Word and Excel Assignment 2017

**Due Date**

**Monday September 11 by noon.** This assignment is worth 2% of your final grade in APSC 100 Module 1. Upload instructions will be emailed when the dropbox is open.

**Purpose**

The purpose of this assignment is to help prepare you to analyze data and create technical reports using Microsoft Excel and Word. It requires you to use the following:

- Microsoft Excel to create tables, scatter plots, and complete data analysis.
- Microsoft Word to import tables/graphs; create text, equations, captions, sample calculations, and drawings; and use built-in tools for heading styles, citations, cross-referencing, tables of contents, lists of figures, and lists of tables.

The assignment requires you to create a summary Microsoft Word document containing the results and discussion for two exercises you will perform in Microsoft Excel. Completing this assignment will prepare you for the more detailed formatting expected for larger, more complex documents. The report generated in this assignment can be used as a template for all reports in APSC 100.

**Relevant Resources**

Microsoft Excel and Word tutorials, as well as Microsoft Office Learning Resources, are available at [http://engineering.queensu.ca/Current-Students/First-Year-Studies/Incoming-Students.html](http://engineering.queensu.ca/Current-Students/First-Year-Studies/Incoming-Students.html)

The tutorials have been specially designed to aid you with the assignment. It is expected that you will read these resources and refer to them when completing the assignment. If you have any additional questions about the assignment, you may contact engineering.first.year@queensu.ca for assistance.

**Required Software**

This assignment can be completed on both PCs and Macs. You will need the following software and plug-ins:

1. Microsoft Excel - Ensure the “Analysis ToolPak” plug-in is installed in your version.
2. Microsoft Word - Ensure you have the option to use the IEEE reference style in the Word citation management tool.

   Detailed installation instructions are included in the Microsoft Excel and Word tutorials mentioned previously in ‘Relevant Resources.’

**Learning Outcomes**

Upon successful completion of this assignment, students will be able to:

1. Input experimental data into Microsoft Excel.
2. Perform calculations in Microsoft Excel using both manually inputting formulas and built-in functions.
3. Generate simple and effective tables and graphs to describe experimental data in Microsoft Excel.
4. Perform basic data analysis in Microsoft Excel. Specifically, students will be able to perform regression and residual analyses as part of a laboratory error analysis.
5. Properly format and organize a formal laboratory report in Microsoft Word.
6. Integrate both graphs and tables created in Microsoft Excel into a laboratory report in Microsoft Word.
7. Generate equations, sample calculations, and basic diagrams in Microsoft Word.
8. Correctly reference resources used in a formal laboratory report using IEEE format.
9. Critically evaluate experimental results on a basic level.

Instructions
This assignment contains two questions:

1. Question 1: Chemical Kinetics - The Use of Luminol to Detect Blood
2. Question 2: Kinematics – Rescuing the Queen’s Grease Pole

The questions are described in detail beginning on page 6.

To complete both questions you will need to create multiple tables and graphs in Microsoft Excel, and you will need to import them into a properly formatted Microsoft Word document. The specific formatting requirements are listed on pages 3 to 5.

Formatting Requirements

1. Saving your File
   ▪ The assignment should be saved as a file entitled:
     Student#_LASTNAME_FIRSTNAME_APSC100_Assignment1

2. Text
   ▪ All text should be left justified.
   ▪ Do not use full justification.
   ▪ Paragraphs should not be indented and should, instead, be separated by a space.
   ▪ Use size 11 Calibri font.
   ▪ Edit your writing for spelling and grammar.
   ▪ Write as concisely as possible.

3. Title Page
   ▪ Include a title page with your name, student number, course number (APSC 100), and submission date.

4. Point of View
   ▪ The report should be written in 3rd person. Do not use “I” or “we.”
5. Headers/Page Numbers
   ▪ Use Word Header & Footer to insert a header, including your last name and the page number, positioned at the top right side of the page.
   ▪ Your name should be separated from the number using a vertical line, similar to “Smith | 1”.
   ▪ The title page should not have a page number.
   ▪ Use Roman numerals (i, ii, iii, etc.) for the page numbers for the Table of Contents, List of Figures, and List of Tables pages.
   ▪ Arabic numbers (1, 2, 3, etc.) begin on the first page of the assignment and should be used for all subsequent pages (including appendices when applicable).

6. Headings
   ▪ Use Word Styles to consistently format your headings for sections and subsections.
   ▪ Each question and the references section should have its own heading.

