readings that are related**: two pulse readings from the same patient.

Use the SPSS data set **New drug.sav** for this example. This is a very small data set but we shall assume the subjects were randomly selected.

The question: Is there a difference in the population means of the first and second pulse rates of each patient?

The Research Hypothesis: There is a difference in the population means of the first and second pulse rates of each patient.

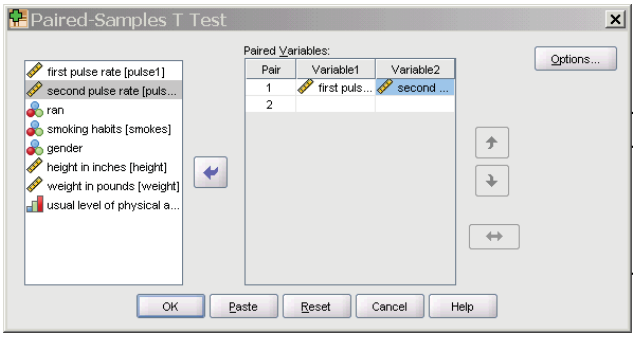
The Null Hypothesis: There is no difference in the population means of the first and second pulse rates of each patient.

Use **Analyze > Compare Means > Paired-Samples T Test**

The dialogue box should be completed by clicking on **Pulse, Time1** clicking on the arrow

and then on **Pulse TIme2** and on the arrow to place them in the variables box.

OK



You should obtain the following Output:

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pulse, Time 1	2.433	12	.2605	.0752
	Pulse, Time 2	2.517	12	.3326	.0960

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Pulse, Time 1 & Pulse, Time 2	12	.969	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Pulse, Time 1 - Pulse, Time 2	-.0833	.1030	.0297	-.1488	-.0179	-2.803	11	.017

By looking at the sample means one can see they are different. The p value is 0.017 showing that the t value is significant.

The null hypothesis is rejected.

The conclusion is that this sample shows there is a significant difference between the population means of the first and second pulse rates of patients.

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t-test for the differences in the Means of independent samples

The requirement for this test is that the samples are randomly selected. There is no need for the underlying population to be normal provided the sample sizes are large, i.e. >30.

Here we are comparing the differences between pairs of readings that are not related.
We shall use the data file **1991 U.S.General Social Survey.sav**

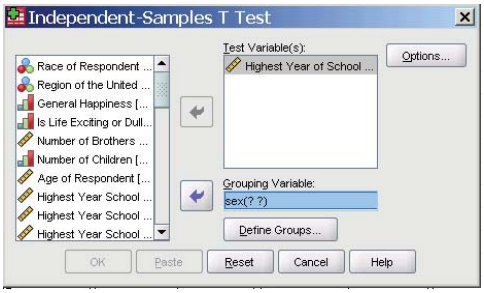
The question:	Is there a difference in the highest year of school completed by males and females?
The Research Hypothesis:	There is a difference in the highest year of school completed by males and females.
The Null Hypothesis:	There is no difference in the highest year of school completed by males and females

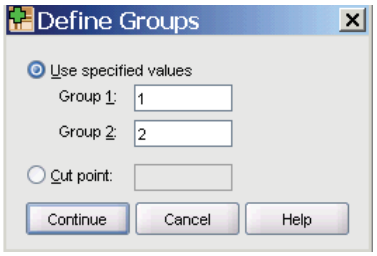
Use **Analyze > Compare Means > Independent-Samples t Test**

Place **Highest Year of School** in the **Test Variable** box and

sex in the **Grouping Variable**

Click on **Define Groups.**





Fill out the box as shown.

The 1 and 2 are the codes for males and females.

You should get the following Output (which is annoyingly wide).

Group Statistics

	Respondent...	N	Mean	Std. Deviation	Std. Error Mean
Highest Year of School Completed	Male	633	13.23	3.143	.125
	Female	877	12.63	2.839	.096

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Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Highest Year of School Completed	Equal variances assumed	11.226	.001	3.887	1508	.000	.602	.155	.298	.906
	Equal variances not assumed			3.824	1276.454	.000	.602	.157	.293	.911

Using the eyeball test again, looking at the means reveals a difference in the sample means. Levene's test indicates, by the p value, whether we should assume equal or unequal variances. If the p value is < 0.05 the evidence suggests that the variances are unequal.

Here p=0.001 so we use the Equal variances **not assumed** line for the t test for the means.

This gives a low p value of < 0.0005 so we conclude that the samples show that there is a significant difference between the population means of the highest year of school completed by male and females.

