

Introduction to Technical Report Writing

1. Introduction

Report writing is an essential skill for engineering students. Therefore, this course provides guidelines to engineering students for writing technical reports (for example on experiments, and final year projects). Engineering reports usually present results, analyze data, and make recommendations in a logical, precise, and accessible manner. Report writing is a requirement for:

- Completing bachelor's degree in Engineering qualification at Benha University
- Central part of succeeding in future employment.

The ability to prepare professional engineering reports is one of the competencies standards specified by NAQAAE (The National Authority for Quality Assurance and Accreditation of Education).

One of the main forms of communication in engineering is the technical report. In the workplace, the report is a practical working document written by engineers for clients, managers, and/or other engineers.

We cannot all be William Shakespeare or Ernest Hemingway, but it is possible to acquire enough writing skill to write simple, declarative sentences and readable reports. Subjects you know about; you can also learn to write about.

If you know clearly "why" you are writing and "who" will read your report, you have the basis for the report design.

In engineering practice, the reader can be a client, a colleague, or a manager. In academic writing, the target reader is usually the examiner. The author must therefore ensure that sufficient background and details are given to convince the examiner. Therefore, the target audience determine the degree of technicality of the language and concepts involved in the report. Consequently, you need to analyze your audience.

2. Audiences Analysis

Three broad categories of audiences for a technical report can usually be identified from the beginning:

1. Technical
2. Non-Technical
3. Mixed

2.1 Technical Audiences are made up of people in the same field as yours. They are the most obvious audience. They are people such as other engineers, technicians, or scientists. They may be people you know within your own organization, or they may work outside.

Their interests may include other things as well, but it is almost certain that they will have an interest in the subject of your report.

2.2 Non-Technical Audiences may include for example, citizen advisory boards, financial experts, legal or administrative readers, and many, many others. Their needs will be quite different from your "technical" readers. As they read your report, they are looking for certain things which it is your job, as a technical writer, to provide.

2.3 Mixed Audiences are the most common audiences include both technical and non-technical readers. Such audiences are more difficult to write for, but there are several principals of report design which, if followed, will provide each reader with the information he or she needs to use your report efficiently. Example for this category is an engineer with financial experts.

For example, if the document is to be read only by engineers, use appropriate scientific vocabulary and detailed supporting data. If it is a tool for executive decisions, present data in lay terms, with clear supporting graphics.

Above all, there is one thing nearly all your readers have in common. They are usually busy and have a great deal of reading to do every day. If you hand them a thick, boring, complicated, and badly written report you will bother them immediately. Overcoming this natural reaction is a challenge, but you can make it easier for them by design your report properly. Principles of good report design are mainly covered later in this course. Once the subject of your report has been identified and its purpose defined, your first task is to analyze your audience.

One of your early tasks as a report writer is to identify and analyze your audiences. You want to know things about them such as:

- ✓ What their technical background is,
- ✓ What their function in the organization is,
- ✓ What their interests are,
- ✓ what level of detail they need from your report?

Your Audience(s), no matter what their background, training, interest, or position of authority, all have two things in common: what your idea will cost? and how long it takes to accomplish? If your report doesn't answer these two questions, it is dead on arrival.

3. Report Purposes

Every report has a purpose. Some common purposes are:

- To **convince** the reader of something. For example:
 - to convince a government agency of the effect of a particular course of action
 - to convince a client that your solution will fulfill their needs
 - to convince the public that a proposed project will bring benefits
- To **encourage** the reader to do something. For example:
 - to encourage a government or council to adopt a particular course of action
 - to encourage a client to choose one design over another
 - to encourage an organization to partner with your company on a project
- To **inform** the reader about something (usually for a further purpose). For example:
 - to provide a government department with information they will base policy on
 - to instruct other engineers who will work from your plans
 - to present the outcomes of a project to stakeholders

When planning an assignment report, your first step is to clarify its purpose; that is, what you want it to achieve: A technical report is meant to convey a specific message or to perform a particular function, rather than to 'teach' the reader about the topic.

The general rule is to begin writing the sections of the report as soon as possible. The table of contents should be drafted very early in the process of writing the report since the table of contents provides a good overview of the entire document and, while the report is being written, provides an indication of which sections still need to be done.

Regardless of the order of the report, a chapter, or an appendix (with tables and figures) should be written as soon as that part of the work has been completed, for example when some apparatus has been developed or set up, a section of theory has been derived, a computer program has been written, or a set of readings has been taken. It is also a good idea to give the written work to a fellow student or a supervisor as early as possible to criticize constructively. Some sections written as appendices in the early phases will remain appendices, while others will later be included in the main text, and some will not be included in the final report.

4. Getting Started

To create a useful report, you need to express the purpose of the report and identify the audience for it. You need to define the following items:

- ✓ Define the purpose of the report and the key information it needs to convey
- ✓ Define the audience and their level of technical understanding
- ✓ Determine the level of detail necessary for the report
- ✓ Organize the data
- ✓ Work with a team of authors

- ✓ Meet deadlines

4.1. When You Work with a Team

When a document is a group effort, first assign a task for each team member. Then, let each team member know the level of detail required, the audience, and the deadlines. Everyone in the team knows how their section fits into the whole document. Since team members often have other responsibilities and busy schedules, follow up with each author to ensure that the commitment is being met and whether any problems have occurred. Finally, you must select one of the team to be an editor who can greatly enhance the final document. The editor's role is to ensure a single, coherent writing style, eliminate redundancies or contradictions, and maintain consistent use of terminology.

4.2. Deadlines

Deadlines should be clear, and team members should commit to them in writing. Managing the document is a project management task that requires frequent contact with all members. One missed deadline can cause an avalanche of missed deadlines. Therefore, it is important to be aware of potential problems before they occur. If possible, it is always best to plan for some leeway in the schedule so that late members do not affect the quality of the project. Remember to allow adequate time for the editor as well as for making copies. Tools such as Microsoft Project are helpful for monitoring progress.

5. Employ Ethical Principles

Accuracy of technical information is the responsibility of the writer. Make sure you have the information you need to write accurate reports by avoiding the following items:

- ✓ Avoid language that attempts to evade responsibility.

- ✓ Avoid language that could possibly mislead readers.
- ✓ Avoid plagiarism.
- ✓ Do not suppress important information.
- ✓ Do not emphasize incorrect information.
- ✓ Avoid hiding part of information that mislead others to follow up your research.

5.1. Plagiarism Definition

Plagiarism can be defined as follows: To use another person's words or ideas as if they were your own. The following are seen as plagiarism:

- ❖ To steal or borrow another person's work
- ❖ To pay another person to write your assignment
- ❖ To copy directly from a source without referencing the original source
- ❖ To use another person's ideas without giving credit to the original ideas
- ❖ To paraphrase another person's work word for word
- ❖ To present false data (fabricated, altered or borrowed without permission)

The worst form of plagiarism is to do it intentionally: to pretend that another person's work is your own; to buy a piece of written work from somebody (for example from the Internet) or to pay somebody to write your assignment for you; or to write something word-for-word from a source without acknowledging that source (or to "cut and paste" from the Internet).

6. Wasted Words and Phrases to Avoid

After you write a sentence, look it over and ask whether there are any words you can cut without affecting the meaning. If so, start cutting, because the shorter version is usually

better. Avoid words and phrases that don't add meaning to a sentence. Some words and phrases to avoid include:

- ❖ all of (replace with “all”)
- ❖ at the present moment in time (replace with “now”)
- ❖ in order to (replace with “to”)
- ❖ in near time (replace with “soon”)
- ❖ utilize or utilization (replace with “use”)
- ❖ actually
- ❖ as you know
- ❖ it can be seen that
- ❖ it has been indicated that
- ❖ it should be noted that

6.1. Grammar and Punctuation

A or An

Use *an* in place of *a* when it precedes a vowel *sound*, not just a vowel. This confuses people most often with acronyms and other abbreviations. Often, writers think it's wrong to use “an” in front of an abbreviation (like MRI) because “an” only goes before vowels. However, the sound determines which article to use. It's “*an MRI*,” assuming you pronounce it “em are eye.”

Every

Every requires a singular verb and singular pronouns. Do not write “Everyone are ...”, use “Everyone is ...”

Different

The word different is often redundant, as in “several different options” or “many different participants”. It is recommended to be “several options and “many participants”.

Affect versus Effect

Affect is usually a verb; *effect* is usually a noun. (AVEN)

A = *Affect* is a

V = Verb

E = *Effect* is a

N = Noun

For example, “The cold weather **affected** the crops.” If you can substitute affect with another verb, you are using the right word: “The cold weather **damaged** the crops.”

So, when you want to use a word to express a change or to describe an action, choose affect.

Effect is used as a noun, meaning “result” or “consequence.” One way to decide if effect is the correct word to use is to replace it with another noun. For example, “His sunburn was an **effect** of exposure to the sun.” Another way to say it is, “His sunburn was a **result** of exposure to the sun.”

Alternate, and Alternative

Alternate (as an adjective or verb) means to go back and forth between two things, as in alternate Mondays (that is, every other Monday), or “we alternate between meeting here and in Cairo.” *Alternative* means a different way of doing things. “One alternative is a calculator; another is a computer.”

Among versus Between

Follow this simple rule: Use *between* for two things, *among* for more than two.

Ensure, Insure

Ensure means “to make certain.” For example, “the legislation ensures discipline.”

Insure is a specific word meaning to set aside resources in case of a loss: “We insure our

car against accidents.”

Compound Words as Adjectives

When you combine two words to describe a noun, use a hyphen between them if the description comes before the noun. If it comes after the noun, don't use a hyphen. For example: “The report is well written”; “They were excited by the well-written report.”

Hyphen versus Dash

As before, hyphen is used in two-word adjective. For example: Three-Phase Circuits.

A dash is used to indicate a range, e.g., 1939–1945.

A long dash is an informal way of marking a parenthetical statement—or a diversion from the main thought—during a sentence. Avoid using dashes in formal writing, use parentheses.

e.g. versus i.e.

The abbreviation *e.g.* means “for example.” *i.e.* is means “that is.” A comma should follow (and precede, if appropriate) both abbreviations. Because these terms are often confused, it's often clearer to use the words *for example* or *that is* instead of these abbreviations.

Less versus Fewer

Use *less* for indefinite quantities, like water or satisfaction. If you can count the items, however, use *fewer*. For example: “Nine items or fewer.”

Numbers

Spell out numbers less than 10; write numbers 10 or greater as figures. Spell out first or fifth but use 14th or 122nd numbers.

Do not begin a sentence with a number: either spell out the number (however large), or rewrite the sentence so it does not begin with a number.

Very large numbers are expressed in figures followed by the word *million*, *billion*, etc. For example: not 1,000,000,000, but 1 *billion*.

Use figures for physical quantities and measurements. For example: 6 meters; 3 cubic feet; 9 gallons.

Punctuation in technical writing

The purpose of punctuation is to convey ideas clearly and without ambiguity.

Colon (:)

A *colon* marks a pause for explanation, expansion, enumeration, or elaboration. Use a colon to introduce a list: item one, item two, and item three. Use it to provide an example.

Semicolon (;)

Connect two sentences which are closely connected, and often not joined with a linking word e.g. The initial survey revealed a high interest; results showed that further development is valid.

Separate complex items in a list e.g. The following factors are critical: the environmental impact statement; the government and union policies; the approval of business and council; and public opinion.

Comma (,)

Show a pause or natural separation of ideas

e.g. After the recommendations were implemented, further evaluations were conducted.

Separate information in a sentence

e.g. The additional results, which were withheld, raised doubts about the initial hypothesis.

Precede linking words, such as ‘but’, ‘so’, ‘hence’, and ‘whereas’

e.g. The aim was to test strength and density, but the measurements taken were not accurate.

Separate information in a list

e.g. The items included: circuit boards, several meters, wires and a power supply.

Capital letters

Used especially in titles and headings where small words such as ‘and’, ‘in’, ‘the’, ‘by’ should not be capitalized. Use also for a person’s name (e.g. ‘Ohm’s law’).

