



Faculty of Science

Laboratory Manual

Introduction to Computer

Bachelor of Biotechnology (Hons.)

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Introduction to Computer

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LINCOLN UNIVERSITY COLLEGE
FACULTY OF SCIENCE (DEPARTMENT OF BIOTECHNOLOGY)
LABORATORY SAFETY RULES

The following rules must be obeyed by all students in the science laboratory of the faculty. Wilful or repeated inadvertent non-compliance may result in dismissal or suspension from the laboratories

- **No entry without permission:**
 - Outsiders are not allowed to enter the laboratory without permission.
 - No student is allowed to enter the laboratory unless permission has been given by a laboratory assistant or a lecturer.
- **At work in the laboratory:**
 - No experiment may be attempted without the knowledge and permission of a lecturer.
 - Students must wear shoes in the laboratory. Students wearing slippers or sandals are not allowed to work in the laboratory.
 - Lab coat must be worn at all times during practical work in the laboratory.
 - Do not mouth pipette chemicals.
 - Do not eat or smoke in the laboratory.
 - Do not taste any chemicals, including dilute solutions. If any acid or alkali accidentally enters your eyes or mouth, wash immediately with plenty of tap water. Inform your lecturer, and seek medical attention if necessary.
 - Paper should be used to light up the Bunsen burners.
 - Used match sticks, filter papers, and other solid waste must never be thrown into the sinks. They must be thrown into the dustbins provided. Lighted match sticks and smoldering materials must be extinguished with tap water before thrown in to the dustbins.
 - Any equipment broken or damaged must be reported to the laboratory assistant.
- **Before leaving the laboratory:**
 - All the equipment and benches must be cleaned at the end of each practical session.
 - Wash hands and arms with soap and water before leaving the laboratory.
 - No student is allowed to take away any chemicals, equipment or other property of the laboratory.

INTRODUCTION

1. The Scientific Method

- Making observations
- Generating hypotheses
- Making predictions
- Designing and carrying out experiments
- Constructing scientific models

2. Practical Exercises

To get the most out of the practical exercises, you need to follow carefully the instructions given. These instructions have been designed to provide you with the experience in the following skills:

- Following instructors
- Handling apparatus
- Having due regard for safety
- Making accurate observations
- Recording results in an appropriate form
- Presenting quantitative results
- Drawing conclusions

3. Following Instructions

Instructions are provided in the order in which you need to carry them out. We would advise that before carrying out the instructions, you read through the entire exercise. This will help you to remember what you have learned.

Each practical exercise in the book begins with a few lines describing its purpose in most cases the following headings are also used:

- Procedure-numbered steps that need to be carried out.
- For consideration -some questions to help you think carefully about the results you have obtained.
- Materials-a list of the apparatus, chemicals and biological materials you need.

4. Handling apparatus

Biologists need to able to use many different types of apparatus, for example, photometers (to measure water uptake by plants), respirometers (to measure oxygen uptake or carbon dioxide production), Petri dishes (for plating out bacteria and other microorganisms) and the light microscope (to magnify specimens). Many of the practical exercises are designed to help you derive the maximum benefit from a piece of apparatus.

5. Having Due Regard for Safety

Surveys have been shown that science laboratories are among the safest places to be. Nevertheless, this is no cause for complacency.

- Always move slowly and carefully in a laboratory.
- Never put your fingers in your mouth or eyes after using chemicals or touching biological specimens until you have washed your hands thoroughly with soap and warm water, and dried them.
- Make sure glass objects (e.g, thermometers, beakers) cannot roll off tables or be knocked onto the floor.
- Wear safely goggles whenever there is a risk of damage to the eyes.

Situations of risk include:

- Heating anything with a Bunsen burner (even heating water has its dangers)
- Handling many liquids, particularly those identified as corrosive, irritant, toxic or harmful

- Handling corrosive or irritant solids
- Some dissection work
- Allow Bunsen burners, tripods, gauze and beakers to cool down before handling them.
- Never allow your own body fluids (especially blood and saliva) to come into contact with someone else, or theirs into contact with you.
- Keep long hair tied back and do not wear dangly earrings.
- Do not allow electrical equipment to come into contact with water.
- If you are unsure how to carry out a scientific procedure, ask.
- Make sure you understand why you are going to do something before you do it.
- Wear a lab coat when using chemicals or handling any biological specimens.
- Follow exactly agreed procedures with regard to cuts, burns, electric shocks and other accidents (e.g. with chemicals).
- Follow exactly all specific safety instructions given in this book or provided by your teacher for particular practical exercises (e.g. use of gloves, disinfection)

With practice, these procedures should become second nature to you. They will enable you to carry out practical work in safety.

6. Making Accurate Observations

In most cases the practical exercise will make it clear what you need to observe, e.g. the time taken for a certain volume of gas to be evolved or the width of a sample cells. Ensure that you know how to use any necessary equipment before starting practical. Think carefully about the precision with which you will make your observations.

7. Recording Results in an Appropriate Form

Results can be recorded in various ways. Often it is helpful to record raw data in a table. Most data will be in the form of numbers, i.e. they will be quantitative data (also known as numerical data). However, some data, e.g. flower colour, will be qualitative data.

One form in which some biological findings can be recorded is a drawing. You don't need to be professional artist to make worthwhile biological drawings. If you follow the following guidelines, a drawing can be of considerable biological value:

- Ensure that your completed drawing will cover at least a third of A4 page.
- Plan your drawing so that the various parts are in proportion and will not be drawn too small. Small marks to indicate the length and breadth of the drawing are a great help in planning and a faint outline can be rapidly drawn to show the relative positions of the parts.
- The final drawing should be made with clean, firm lines using a sharp HB pencil and, if needed, a good quality eraser (not a fluid). If important details are too small to be shown in proportion, they can be put in an enlarged drawing at the side of the main drawing.
- Avoid shading and the use of colour unless you are an excellent artist and they really help, for example when drawing soil profiles.
- When drawing structures seen with the naked eye or hand lens, use two lines to delineate such things as blood vessels and petioles. This will help you to indicate the relative widths of such structures.
- When drawing low power plan drawings from the light microscope, do not attempt to draw individual cells-just different tissues.
- When drawing plant cells at high power under the light microscope, use two lines to indicate the width of cell walls, but a single line to indicate a membrane.
- Always put a scale on each drawing.

