

Excel-erate Your Data Analysis Skills: Excel Tips and Tricks to Make Your Heart Skip a Beat

McGill University Libraries

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Excel-erate Your Data Analysis Skills:	1
Excel Tips and Tricks to Make Your Heart Skip a Beat	1
1 Introduction	2
2 Quick Introduction to Excel	3
Rows, Columns, and Cells	3
Data Types	3
3 General Tips	4
Tip #1: Freeze Panes	4
Tip #2: use a pick list in Excel	4
Tip #3: Flash fill (ctrl + e)	5
4 Calculations	6
Example I: Total Medals = Gold + Silver + Bronze	7
Example II: Percent of Total Medals for Canada = (Canada total/Over total) * 100	9
Note on troubleshooting errors	13
5 Built-In Functions	14
How to calculate the average total medals	14
6 Functions and Calculation Tips	15
Tip #4: AutoSum	15
Tip #5: Adding the Current Date or Current Time	16
Tip #6: Combine Text Quickly	16
7 Trend Charts	18
8 Exporting into Word	33
9 Cross-Sectional Charts-	34
Tip #9 : Analyze Data	34

1 Introduction

This guide has been designed to accompany the Excel workshop offered by the McGill Libraries. It is based on a workshop originally developed by the Empirical Reasoning Center, at Barnard College. The example dataset is available on kaggle, an online community for data science and machine learning. According to the description, “This is a historical dataset on the modern Olympic Games, including all the Games from Athens 1896 to Rio 2016.” User rgriffin scraped this data from www.sports-reference.com in May 2018. “Note that the Winter and Summer Games were held in the same year up until 1992. After that, they staggered them such that Winter Games occur on a four year cycle starting with 1994, then Summer in 1996, then Winter in 1998, and so on. A common mistake people make when analyzing this data is to assume that the Summer and Winter Games have always been staggered.”

The original source of the data in kaggle is here:

<https://www.kaggle.com/datasets/heesoo37/120-years-of-olympic-history-athletes-and-results/data>

The topics covered in this workshop include:

- Important Terminology
- Calculations
- Built-In Functions
- Sorting & Filtering Data
- Line Charts
- Column Charts

** Note

Excel is a Microsoft Office Software that is one of the most commonly used proprietary spreadsheet software. LibreOffice, OpenOffice.org, Gnumeric are other examples of open source spreadsheet programs. They have similar functionalities, although some might be represented

slightly differently.

2 Quick Introduction to Excel

Rows, Columns, and Cells

- Cells are identified by the row-column combination.
- Ranges of cells are identified by a colon (i.e. A2:I2, means the range of cells starting at A2 and finishing at I2).
- Convention is to organize your data with observations as rows and variables as columns.
- A good practice is to only put one value in each cell.
- Each Excel document is built of multiple worksheets. You can use them to organize your data and you can link data across worksheets, like tabs in a browser window.

Data Types

- The most common ones are numerical (right justified in cell) or textual (left justified in cell).
 - You can think of numerical data as intervals – any measurement that can be placed in ascending/descending order equidistant to the next value.
 - Numerical data will be right justified in the cell and textual, left justified.
- Binary variables are also a common data type.
 - Binary numbers are the language used by computers and are represented by zeros and ones.
 - A value of one indicates “true” or “yes,” and a value of zero indicates “false” or “no.”

3 General Tips

Tip #1: Freeze Panes

Sometimes when you have complex data it is really useful to have the headers stay at the top of the page, even if you scroll through rows of data. Excel has a functionality that allows you to do this really quickly. This functionality is called “Freeze Panes”.

You want to click on the View tab, and go to the Freeze Panes sub-section. You can then choose if you want to freeze the top row, the first column, or any two panes of your choice.

The screenshot shows the Microsoft Excel ribbon with the 'View' tab selected. In the 'View' tab's ribbon group, there is a 'Freeze Panes' button with a dropdown arrow. A context menu is open from this button, containing three items:

- Unfreeze Panes**: Description: Unlock all rows and columns to scroll through the entire worksheet.
- Freeze Top Row**: Description: Keep the top row visible while scrolling through the rest of the worksheet.
- Freeze First Column**: Description: Keep the first column visible while scrolling through the rest of the worksheet.

The main Excel window displays a table of data with columns for ID, Sex, Sex_Binary, Age, Team, NOC, City, Sport, Event, Medal, and Games. The first few rows of data are visible, including entries for Denmark, Finland, Sochi, London, Helsinki, and various Alpine Skiiing events.

ID	Sex	Sex_Binary	Age	Team	NOC	City	Sport	Event	Medal	Games
2	4 M	0	34	Denmark	DEN	Paris	Tug-Of-War	Tug-Of-War	Gold	1900 Summer
3	15 M	0	30	Finland	FIN	Antwerpen	Swimming	Swimming	Bronze	1920 Summer
4	15 M	0	30	Finland	FIN	Antwerpen	Swimming	Swimming	Bronze	1920 Summer
5	16 M	0	28	Finland	FIN	Sochi	Ice Hockey	Ice Hockey	Bronze	2014 Winter
6	17 M	0	28	Finland	FIN	London	Gymnastic	Gymnastic	Bronze	1948 Summer
7	17 M	0	32	Finland	FIN	Helsinki	Gymnastic	Gymnastic	Bronze	1952 Summer
8	17 M	0	28	Finland	FIN	London	Gymnastic	Gymnastic	Gold	1948 Summer
9	17 M	0	28	Finland	FIN	London	Gymnastic	Gymnastic	Gold	1948 Summer
10	17 M	0	28	Finland	FIN	London	Gymnastic	Gymnastic	Gold	1948 Summer
11	20 M	0	20	Norway	NOR	Albertville	Alpine Skii	Alpine Skii	Bronze	1992 Winter
12	20 M	0	22	Norway	NOR	Lillehamm	Alpine Skii	Alpine Skii	Bronze	1994 Winter
13	20 M	0	20	Norway	NOR	Albertville	Alpine Skii	Alpine Skii	Gold	1992 Winter
14	20 M	0	30	Norway	NOR	Salt Lake C	Alpine Skii	Alpine Skii	Gold	2002 Winter
15	20 M	0	30	Norway	NOR	Salt Lake C	Alpine Skii	Alpine Skii	Gold	2002 Winter
16	20 M	0	34	Norway	NOR	Torino	Alpine Skii	Alpine Skii	Gold	2006 Winter
17	20 M	0	22	Norway	NOR	Lillehamm	Alpine Skii	Alpine Skii	Silver	1994 Winter

Tip #2: use a pick list in Excel

Press Alt + Down Arrow to see a list of values already existing in your column. Let's say you wanted to change the team name for some athletes, and a few of the athletes that competed for West Berlin would be changed to Germany. If you wanted to see the different values, press Alt + Down arrow

	A	B	C	D	E	F	G	H	I	J	K
1	ID	Sex	Sex_Binary	Age	Team	NOC	City	Sport	Event	Medal	Games
2	4	M	0	34	Denmark/DEN	PAR	Tug-Of-Wa	Tug-Of-Wa	Gold	1900 Summer	
3	15	M	0	30	Finland	FIN	Antwerper	Swimming	Swimming	Bronze	1920 Summer
4	15	M	0	30	Finland	FIN	Antwerper	Swimming	Swimming	Bronze	1920 Summer
5	16	M	0	28	Gem IV	FIN	Sochi	Ice Hockey	Ice Hockey	Bronze	2014 Winter
6	17	M	0	28	Georgia	FIN	London	Gymnastic	Gymnastic	Bronze	1948 Summer
7	17	M	0	32	Germany	FIN	Helsinki	Gymnastic	Gymnastic	Bronze	1952 Summer
8	17	M	0	28	German	FIN	London	Gymnastic	Gymnastic	Gold	1948 Summer
9	17	M	0	28	German	FIN	London	Gymnastic	Gymnastic	Gold	1948 Summer
10	17	M	0	28	Ghana	FIN	London	Gymnastic	Gymnastic	Gold	1948 Summer
11	20	M	0	20	Norway	NOR	Albertville	Alpine Skii	Alpine Skii	Bronze	1992 Winter
12	20	M	0	22	Norway	NOR	Lillehamm	Alpine Skii	Alpine Skii	Bronze	1994 Winter
13	20	M	0	20	Norway	NOR	Albertville	Alpine Skii	Alpine Skii	Gold	1992 Winter
14	20	M	0	30	Norway	NOR	Salt Lake C	Alpine Skii	Alpine Skii	Gold	2002 Winter
15	20	M	0	30	Norway	NOR	Salt Lake C	Alpine Skii	Alpine Skii	Gold	2002 Winter
16	20	M	0	34	Norway	NOR	Torino	Alpine Skii	Alpine Skii	Gold	2006 Winter
17	20	M	0	22	Norway	NOR	Lillehamm	Alpine Skii	Alpine Skii	Silver	1994 Winter
18	20	M	0	22	Norway	NOR	Lillehamm	Alpine Skii	Alpine Skii	Silver	1994 Winter

Tip #3: Flash fill (ctrl + e)

Click on cell L1 and type “Year” then enter. Click on cell M1 and type “Season” then enter. We will use the flash fill shortcut to separate the year and season of the olympic games (the Games column). Type “1900” into cell L2, “Summer” into M2, “1920” into L3, “Summer” into M3, “1920” into L4, “Summer” into M4, and “2014” into L5 and “Winter” into M5.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	ID	Sex	Sex_Binary	Age	Team	NOC	City	Sport	Event	Medal	Games	Year	Season
2	4	M	0	34	Denmark/DEN	PAR	Tug-Of-Wa	Tug-Of-Wa	Gold	1900 Summer	1900	Summer	
3	15	M	0	30	Finland	FIN	Antwerper	Swimming	Swimming	Bronze	1920 Summer	1920	Summer
4	15	M	0	30	Finland	FIN	Antwerper	Swimming	Swimming	Bronze	1920 Summer	1920	Summer
5	16	M	0	28	Finland	FIN	Sochi	Ice Hockey	Ice Hockey	Bronze	2014 Winter	2014	Winter
6	17	M	0	28	Finland	FIN	London	Gymnastic	Gymnastic	Bronze	1948 Summer		
7	17	M	0	32	Finland	FIN	Helsinki	Gymnastic	Gymnastic	Bronze	1952 Summer		
8	17	M	0	28	Finland	FIN	London	Gymnastic	Gymnastic	Gold	1948 Summer		
9	17	M	0	28	Finland	FIN	London	Gymnastic	Gymnastic	Gold	1948 Summer		
10	17	M	0	28	Finland	FIN	London	Gymnastic	Gymnastic	Gold	1948 Summer		
11	20	M	0	20	Norway	NOR	Albertville	Alpine Skii	Alpine Skii	Bronze	1992 Winter		
12	20	M	0	22	Norway	NOR	Lillehamm	Alpine Skii	Alpine Skii	Bronze	1994 Winter		
13	20	M	0	22	Norway	NOR	Albertville	Alpine Skii	Alpine Skii	Gold	1994 Winter		

Click cell L6. Hold CTRL and e at the same time and release. The years of the olympic games should fill down column L. Repeat for column M for seasons. Cool!