Analysis of Variance

We are assuming here that we have independent simple random samples drawn from normal populations.

Analysis of variance is a method for comparing the means of several populations. Simple random samples are drawn from each and are used to test the null hypothesis that the population means are all equal. ANOVA compares the variation among groups with the variation within groups.

The question: Is there a difference in the population means of the Highest year of school completed for each region?

The Research Hypothesis: There a difference in the population means of the Highest year of school completed for each region.

The Null Hypothesis: There is no difference in the population means of the Highest year of school completed for each region.

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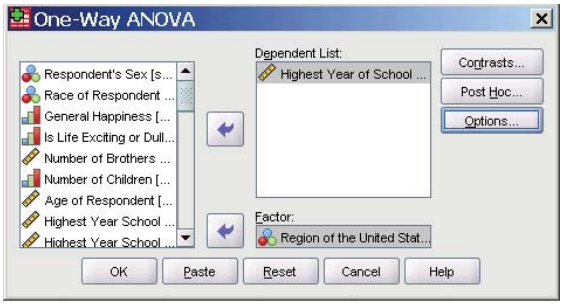
- Use **Analyze > Compare Means > One-Way ANOVA**

Fill out the dialogue box as shown with

the **Highest Year of School** in the **Dependent List**,

and **Region of the United States** as the **Factor.**



Click on the **Options** button and select **Descriptive Statistics**;

The Output is:

Oneway

Descriptives

Highest Year of School Completed

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
North East	676	13.00	2.778	.107	12.79	13.21	3	20
South East	411	12.46	3.352	.165	12.13	12.78	0	20
West	423	13.11	2.885	.140	12.83	13.38	3	20
Total	1510	12.88	2.984	.077	12.73	13.03	0	20

ANOVA

Highest Year of School Completed

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	104.635	2	52.317	5.914	.003
Within Groups	13332.084	1507	8.847		
Total	13436.719	1509			

The p value is 0.003 which is <0.05, so we conclude that there is evidence to suggest that that the means of the 3 populations are not all the same.

Non-Parametric Tests

A **parameter** is a number describing the **population**, e.g. the mean or standard deviation, as distinct from a **statistic** which is a number that can be calculated from the **sample** data without needing to know anything else about the population.

Many statistical tests are parametric tests and make the assumption that the populations involved have 'normal distribution'. These tests are very useful and robust but there are occasions when we would like to compare two samples which we cannot assume come from a 'normal' population, or where the measurements are on an ordinal scale as distinct from an interval one.

For such populations we use **non-parametric** tests. We can use these on 'normal' data too.

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Note: if the values in the population have a skewed distribution, or if the measurement scale is ordinal then it is better to use the median rather than the mean.

Wilcoxon Rank-Sum Test also known as the Mann Whitney U test for independent samples

The question: Is the population median of the Highest Year of School Completed the same for males and females?

The Hypothesis: There is a difference in the population median of the Highest Year of School Completed for males and females?

The Null Hypothesis: There is no difference in the population median of the Highest Year of School Completed for males and females?

First we need to find the median Highest Year of School Completed for males and females.
Use **Explore**. males: 13.23; females: 12.63.

These are two independent samples; the variable (Highest Year) we shall treat as continuous.
Use **Analyze > Nonparametric Tests > 2 Independent Samples**

Complete the dialogue box as shown using the **Define groups** button for the genders (1, 2).

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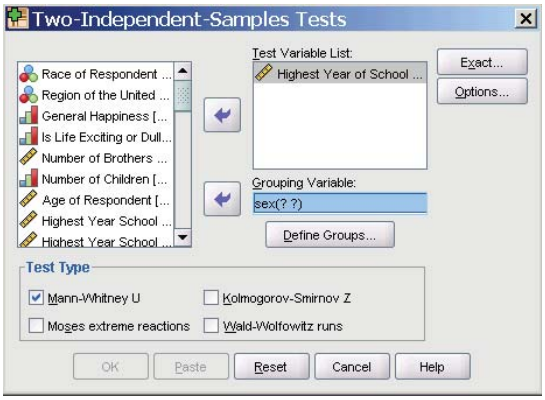

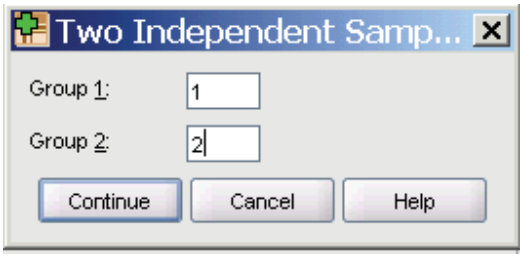

The Output is:

Ranks

	Resp...	N	Mean Rank	Sum of Ranks
Highest Year of School Completed	Male	633	806.98	510817.00
	Female	877	718.34	629988.00
	Total	1510		

Test Statistics[a]

	Highest Year of School Completed
Mann-Whitney U	244985.000
Wilcoxon W	629988.000
Z	-3.964
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Respondent's Sex

This is the p value of 0.000 which is < 0.05.