8. Presenting Quantitative Results

Presentation of data is all about using graphs or other visual means to make it easier to see what your results tell you. The following four ways of presenting data are the most frequently used in biology: line graphs, bar charts, histograms and scatter graphs (Figure 1).

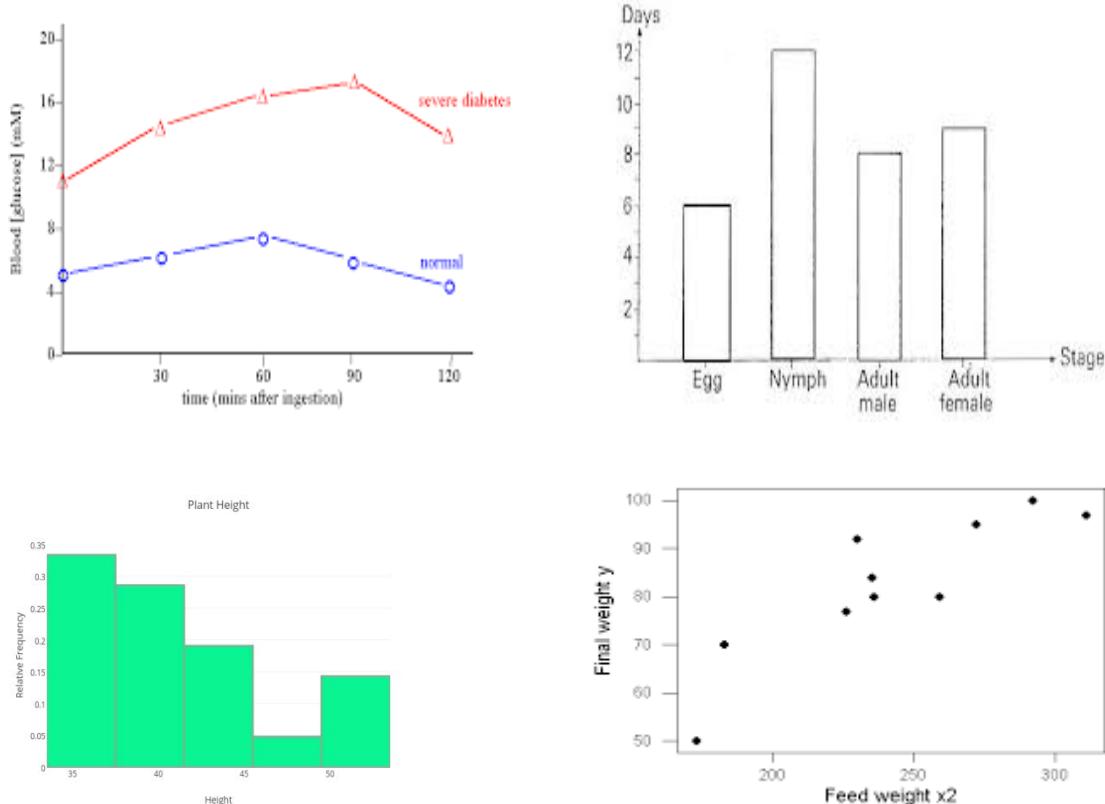


Figure 1: Line graphs, bar charts, histograms and scatter graphs

9. Drawing Conclusions

Finally, you will need to draw conclusions. If your practical exercise has involved the testing of a hypothesis, for example that the enzyme pepsin works better at low pH than in neutral or alkaline conditions, your conclusion should indicate whether the hypothesis has been refuted (i.e. shown not to be the case) or supported. Of course, even if your hypothesis has been supported, it doesn't mean that it has been confirmed with 100% certainty- in other words it isn't proved. Science proceeds more by showing that certain ideas are wrong than by showing that others are right (think about that!). Your conclusion might therefore include further ways of testing the original hypothesis, or might raise new possibilities to be investigated.

Often you will only be able to arrive at your conclusions after statistically analysing your data.

10. Writing a Scientific Lab Report

Title

- Communicate the subject investigated in the paper.

Introduction

- State the hypothesis.
- Give well-defined reasons for making the hypothesis.
- Explain the biological basis of the experiment.
- Cite sources to substantiate background information.

- Explain how the method used will produce information relevant to your hypothesis.
- State a prediction based on your hypothesis. (If the hypothesis is supported, then the results will be.)

Materials and Methods

- Use the appropriate style.
- Give enough detail so the reader could duplicate your experiment
- State the control treatment, replication and standardized variables that were used.

Results

- Summarize the data (do not include raw data).
- Present the data in an appropriate format (table or graph).
- Present tables and figures neatly so they are easily read.
- Label the axes of each graph completely.
- Give units of measurement where appropriate.
- Write a descriptive caption for each table and figure.
- Include a short paragraph pointing out important results but do not interpret the data.

Discussion

- State whether the hypothesis was supported or proven false by the results, or else state that the results were inconclusive.
- Cite specific results that support your conclusions.
- Give the reasoning for your conclusions.
- Demonstrate that you understand the biological meaning of your results.
- Compare the results, with your predictions and explain any unexpected results.
- Compare the results to other research or information available to you.
- Discuss any weaknesses in your experimental design or problems with the execution of the experiment.
- Discuss how you might extend or improve your experiment.

