Group Assignment Justifications

Question 2:

The three measurements for central tendency we found were for the mean, median, and mode. However, we could not find the mode for any of our securities as the monthly percentage returns were all different. Hence, no value for the percentage return occurred more than once, therefore there was no mode and all our excel formulas returned the "N/A" value. The security with the highest mean percentage return (6.66%) was the Shopify security (SI), which means that its value grew the most on a monthly basis over the three year period. The stock with the lowest mean percentage return (0.06%) was Brookfield Property Partners (BPP), which means that its stock showed the least growth in value over the same period. The stock with the highest median value was also Shopify, which indicates that its histogram is likely normally distributed as the mean is not far from the median. However, the Blackberry stock (BT) was the only stock with a negative median, which indicates that the stock was losing value in the middle of the three year period during which this data was collected (unlike the Shopify stock).

*Abbreviations have been used for the securities named in this document (ex. SU, ENB, etc.). Please refer to the overview page in the excel document for their full names and formulas.

Central Tendency	SU	ENB	BT	SI	TD	RB	HRE	BPP
Mean	0.61%	0.43%	0.38%	**6.66%**	0.61%	0.56%	0.38%	**0.06%**
Median	2.17%	0.70%	**-0.19%**	**7.86%**	0.82%	0.82%	0.09%	0.09%
Mode	#N/A	#N/A	#N/A	#N/A	N/A	N/A	#N/A	#N/A
Variability								
IQR	9.40%	6.25%	**17.25%**	14.75%	4.93%	3.93%	**3.01%**	6.66%
Standard Deviation	6.29%	5.66%	**11.51%**	11.30%	3.93%	3.60%	**2.88%**	4.93%
Coefficient of Variation	1037.50 %	1309.27 %	3038.66 %	**169.58 %**	644.19 %	643.63 %	758.92 %	**7832.40 %**

The three measurements we used for the variability of the securities were the interquartile range (IQR), standard deviation, and the coefficient of variation. The stock with the highest IQR was BT, which means it had the most variability about the mean (in the middle half of the data). This means that the stock was likely fluctuating a lot in the middle of the three years during which the monthly percentage return data was measured, whereas the HRE stock varied the least in the same period (with an IQR of only 3.01%). The high variability of the BT is also demonstrated by the fact that it had the highest standard deviation among all the securities we compared (11.51%), which means its percentage return every month deviated the most from the mean. On the other hand, the lack of variability in the HRE stock is supported by its standard deviation value of 2.88%, which is the lowest among all the securities. Lasty, we computed the coefficient of variation for each stock by dividing the standard deviation over the mean. The stock with the lowest coefficient of variation (169.58%) was the SI stock, which means that its

mean percentage values had the lowest level of dispersion about the mean. The BPP stock had the highest level of dispersion about the mean, as it had the highest value for the coefficient of variation (7832.40%).

Question 3:

For this question, we picked the security with the highest mean percentage return and the lowest standard deviation over the three-year period, which is Shopify (SI). The higher the mean percentage return, the greater the financial reward for the investor. The lower the standard deviation from the mean, the lower the risk of the stock's value fluctuating. We used the coefficient of variation (CV) to determine the stock with the highest mean percentage return and lowest standard deviation as it is a ratio that divides the standard deviation over the mean. Since the mean would be the denominator, a higher mean percentage return would result in a lower CV. As the standard deviation is the numerator, a lower standard deviation would also result in a lower CV. Hence, we found the CV values of all of our securities and selected the security with the lowest value for the CV, which was the shares for SI.

Central Tendency	SU	ENB	BT	SI	TD	RB	HRE	BPP
Mean % Return	0.61%	0.43%	0.38%	**6.66%**	0.61%	0.56%	0.38%	0.06%
Standard Deviation	6.29%	5.66%	11.51%	**11.30%**	3.93%	3.60%	2.88%	4.93%
Coefficient of Variation	1037.50 %	1309.27 %	3038.66 %	**169.58 %**	644.19 %	643.63 %	758.92 %	7832.40 %

Question 4:

Our approach to compare the various stocks in the different securities was to create bins that captured all the data. By creating ten bins to sort the percentage returns of the eight securities with the same class width of 5.00% for each histogram, we were able to compare the skewness and level of kurtosis more accurately. The distribution among the different securities was found to be very different in shape. These differences can be used to describe the securities' behaviour.

