FINANCE GROUP COURSEWORK

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MSIN0021: FINANCE II

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1) PART A

Notes:

1. Due to space concerns, the pictures that are to follow illustrate a sample of those 60 points, along with the formula used. Keep in mind that this applies to all the steps.
2. The calculations of the stock are illustrated in blue, and the calculations of the bond are illustrated in green.
3. We used the current risk-free rate of 0.05%, illustrated in our calculations as 0.0005.

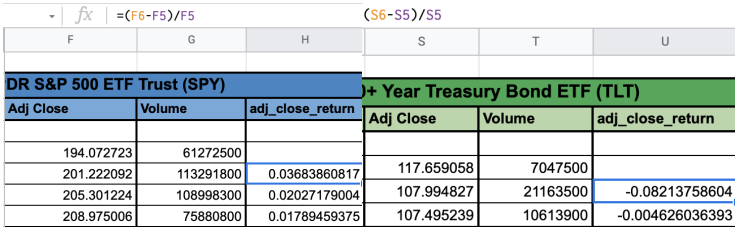
Exercise 1

Step 1: We selected the last trading day of each month in the last 5 years for SPY and TLT and we used the "Adj Close" column for calculations.

Step 2: We computed the monthly returns ("adj_close_return") using the formula below and got 60 data points.

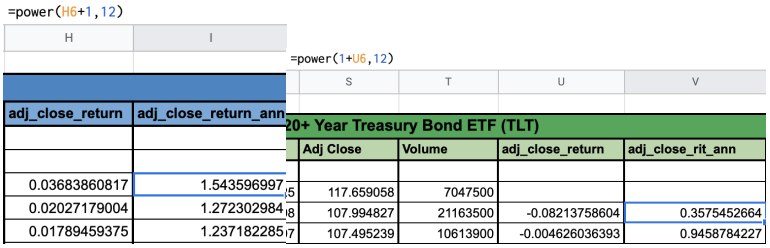
$$r_{i,t} = \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}}$$

where:
$r_{i,t}$ = return on stock i for month t
$P_{i,t}$ = closing price on stock i for month t
$P_{i,t-1}$ = closing price on stock i for month $t-1$



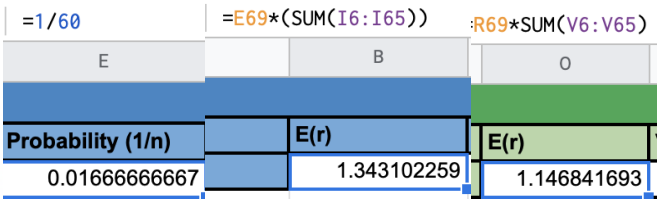
Step 3: Annualized monthly returns using the formula below. (Gross returns) ("adj_close_return_ann").

$$r_{ann} = (1 + r_{mon})^{12}$$

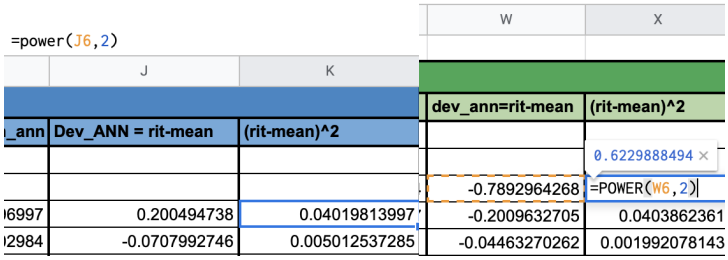


Step 4: We computed the expected returns of the stock and bond using the formula below, where n is the number of data points (60). Cell E69 is the answer to 1/n.

$$\bar{r}_t = \frac{1}{n}\sum r_t;$$



Step 5: Using the means in Step 4, we further calculated return minus mean and squared it.



Step 6: We calculated the variance using the formula below and standard deviation by square rooting the variance. Cell F69 is 1/ (60-1).

$$\mathrm{Var}(r) \equiv \sigma^2 = \sum_{s=1}^{S} p(s)\,[r(s) - E(r)]^2$$

=E69*(SUM(K6:K65)) =SQRT(P69)

C	D	P	Q
Var(r)	**SD**	**Var(r)**	**SD**
0.4457549398	0.6676488147	0.292560959	0.540889045

Step 7: We computed the covariance by calculating the sum of the product between the deviation of both the stock and bond, i.e., the return minus mean of the stock times the return minus mean of the bond times the probability 1/n. Furthermore, we computed the correlation based on the formula: Cov(S, B)/SDstock*SDbond.