Conclusion

- Restate your conclusion.
- Restate important results.

Literature Cited

- Use the proper citation form in the text.
- Use proper citation form in the Literature Cited section.
- Refer in the text to any source listed in this section.

Acknowledgement

- State any appropriate acknowledgement that you think is necessary.

Practical 1

Title: Word processing and spreadsheet

Objectives:

After completing the practical, you will be able:

1. To format and prepare a word document for a project
2. To introduce Microsoft Excel's working environment

PART I: Microsoft Word – formatting of a word document for a project

Introduction

Microsoft Word is a word processor developed by Microsoft. It was first released on October 25, 1983 under the name Multi-Tool Word for Xenix systems. Subsequent versions were later written for several other platforms including IBM PCs running DOS (1983), Apple Macintosh running Classic Mac OS (1985), AT&T Unix PC (1985), Atari ST (1988), OS/2 (1989), Microsoft Windows (1989), SCO Unix (1994), and macOS (2001). Commercial versions of Word are licensed as a standalone product or as a component of Microsoft Office, Windows RT or the discontinued Microsoft Works suite. Microsoft Word Viewer and Office Online are freeware editions of Word with limited features.

Procedure:

1. Open Microsoft Office – MS Word – File – New.
2. Continuous page numbers except first page
3. Line numbers
4. Save the document as "Computer Practical 1" in your pen drive
5. Make a title page:
 - o Specify margins to 3cm all sides
 - o Title of proposed project: (you may search for a computer-biotechnology related paper from internet)
 - Change case to uppercase
 - Bold
 - Times New Roman
 - Italic the scientific name
 - Centered
 - No after and before spacing
 - Line spacing 1.15
 - o Full name
 - Change case to uppercase
 - Normal
 - Times New Roman
 - Centered
 - o Matric number of the student
 - o Name of the subject and your department
 - o Name of the University; and
 - o Name of your lecturer
 - o The month and year of the project
6. Abstract page:
 - o Specify margins to 3cm all sides

- Copy (from the online source) and past.
 - Modify the text where applicable.
 - Align the text to both left and right margins (Justify)
 - Use sentence case option.
 - Times New Roman
 - Size 12
 - Title bold
 - Text normal
 - Italic the scientific names
 - Line spacing 1.5
- 7. Introduction:
 - One page only
 - Specify margins to 2.5cm all sides
 - Select, copy and compile (from the online source) and past.
 - Align the text to both left and right margins (Justify)
 - Use sentence case option.
 - Times New Roman
 - Size 12
 - Title bold
 - Text normal
 - Italic the scientific names
 - Line spacing 1.5
 - Paragraph indent, first line 0.2"
 - After spacing paragraph
- 8. Main text:
 - Specify margins to 2.5cm all sides
 - Select, copy and compile (from the online source) and past.
 - Align the text to both left and right margins (Justify)
 - Use sentence case option.
 - Times New Roman
 - Size 12
 - Title bold
 - Text normal
 - Italic the scientific names
 - Line spacing 1.5
 - Paragraph indent, first line 0.2"
 - After spacing paragraph
 - Make a table (at least 4x4) in the middle of the text
 - Make one landscape page in the middle of the text and insert a picture with Figure legends

**Practice: Generate a word document by following the above instructions.
Attach a copy of the document to your practical report.**

Introduction

Excel is a spreadsheet program in the Microsoft Office system. You can use Excel to create and format workbooks (a collection of spreadsheets) in order to analyze data and make more informed business decisions. Specifically, you can use Excel to track data, build models for analyzing data, write formulas to perform calculations on that data, pivot the data in numerous ways, and present data in a variety of professional looking charts.

Procedure:

Opening Microsoft Excel:

You may have a shortcut to Excel on your desktop, if so double click the icon and Excel will open. If not follow the steps below:

1. Click on the Start button
2. Highlight Programs
3. Highlight Microsoft Office
4. Click on Microsoft Excel

Create a New Workbook

1. Click the File tab and then click New.
2. Under Available Templates, double click Blank Workbook or Click Create.

Enter Data in Worksheet

1. Click the cell where you want to enter data.
2. Type the data in the cell.
3. Press enter or tab to move to the next cell.

Select Cells and Ranges

In order to complete more advanced processes in Excel you need to be able to highlight or select cells, rows and columns. There are a variety of ways to do this, see the table below to understand the options.

To select	Do this
A single cell	Click the cell, or press the arrow keys to move to the cell.
A range of cells	Click the first cell in the range, and then drag to the last cell, or hold down SHIFT while you press the arrow keys to extend the selection.
A large range of cells	Click the first cell in the range, and then hold down SHIFT while you click the last cell in the range. You can scroll to make the last cell visible.
All cells on a worksheet	Select All button Click the Select All button or press CTRL+A.
Nonadjacent cells or cell ranges	Select the first cell or range of cells, and then hold down CTRL while you select the other cells or ranges. NOTE: You cannot cancel the selection of a cell or range of cells in a nonadjacent selection without canceling the entire selection.
An entire row or column	Click the row or column heading. 1 Row heading • Column heading
Adjacent rows or columns	Drag across the row or column headings. Or select the first row or column; then hold down SHIFT while you select the last row or column.
Nonadjacent rows or columns	Click the column or row heading of the first row or column in your selection; then hold down CTRL while you click the column or row headings of other rows or columns that you want to add to the selection.
Cells to the last used cell on the worksheet (lower-right corner)	Select the first cell, and then press CTRL+SHIFT+END to extend the selection of cells to the last used cell on the worksheet (lower-right corner).
Cells to the beginning of the worksheet	Select the first cell, and then press CTRL+SHIFT+HOME to extend the selection of cells to the beginning of the worksheet. NOTE: To cancel a selection of cells, click any cell on the worksheet. This is not applicable to cells with formulas in it.

