Computer Essentials for Engineers

GNG1103 – Engineering Design

Part A2 –Google Sheets

This lab can be done using either Microsoft (MS) Excel or Google Sheets. While MS Excel is more powerful, Google sheets offers very similar functionality and is easier for collaborative work, where the document is being shared by multiple people in real time. You can choose which tool you are going to use, but they are very similar, in terms of the way that they are used.

- (PC or MAC) What is the difference between Google Sheets files, "saved as" files with a suffix of: .tsv. What about suffixes of: .ods,.xlsx and .csv?

.tsv:_____

.ods:_____

.xlsx:_____

.csv:_____

Spreadsheet tools are based on an array or a grid of individual "cells", that are each labelled with a grid reference (e.g. the top-most and left-most cell has a label of 'A1'). Each cell is a separate box, into which you can type text of any kind and which can be filled with different colours or surrounded with customized borders. However, the real power of a spreadsheet application, is the use of a cell to capture customized and complex calculated formulae, which depend on the value of other cells in the spreadsheet.

Look at: https://www.youtube.com/watch?v=QTgvX5MLPC8.

What is the label for the cell in row 5 and column 3?

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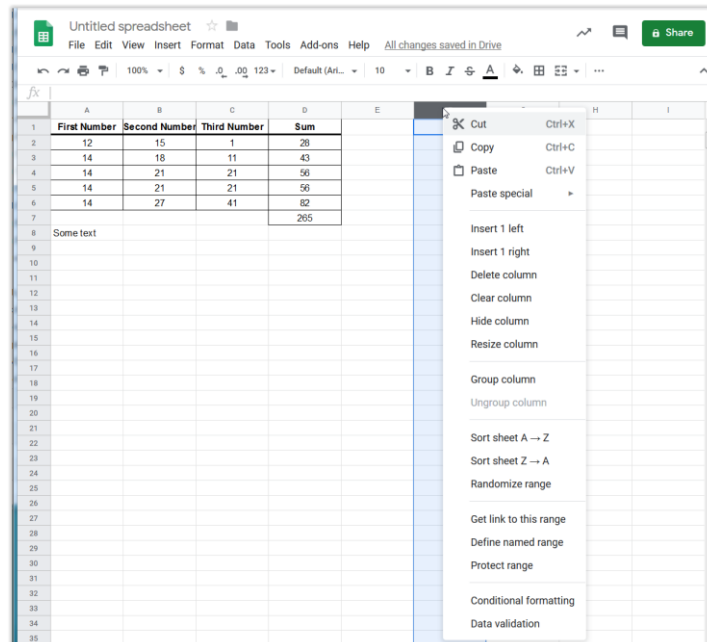We will now start to create most of the spreadsheet in the figure below:

Take a moment to familiarize yourself with some of the features in the figure:

- The 'Formula Bar' contents for this selected cell are shown in the long box to the right of the *fx* designation in both tools. In this case, some text has been already entered in cell A8 ('Some text). Note that the single quote character (found on U.S. keyboards below

the double quote character) at the beginning of the text tells the program that this is just random dumb text and that it should be displayed 'as is'. This leading character will not be displayed in the actual spreadsheet.

- Pull down on the bottom of the 'Formula Bar' box to stretch it to the size you want. This is useful for more complex formula entry. Press the same icon area again (now shown as '^') to restore back to the more compact display form of the 'Formula Bar'.
- Note the way that cells are indexed or labelled (i.e. letters across the page and numbers down the page).
- There are lots of other icons, whose functions you can probably guess. Take a few moments, though, and hover your mouse over a few of them to see some context-sensitive help information for each (you will need to wait a few seconds, after you stop moving your mouse to see something).