4 Calculations

Excel is extremely powerful for executing mathematical calculations. Calculations are done through the use of formulas. For the moment, we will focus on simple mathematical formulas. Formulas can do simpler tasks, such as additions or multiplications, or more complex calculations, such as returning the cosine of an angle.

1. Formulas always begin with '='. This tells Excel that you are not just entering numbers.
2. You can write the function yourself, or you could refer to a preset formula
3. Math operators in Excel:
 - To add, use a plus sign: +
 - To subtract, use a minus sign (hyphen): -
 - To multiply, use the asterisk: *
 - To divide, use the backslash: /
 - Greater than is represented by the following sign: >
 - Less than is represented by the following sign: <
 - The math operator for “not equal” (i.e. “does not equal”) is represented by the less than and greater than signs together, like a diamond: ◊

Example I: Total Medals = Gold + Silver + Bronze

Click on the Medals_OverTime_All sheet. This sheet contains information on the number of gold, silver, and bronze medals. We are interested in the total number of medals per country by year, which is the sum of gold, silver, and bronze medals for each year.

Here are the steps to calculating the total number of medals?

1. Label the column where this variable will go, in this case F1.
2. In the cell that is on the same row as the values you want to add, type the formula.
3. The formula is =B2+C2+D2
4. Press enter.

See the figure below:

	A	B	C	D	E	F	G
1	Year	Gold_All	Silver_All	Bronze_All	Canada_Totals	Total medals	
2	1896	62	43	38		=B2+C2+D2	
3	1900	201	228	175	2		
4	1904	173	163	150	48		
5	1906	157	156	145	2		
6	1908	294	281	256	52		
7	1912	326	315	300	8		

Now you want this calculation to apply to the whole column. To do this, select cell F2 then place your cursor over the bottom right corner of cell F2; you will see the cursor become a small black cross. Double click to autofill the column. If you select any cell in that column, you should see the formula but the row numbers should refer to that row's data. The column should look like the following figure.

SHEET VIEW WORKBOOK VIEWS

F6 $=B6+C6+D6$

A	B	C	D	E	F	G
1	Year	Gold_All	Silver_All	Bronze_All	Canada_Totals	Total medals
2	1896	62	43	38		143
3	1900	201	228	175	2	604
4	1904	173	163	150	48	486
5	1906	157	156	145	2	458
6	1908	294	281	256	52	831
7	1912	326	315	300	8	941
8	1920	493	448	367	16	1308
9	1924	332	319	311	29	962
10	1928	275	267	281	45	823
11	1932	261	246	232	59	739
12	1936	348	347	330	35	1025
13	1948	330	332	325	22	987
14	1952	351	335	347	21	1033
15	1956	353	342	348	39	1043
16	1960	359	342	357	30	1058
17	1964	408	406	401	12	1215
18	1968	425	410	421	30	1256

This method is called relative referencing because the cell references change to correspond to the current row of data (i.e. the formula is relative to the row where it's located). Even though we typed ‘=B2+C2+D2’ the formula in the sixth row says ‘=B3+C3+D3’ instead. Relative referencing is one of the ways to reference a cell.

Example II: Percent of Total Medals for Canada = (Canada total/Over total) * 100

We also want to calculate the percent of the total medals that were earned by team Canada and then display that number as a percent rather than a proportion decimal. We will start by calculating the proportion of the total medals that went to Canada for each year.

Here are the steps to calculating the proportion of medals that went to Canada:

5. Label the column where this variable will go, in this case G1.
6. In the cell that is on the same row as the values you want to add (G2), type the formula.
7. The formula is =E2/F2
8. Press enter.
9. Apply the calculation to the whole column. To do this, select cell G2 then place your cursor over the bottom right corner of cell G2; you will see the cursor become a small black cross. Double click to autofill the column.

	A	B	C	D	E	F	G	H
1	Year	Gold_All	Silver_All	Bronze_All	Canada_Totals	Total medals	Canada Totals	Proportion
2	1896	62	43	38		143		0
3	1900	201	228	175	2	604		0.003311258
4	1904	173	163	150	48	486		0.098765432
5	1906	157	156	145	2	458		0.004366812
6	1908	294	281	256	52	831		0.062575211
7	1912	326	315	300	8	941		0.008501594
8	1920	493	448	367	16	1308		0.012232416
9	1924	332	319	311	29	962		0.03014553
10	1928	275	267	281	45	823		0.054678007

Now we will convert the decimal proportion to a percent. To do this we can use absolute referencing. We will start by entering '100' in cell H1.

Then we will label column I ‘Canada Percent of Total Medals’ then use the formula ‘=G2*H1’ in cell I2 and press enter. You should see the correct calculation (which will be 0 since 0*100 is 0).

	A	B	C	D	E	F	G	H	I	J
1	Year	Gold_All	Silver_All	Bronze_All	Canada_Totals	Total medals	Canada Totals Proportion	100	Canada Percent of total medals	
2	1896	62	43	38		143		0	=G2*H1	
3	1900	201	228	175	2	604	0.003311258			
4	1904	173	163	150	48	486	0.098765432			
5	1906	157	156	145	2	458	0.004366812			
6	1908	294	281	256	52	831	0.062575211			
7	1912	326	315	300	8	941	0.008501594			
8	1920	493	448	367	16	1308	0.012232416			
9	1924	332	319	311	29	962	0.03014553			
10	1928	275	267	281	45	823	0.054678007			
11	1932	261	246	232	59	739	0.079837618			

If you were to apply this formula without using absolute referencing to the rest of the column you would see 0’s autopopulate the whole column like in the following figure.

	A	B	C	D	E	F	G	H	I	J
1	Year	Gold_All	Silver_All	Bronze_All	Canada_Totals	Total medals	Canada Totals Proportion	100	Canada Percent of total medals	
2	1896	62	43	38		143		0	0	
3	1900	201	228	175	2	604	0.003311258		0	
4	1904	173	163	150	48	486	0.098765432		0	
5	1906	157	156	145	2	458	0.004366812		0	
6	1908	294	281	256	52	831	0.062575211		0	
7	1912	326	315	300	8	941	0.008501594		0	
8	1920	493	448	367	16	1308	0.012232416		0	
9	1924	332	319	311	29	962	0.03014553		0	
10	1928	275	267	281	45	823	0.054678007		0	
11	1932	261	246	232	59	739	0.079837618		0	
12	1936	348	347	330	35	1025	0.034146341		0	
13	1948	330	332	325	22	987	0.022289767		0	
14	1952	351	335	347	21	1033	0.020329138		0	
15	1956	353	342	348	39	1043	0.037392138		0	
16	1960	359	342	357	30	1058	0.028355388		0	
17	1964	408	406	401	12	1215	0.009876543		0	
18	1968	425	410	421	30	1256	0.02388535		0	
19	1972	474	455	485	12	1414	0.008486563		0	
20	1976	508	505	518	26	1531	0.016982364		0	
21	1980	520	521	542	2	1602	0.001219420		0	

If you look at the formula in cell I3, you should see “=G3*H2.” Cell H2 is actually blank, and Excel reads blank cells as zero and thus is multiplying the proportion in column G by 0. Instead of multiplying by cell H2, we wanted to still refer to cell H1, which equals 100. This is an example of absolute referencing. If you wish to always refer to a specific cell’s value, you can use absolute references. This referencing is achieved by adding a dollar sign (\$) either before the column letter, the row number or before both. If you autofill the formula across multiple rows,

you can add the dollar sign before the row number (row identifier, i.e. I\$2), since the letter would never change. If you want to copy a formula across multiple columns, you then add the dollar sign before the column letter (\$I2). When in doubt, you can add both (\$I\$2).

We can edit our original formula to force Excel not to update the cell H1 reference as we apply the formula to the rest of the column. To do this, click on cell I2 to edit the formula. You want to add dollar signs in front of the H and in front of the 1, like in the following figure.

	A	B	C	D	E	F	G	H	I	J
1	Year	Gold_All	Silver_All	Bronze_All	Canada_Totals	Total_medals	Canada_Totals	Proportion	Canada_Percent_of_total_medals	
2	1896	62	43	38		143	0		=G2*\$H\$1	
3	1900	201	228	175	2	604	0.003311258		0	
4	1904	173	163	150	48	486	0.098765432		0	
5	1906	157	156	145	2	458	0.004366812		0	
6	1908	294	281	256	52	831	0.062575211		0	
7	1912	326	315	300	8	941	0.008501594		0	
8	1920	493	448	367	16	1308	0.012232416		0	
9	1924	332	319	311	29	962	0.03014553		0	
10	1928	275	267	281	45	823	0.054678007		0	
11	1932	261	246	232	59	739	0.079837618		0	
12	1936	348	347	330	35	1025	0.034146341		0	

The dollar signs tell Excel not to update that cell reference when you apply the formula to the rest of the column. This is why we call this method absolute referencing. Excel sometimes uses the dollar sign to create charts, don't feel intimidated if you come across dollar signs, just think that it refers to a specific cell, no matter how much you drag, copy, or autofills the formula.

Once we edit the formula in cell I2, we can apply the formula to the rest of the column.

Another option for changing a decimal proportion to a percent is by highlighting the data in column G (click on G2, hold down CTRL+Shift+Down Arrow at the same time or Command+Shift+Down arrow on a Mac, and the whole column should select). Go to the home ribbon and click on the little percent sign icon (see figure below).

The screenshot shows the Microsoft Excel ribbon with the 'Home' tab selected. In the 'Number' group, a dropdown menu is open, showing options like 'General', '\$', '%', and commas. A red arrow points to the '%' icon. The status bar at the bottom right displays 'Percent Style (Ctrl+Shift+%)' and 'Format as a percent.' Below the ribbon, a table is visible with columns for Year, Gold_All, Silver_All, Bronze_All, Canada_Totals, Total medals, Canada Totals, and Proportion. The 'Proportion' column contains numerical values representing proportions of the total medals.