Modifying Spreadsheets

In order to create an understandable and professional document you will need to make adjustments to the cells, rows, columns and text. Use the following processes to assist when creating a spreadsheet.

Cut, Copy, and Paste Data

You can use the Cut, Copy, and Paste commands in Microsoft Office Excel to move or copy entire cells or their contents. NOTE: Excel displays an animated moving border around cells that have been cut or copied. To cancel a moving border, press ESC.

Move/Copy Cells

When you move or copy a cell, Excel moves or copies the entire cell, including formulas and their resulting values, cell formats, and comments.

1. Select the cells that you want to move or copy.
2. On the Home tab, in the Clipboard group, do one of the following:
 - a. To move cells, click Cut.
 - b. To copy cells, click Copy.
3. Click in the center of the cell you would like to Paste the information.
4. On the Home tab, in the Clipboard group, click Paste.

Set Column/Row Width/Height with Mouse

To change the width of one column/row

1. Place your cursor on the line between two rows or columns.
2. A symbol that looks like a lower case t with arrows on the horizontal line will appear.
3. Drag the boundary on the right side of the column/row heading until the column/row is the width that you want.

To change the width of multiple columns/rows

1. Select the columns/rows that you want to change.
2. Drag a boundary to the right of a selected column/row heading.
3. All selected columns/rows will become a different size.

To change the width of columns/rows to fit the contents in the cells

1. Select the column(s) or row(s) that you want to change.
2. Double-click the boundary to the right of a selected column/row heading.
3. The Column/Row will automatically be size to the length/height of the longest/tallest text.

Merge and Center Cells

1. Select two or more adjacent cells that you want to merge.
2. On the Home tab, in the Alignment group, click Merge and Center.
3. The cells will be merged in a row or column, and the cell contents will be centered in the merged cell.

Merge Cells

To merge cells only, click the arrow next to Merge and Center, and then click Merge Across or Merge Cells.

Split Cells

1. Select the merged cell you want to split.
2. To split the merged cell, click Merge and Center. The cells will split and the contents of the merged cell will appear in the upper-left cell of the range of split cells.

Automatically Fill Data

To quickly fill in several types of data series, you can select cells and drag the fill handle.

To use the fill handle, you select the cells that you want to use as a basis for filling additional cells, and then drag the fill handle across or down the cells that you want to fill.

1. Select the cell that contains the formula that you want to be brought to other cells.
2. Move your cursor to the small black square in the lower-right corner of a selected cell also known as the fill handle. Your pointer will change to a small black cross.
3. Click and hold your mouse then drag the fill handle across the cells, horizontally to the right or vertically down, that you want to fill.
4. The cells you want filled will have a gray looking border around them. Once you fill all of the cells let go of your mouse and your cells will be populated.

Formatting Spreadsheet

To further enhance the spreadsheet we format a number of elements like text, numbers, coloring and table styles.

Wrap Text:

You can display multiple lines of text inside a cell by wrapping the text. Wrapping text in a cell does not affect other cells.

Click the cell in which you want to wrap the text.

2. On the Home tab, in the Alignment group, click Wrap Text.
3. The text in your cell will be wrapped.

Cell Borders:

By using predefined border styles, you can quickly add a border around cells or ranges of cells. If predefined cell borders do not meet your needs, you can create a custom border.

Apply Cell Borders:

1. On a worksheet, select the cell or range of cells that you want to add a border to, change the border style on, or remove a border from.
2. Go to the Home tab, in the Font group
3. Click the arrow next to Borders
4. Click on the border style you would like
5. The border will be applied to the cell or cell range NOTE: To apply a custom border style, click More Borders. In the Format Cells dialog box, on the Border tab, under Line and Color, click the line style and color that you want.

Remove Cell Borders:

1. Go to the Home tab, in the Font group
2. Click the arrow next to Borders
3. Click No Border.

Cell Styles

You can create a cell style that includes a custom border, colors and accounting formatting.

1. On the Home tab, in the Styles group, click Cell Styles.
2. Select the different cell style option you would like applied to your spreadsheet.

Cell and Text Coloring

You can also modify a variety of cell and text colors manually.

Cell Fill

1. Select the cells that you want to apply or remove a fill color from.
2. Go to the Home tab, in the Font group and select one of the following options:
 - a. To fill cells with a solid color, click the arrow next to Fill Color, and then under Theme Colors or Standard Colors, click the color that you want.
 - b. To fill cells with a custom color, click the arrow next to Fill Color, click More Colors, and then in the Colors dialog box select the color that you want.
 - c. To apply the most recently selected color, click Fill Color.

Remove Cell Fill

1. Select the cells that contain a fill color or fill pattern.
2. On the Home tab, in the Font group, click the arrow next to Fill Color, and then click No Fill.

Text Color

1. Select the cell, range of cells, text, or characters that you want to format with a different text color.
2. On the Home tab, in the Font group and select one of the following options:
 - a. To apply the most recently selected text color, click Font Color
 - b. To change the text color, click the arrow next to Font Color, and then under Theme Colors or Standard Colors, click the color that you want to use.

Customize Worksheet Tab

1. On the Sheet tab bar, right-click the sheet tab that you want to customize
2. Click Rename to rename the sheet or Tab Color to select a tab color.
3. Type in the name or select a color you would like for your spreadsheet.
4. The information will be added to the tab at the bottom of the spreadsheet.

Exercise:

Lab Task 1:

1. Enter the data "Sunday" into cell A1 and "Monday" into cell B1.
2. Type in "17/08" into cell E8.
3. Type in "2" into cell I8 and "4" into cell I9

➤ Paste a screen picture from the output to your practical report.