1. Select cell A1 with your mouse, type the first column title as: *'First number* (once again, the single quote character tells the tool not to try and interpret the characters that follow it as numbers or as a formula). You need to type the required text into the 'Formula Bar'.
2. Type in the other column titles of: *'Second number, 'Third number* and *'Sum* into the other cell locations (i.e. B1, C1 and D1) and change the format of all of these text titles to be bold and italic format, using the appropriate icons under the 'Home' menu (no menu titles in Google Sheets) and font name indicator (see the figures). You can resize the width of columns by dragging the border of the column in the area where the cell index letters are displayed. You do a similar thing on the row number borders to change the height of rows.
   - If you double-click on the border between column index letters at the top, it will auto-resize the column on the left to be just big enough to fully display the largest current object in that column. Same thing for row heights, using the border between the number indices on the left.
   - You can also select an entire column or an entire row by clicking on the letter or number index. Then, you can right-click to get a resize column option and some other things too (see the figure, where all of column F is being selected by clicking on the letter itself).
   - Multiple columns can also be selected in the same way, but while holding down the shift key (contiguous cell range) or the control key (selective) at the same time as the mouse is clicked.

3. In cell A2, now type the first actual number twelve, by typing *12* (note that this must **not** be preceded with a single quote character, since now we **do** want this value to be interpreted as a number and not just as text characters)
4. Type in the next two numbers in the first row (i.e. values of 15 and 1 in cells B2 and C2).
5. In cell D2, type in the formula to calculate the sum of row 2 by typing: *=A2+B2+C2* (the equals sign character at the start indicates that this is a formula which should be evaluated by the program).

What is the value in cell D2 after you have typed the formula and hit enter/carriage return (or clicked with the mouse on the check mark to the left of the 'Formula Box')?

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6. The colon is used to indicate a cell range. Therefore, A2:C2 would be the rectangular 1 by 3 grid of cells with A2 at the left and C2 at the right. Next, change the formula in D2 to use the *sum* function so that it is: *=sum(A2:C2)* and note what changes have occurred below:

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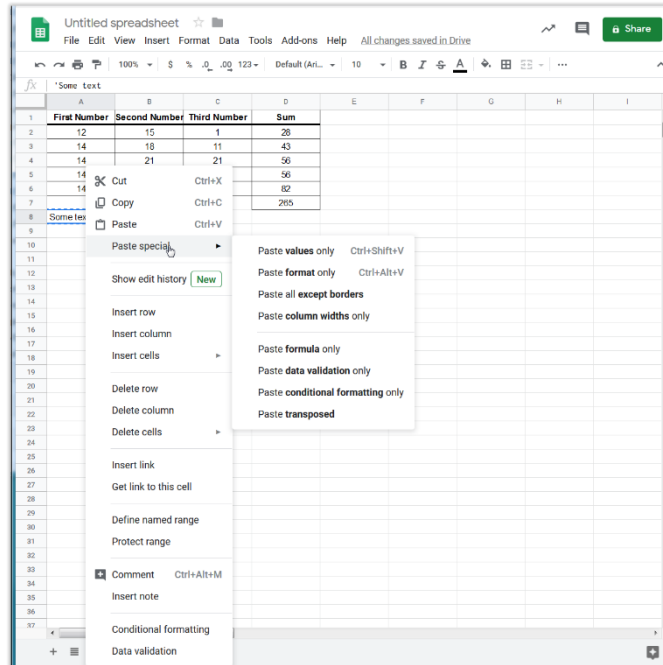
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What are the dimensions of the cell grid that is specified by the cell range of A2:D6?

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7. Rather than typing each of the numbers in this example, we can spot some patterns and use a simple formula to fill the values in quickly, starting with single numerical values in row 2, combined with simple formulae in the remaining cells.
8. In cell A3, type the formula: *=A2+2* to replace the number value of 14