Apostrophes for ownership (‘)

Place the apostrophe at the end of the owner-word, then add a possessive s

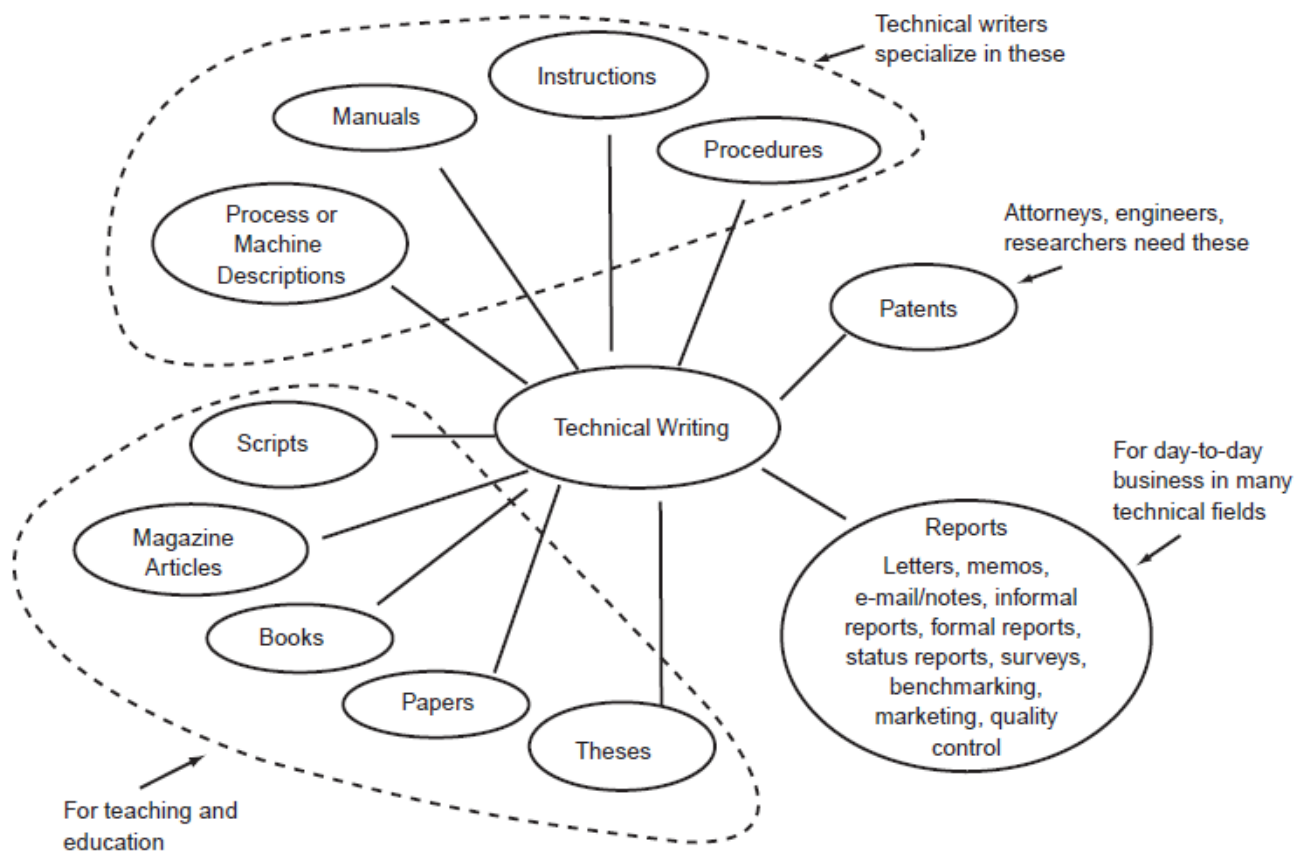
e.g. The researcher’s results. (one researcher owns the results)

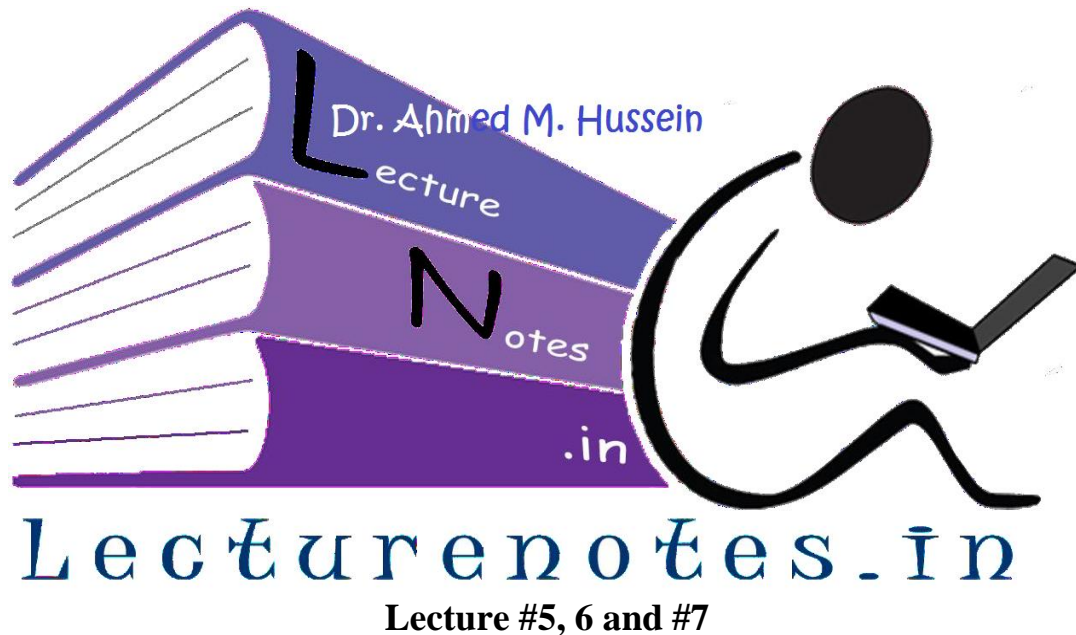
If the original word ends in an s, place the apostrophe at the end of the owner word without adding a possessive s

e.g. The researchers’ results. (more than one researcher owns the results)

7. Spectrum of Technical Writing

Technical writing is a broad term that includes a wide variety of documents in science, engineering, and the skilled trades. The major types of documents in technical writing can be grouped into four major categories as shown in Fig. 1.





Characteristics of Effective Technical Writing

1. *The four C's that characterize reports*

- *Clarity* -- it is easily understood by your intended audience
- *Comprehensiveness* -- all the necessary information is present
- *Conciseness* -- it is clear without redundancy
- *Correctness* -- it is grammatical and follows conventions

2. **Formatting guidelines of technical report writing**

Appropriate formatting of reports improves the readability of information. This lecture outlines essential formatting guidelines. An important principle underlying all formatting choices is consistency. Therefore, each report should maintain the same internal style and structure, which can be achieved.

3. **Basic Report Structure**

Most reports contain the sections listed below. Where each report will differ is in the body; the sections you decide to include will depend on the type of report and the specific topic.

A report usually has the following components:

- Cover Page
 - Title page
 - Abstract
 - Dedication*
 - Disclaimer*
 - Acknowledgement
 - Table of contents
 - List of Tables
 - List of Figures
 - Nomenclature*
 - Introduction chapter
 - Central Chapters
 - Conclusions
 - References
 - Appendices*
 - Bibliography*
- Preliminary Pages
- * Optional Pages
- Main Text Pages
- Supplement Pages

3.1 Templates

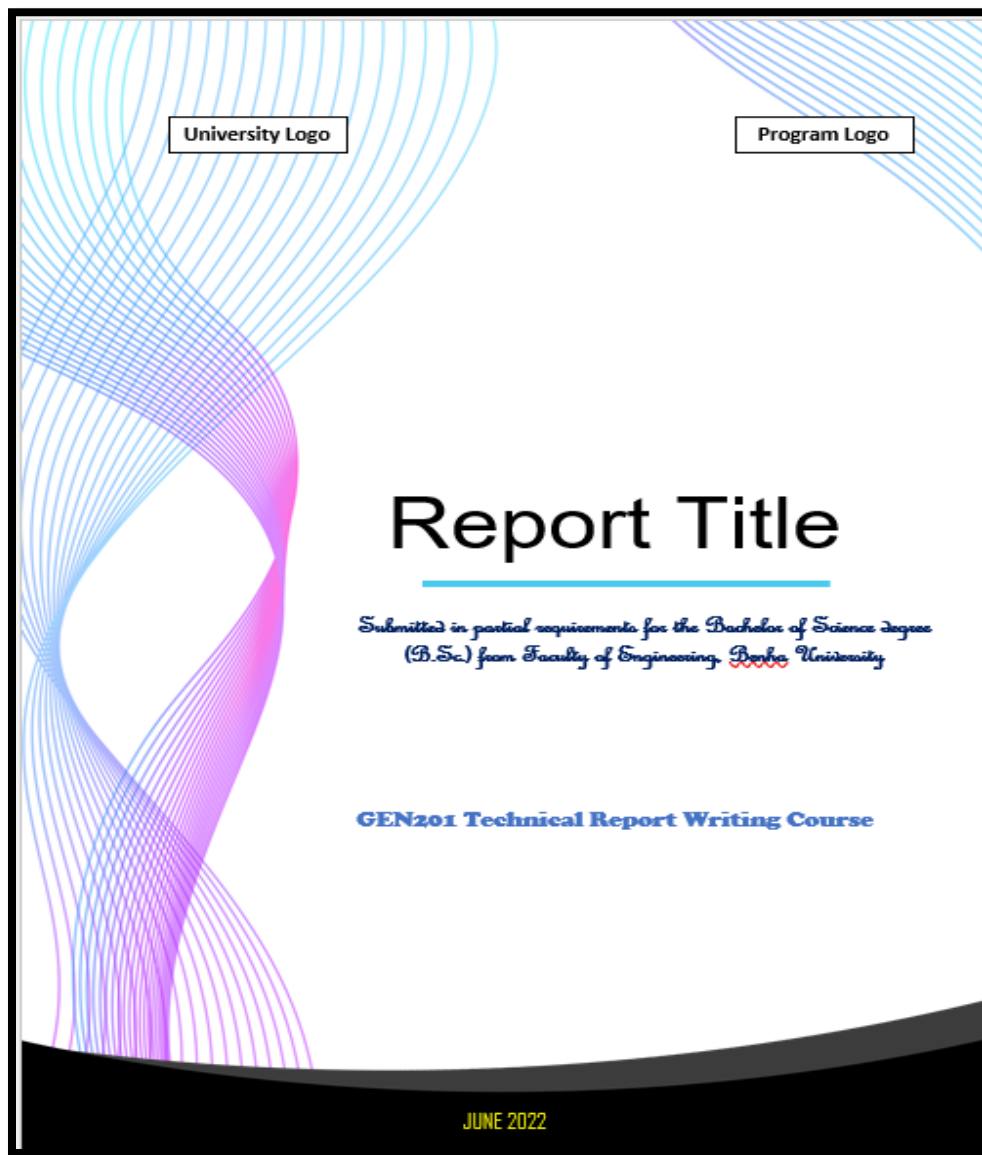
One way in which consistency of a word-processed, or LaTeX-processed report can be achieved is using a template. The template forms the basis of a docx or tex processed document as it determines the basic structure and formatting for the entire document. You can use templates provided software processor or use the ones provided by your lecturers. When using a template, styles can be created and modified to suit your purposes. For example, you can create styles for the several levels of headings. Creating a style saves you the tedium of applying the same font size, appearance, numbering and white space every time you type a heading or sub-heading. The single most significant advantage is that using styles allows you to automatically create a Contents page.

In the following section, each component of the report structure is explained:

3.2 Cover Page

The purpose of the cover page is to protect and identify the whole report. The cover page should be simple and attractive. It should contain the following information:

- University name & Faculty name with logo
- Subject name and code
- Project (report) title
- Date of submission



The title of the report must be considered carefully. A good title is striking and clearly reflects the contents of the report. The title of the report should indicate exactly what the report is about. The reader should know not only the general topic, but also the specific aspect of the topic addressed in the report. Compare the following pairs of report titles:

Weak titles	Strong titles
Bridge Analysis	Analysis of a prestressed concrete bridge
Internet-Based ATIS	An evaluation of Internet based Automated Traveller Information Systems


Most of the reports you write at university will form part of the assessment for particular units. You will therefore often talk about ‘Assignment 1’ or ‘the water project’, for example. These terms can form part of the title, but the report will usually need a more specific title too. Compare the following examples:

Weak titles	Strong titles
Assignment 1	Assignment 1: Water consumption data collection
Lab Report 1	Laboratory Report 1: Experimental Determination of Transformer Parameters

3.3 Title Page

The title page contains all information given on the cover page with white background with extra information:

- Student names and ID or affiliation
- Supervisor name

Kingdom of Saudi Arabia Ministry of Higher Education Prince Sattam bin Abdulaziz University College of Engineering Department of Electrical Engineering	 <p>جامعة الأمير سطام بن عبد العزيز Prince Sattam Bin Abdulaziz University</p>	المملكة العربية السعودية وزارة التعليم العالي جامعة الأمير سطام بن عبد العزيز كلية الهندسة قسم الهندسة الكهربائية
Graduation Project 2 EE4990 Solar LED Street Lighting System		
Submitted by: Abdulaziz Ahmad Alqunaisi - 435050189 Mohammed Nasser Alyousef - 435050287 Faisal Saleh Abdulaziz Aldouk- 435050305 Abdullah Abdulaziz Alsunaid - 435050237		
Supervised by: Dr. Ahmed Mustafa Hussein		
Submitted in partial fulfillment of the requirements for the bachelor's degree in electrical engineering program at College of Engineering at Sattam Bin Abdulaziz University, Al-Kharj, Saudi Arabia		
July 2019		

3.4 Abstract

Abstracts highlight major points of the report and explain why your work is important. Abstract is not an introduction to the report. It often provides no background information. Abstract is also known as an overview, or short summary. The abstract is often written last as its purpose is to provide a summary of the report's essential information. All material in the abstract will also be explained in more details through the report. The abstract should appear on a separate page after the title page, and it is usually about 100–200 words in length. The abstract should include the following elements:

- why? *purpose* of the report (Intro) **P**
- how? brief details of the approach/procedure/*methods* (Method) **M**
- what? important *results*/findings (Results) **R**
- so what? major *conclusion(s)* and recommendation(s) (Conclusion) **C**

When you are writing your abstract, you should avoid:

- Extensively referring to other works
- Defining any terms
- Adding information that isn't contained in the larger work

Abstract for the report with the title “**Video Game Addiction and College Performance Among Males**”

This report explores the pattern of video game usage and video game addiction among male college students and examines how video game addiction was related to expectations of college engagement, and college Grade Point Average (GPA). More than 4-hundred first-year students at faculty of Engineering are targeted. In the week before the start of classes, participants are given two surveys: one of expected college engagement, and the second of video game usage, including a measure of video game addiction. Results suggested that video game addiction is (a) negatively correlated with expected college engagement, (b) negatively correlated with college GPA that occurred during the first year in college. Results are discussed in terms of implications for male students' engagement and success in college, and in terms of the construct validity of video game addiction.