=E69*SUM(AB6:AB65) =G74/(D69*Q69)

AB	G	H
Simple devS * devB	**COV(S,B)**	**COR(S,B)**
-0.1582497803 ×	-0.08145421027	-0.2255574986
=J6*W6		
0.01422805378		
0.004727494665		

Step 8: We calculated the weights of the stock and bond using the formula below.

$$w_B = \frac{[E(r_B) - r_f]\sigma_S^2 - [E(r_S) - r_f]\sigma_B\sigma_S\rho_{BS}}{[E(r_B) - r_f]\sigma_S^2 + [E(r_S) - r_f]\sigma_B^2 - [E(r_B) - r_f + E(r_S) - r_f]\sigma_B\sigma_S\rho_{BS}} \qquad (6.10)$$

$$w_S = 1 - w_B$$

=((O69-B76)*C69-(B69-B76)*G74)/((O69-B76)*C69+(B69-B76)*P69-(O69-B76+B69-B76)*G74)

B	C	D	E	F
Weights				
WB	**WS**			
0.5606321035	0.4393678965			

Therefore, the weights are SPY: 44%; TLT: 56%.

Exercise 2

The statement is appropriate as the minimum variance portfolio contains assets that are hedged when traded together, resulting in the lowest possible risk for the rate of expected return. For computing the stock weight for the MVP, we used the formula below. For the bond weight, we used: Wb = 1 - Ws.

$$w_S(min) = \frac{(\sigma_B^2 - \sigma_B\sigma_S\rho_{BS})}{(\sigma_B^2 + \sigma_S^2 - 2\sigma_B\sigma_S\rho_{BS})}$$

Therefore, the weights are as follows: SPY: 41.5%; TLT: 58.5%

=(power(Q69,2)-Q69*D69*H74)/(power(Q69,2)+power(D69,2)-2*Q69*D69*H74)

B	C	D	E
Minimum Variance			
WS(min)	**WB(min)**		
0.4150078523	0.5849921477		

Exercise 3

The Sharpe ratio based on the balanced portfolio is calculated using this formula and is as follows:

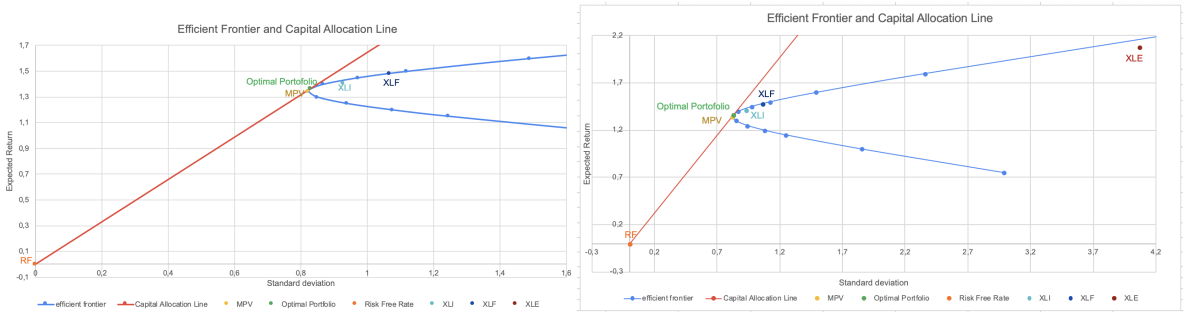
=(B86-B76)/D86

E
Sharpe Ratio
3.319458438

$$S_P = \frac{E(r_P) - r_f}{\sigma_P}$$

Exercise 4

The calculations for E(r), SD, Covariance and Variance follow the same method as in Exercise 1, steps 1-7 for each stock (XLI, CLF, XLE). For plotting the efficient frontier, we used solver, in which we set the objective to Minimize variance with two constraints: 1. The Sum of weights would be equal to 1 and 2. Expected return is a fixed value that we change for every point on the efficient frontier. We did it for 14 points (including MVP and Optimal, see Excel for all). The CAL was plotted starting from the risk-free rate, tangent to the efficient frontier and intersecting in the Optimal Portfolio.