9. Copy A3's formula and paste it into the cell range A4:A6.
10. Inspect the formulae in cells A4, A5 and A6. Is this what you expected? If not, fix it by using the same copy command for cell A3, but this time selecting the cell range A4:A6 and then selecting *Edit/Paste special/Paste values* (or use the *Ctrl+Shift+V* keyboard shortcut) or right-clicking to see almost the same menu (with an added edit history). This will not copy the formula but the actual value of the cell A3.
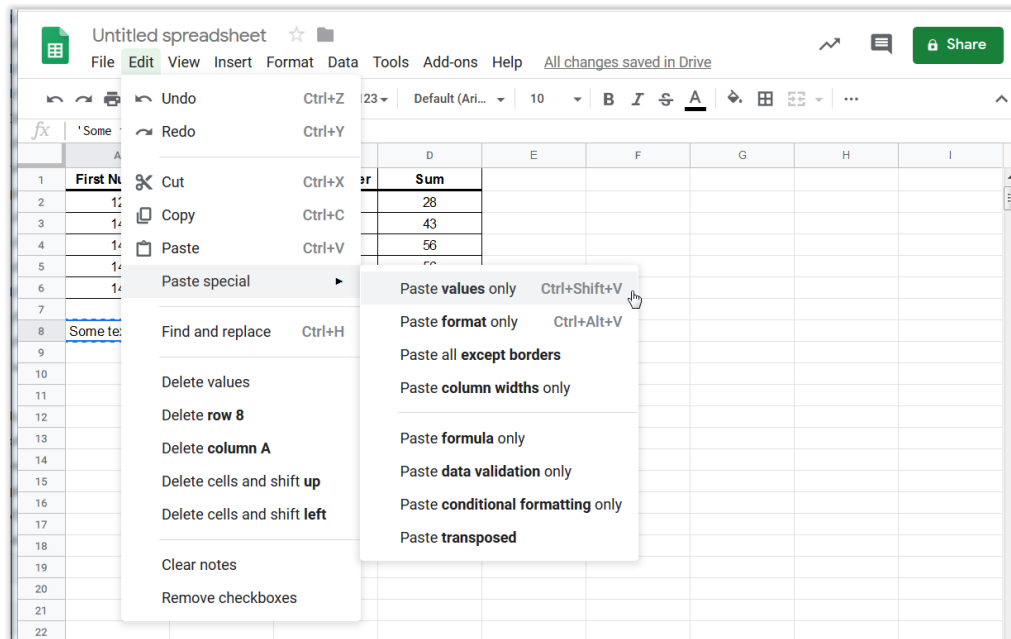
You can choose the other options to get different kinds of special pasting operations, for example, "Paste format only" is useful if you want to retain special formatting like boxes or colours). You can just paste the formulas, etc. for now, we will copy just the values to get what we want.

11. Copy cell D2 using ctrl-c (*CTRL* key and *c*, simultaneously pressed on a PC) or ⌘*c* (on a MAC) or by right-clicking and then selecting 'copy' or by using the 'copy' icon under the 'Edit' menu title in Google Sheets. Then, select the cell range D3:D6 with your mouse, by clicking and dragging with your mouse.
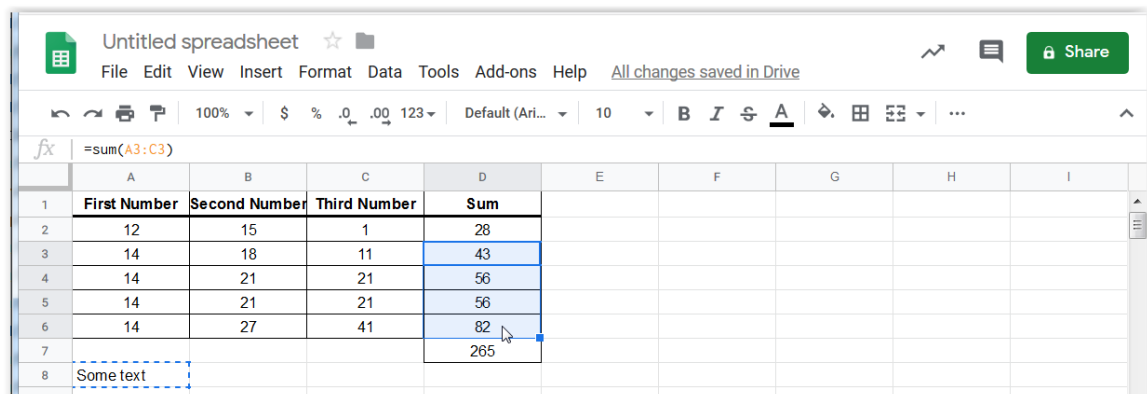
12. Use *Ctrl-v* (PC) or ⌘*v* (MAC) to paste the formula from cell D2 into the selected cell range of D3:D6, as is being done in the previous figure.