	A	B	C	D	E	F	G	
1	Year	Gold_All	Silver_All	Bronze_All	Canada_Totals	Total medals	Canada Totals	Proportion
2	1896	62	43	38		143		0
3	1900	201	228	175	2	604		0.003311258
4	1904	173	163	150	48	486		0.098765432
5	1906	157	156	145	2	458		0.004366812
6	1908	294	281	256	52	831		0.062575211
7	1912	326	315	300	8	941		0.008501594
8	1920	493	448	367	16	1308		0.012232416
9	1924	332	319	311	29	962		0.03014553
10	1928	275	267	281	45	823		0.054678007
11	1932	261	246	232	59	739		0.079837618
12	1936	348	347	330	35	1025		0.034146341
13	1948	330	332	325	22	987		0.022289767

Column G should be converted into percentages with the percent sign.

Note on troubleshooting errors

Excel always gives you some information when you make an error. The first thing to notice is that error messages always start with a hashtag (#) and finish with a punctuation sign (often ! or ?). For example, the “#DIV/0!” error is the message that appears when you try dividing a number by zero. This is because empty cells are treated as zeros for the purposes of mathematical calculations. The error message is short, but meant to give you some information. Other common error messages are: #NAME?, #NULL!, #REF!, #VALUE!. If you see those, don’t panic and try copying the error in Google. You can also hover your cursor over the small green triangle that appears in the top left corner of the cell with an error message. This will reveal a yellow caution sign with an explanation point, which is a drop down menu that you can click to gain further information about the error or help.

5 Built-In Functions

Rather than type out every calculation by hand, we can use Excel's built-in functions. Common calculations like averages, medians, sums, and maximums have their own Excel functions.

If you think Excel may have the function you want to use you can go to the 'Formulas' tab and select 'Insert Function'. The functions are organized categorically in the function library (to the right of the 'Insert Function' box).

How to calculate the average total medals

There are two ways to access Excel's built-in formulas. You can either look at the Formulas tab and through the different categories. Formulas are organized alphabetically. Average is under More Functions > Statistical. When you go this way, a pop-up window appears and gives you information about how to use the formula and what data the formula expects. When the formula asks for a number, you can enter a number, a cell identifier, a range, ...

The other way is to type the name of the formula, in this case "Average". Once you start typing "A" a dropdown will appear. You can double-click on the formula you want. A shadow explanation will show up, helping you understand the formula.

In cell K1 type the label 'Average Total Medals'. In cell K2 you will calculate the average by entering the formula '=AVERAGE(F2:F36)'. Instead of typing the cell references, try clicking on cell F2 and dragging the cursor down to cell F36 then typing the close parenthesis. The formula should look like the following figure.

	B	C	D	E	F	G	H	I	J	K	L
1	Gold_All	Silver_All	Bronze_All	Canada_Totals	Total medals	Canada Totals Proportion	100	Canada Percent of total medals		Average total medals	
2	62	43	38		143	0%		0		=average(F2:F36)	
3	201	228	175	2	604	0%		0.331125828			
4	173	163	150	48	486	10%		9.87654321			
5	157	156	145	2	458	0%		0.436681223			
6	294	281	256	52	831	6%		6.257521059			
7	326	315	300	8	941	1%		0.850159405			
8	493	448	367	16	1308	1%		1.22324159			
9	332	319	311	29	962	3%		3.014553015			
10	275	267	281	45	823	5%		5.467800729			
11	261	246	232	59	739	8%		7.98376184			
12	348	347	330	35	1025	3%		3.414634146			
13	330	332	325	22	987	2%		2.228976697			
14	351	335	347	21	1033	2%		2.032913843			
15	353	342	348	39	1043	4%		3.739213806			

6 Functions and Calculation Tips

Tip #4: AutoSum

This is not exactly a tip, but a shortcut created by Excel for easily calculating Sums.

Let's say you would like to have the Sum of all medals earned by Canada. You can simply go at the bottom of the column and click and AutoSum. Excel will automatically select the range of data that makes most sense based on what cell you selected.

Extra tip: Instead, try to stay at the bottom of the column and click on Alt and +=

The screenshot shows the Microsoft Excel ribbon with the 'Formulas' tab selected. In the 'Function Library' group, the 'Insert Function' button is highlighted with a red arrow. The formula bar displays the formula '=SUM(E3:E36)'. Below the ribbon, a table is visible with columns labeled 'Gold_All', 'Silver_All', 'Bronze_All', 'Canada_Totals', 'Total medals', 'Canada Totals', and 'Proportion'. The 'Proportion' column contains percentages such as 3%, 11%, 2%, etc. The 'Canada_Totals' column shows values like 1842, 440, 2004, etc. The 'Total medals' column shows values like 608, 605, 629, etc. The 'Silver_All' column shows values like 145, 145, 150, etc. The 'Bronze_All' column shows values like 663, 661, 680, etc. The 'Gold_All' column shows values like 162, 157, 159, etc.

Tip #5: Adding the Current Date or Current Time

If you want to add today's date to your spreadsheet. Let's say you want to add a last updated date and time at the bottom of the table on one of the sheets:

- Click on Ctrl + Semicolon (;) to add the current date.
- Click on Ctrl + Shift + Colon (:) to add the current time.

Tip #6: Combine Text Quickly

I would like to have one column that contains both the team and the event. Using the Flash Fill Example, click on column N. Instead of using the Concatenate function (which is an option), you can simply write =E2& “,”&I2. If you try to use the plus sign (+), Excel will return an error, but using the ampersand (&) allows you to combine text.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	ID	Sex	Sex_Binary	Age	Team	NOC	City	Sport	Event	Medal	Games	Year	Season	Team and Event		
2	4	M	0	34	Denmark/DEN		Paris	Tug-Of-War	Tug-Of-War	Gold	1900 Summer	1900 Summer		Denmark/Sweden, Tug-Of-War Men's T		
3	15	M	0	30	Finland	FIN	Antwerpen	Swimming	Swimming	Bronze	1920 Summer	1920 Summer		Finland, Swimming Men's 200 metres B		
4	15	M	0	30	Finland	FIN	Antwerpen	Swimming	Swimming	Bronze	1920 Summer	1920 Summer		Finland, Swimming Men's 400 metres B		
5	16	M	0	28	Finland	FIN	Sochi	Ice Hockey	Ice Hockey	Bronze	2014 Winter	2014 Winter		Finland, Ice Hockey Men's Ice Hockey		
6	17	M	0	28	Finland	FIN	London	Gymnastic	Gymnastic	Bronze	1948 Summer	1948 Summer		Finland, Gymnastics Men's Individual A		
7	17	M	0	32	Finland	FIN	Helsinki	Gymnastic	Gymnastic	Bronze	1952 Summer	1952 Summer		Finland, Gymnastics Men's Team All-Ar		
8	17	M	0	28	Finland	FIN	London	Gymnastic	Gymnastic	Gold	1948 Summer	1948 Summer		Finland, Gymnastics Men's Team All-Ar		
9	17	M	0	28	Finland	FIN	London	Gymnastic	Gymnastic	Gold	1948 Summer	1948 Summer		Finland, Gymnastics Men's Horse Vault		
10	17	M	0	28	Finland	FIN	London	Gymnastic	Gymnastic	Gold	1948 Summer	1948 Summer		Finland, Gymnastics Men's Pommelled		
11	20	M	0	20	Norway	NOR	Albertville	Alpine Skii	Alpine Skii	Bronze	1992 Winter	1992 Winter		Norway, Alpine Skiing Men's Giant Slalo		
12	20	M	0	22	Norway	NOR	Lillehamm	Alpine Skii	Alpine Skii	Bronze	1994 Winter	1994 Winter		Norway, Alpine Skiing Men's Super G		
13	20	M	0	20	Norway	NOR	Albertville	Alpine Skii	Alpine Skii	Gold	1992 Winter	1992 Winter		Norway, Alpine Skiing Men's Super G		
14	20	M	0	30	Norway	NOR	Salt Lake City	Alpine Skii	Alpine Skii	Gold	2002 Winter	2002 Winter		Norway, Alpine Skiing Men's Super G		
15	20	M	0	30	Norway	NOR	Salt Lake City	Alpine Skii	Alpine Skii	Gold	2002 Winter	2002 Winter		Norway, Alpine Skiing Men's Combined		
16	20	M	0	24	Norway	NOR	Torino	Alpine Skii	Alpine Skii	Gold	2006 Winter	2006 Winter		Norway, Alpine Skiing Men's Super G		

7 Trend Charts

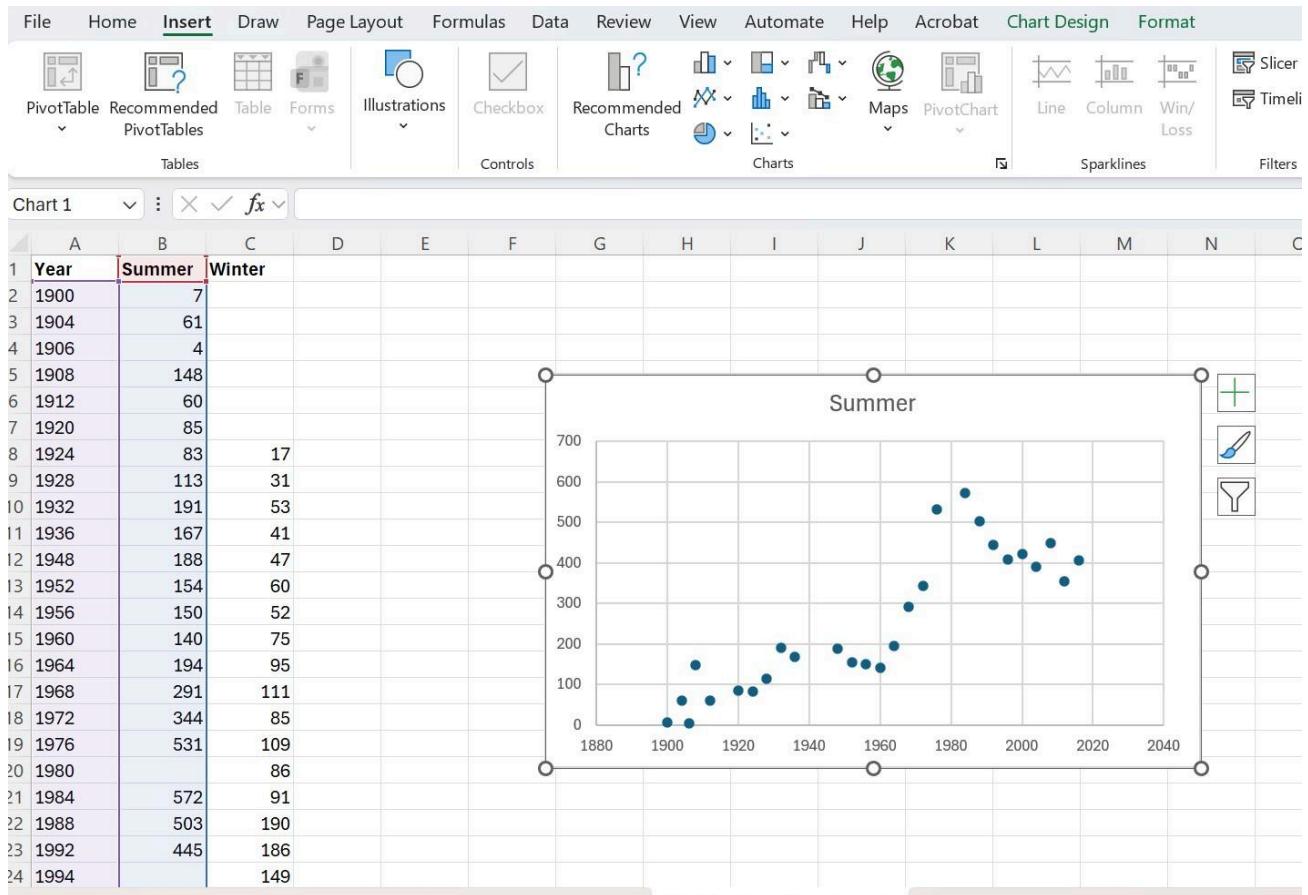
While calculations like averages help us understand our data, charts are very useful for understanding multiple dimensions of our data. Trend charts are useful for visualizing the relationship between two or more variables over a time series or a series of events (e.g. years, temperature change, etc). We want to plot the relationship between the number of medals earned by Canada across Summer and Winter games over the years. Basically, we want to answer the question: how has Canada's medal count changed over time depending on the summer or winter games? The chart won't necessarily answer this question directly, but will enable us to quickly identify patterns or trends to investigate further.

