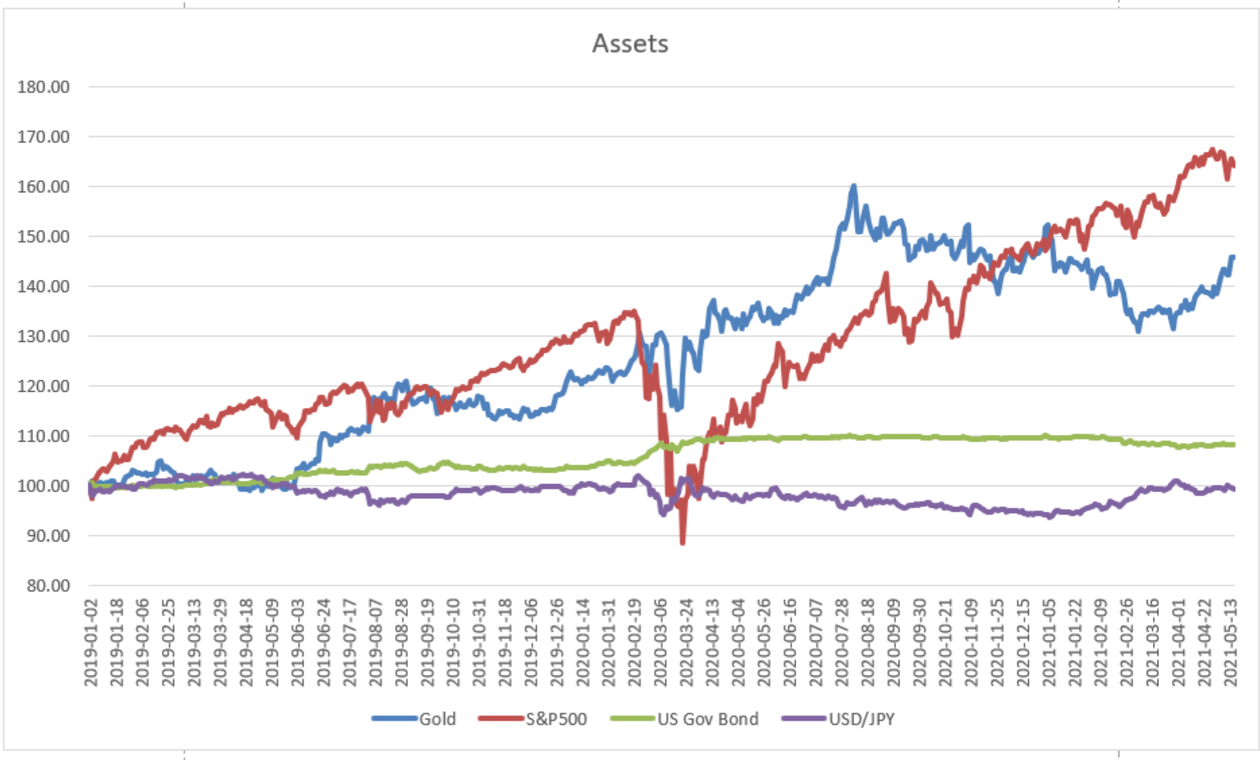
It is important for traders to be able to visualise data clearly.
In this sheet, you should produce a graph that shows how the four assets have performed over time.
You may need to normalise the data first so that all assets can be seen clearly on the one graph.
One standard way to do this is to divide the price of each asset by its original value (the first value in the dataset) and then multiply by 100.

TASK. Fill in the table of normalised data and produce a line graph showing how the assets have moved over time.