Exercise 5

For computing the weights for the minimum variance portfolio, we used the solver function in Excel. We entered sample weights (0.6,0.5, -0.1), with the third one being 1 minus the other two weights. We set the objective MIN variance and allowed negative results (for allowing shorting) in solver and Excel computed the weights for the MVP by changing the variable cells (the weights of the first two) with the third being 1 minus the other two. The weights are as follows:

Exercise 5 - MVP (used solver) - Short Sales Allowed			
Weight on XLI	**Weight on XLF**	**Weight on XLE**	**Variance**
0,895580201	0,229015138	-0,124595339	0,678643999

Exercise 6

For computing the weights of the three ETFs that correspond to the best risk-return trade-off we maximized the Sharpe Ratio using solver. The method is the same as in exercise 5, with one difference. Instead of the objective being MIN variance, we set it to MAX and selected the Sharpe Ratio, offering us the highest Sharpe ratio possible. The Sharpe Ratio and weights are as follows:

	Exercise 6 - Best Risk Return Trade Off Portofolio - Highest Sharpe Ratio - Used Solver		
Sharpe ratio	**Weight on XLI**	**Weight on XLF**	**Weight on XLE**
1,642908938	0,785029197	0,316470725	-0,101499922

Exercise 7

a. For computing the betas of the stocks, we used the formula Beta = Covariance/Variance where Covariance= measure of a stock's return relative to that of the market and Variance = Measure of how the market moves relative to its mean.
The calculations for Covariance and Variance follow the same method as in Exercise 1, steps 1-7.

Monthly			
	AAPL	**GOOG**	**SPY**
E(r)	0.03269331449	0.02441454922	0.0154185767
PROBABILITY (1/n)	0.01666666667	0.01666666667	0.01666666667
Variance			0.001904614803

Covariance	**AAPL**	**GOOG**
SPY	0.00230615107	0.002004078225

The monthly Betas for the two stocks are as follows.

BETA APPL	**BETA GOOG**
1.210822822	1.05222233

b. The annualized alphas for AAPL and GOOG were computed following the formula below and are as follows. (Annualized betas) R=annualized return of the stock; Rm= expected return of market(index).

$$\text{Alpha} = R - R_f - \text{beta}\,(R_m - R_f)$$

=B84-B93-F69*(D84-B93)

	A	B	C
		APPL	GOOG
Alpha		0.1174386969	0.1295665887

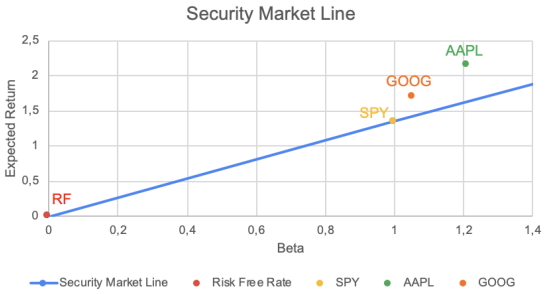
c. Using Excel, we did the linear regression for both AAPL and GOOG. Blue highlights the explained variance(R^2) and green highlights the variance of residuals. (Residual, SS)

R Square	0.2530656593	APPL
Adjusted R Square	0.240187481	
Standard Error	1.772960332	
Observations	60	
ANOVA		
	df	*SS*
Regression	1	61.76988895
Residual	58	182.3165238

R Square	0.3851495712	GOOG
Adjusted R Square	0.3745487017	
Standard Error	0.9993428354	
Observations	60	
ANOVA		
	df	*SS*
Regression	1	36.28414872
Residual	58	57.92379395

Exercise 8

For plotting the Security Market Line (SML), we used the monthly values for Beta and annualised values for expected return. Both GOOG and AAPL appear above the SML, indicating that both securities are under-priced.



Exercise 9

The Treynor-Black model assumes that markets are highly but not perfectly efficient. Consequently, along with the passively managed portfolio, an actively managed portfolio could be built with AAPL and GOOG, as both stocks appear to be under-priced and therefore additional information could be used to generate excess returns. (See ex.8)

In the active portfolio, the initial weight of each security should be proportional to the information ratio, that is the expected alpha return of the individual security, divided by the unsystematic risk squared. Based on this formula, the higher alpha of the security, the higher the weight should be attributed to it and the higher the unsystematic risk (the volatility in the security's price), the lower the weight should be assigned to it. Thus, from what we found in ex.7, a higher weight should be assigned to GOOG when compared to AAPL, as its alpha is higher, and its variance of residuals is lower. Since both alphas are positive, we would expect a positive weight for both securities in the active portfolio.

The alpha and the residual standard deviation should be computed again to determine the weight of the active portfolio in the overall one. Then, this can be subtracted from one to find the weight of the passive portfolio.