To start, we want to look at the next worksheet of data in "Medals_Over_Time_Canada." The data looks like the following figure.

	A	B	C	D
1	Year	Summer	Winter	
2	1900	7		
3	1904	61		
4	1906	4		
5	1908	148		
6	1912	60		
7	1920	85		
8	1924	83	17	
9	1928	113	31	
10	1932	191	53	
11	1936	167	41	
12	1948	188	47	
13	1952	154	60	
14	1956	150	52	
15	1960	140	75	
16	1964	194	95	
17	1968	291	111	
18	1972	344	85	
19	1976	531	109	
20	1980		86	
21	1984	572	91	
22	1988	503	190	
23	1992	445	186	
24	1996		149	

Go to the “Insert” tab, and look within the ‘Charts’ group where you will see small icons representing different types of charts (e.g. column chart, pie chart, etc). [Choosing the relevant chart](#) depends on the nature of your data. Most charts in Excel (e.g. bar, column, line) will treat the horizontal axis (x-axis) as a text/string type of data, meaning the visualization will display differences across categories. If you would like to display numeric data on the x-axis, you will need to use a scatter plot (even for a histogram). Which chart should we select to visualize these data?

Select the first data series you want to chart. There are two ways to construct charts in Excel: by pre-selecting data to appear in the chart or by scratch (using a blank chart). We will pre-select data for this chart. To build a time series chart in excel (showing trends over time as discrete units), time needs to be on the horizontal (x) axis. By convention, the independent variable is always displayed on the x-axis and the dependent variable is displayed on the y-axis (vertical axis). Sometimes it's difficult to decide which variable is independent of the other. Independent means that a variable does not change or is not affected by the other (dependent) variable, but rather that the independent variable causes a change or affects the dependent variable. Time is always independent (nothing affects time directly, but everything else can change as a consequence of the movement of time). Thus, we want "year" to be on the x-axis. When pre-selecting more than one column, the column on the left will be placed on the x-axis and the column on the right will be placed on the y-axis. The columns will need to be directly adjacent to each other. Our table in the Medals_Over_Time_Canada sheet is thus set up correctly. Select the Year and Summer columns, including these variable names (e.g. select from cell A1 to B35). Select the "Scatter" drop-down box, and select the first option (Scatter). The initial chart should look like the following figure:



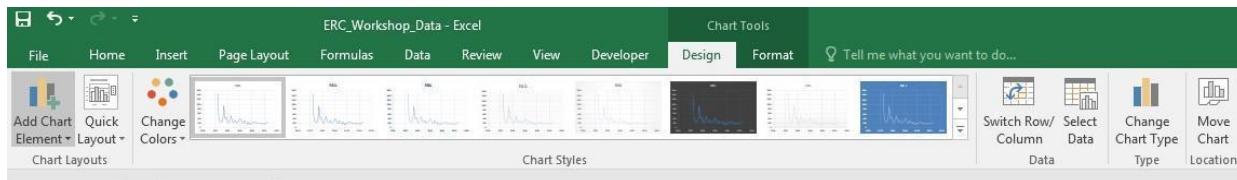
Discussion points

- What other charts are available to you?
- Is there another chart that could be used to represent the date?
- Why did we suggest the scatter chart instead of a line chart?

The reason why we chose the scatter chart (including scatter line) instead of a line chart is because our independent variable (the variable that goes on the horizontal/x-axis) is numerical. Line charts in Excel treat all variables as text. That means that we would not be able to edit the chronological order of the horizontal axis or zoom in on specific years. Basically, we would not have the ability to edit dates as numbers.

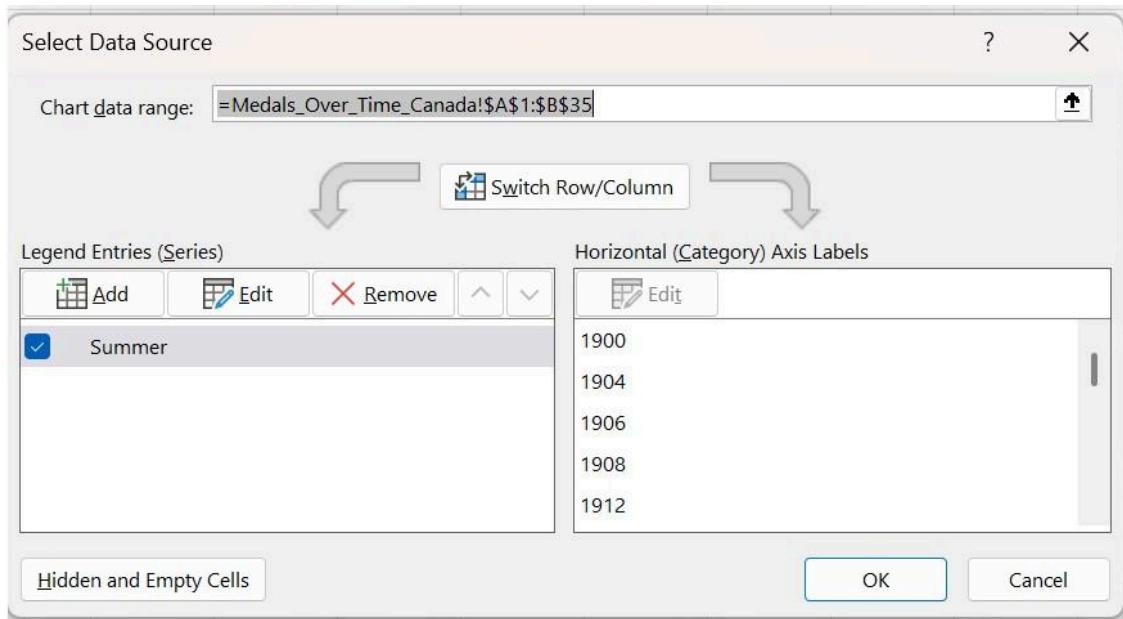
This line chart illustrates the total medals earned by Canada trend over time for the summer olympic games. Now we want to add another data series (variable) to this chart for medals earned by Canada over time for the winter olympic games. To do this you want to click on the

chart to select it. Then you want to click on the “Select Data” button under the “Design” tab, seen below.

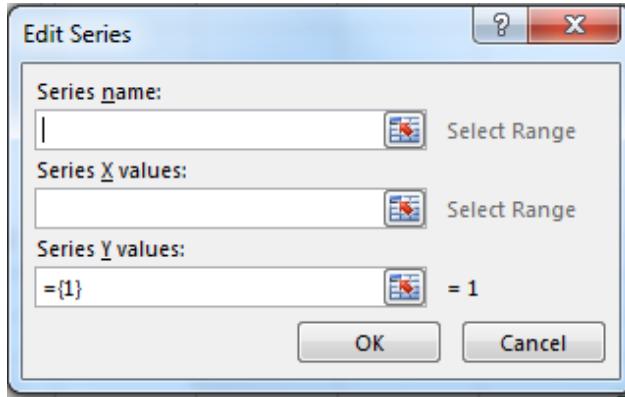


The “Select Data” button should open a pop-up dialog window like below.

This dialog box currently shows that your chart already has one series called “Summer.”

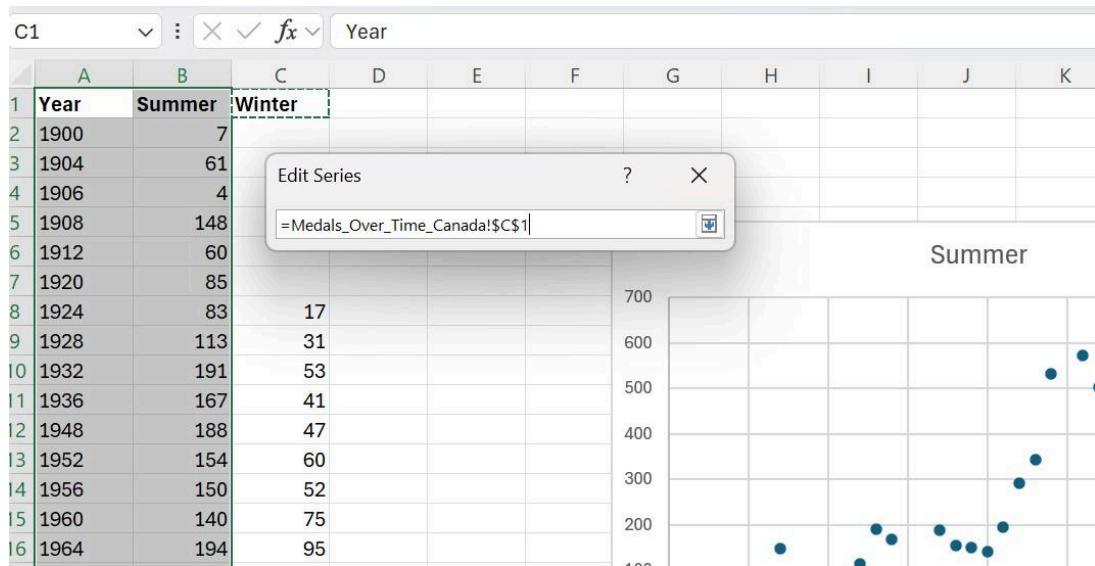


Now we want to add a second series for the winter games. To do this click the “Add” button under “Legend Entries (Series).” You will see a new pop up window like the figure below.