3.5 Dedication

This is a short sentence, in the middle of a separate page, in which the report is dedicated to a family member, or a friend. It may be left out and is seldom included in short technical reports. It is more suited to theses.

3.6 Disclaimer

A ‘disclaimer’ or declaration of authenticity is often required in major pieces of work such as large reports, projects, and theses. It is a signed statement declaring that the report is the work of the stated author(s). The disclaimer should appear on a page following the abstract. This is an example of disclaimer statement:

I declare the following to be my own work, unless otherwise referenced, as defined by the University’s policy on plagiarism ... followed by the author’s signature.

Students are not guilty of plagiarism if they have correctly referenced the sources of all material which is not their own work.

3.7 Acknowledgments

The acknowledgments page is optional; however, it is essential that significant assistance, editing, or work carried out by another person or organization be acknowledged. Also, students may wish to thank colleagues or supervisors. Also, we must acknowledge institutions that provided money or made facilities available.



Thanks to my supervisor **Dr. Ahmed** for being so patient and to **Dr. Essam** from Electrical Engineering lab for putting me right on how to use the equipment. Without your help this project might never have got off the ground.



I would like to thank my supervisor **Dr. Ahmed M. Hussein**, Benha University for his encouragement and guidance throughout the project. Also, I would like to express deep thanks to **Dr. Mohamed Salah**, Cairo University for his help in setting up my experiments.

ACKNOWLEDGMENTS

First of all, we would like to express our thanks to Allah for his guidance also our parents who always stand beside us, support us and pray for us.

Second, we would like to express our deep gratitude to our esteemed faculties who have always been source of motivation and firm support throughout the project. It is us privilege to express our sincerest regards to our project supervisors, Dr. Ahmed Mustafa Hussein and Dr. Brahim Mohammed Mrabet, for their valuable inputs, able guidance, encouragement and whole-hearted cooperation throughout the duration of our project.

Finally, we express our sincere thanks to the Saudi - German manufacturer of solar cell company for their support either by providing us a solar module or by giving their experience in different parts throughout this project.

3.8 Table of Contents

The table of contents must begin on a new page. The page is provided with a heading, such as “Contents” or “Table of Contents”, followed by a list of the three main levels of headings and their page numbers. Journal papers do not have a table of contents.

The first item in the table of contents should be the first heading that appears after the table of contents, for example List of Figures. Front matter that precedes the table of contents are not listed. Appendices must be listed, each with their title and starting page.

TABLE OF CONTENTS

Acknowledgements.....	vi
List of Figures.....	viii
List of Tables.....	x
Chapters	
1. INTRODUCTION.....	1
1.1 Basics Of Solar Cells.....	3
1.2 Physics Of Solar Cells.....	7
1.3 Solar Array's.....	10
2. CHARACTERISTICS OF A PV MODULE.....	12
2.1 Types Of Solar Panels.....	12
2.2 Electrical Connections Of The Modules.....	15

3.9 List of Tables and List of Figures

These lists, arranged according to the table and figure number, each begin on a new page and indicate the relevant page number in the right-hand column. The titles of tables and figures must be descriptive enough so that a specific figure or table can be identified in the list and must correspond to the title used for the figure or table in the text.

List of Figures		
Figure No.	Title	Page
1.1	Applications of solar LED lighting system	3
1.2	Block Diagram Solar LED Street Lighting System	4
1.3	Solar LED Street Light structure	5
2.1	Photoelectric effect	8
2.2	Silicon crystal lattice	8
2.3	Solar radiation paths.	9
2.4	Definition of AM.	10
2.5	Illustration of AM1.5 path for a surface at 37° tilt.	10

3.10 Nomenclature

The list of symbols that are used must begin on a new page. The list is arranged in the following sequence: All the ordinary symbols are listed first, followed by the superscripts and then the subscripts. Finally, the auxiliary symbols, for example overbar and underscore for vectors and averages or accent marks for time-dependent components, are listed. The following order must be used within each of these groups:

First, all the Roman letters (in alphabetical order, with the capital letter of each symbol before the small letter, for example “A” followed by “a”, followed by “B”); Then all the Greek symbols (in the order of the Greek alphabet, capital letters before small letters);

A consistent set of symbols should be used (for example do not use V , C and W for velocity, unless there is a consistent difference, such as V for relative flow velocity, C for absolute flow velocity and W for blade velocity). If equations are taken from sources that use other symbols, the symbols should be “translated” into the set that has been selected for the report.

3.11 Introduction

The introductory chapter should provide the reader with the following information:

- The context in which the report originated, how it links to or differs from preceding or related work, the limitations that were placed on the work.
- The purpose of the report.
- The motivation for the work or report, that is, why the work was undertaken.

The introduction also contains a general overview of previous work in the field and definitions of words or expressions that have a specific meaning in the document. This what is called **literature review**. Literature is used to list the textbooks and journal articles related to the report topic, it can also include official publications such as engineering standards and government reports.

Example:

Introduction: Over one billion people in developing countries do not have access to electricity [1]. Indoor lighting, where available, is therefore usually provided by kerosene lamps or candles, which are expensive and can emit dangerous gases such as carbon monoxide and sulphur dioxide [2]. Even when available, the light they produce is not sufficient to read by. Many children in developing countries are therefore unable to study outside of daylight hours, which negatively affects their potential to succeed at school. To address this problem, an inexpensive, reliable, clean and safe source of reading light has been developed. The portable LED desk lamp presented here ...

3.12 Conclusions

The conclusion of a report must be related to, and resulting from, the material which appears in the report. It must not introduce any new material. Quite often present tense is used. For example: “*the cement tested in this project is a good candidate for the dense-phase mode of pneumatic transportation*”.

Conclusions are quite often read by managers before the main text of the report and hence, should summarize the main points clearly. This section also may include:

- Aim(s) and objective(s) of the report,
- application(s) of results,
- limitations and advantages of the findings,
- judgement/evaluation of the author(s).

Conclusion

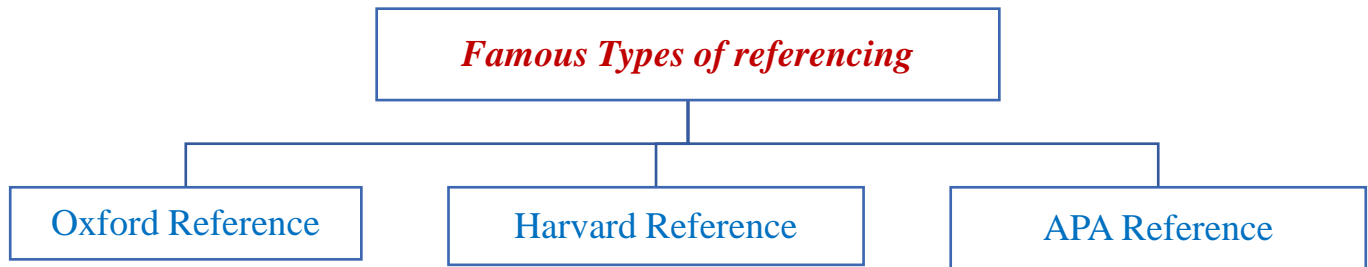
A simple but effective approach is presented for extracting unknown parameters of PV modules using the single-diode model based on three remarkable points provided in the manufacturer's datasheet. This is achieved by formulating a closed-form expression as a function of module series resistance and solving numerically while increasing the value of the ideality factor (a) in small increments. The effectiveness of the formulation presented in the study is demonstrated by comparing the results alongside those from reference characteristics provided by manufacturers of the BP SX-150 and MSX-60 PV modules. The results show a close correlation in terms of the unknown parameters. Moreover, compared with similar computations in the literature, the computation results from our study for both PV modules produced better outcomes.

The conclusion does NOT:

- provide background information on the topic
- explain the motivation for the project
- refer to figures, tables or references contained in the report.

3.13 Referencing

In-text citations are used throughout the report to acknowledge the sources of information. The full references for the citations are then listed at the end of the report in the Reference list.



Oxford Reference

Source	Example
Book: print	Simons, N. E., Menzies, B. & Matthews, M., A Short Course in Soil and Rock Slope Engineering, London, Thomas Telford Publishing, 2001.
Book: online/electronic	Simons, N. E., Menzies, B. & Matthews, M., A Short Course in Soil and Rock Slope Engineering, [Online] London, 2001, Thomas Telford Publishing. Available from: http://www.mylibrary.com?ID=93941 [Accessed 18th June 2008].
Book: chapter in an edited book	Partridge, H. & Hallam, G., Evidence-based practice and information literacy, In: Lipu, S., Williamson, K. & Lloyd, A. 2007, (eds.) Exploring methods in information literacy research. Wagga Wagga, Australia, Centre for Information Studies, pp. 149-170.
Journal article: print	Chhibber, P. K. and Majumdar, S. K., "Foreign ownership and profitability: Property rights, control, and the performance of firms in Indian industry", Journal of Law & Economics, 2001, 42 (1), 209-238.
Journal article: online/electronic	Wang, F., Maidment, G., Missenden, J. and Tozer, R., "The novel use of phase change materials in refrigeration plant. Part 1: Experimental investigation", Applied Thermal Engineering, 2007, [Online] 27 (17-18), 2893-2901, Available from: doi:10.1016/j.applthermaleng.2005.06.011 [Accessed 15th July 2008].
Conference proceeding: individual paper	Van Cotthem, A., Charlier, R., Thimus, J.-F. and Tshibangu, J.-P., "Multiphysics coupling and long term behaviour in rock mechanics", Proceedings of the International Symposium of the International Society for Rock Mechanics, EUROCK 2006, 9-12 May 2006, Liège, Belgium. London, Taylor & Francis. pp. 211-216.
Report	Leatherwood, S., "Whales, dolphins, and porpoises of the western North Atlantic", U.S. Dept. of Commerce. Report number: 63, 2001.
Lecture / Presentation	Wagner, G, Structural and functional studies of protein interactions in gene expression, [Lecture] Imperial College London, 12th December, 2006.

Harvard Reference

Source	Example
Book: print	Simons, N. E., Menzies, B. & Matthews, M. (2001) A Short Course in Soil and Rock Slope Engineering. London, Thomas Telford Publishing.
Book: online/electronic	Simons, N. E., Menzies, B. & Matthews, M. (2001) A Short Course in Soil and Rock Slope Engineering. [Online] London, Thomas Telford Publishing. Available from: http://www.mylibrary.com?ID=93941 [Accessed 18th June 2008].
Book: chapter in an edited book	Partridge, H. & Hallam, G. (2007) Evidence-based practice and information literacy. In: Lipu, S., Williamson, K. & Lloyd, A. (eds.) Exploring methods in information literacy research. Wagga Wagga, Australia, Centre for Information Studies, pp. 149-170.
Journal article: print	Chhibber, P. K. & Majumdar, S. K. (1999) Foreign ownership and profitability: Property rights, control, and the performance of firms in Indian industry. <i>Journal of Law & Economics</i> , 42 (1), 209-238.
Journal article: online/electronic	Wang, F., Maidment, G., Missenden, J. & Tozer, R. (2007) The novel use of phase change materials in refrigeration plant. Part 1: Experimental investigation. <i>Applied Thermal Engineering</i> . [Online] 27 (17-18), 2893-2901. Available from: doi:10.1016/j.applthermaleng.2005.06.011 [Accessed 15th July 2008].
Conference proceeding: individual paper	Van Cotthem, A., Charlier, R., Thimus, J.-F. and Tshibangu, J.-P. (eds.) Eurock 2006: Multiphysics coupling and long term behaviour in rock mechanics: Proceedings of the International Symposium of the International Society for Rock Mechanics, EUROCK 2006, 9-12 May 2006, Liège, Belgium. London, Taylor & Francis. pp. 211-216.
Report	Leatherwood, S. (2001) Whales, dolphins, and porpoises of the western North Atlantic. U.S. Dept. of Commerce. Report number: 63.
Lecture / Presentation	Wagner, G. (2006) Structural and functional studies of protein interactions in gene expression. [Lecture] Imperial College London, 12th December.

