

Working with Data in Excel

McGill University Libraries

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1 Introduction

This guide has been designed to accompany the Excel workshop offered by the McGill Libraries. It was built with material originally developed by the [Empirical Reasoning Center](#), at Barnard College. The example dataset was compiled by Walt Hickey at [fivethirtyeight.com](https://data.fivethirtyeight.com/) (all open data available here: <https://data.fivethirtyeight.com/>) and contains information on 1,794 films released from 1970 to 2013. His article, “[The Dollar-And-Cents Case Against Hollywood’s Exclusion of Women](#)” examines the budgets and revenues of films that pass the Bechdel test (original Bechdel dataset here: <https://github.com/fivethirtyeight/data/tree/master/bechdel>). The Bechdel test is a popular method of measuring how female-friendly a movie is. To pass the test: 1) there must be two named female characters, 2) the two women must talk to each other, and 3) the conversation cannot be about a man.

The topics covered in this workshop include:

- Important Terminology
- Calculations
- Built-In Functions
- Sorting & Filtering Data
- Line Charts
- Exporting into Word
- 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.

Poll Everywhere Questions

- What type of activities do you do with a spreadsheet software?

2 Important Terminology

Excel is a spreadsheet software that is used to organize, manipulate, and analyze tabular data. That is, data is entered as a table with rows and columns.

1. Rows are identified by row numbers.
2. Columns are identified by column letters.
3. 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). In the figure below, A2:I2 is highlighted in yellow; D1:D11 is highlighted in blue; and, D2 is highlighted in green.

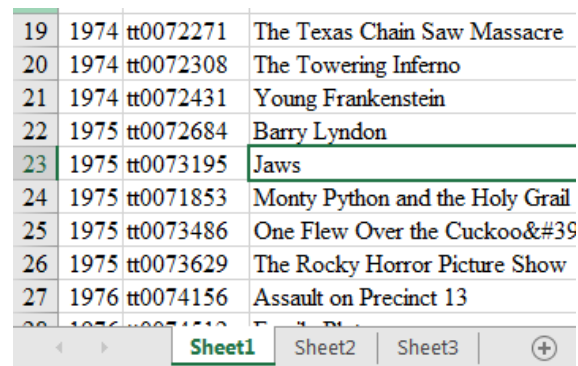
	A	B	C	D	E	F	G	H	I
1	Year	IMDB code	Movie Title	Bechdel Test	Bechdel Pass (Binary)	Budget (2013)	Domestic Gross (2013)	International Gross (2013)	Budget Category
2	1970	tt0065466	Beyond the Valley of the Dolls	PASS	1	5997631	53978683	53978683	low
3	1971	tt0067065	Escape from the Planet of the Apes	FAIL	0	14386286	70780525	70780525	low
4	1971	tt0067741	Shaft	FAIL	0	305063707	404702718	616827003	high
5	1971	tt0067800	Straw Dogs	FAIL	0	143862856	59412143	64760273	high
6	1971	tt0067116	The French Connection	FAIL	0	12659931	236848653	236848653	low
7	1971	tt0067992	Willy Wonka & the Chocolate Factory	FAIL	0	17263543	23018057	23018057	medium
8	1972	tt0069089	Pink Flamingos	PASS	1	66866	2305762	2305762	low
9	1972	tt0068646	The Godfather	FAIL	0	39004975	752051643	1496119403	medium
10	1973	tt0069704	American Graffiti	FAIL	0	4074506	603047833	734145189	low
11	1973	tt0068699	High Plains Drifter	FAIL	0	82329139	82329139	82329139	high

Figure 1: Data in Tabular Form

2.1 Data Organization

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. In the example dataset each observation is a movie. For all observations, there are nine variables: Year, IMDB code, Movie Title, etc.

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. Worksheets are found on the bottom of the window, as shown in the following figure. A good practice is to avoid spaces and choose descriptive names when you name worksheets. Computers struggle to read whitespaces when you automate tasks, avoiding spaces will even help when you want to refer to a cell in another sheet. Camelcase (StartingEachWordWithACapitalLetter) or underscore (between_words) are general best practices.



19	1974	tt0072271	The Texas Chain Saw Massacre
20	1974	tt0072308	The Towering Inferno
21	1974	tt0072431	Young Frankenstein
22	1975	tt0072684	Barry Lyndon
23	1975	tt0073195	Jaws
24	1975	tt0071853	Monty Python and the Holy Grail
25	1975	tt0073486	One Flew Over the Cuckoo's Nest
26	1975	tt0073629	The Rocky Horror Picture Show
27	1976	tt0074156	Assault on Precinct 13

Figure 2: Worksheets in Excel

2.2 Data Types

There are many different data types in Excel. 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. An example of numerical data in our dataset is “Budget” because dollar values are a numerical measurement that can be ordered. Generally speaking, digits will be numerical data, however numbers can be represented in a textual format. You can look at how the value is justified in the cell, that is a quick way to see what the data type is, no matter the value. Numerical data will be right justified in the cell and textual, left justified. You can control this by right-clicking the cell, row or column and choosing Format Cells. The dialogue box (see figure 3) offers you many options to store the data in specific ways. Beyonds text and numbers, you can also select defined formats, such as dates and currency.

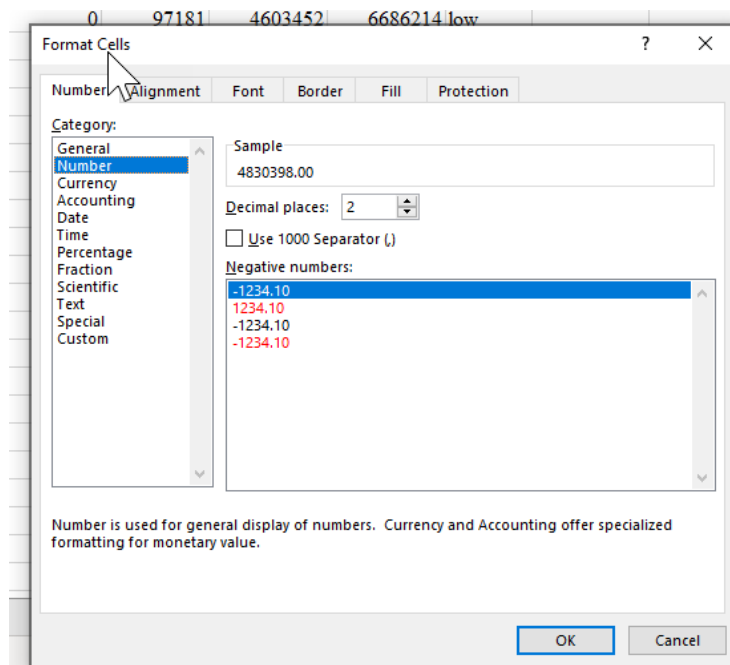


Figure 3: Format Cells dialogue box

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.” An example of a binary variable is the “Bechdel Pass (Binary)” variable, which is the numerical version of the “Bechdel Test” variable. A value of one indicates that that movie passed the Bechdel Test, and a value of zero indicates that that movie failed the Bechdel Test.

There is also a measurement scale. Categorical data are either words or numbers that represent discrete categories – any measurement that has a limited number of possible values, and these can be ordinal (can be placed in a sequence or rank, e.g. race winners, likert scale, etc.) or nominal (no way to order categories, e.g. cities, movies, fruit, first names, gender, race). An example of an ordinal categorical variable in our dataset is the “Budget Category” because the possible values are only “low,” “medium,” and “high. Numerical data are numeric variables and these can be interval or ratio. These are usually ranked numbers, on a specific scale, for example temperature or height. The difference between interval and ratio is what the zero means (it is a point on the scale or it means nothing exists). This is especially important when you want to analyze data (for example with statistical analysis).

3 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: <>

3.1 Example I: Total Gross = Domestic Gross + International Gross

This dataset contains information on movies' domestic gross revenue and international gross revenue. We are interested in the total gross revenue, which is the sum of domestic and international revenue.

Instructor notes: Talk about cell references at this point. Explain how you can type the value and the result will be exact. However, it makes more sense to use the cell's identifier. In Excel, when you use a cell's identifier in a formula or calculation, you are actually using the cell's value. This means that you can change the value in the cell and the result of the calculation will be automatically updated.

Here are the steps to calculating the total gross revenue?

1. Label the column where this variable will go, in this case J1.
2. In the cell that is on the same row as the values you want to add, type the formula.
3. The formula is =G2+H2.
4. Press enter.