What happened? Find out by selecting the cells in the cell range D3:D6 (e.g. D3, D4, D5 or D6) and examining the formula bar and then describing what you see:

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13. Next, sum these summed values, themselves, by typing the following partial formula into the formula bar for cell D7: =*sum(*

14. Next, select the cell range D2:D6 with your mouse by dragging and clicking as before and then type the closing bracket: *)* followed by the *ENTER/carriage return* key to finish off entering the formula.
15. The result should be the formula: *=sum(D2:D6)* in cell D7, without any spaces. You can check this by selecting cell D7 with your mouse and then examining the formula in the formula bar. You can fix up the formula using just the keyboard and arrow keys too, of course.

What does the value in cell D7 represent, in terms of the numbers that are stored in columns A, B and C?

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16. If you click with the mouse *inside* the formula bar for D7, you should see the referenced cells in the formula bar *=sum(D2:D6)* highlighted in a colour.

How else could you calculate exactly the same value that was in D7, but instead rewriting your formula to just use the cell range A2:C6 (i.e. without any intermediate summed row values in column D)? Write your formula into cell D9 and compare this value in cell D7. Are they the same, like they should be?

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17. Now, type the following formula into cell B3: *=B$2+3*
18. Copy B3's formula and paste it into the cell range B4:B6. What changed? Was this what you expected?

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19. In C3, type: *=C2+10.*
20. Click on cell C3. Now click and hold the little square in the bottom right hand corner. Drag it down to cell C6. What happened? What formulae are in cells C4 to C6?
21. Change B3's formula to: *=B2+3.*
22. Highlight cell B3 and C3 by clicking on cell B3 and dragging the cursor over to C3. Click and hold the little square in the bottom right of these highlighted cells and drag it down to C6. What happened this time? Was this what you expected? Verify the formulae for B4, B5, B6, C4, C5 and C6.

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Explain, in your own words, the difference that the *$* prefix makes in cell formula references, when those cells are being copied. *Hint*: use words like **absolute** and **relative or maybe 'fixed' or 'changes by …' etc.**!
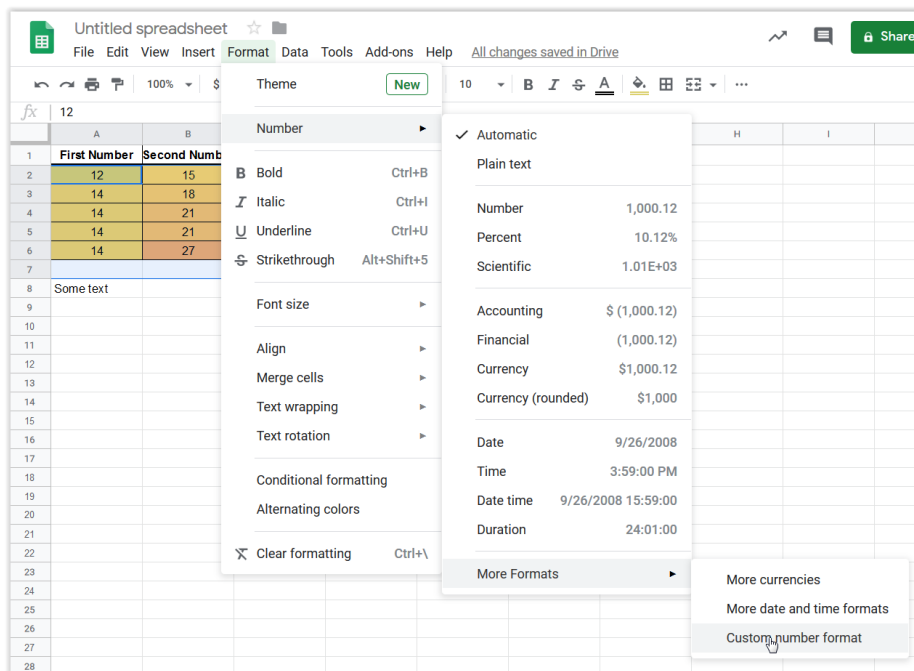
_____

23. Changes cell B3 back to *=B2+3* and cell C3 back to *=C2+10*. Repeat step 22. The numbers in the whole table should now match those in the very first figure.

Using an internet search to find the appropriate Google Sheets function (or by typing your best guess in the formula bar and investigating the autofill alternatives) determine how you would calculate the average of the numbers in the cell range A2:C6, storing the result in D8. What is this function and how did you write it in cell D8?

