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Remember: Any group members who did **not contribute to the project should be given all zero (0) points for the collaboration grade on the GWP submission page.*

Statement of integrity: By typing the names of all group members in the text boxes below, you confirm that the assignment submitted is original work produced by the group (excluding any non-contributing members identified with an "X" above).	
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Team member 3	**Shailza Virmani**

Use the box below to explain any attempts to reach out to a non-contributing member. Type (N/A) if all members contributed. **Note:** You may be required to provide proof of your outreach to non-contributing members upon request.
N/A

Portfolio A:

[Yahia Hammami]

The stocks chosen for **Portfolio A** and the weights and positions allocated to each can be found in **Table 1**.

Table 1. Portfolio A asset allocation.

Company Symbol	Weight	Position
AAPL	150%	Long
NFLX	-50%	Short

Portfolio's A statistics are calculated in **Table 2**, using the following formulas:

$$Average\ return = Weight_{AAPL} \times Mean\_Return_{AAPL} + Weight_{NFLX} \times Mean\_Return_{NFLX} \quad (1)$$

$$Variance = Variance_{AAPL} + Variance_{NFLX} + 2 \times Covariance_{AAPL\_NFLX} \quad (2)$$

Table 2. Portfolio A calculated statistics.

Average Return	Volatility
8.21%	1.24%

1. **Shorting**

a. Portfolio A, which consists of a long position in the AAPL stock with a weight of 150% and a short position in the NFLX stock with a weight of -50% can be shorted.

b. Shorting this portfolio is done by doing the exact opposite, shorting the AAPL stock and holding the NFLX stock.

2. **Credit Risk**

a. Since there is no promise of payment there is no credit risk. This portfolio is not mainly exposed to market risk since.

b. The Credit risk is the possibility of economic loss that results from the counterparty's failure in meeting its contractual obligation.

3. **Portfolio Statistics**

a. The weighted return was calculated according to Formula (1) to be 8.21%, as shown in **Table 2**.
b. The standard deviation was calculated using Formula (2) and found to be 0.0001541671694054597.

4. **Diversification**

a. The correlation between the two stocks is 0.46 and noting that they both belong to the technology industry, shorting one stock and holding the other by taking a long position makes this portfolio less exposed to the variation coming from the industry.
b. This portfolio cannot be considered well diversified because it includes only two stocks which are not enough.

5. **Comparting Portfolios**

a. Compared to other portfolios, **Portfolio A** has less stocks in it, so it is less diversified, which makes it more exposed to the specific risk related to these two stocks, making it relatively riskier than the other portfolios. This is expressed in having higher standard deviation than the other two portfolios.
b. As a compensation for having higher risk, **Portfolio A** has a higher return than the other two portfolios.

6. **Assessing Risk**

a. Since the portfolio consists of 150% of AAPL stock, any economic event that will affect the Apple Corporation will have a huge impact on the portfolio and this event can be a decline in the economic growth, which can have an effect on the sales of Apple, because its products are relatively expensive and that will be reflected in a decrease in the share price.
b. The other portfolios are also affected by this economic event because it affects the market as a whole, also the weight of the AAPL stock is high in both of them.

7. Performance

a. The factors that will lead to the appreciation of AAPL's stock price are related to the tech industry in general, new innovation and new technology is an example. The economic growth is a very important factor here for Apple, because as mentioned previously it has an impact on the sales of the company, meaning in case of an economic boom AAPL stock will skyrocket.

b. The previously mentioned economic event will have an effect on all the stocks in the market, especially the ones in the tech industry so all portfolios will appreciate in value.

8. Disrupters

a. The central bank can influence the stock market by change the risk free rate which is inversely related to the real rate of return and the economic growth. If the central bank increases the risk free rate people will invest less in risky assets like stock and more in government bonds and fixed income assets, leading to a decrease in liquidity in the stock market and the stocks losing some value.

b. One of the investment banks' role is to help match sellers and investors, therefore increasing liquidity in the market. Liquidity is an important factor for any financial instrument and it has a direct effect on the instrument's price. In conclusion, the effect of the investment banks on the portfolio is that it makes it more liquid, easier to buy and sell, which makes it more valuable.