See the figure below:

	A	B	C	D	E	F	G	H	I	J
1	Year	IMDB code	Movie Title	Bechdel Test	Bechdel Pass (Binary)	Budget (2013)	Domestic Gross (2013)	International Gross (2013)	Budget Category	Total Gross
2	1970	tt0065466	Beyond the Valley of the Dolls	PASS	1	5997631	53978683	53978683	low	=G2+H2
3	1971	tt0067065	Escape from the Planet of the Apes	FAIL	0	14386286	70780525	70780525	low	
4	1971	tt0067741	Shaft	FAIL	0	305063707	404702718	616827003	high	
5	1971	tt0067800	Straw Dogs	FAIL	0	143862856	59412143	64760273	high	
6	1971	tt0067116	The French Connection	FAIL	0	12659931	236848653	236848653	low	
7	1971	tt0067992	Willy Wonka & the Chocolate Factory	FAIL	0	17263543	23018057	23018057	medium	

Figure 4: Calculate Total Gross

Now you want this calculation to apply to the whole column. To do this, select cell J2 then place your cursor over the bottom right corner of cell J2; you will see the cursor become a small black cross. Click and drag down the whole column (until the data ends). 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.

	A	B	C	D	E	F	G	H	I	J
1	Year	IMDB code	Movie Title	Bechdel Test	Bechdel Pass (Binary)	Budget (2013)	Domestic Gross (2013)	International Gross (2013)	Budget Category	Total Gross
2	1970	tt0065466	Beyond the Valley of the Dolls	PASS	1	5997631	53978683	53978683	low	107957366
3	1971	tt0067065	Escape from the Planet of the Apes	FAIL	0	14386286	70780525	70780525	low	141561050
4	1971	tt0067741	Shaft	FAIL	0	305063707	404702718	616827003	high	1021529721
5	1971	tt0067800	Straw Dogs	FAIL	0	143862856	59412143	64760273	high	124172416
6	1971	tt0067116	The French Connection	FAIL	0	12659931	236848653	236848653	low	473697306
7	1971	tt0067992	Willy Wonka & the Chocolate Factory	FAIL	0	17263543	23018057	23018057	medium	46036114
8	1972	tt0069089	Pink Flamingos	PASS	1	66866	2305762	2305762	low	4611524
9	1972	tt0068646	The Godfather	FAIL	0	39004975	752051643	1496119403	medium	2248171046
10	1973	tt0069704	American Graffiti	FAIL	0	4074506	603047833	734145189	low	1337193022
11	1973	tt0068699	High Plains Drifter	FAIL	0	82329139	82329139	82329139	high	164658278
12	1973	tt0070707	Sleeper	FAIL	0	10487788	96197818	96197818	low	192395636
13	1973	tt0070047	The Exorcist	PASS	1	62926730	1074306128	2111900435	medium	3186206563
14	1973	tt0070735	The Sting	FAIL	0	28841418	837011132	837011132	medium	1674022264
15	1974	tt0071222	Black Christmas	PASS	1	42513535	76693179	76693179	medium	153386358
16	1974	tt0071230	Blazing Saddles	FAIL	0	12281688	564485269	564485269	low	1128970538
17	1974	tt0071360	The Conversation	FAIL	0	7557962	20878869	20878869	low	41757738

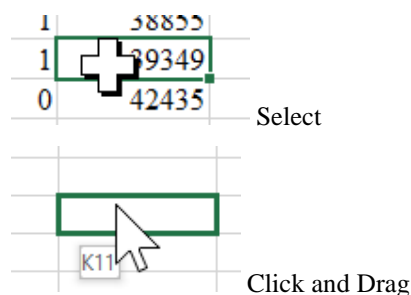
Figure 5: Calculate Total Gross II

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 '=G2+H2' the formula in the third row says '=G3+H3' instead. 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. L\$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 (\$L2). When in doubt, you can add both (\$L\$2).

In Excel, there are various different types of cursors which do different actions, the most important ones are:

- Select: allows you to select a cell
- Click and Drag: allows you to copy and paste by dragging
- Autofill: it copies and pastes or automatically fills a series to fill out the column or row.
- Resize: you use this cursor to resize columns and rows.

Figures:



0	42435	
1	53412	
0	56177	Autofill
1	38855	
1	39349	Resize
0	42435	

3.2 Example II: International Gross in millions = International Gross / 1,000,000

We also want to change the units of the International Gross variable to be in millions of dollars rather than dollars. To do this we can use absolute referencing. We will start by entering '1,000,000' (with or without commas) in cell K1.

Figure 6: Enter 1 million

	A	B	C	D	E	F	G	H	I	J	K
1	Year	IMDB code	Movie Title	Bechdel Test	Bechdel Pass (Binary)	Budget (2013)	Domestic Gross (2013)	International Gross (2013)	Budget Category	Total Gross	1,000,000

Then we will label column L 'Int. Gross in Millions' then use the formula '=H2/K1' in cell L2 and press enter. You should see the correct calculation.

	A	B	C	D	E	F	G	H	I	J	K	L
1	Year	IMDB code	Movie Title	Bechdel Test	Bechdel Pass (Binary)	Budget (2013)	Domestic Gross (2013)	International Gross (2013)	Budget Category	Total Gross	1,000,000	Int. Gross in Millions
2	1970	tt0065466	Beyond the Valley of the Dolls	PASS	1	5997631	53978683	53978683	low	107957366		=H2/K1
3	1971	tt0067065	Escape from the Planet of the Apes	FAIL	0	14386286	70780525	70780525	low	141561050		
4	1971	tt0067741	Shaft	FAIL	0	305063707	404702718	616827003	high	1021529721		
5	1971	tt0067800	Straw Dogs	FAIL	0	143862856	59412143	64760273	high	124172416		
6	1971	tt0067116	The French Connection	FAIL	0	12659931	236848653	236848653	low	473697306		
7	1971	tt0067992	Willy Wonka & the Chocolate Factory	FAIL	0	17263543	23018057	23018057	medium	46036114		
8	1972	tt0069089	Pink Flamingos	PASS	1	66866	2305762	2305762	low	4611524		
9	1972	tt0068646	The Godfather	FAIL	0	39004975	752051643	1496119403	medium	2248171046		
10	1973	tt0069704	American Graffiti	FAIL	0	4074506	603047833	734145189	low	1337193022		
11	1973	tt0068699	High Plains Drifter	FAIL	0	82329139	82329139	82329139	high	164658278		

Figure 7: Calculate International Gross in millions

If you were to apply this formula without using absolute referencing to the rest of the column you would see the error message, "#DIV/0!" like in the following figure.

	A	B	C	D	E	F	G	H	I	J	K	L
1	Year	IMDB code	Movie Title	Bechdel Test	Bechdel Pass (Binary)	Budget (2013)	Domestic Gross (2013)	International Gross (2013)	Budget Category	Total Gross	1,000,000	Int. Gross in Millions
2	1970	tt0065466	Beyond the Valley of the Dolls	PASS	1	5997631	53978683	53978683	low	107957366		54
3	1971	tt0067065	Escape from the Planet of the Apes	FAIL	0	14386286	70780525	70780525	low	141561050		#DIV/0!
4	1971	tt0067741	Shaft	FAIL	0	305063707	404702718	616827003	high	1021529721		#DIV/0!
5	1971	tt0067800	Straw Dogs	FAIL	0	143862856	59412143	64760273	high	124172416		#DIV/0!
6	1971	tt0067116	The French Connection	FAIL	0	12659931	236848653	236848653	low	473697306		#DIV/0!
7	1971	tt0067992	Willy Wonka & the Chocolate Factory	FAIL	0	17263543	23018057	23018057	medium	46036114		#DIV/0!
8	1972	tt0069089	Pink Flamingos	PASS	1	66866	2305762	2305762	low	4611524		#DIV/0!

Figure 8: Calculation Error

If you look at the formula in cell L3, you should see "=H3/K2." Cell K2 is actually blank, and Excel reads blank cells as zero and returns an error when you Instead of dividing by cell K2, we wanted to still refer to cell K1, which equals 1 million. We can edit our original formula to force Excel not to update the cell K1 reference as we apply the formula to the rest of the column. To do this, click on cell L2 to edit the formula. You want to add dollar signs in front of the K and in front of the 1, like in the following figure.

	A	B	C	D	E	F	G	H	I	J	K	L
1	Year	IMDB code	Movie Title	Bechdel Test	Bechdel Pass (Binary)	Budget (2013)	Domestic Gross (2013)	International Gross (2013)	Budget Category	Total Gross	1,000,000	Int. Gross in Millions
2	1970	tt0065466	Beyond the Valley of the Dolls	PASS	1	5997631	53978683	53978683	low	107957366		#DIV/0!
3	1971	tt0067065	Escape from the Planet of the Apes	FAIL	0	14386286	70780525	70780525	low	141561050		#DIV/0!
4	1971	tt0067741	Shaft	FAIL	0	305063707	404702718	616827003	high	1021529721		#DIV/0!
5	1971	tt0067800	Straw Dogs	FAIL	0	143862856	59412143	64760273	high	124172416		#DIV/0!
6	1971	tt0067116	The French Connection	FAIL	0	12659931	236848653	236848653	low	473697306		#DIV/0!
7	1971	tt0067992	Willy Wonka & the Chocolate Factory	FAIL	0	17263543	23018057	23018057	medium	46036114		
8	1972	tt0069089	Pink Flamingos	PASS	1	66866	2305762	2305762	low	4611524		

Figure 9: Fixing the Calculation

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 L2, we can apply the formula to the rest of the column. This time, instead of clicking and dragging, try clicking on cell L2. Then move the cursor over the bottom right corner of the cell L2 until the cursor turns into a small black cross. Now double click. The formula should be applied down the column until the next blank cell of data. The fixed column should look like the following figure.