In this new optimal risky portfolio, we combine the Sharpe ratio of the passive portfolio and the information ratio of the active one, creating a new CAL with a steeper slope which indicates a higher expected return while keeping the size of the risk equal to the passive portfolio.

The information ratio of the active portfolio equals the Sharpe ratio of the active portfolio. Thus, the CAL of the optimal portfolio includes the sum of active and passive Sharpe ratios and has a steeper slope than that of the passive portfolio's CML. Consequently, by adding the active portfolio, a new efficient frontier that has a higher expected return for the same level of risk would be created. That is, the slope of CAL>CML. (1)

2) PART B **(973 words)**

We assume that both the money managers follow two distinct active investment strategies and since one manager is said to believe in technical analysis, we imply that the other follows fundamental analysis. Both these approaches are part of active investment, where the goal of the manager is to outperform the market by taking complete advantage of short-term price fluctuations.

Technical analysis essentially looks for recurrent and predictable trends in stock prices. It involves the examination of statistical trends like price movement and volume to explore and evaluate investments. Fundamental analysis examines connected economic and financial elements like the balance sheet, microeconomic indicators, and consumer behaviour to determine a security's intrinsic value. (2)

The Efficient Market Hypothesis (EMH) states that prices of all securities fully reflect the available information about them. There are three tenets to the EMH. The weak form holds that today's stock prices reflect all the data of historical prices and no form of technical analysis can be used to effectively assist investors in making trading decisions. However, excess returns might be possible through fundamental analysis as investors can boost their chances of making higher-than-average market profits by analysing the firms' financial records. (3) The semi-strong form states that all publicly available information is already used in the computation of a stock's current price, thus investors can't utilise technical or fundamental analysis for gaining higher returns in the market. The strong form states that all information, whether public or not, is discounted in the stock price, hence no extra gain using either technical or fundamental analysis is possible. (4)

Overall, the EMH implies that technical analysis should be fruitless: the previous history of prices and trade volume is publicly available at a low cost, making any information gained from analysing past trades, already being reflected in stock prices. Furthermore, even though fundamental analysis agrees with the weak form of the EMH, EMH still predicts that most fundamental analyses would fail. If the analyst bases his/her assessment of the firm's prospects on publicly available earnings and industry data, it is unlikely that his/her assessment will be more accurate than that of competing analysts. Thus, according to the EMH, both money managers, using their respective philosophies of investment, will not be able to help an investor generate returns greater than those obtained by holding a randomly selected portfolio of individual stocks with comparable risks.

Contradicting the supporters of EMH, both technical and fundamental analysis can be utilised to aid portfolio managers in investing decisions. Technical analysis can prove to be successful under certain conditions such as under the existence of momentum and reversal effects which have challenged the EMH. Retail and institutional investors believe that a stock's future returns can be predicted for profit if momentum or reversal is grasped. The momentum effect states that stocks which have performed well in the past, would most likely continue to outperform those that have underperformed in the future. (5) The manager can measure their stocks' momentum and identify trends using technical analysis which can help them in generating higher returns than the market. Under reversal effect, stock prices overreact to relevant news, resulting in the reversal of extraordinary investing performance. Short-term overreaction, according to some studies, may lead to long-term reversals when investors recognise and correct past pricing errors. (6) Utilising technical analysis, a manager can generate excess profits if the stock portfolio is influenced by the reversal effect.

Furthermore, it is possible for managers following fundamental analysis to gain profit due to the evidence of anomalies such as the P/E effect. For example, according to Dreman, in a 1995 paper, low P/E stocks have greater expected returns. (7) Many investors have also repeatedly outperformed the market by employing fundamental analysis including Warren Buffett who has outplaced the averages year by year. (8)

Broadly speaking, analysing a company’s financial and competitive position can provide its own set of benefits to the managers: investors can get a better picture of how much a company is worth by focusing solely on the business rather than the stock price. Calculating the premium to fair value at which stocks are trading can help manage portfolio risk. Asset allocation considerations can then be made to limit a portfolio's potential downside. (9)

In general, both the analyses are considered as diametrically opposed ways of studying securities. The fundamentalist investigates the market movement's cause, whereas the technician studies its consequence. (10) It can be said, however, that both have a place in trade planning and portfolio management. Thus, it can be said that both managers, using their respective philosophies of investment can have success.