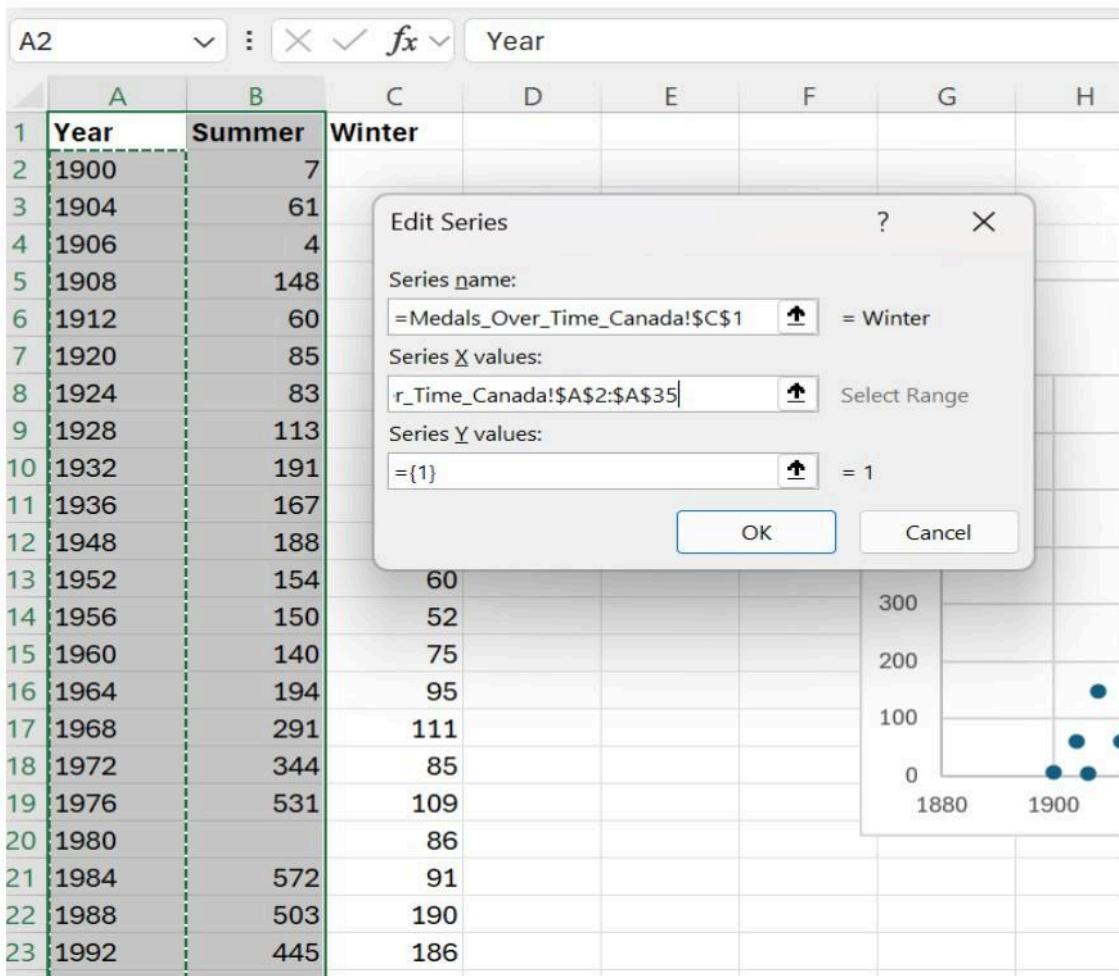


This window lets us name the second series (to be displayed in a legend), enter the X values to be graphed, and enter the Y values.

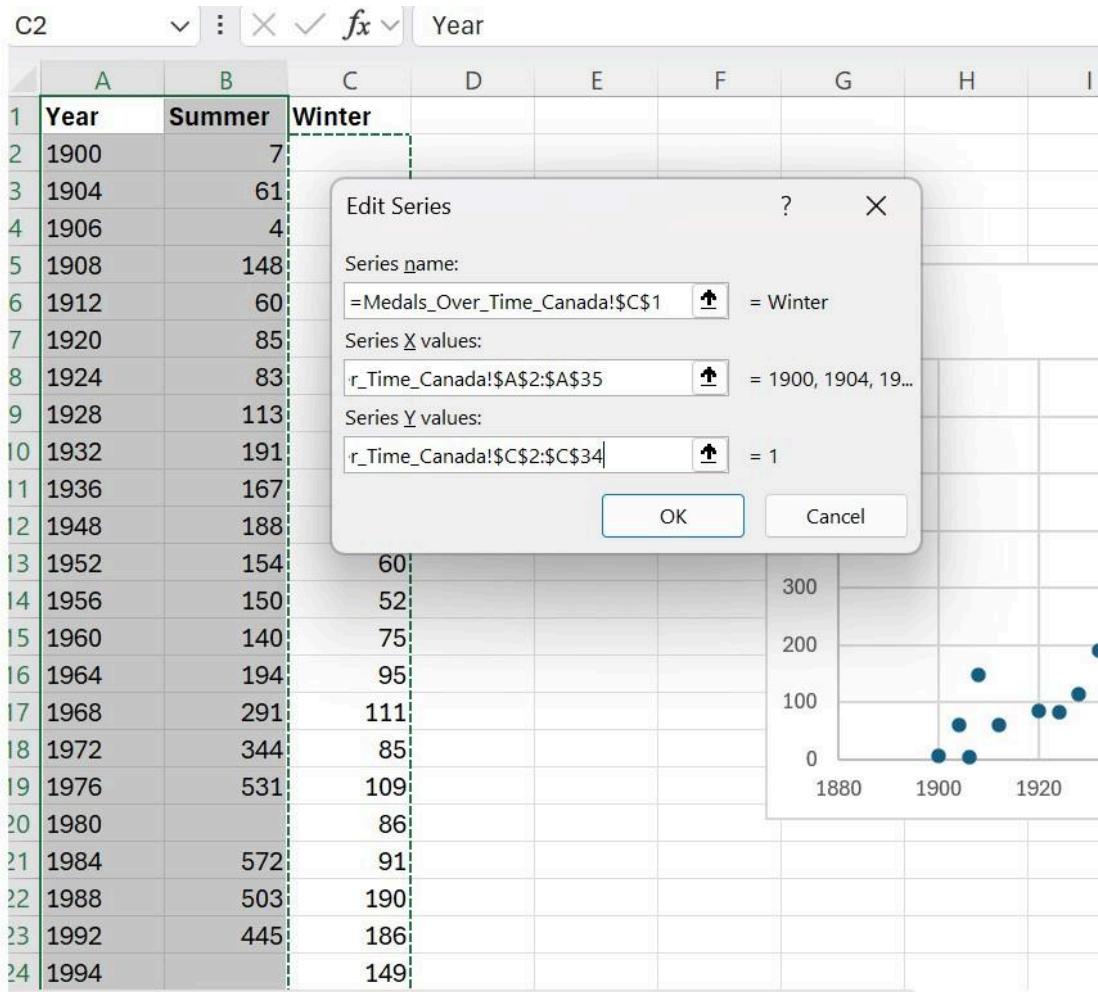
To name the series click on the button next to the “Series name” text box. Now we want to click on the single cell that contains the name of the series, “Winter” in cell C1 like below. You could also type the word “Winter”. Then you want to press Enter to be taken back to the previous window. A reason we might want to click on the cell rather than type the cell reference is because we may need to specify the Worksheet as well, so clicking tends to be more efficient and ensure there won’t be errors down the line.



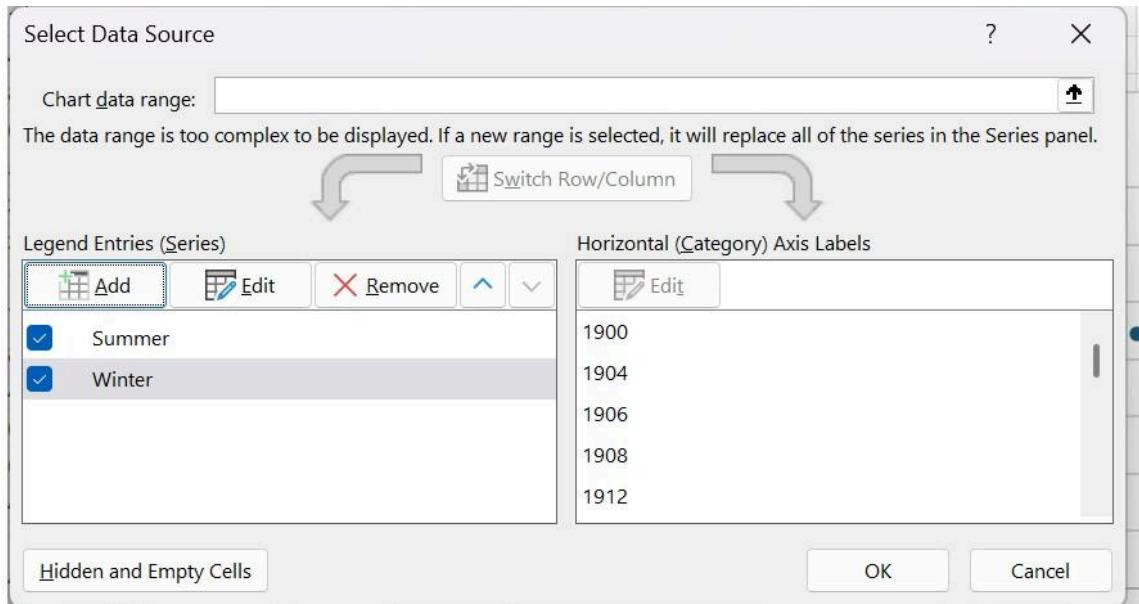
Next we want to add the X values of the Winter series. We want years on the X axis, so we are going to select the data in the Year column. The Y values will then match up to these X values by row number. Start by clicking the button next to the “Series X values” text box. Now we want to select only the data in the “Year” column, not the variable label. So, select from cell A2 to cell A35, like below. Then press Enter.