APA (American Psychological Association) Reference

Source	Example
Book	Dancey, C. P., & Reidy, J. (2004). <i>Statistics without maths for psychology: Using SPSS for Windows</i> (3rd ed.). Harlow, England: Pearson/Prentice Hall.
Book chapter in edited book	Kestly, T. (2010). Group sandplay in elementary schools. In A. A. Drewes & C. E. Shaefer (Eds.), <i>School-based play therapy</i> (2nd ed., pp. 257-282). Hoboken, NJ: John Wiley & Sons.
Electronic book (eBook)	Nydegger, R. (2018). <i>Clocking in: The psychology of work</i> . Retrieved from https://ebookcentral.proquest.com
Course handout/ Lecture notes (electronic version)	Archard, S., Merry, R., & Nicholson, C. (2011). <i>Karakia and waiata</i> [Powerpoint slides]. Retrieved from TEPS757-11B (NET): Communities of Learners website: http://elearn.waikato.ac.nz/mod/resource/view.php?id=174650
Journal article (academic/scholarly) with DOI	Cavenagh, N., & Ramadurai, R. (2017). On the distances between Latin squares and the smallest defining set size. <i>Journal of Combinatorial Designs</i> , 25(4), 147–158. https://doi.org/10.1002/jcd.21529
Journal article with no DOI	Germann, F., Ebbes, P., & Grewal, R. (2015). The chief marketing officer matters! <i>Journal of Marketing</i> , 79(3), 1-22.

DOI (Digital Object identifier).

Example:

1560

IEEE TRANSACTIONS ON POWER SYSTEMS, VOL. 27, NO. 3, AUGUST 2012

Modeling of a Centralized Microgrid Protection System and Distributed Energy Resources According to IEC 61850-7-420

Taha Selim Ustun, Cagil Ozansoy, and Aladin Zayegh

Oxford Reference:

[1] Taha Selim Ustun, Cagil Ozansoy, and Aladin Zayegh, “Modeling of a Centralized Microgrid Protection System and Distributed Energy Resources According to IEC 61850-7-420”, IEEE Transactions on Power Systems, 2012, 27 (3), 1560-1565.

Harvard Reference:

[2] Taha Selim Ustun, Cagil Ozansoy, and Aladin Zayegh, (2012) Modeling of a Centralized Microgrid Protection System and Distributed Energy Resources According to IEC 61850-7-420, IEEE Transactions on Power Systems, 27 (3), 1560-1565.

APA Reference:

[3] Taha Selim Ustun, Cagil Ozansoy, and Aladin Zayegh, (2012). Modeling of a Centralized Microgrid Protection System and Distributed Energy Resources According to IEC 61850-7-420., *IEEE Transactions on Power Systems*, 27 (3), 1560-1565.

Example:

There are 3 authors (Lee Beveridge, Wigner Jordan, and Qamber Miller) published 12-page article in IEEE Transaction on Electronic Devices journal in December 2021, volume 46, number 3. The article is titled: “Theory of traveling wave optical laser”. The starting page number of the printed article is 641. Write the citation of that article according to:

- a) Oxford Reference format,
- b) Harvard Reference format,
- c) APA Reference format.

a) According to Oxford reference format:

Beveridge, L., Jordan, W., and Miller, Q., “Theory of traveling wave optical laser”, IEEE Transaction on Electronic Devices, December 2021, 46 (3), 641-652.

b) According to Harvard reference format:

Beveridge, L., Jordan, W., and Miller, Q., (December 2021) Theory of traveling wave optical laser. IEEE Transaction on Electronic Devices, 46 (3), 641-652.

c) According to APA reference format:

Beveridge, L., Jordan, W., and Miller, Q. (December 2021). Theory of traveling wave optical laser. *IEEE Transaction on Electronic Devices*, 46 (3), 641-652.

3.14 Appendix

Explanatory material that would interfere with the logical continuity.

Supporting material not critical and may be of interest only to a few readers.

Supplementary calculations; detailed derivations; datasheets; charts, maps, graphs as additional information; detailed experimental results; description of equipment; description of software tool; Each item must have an identifying tag and a title.

- each appendix must be labelled with a number (or letter) and title
- the appendix numbers and titles must be listed on the Contents page under the heading Appendices (if more than one) or Appendix (if only one)
- each appendix must be referred to by number (or letter) at the relevant point in the text.

4. Format of pages

4.1 Paper and Margins

A4 paper is appropriate, and printing on one side only is often preferred for assessment purposes.

Wide margins are recommended; for example, allowing 2.5 cm on all sides. Bound reports have a left-hand margin of at least 3.5 cm, and 1.5 cm on the other three sides.

4.1.1 Page numbering

The title page should not be numbered. All other pages may be numbered either in the right-hand upper corner, or in the center at the bottom of the page. Roman numerals — i, ii, iii, iv etc. — are usually used to number the preliminary pages.

Arabic numerals — 1, 2, 3, 4 etc. — are used to number the main text. Pages in the Appendices can be numbered internally, according to the letter of the individual appendix

and the number of pages within each appendix — A1, A2, B1, C1, C2, C3 etc. (where Appendix A has two pages; Appendix B has one page, and so on).

4.1.2 Headers and Footers

Headers or footers position page numbers automatically. Two different headers or footers must be created so that the preliminary pages are numbered separately from the text of the report. Student name and ID number can appear in a footer in 9-point size.

Font

A Times New Romans is usually chosen for the text of a report. A different font (such as Arial) may be used for headings and tables. The same font should be used throughout the whole report, unless a second font is chosen for headings and tables.

6 Size and style of type

12-point type is the normal size for the text of a report. 10-point may be used for figures and tables.

First-level	16 bold	6 Environmental Impact
Second-level	14 bold	6.1 Chemical Waste
Third-level	12 bold	6.1.1 Cost Analysis
Fourth-level	12 bold italics	<i>6.1.1.1 Equipment Costs</i>

Headings without text should never appear on the bottom line of a page.

Technical reports use headings to divide information into sections. The headings help reader locate relevant information quickly.

Capital letters are used for the first letter of the first word in each heading only; except for any acronyms (e.g. IEEE), trade names, or personal names and places, which may require more than one capital.

Format of text :Justification

Text must be justified (right and left margins).

Line spacing

- 1.5 line spacing is generally used for work submitted for assessment.
- extra line spacing should be used in the following cases:
 - to separate paragraphs
 - to separate figures, tables, equations, and long quotations from the text
 - to separate a main heading from the section of text which comes before

Indentation and centering

- Indenting text at the beginning of a paragraph is necessary. But if an extra line space is inserted between paragraphs, no need for the indentation.
- indentation is appropriate for lists with bullet points (•)
- figures and tables may be centered in the text

Figures and Tables

Figures include diagrams, graphs, sketches, photographs, and maps

Tables summarize data in rows and columns; a dash (—) indicates no data

All figures and tables may be centered

All figures and tables should be labelled in bold with the appropriate consecutive number, (figures are generally labelled at the bottom, and tables at the top)

All figures and tables must be referred to in the text (e.g. ‘see Figure 14’); avoid using words such as ‘Figure above’ or ‘Table below’

Figures and tables can be separated from the text with extra line spacing.

Example:

The single-diode model, shown in Fig. 1, has become the most widely used model as it offers a good compromise between simplicity and accuracy [1,2].

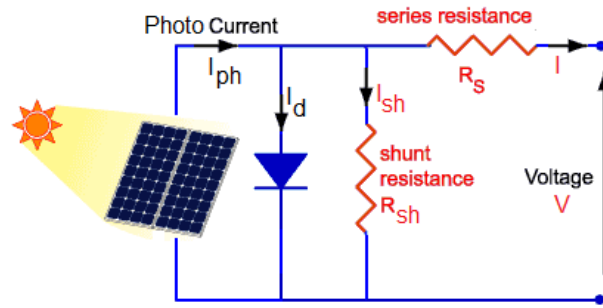


Fig. 1. Single-diode equivalent circuit for PV module

Two examples of such module are BP SX-150 and MSX-60 modules whose basic information are presented in Table 1. More details about these two PV modules are provided by manufacturer websites.

Table 1: Electrical characteristics of BP SX-150 and MSX-60 PV modules at STC

Parameters	Datasheet Value	
	BP SX-150	MSX-60
Maximum Power (P_{max})	150 W	60 W
Voltage at MPP (V_{mp})	34.5 V	16.8 V
Current at MPP (I_{mp})	4.35 A	3.56 A
Short-circuit current (I_{sc})	4.75 A	3.87 A
Open-circuit voltage (V_{oc})	43.5 V	21.0 V
Temperature coefficient of I_{sc}	$(0.065 \pm 0.015) \% / ^\circ\text{C}$	$(0.065 \pm 0.015) \% / ^\circ\text{C}$
Temperature coefficient of V_{oc}	$-(160 \pm 20) \text{ mV} / ^\circ\text{C}$	$-(80 \pm 10) \text{ mV} / ^\circ\text{C}$
Series-connected cells (N_s)	72	36

Equations:

All equations must be centered and numbered,

All equations must be referred to in the text (e.g. ‘as explained by eqn. (1)’); avoid using words such as ‘equation above’.

Example:

The current (I) and voltage (V) in the single-diode model are related as defined by eqn. (1).

$$I = I_{ph} - I_o \left[\exp\left(\frac{V + IR_s}{V_T}\right) - 1 \right] - \frac{V + IR_s}{R_{sh}} \quad (1)$$

Active or passive voice

Example 1: “We therefore decided that...”.

This sentence is written in the **active** voice. It has a subject who performed the verb: “**We** decided...”.

Example 2: “The pipe was cut...”

This is written in the **passive** voice. It does not specify who performed the verb: we don’t know who cut the pipe.

The convention of using the passive voice when writing about method is to avoid:

- beginning every sentence with “I” or “We”, which would sound repetitive
- focusing on *who* did the work rather than *what* they did, which is more important.

Therefore, it is recommended to use of the passive voice in academic writing. Nevertheless, it is still best to avoid overuse of “I” or “we” when describing what you did, for the reasons given above.

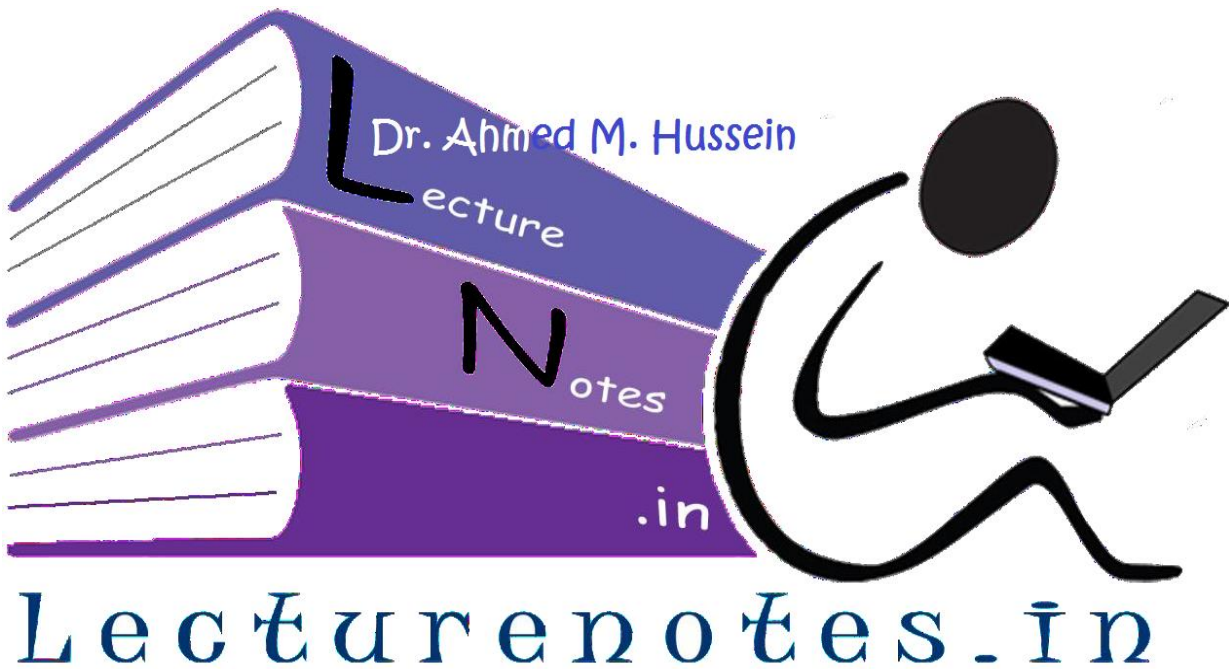
Uses of ‘we’

You may have been told not to use “I” or “we” in your reports; however, there are two cases in academic writing when ‘we’ is quite acceptable.