7. Tables and Graphs
   ▪ Use consistent formatting for tables and graphs.
   ▪ Consider the following guidelines for effective graphics in a laboratory report:
     
     **Tables**
     1. **Maximize white space.**
        a. Eliminate vertical lines between cells.
        b. Where possible, minimize the number of horizontal lines between cells.
     2. **Centre text** in cells.
     3. **Avoid** using **colour** where possible.

     **Graphs**
     1. **Do not include chart titles.** Your figure caption should sufficiently introduce the contents of your graph.
     2. Do include **axis titles** (with units).
     3. **Eliminate/Reduce horizontal and vertical gridlines when appropriate.** Horizontal and vertical gridlines should only be included if they highlight key data points or are critical for making your graph more legible.
     4. **Avoid** using **colour** where possible.
     5. When inserting graphs into a report, make sure they are an appropriate size. Graphs/ Figures should be as small as possible, while still remaining clear and legible to the naked eye (without zoom). It is appropriate to conserve space and place figures side-by-side if they are clear, legible, and their content is related.

8. Captions
   ▪ Include captions below figures and above tables using the Word Captions tool.
   ▪ Refer to each figure and table in the body of your report using cross-referencing, also found under the Word Captions tool. Use the “Only Label and Number” option when inserting cross-references such that the references appear as “Table 1” or “Figure 1” in the body of the report.
9. **Table of Contents**
   - Use Word **Table of Contents** to generate a Table of Contents page from the headings. Note that Word will do this automatically provided that you have used styles for your section headings.

10. **List of Figures/ List of Tables**
    - Use Word **Captions** to insert a List of Figures and List of Tables immediately after the Table of Contents page, generated from the captions used for your figures.
    - The Table of Contents, List of Figures, and List of Tables should **not** be included in the Table of Contents.

11. **References**
    - Use Word **Citations & Bibliography** to insert in text citations and add a references section to the end of your document.
    - Reference all documents used.
    - Citations must be in IEEE style.
    - It is not mandatory that you use the Microsoft Word citation management tool. You are free to use other citations management tools (e.g. Zotero).
    - **No citation management tools are perfect.** It is always expected that you manually check that your citations are generated in proper IEEE format and that you make all necessary adjustments.

12. **Significant Figures**
    - If not instructed otherwise, for the purposes of this assignment, report all numerical values to 4 significant figures.

13. **Numbering Equations**
    - Number all equations included in the body of the report.
    - Any equations included should be referenced at least once by number in the explanatory text.
    - It is **not** expected that students use Word **Captions** to generate equation captions, cross-references, or a List of Equations.

14. **Sample Calculations**
    - Consider the following structure for effective sample calculations:
      I. Include the generic form of the equation. Ensure the equation is numbered.
      II. Define all variables.
      III. Substitute numeric values into the equation **with units**.
      IV. Report the final answer with units.

15. **Units**
    - When reporting units, ensure there is a space between the numerical value and the unit.

    However, a space should not be left between the numerical value and the unit for percentages or degrees.
Question 1: Chemical Kinetics - The Use of Luminol to Detect Blood

You are watching the latest episode of your favourite crime show and notice the forensic scientists spraying the crime scene with a mysterious substance that makes blood splatter glow (Figure 1). You become curious about the chemical used and why it causes blood splatter to glow, but not other substances like saliva. After conducting some research, you discover that the chemical of interest is luminol. As shown in Figure 2, the reaction of luminol with hydrogen peroxide in the presence of an iron catalyst produces a chemical called 3-aminopthalate and a characteristic blue glow (light).


**Disclaimer:**

For the purposes of this assignment, the reaction of luminol and hydrogen peroxide, in the presence of an iron catalyst, has been greatly simplified. The quantitative kinetic data provided was generated randomly and is not necessarily representative of the true kinetics of this reaction. As such, the reaction order determined and the rate constants calculated should not be used or referenced for any purposes other than this assignment.

You decide to perform a series of experiments, to investigate the kinetics of the reaction.

You mix a solution of luminol, hydrogen peroxide, and BLOOD. You measure the concentration of luminol remaining over time. The experimental data you collect is in the first two columns of Table 1.

**Reminder:**

\[ \text{concentration of luminol} = [\text{luminol}] \]
Table 1: Experimental data you collect showing the consumption of luminol with time in a solution of hydrogen peroxide, luminol, and blood.

<table>
<thead>
<tr>
<th>Time (s)</th>
<th>[luminol] (mol/L)</th>
<th>ln ([luminol]) (mol/L)</th>
<th>1/ [luminol] (L/mol)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>18.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>13.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>11.89</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>7.90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>6.57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>3.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>1.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>1.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>0.36</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

You know that the rate of the reaction of luminol can be expressed by Equation 1 (below). However, you do not know the reaction order, n (0, 1, or 2). You are also unsure of the value of the reaction rate constant, k.

\[
\text{rate} = k [\text{luminol}]^n
\]  \hspace{1cm} (1)

Your friend, Rory, mixes a solution of luminol, hydrogen peroxide, and SALIVA (instead of blood). He also measures the concentration of luminol remaining over time. The experimental data he collected is included in Table 2. Unfortunately, silly Rory does not use the same measurement units as you.

Table 2: Experimental data Rory collects showing the consumption of luminol with time in a solution of hydrogen peroxide, luminol, and saliva.

<table>
<thead>
<tr>
<th>Time (hrs)</th>
<th>Uncertainty in Time (± hrs)</th>
<th>[luminol] (mol/mL)</th>
<th>Uncertainty in [luminol] (± mol/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.001555</td>
<td>0.000005</td>
<td>0.02</td>
<td>0.00002</td>
</tr>
<tr>
<td>0.005478</td>
<td>0.000005</td>
<td>0.01888</td>
<td>0.00004</td>
</tr>
<tr>
<td>0.009999</td>
<td>0.000005</td>
<td>0.01522</td>
<td>0.00001</td>
</tr>
<tr>
<td>0.011902</td>
<td>0.000005</td>
<td>0.01295</td>
<td>0.00005</td>
</tr>
</tbody>
</table>

Steps to Follow

1. Enter your data (Table 1) into an Excel spreadsheet. Be sure to include units in the column headers. In your Excel spreadsheet, populate the last two columns of your table (Table 1). Express all values to two decimal places.

2. Create the following three separate scatter plots for your data:
a) Graph 1 – time, t on the horizontal axis (in seconds) and luminol concentration, [luminol] on the vertical axis (in mol/L)

b) Graph 2 – time, t on the horizontal axis (in seconds) and the natural logarithm of luminol concentration, ln[luminol] on the vertical axis in (mol/L)

c) Graph 3 – time, t on the horizontal axis (in seconds) and the inverse of luminol concentration, 1/[luminol] on the vertical axis in (L/mol)

Add appropriate axis ranges, axis titles (with units), and professional formatting to all graphs.

3. Add a trendline to the t vs. [luminol] graph of your data (Graph 1). Display the equation of the trendline on the graph. Ensure the equation is in terms of [luminol] and t. Note that the Excel trendline is the result of a linear regression, which places a line of best fit to the data. The slope of this line is \(-k\), the negative of the reaction rate constant expressed in Equation 1.

4. In a separate table in your Excel spreadsheet, enter Rory’s data (Table 2), using column format (i.e. like you entered your data). Add additional columns to include the measurement uncertainties. Also, add additional columns beside Rory’s data table to convert all measurements and uncertainties to the same units that you used (s and mol/L).

5. Add Rory’s data points to the same t vs. [luminol] graph of your data (Graph 1). Ensure you use different markers for Rory’s data. Include a legend on Graph 1 that displays the appropriate name for each series.

6. Add vertical and horizontal error bars to Rory’s data points.

7. Add a trendline to Rory’s data points and display the equation on the graph. Be sure to place both equations such that they are adjacent to their respective trendlines.

To Hand In
At a minimum, include the following in the report you generate in Word for submission:

1. Introduction-
   1. A short paragraph outlining the two sets of data and describing the tables, graphs, and equations you are including. Be sure to uses Word Captions to add captions and cross-references when referring to the graphs and tables in your report. Also, ensure you number equations and refer to them by number in your report.

2. Results and Analysis-
   1. The Excel tables of your data, Rory’s data, and Rory’s data with correct units. Remember to number each table and include an explanatory caption (generated using Word Captions) above each table to describe it. You should have three separate tables.
II. The Excel graphs of the results. Remember to include a figure number and explanatory caption (generated using Word Captions) under each figure to describe its contents. You should have three separate graphs (Graph 1 with your and Rory’s data), Graph 2, and Graph 3. In your report, Graph 2 and Graph 3 should be placed side-by-side.

III. The complete rate equations (see structure of Equation 1) describing both your data and Rory’s data. To do so, you will need to identify the reaction rate constant, $k$, for both your data and Rory’s data. You will also need to identify the reaction order, $n$ of your data (0, 1, or 2). To do so, please consult the reference graphs included in Figure 3.

You should produce two separate rate equations. To create equations, use the Equation option under Word Symbols.

![Reference graphs](image)

*Figure 3 - Reference graphs used to differentiate between 0, 1, and 2 order reactions [5].*

Please note that you can make the assumption that Rory’s data has the same reaction order as your data. You should produce two separate rate equations. To create equations, use the Equation option under Word Symbols.

3. Conclusion -
   I. A paragraph commenting on whether or not the reaction rate of luminol in the presence of blood differs from the reaction rate of luminol in the presence of saliva. Include potential reasons for the similarity or difference.

II. A journal article must be cited in your report. If you cannot find another journal article you may consult and cite the following journal article:

Question 2: Kinematics – Rescuing the Queen’s Grease Pole

Oh no! The legendary Queen’s Engineering and Applied Science Grease Pole has been stolen by students from another faculty on-campus! Two brave 4th year students, Jeff and Alex, decide to try and rescue it. They have no idea what faculty stole the Pole, so they do not know what building to rescue it from. As shown below, an anonymous source sends a letter to Jeff and Alex providing some clues as to the location of the pole and how it was stolen. Please note that this story is entirely fictitious.

Dear Jeff and Alex,

It has come to my attention that you are determined to rescue the beloved Queen’s Grease Pole. A very noble cause, I must say. Unfortunately, I do not know exactly which faculty stole the Pole, but I can provide you with some information.

• The pole was transported from the Faculty of Engineering & Applied Science’s building (the ILC) to the burglar’s faculty building by truck.

• During the first 30 seconds of its journey, the velocity of the truck varied. The velocity measurements were recorded every 3 seconds ($\Delta t = 3$ seconds), as shown in Table 3.

Table 3: The velocity that the burglar’s truck was travelling when measured every 3 seconds during the first 30 seconds of its journey.

<table>
<thead>
<tr>
<th>Time (s)</th>
<th>Velocity, $v$ (m/s)</th>
<th>Distance Travelled (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1.08</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>4.21</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>4.43</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>5.90</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>6.65</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>8.11</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>9.80</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>11.34</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>12.85</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>15.11</td>
<td></td>
</tr>
</tbody>
</table>

• After the first 30 seconds, the truck travelled at a constant velocity of 13.64 m/s for 13.51 seconds before making an abrupt stop at its destination (the burglar’s faculty building). The truck failed to stop at any traffic lights/stop signs.

I am sorry I cannot be of more help. Please bring our Pole back to safety.

Sincerely,

A Friend of Queen’s Faculty of Engineering & Applied Science
Jeff and Alex remember basic kinematic equations from high school physics. These equations, Equations 2, 3, and 4, are included below. Remember that these equations assume constant acceleration.

\[
v = v_i + (a \times t) \tag{2}
\]
\[
d = \left(\frac{v_i + v_f}{2}\right) \times \Delta t \tag{3}
\]
when velocity is constant, \( d = v \times \Delta t \) \tag{4}

where,

\[
\begin{align*}
v_f &= \text{final velocity} \\
v_i &= \text{initial velocity} \\
d &= \text{distance travelled} \\
a &= \text{acceleration} \\
t &= \text{time} \\
\Delta t &= \text{time interval}
\end{align*}
\]

With the information given, Jeff and Alex determined what faculty stole the Pole and successfully rescued it. Can you?

Steps to Follow

1. Enter the data given in the letter (Table 3) into an Excel spreadsheet. Be sure to include units in the column headers.

2. In your Excel spreadsheet, populate the last column of your table (Table 3) using Equation 3. You want to determine the distance travelled over each interval in meters.

Hints:

- \( \Delta t \) is constant (\( \Delta t = 3 \) s)
  - You should input \( \Delta t \) into a separate cell in your Excel worksheet and call the cell as a constant in your formula using dollar signs (e.g. $A$1)
- \( v_i \) and \( v_f \) both vary from cell to cell
- For a given cell, you can assume that \( v_i \) is equal to \( v_f \) of the previous/above cell and \( v_i \) is equal to the velocity at that point in time, \( v \)
- To populate the first cell you can assume that \( v_i \) is 0 m/s

3. Use the SUM() function in Excel's Function Library to find the total distance travelled in the first 30 seconds of the truck's journey from the ILC. Display the results in a new (appropriately labeled) row at the bottom of the table.

4. Construct a scatter plot of the data given. Your graph should have velocity, \( v \), on the y-axis (in m/s) and time, \( t \) on the x-axis (in s).

Add appropriate axis ranges, axis titles (with units), and professional formatting to ALL graphs.

5. Add a trendline to the data series and display the equation on the graph using correct variable names. Considering Equation 2, the graph has the form, \( v = v_i + (a \times t) \), where \( v_i \) and \( a \) are
unknown quantities to be fit from the generic linear equation of the form $y = (m \times x) + b$. In this equation $m$ is the slope of the line and $b$ is the $y$-intercept.

6. Use Excel **Analysis** to complete a regression analysis with a **68% confidence level**. Produce both **residuals** and a **residual plot** for the data series.

**Please Note:**
- You cannot access Excel **Analysis** unless you have enabled the “**Analysis ToolPak**” plug-in.
- **Do not worry** if you don’t understand the meaning of the confidence level. Confidence levels are related to standard error and will be explored in APSC 100 Module 2.

7. Enter the **table** below (Table 4) into your Excel spreadsheet with appropriate values obtained from the regression analysis. Remember that the **acceleration**, $a$, is the **slope of the trendline** in m/s$^2$.

**Table 4** – The format of the table which you should create in your Excel spreadsheet to summarize the results of your regression analysis.

<table>
<thead>
<tr>
<th>Acceleration, $a$ [m/s$^2$]</th>
<th>Acceleration Standard Error [±m/s$^2$]</th>
<th>Intercept [m/s]</th>
<th>Intercept Standard Error [± m/s]</th>
</tr>
</thead>
</table>

8. Use Excel **Analysis** to generate descriptive statistics about the regression output. The objective is to determine the mean and standard error of the residuals of the regression analysis. Make sure you check the summary statistics box and use a 68% confidence level.

9. Enter the table below (Table 5) into your Excel spreadsheet with appropriate values obtained from the summary statistics.

**Table 5** – The format of the table which you should create in your Excel spreadsheet to summarize the results of your residual analysis.

<table>
<thead>
<tr>
<th>Residual Mean</th>
<th>Residual Standard Error</th>
</tr>
</thead>
</table>

10. In Microsoft Word, using the **Equation** option under Word **Symbols** generate the following two sample calculations:

**Remember:**
- It is assumed that at the end of the truck’s journey it came to an abrupt stop (**you do not need to account for deceleration**).
a) **Sample Calculation #1:** Using Equation 4, calculate the distance the truck travelled over the last 13.51 s ($\Delta t = 13.51\, s$) of its journey when it was travelling at a constant speed of 13.64 m/s. Your final answer should be reported in metres.

b) **Sample Calculation #2:** Calculate the total distance the truck travelled to the burglar’s faculty building. This will be the sum of the total distance the truck travelled in the first 30 seconds and the distance the truck travelled over the last 13.51 s.

Be sure to review the structure for producing effective sample calculations included on page 4.

11. Using Google Maps and the total distance the truck travelled, identify what faculty’s building the Pole must be rescued from.

**Hints:**
- When using Google Maps, the starting location is “ILC, 45 Union Street West, Kingston, ON” and the end location could be one of the following faculty buildings:
  - School of Nursing located at “Cataroqui Building, Kingston, ON K7L 3J8”
  - School of Computing located at “Goodwin Hall, 25 Union Street West, Kingston, ON”
  - Smith School of Business located at “Goodes Hall, 143 Union Street West, Kingston, ON”
  - Faculty of Arts and Science at “Dunning Hall, 94 University Avenue, Kingston, ON”

**To Hand In**
At a minimum, include the following in the report you generate in Word for submission:

1. Introduction-
   - I. **Same as Question 1.**

2. Results and Analysis-
   - I. The completed Excel table (Table 3) provided to Jeff and Alex in the letter, the table you generated to summarize the regression analysis (Table 4), and the table you created to summarize the residual analysis (Table 5). Remember to number each table and include an explanatory caption (generated using Word Captions) above each table to describe it. You should have three separate tables.
   
   II. Both the Excel graph of velocity, $v$ vs. time, $t$ (including trendline and equation), and the residual plot generated using regression analysis. Remember to include a figure number and explanatory caption (generated using Word Captions) under each figure to describe its contents. You should have two separate plots.

   III. The two required sample calculations explained previously.

3. Conclusion-
   - I. The burglar’s faculty building and the total distance it is from the Faculty of Engineering & Applied Science (ILC) by truck.
II. The complete equation of the form  \( v_f = v_i + (a \times t) \), modelling the motion of the burglar’s truck over the first 30 seconds of its journey. Generate this using the equation editor under Word **Symbols**. Discuss the significance of the y-intercept, \( v_i \). What should this intercept be if there was no measurement error?

III. A short analysis of what you notice about the residual plot and the mean of the residuals. Is the equation (generated above) a good fit for the data?

**References**