9. Re-assessing Risk

a. The two instruments in **Portfolio A** are the AAPL and NFLX stock. The NFLX stock skewness is -3.1 compared to -0.3 for AAPL which indicated that the NFLX stock is more negatively skewed, meaning that the left tail is relatively longer than the right one so the return is most of the days negative for both of them, but it is more significant for the NFLX stock.

b. There are many types of correlation, including the one given in the .csv file, which is linear correlation. When the two assets are independent we can conclude that the correlation is null, but the opposite is not always correct, meaning that the two assets in **Portfolio A** that have a linear correlation coefficient of 0.46 can have another nonlinear relation between them with a higher or lower coefficient.

Portfolio B:

[Sorin Muraru]

The stocks chosen for **Portfolio B** and the weights and positions allocated to each can be found in **Table 3**.

Table 3. Portfolio B asset allocation.

Company Symbol	Weight	Position
AAPL	60%	Long
NFLX	15%	Long
META	15%	Long
GOOG	10%	Long

The Average Return and Volatility of **Portfolio B** calculated for **Step 1** are shown in **Table 4**. I computed these with the help of my group members using Python in a Google Colab code (Virmani 1).

Table 4. Calculated average return and volatility of Portfolio B.

Average Return	Volatility
2.43%	0.86%

The answers for **Step 2** regarding **Portfolio B** are presented below:

1. **Shorting**

a. Yes, this portfolio can be shorted.

b. The mechanism is one of the simplest involved, each stock has to be sold short by borrowing it first from the broker/exchange according to its allocated weight in the portfolio. All the opened short positions will have to be covered at a later date by buying each stock according to the weights allocated in the portfolio.

2. Credit Risk

a. As nothing is lent in the case of buying this portfolio, there is no credit risk.
b. Credit risk refers to the situation in which the borrower does not fully pay the lender his or her due amount, invoking various reasons up to the extreme case of unwillingness or inability, resulting at worst in a default.

3. Portfolio Statistics

a. The weighted return of the portfolio is 2.43%, as shown in **Table 4**.
b. The variance of the portfolio is 0.00007469688026198356.

4. Diversification

a. The diversification between two assets refers to achieving as large a return with a minimized volatility, more precisely with very reduced uncertainty. This means there is a low chance of losses so that little risk is incurred. However, this usually results in lower returns as well.
b. Given a computed coefficient of variation for the whole portfolio of 0.35527, it is expected that every percentage point of return implies a degree of volatility of 0.35527 points. Although the overall volatility of the portfolio is rather small at 0.86%, this coefficient of variation is showing a large risk tolerance per point of return is needed for this portfolio.

5. Comparing Portfolios

a. In terms of absolute risk, this portfolio ranks lowest (risk ranking), given the smallest standard deviation. However, in terms of points of risk per point of return, it ranks 1st (as in the highest number of points of risk per points of return). Overall, this portfolio would be suitable for risk-averse investors who seek lower absolute risks and not demanding high returns.
b. In terms of return, this portfolio ranks lowest, as the return is a mere 2.43%, being comparable to short-term risk-free bonds of developed countries or solid corporations, or sometimes even certificates of deposit.

6. **Assessing Risk**

a. Conditions or scenarios that would affect this portfolio are cases that disrupt the expected return or volatility to extreme levels. Given the high weight allocated to AAPL (60%), it is expected that any event affecting the Apple products or services in a negative way would lead to high losses to be incurred by this portfolio. This could involve, for example, lack of electric energy (power) supply, which would render the Apple devices useless, as any power cut would also stop Internet and Mobile services, making them rely only on a battery that would allow the device to do little other than keeping an agenda for a little while, showing the time or turning on the flashlight.

b. Given that all the stocks that are part of this portfolio are bought into (long positions taken for all) and that they are all part of the tech industry, the latter sector would be hit by the extreme conditions mentioned above and therefore all the stocks would be affected, potentially driving this portfolio's returns to extreme losses.

7. **Performance**

a. Economic conditions or scenarios that would greatly improve the securities involved in this portfolio are those very favorable to the tech industry, as all the positions taken in this portfolio are long positions. Given the highest weight allocated to Apple (60%), it is to be expected that favorable conditions for Apple products and services would push the portfolios returns the greatest. Such scenarios could involve conditions disrupting travel leading to increased digitalization in terms of business meetings, education or home entertainment. The increased demand for Apple products and services would drive the portfolios returns upwards.

b. Once again, given that all stocks that are part of this portfolio are part of the tech industry and only long positions are taken, the economic conditions mentioned above would be favorable to the other stocks as well, leading to even higher expected returns overall.