Consider the examples below:

The number of animal extinctions is rapidly increasing worldwide. In Australia, we have now lost 54 species, with another 457 classified endangered or vulnerable (Commonwealth of Australia, 2018).

In this case, “we” means ‘we Australians’ and refers to our society. It could also refer to human beings in general.



Lecture # 8 and #9

Graphical Representation of Data

Data are individual facts, statistics, or items of information, often numeric. In a more technical sense, data are a set of values of qualitative or quantitative variables about one or more persons or objects, while a **datum** (singular of *data*) is a single value of a single variable.

1. Meaning of data

If you recorded the minimum and maximum temperature of a city, rainfall, time of sunrise and sunset of certain location, attendance of students in certain course, all these are considered as data.

As an example of data, the number of students registered in GEN201 course is recorded in Table 1.

Table 1: Number of students registered in GEN201 course

Program	Students
CCE	125
EEC	11
CSM	40
ESE	27
IND	55

The complete set of information given in Table 1 is called a **population**. Each of the elements is called a **piece of data**.

2. Presentation of Data in Sequence

The simplest way to organize a set of data is to present the data in a sequence. This makes it easy to comprehend and interpret. For example, let us consider the height (cm) of **15** children as shown below:

Height: 142,156,139,148,150,149,148,144,150,152,148,149,147,141 and 145.

Little can be said about the height of the children from these numbers. Even if you try, you will find yourself re-arranging them in some way. For example, you may be looking for the minimum and the maximum figures or the number that is most frequent. If you arrange these heights in a sequence from lowest to highest.

Height: 139,141,142,144,145,147,148,148,148,149,149,150,150,152 and 156.

Now, one can say that the height of the children varies from **139** cm to **156** cm; there are 3 children having the same height of **148** cm and the number of children having height below **148** cm and having height above **148** cm is the same.

Data can be arranged in two ways. One, from lowest to highest referred to as the ascending order, and the other, from highest to lowest referred to as the descending order of presentation.

Check your progress

Problem #1

Arrange the marks of 20 students in GEN201 course and answer the following questions:

65, 48, 39, 57, 70, 49, 33, 72, 61, 42, 38, 66, 75, 57, 45, 59, 60, 47, 55, 68

How many students have scored 60 and above?

How many students have scored below 50?

What are the minimum and maximum scores?

3. Presentation of Data in Classes

To interpret large data, even if it is arranged in sequence, the data are organized into groups called classes and presented in a table which gives the frequency in each group. Such a frequency table gives a better overall view of the distribution of data and enables a person to rapidly comprehend important characteristics of the data.

For example, a test - out of 50 marks - is recorded for a course of 40 students and the marks are as listed below.

35, 40, 22, 32, 41, 18, 20, 40, 36, 29, 24, 28, 28, 31, 39, 37, 27, 29, 40, 35, 38, 30, 45, 26, 20, 25, 32, 31, 42, 28, 33, 32, 29, 26, 48, 32, 16, 46, 18, 44.
--

We notice that the marks ranged from 16 to 48.

Considering the class length is 5, therefore we need $\frac{48-16}{5} = 6.4 = 7$ groups

The seven groups are given in Table 2.

Table 2: The seven groups representing data

Marks	No. of Students
45 – 49	3
40 – 44	6
35 – 39	6
30 – 34	8
25 – 29	10
20 – 24	4
15 – 19	3
Total	40

From Table 2, we can easily comprehend the distribution of marks e.g. 10 students have scores from 25 to 29, while only 7 students have a score lower than 50% etc.

4. Graphical Representation of Data

We use graphics to understand the problem under investigation. Pictures can convey an overall message much better than a list of numbers. In this section we describe some graphical presentations of data.

4.1 Dot Plot

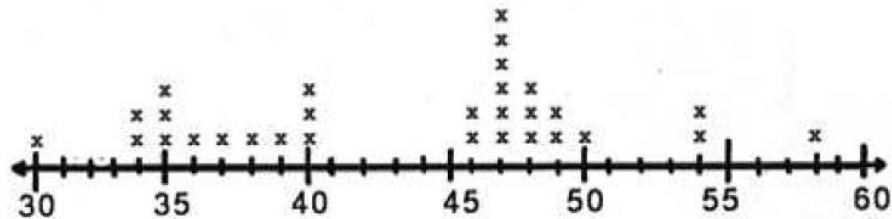
Dot plot is a graphical representation of numerical data. A dot plot is a number line with x's placed above specific numbers to show their frequency. By the frequency of a number, we mean the number of occurrence of that number.

Example:

Suppose thirty people live in an apartment building with the following ages:

58 30 37 36 34 49 35 40 47 47
39 54 47 48 54 50 35 40 38 47
48 34 40 46 49 47 35 48 47 46

Make a dot plot of the ages.



This graph shows all the ages of the people who live in the apartment building. It shows the youngest person is 30, and the oldest is 58. Most people in the building are over 46 years of age. The most common age is 47. Line plots allow several features of the data to become more obvious. For example, outliers, clusters, and gaps are realized.

- **Outliers** are data points whose values are significantly larger or smaller than other values, such as the ages of 30, and 58.
- **Clusters** are isolated groups of points, such as the ages of 46 through 50.
- **Gaps** are large spaces between points, such as 41 and 45.

Check your progress

Problem #2

Following are the ages of the 30 students at a High School who participated in activity. Draw a dot plot to represent these data.

10 10 11 10 13 8 10 13 14 9
14 13 10 14 11 9 13 10 11 12
11 12 14 13 12 8 13 14 9 14

Problem #3

The heights (in inches) of the players on a professional basketball team are

70, 72, 75, 77, 78, 78, 80, 81, 81, 82, and 83.

Make a dot plot of the heights.

Problem #4

Draw a Dot Plot for the following data set.

50 35 70 55 50 30 40

65 50 75 60 45 35 75

60 55 55 50 40 55 50

4.2 Stem and Leaf Plot

Another type of graph is the stem-and-leaf plot. It is closely related to the dot plot except that the number line is usually vertical, and digits are used instead of x's. To illustrate the method, consider the following scores which twenty students got in a GEN201 course:

69 84 52 93 61 74 79 65 88 63

57 64 67 72 74 55 82 61 68 77

We divide each data value into two parts. The left group is called a stem and the remaining group of digits on the right is called a leaf. We display horizontal rows of leaves attached to a vertical column of stems. we can construct the following table

5		2	7	5					
6		9	1	5	3	4	7	1	8
7		4	9	2	4	7			
8		4	8	2					
9		3							

where the stems are the ten digits of the scores and the leaves are the one digits.

If you are comparing two sets of data, you can use a back-to-back stem-and-leaf plot where the leaves of sets are listed on either side of the stem as shown in the table below.

									9	6	0	5	7										
							8	7	6	4	1	1											
8	8	7	6	5	5	3	2	2	2	2	2	2	5	6	7	8	8	9					
					9	9	6	4	4	3	2	3	1	2	3	4	4	4	5	6	7	8	9
									9	6	5	1	4	2	3	5	6	7	8	9	9		

where the stems represent the tens digits of both scores and the leaves represent the ones digits.

Check your progress

Problem #5

Given below the scores of a class of 26 fourth graders.

64 82 85 99 96 81 97 80 81 80 84 87 98

75 86 88 82 78 81 86 80 50 84 88 83 82

Make a stem-and-leaf plot of the scores.

Problem #6

Make a back-to-back stem-and-leaf plot for the following test scores:

Class 1:

100 96 93 92 92 92 90 90 89 89 85 82 79 75 74 73

73 73 70 69 68 68 65 61

Class 2:

79 85 56 79 84 64 44 57 69 85 65 81 73 51 61 67

71 89 69 77 82 75 89 92 74 70 75 88 46

1.3 Histogram

When we deal with large sets of data, a good overall picture and sufficient information can be often conveyed by distributing the data into several classes and to determine the number of elements belonging to each class, called class frequency. For instance, the following table shows some test scores of a course.

65 91 85 76 85 87 79 93 82 75 100 70 88 78 83 59
87 69 89 54 74 89 83 80 94 67 77 92 82 70 94 84
96 98 46 70 90 96 88 72

It's hard to get a feel for this data in this format because it is unorganized. To construct a frequency distribution,

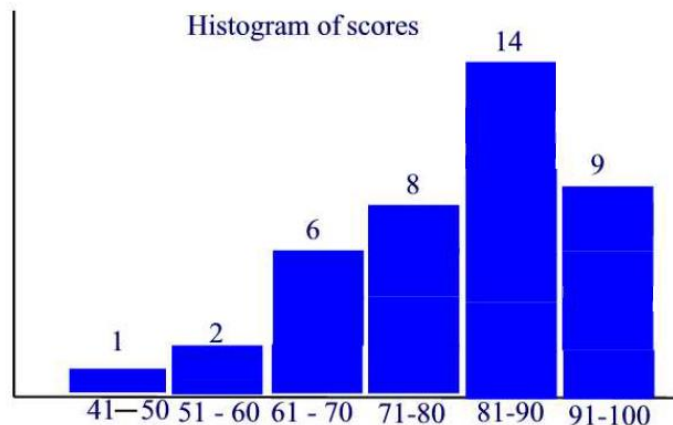
$$\text{Compute the class width } CW = \frac{\text{Largest data value} - \text{smallest data value}}{\text{Desirable number of classes}}$$

Round CW to the next highest whole number so that the classes cover the whole data.

Thus, if we want to have 6 class intervals, then $CW = (100 - 46) / 6 = 9$. The low number in each class is called the lower-class limit, and the high number is called the upper-class limit. With the above information we can construct the following table called frequency distribution.

Class	Frequency
41-50	1
51-60	2
61-70	6
71-80	8
81-90	14
91-100	9

Once frequency distributions are constructed, it is usually advisable to present them graphically. The most common form of graphical representation is the histogram.



Check your progress

Problem #7

Suppose a sample of 38 female university students was asked their weights in pounds, and the following results are recorded:

130 108 135 120 97 110 130 112 123 117 170 124
120 133 87 130 160 128 110 135 115 127 102 130
89 135 87 135 115 110 105 130 115 100 125 120 120 120

- Suppose we want 9 classes intervals. Find CW.
- Construct a frequency distribution.
- Construct the corresponding histogram.

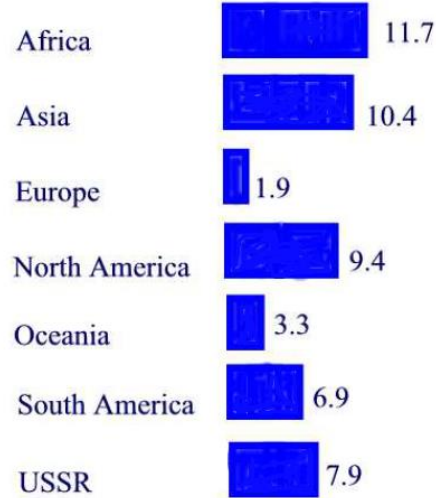
1.4 Bar Graph

Bar Graph is similar to histogram. It is often useful in conveying information about categorical data where the horizontal scale represents some nonnumerical attribute. The bars can be vertical or horizontal. The length of a bar represents the quantity we wish to compare.

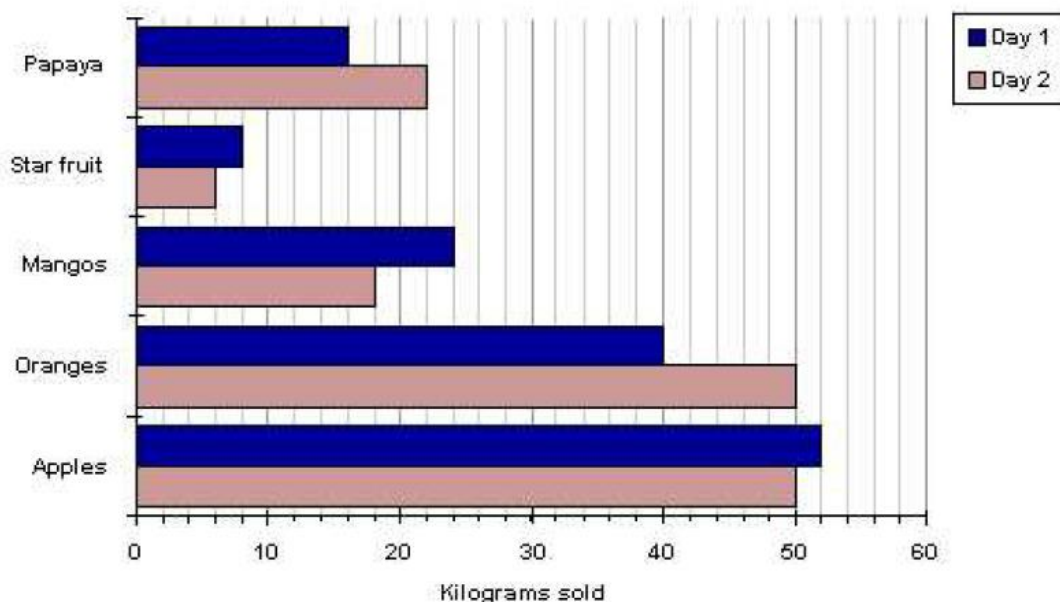
Example:

The areas of the various continents of the world (in millions of square miles) are:

11.7 for Africa; 10.4 for Asia; 1.9 for Europe; 9.4 for North America; 3.3 Oceania; 6.9 South America; 7.9 Soviet Union. Draw a bar chart representing the above data and where the bars are horizontal.