Notice how Excel automatically detected that 17/08 was a date and converted it to 17-Aug. We will discuss formatting data later on in this lab. Now, we want to select both cells A1 and B1 together. To do this, click A1 and without releasing the mouse button, move the mouse over cell B1.

To get excel to auto-complete this row, we now position the mouse cursor at the bottom-left corner of the rectangle. Make sure the cursor has changed into a + sign. Now hold down the cursor and drag it to the left till I1.

➤ Paste a screen picture from the output to your practical report.

Lab Task 2:

1. Auto-complete cells I8 and I9 all the way to I14.
2. Auto-complete cell E8 all the way to E12.

Basic Calculations: When working on a spreadsheet, you will almost definitely need to perform some calculations on the data you have. The first thing you need to remember about Excel calculations is that formulas always start with an = sign. Let us begin with a very simple calculation. Type "=3+5" into cell A5 as shown below. Press Enter. Excel automatically replaces the formula with the result of the equation.

Now let us calculate the sum of the numbers in I8 and I9. In cell J10, type "=I8+I9". One other option is to type in "=", then select cell I8. After that, type in "+" and then select I9.

Pressing Enter will give you the result of the calculation. Double clicking on the cell with the formula allows you to edit the formula. Excel has built-in functions that make your life easier. One of them is the SUM function. In cell J11, type "=sum (". Now select both cells I8 and I9. Pressing Enter gives you the same result as the plus operation we did in cell J10. Try changing the value in cell I8 and notice how the change is reflected in both formulas.

Lab Task 3:

1. Open Sheet 2 in your workbook.
2. In cells A1 and A2, type 1000 and 1500 respectively.
3. Use auto-complete to fill in cells A3 to A8.
4. Calculate the following values for cells A1 to A8 using built-in Excel functions:
 - a) Sum
 - b) Maximum c) Minimum d) Average
 - e) Median
 - f) Standard deviation
5. Enter the number 5000 into cell A9 and modify all the above formulas to include it.
6. Calculate the sum of the Maximum and Minimum, and then divide this number by the standard deviation.

Notice: Generate an Excel spreadsheet and carry out the lab tasks by following the above instructions. Attach screenshot pictures of the spreadsheets to your practical report.

Practical 2

Title: EndNote | Thomson Reuters

Objective:

After completing the practical, you will be able:

1. To understand the EndNote | Thomson Reuters, EndNote styles, working with references and citations; and formating thesis and article citations

Introduction:

EndNote is the standard software tool for publishing and managing bibliographies, citations and references on the Windows and Macintosh desktop. EndNote is a commercial reference management software package, used to manage bibliographies and references when writing essays and articles. It is produced by Thomson Reuters.

Getting Started:

Install EndNote: follow by the steps and instructions.

Opening EndNote:

You may have a shortcut to Excel on your desktop, if so double click the icon and EndNote will open. If not follow the steps below:

- Click on the Start button
- Highlight Programs
- Highlight EndNote
- Click on EndNote

Exercise:

1. Open Microsoft Office – MS Word – File – New.
2. Continuous page numbers except first page
3. Save the document as “Computer Practical 3” in your pen drive
4. Make a title page:
 - o Specify margins to 1” all sides
 - o Title of project: (you may search for a paper from internet)
 - Change case to uppercase
 - Bold
 - Times New Roman
 - Italic the scientific name
 - Centered
 - No after and before spacing
 - Line spacing 1.15

- Full name
- Change case to uppercase
- Normal
- Times New Roman
- Centered
- Matric number of the student
- Name of the subject and your department
- Name of the University; and
- Name of your lecturer
- The month and year of the project
- All follow same features as the earlier

5. Main text:

- Specify margins to 1" all sides
- Select, copy and compile (from the online source) and past.
- The text should include at least 10 citations.
- Align the text to both left and right margins (Justify)
- Use sentence case option.
- Times New Roman
- Size 12
- Title bold
- Text normal
- Italic the scientific names
- Line spacing 1.5
- Paragraph indent, first line 0.2"
- After spacing paragraph

6. EndNote:

- Select and find a journal style that has not listed in the software default (e.g. Biodiversity journal).
The styles can be found by searching "EndNote styles".
- Transfer the file to Program Files/Endnote/Styles
- Compare the references from the original source to the style imported. Then, make the necessary amendments.
- Open scholar.google.com
- Click on settings
- Search results
- Bibliography manager
- Show links to import citations into **EndNote**
- Search the title of references in the Google Scholar
- Import to EndNote
- Make the necessary changes into imported references from Google scholar.
- Save
- Save library as a copy in your pen drive as backup
- Open your word document
- Click on Endnote menu
- Insert citation
- Find your reference
- Insert in the correct part of your text

- The same action for the rest of references
- Change the style to Biodiversity
- Update the citations
- After final check and completing, convert the citations to plain text

Practical 3

Title: Statistical analysis software: SPSS Inc.

Objective:

After performing this practical, students should have the knowledge of:

➤ SPSS statistical software

- Data editor
- Output viewer
- Syntax editor
- Script window

Introduction:

Originally it is an acronym of Statistical Package for the Social Science but now it stands for Statistical Product and Service Solutions

One of the most popular statistical packages which can perform highly complex data manipulation and analysis with simple instructions

Procedure:

Getting Started:

Install SPSS: follow by the steps and instructions.

Opening EndNote:

You may have a shortcut to SPSS on your desktop, if so double click the icon and SPSS will open. If not follow the steps below:

1. Click on the Start button
2. Highlight Programs
3. Highlight SPSS
4. Click on SPSS

Comparing Means Of More Than Two groups

One Way ANOVA

The One Way ANOVA procedure compares means from several groups, simultaneously. Ideally, for this test, the subjects should be selected randomly within each group.