8. Disrupters

a. Central banks may choose to increase or decrease the risk-free rates. In turn, each of these two scenarios would affect the stock market as a whole by decreasing liquidity or increasing it thereof. For example, increasing the key interest rate would result in investors being less interested in the stock market and therefore many would exit it, leading to the share prices of all the stocks in the portfolio to fall. In addition, given the highest weight allocated to Apple stock (60%), and the fact that Apple products or services can be considered premium and therefore costly, it is possible that people would take loans or other forms of financing and pay interest rates. Higher interest rates may therefore adversely demand for Apple products or services and may consequently drive this portfolio's returns lower.

b. Investment banks would be able to play a similar role to a market maker for a short while and provide liquidity in the market for a certain stock. Also, investment bank can provide financing for investors, companies or funds and therefore help the liquidity of the stocks in the portfolio. Similarly, if investment banks offer loans to the companies that are included in the portfolio, this may be seen as a good thing by investors and analysts, and therefore increase the price of the shares involved, as it would help the companies survive any crisis period or help expand their operations further, with good perspectives for the future.

9. Re-assessing Risk

a. The skewness of daily returns of each stock in the portfolio shows that they have exclusively longer tails on the negative side of the return distribution. AAPL has a 10 times smaller skewness than NFLX, while META has a 10 times larger skewness than GOOG.

b. Given the type of correlation (Pearson) presented in the .csv file, which is linear, it is, of course, possible to also deduce and perform a Spearman rank correlation. There is a difference between these two, as the latter can only give ordinal information, while the Pearson correlation gives quantitative information (ratios). The most correlated stocks in the portfolio are AAPL and GOOG, followed by META and GOOG and then by META and AAPL.

Portfolio C :

[Shailza Virmani]

For doing calculations for variance, standard deviations and the rest of the required computations, I have used Python code written in Google Colab (Virmani 1).

The stocks chosen for **Portfolio C** and the weights and positions allocated to each can be found in **Table 5**.

Table 5. Portfolio C asset allocation.

Company Symbol	Weight	Position
AAPL	140%	Long
AMZN	10%	Long
NFLX	-30%	Short
META	-30%	Short
GOOG	10%	Long

Table 6 shows the Average Return and Volatility of **Portfolio C** calculated for **Step 1**.

Table 6. Calculated average return and volatility of Portfolio C.

Average Return	Volatility
7.77%	1.13%

The formulas used in the Python code (Virmani 1) to compute Average Return and Volatility are the following:

$$Average\ return = Weight_{AAPL} \times Mean\_Return_{AAPL} + Weight_{AMZN} \times Mean\_Return_{AMZN} + Weight_{NFLX} \times Mean\_Return_{NFLX} + Weight_{META} \times Mean\_Return_{META} + Weight_{GOOG} \times Mean\_Return_{GOOG} \quad (3)$$

$$Volatility = \sqrt{Variance_{Portfolio\ C}} \quad (4)$$

The answers to **Step 2** are shown in the following paragraphs.

1. **Shorting**
   a. Yes, **Portfolio C** can be shorted based on the details provided: "Buy some stocks and short some other stocks.".
   b. In accordance with the explanation in the course, the mechanics of shorting are – "borrowing a security that you don't own, selling it in the marketplace (which gives you cash), and waiting for the capital depreciation to occur. Capital depreciation means that the price drops, after which you would buy back, or cover the short, collect the difference between the high price at which you sold and the low price at which you bought, and then return the security to its original owner.".
2. **Credit Risk**
   a. Yes, as **Portfolio C** can be shorted it possesses credit risk.
   b. Here the credit risk would be for the lender, as the lender would be expecting the borrower to pay the principal [the lended asset] as well as the interests.
3. **Portfolio Statistics**
   a. The weights for **Portfolio C's** assets, as shown in **Table 5**¸are [AAPL, AMZN, NFLX, META, GOOG] = [1.4, 0.1, -0.3, -0.3, 0.1]. The weighted return, according to Formula (3) is calculated to be 7.77%.
   b. To compute the variance, Formula (5) was used:

$$Variance = \overrightarrow{Weights^T} \times Covariance\_Matrix \times \overrightarrow{Weights} \quad (5)$$

where $\overrightarrow{Weights}$ is the weights vector of the securities in the portfolio, $\overrightarrow{Weights^T}$ is the transpose of the weights vector, and the Covariance Matrix is computed according to Formula (6):

$$Covariance\ Matrix = D \times Correlation\ Matrix \times D \quad (6)$$

where D refers to the determinant matrix having the standard deviation in its diagonal. The variance is then calculated to be 0.0001292297784982216.