24. Create a bar chart of your data by selecting the cell range A1:D6 with your mouse and then the INSERT/chart option to get the result shown in the figure.
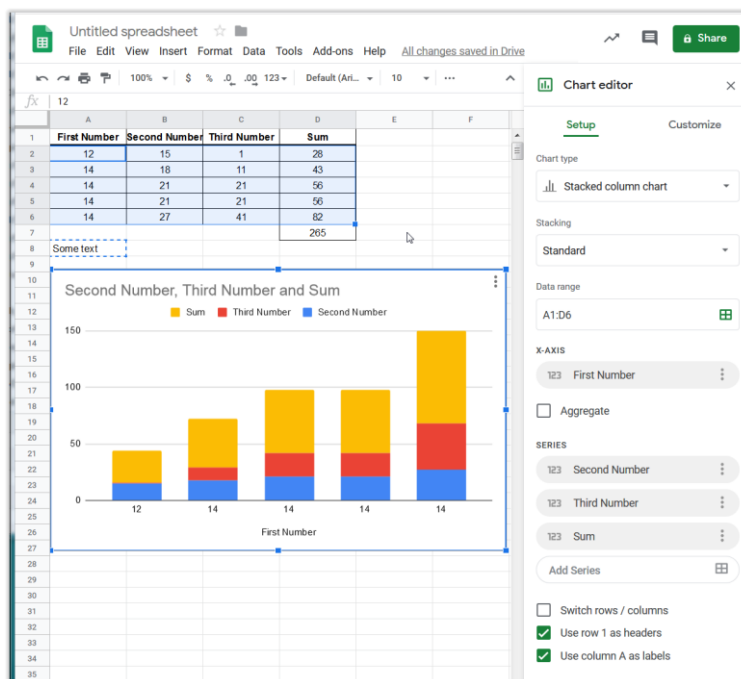

25. Try some other chart types (e.g. '3D pie chart' or …) using the same method. Note that you can hover over the icons to get the right one. Different charts will be better at displaying different kinds of data. Always pick the most informative or useful type, when displaying your data. For this example, with a sum as one of the data series, 'Stacked columns' is less useful than the 'Column Chart' format.
26. Change the number of decimal digits from none to three. In Google Sheets, do this by selecting the cell range A2:D7, then use the Format/Number/More Formats/Custom number format menu options and then type '0.000' in the text box.

27. Undo this change by typing *Ctrl-Z* (PC) or ⌘*-z* (MAC).

28. Add automatic colouring that is proportional to the cell value range A2:C6 by selecting the cells in question. Select Format/Conditional Formatting and then click on the 'Çolor Scale' tab and then the *Preview* bar to see the options (pick the bottom green/yellow/red one, unless you part of the population who has difficulty seeing different colours, in which case you should use a colour that you can see or a shade of grey).