We used the difference between the mean and the median to determine skewness:

Stock:	SU	ENB	BT	SI	TD	RB	HRE	BPP
Mean	0.61%	0.43%	0.38%	6.66%	0.61%	0.56%	0.38%	0.06%
Median	2.17%	0.70%	-0.19%	7.86%	0.82%	0.82%	0.09%	0.09%
Absolute value of difference between mean and median:	1.56%	0.27%	0.57%	1.19%	0.21%	0.26%	0.29%	0.03%

A relatively normal, mesokurtic distribution can be found with the SU and BPP histograms, as their distributions occupy a moderate number of bins and their height is not sharply peaked or flat. However, their means are smaller than their medians (refer to the table

above for differences between the mean and median), so their frequency distributions are more negatively skewed. We found that the histograms for BT and SI used the most bins as their monthly percentage returns had substantially increased and decreased within the three-year span. The peaks of their frequency distributions are relatively flat and their values are more dispersed, which resembles a platykurtic frequency distribution. However, the mean for BT is greater than the median, so it is positively skewed, unlike SI, which is negatively skewed since its mean is smaller than the median. The HRE stock's mean is also greater than its median, so it is the only other stock that is positively skewed. The HRE, RB, ENB, and TD histograms have a leptokurtic frequency distribution as there are more values in the bins close to the mean and their distributions also have a sharp peak with heavy tails. Like SU and BPP, their histograms are negatively skewed as their mean values are smaller than their medians.

SI's distribution is what you would expect from a technology stock, which has sharp increases and decreases in its monthly price according to changes in the market. That would explain why its percentage returns vary significantly, making its distribution appear platykurtic and employ more bins. Stocks in more stable industries such as finance and housing (e.g. RB, TD, and HRE) will offer less volatility which will make the shape of their histograms more frequent towards the mean and median (because of infrequent jumps and slips in stock price). Further, their frequency distributions would appear to be more leptokurtic because their monthly percentage return values would mostly occupy bins that are close to the mean.

Question 5:

The stock we chose to analyze is Brookfield Property Partners (BPP) as its histogram's distribution most closely resembled that of a continuous, mesokurtic, normal distribution curve among our eight securities. A normal distribution is characterized by a symmetric bell shape, with an equal mean and median located in the centre. The BBP stock has a mean of 0.06% and a median of 0.09% with a difference of 0.03%, making it the most closely related mean and median across our eight stocks. Since the median is a bit larger than the mean, the BPP stock's histogram is slightly negatively skewed. Furthermore, from the BPP histogram, we can see that the shape is rather asymmetric, which stems from the difference between the median and mean. This also means that most values are concentrated on the right side of the distribution graph, while the values on the left side are more dispersed. All of these factors conclude that the BPP stock is a left-skewed distribution most representative of a normal distribution in comparison to the rest of our stocks. As the percentage returns of the BPP stock have followed a normal distribution over three years, it will likely continue to follow this distribution for the percentage returns in the future.

Stock:	SU	ENB	BT	SI	TD	RB	HRE	BPP
Mean	0.61%	0.43%	0.38%	6.66%	0.61%	0.56%	0.38%	0.06%
Median	2.17%	0.70%	-0.19%	7.86%	0.82%	0.82%	0.09%	0.09%
Abs. value of difference between mean and median:	1.56%	0.27%	0.57%	1.19%	0.21%	0.26%	0.29%	**0.03%**

BPP has a continuous distribution because return percentages are continuous variables (they can theoretically take on any value). Since it is continuous, we can make assumptions on its future performance via calculations using its highest frequency to determine its kurtosis.

Histogram Peak	SU	ENB	BT	SI	TD	RB	HRE	BPP	Mean Peak
Highest Frequency (used to determine kurtosis)	9.00	16.00	7.00	8.00	16.00	17.00	17.00	**12.00**	**12.75**
Histogram Bins	**SU**	**ENB**	**BT**	**SI**	**TD**	**RB**	**HRE**	**BPP**	**Mean Bins**
Bins Used	6.00	6.00	10.00	9.00	4.00	4.00	3.00	**5.00**	**5.88**

The highest frequency of a histogram is its peak. The average peak value amongst our eight histograms is 12.75, whereas the peak for the BPP stock's histogram is 12.00. Therefore, BPP has the peak which is closest to the mean peak value. This indicates that the kurtosis of its histogram is relatively mesokurtic (moderately peaked) with other stocks having a more leptokurtic (sharply peaked) or platykurtic (flat peaked) shape, with their highest frequency being much higher or lower than the mean, respectively. Furthermore, the frequency distribution of BPP's histogram used 5 bins, which is quite close to the 5.88 bins our eight stocks used on average. Hence, its histogram is relatively moderate in breadth (since it used a moderate number of bins), which is also indicative of a mesokurtic distribution.