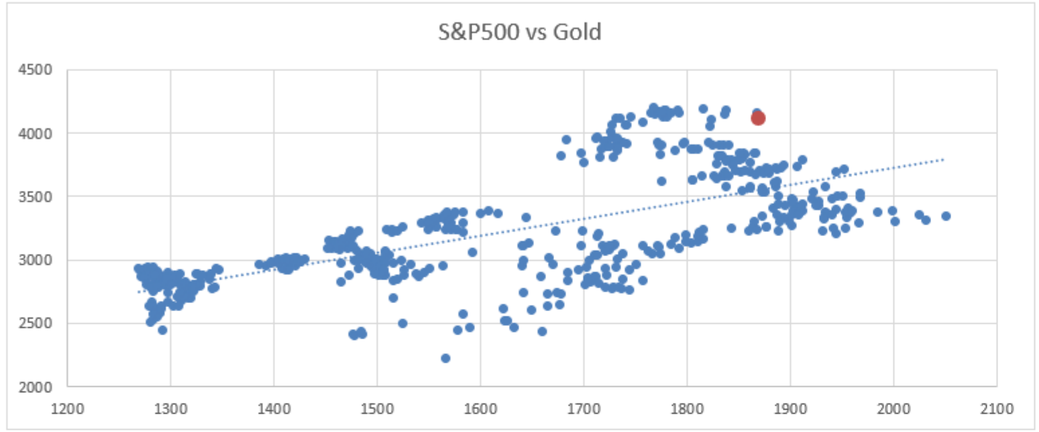
Normalised Data

Date	S&P500	Gold	US Gov Bond	USD/JPY
2019-01-02	100.00	100.00	100.00	100.00
2019-01-03	97.48	100.84	100.54	97.97
2019-01-04	100.81	100.13	100.06	98.30
2019-01-07	101.57	100.45	99.91	98.96
2019-01-08	102.45	100.17	99.69	99.04
2019-01-09	102.85	100.65	99.73	99.19
2019-01-10	103.31	100.29	99.74	98.65
2019-01-11	103.35	100.48	99.86	98.75
2019-01-14	102.77	100.63	99.85	98.90
2019-01-15	103.76	100.41	99.86	98.71
2019-01-16	104.07	100.83	99.78	99.07
2019-01-17	104.95	100.78	99.66	99.42
2019-01-18	106.39	100.02	99.45	99.53
2019-01-22	104.82	100.12	99.66	100.00
2019-01-23	105.07	100.16	99.56	99.71
2019-01-24	104.90	99.85	99.75	99.84
2019-01-25	106.07	101.28	99.56	99.94
2019-01-28	105.22	101.67	99.60	99.76
2019-01-29	105.15	102.12	99.73	99.62
2019-01-30	106.83	102.26	99.91	99.77
2019-01-31	107.71	103.02	100.15	99.37
2019-02-01	107.70	102.80	99.86	99.25
2019-02-04	108.37	102.60	99.75	99.79
2019-02-05	108.76	102.59	99.84	100.27
2019-02-06	108.70	102.22	99.85	100.25
2019-02-07	107.69	102.22	100.05	100.28
2019-02-08	107.78	102.55	100.11	100.08
2019-02-11	107.86	102.03	99.96	100.13
2019-02-12	109.31	102.20	99.90	100.67



In this sheet, you will examine the linear regression between the different assets.

Many of these assets are correlated to each other. For example, here is a scatterplot of the S&P500 against Gold from the data.



The current (Gold, S&P500) pair has been added as a red dot. One might infer from the above graph that the S&P500 is currently overpriced relative to Gold as the current point sits above the trend line.
It is a large assumption that the fair value is on the trend line but we will adopt it to keep this analysis short.
Does it make sense to fit a trend line? Are the assets even correlated?
One way to measure the correlation between two variables is to use an R value. This is done for you below using the CORREL() function.

R	0.68

The R value is a measure of how well the line-of-best-fit (plotted) fits the above data. It ranges between -1 and 1.

You can also find the y-intercept and gradient of the line using INTERCEPT() and SLOPE():

y intercept	1058.90
gradient	1.33

Now we can answer the following question. How expensive is the S&P500 relative to Gold? We want to see how far the current market value is above the line of best fit (this is called a residual).

Residual	575.19
Residual%	13.95

Currently, using the above methodology, the S&P500 is about 14% more expensive than gold.
Again, it is important to note that this analysis is **massively** oversimplified.

TASK. Using the above method, compare each pair of assets to fill in the remainder of the below table: You can fill out these other tables to get there.

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Residual%	S&P500	Gold	US Gov Bond	USD/JPY
S&P500		14.0	18.1	24.2
Gold	-3.40		6.2	17.9
US Gov Bond	-1.97	-1.47		3.4
USD/JPY	2.74	2.75	1.98	

Make a table of gradients

Gradients	S&P500	Gold	US Gov Bond	USD/JPY
S&P500		1.33	60.35	-76.58
Gold	0.35		49.98	-72.19
US Gov Bond	0.01	0.02		-1.33
USD/JPY	0.00	-0.01	-0.37	

Make a table of intercepts

Intercepts	S&P500	Gold	US Gov Bond	USD/JPY
S&P500		1058.90	-4117.94	11460.51
Gold	498.24		-4454.58	9391.84
US Gov Bond	103.11	92.18		264.45
USD/JPY	114.31	119.67	153.25	

Current Prices		4123.00
	Residuals	S&P500
4123.00	S&P500	
1867.80	Gold	-63.44
124.19	US Gov Bond	-2.44
108.87	USD/JPY	2.99

Before we can make a call on what the best trade appears to be, we need to get a measure of the volatility for each of these assets. We will do this in the next sheet.

Now that we have all the details, we can average out the residuals to see how over/under priced the asset is relative to the others. We also include the R-values as weights, for a low R value implies a relationship of little meaning.

R Values	S&P500	Gold	US Gov Bond	USD/JPY	**Average**
S&P500		0.68	0.59	0.40	9.90
Gold	0.68		0.95	0.73	5.56
US Gov Bond	0.59	0.95		0.71	-0.05
USD/JPY	0.40	0.73	0.71		1.50

This number means that on average and relative to the other assets, the S&P500 is a 9.93% sell.

In the previous sheet, you saw a very rough way to compare prices between different assets.
In this sheet, you will calculate the **volatility** of each asset. Volatility is equal to the **standard deviation of the returns of the product** and is a measure of how much each asset moves. It is often used as a proxy for how much risk the asset carries.

Here is a quick lesson on **how to calculate volatility.**

Suppose we have a stock X with the following close prices. We will show you how to calculate the historical volatility in excel below.

Date	X	Returns (%)
2021-04-14	100	
2021-04-15	99.5	-0.5
2021-04-19	102	2.5
2021-04-20	101.5	-0.5
2021-04-21	100.5	-1.0
2021-04-22	96.5	-4.0
2021-04-26	97	0.5
2021-04-27	99	2.1
2021-04-28	101.5	2.5
2021-04-29	102.5	1.0
2021-05-03	103.5	1.0
2021-05-04	102	-1.4
2021-05-05	101	-1.0
2021-05-06	104.5	3.5
2021-05-10	103	-1.4
2021-05-11	103.5	0.5
2021-05-12	104	0.5
2021-05-13	102.5	-1.4
2021-05-17	107	4.4
2021-05-18	109.5	2.3

StdDev	2.1	Here we use the STDEV.S() function to get the standard deviation of returns
Volatility	32.6	Traders annualise volatility by multiplying by SQRT(252)

Therefore, the volatility of stock X is 32.6.

TASK. Use the data in the ClosePriceData tab to calculate the annualised volatility of each asset.

Start by building a table of returns:

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Date	S&P500	Gold	US Gov Bond	USD/JPY
2019-01-02				
2019-01-03	-2.52	0.84	0.54	-2.03
2019-01-04	3.41	-0.70	-0.47	0.34
2019-01-07	0.76	0.32	-0.15	0.66
2019-01-08	0.86	-0.28	-0.22	0.09
2019-01-09	0.39	0.48	0.04	0.15
2019-01-10	0.45	-0.36	0.01	-0.54
2019-01-11	0.04	0.19	0.12	0.10
2019-01-14	-0.56	0.16	-0.01	0.15
2019-01-15	0.97	-0.22	0.01	-0.19
2019-01-16	0.30	0.42	-0.08	0.36
2019-01-17	0.84	-0.05	-0.12	0.36
2019-01-18	1.38	-0.75	-0.21	0.11
2019-01-22	-1.48	0.09	0.21	0.47
2019-01-23	0.24	0.05	-0.10	-0.29
2019-01-24	-0.16	-0.31	0.18	0.13
2019-01-25	1.12	1.43	-0.18	0.10
2019-01-28	-0.81	0.39	0.04	-0.18
2019-01-29	-0.07	0.45	0.13	-0.13
2019-01-30	1.60	0.13	0.18	0.15
2019-01-31	0.82	0.75	0.24	-0.40
2019-02-01	-0.01	-0.21	-0.29	-0.13
2019-02-04	0.63	-0.20	-0.11	0.55
2019-02-05	0.36	-0.01	0.08	0.48
2019-02-06	-0.05	-0.36	0.01	-0.02
2019-02-07	-0.93	-0.01	0.20	0.03
2019-02-08	0.08	0.33	0.05	-0.20
2019-02-11	0.07	-0.51	-0.15	0.05
2019-02-12	1.35	0.17	-0.05	0.54
2019-02-13	0.17	0.12	-0.15	0.10
2019-02-14	-0.22	-0.08	0.22	0.37
2019-02-15	1.22	0.63	-0.10	-0.35
2019-02-19	0.06	1.67	0.10	0.05
2019-02-20	0.30	0.24	-0.03	-0.02

	S&P500	Gold	US Gov Bond	USD/JPY
StdDev	1.61	1.14	0.19	0.46
Volatility	25.61	18.13	2.96	7.33

Now, you need to calculate the **risk-adjusted reward** you see in each trade. This involves dividing the amount of reward you see by the volatility.

	Reward	Volatility	Risk-Adjusted Reward
Short S&P500	9.90	25.61	0.39
Long Gold	-5.56	18.13	-0.31
Long US Government Bonc	0.05	2.96	0.02
Short USD/JPY	1.50	7.33	0.20

Best trade is:

Short S&P500

Reason:

The asset is overpriced versus all other assets.
This is true even after adjusting for volatility.
Second best trade is to sell USD/JPY.

What are some drawbacks of this analysis?

Overly simplistic.
Doesn't consider nature and bounds of different classes.
Time period is fairly generic.
In reality, context to risk-off would provide insight.