4. **Diversification**

a. Diversification refers to the procedure that mixes a variety of investments within a portfolio to reduce overall portfolio risk. Diversification between two assets means reducing the risk of investment by using negative correlation to compute the variance. Reducing risk means reducing the variance of the portfolio, therefore we need a negative correlation. Example: suppose we have two stocks A and B and we invested 50% of our capital in A and the rest in B: this is known as diversification of assets.

b. Yes, as the variance is the least when compared to the variances of the other portfolios.

5. **Comparing Portfolios**

a. **Portfolio C** has the second highest weighted return & lowest variance. So I think **Portfolio C** would be the best as it has good returns and is more diversified in comparison to **Portfolio A**, in which the returns are high but is overall less diversified.

b. **Portfolio C** has lesser returns, i.e. +7.77%, and therefore ranks 2nd.

6. **Assessing Risk**

a. During COVID pandemic, people stayed at home and hence, the interaction of public with one another for office meetings (Meet, Zoom, Duo, META etc.) were on demand, which resulted in a rise of the price of stocks of META and GOOG. Also, the rate of people watching videos on Netflix, Amazon Prime, etc. increased, leading to an increase in the stock price of AMZN (due to Amazon Prime), NFLX (due to Netflix) & AAPL (due to AAPL TV). However, after this period, the use for these products declined, which resulted in the decline in stock prices of these entities.

Other economic conditions that could affect the stocks are:

- Trade Wars: imports become expensive due to high taxes, depending upon the country of import.
- Unemployment: when unemployment rate rises and the hiring rate falls, as a result the investor may hold off from investing or even exit their existing positions.
- GDP: a fall in GDP would lead to falling prices in the stock market and vice-versa.
- Inflation: when inflation rises, the stock market falls.
- Interest rates: a rate hike could lead to a drop in stock prices.

This information presented at **Point 6** was taken from Scripbox (Pati 2).

b. All these stocks, i.e. AAPL, AMZN, NFLX, META, GOOG, are owned by the technology sector and hence they are correlated, therefore similar events would impact them in both ways – positively as well as negatively.

7. Performance

a. Conditions that could improve each security:

- The bandwagon effect which led people to increase the usage of online shopping, online payments, watching series which further led to the increase in price of these stocks.
- In Budget for the year 2019 in India, the government lowered to corporate tax, which laid an impact on the stock prices.
- If the same pandemic (as discussed in **Point 6 a** above) or any other pandemic occurs, then the prices of these stocks would rise again and the use of these would also increase when people work from home.
- Developing the technologies (e.g. Robo Advisers, Bitcoin & Blockchain technologies, etc.) would improve each security.

b. Both of the above mentioned conditions would benefit the other members of the portfolio.

8. Disrupters

a. The Central banks influence interest rates/policy rates to adjust the supply of money to keep the economy humming. When interest rates rise investors believe that growth of stocks would be less favourable as their long-term cash flow is reduced and the ability to have security low-cost debt financing becomes more difficult. When the interest rates are low, it's the golden age for growth stocks as capital can be obtained cheaply and growth easier to come by. This would create a fallacious image which says that the entity is more profitable.

b. The investment banks are the agents for capital formation & price setting. The investment banks help their clients with financing, hedging, research and more. These help businesses (local & global) with capital financing. These also influence the stock prices and distributed dividends as investors always seek higher dividends. These can impact **Portfolio C**, but not more so than the Central Bank.

9. Re-assessing Risk

a. No two investments have the same skew. Explicitly:
   i. For AAPL stock it is -0.33517305
   ii. For AMZN stock it is -0.312865226
   iii. For NFLX stock it is -3.101653581
   iv. For META stock it is -1.936505944
   v. For GOOG stock it is -0.197699834

b. Yes. Pearson is used to measure the strength of linear relationship, while Spearman is used to measure the degree of association.

WORKS CITED:

(1) Virmani, Shailza. *GWP 1.ipynb.* Google Colab, 2022.
(2) Pati, Satyam, *Factors affecting US Stocks Market.* Scripbox, 2022, as found at https://scripbox.com/pf/factors-affecting-us-stocks-market/.