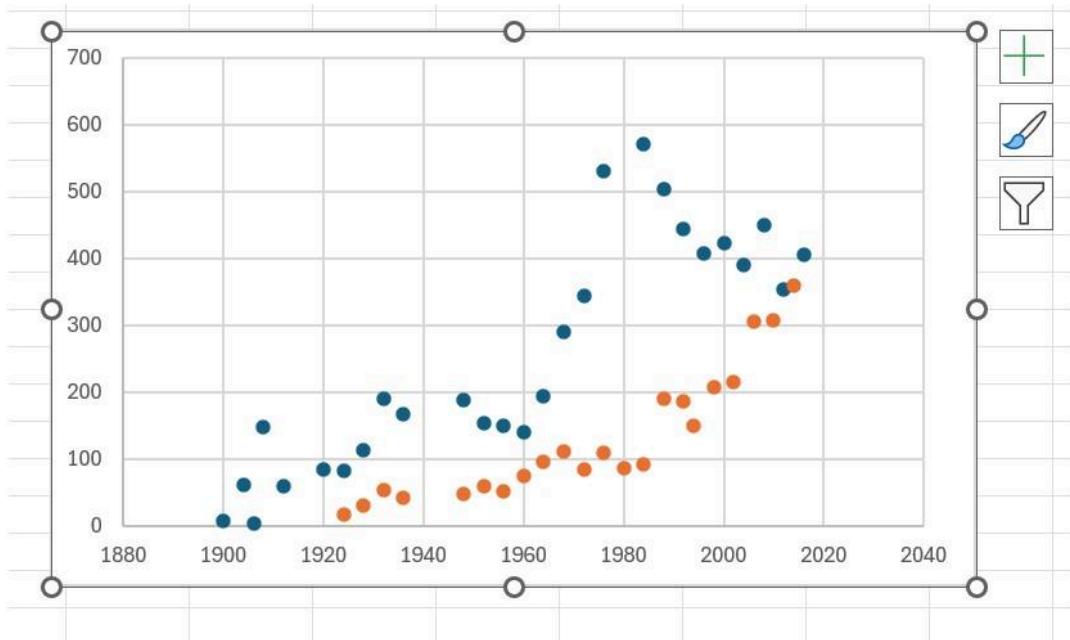
The last piece of information is the Y values of the Winter series. Start by clicking on the button next to the “Series Y values” text box. You will see that the text box already has “={1}” entered. Delete this!! It is really important that you not click on any cells until this text box is empty. Now we want to select only the data in the “Winter” column, not the variable label. So, select from cell C2 to cell C34. Then press Enter. Once all three text boxes have been filled, the pop up window should look like the following figure.



Now press “OK” to be taken back to the first pop up window. The first pop up window should now look like the following figure. This pop up window indicates that we have two series on the same chart: Summer and Winter.



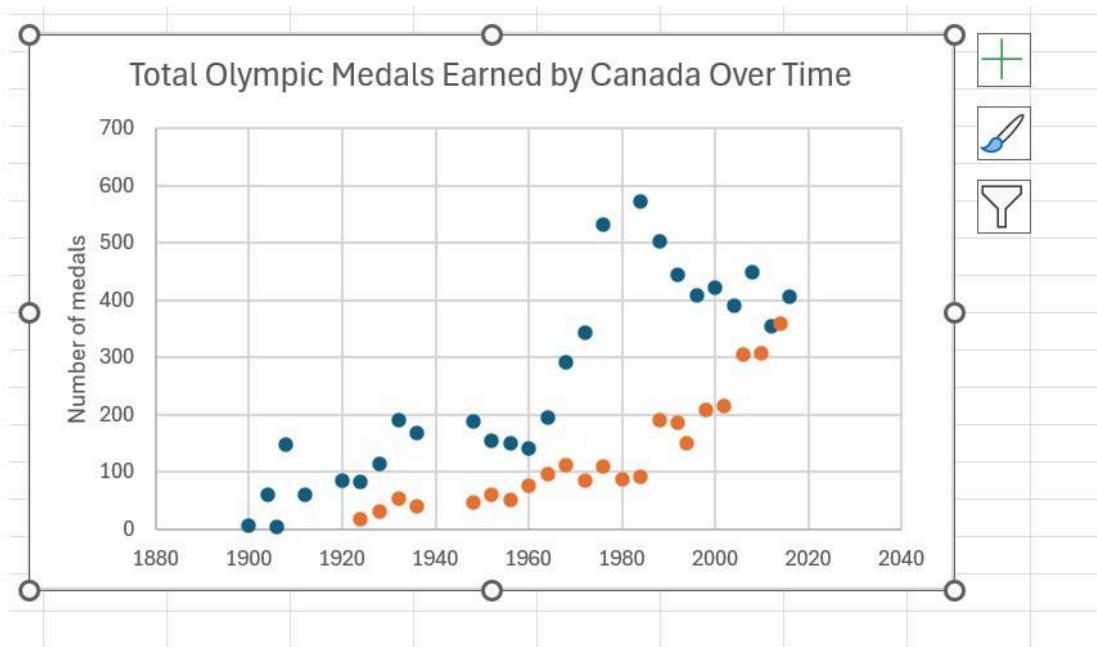
Click on “OK” to see the new chart, like below!



While we know that this chart is correct and what it means, it would not be clear to anyone else. For a chart to be effective, the information needs to be explicit. Formatting the chart will make a significant difference. Important elements include:

- Chart and Axis Title
- Legend
- Removing white space around the data (formatting the axes)

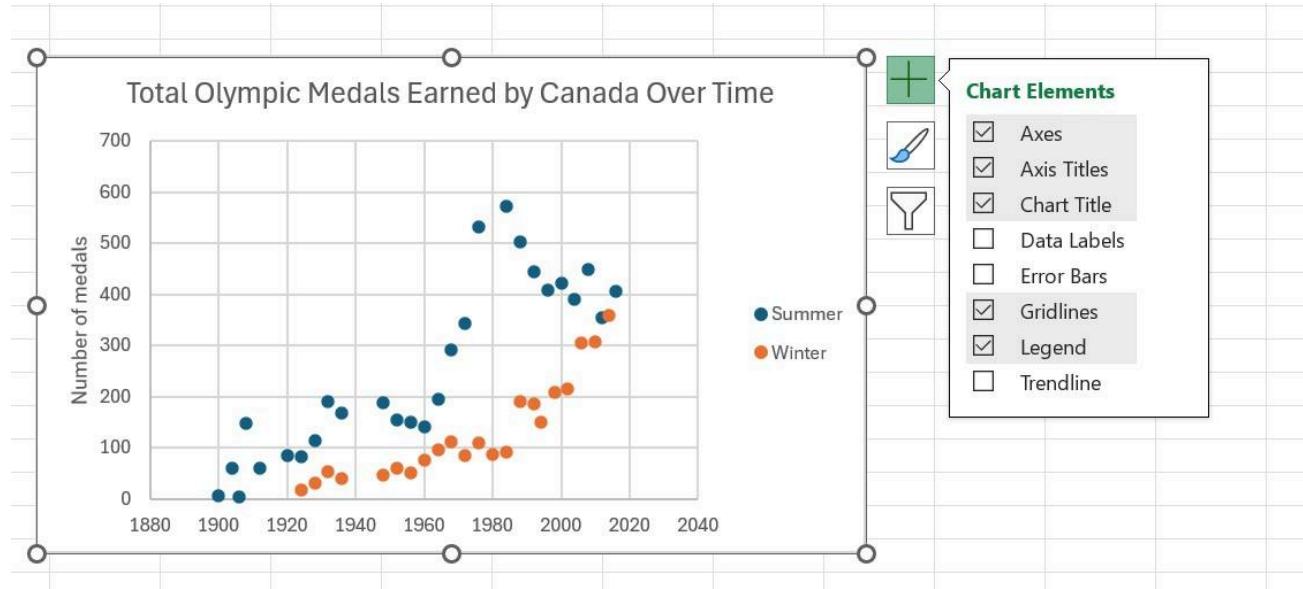
To add chart and axes titles, click on the chart once and then click on the green plus sign in the top right corner of the chart. Check “Chart Title” and “Axes Titles.” You can edit the titles in the text boxes that appear on the chart. Change the chart title to “Total Medals Earned by Canada Over Time.” Label the Y-axis “Frequency of Medals.” It is important to always include the units. To delete the X axis title, select the text box and press Backspace. When time is on the X axis you do not need an axis title (it’s the one case where it’s obvious that it’s a year or a date). Your chart should now look like the following figure.



Exercise

Now can you try adding a legend indicating which colored dots indicate the medals for summer vs. winter. To insert a legend, select the green plus, select “legend.” To change the placement of the legend, select the arrow to the right of “legend” and choose among the options. Your chart

should now look like the following figure.

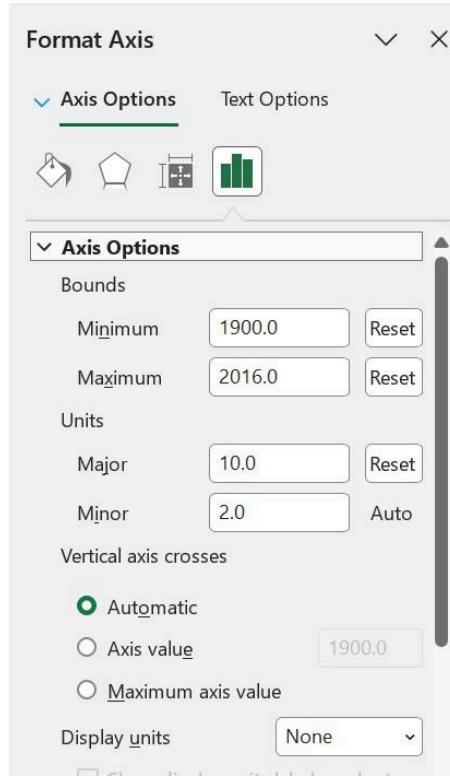


- Chart size

Select the chart and move your mouse over one of the square boxes on each corner and in the center of the borders. When the cursor looks like a double arrow then click and drag the borders of the chart to the preferred size. Solid lines will show the new size. The chart will automatically adjust all of the features like the titles and legend.

- Axis limits

Select the green plus sign, select “Axes,” select the arrow to the right of “Axes,” and select “More Options” to edit formatting. A sidebar should open. To change the numbering on the axes, select “Axis Options,” then select the bar chart icon, and select the “Axis Options” drop down. The sidebar should look like the following figure.



X-Axis Sidebar

You will have to edit each axis one at a time. To edit the X-axis click on the X-axis on the chart. Then the sidebar will reflect the X axis settings. The “Minimum” changes where the chart begins on the left. The “Maximum” changes where the chart ends on the right. The “Major Unit” changes the interval between the tick marks and labels. What happens if you add a minimum and a maximum? Try changing the minimum to 1900 and the maximum to 2016.

Now you will have to switch to editing the Y-axis. To do this, click on one of the numbers in the Y-axis, and the sidebar will change to reflect the Y-axis. Change the major unit to 10. The sidebar should look like the following figure.