Example 1. A researcher wants to evaluate the effects of four types of cereals (W,X,Y,Z) on weight gain. In a laboratory experiment, 20 mice were weighed and randomly assigned to one of the four cereal types. Weight gain (gm) was recorded at the end of the study.

W	X	Y	Z
8	5	6	3
8	6	5	8
7	5	5	7
8	6	6	2
9	3	8	5

One of the important assumptions is that the variance in weight gain must be similar across the cereal types. This condition is known as homogeneity. Then, the data must be normally distributed. The other condition is that the individuals in each group are independent of each other.

Enter the data in SPSS

Variable View

The Variable View window displays two variables:

- Cereal**: Type Numeric, Width 8, Decimals 0, Label Cereal Type, Values {1, W}..., Miss None
- Wt.Gain**: Type Numeric, Width 8, Decimals 0, Label Weight Gain in, Values None, Miss None

Data View (Enter the weight gains in a single column, cereal type in the other)

The Data View window shows 12 rows of data:

	Cereal	Wt.Gain	var	var	var	var	var
1	W	8					
2	W	8					
3	W	7					
4	W	8					
5	W	9					
6	X	5					
7	X	6					
8	X	5					
9	X	6					
10	X	3					
11	Y	6					
12	Y	5					

To Obtain an Independent-Samples T Test

From the menus choose:

Analyze
Compare Means
One-Way ANOVA...



Results

Descriptives

Weight Gain in gm

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
W	5	8.00	.707	.316	7.12	8.88	7	9
X	5	5.00	1.225	.548	3.48	6.52	3	6
Y	5	6.00	1.225	.548	4.48	7.52	5	8
Z	5	5.00	2.550	1.140	1.83	8.17	2	8
Total	20	6.00	1.919	.429	5.10	6.90	2	9

Test of Homogeneity of Variances

Weight Gain in gm

Levene Statistic	df1	df2	Sig.
3.000	3	16	.062

p-value = 0.062 > 0.05

Equality of variances assumption is met.

ANOVA

Weight Gain in gm

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	30.000	3	10.000	4.000	.027
Within Groups	40.000	16	2.500		
Total	70.000	19			

From the ANOVA table, the p-value is 0.027 which is less than 0.05.

Therefore at least one pair of cereals differs significantly in terms of weight gain.

Then, check if the data are distributed normally.

Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Weight Gain (gm)	.151	20	.200*	.932	20	.170

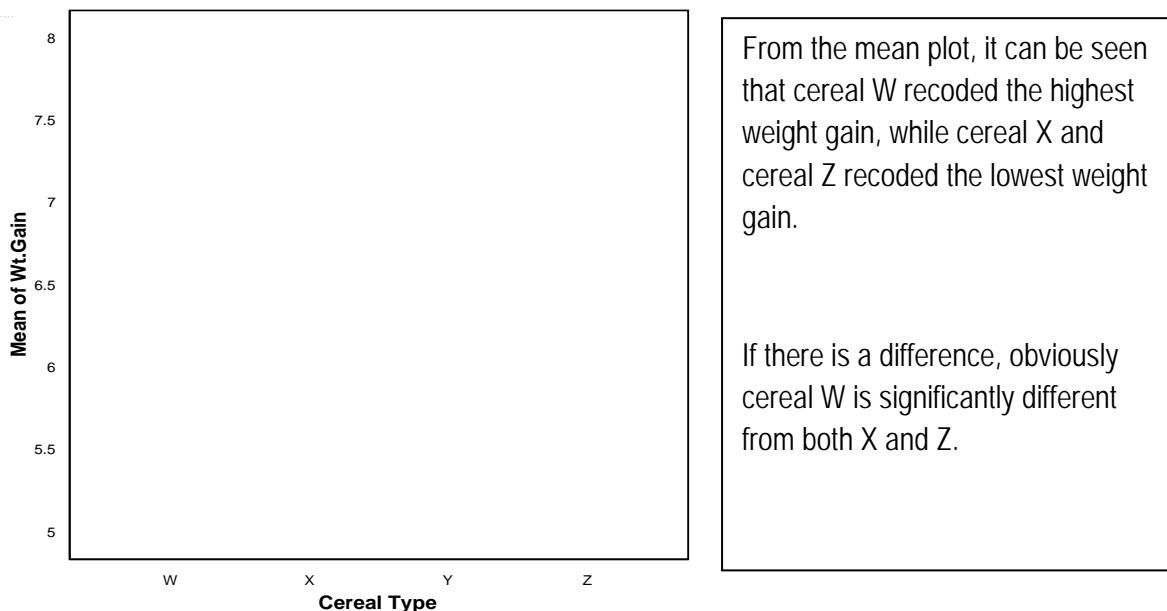
*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Since, the p-values of 0.200 and 0.170 are both more than 0.05, there is no significant departure from normality for the weight gain across different types of cereal. Thus, assumption is fulfilled.

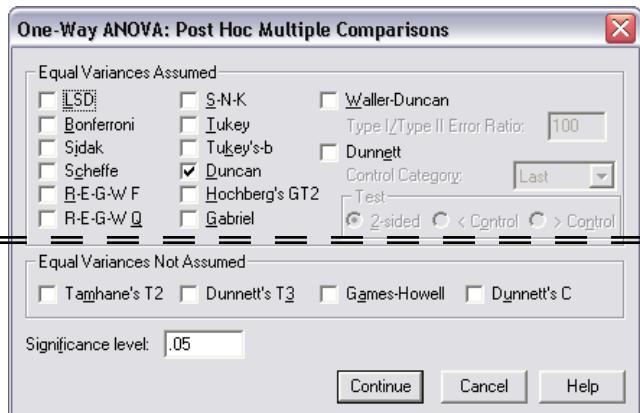
The next question is, which pairs differ significantly from each other?

The Mean Plot



Post Hoc Multiple Comparison

Redo the analysis and from the pop up, click Post Hoc...