	A	B	C	D	E	F	G	H	I	J	K	L
1	Year	IMDB code	Movie Title	Bechdel Test	Bechdel Pass (Binary)	Budget (2013)	Domestic Gross (2013)	International Gross (2013)	Budget Category	Total Gross	1,000,000	Int. Gross in Millions
2	1970	tt0065466	Beyond the Valley of the Dolls	PASS	1	5997631	53978683	53978683	low	107957366		53.98
3	1971	tt0067065	Escape from the Planet of the Apes	FAIL	0	14386286	70780525	70780525	low	141561050		70.78
4	1971	tt0067741	Shaft	FAIL	0	305063707	404702718	616827003	high	1021529721		616.83
5	1971	tt0067800	Straw Dogs	FAIL	0	143862856	59412143	64760273	high	124172416		64.76
6	1971	tt0067116	The French Connection	FAIL	0	12659931	236848653	236848653	low	473697306		236.85
7	1971	tt0067992	Willy Wonka & the Chocolate Factory	FAIL	0	17263543	23018057	23018057	medium	46036114		23.02
8	1972	tt0069089	Pink Flamingos	PASS	1	66866	2305762	2305762	low	4611524		2.31
9	1972	tt0068646	The Godfather	FAIL	0	39004975	752051643	1496119403	medium	2248171046		1,496.12
10	1973	tt0069704	American Graffiti	FAIL	0	4074506	603047833	734145189	low	1337193022		734.15

Figure 10: The Correct Calculation

These numbers can look intimidating because there are many digits after the decimal point. To change this, go to Format Cells again (by right clicking on a column) and change the number of digits after the decimal to two in the numbers category.

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 ?). The error we saw earlier “#DIV/0!” 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.

4 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), as in the following figure. Try using the "Insert Function" button to look up how to calculate the average. Click on an empty cell, then click on "Insert Function."

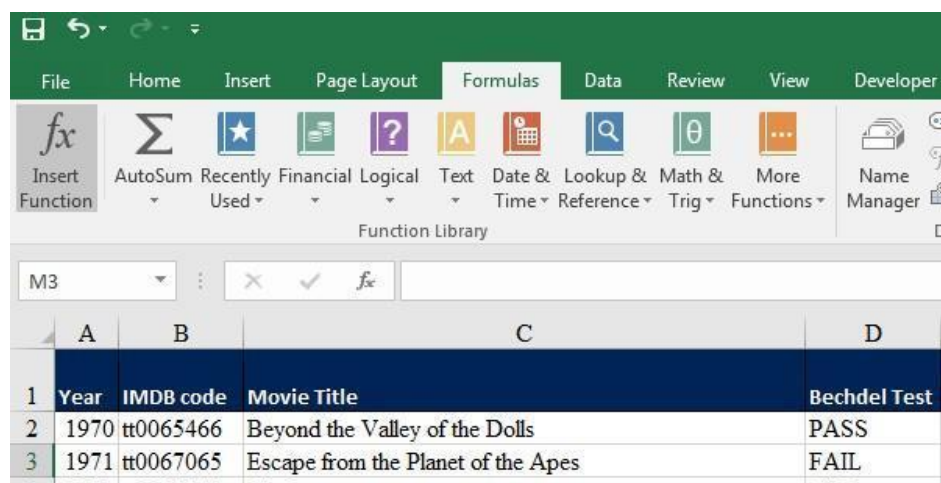


Figure 11: Other Built-In Functions

That is the first of two ways to access Excel's built-in formulas. 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 M1 type the label 'Average Total Gross'. In cell M2 you will calculate the average by entering the formula '=AVERAGE(J2:J1777)'. Instead of typing the cell references, try clicking on cell J2 and dragging the cursor down to cell J1777 then typing the close parenthesis. The formula should look like the following figure.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Year	IMDb code	Movie Title	Bechdel Test	Bechdel Pass (binary)	Budget (2013)	Domestic Gross (2013)	International Gross (2013)	Budget Category	Total Gross	1,000,000	Int. Gross in Millions	Average Total Gross		
2	1970	m0065466	Beyond the Valley of the Dolls	PASS	1	5997631	53978683	53978683	low	107957366		53.98	=AVERAGE(J2:J1777)		
3	1971	m0067065	Escape from the Planet of the Apes	FAIL	0	14386286	70780525	70780525	low	141561050		70.78	AVERAGE(number1, [number2], ...)		
4	1971	m0067741	Shaft	FAIL	0	305063707	404702718	616827003	high	1021529721		616.83			
5	1971	m0067800	Straw Dogs	FAIL	0	143862856	59412143	64760273	high	124172416		64.76			

Figure 12: Average Total Gross

You can also use more than one function in a single cell. On your own, calculate the average using the sum and count functions. In cell M3 enter the formula ‘=sum(J2:J1777)/count(J2:J1777)’.

5 Sorting

There are many reasons why you may want to sort your data. You may want a list of alphabetized names, or you may want observations organized by date so you can enter more variables.

Currently, the dataset is sorted by budget. We are going to sort this data set by year and then movie title. When you sort on two variables, the dataset is first sorted according to the first variable. But what happens when two observations have the same value? If we sort by year then there are five movies from 1971, what order should they be listed in? By adding a second variable, you tell Excel exactly what to do. For all of the movies released in the same year, we want them alphabetized by Movie Title.

To do this, we need to highlight all of the data including the variable names. Any cells that are NOT selected will remain in the exact order they are now. There are many ways to highlight the data. We will click on cell A1. Then we will press CTRL + Shift + (the right arrow). This will highlight the cells from A1 to J1.

Figure 13: Highlight the First Row

	A	B	C	D	E	F	G	H	I
1	Year	Movie Title	Bechdel Test	Bechdel Pass (Binary)	Budget (2013)	Domestic Gross (2013)	International Gross (2013)	Budget	Total Gross (2013)

Now we want to highlight all of the rows below those cells. Now press CTRL + Shift + (the down arrow).

Now all of the data should be selected.

1773	2012	The Dark Knight Rises	FAIL	0	279025606	454699213	1095143990	high	1549843203
1774	1997	Titanic	PASS	1	290247625	955890356	3171930973	high	4127821329
1775	1971	Shaft	FAIL	0	305063707	404702718	616827003	high	1021529721
1776	2007	Pirates of the Caribbean: At World's End	PASS	1	337063045	347647302	1079721346	high	1427368648
1777	2009	Avatar	FAIL	0	461435929	825707158	3022588801	high	3848295959

Figure 14: Highlight All of the Data

Now we want to sort the data. In the Home tab, in the Editing group, click on the arrow next to the “Sort & Filter” button. Then choose the “Custom Sort” option.



Figure 15: Sort & Filter

You should see the following pop-up window.

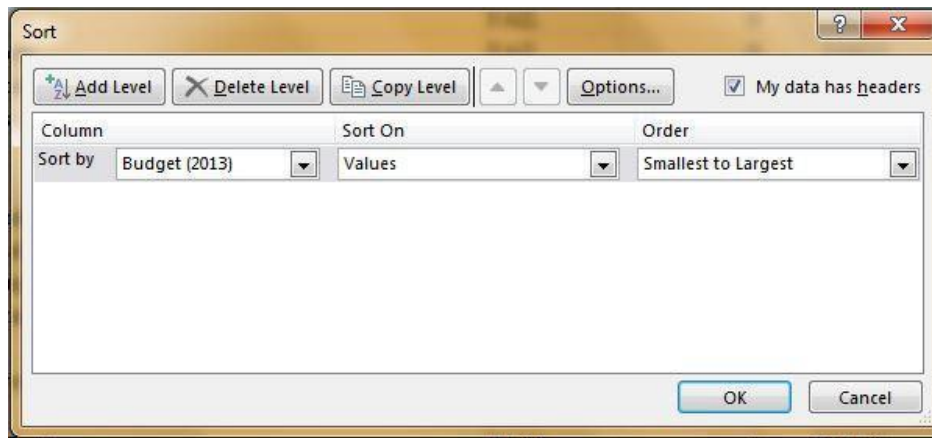


Figure 16: Sort & Filter Pop-Up Window

The first thing you want to do is check “My list has headers” so your variable names are not sorted like an observation. When alphabetizing movie titles, you don’t want to move the “Movie Title” variable name to the Ms; it should stay in row 1.



Figure 17: My List Has Headers

Then you want to choose “Year” under the Column drop down menu. Then you want to click the plus sign to add a second variable to sort by. In the second row, choose “Movie Title” under the Column drop down menu. Then press “OK.”

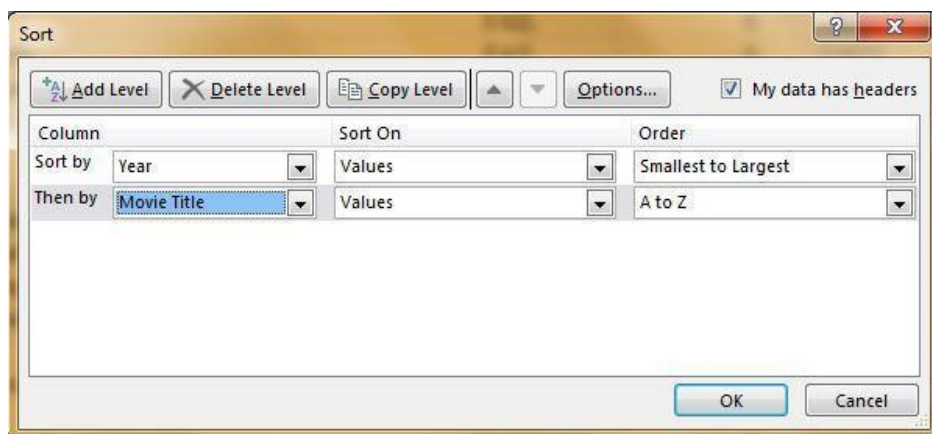


Figure 18: Sort by Year and Movie Title

Now You should notice that the dataset has been sorted.

Note

Sometimes, like in this case, you might get a warning about numbers stored as text and how you want to sort those. You need to think about your data and choose the option that makes the most sense.

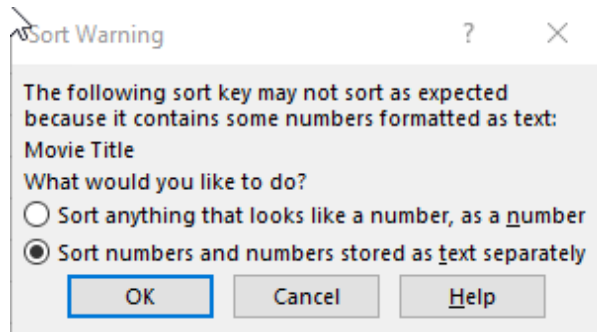


Figure 19: Warning when numbers are stored as text

6 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 average international gross and year. We are also interested in how this relationship differs between movies that pass and fail the Bechdel test. Basically, we want to answer the question: how has international gross revenues changed over time depending on the female-friendliness of the movies? 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 "Sheet2." The data looks like the following figure.

	A	B	C
1		Average International Gross (in millions of US\$)	
2	Year	FAIL	PASS
3	1972	1496.119403	2.305762
4	1973	437.4208195	2111.900435
5	1974	248.8127096	173.681342
6	1976	286.7954868	83.95092833
7	1977	941.1581218	76.1260665
8	1978	401.1365307	698.3848325
9	1979	458.005208	501.9863905
10	1980	277.8116025	132.0941078
11	1981	204.9210759	65.414737
12	1982	332.8596088	170.865533
13	1983	506.2787697	305.7703185
14	1984	272.5384364	331.7677283
15	1985	245.1118908	65.516487
16	1986	329.216982	127.1885675
17	1987	226.6754494	26.4417445
18	1988	228.6162467	103.8212566
19	1989	284.6852869	189.648037
20	1990	392.8091896	179.4215988
21	1991	357.8755797	289.6321072
22	1992	213.0988884	134.7251768
23	1993	187.6256578	390.5577928
24	1994	323.3800446	179.2884382
25	1995	230.4810622	186.8928914
26	1996	169.8906118	175.8488778

Figure 20: Worksheet 2

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 Sheet2 is thus set up correctly. Select the Year and Fail columns, including these variable names (e.g. select from cell A2 to B43). Select the “Scatter” drop-down box, and select the last option (Scatter with Straight Lines). The initial chart should look like the following figure:

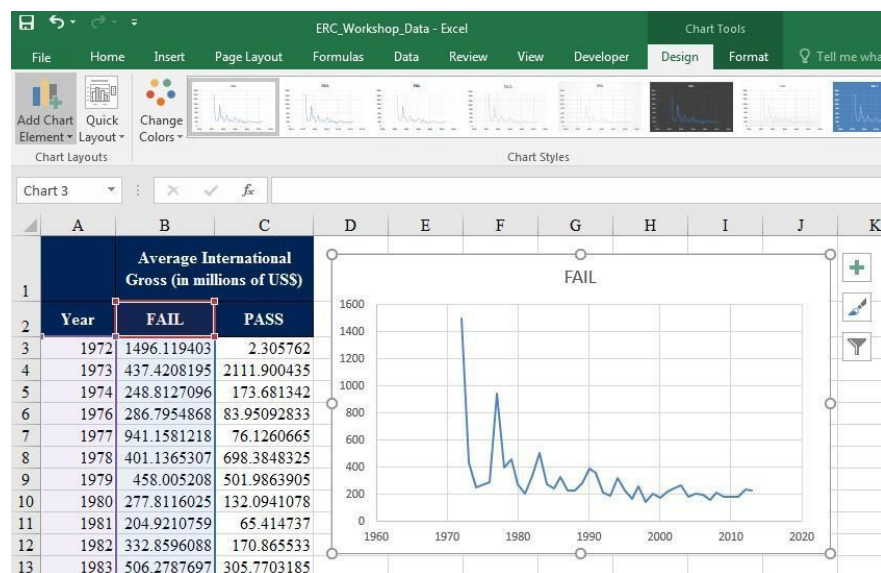


Figure 21: Initial Line Chart

The reason why we chose the scatter line chart 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 Average International Gross trend over time for movies that fail the Bechdel Test. Now we want to add another data series (variable) to this chart for movies that pass the Bechdel Test. 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.

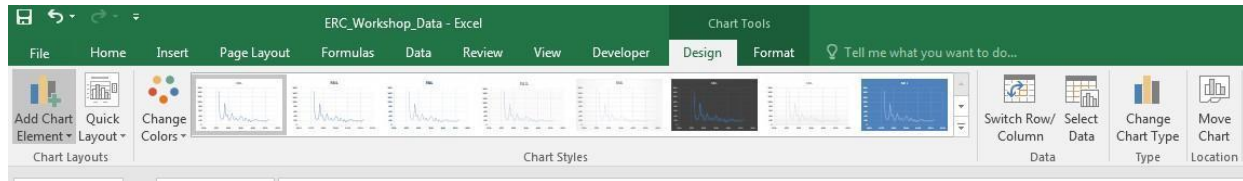


Figure 22: Select Data

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 “FAIL.”

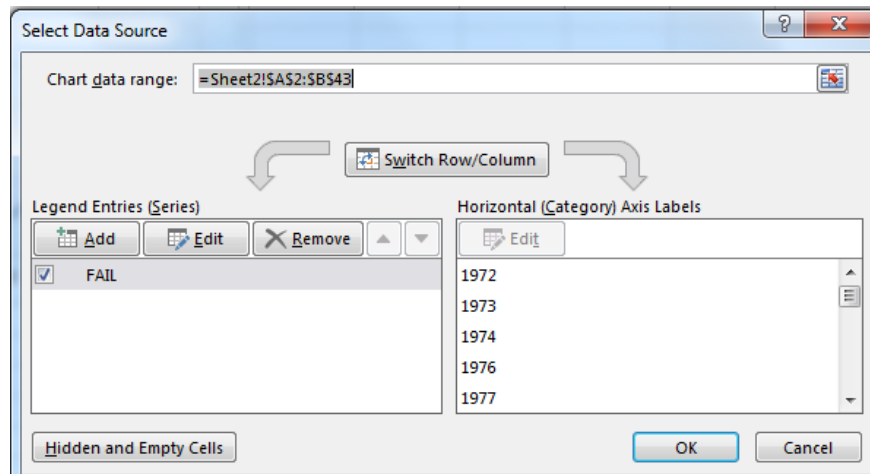


Figure 23: Select Data Pop-Up

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

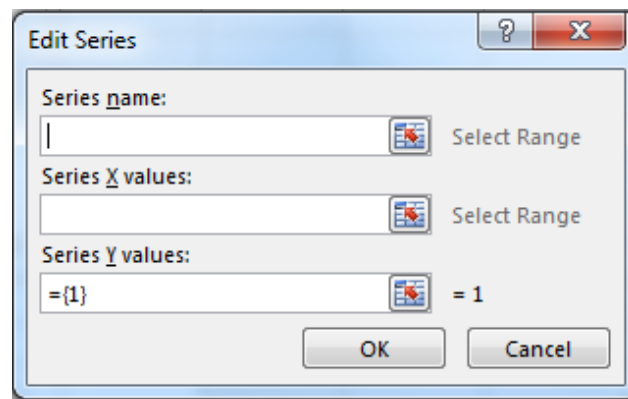


Figure 24: Add Series

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, “Pass” in cell C2 like below. You could also type the word “Pass”. 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.

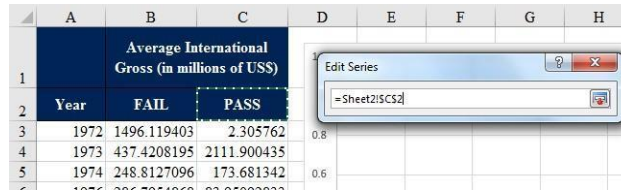


Figure 25: Add Name

Next we want to add the X values of the Pass 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 A3 to cell A43, like below. Then press Enter.

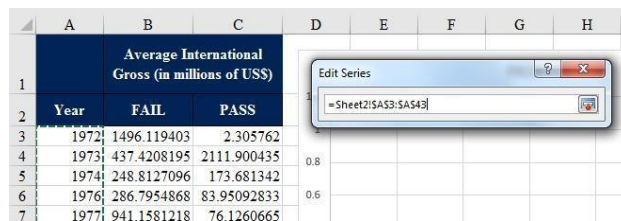


Figure 26: Add X Values

The last piece of information is the Y values of the Pass series. We want the average international gross in millions of dollars for just the movies that passed the Bechdel Test on the Y axis to correspond with our selected X values. 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 “PASS” column, not the variable label. So, select from cell C3 to cell B43. Then press Enter. Once all three text boxes have been filled, the pop up window should look like the following figure.

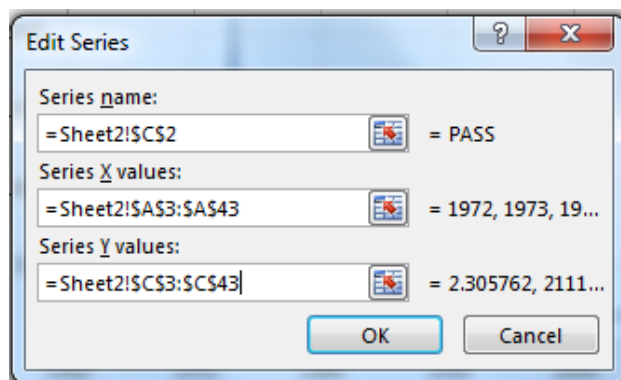


Figure 27: Add Series

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: PASS and FAIL.

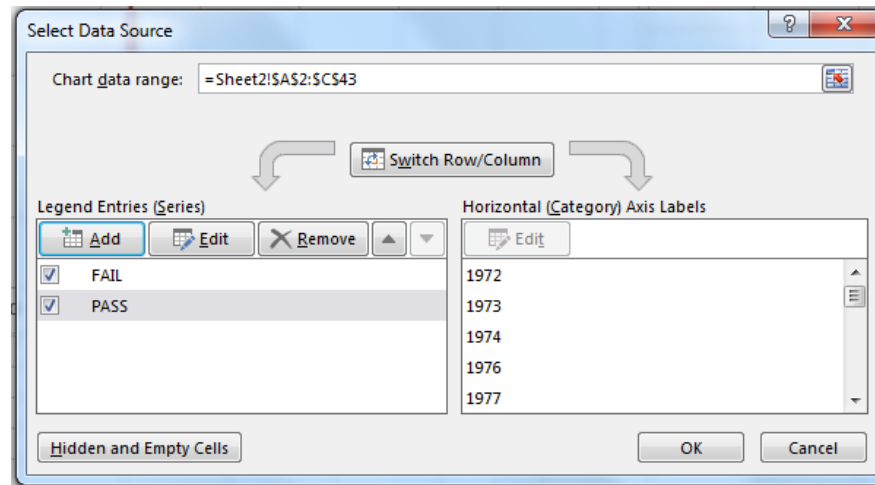


Figure 28: Two Series

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

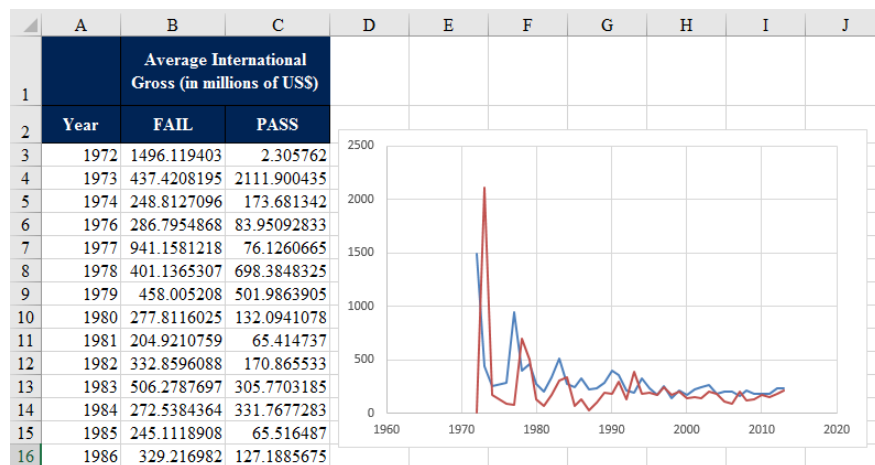


Figure 29: Line Chart with Two Series

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 “Average International Gross by Bechdel Test Results.” Label the Y-axis “Average International Gross (millions of US dollars).” 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.

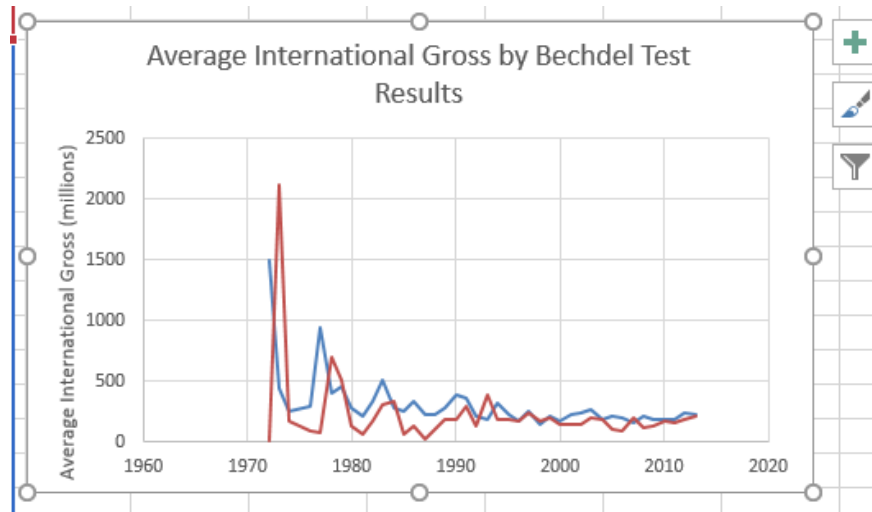


Figure 30: Chart and Axes Titles

Now can you try adding a legend indicating which colored line indicates the movies that passed the Bechdel Test and which one indicates the ones that failed it. 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.

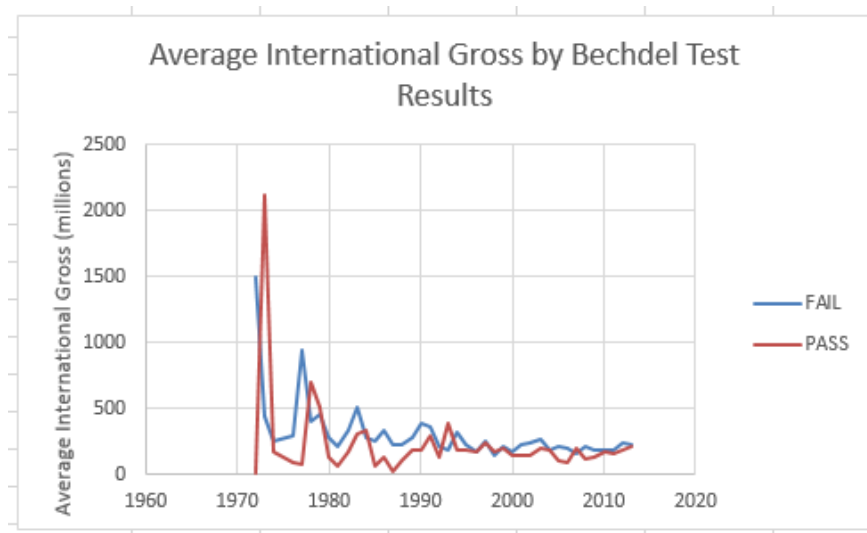


Figure 31: Legend

- 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.

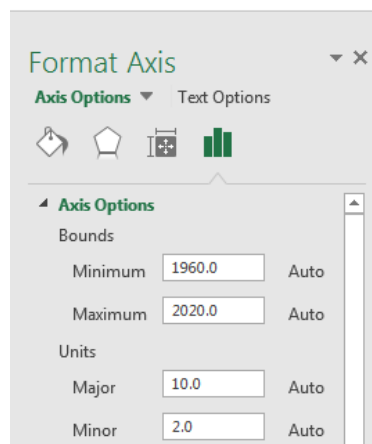


Figure 32: X-Axis Sidebar

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 1970 and the maximum to 2015.

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 from 100 to 250. The sidebar should look like the following figure.

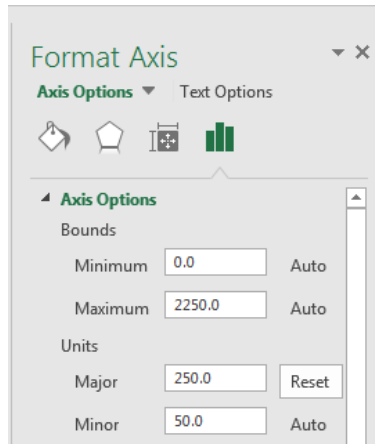


Figure 33: Y-Axis Sidebar

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”.

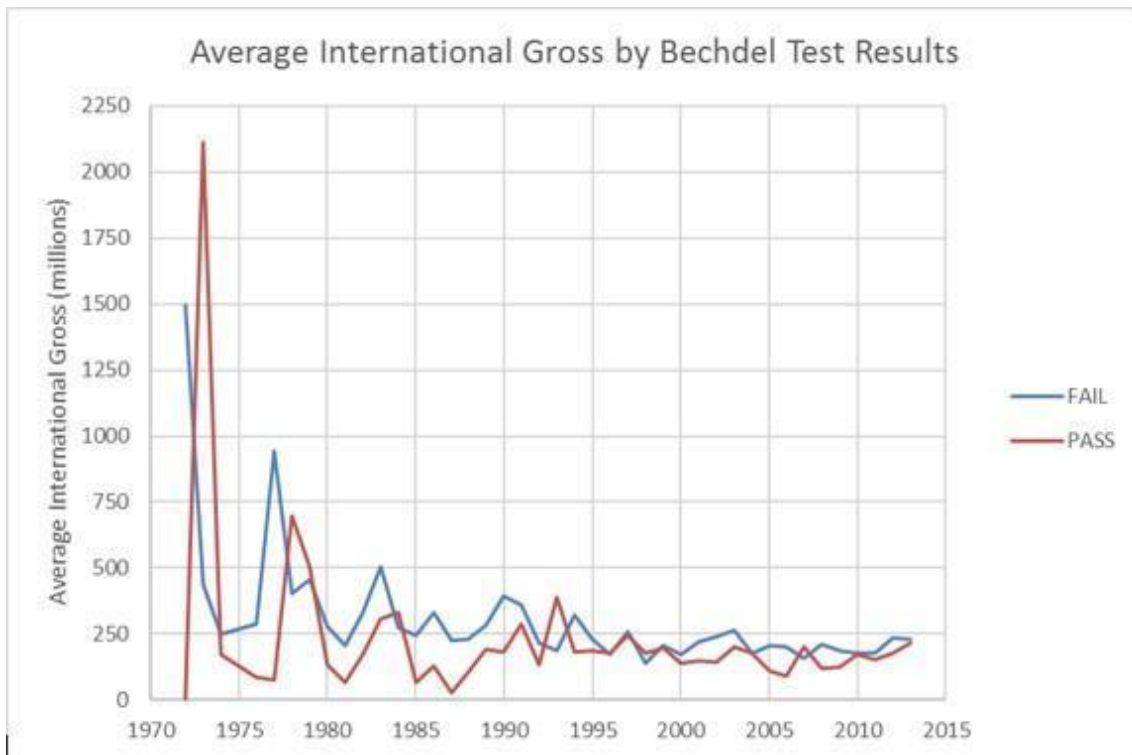


Figure 34: Final Line Chart

7 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?

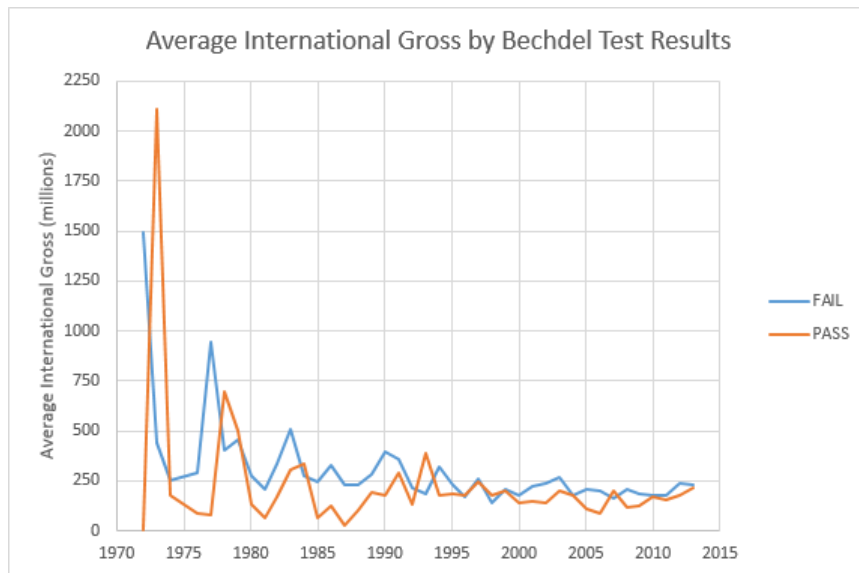


Figure 35: Line Chart in Word

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.

8 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 movies in each budget category by their Bechdel Test result. Basically, we want to answer the question, do studios invest less money in female-friendly movies?

To start, we want to look at the next worksheet of data in "Sheet3." The data looks like the following figure.

	A	B	C	D
1		Number of Films		
2	Bechdel Test	High Budget	Medium Budget	Low Budget
3	FAIL	300	471	213
4	PASS	149	420	228

Figure 36: Worksheet 3

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.

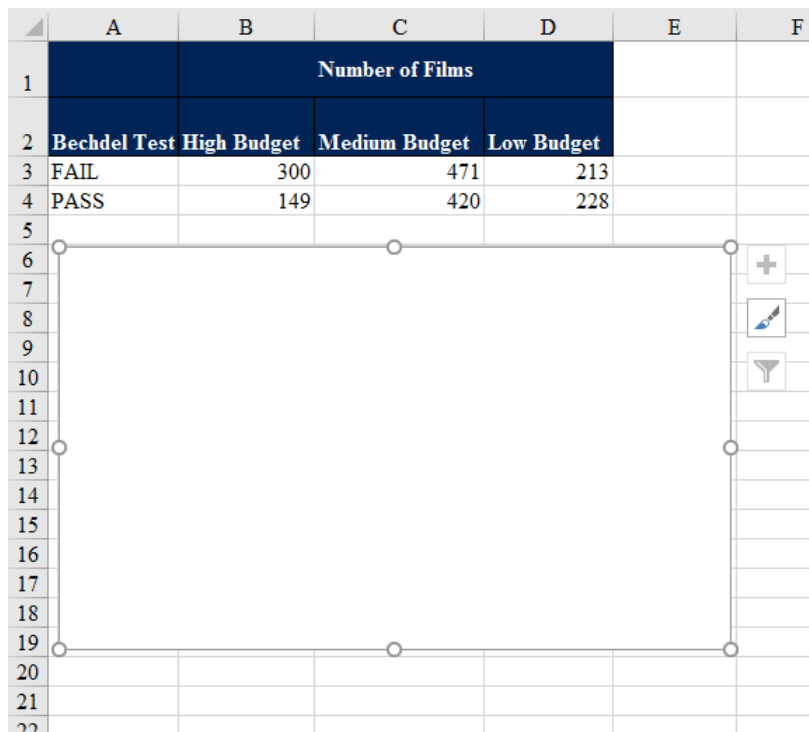


Figure 37: Blank Chart

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 “Line 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.

We then want to add data to this chart by using the Select Data dialog menu. It will be slightly different than the window for the previous chart. First, we want to add a series for the movies that fail the Bechdel test. To do this click the “Add” button under “Legend Entries (Series).” You will see the pop-up window like the figure below.

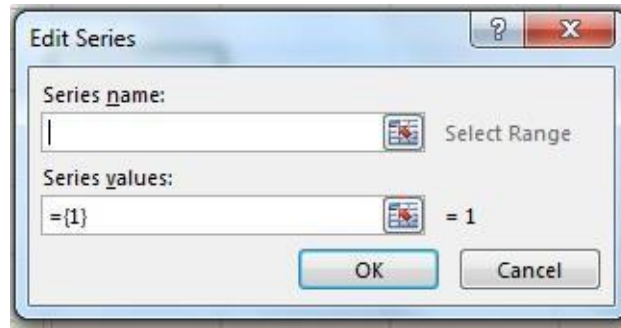


Figure 38: Add Series

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 “FAIL” in cell A3. Then you want to press Enter to be taken back to the previous window.

Next we want to add the values to the Fail series, the number of films 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 “FAIL” row, not the variable label. So, select from cell B3 to D3. 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 “PASS” series in the next row of data. In brief:

1. click “Add”
2. for series name, click on cell A4
3. for series values, select cells B4 to D4
4. click “OK”

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

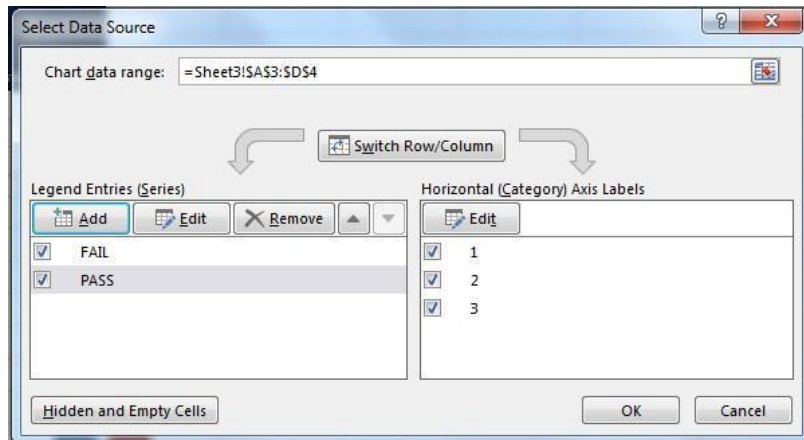


Figure 39: Two Series

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 B2 to D2. The pop-up should look like the following figure. Then press Enter.

	A	B	C	D
1		Number of Films		
2	Bechdel Test	High Budget	Medium Budget	Low Budget
3	FAIL	300	471	213
4	PASS	149	420	228
5				
6				
7				
8				
9				

Axis Labels	
<input type="text" value="=Sheet3!\$B\$2:\$D\$2"/>	

Figure 40: Select Categories

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

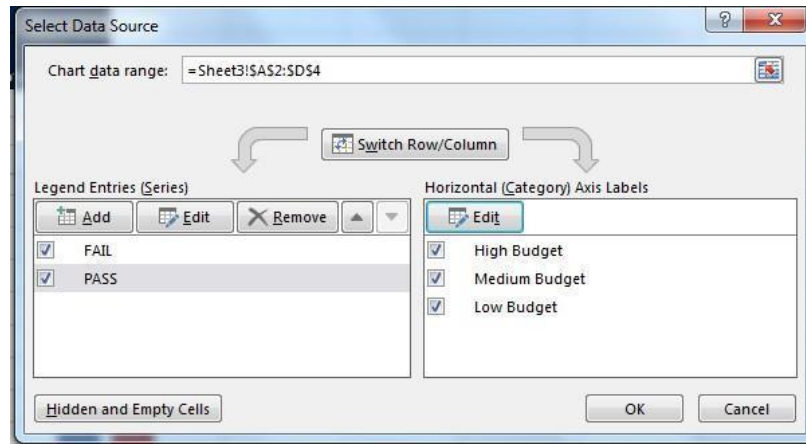


Figure 41: Complete Select Data

Press “OK” to see the new chart!

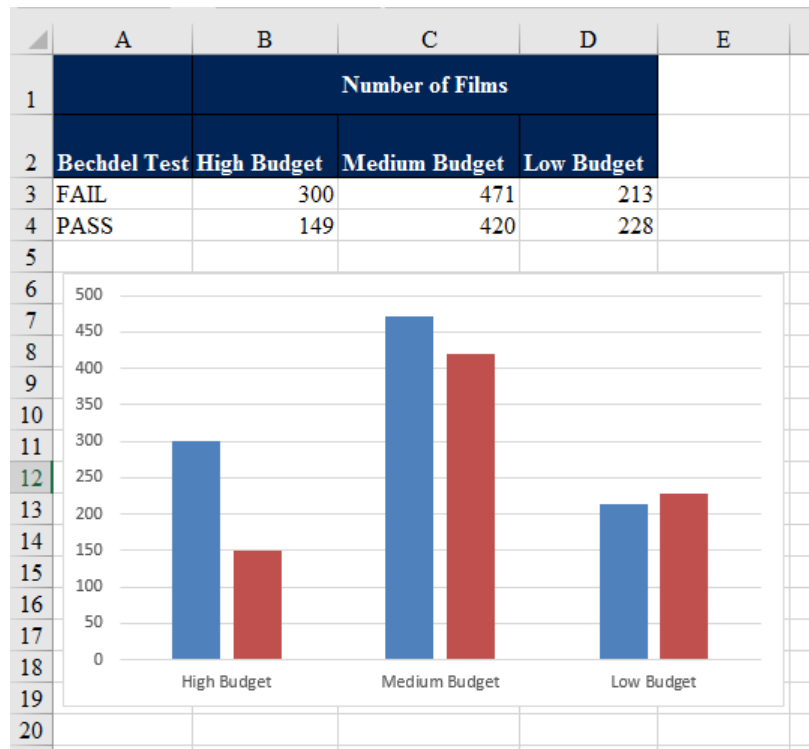


Figure 42: Initial Column Chart

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 Films by Budget & Bechdel Test Result.” Label the Y-axis “Number of Films.” Label the X-axis “Budget.” Your chart should now look like the following figure.

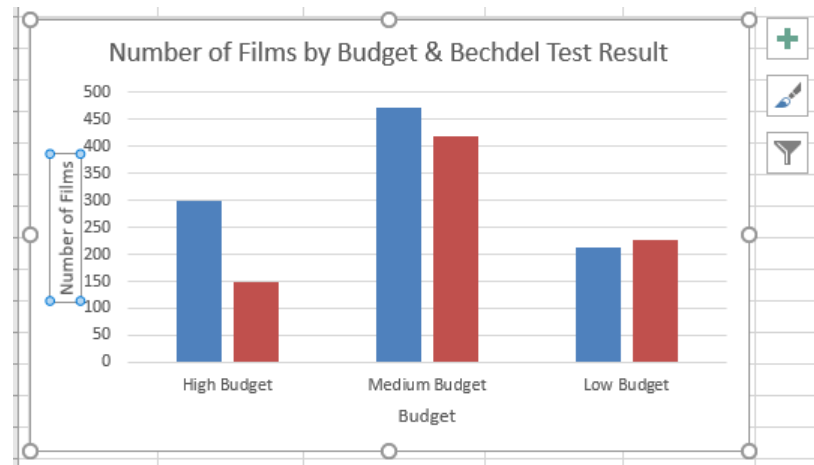


Figure 43: Chart and Axes Titles

- 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. Your chart should now look like the following figure.

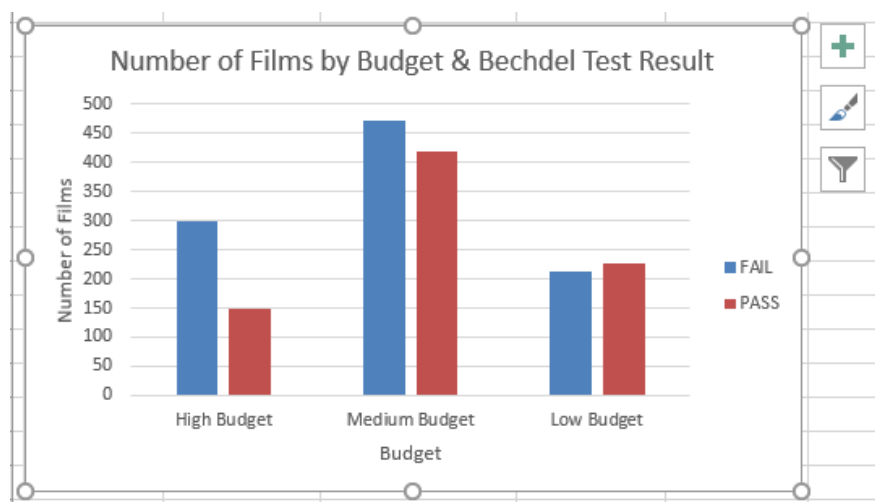


Figure 44: Legend

- 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.

- Gridlines

To delete gridlines, select the green plus, unselect “Gridlines.” Your chart should look like the following figure.

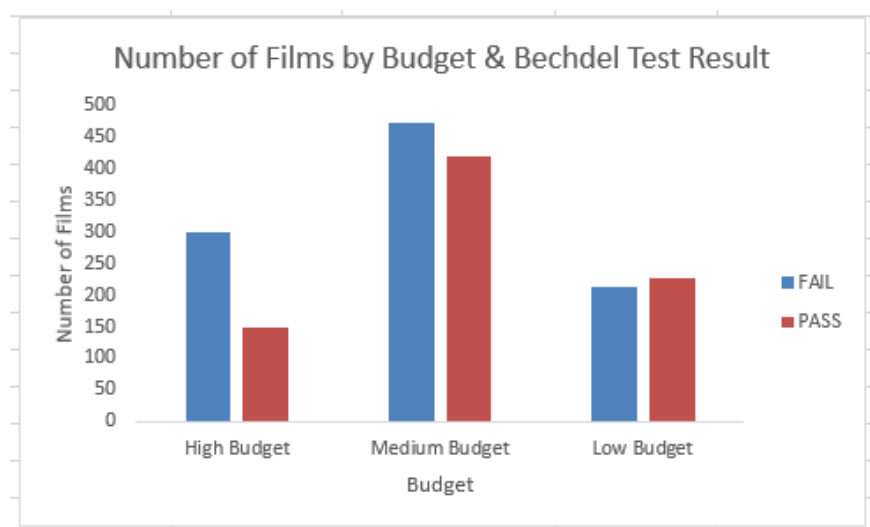


Figure 45: Gridlines

- 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. The “Major Unit” changes the interval between the tick marks and labels. Change the major unit to 100. When you press Enter the chart will automatically update to your adjustments. The sidebar should look like the following figure.

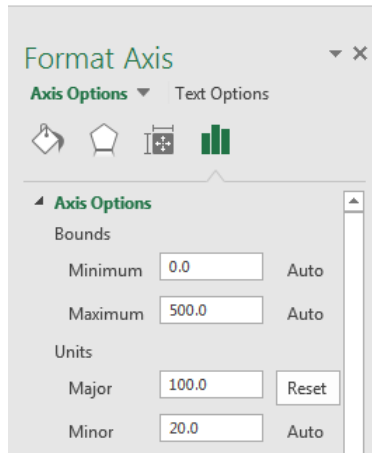


Figure 46: Y-Axis Sidebar

- 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.

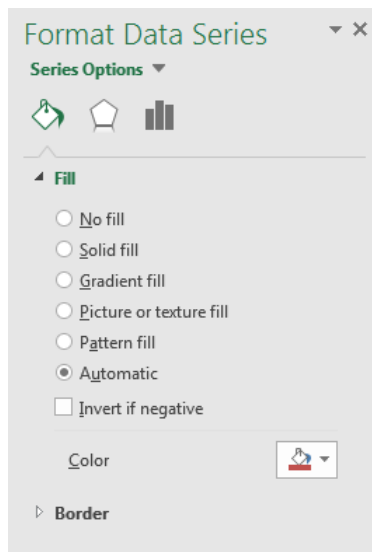


Figure 47: Data Markers Sidebar

To format the second series, click once on one of the other bars. Now change the data markers to another color. Your chart should now look like the following figure.

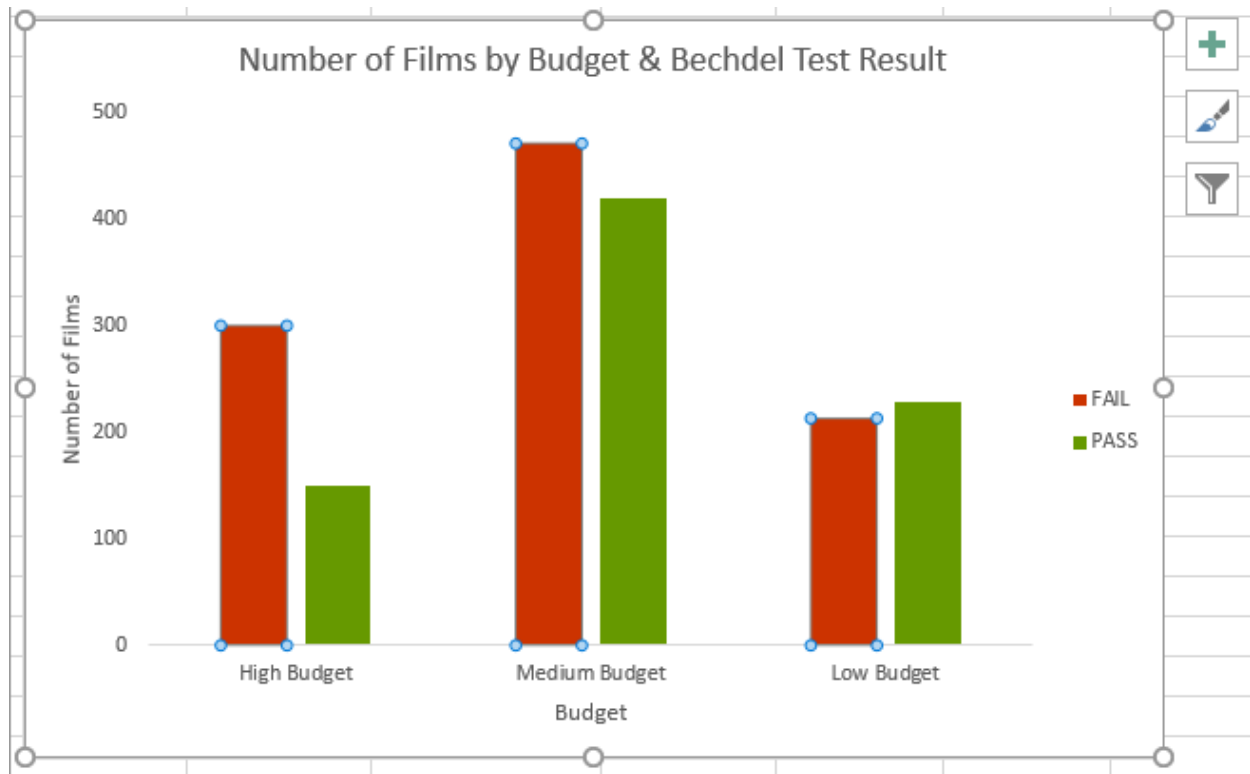


Figure 48: New Bar Colors

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.

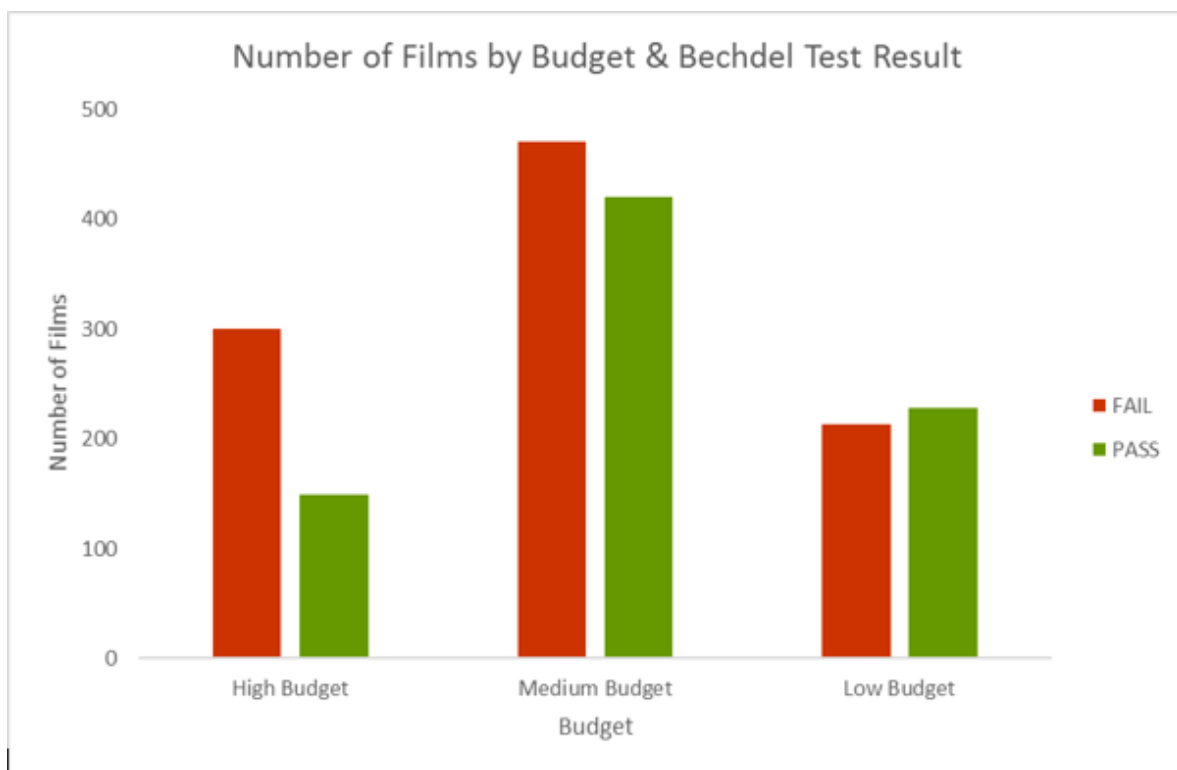


Figure 49: Final Column Chart