A double bar graph is similar to a regular bar graph, but gives 2 pieces of information for each item on the vertical axis, rather than just 1. The bar chart given below, shows the weight in kilograms of some fruit sold on two different days by a local market. This lets us compare the sales of each fruit over a 2-day period, not just the sales of one fruit compared to another. We can see that the sales of star fruit and apples stayed most nearly the same. The sales of oranges increased from day 1 to day 2 by 10 kilograms. The same amount of apples and oranges was sold on the second day.



Check your progress

Problem #8

Given are several gasoline vehicles and their fuel consumption averages.

Buick 27 mpg; BMW 28 mpg; Honda Civic 35 mpg; Geo 46 mpg

Neon 38 mpg; Land Rover 16 mpg

Draw a *vertical* bar graph to represent these data.

Problem #9

The figures for total population at decade intervals since 1959 are given below:

Year	Total UK Resident Population
1959	51,956,000
1969	55,461,000
1979	56,240,000
1989	57,365,000
1999	59,501,000

Construct a *horizontal* bar chart for this data.

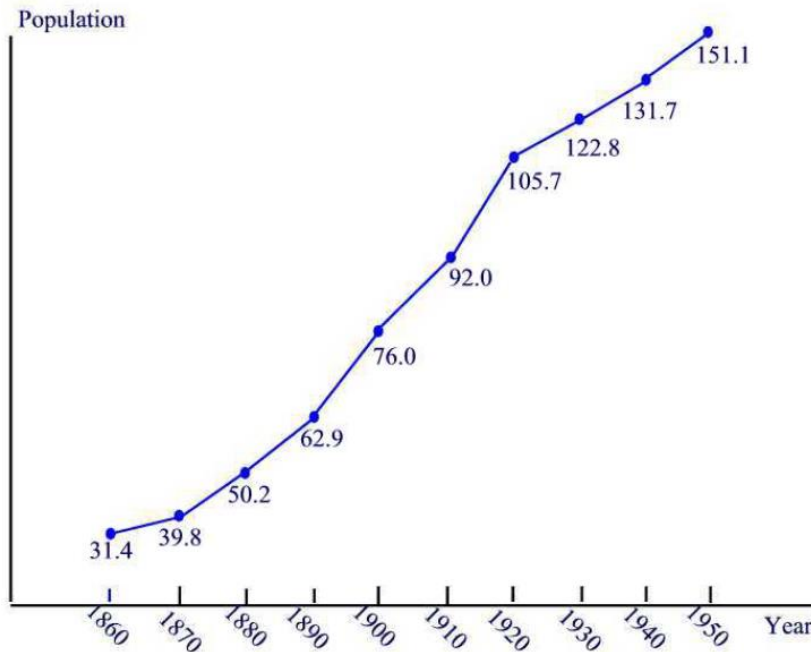
1.5 Line Graph

A Line graph is particularly appropriate for representing data that vary continuously. A line graph typically shows the trend of a variable over time. To construct a line plot, we put time on the horizontal scale and the variable being measured on the vertical scale and then we connect the points using line segments.

Example:

The population (in millions) of the US for the years 1860-1950 is as follows:

31.4 in 1860; 39.8 in 1870; 50.2 in 1880; 62.9 in 1890; 76.0 in 1900; 92.0 in 1910; 105.7 in 1920; 122.8 in 1930; 131.7 in 1940; and 151.1 in 1950. Make a line plot showing this information.



1.6 Pie Chart

A circle graph or pie chart, consists of a circular region partitioned into disjoint sections, with each section representing a part or percentage of a whole. To construct a pie chart we first convert the distribution into a percentage distribution. Then, since a complete circle corresponds to 360 degrees, we obtain the central angles of the various sectors by multiplying the percentages by 3.6. We illustrate this method in the next example.

Example:

A survey of 1000 adults uncovered some interesting housekeeping secrets. When unexpected company comes, where do we hide the mess? The survey showed that 68% of the respondents toss their mess in the closet, 23% shove things under the bed, 6% put things in the bathtub, and 3% put the mess in the freezer. Make a circle graph to display this information.

We first find the central angle corresponding to each case:

in closet $68 \times 3.6 = 244.8$

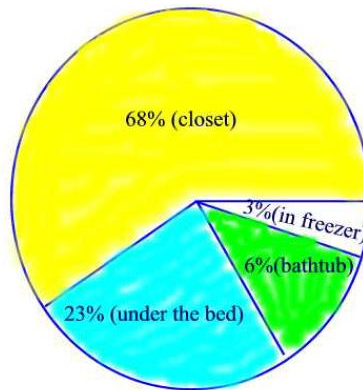
under bed $23 \times 3.6 = 82.8$

in bathtub $6 \times 3.6 = 21.6$

in freezer $3 \times 3.6 = 10.8$

Note that

$244.8 + 82.8 + 21.6 + 10.8 = 360.$



Check your progress

Problem #10

The following data represents a survey of people's favorite ice cream flavor

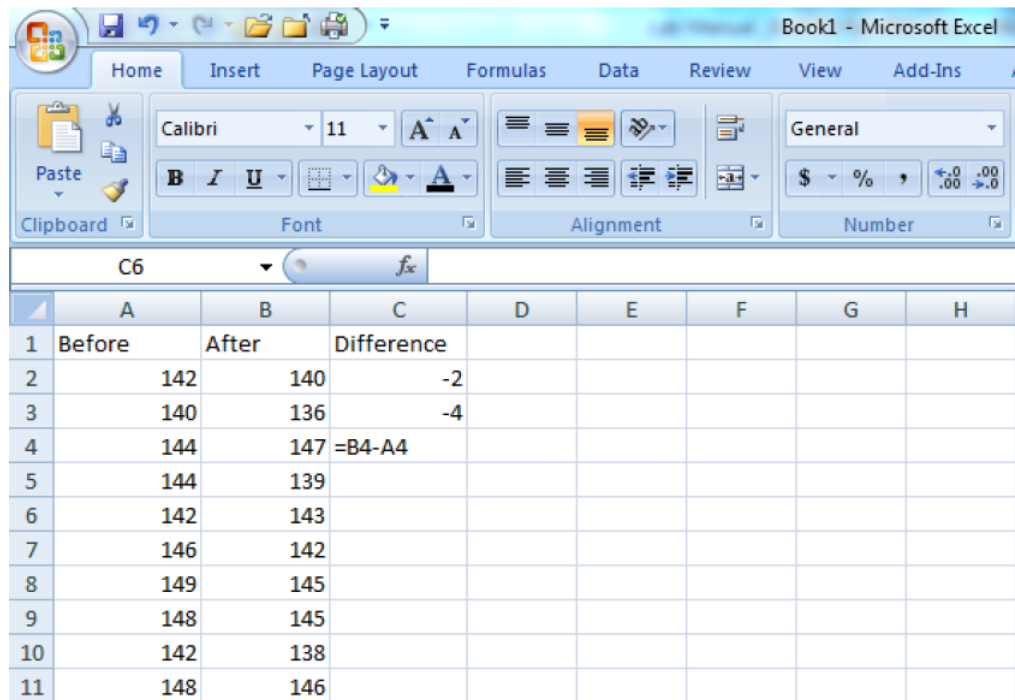
Flavor	Number of people
Vanilla	21.0%
Chocolate	33.0%
Strawberry	12.0%
Raspberry	4.0%
Peach	7.0%
Neapolitan	17.0%
Other	6.0%

Plot a pie chart to representing the data.

5. Data Analysis and Graphing in Excel

5.1 How to Enter Data in Excel

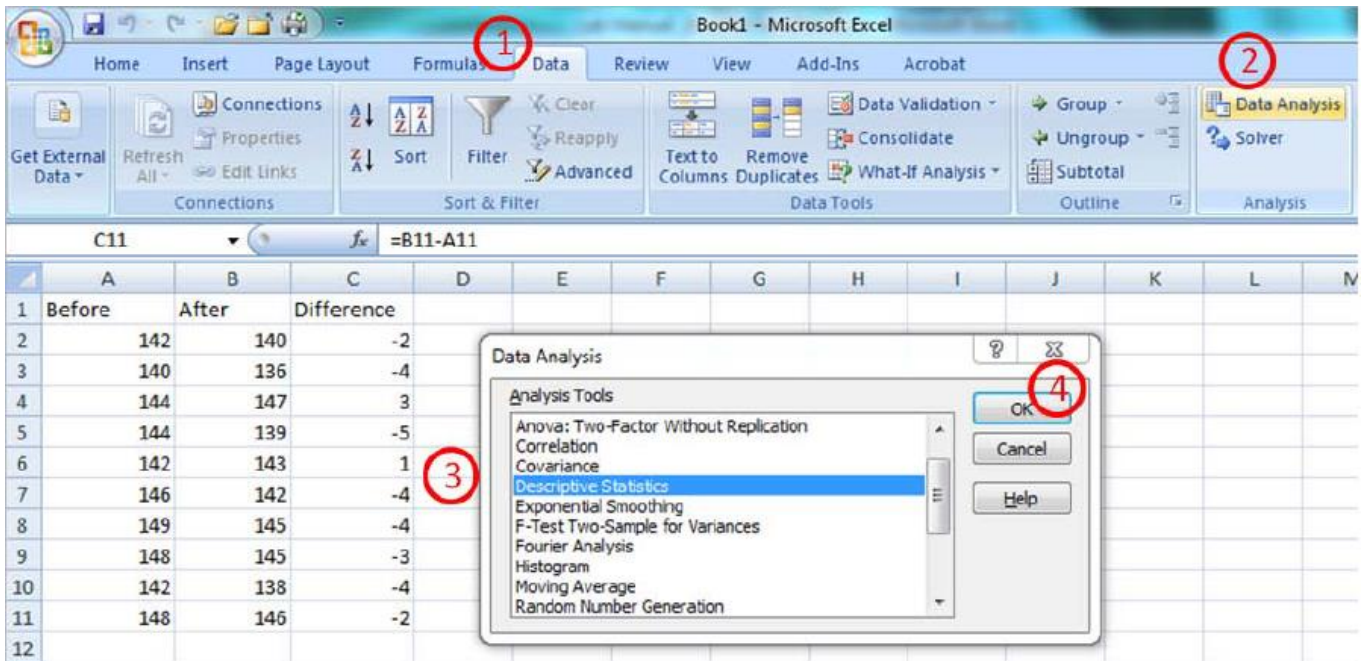
1. Open an excel worksheet
2. In the first row, label column A, column B, and column C
3. Enter raw data into the columns A and B
4. In the column C, enter a function (equation or formula starts with “ = ” symbol) to tell Excel to subtract the values in columns A and B, as shown in figure below.



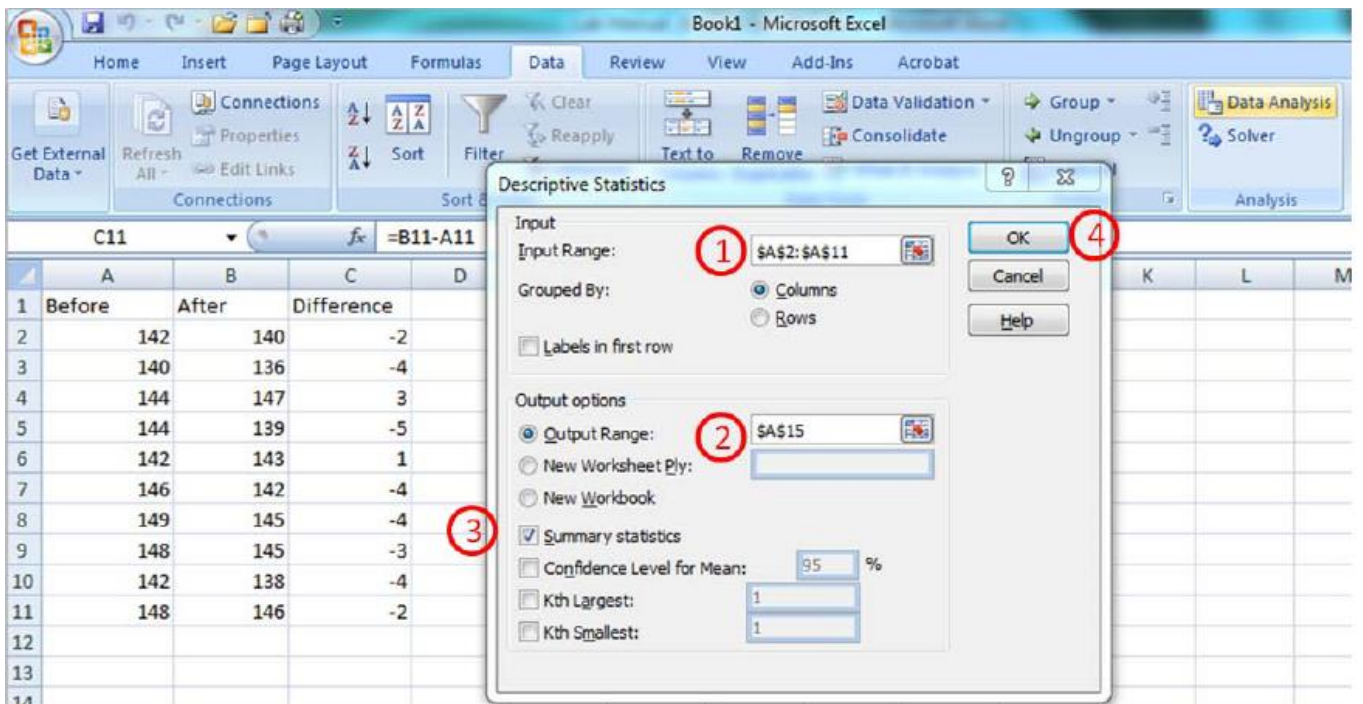
	A	B	C	D	E	F	G	H
1	Before	After	Difference					
2	142	140	-2					
3	140	136	-4					
4	144	147	=B4-A4					
5	144	139						
6	142	143						
7	146	142						
8	149	145						
9	148	145						
10	142	138						
11	148	146						

5.2 How to Calculate Summary Statistics in Excel

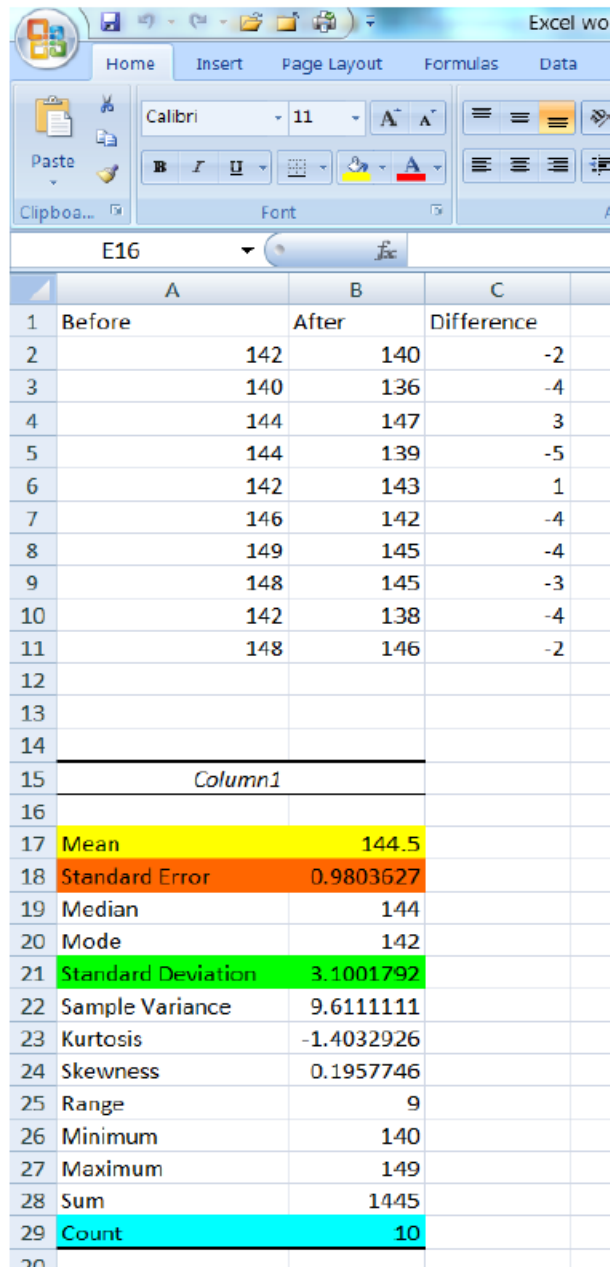
Open the worksheet with your data. Select the “Data” tab ①, then “Data Analysis” ②, then from the list choose “Descriptive Statistics” ③ and select “OK” ④.



From here, with your cursor in the Input Range ¹, select your data in column A. Then put your cursor in the Output Range block ² and select an empty cell in work sheet. Click the box labeled “Summary Statistics” ³ so a check mark appears, then select “OK” ⁴.



Excel will now show you the summary statistics. we have added highlights to show the mean, standard deviation, standard error, and sample size which are the summary statistics that you will most commonly use for your reports.



	A	B	C
1	Before	After	Difference
2		142	140
3		140	136
4		144	147
5		144	139
6		142	143
7		146	142
8		149	145
9		148	145
10		142	138
11		148	146
12			
13			
14			
15	<i>Column1</i>		
16			
17	Mean	144.5	
18	Standard Error	0.9803627	
19	Median	144	
20	Mode	142	
21	Standard Deviation	3.1001792	
22	Sample Variance	9.6111111	
23	Kurtosis	-1.4032926	
24	Skewness	0.1957746	
25	Range	9	
26	Minimum	140	
27	Maximum	149	
28	Sum	1445	
29	Count	10	

5.3 How to Graph Data in Excel

To create a chart:

- Select the data to appear to appear in the chart (with labels if relevant)
- Use the Insert tab and Charts Group and click on the relevant chart in this group.

The main types of charts used in analysis of data are:

- Column chart: for comparing data across categories
- Pie Chart: for showing the relative shares of categories in a total
- Line Chart: for showing trends in a series over time

Excel defaults usually lead to a chart that is reasonable but still needs customizing. The general approach is to note that the chart has several areas:

- Chart Title
- Plot Area
- The x-axis (for charts other than pie chart) and Labels
- The y-axis (for charts other than pie chart) and Labels
- Legend Entry (explains the symbols used in the chart)

To edit an existing chart, select the chart (click inside the chart and the border becomes highlighted). Then select within the chart that part of the chart you wish to change and right click to obtain the menu for reformatting the chart.

5.3.1 Bar (Column) Graph

As an example, consider categorical data on Health Care Expenditures in billion US dollars.

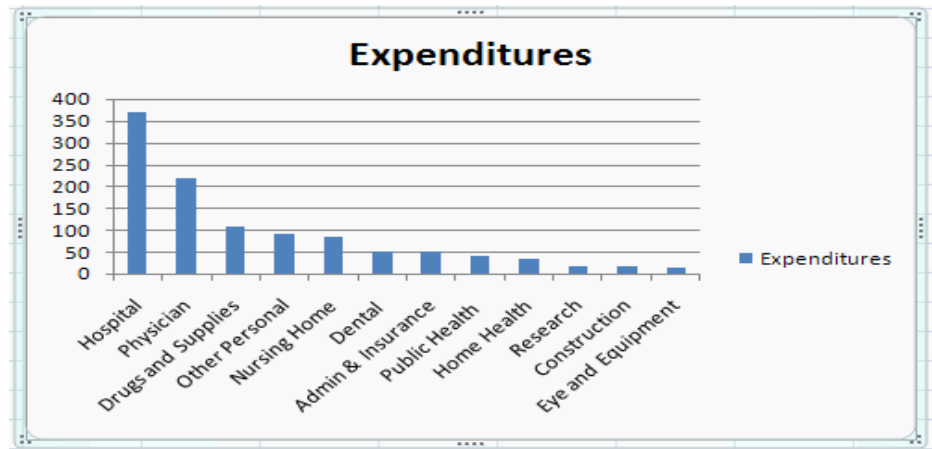
To create a **Bar chart** from these data

- Highlight the data and headings (here columns A1:B13)

- Select the Insert Tab and Charts group and click on Column Chart
- Select the first of the 2-D Column Charts (a clustered column chart).

This yields:

	A	B
1	Category	Expenditures
2	Hospital	371
3	Physician	218
4	Drugs and Supplies	109
5	Other Personal	92
6	Nursing Home	83
7	Dental	51
8	Admin & Insurance	50
9	Public Health	39
10	Home Health	32
11	Research	18
12	Construction	17
13	Eye and Equipment	14

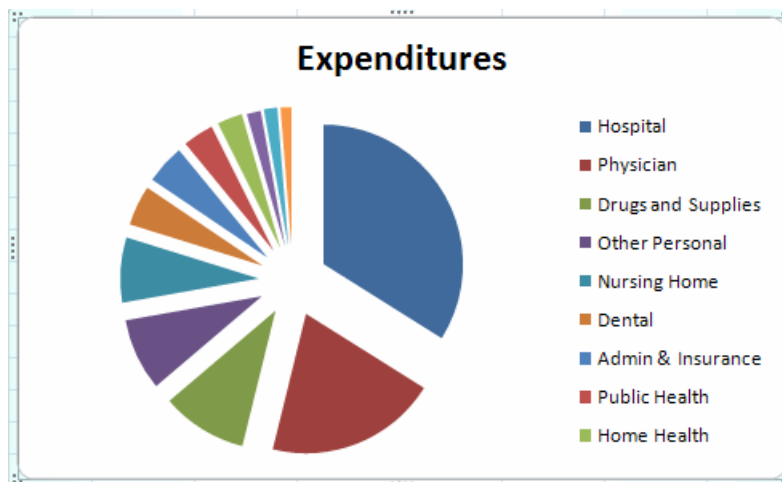


5.3.2 Pie Chart

To create a **pie chart** from the above

- Highlight the data and headings (here columns A1:B13)
- Select the Insert Tab and Charts group and click on Pie Chart
- Select the second of the 2-D Pie Charts (an exploded pie chart).

This yields:



6 Statistical Analysis of Data (Manual Calculation)

6.1 Mean and Median Values

The average value of a set of measurements of a constant quantity can be expressed as either the mean value or the median value. As the number of measurements increases, the mean and median values become so close to each other.

For any set of n measurements $x_1, x_2 \dots x_n$ of a constant quantity, the most likely true value is the mean which is given by:

$$\text{mean} = \bar{x} = \frac{x_1 + x_2 + x_3 + \dots + x_n}{n}$$

The median is the middle value when measurements in the data set are written down in ascending order of magnitude. If the total number of readings is **odd**, such as for a set of nine measurements $x_1, x_2 \dots x_9$ arranged in order of magnitude, the median value is x_5 . For an **even** number of measurements, the median value is midway between the

two center values, that is, for 10 measurements $x_1, x_2 \dots x_{10}$, the median value is given by $(x_5+x_6)/2$.

Example:

Suppose that the length of a steel bar is measured by several different observers and the following set of 11 measurements are recorded (in mm), this measurement set is considered set A.

(Measurement set A)

398 420 394 416 404 408 400 420 396 413 430

The mean value is calculated as:

$$\bar{x} = \frac{398 + 420 + 394 + 416 + 404 + 408 + 400 + 420 + 396 + 413 + 430}{11} = 409$$

To calculate the median, the 11 readings are arranged in ascending order

394 396 398 400 404 408 413 416 420 420 430

Median = 408 (the 6th reading)

Note: the difference between the min reading (394) and the max reading (430) is 36

Suppose now the measurements are taken again using a better measuring rule and with the observers taking more care to produce the following measurement set B:

(Measurement set B)

409 406 402 407 405 404 407 404 407 407 408

The mean value is calculated as:

$$\bar{x} = \frac{409 + 406 + 402 + 407 + 405 + 404 + 407 + 404 + 407 + 407 + 408}{11} = 406$$

To calculate the median, the 11 readings are arranged in ascending order

402 404 404 405 406 407 407 407 407 408 409

Median = 407 (the 6th reading)

Note: the difference between the min reading (402) and the max reading (409) is 7

Now the question is, which of the two measurement sets, A and B, and the corresponding mean and median values should we have the most confidence in? The answer is, we can regard measurement set B as being more reliable because the measurements are much closer together (the spread is only 6). In set A, the spread is 36. Thus, the smaller the spread of the measurements, the more confidence we have in the mean or median value calculated.

From another point of view, if the number of readings is increased, the mean and median values become very close to each other.

Let us now see what happens if we increase the number of measurements by extending measurement set B to 23 measurements. We will call this measurement set C.