Equal Variance Assumed:

Choose one of these test is the assumption of equality of variances is acceptable. That is if the Levene's Test gives a p-value > 0.05

(Homogenous)

Equal Variance Not Assumed:

Choose of these test if Levene's Test gives a p-value < 0.05 (Heterogeneous)

In the case of the weight gains, we have homogeneity. Perhaps, we can try Duncan.

Results

Weight Gain in gm			
Duncan ^a			
Cereal Type	N	Subset for alpha = .05	
		1	2
X	5	5.00	
Z	5	5.00	
Y	5	6.00	6.00
W	5	8.00	
Sig.		.358	.063

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 5.000.

From the Duncan's Post Hoc Test, X, Z, Y are similar ($p\text{-value}=0.358 > 0.05$).

Y, W are similar ($p\text{-value}=0.063 > 0.05$)

X and Z are different from W.

So, we can conclude that the weight gain in cereal W is significant higher compared to both X and Z.

Example 2

W	X	Y	Z
8	5	6	2
8	6	5	8
7	5	5	7
8	6	6	2
9	3	8	5

Change

Results

Descriptives

Weight Gain in gm

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minim um	Maxi mum
					Lower Bound	Upper Bound		
W	5	8.00	.707	.316	7.12	8.88	7	9
X	5	5.00	1.225	.548	3.48	6.52	3	6
Y	5	6.00	1.225	.548	4.48	7.52	5	8
Z	5	4.80	2.775	1.241	1.35	8.25	2	8
Total	20	5.95	2.012	.450	5.01	6.89	2	9

Test of Homogeneity of Variances

Weight Gain in gm

Levene Statistic	df1	df2	Sig.
4.184	3	16	.023

p-value = 0.023 < 0.05

Equality of variances assumption is not met.

ANOVA

Weight Gain in gm

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	32.150	3	10.717	3.827	.031
Within Groups	44.800	16	2.800		
Total	76.950	19			

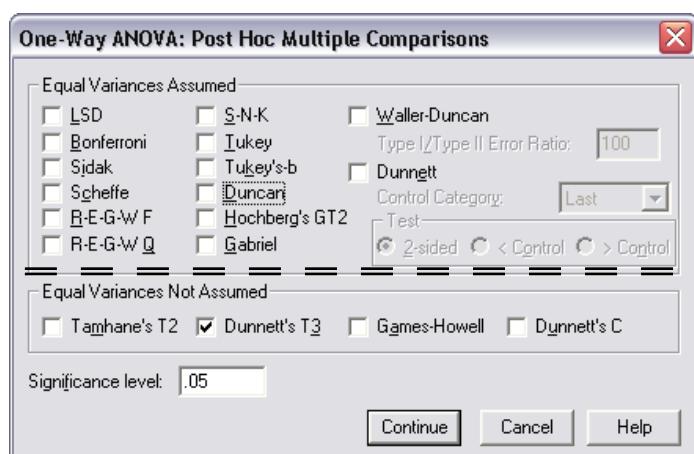
From the ANOVA table the p-value is 0.031, which is less than 0.05.

Therefore at least one pair of cereals differs significantly in terms of weight gain.

Next question is, which pairs differ significantly from each other?

Post Hoc Multiple Comparison

Redo the analysis and from the pop out click Post Hoc...



Equal Variance Assumed:

Choose one of these test is the assumption of equality of variances is acceptable. That is if the Levene's Test gives a p-value > 0.05

(Homogeneous)

Equal Variance Not Assumed:

Choose of these test if Levene's Test gives a p-value < 0.05
(Heterogeneous)

In this case, since we do not have homogeneity, we have to choose a test from the lower half of the options. Perhaps, we can try Dunnett's T3.

Results

Multiple Comparisons

Dependent Variable: Weight Gain in gm

Dunnett T3

(I) Cereal Type	(J) Cereal Type	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
W	X	3.000*	.632	.013	.73	5.27
	Y	2.000	.632	.084	-.27	4.27
	Z	3.200	1.281	.234	-2.06	8.46
X	W	-3.000*	.632	.013	-5.27	-.73
	Y	-1.000	.775	.731	-3.61	1.61
	Z	.200	1.356	1.000	-4.93	5.33
Y	W	-2.000	.632	.084	-4.27	.27
	X	1.000	.775	.731	-1.61	3.61
	Z	1.200	1.356	.922	-3.93	6.33
Z	W	-3.200	1.281	.234	-8.46	2.06
	X	-.200	1.356	1.000	-5.33	4.93
	Y	-1.200	1.356	.922	-6.33	3.93

*. The mean difference is significant at the .05 level.

From the Dunnett's T3 Multiple Comparison, W and X are different from each other.

(p-value = 0.013 < 0.05). All other cereals do not differ from each other pairwise.

We conclude that the weight gain in cereal W is significant higher compared to both X.