This indicates that we should reject the null hypothesis.

The conclusion is, that on the basis of this sample, there is evidence to suggest that the population median highest year of schoolc for males and females are not the same.

Compare this with the t-test result. The probabilities are different, but the conclusion is the same.

Wilcoxon Signed-Ranks test for paired samples

We shall again use the SPSS data set New drug.sav for this example. This is a very small data set but we shall assume the subjects were randomly selected.

The question: Is there a difference in the population median of pulse rates 1 and 2 of patients.

The Research Hypothesis: There is a difference in the population median of pulse rates 1 and 2 of patients.

The Null Hypothesis: There is no difference in the population median of pulse rates 1 and 2 of patients.

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We are comparing the differences between pairs of readings that are related: the two pulse rates are from the same patient.

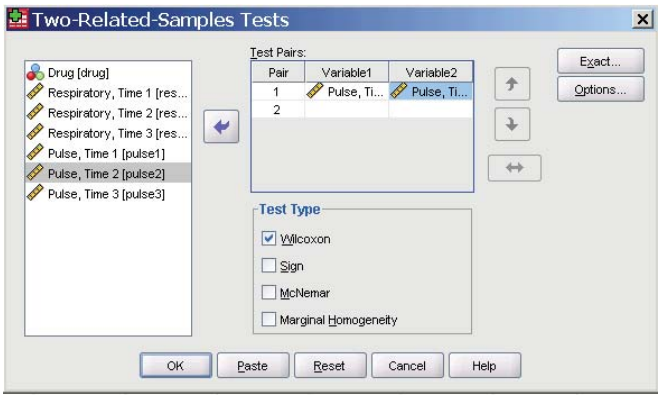
Use **Analyze > Nonparametric Tests > 2 Related Samples**

Complete the dialogue box

by placing both
Pulse, Time1 and **Pulse, Time2**

in the Test Pairs box

and ticking the Wilcoxon box.



The Output is:

Wilcoxon Signed Ranks Test

The Negative Ranks refer to where Pulse2 is less than Pulse 1.

The Positive Ranks are those where Pulse2 is greater than Pulse1.

Ties are where Pulse2 equals Pulse1

Ranks

		N	Mean Rank	Sum of Ranks
Pulse, Time 2 - Pulse, Time 1	Negative Ranks	2[a]	4.50	9.00
	Positive Ranks	9[b]	6.33	57.00
	Ties	1[c]		
	Total	12		

a. Pulse, Time 2 < Pulse, Time 1
b. Pulse, Time 2 > Pulse, Time 1
c. Pulse, Time 2 = Pulse, Time 1

Test Statistics[b]

	Pulse, Time 2 - Pulse, Time 1
Z	-2.233[a]
Asymp. Sig. (2-tailed)	.026

a. Based on negative ranks.
b. Wilcoxon Signed Ranks Test

The p value is given as .026 which t is <0.05, indicating that we should not accept the null hypothesis.

The conclusion is that there is a difference in the two pulse rates of the patients.

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8. And finally

This is not a statistics textbook. This has been a book about using SPSS, written for non statisticians.

You are probably reading it because you have data to analyse, and want to find out how SPSS can help you. It won't be able to help unless you understand what your data is measuring, which of your numbers mean a measurement, and which are merely shorthand codes for answering "Yes" or "I do a lot of training."

Time spent thinking about your data is never wasted. Think about what you would like your final report to say; it will direct your analysis. Firstly though do the simple stuff: look at frequencies, draw charts (simple ones) and produce two way tables. Make sure you produce two of these each time, one showing row percentages and one showing column percentages, and don't be tempted to combine them in one because that leads to confusion. Keep it simple.

With luck through doing this the data should start to tell you its story, and once you have a handle on that you will be well away.

Because this is not statistics textbook I suggest you find one that suits you and consult it from time to time. Better still find a statistician, who will be very grateful for all the simple stuff you have done first!

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