**409 406 402 407 405 404 407 404 407 407 408 406 410 406 405 408 406 409 406 405
409 406 407**

The mean value is calculated as:

$$\bar{x} = \frac{409 + 406 + 402 + 407 + 405 + 404 + 407 + 404 + 407 + \dots + 407}{23} = 406.5$$

To calculate the median, the 23 readings are arranged in ascending order

**402 404 404 405 405 405 406 406 406 406 406 406 407 407
407 407 407 408 408 409 409 409 410**

Median = 406 (the 12th reading)

Note: the difference between the min reading (402) and the max reading (410) is 8

This confirms that the median value tends toward the mean value as the number of measurements increases.

6.2 Standard Deviation and Variance

Expressing the spread of measurements simply as a range between the largest and the smallest value is not the suitable way of examining how measurement values are distributed about the mean value. A much better way of expressing the distribution is to calculate the variance or standard deviation of the measurements. The data set with the smallest variance and standard deviation the most precise data set.

First, calculate the deviation (d_n) of each measurement x_n from the mean value \bar{x} in a set of measurements x_1, x_2, \dots, x_n :

$$\text{Deviation } (d_n) = x_n - \bar{x}$$

Variance (v) The degree to which the value varies about the mean value

$$v = \frac{(d_1)^2 + (d_2)^2 + (d_3)^2 + \dots + (d_n)^2}{n}$$

Standard deviation (σ)

$$\sigma = \sqrt{\text{variance}} = \sqrt{\frac{(d_1)^2 + (d_2)^2 + (d_3)^2 + \dots + (d_n)^2}{n}}$$

High values of v and σ means low precision (spreading of data)

Low values of v and σ means High precision (spreading of data)

Unfortunately, these formal definitions for the variance and standard deviation of data are made with respect to an infinite population of data values whereas, in all practical situations, we can only have a finite set of measurements. A better adjustment of the variance of the infinite population can be obtained by multiplying the above formula with Bessel correction factor ($n/n-1$):

$$v = \frac{(d_1)^2 + (d_2)^2 + (d_3)^2 + \dots + (d_n)^2}{n - 1}$$

$$\sigma = \sqrt{\text{variance}} = \sqrt{\frac{(d_1)^2 + (d_2)^2 + (d_3)^2 + \dots + (d_n)^2}{n - 1}}$$

If $n < 30$, we will use the above 2 equations

Example:

Calculate v and σ for measurement sets A, and B given in the previous example.

n	Set A						Set B					
	x_n	\bar{x}	d_n	d_n^2	v	σ	x_n	\bar{x}	d_n	d_n^2	v	σ
1	398	409	-11	121	137	11.7	409	406	3	9	4.2	2.05
2	420		11	121			406		0	0		
3	394		-15	225			402		-4	16		
4	416		7	49			407		1	1		
5	404		-5	25			405		-1	1		
6	408		-1	1			404		-2	4		
7	400		-9	81			407		1	1		
8	420		11	121			404		-3	9		
9	396		-13	169			407		1	1		
10	413		4	16			407		1	1		
11	430		21	441			408		2	4		

Thus, as the variance and the standard deviation decrease for a measurement set, we are able to express greater confidence that the calculated mean or median value is close to the true value, that is, that the averaging process has reduced the random error value close to zero. Based on the values of variance and the standard deviation, the data set (B) is more confident (precise) than data set (A).

Check your progress

Problem #11

A circuit was tuned for resonance by nine different students, and the following values for the resonant frequency of the circuit were recorded. Compute:

- The arithmetic mean,

- The mode,
- The median,
- The variance,
- The standard deviation,
- Check your answer using MS Excel (Give a screen shot of your Excel results)

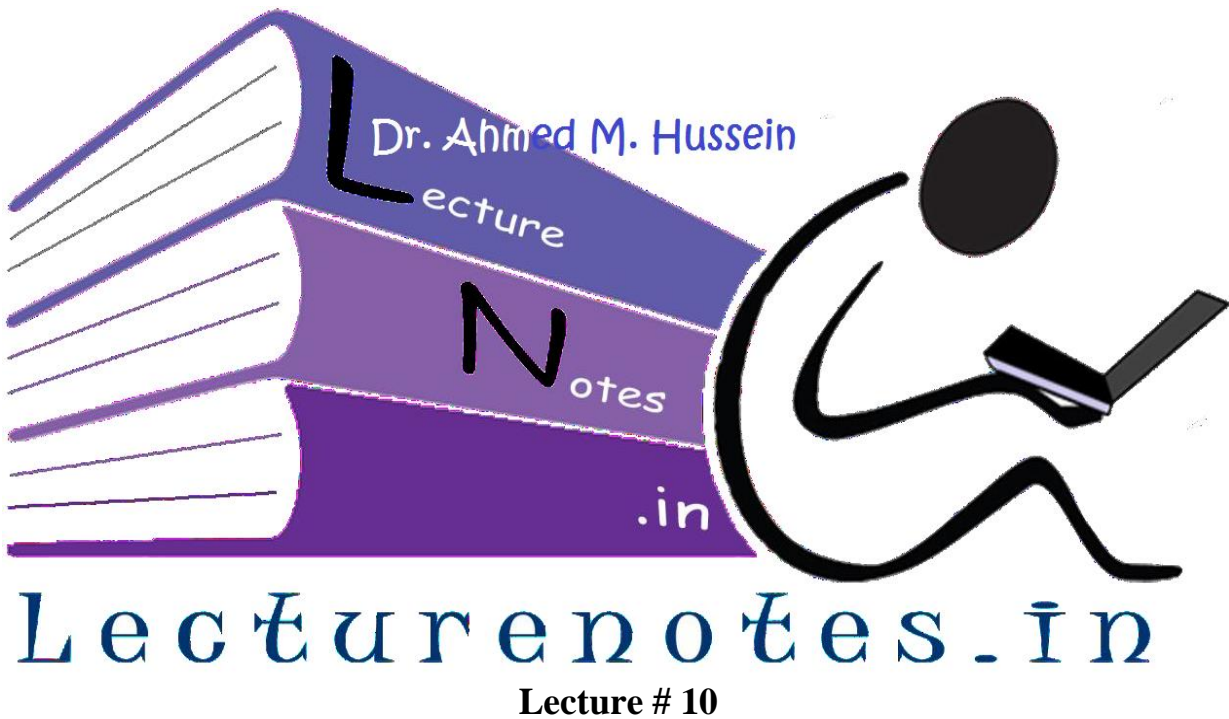
Reading #	Frequency (Hz)
1	532
2	548
3	543
4	535
5	546
6	531
7	543
8	532
9	540

Problem #12

Six determinations of a quantity, as given in table below:

Reading#	1	2	3	4	5	6
Value	12.35	12.71	12.48	12.24	12.63	12.58

- (a) The arithmetic mean.
- (b) The standard deviation.
- (c) Check your answer using MS Excel (Give a screen shot of your Excel results)



Crafting an Effective Cover Letter and Resume

1. Cover Letter

Cover letters serve two purposes:

- Express your *interest* in the organization and position to which you are applying
- Highlight your *skills and experiences* given in your resume

The goal of this chapter is to break down the structure of a cover letter, and show some examples of how to incorporate different experiences into your letters for various Engineering fields.

Paragraph 1: Introduce Yourself

- *Identify the position* you are applying for, and how you learned of it.
- Explain why you are *interested* in applying for this role.

- You may want to include your year (e.g. junior/senior), college, and major.
- Be sure to include something *specific* about the company

Paragraphs 2 & 3: Sell Yourself

- Indicate that you understand the position requirements and illustrate that you possess the skills required to add value in the role.
- Highlight character traits and/or specific experiences that prove you are a good fit for the organization and the role.
- Do elaborate on skills and stories – be specific!!
- Look at the required skills section of the job posting for ideas of what to highlight.
- Answer the question: Why am I right for this position?

Paragraph 4: Closing

- Keep this paragraph *short and sweet*.
- Summarize your qualifications for the position and *reiterate why you* are a good fit.
- Provide *contact information* (cell phone and email).
- Say *thank you!*

A Few Tips & Tricks

- If you don't have the name of a contact, address the letter to "Dear Hiring Manager," or "Dear Human Resources Director." Don't address the letter to "To whom it may concern," or "Dear Sir/Madam"
- Limit the letter to 3-4 paragraphs, and 1 page.
- Expand on your resume; do not repeat it verbatim.
- Do not copy exact words/phrases from sample cover letters.
- Confirm that you've included the correct company name and contact information.

- Be enthusiastic. Show off your personality!

Example:

APPLYING FOR A POSITION IN CONSULTING HIGHLIGHTING ACADEMICS &
INDUSTRY EXPERIENCE

I am writing to express my interest in the Summer 2022 Intern Program at ABB company. I am currently a junior at Benha University, faculty of Engineering, Electrical Engineering and Control Program (EECP), with a major in control. I have a strong desire to use my technical background and problem-solving skills to tackle relevant control problems. I am very interested in ABB's commitment to developing solutions that have lasting impacts on global clients, as well as its investment in employees' professional development through personal career advisors.

The main reason I chose EECP was the opportunity to understand different control courses to solve global issues with innovative ideas. I am a unique thinker, and I love tackling challenging problems. I want to apply my engineering background to address higher-level control problems and innovate creative solutions. I am drawn to intelligent control consulting for the opportunity to use my analytical skills and creativity to help designers how to identify and resolve key points. I enjoy close interaction with clients and creating dynamic solutions tailored towards their specific needs.

As part of graduation team member on campus, I worked on a project last semester for an equipment controlling and monitoring a water pumping system. The aim of this project is to show how technology became smart and how they could enhance the human life. After designing the suitable layout and after many site visits, our final system is obtained using technology solutions to make the client's leasing process more convenient, efficient, and engaging. Through technologically optimized services, we can solve any problems.

I am very interested in ABB for their emphasis on data-driven insight, due diligence, and the delivery of impactful and sustainable solutions. The company's values match my

original intentions of using my technical knowledge to generate solutions, and with my background, I am confident I can bring diversity and value to your team. I would welcome the opportunity to speak with you and can be reached at (xxx) xxx-xxxx and xxx@feng.bu.edu.eg. Thank you for your time and consideration.

Assignment

Write a cover letter applying for position in a company highlighting your academic and industry experiences.

2. Resume

A resume is a marketing brochure about you. It describes your skills, experience and your education. The purpose of an effective resume is to get you an interview. Here is the checklist of all information that should be included in the resume.

Resume Checklist

FORMATTING & MECHANICS

- Document fits on one page without overcrowding. Check with a career advisor for rare exceptions.
- Font size is 10-12 point and is professional and uniform throughout resume.
- Resume is visually appealing.
- Dates are uniformly formatted, NOT placed in the left-hand margin
- Judicious use of bold, italics, and underlines enhances appearance and readability.
- There are no errors in capitalization, spelling, word usage, grammar, and punctuation.
- Margins are no smaller than .5 inches.
- Entries are listed in reverse chronological order (current to oldest) in each section.

CONTACT INFORMATION

- Includes 1 address, 1 phone number, and 1 professional email address.
- If applicable, contact information may include links to a professional portfolio, website, or LinkedIn page.

EDUCATION

- Education is first section on resume, below contact info. Include honors/awards here (e.g., Dean's List).
- Each educational institution (high school/college) includes name and location (City, State).
- Junior/Seniors' resumes usually omit High School. Check with a career advisor for exceptions.
- Study abroad is listed (institution, country, and dates of study), if applicable.
- Degree, month, and year of graduation are identified (i.e. "Bachelor of Arts, May 2017" or "Bachelor's degree, May 2017," if undeclared)
- Major(s) and minor(s), if declared, are listed.
- Including coursework is optional and can be a separate section. List selected courses relevant to job/internship.
- GPA is listed if 3.0 or higher. Include 2 decimal places. Do not round up.

EXPERIENCE (CAN BE MORE THAN 1 SECTION WITH TAILORED HEADINGS)

- Include paid, volunteer, intern, and extracurricular activities.
- Include 4 items: employer/organization name, location (City, State), dates, and title/role.
- Use a round or square, solid bullet (■ , ●) to list your accomplishments and skills.
- Start descriptions with strong skill-based verbs (see the next page). Use present tense for ongoing work.
- Phrases are concise and provide useful information. To convey maximum impact, ask yourself, "So what?"
- Use quantitative information, when possible, to prove your results and effectiveness.

SKILLS

- Skills can be listed in a separate category.
- Skills are identified by type, including computer, language, technical, and laboratory skills.
- Proficiency level is included for languages (native, fluent, proficient, conversant).
- Do not include personal attributes or soft skills (e.g., teamwork, communication).

ADDITIONAL

- Include dates of participation for activities. A category of interests is optional.
- If publication section is included, it is appropriately formatted.
- Document does not include use of personal pronouns (I, me, we) or articles (a, the).
- List of references is not included. Do *not* use the phrase, "References available upon request."

Assignment

Write your resume that gives prospective employers an important message about academic qualifications, soft skills, and talents in order to achieve a position in a high-ranked company.