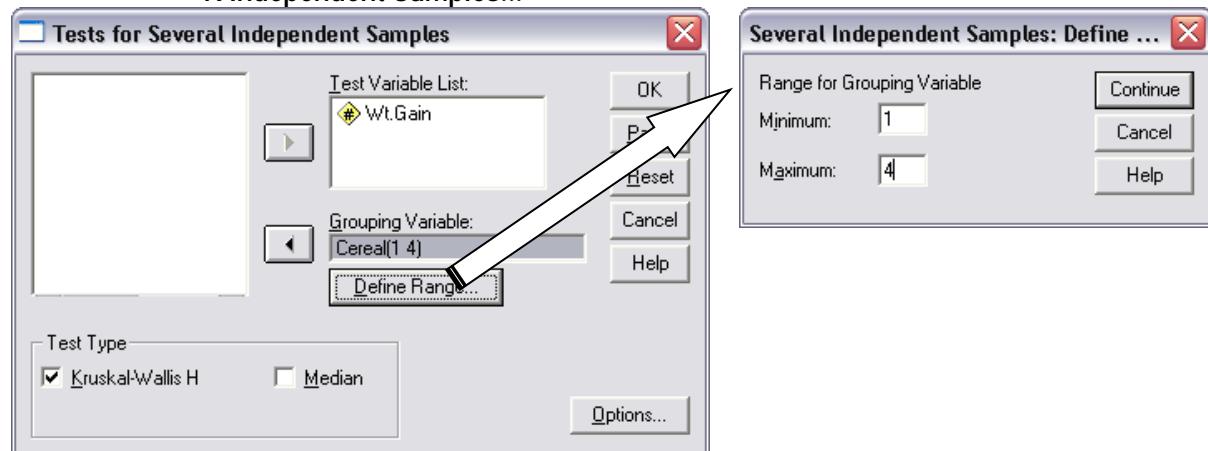
This could be surprising since from the descriptive table above we see that the mean of Z is the lowest, even lower than that on X. But look at the standard deviation. The standard deviation for Z is very much higher compared to that of X.

Next, perhaps should try the nonparametric test.

To Obtain a K Independent Samples Nonparametric Test

From the menus choose:

Analyze
Nonparametric Tests
K Independent Samples...



Results

Nonparametric Kruskal-Wallis Test

Ranks			
	Cereal Type	N	Mean Rank
Weight Gain in gm	W	5	16.90
	X	5	7.20
	Y	5	10.00
	Z	5	7.90
	Total	20	

Test Statistics ^{a,b}	
	Weight Gain in gm
Chi-Square	8.751
df	3
Asymp. Sig.	.033

a. Kruskal Wallis Test

b. Grouping Variable: Cereal Type

The p-value of this test is 0.033, which is less than 0.05.

There is some evidence based on ranking that there is a difference in weight gains.

The mean rank for W 16.90 and for X it is 7.20.

Thus, we can conclude that weight gain in W higher compared X.

Rank Values

W	X	Y	Z
17	6	10.5	1.5
17	10.5	6	17
13.5	6	6	13.5
17	10.5	10.5	1.5
20	3	17	6

Exercises:

1. The following are the BP measurements for a sample of Malays, Chinese and Indians.

Malays			Chinese			Indians		
125	126	134	136	131	135	138	137	140
132	125	130	135	136	132	147	142	
146			134	139				

2. Students' Statistics marks for a random sample of nine students from three classes.

Class A			Class B			Class C		
80	60	65	79	65	62	75	60	56
76	55	78	75	65	75	70	70	60
77	78	79	70	80	75	75	80	70

3. Masses of miniature tomatoes produced in three greenhouses.

Greenhouse 1	1.42	1.64	1.81	1.53
Greenhouse 2	1.85	1.74	2.23	2.18
Greenhouse 3	1.75	1.31	1.95	1.59

4. The percent porosity of crucibles fired at four different temperatures as follows:

2600°F	2675°F	2750°F	2825°F
18.8	16.7	15.7	14.4
14.7	14.3	13.1	11.9
14.9	12.5	11.5	9.8
14.2	12.6	11.7	11.3
15.3	13.7	11.3	11.3

5. The Air Pollution Index (API) over four locations in five towns at 5:00 pm on a particular day.

T1	T2	T3	T4	T5
200	199	175	202	200
199	217	174	213	196
192	198	180	218	198
203	194	165	207	202

For the questions above

- a) Write an objective.
- b) Describe the measurements in each group.
- c) Test if the data are distributed normally.
- d) Test if the variances are similar (homogeneity).
- e) Test if there is a significant difference in means between the group measurements.
- f) Perform an appropriate Post Hoc test to compare group differences.
- g) Perform a nonparametric test and compare the result.

Practical 4

Title: Basic computer programming: Qbasic

Objective:

After completing the practical, you will be able:

1. To introduce basic computer programming using Qbasic software

Introduction:

QB64 (originally QB32)[1] is a self-hosting BASIC compiler for Microsoft Windows, Linux and Mac OS X, designed to be compatible with Microsoft QBasic and QuickBASIC. QB64 is a C++ emitter, which is integrated with a C++ compiler to provide compilation via C++ code and GCC optimization.

QB64 implements most QBasic statements, and can run many QBasic programs, including Microsoft's QBasic Gorillas and Nibbles games. Furthermore, QB64 has been designed to contain an IDE resembling the QBASIC IDE. QB64 also extends the QBASIC programming language to include 64-bit data types, as well as better sound and graphics support. It can also emulate some DOS/x86 specific features such as INT 33h mouse access, and timers.

Contents

QB64 like any other compiler program has its own command. It may differ from one to another but in the end of the day it still compiles. So, here are listed several commands that are used in QB64:

PRINT

Writes text and numerical for example if the command is PRNT "Hello There Human", it will show the word 'Hello There Human'.

SLEEP

Stops the programs procedure to continue until any key is pressed.

INPUT

Request a STIRING or numerical keyboard entry from a program user. For example, INPUT "I AM A ROBOT"

DIM

Is used to declare a variable type or dimension. Usually use to be connected with input.

DECLARE

Used to tell that a SUB or FUNCTION is created to be used in the program.

SUB

Procedures are programs within programs that can return multiple calculations.

END

Required at the end of the block of library declarations.

ELSEIF

Used in IF...THEN block statements or block of statements.

IF

A condition flow statement or block of statements.

ELSE

Statements to offer an alternative to other conditional statements.

FOR/NEXT

A counter loop procedure that repeats code a specified number of times.

DO UNTIL

Used in programs to repeat code or return to the start of a procedure.

LOOP

Procedure that repeats code until or while a condition is true.

Exercise

Watch videos 1 - 4 and follow the procedures.



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