Speaking of followers of passive investing, they refer to the EMH to support their investment case. With context to the EMH, active management is mostly wasted effort and unlikely to repay the costs invested. (11) EMH advocates passive investment management overactive, which focuses on building a well-diversified portfolio of securities without trying to identify undervalued or overvalued stocks. It is mostly represented by a buy-and-hold strategy. (12) According to EMH proponents, investors would be better off adopting a suitable asset allocation and investing in a well-diversified portfolio of passively managed funds. They choose index funds or exchange-traded funds (ETFs) that simply replicate the underlying and provide the same returns as the market as a whole.

On the other hand, critics of EMH are mainly active investors or speculators who believe that by exploiting inefficiencies in financial markets, they may beat the market average. These include both technical investors, who focus on short-term patterns and past prices, and fundamental investors, who use public data and analysis to identify stocks that are oversold/overbought. (13)

Thus, to conclude, since the followers of passive investing support EMH, the philosophies of investment employed by both the money managers at Beaver Asset Management cannot be rationalised by them.

3) APPENDIX

Minutes Table

Date	Time
09.11.2021	Tania, Giulia, Mihnea: 4h
11.11.2021	Tania, Giulia, Mihnea: 2h
22.11.2021	Tania, Giulia, Mihnea: 2h
24.11.2021	All Members: 2h
25.11.2021	Gauri, Giulia: 4h Mihnea, Tania: 6h
26.11.2021	Mihnea, Gauri: 4h Giulia, Tania: 5h
28.11.2021	All members: 12h

4) REFERENCES

(1) THE POWER OF AN ACTIVELY MANAGED PORTFOLIO: AN EMPIRICAL EXAMPLE USING THE TREYNOR-BLACK MODEL. [Internet] Olemiss. 2015. [Accessed: 28 November 2021] Available at: http://thesis.honors.olemiss.edu/320/1/Treynor-Black%20Model.pdf

(2) Fundamental Analysis [Internet] Investopedia. 2021. [Accessed: 28 November 2021] Available at: https://www.investopedia.com/terms/f/fundamentalanalysis.asp

(3) Efficient Markets Hypothesis [Internet] Corporatefinanceinstitute. 2021. [Accessed: 28 November 2021] Available at: https://corporatefinanceinstitute.com/resources/knowledge/trading-investing/efficient-markets-hypothesis/

(4) Efficient Markets Hypothesis (EMH). [Internet] TheBalance. 2021. [Accessed: 28 November 2021] Available at: https://www.thebalance.com/efficient-markets-hypothesis-emh-2466619

(5) BM(book-to-market ratio) factor: medium-term momentum and long-term reversal. [Internet] Springeropen. 2018. [Accessed: 28 November 2021] Available at: https://jfin-swufe.springeropen.com/articles/10.1186/s40854-017-0085-6

(6) Reversal Effect. [Internet] TheFreeDictionary. 2021. [Accessed: 28 November 2021] Available at: https://financial-dictionary.thefreedictionary.com/reversal+effect

(7) Efficient Market Hypothesis. [Internet] Economicshelp. 2009. [Accessed: 28 November 2021] Available at: https://www.economicshelp.org/blog/1661/economics/efficient-market-hypothesis/

(8) Efficient Market Hypothesis: Is the Stock Market Efficient? [Internet] Investopedia. 2021. [Accessed: 28 November 2021] Available at: https://www.investopedia.com/articles/basics/04/022004.asp

(9) Fundamental vs. technical analysis – Beginner's guide with pros and cons of each investment analysis method. [Internet] Lehnerinvestment. 2021. [Accessed: 28 November 2021] Available at: https://www.lehnerinvestments.com/en/fundamental-vs-technical-analysis-beginners-guide/

(10) Technical Analysis vs Fundamental Analysis [Internet] Elearnmarkets. 2021. [Accessed: 28 November 2021] Available at: https://www.elearnmarkets.com/blog/technical-analysis-fundamental-analysis/

(11) The Performance of SPI Stocks in Relation to their P/E Ratios. [Internet] Core. 2016. [Accessed: 28 November 2021] Available at: https://core.ac.uk/download/pdf/80277918.pdf

(12) The Role of Portfolio Management in an Efficient Market [Internet] Mbaknol. 2021. [Accessed: 28 November 2021] Available at: https://www.mbaknol.com/investment-management/the-role-of-portfolio-management-in-an-efficient-market/

(13) What is the efficient market hypothesis (EMH)? [Internet] IG. 2021. [Accessed: 28 November 2021] Available at: https://www.ig.com/uk/trading-strategies/what-is-the-efficient-market-hypothesis--emh---191217