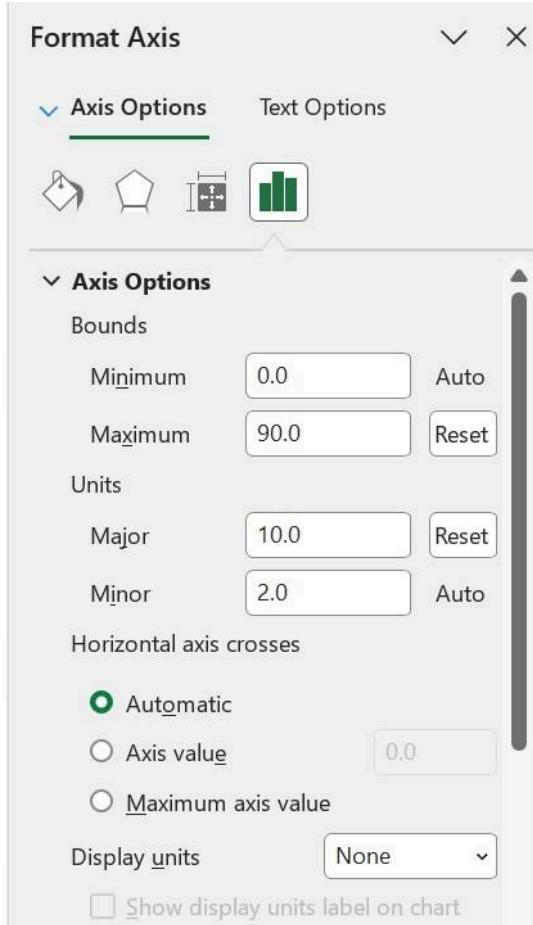
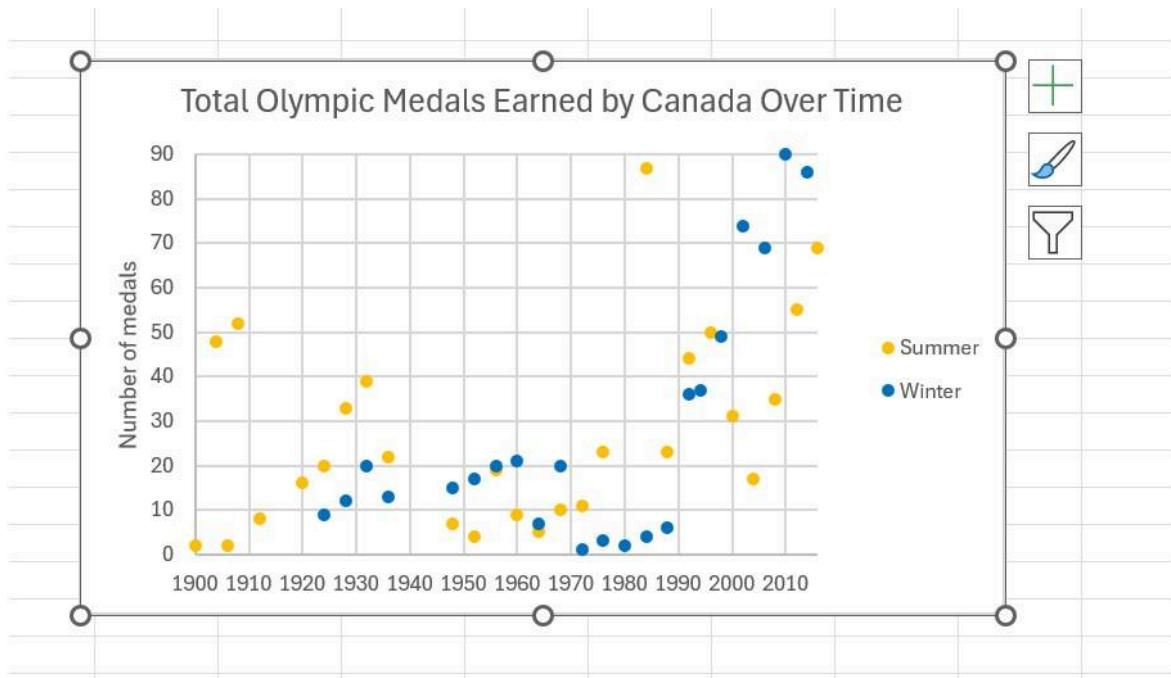


Figure 31: Y-Axis Sidebar

Your final chart should look like the figure below! Now you know how editing certain features works, you should be able to edit other features. How do you think you edit the grid-lines? Click the green plus sign at the top right corner of the chart and un-select the box next to “gridlines”.



8 Exporting into Word

Charts are a great way to understand your data before conducting any formal analyses. However, they are also very useful tools in final reports. Having the chart in Excel won't work if you want to include it in a report, but you can export your chart in Word!

Select the chart; copy (CTRL + C) & paste it (CTRL + V) into a Word document. The formatting will change, and the chart will remain editable! The colors will likely change, like the following figure. What could be a solution to prevent this? What would be the best way to add your chart to Word while making sure the chart will never change?

To prevent this, paste the chart as a picture. Right click on the Word document and under 'Paste Options' select 'Picture'. Then your chart will neither change nor be editable.

9 Cross-Sectional Charts-

Cross-sectional data compare units for one point in time (vs a time series). Column charts are useful when you have cross-sectional categorical data. We want to plot the number of medals in each medal category by the season of the olympic games.

To start, we want to look at the next worksheet of data in “Medals_bySeason_Canada.” The data looks like the following figure.

	A	B	C	D	E	F	G	H	I	J	K
1	Olympic Season	Gold	Silver	Bronze							
2	Summer	158	239	344							
3	Winter	305	199	107							
4											
5											
6											
7											
8											
9											
10											
11											

Tip #9 : Analyze Data

Instead of making the chart ourselves, let's see if Excel's fun built-in machine learning buddy can generate the chart for us! Click on the Analyze Data in the Data ribbon (if enabled from your enterprise Microsoft product - if it's not follow the next set of instructions to create the chart manually).

The screenshot shows the Microsoft Excel ribbon with the 'Data' tab selected. In the 'Data Tools' group, the 'What-If Analysis' button is highlighted with a red arrow. A tooltip window titled 'Analyze Data' is open, containing the text: 'Discover more about your data. Analyze Data looks for patterns in your data that it can use to create intelligent, personalized suggestions.' The main worksheet area shows a table with data for Olympic seasons.

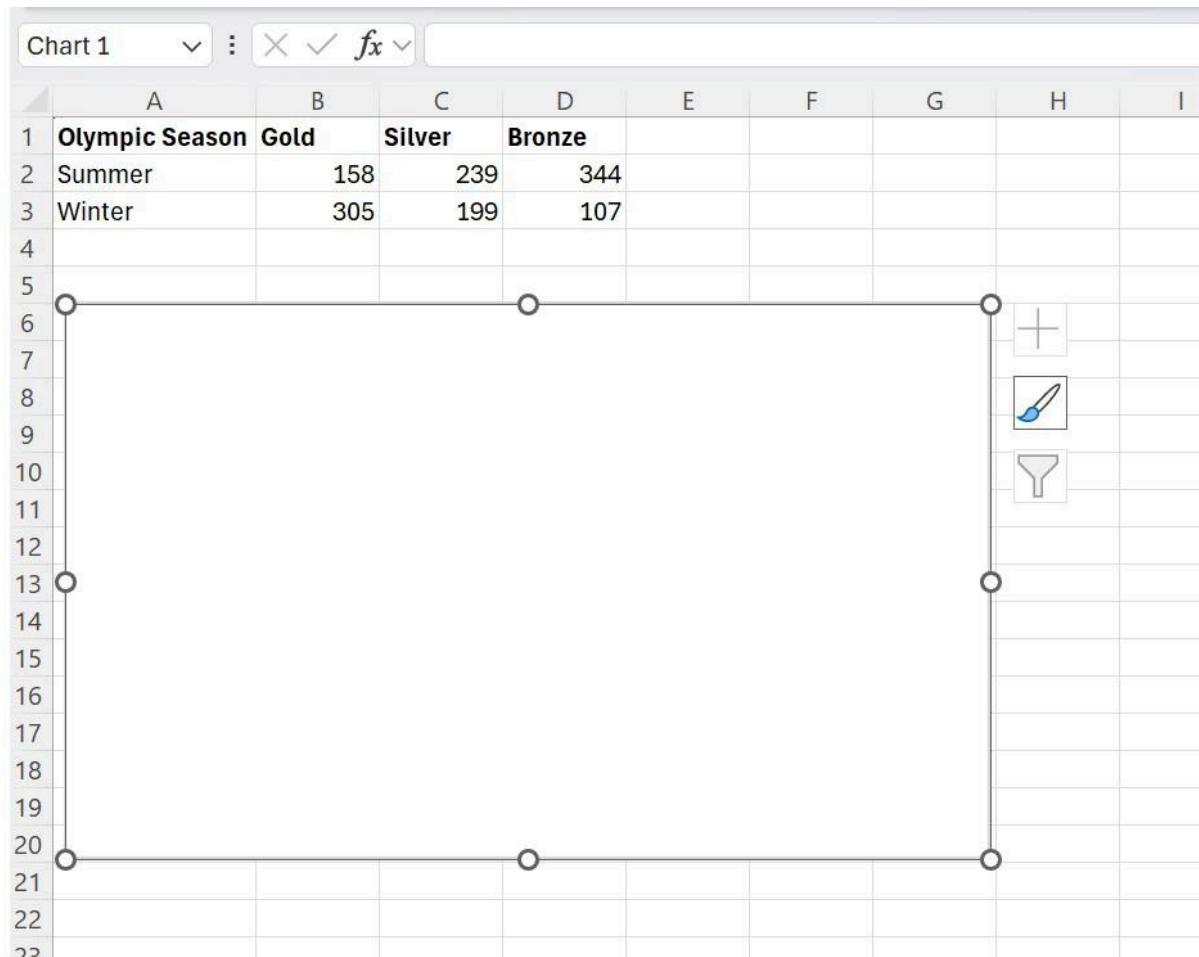
Insert the first chart suggestion, that's it! Well, let's clean it up a bit, but not bad, eh?!

Edit the axis titles and chart title (see section below). Always check that the chart makes sense!

The screenshot shows the Microsoft Excel interface with the 'Analyze Data' pane open. The 'Discover insights' section displays a bar chart comparing Gold, Silver, and Bronze medal counts for Summer and Winter Olympic seasons. A red arrow points to the '+ Insert Chart' button at the bottom of the pane. The main worksheet area shows the same table as the previous screenshot.

