**Purpose**

To develop the skills of presentation, analysis, and interpretation of biological data.

**Procedure**

We will use data from Moodle to learn how to calculate measures of central tendency and variability, as well as how to produce informative graphs.

**Step 1: Obtain the data**

On Moodle, under the Week 5 ‘Activity 2—Presenting and interpreting data’ link you will need to download the file ‘Data Handling Spreadsheet’. This is a Microsoft Excel file [.xlsx] and we will be producing all the necessary information within this Microsoft Office program.

**Step 2: Open the spreadsheet and examine the variables**

Are the variables continuous, ordinal, or discrete?

**Step 3: Calculate the measures of central tendency**

In this example the data is normally distributed, so mean would be the most suitable measure of central tendency.

Select the cell B29 (corresponding to column B, row 29) and type in the cell:

=AVERAGE(B7:B27)

Press ‘Enter’, and the cell will now display the mean blood alcohol content of females at 30 mins (0.0181 mL/L). Repeat these steps for each column to calculate the mean blood alcohol content for each time period for both males and females. Note: The data for the male students ranges across rows 7:22.

Select the cell B30 (corresponding to column B, row 30) and type in the cell:

=MEDIAN(B7:B27)

Press 'Enter', and the cell will now display the median blood alcohol content of females at 30 mins (0.02 mL/L). Repeat these steps for each column to calculate the median blood alcohol content for each time period for both males and females. Note: The data for the male students ranges across rows 7:22.

Select the cell B31 (corresponding to column B, row 31) and type in the cell:

=MODE(B7:B27)

Press ‘Enter’, and the cell will now display the modal blood alcohol content of females at 30 mins (0.02 mL/L). Repeat these steps for each column to calculate the modal blood alcohol content for each time period for both males and females. Note: The data for the male students ranges across rows 7:22.

Do the three measures of central tendency agree with each other? What does this tell us about the data? [Without graphing the dataset, is it more likely to be normally distributed or positively/negatively skewed?]

**Step 4: Calculate the error margins**

No measure of central tendency is a perfect representation of a dataset. Calculating an error margin informs us on the accuracy of our measures of central tendency. In this case, we are interested in the standard deviation.

Select the cell B32 (corresponding to column B, row 32) and type in the cell:

=STDEV.S(B7:B27)

Press ‘Enter’, and the cell will now display the standard deviation for the blood alcohol content of females at 30 mins (0.0087). Repeat these steps for each column to calculate the standard deviation of blood alcohol content for each time period for both males and females. Note: The data for the male students ranges across rows 7:22.

Select the cell B33 (corresponding to column B, row 33) and type in the cell:

=STDEV.S(B7:B27) / SQRT(COUNT(B7:B27))

Press ‘Enter’, and the cell will now display the standard error of the mean [SEM] for the blood alcohol content of females at 30 mins (0.0019). Repeat these steps for each column to calculate the standard error of the mean of blood alcohol content for each time period for both males and females. The data for the male students ranges across rows 7:22.

**If you were to write these results in a scientific report they would appear as:**

*“The average blood alcohol content for females after 30 mins of drinking was* ***0.02 ± 0.01 mL/L****.”*

**Step 5: Create a bar graph of the means**

From the ‘Ribbon’ menu select the ‘Insert’ tab and from the chart options select ‘2-D Column’ -> ‘Clustered Column’.

Position and resize the blank chart on your spreadsheet. From the ‘Chart Design’ click on the ‘Select Data’ icon. From the ‘Select Data Source’ dialog box, click the ‘+’ button under the ‘Legend entries (series)’ section. Name the series ‘Females’ and click on the ‘Y values’ icon (see below).

From the spreadsheet, select the data range B29:E29 and click on the  icon to return to the ‘Select Data Source’ dialog box.

Repeat the process to select the data for the male students: Click the ‘+’ button under the ‘Legend entries (series)’. Name the series ‘Males’ and click on the ‘Y values’ icon (see below).

This time, select the data range H29:K29 before returning to the ‘Select Data Source’ dialog box.

Next, we need to select the correct labels for the time intervals on the horizontal axis. From the ‘Select Data Source’ dialog box click on the ‘Horizontal (category) axis labels’ icon and select rows B6:E6 before returning to the ‘Select Data Source’ dialog box.

Click ‘OK’

**Step 6: Add axis titles and a legend**

Next, we need to add the correct axis titles to the graph. From the ‘Chart Design’ tab, select ‘Add Chart Element’ -> ‘Axis Titles’ -> ‘Primary Horizontal’. Click on the axis title and rename it to ‘Time (min)’. Repeat this process for the ‘Primary Vertical’ axis and rename it to ‘Blood Alcohol Content (mL/L)’.

Remove the chart title by selecting ‘Add Chart Element’ -> ‘Chart Title’ -> ‘None’. Select the vertical axis by clicking on any one of its values, right click and select ‘Format Axis’. From the ‘Format Axis’ pane select the ‘Axis Options’ tab, expand the ‘Number’ category and change the ‘Decimal places’ value to ‘2’. Lastly, select ‘Add Chart Element’ -> ‘Legend’ -> ‘Right’ to add a legend to the chart.

**Step 7: Add error bars to the chart**

Select the chart and, from the ‘Chart Design’ tab, select ‘Add Chart Element’ -> ‘Error Bars’ -> ‘More Error Bars Options’. From the ‘Add Error Bars’ dialog box select ‘Females’ and click ‘OK’.

From the ‘Format Error Bars’ pane, select the ‘Error Bar Options’ tab and then select ‘Direction -> Both’, ‘End Style -> Cap’, and ‘Custom’ -> ‘Specify Value’.

For the ‘Custom Error Bars’ dialog box, select rows B32:E32 for both the ‘Positive’ and ‘Negative’ error values. Click ‘OK’.

Repeat the process for the male students by selecting the chart and, from the ‘Chart Design’ tab, select ‘Add Chart Element’ -> ‘Error Bars’ -> ‘More Error Bars Options’. From the ‘Add Error Bars’ dialog box select ‘Males’ and click ‘OK’. From the ‘Format Error Bars’ pane, select the ‘Error Bar Options’ tab and then select ‘Direction -> Both’, ‘End Style -> Cap’, and ‘Custom’ -> ‘Specify Value’ (see below). For the ‘Custom Error Bars’ dialog box, select rows H32:K32 for both the ‘Positive’ and ‘Negative’ error values.

Click ‘OK’.

Select the chart and copy and paste it to a new area in your spreadsheet. From the ‘Chart Design’ tab, select ‘Change Chart Type’ -> ‘Line’ -> ‘Line’. Your second bar chart should now change to a line chart whilst maintaining the correct axis titles, legends, and error bars.