29. The result of this selection should be as shown in the figure. As you can see, the cells are now filled with a colour scale that is proportional to their value. This can be useful for spotting trends in data or for detecting outliers. These colours will update automatically as the values in the cells change. The smallest value will be shown as the most extreme end of the selected colour scale and the largest value will shown with the colour at the other extreme end of the scale.
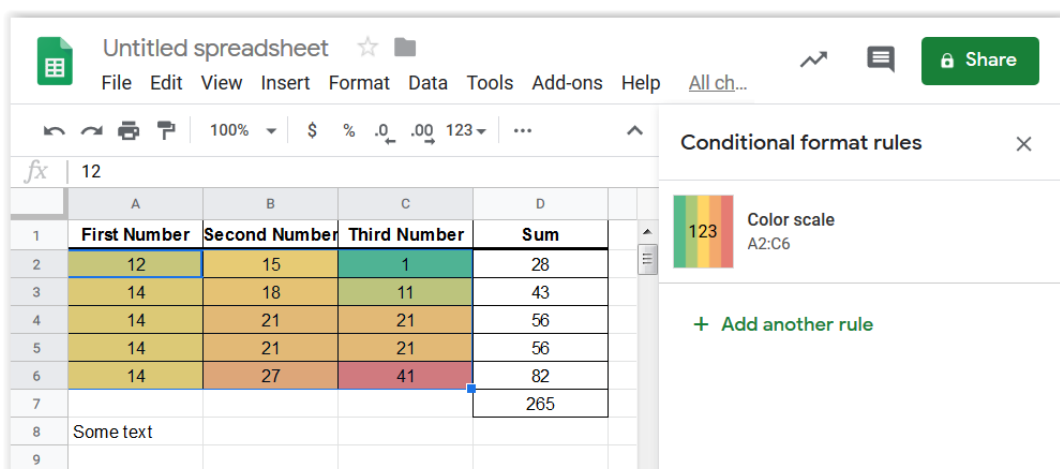
Conditional Formatting (multi-colour)
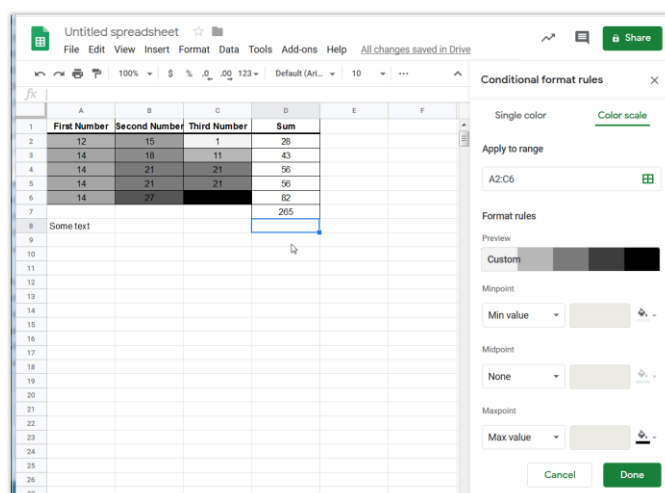
Conditional Formatting (grey tones only)

30. Now add cell borders and then centre the values in the table (top and bottom centering as well as left and right centering) to improve the appearance of your spreadsheet.

31. Your spreadsheet is saved automatically, but you need to use *File/Download* to get a copy of the file, so that you can submit the resulting file (along with the filled-in version of this lab) into Brightspace under the 'Labs/Part A' folder.

Exercise

Now it's time for you to practice what you've learned! It is important that you *try* to do this exercise *by yourself*, first, before giving up and asking anyone else for help. This will help you determine whether you have learned the material adequately or not. If you are too short of time in the lab (i.e. it has taken you more than an hour just to get to this spot) then do this next exercise at home, where you can take your time and think about things better, and move on to the next part of the lab now (i.e. Part B – MS Word/Google Docs).

If you *must* do the exercise after the lab at home, because of lack of time, then you will not be able to demonstrate your functionality to the Teaching Assistant. Instead, you can write out the formula that you created (for cells C2 and D2) in the space below as well as submitting your spreadsheet into Brightspace:

Formula (cell C2): =

Formula (cell D2):=

Instructions
1. Import the text data file downloaded from Brightspace (lab 1 folder) called students.txt (text file) and cut and paste the data values so that they are located in the cell range B4:E29, including the titles, as shown in the next diagram. It is also possible to import files (with different formats), so that values separated by characters of your choice will be placed into different cells. However, while extremely useful, this process will not be practiced as part of this lab.
2. Create formulae in the correct cell locations (based on the diagram) to locate the row with a student ID that is equal to the value typed into the B2 search cell.
3. Display the value of the student's full name (in the format: "Firstname Lastname") in cell C2 as well as the corresponding userID in cell D2, as shown in the next figure (*Hint*: Do an internet search to find MS Excel/Google Sheets functions that can do a lookup of values in a table based on an initial column key value and then another function to concatenate multiple text strings together).
4. Save your work! Use the *File/Download*. menu item.
5. Demonstrate the functionality of your spreadsheet to the Teaching Assistant
   - Make sure that the formatting is *also* very similar to that shown in the diagram too!). Aesthetics is an important design criterion in many design tasks.
   - Note that it should be possible to change the value in cell B2 and the cells displayed in C2, and D2 will change appropriately, according to that value. Test your spreadsheet formulae properly before demonstrating it!

Your final spreadsheet should look like the following figure. Note that you should be able to change the value in the blue box and then see only the values in the green box changing to the

correct values as a result, automatically. What happens when the student ID that is typed into the blue box does not exist in column B of the list below and what does this mean?

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Looking up values using an index value in the first column