Or, doing it manually:

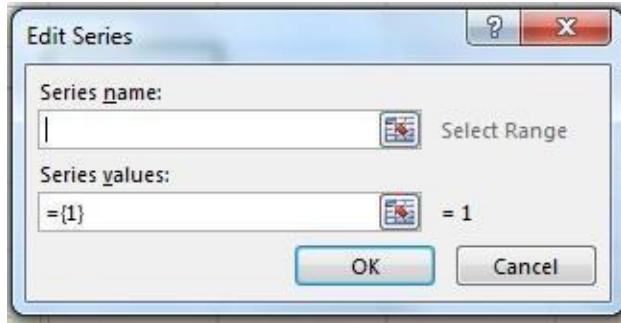
This time, we will begin with an empty chart. Go to the “Insert” tab, within in the “Charts” group select the “Column” drop-down box, and select the first option (Clustered Column Chart). The empty chart should look like the following figure.



Now we need to add data to our chart. To do this you want to click on the chart to select it. Then you want to click on the “Select Data” button under the “Design” tab. See the “Trend Chart” section for a figure.

The “Select Data” button should open a pop-up window like before, but this time it should not list any series.

First, we want to add a series for the summer olympic medals. To do this click the “Add” button under “Legend Entries (Series).” You will see the pop-up window like the figure below.



This pop-up window is slightly different than the first pop-up window. Here, we can only add one set of values because the X-axis values will be our budget categories.

To name the series click on the button next to the “Series name” text box. Now we want to click on the single cell that contains “Summer” in cell A2. Then you want to press Enter to be taken back to the previous window.

Next we want to add the values to the Summer series, the number of medals in each category.

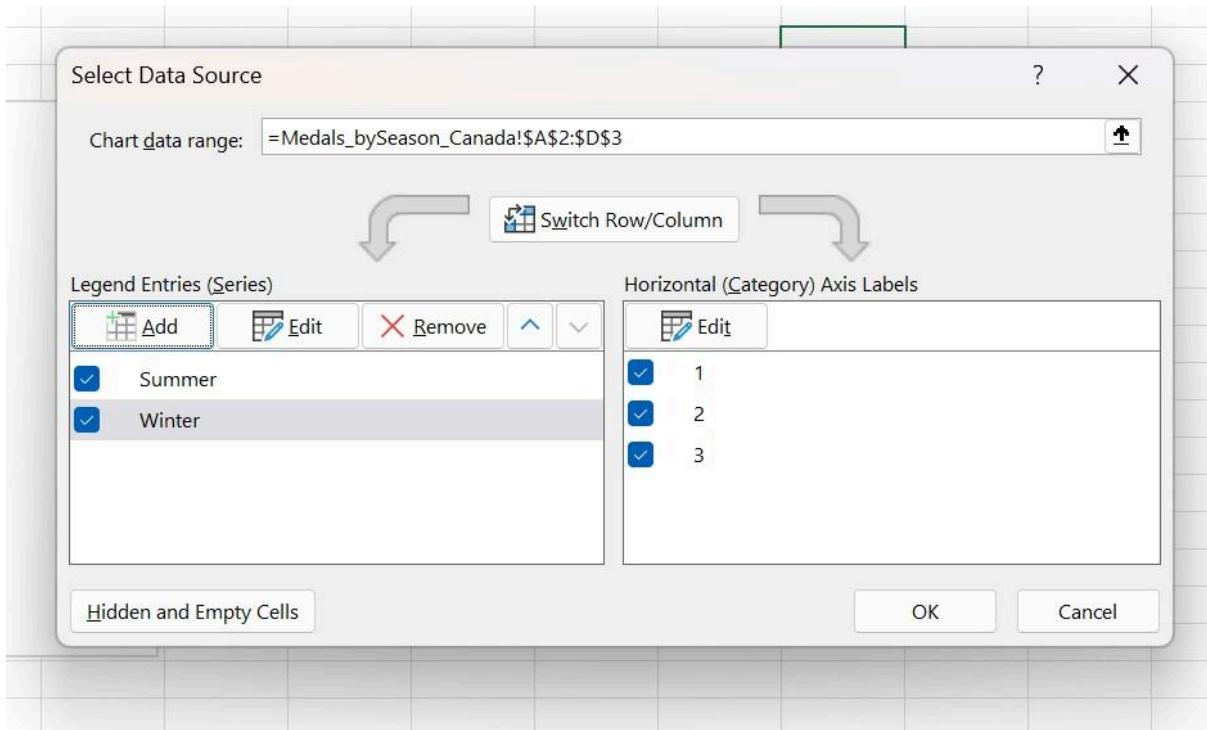
Start by clicking the button next to the “Series values” text box. Delete the “=1” entered! Now select only the data in the “Summer” row, not the variable label. So, select from cell B2 to D2.

Then press Enter.

Now press “OK” to be taken back to the first pop-up window. We want to repeat the same process for the “Winter” series in the next row of data. In brief:

1. click “Add”
2. for series name, click on cell A3
3. for series values, select cells B3 to D3
4. click “OK”

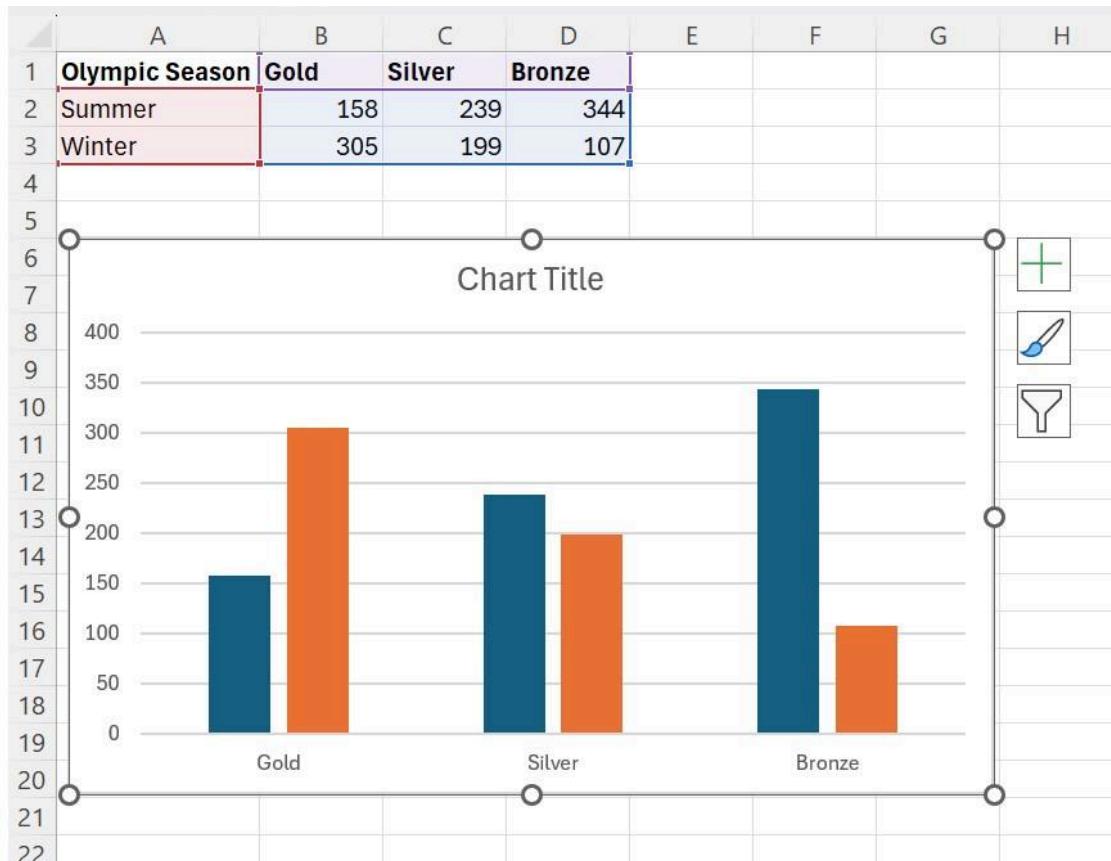
Now your pop-up window should look like the following figure:



Finally, we need to indicate the names of our categories. To do this click “Edit” under “Horizontal (Category) Axis Labels.” This will open a new pop-up window. Under “Axis Labels” you will select the names of the categories. Click the button next to the text box and select cells B1 to D1. The pop-up should look like the following figure. Then press Enter.

Your pop-up window should now list the category names, like the following figure:

Press “OK” to see the new chart!



Now we need to edit the formatting to make the chart easy to read. Important elements, that we previously discussed, include: Chart and Axes titles, a legend, adjusting the chart size and delete the gridlines. Try formatting the chart to make it more usable. We will then discuss other formatting options to manipulate the chart.

- **Chart and Axes Titles**

To add chart and axes titles, click on the chart once and then click on the green plus sign in the top right corner of the chart. Check “Chart Title” and “Axes Titles.” You can edit the titles in the text boxes that appear on the chart. Change the chart title to “Number of Olympic Gold, Silver, and Bronze Medals Earned by Canada by Season”. Label the Y-axis “Number of Medals.” Label the X-axis “Medal Categories.”

- **Legend**

To insert a legend, select the green plus, select “legend.” To change the placement of the legend, select the arrow to the right of “legend” and choose among the options.

- **Gridlines**

To delete gridlines, select the green plus, unselect “Gridlines.”

- **Axis limits**

Select the green plus sign, select “Axes,” select the arrow to the right of “Axes,” and select “More Options” to edit formatting. A sidebar should open. To change the numbering on the axes, select “Axis Options,” then select the bar chart icon, and select the “Axis Options” drop down.

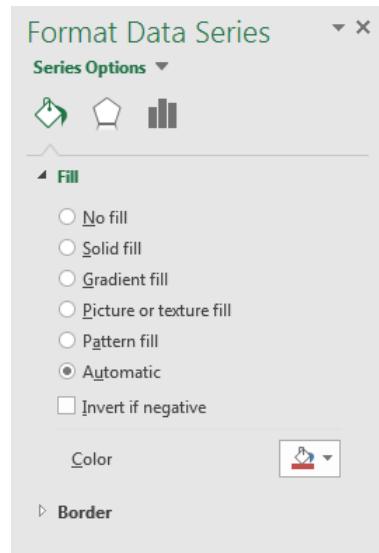
We only need to edit the Y-axis, so click on one of the numbers in the Y-axis. Then the sidebar will reflect the Y-axis settings.

- **Data Markers**

The colors of your chart should also fit the data. To change the color of the bars, you want to format the data markers.

To format the data markers, select the chart, right click on a bar, and select “Format Data Series.” You will have to format each series one at a time.

To change the color of the bar you selected, select the paint can icon, and edit the “Fill” and “Border” options. Select solid fill and a new color. The sidebar should look like the following figure.



To format the second series, click once on one of the other bars. Now change the data markers to another color.

Now your chart is ready to be exported to the Word document. Copy (CTRL + C) and paste as picture the column chart. The final chart should look like the following figure:

