Birla Institute of Technology & Science, Pilani.
Hyderabad Campus, First Term 2022-23
Course No. ECON F412/FINF313 Course Title: Security Analysis & Portfolio Management

Midsem Examination Marks: 60 (30% weight) Date/Venue/Time: 31/10, FN (11AM-12:30AM)

Instructions: This is a CLOSED book examination. Only calculators are allowed. Answer in the required format wherever mentioned to be considered for evaluation.

Question I: (20 MARKS)

*"**Virat Kohli's innings of a lifetime ensured India's win by four wickets over Pakistan on Sunday in the T20 World Cup 2022**." …HT Sports desk Oct 26, 2022*
"Virat Kohli renews bat sponsorship deal with MRF for over Rs 100 crore for 8 years"….ET Prime June 13, 2017

Major brands spend millions of dollars each year on sports sponsorships. What benefits do these brands receive for their money? An increase in stock returns probably?
As an analyst at a company with a major brand, you are trying to analyze the impact of the performance of a sports celebrity ambassador on the stock returns of the associated company.
You wanted to analyze the impact of the sports celebrity ambassador's performance on stock returns of two of the associated companies; Tyres MFR Ltd.(**TM**) and MotoHero Co. Ltd. (**MH**). The event day is **23rd October 2022** when the sportsman undoubtedly had the best innings of his sports life.
The next trading day can be taken as event day 0.

You fitted the Fama French 3-factor model (equation 1) to find the estimates of the sensitivity of returns for the estimation period (-220 to -20 days from event day) for the two firms (TM and MH).

$$Ri - Rf = \alpha i + \beta 1i\ (Rm - Rf) + \beta 2i\ (SMB) + \beta 3i\ (HML) + ei \ldots.(1)$$

Following Table 1.1 are the results of the Fama French 3 factor model of asset returns
Table 1.1 : Estimates of Fama French 3 factor model

Company	$\beta 1$	$\beta 2$	$\beta 3$	alpha
TM	0.3	-0.1	-0.7	Insignificant
MH	0.7	-0.2	0.2	Insignificant

You have the following information Table 1.2 on the Adjusted Closing Prices of the two associated company, and of a Market Index.

Table 1.2: Adjusted Closing Prices

	Adjusted Closing Prices (INR)		
Date	TM	MH	Market Index
19-10-2022	83149	2541	17512
20-10-2022	84172	2566	17564
21-10-2022	86225	2570	17576
24-10-2022	86292	2582	17731
25-10-2022	87343	2586	17656
27-10-2022	87363	2611	17737

The returns data for stocks based on book to market and size are provided in Table 1.3. The returns of the below stocks based on size and book to market in Table 1.3 can be considered constant for the three event window days (-1 to +1)

Table 1.3 : Returns information

Returns	Value stocks	Neutral stocks	Growth stocks
Small size	0.41%	0.28%	0.22%
Big size	0.12%	0.24%	0.24%

The risk free rate is 0.02% and is considered constant for the event window days (-1 to +1). Neutral stocks are in between value stocks and growth stocks based on book to market figures.

Kindly note answers to be expressed in % till 2 decimal places
Results to be shown in Table format with Days relative to the event as one of the columns and required answer as another column.

1.1 *(2 marks)* Find the Actual returns for event window days of -1 to +1 for the two companies (TM and MH) and Show results in Table format with Days relative to the event as one column and actual returns (expressed as %) as another column. *(Assume continuously compounding for returns calculation)*

1.2 *(4 marks)* Find the return associated with the factors SMB and HML and Market risk premium for the event window days (-1 to +1) and show in the Table format.

1.3 *(4 marks)* Find the expected return for event window days of -1 to +1 for the two companies (TM and MH) and Show results in Table format.

1.4 *(6 marks)* Find the Abnormal returns and Cumulative abnormal returns for the two companies (TM and MH) and Show results in Table format.

1.5 *(4 marks)* Calculate the Cumulative average abnormal returns and interpret the result.
Do you find an impact of the sports celebrity ambassador's performance on the stock returns of associated brands/companies?

Question II: (10 MARKS)

"The difference between tax avoidance and tax evasion is the thickness of a prison wall" ----Denis Healey

You were watching the TV Series '*Billions*" where the hedge fund (*Axe Capital*) manager *Bobby Axelrod* wanted to lock in the profits without selling the stocks. This was in the Year 2021. The hedge fund *Axe Capital* had gone long in the stock of XYZ company; 15000 shares of stock purchased at 50$ per share in January 2021. The expectation was that the price of the stock will appreciate, however the uncertainty was more. The short-term capital gain tax was 20% and the long-term capital gains tax was 0%.
The stock price went to 75$ per share at the end of the Year 2021. Axelrod wanted to lock in the profits. However, due to tax purposes, he did not want to sell the stocks in the market but still lock in the profits and ***avoid*** higher tax.
2.1 *(4 marks)* What strategy can Axelrod adopt to lock-in the profits now i.e. at the end of Year 2021 when price of XYZ is $75 per share? *Note: There are no restrictions in the market.*
2.2 *(6 marks)* Also show using this strategy what his gain or loss be if the prices in April 2022 were as follows *(if he was long he sold it, if short he covered the short sale):* -

a. Price of XYZ = $100
b. Price of XYZ = $30

Question III: (10 marks)

" Take risks: If you win you will be happy, if you lose you will be wise"

Consider the following "portfolio choice" problem. The investor has initial wealth '**w'** and utility u(x) = ln(x). The portfolio choice problem is between cash holdings (a safe asset) and equity fund (a risky asset). The Table 3.1 shows the random real returns in the various states of nature.

Table 3.1 : Real returns

State of Nature	Probability of state	Real return of Safe asset (Cash)	Real return of Risky asset (Equity fund)
Boom	0.4	0%	5%
Recession	0.6	0%	-1%

Let A be the amount invested in risky asset and w-A in safe asset.

3.1 *(5 marks)* Find A as a function of w. Does investor put more or less of his portfolio into the equity fund as his wealth increases? Show the calculations by maximizing utility function.

3.2 *(5 marks)* Another investor has utility function as u(x) = -e^(-x). How does her investment in the risky asset change with wealth? Is there a relationship in this case between A and w? Show your calculations by maximizing utility function. (*Note: ^ is raise to the power*)

Question IV: (20 MARKS)

"A sovereign wealth fund is a state-owned investment fund comprised of the money generated by the government, often derived from a country's surplus reserves. A few of the objectives of this fund is to provide sustainable long-term capital growth, increase savings for future generation, and fund social and economic development to name a few".

You are working as an intern at NIIF under the Ministry of Finance and your task is to manage the Strategic fund (a sovereign wealth fund). You have an asset allocation problem at hand. Each year the Strategic fund at NIIF was expected to deliver a 20% return on the investment portfolio in order to meet sustainable long-term capital growth and be able to cover the funding for the social and economic development of the country.

You have done some thorough research on equity-linked funds and have suggested an overall investment plan that allocates the assets across three broad classes in order to achieve diversification. There is no short selling allowed in the market.

1. A Power and Infra fund (PI)
2. A Special Opportunity Venture fund (SV)
3. A blue-chip equity fund (BE)

You wanted to calculate the estimates of portfolio inputs to the optimization problem using a Macroeconomic based multi-factor model like the Arbitrage Pricing theory model. You used a 3-factor model to calculate the estimates by running a multivariate regression.

$$Ri = \alpha i + \boldsymbol{\beta} i1\, \boldsymbol{F}1 + \boldsymbol{\beta} i2\, \boldsymbol{F}2 + \boldsymbol{\beta} i3\, \boldsymbol{F}3 + ei$$

Where Ri returns to asset i, αi is the intercept term in the equation for asset i, $\boldsymbol{\beta} iz\ is\ sensitivity\ of\ return\ to\ asset\ i\ to\ factor\ z, Fz\ is\ the\ factor\ returns, ei\ is\ error\ term$

The 3 factors you had considered were Policy uncertainty (*denoted as Policy; F1*), unanticipated changes in the climate (*denoted as Climate; F2*) and a Geopolitical risk factor (*denoted as Geopolitical; F3)*
The annualized return (i.e. premiums) related to risk factors such as *Policy* was 8%, *Climate* was 10% and *Geopolitical* was 12%. The annualized standard deviation of returns for *Policy* was 20%, *Climate* was 15% and *Geopolitical* was 12%. All factor returns and factor standard deviation are APR rate monthly compounding.
The factor *Policy* and *Climate* were correlated with a correlation coefficient of –ve 0.2, the factor *Policy* and *Geopolitical* were correlated with a correlation coefficient of 0.3, and the factor *Climate* and *Geopolitical* were correlated with a correlation coefficient of –ve 0.1.
Note: -ve means negative

Following are the results of the regression performed. The **monthly** returns of the fund (dependent variable; Ri) were regressed against the **monthly** returns of the three factors

$$Ri = \alpha i + \boldsymbol{\beta} i1 * \boldsymbol{Policy} + \boldsymbol{\beta} i2\ \boldsymbol{Climate} + \boldsymbol{\beta} i3\ \boldsymbol{Geopolitical} + ei$$

The estimates of α's, β's and error standard deviation for all three funds are provided in Table 4.1 from the regression output ran with monthly returns.

Table 4.1: Regression Output

Funds (i)	α_i	$\beta_i 1$	$\beta_i 2$	$\beta_i 3$	error standard deviation$_i$
PI	0.1%	0.3	0.6	0.5	1%
SV	1.6%	0.5	0.2	0.6	2%
BE	0.8%	-ve0.7	0.5	0.2	3%

4.1 *(4 marks)* Calculate the annualized return for all three funds and write as a 3x1 matrix. Answers in % till 2 decimal places.

4.2 *(4 marks)* Calculate the annualized standard deviation of returns for all three funds as 3x1 matrix. Answers in % expressed in 2 decimal places.

4.3 *(4 marks + 3 marks + 1 marks)* Calculate the annualized covariance and correlation coefficients and present it as 3x3 matrix of variance-covariance matrix and correlation matrix. Comment on the correlation values. Covariances expressed as % with 2 decimal places, and correlation expressed as decimals 2 digit.

4.4 (*4 marks*) How will you solve the asset allocation problem? Write your portfolio optimization method equations (objective function) and constraints as matrix equations wherever possible.

FORMULA LIST

$$E(R_{port}) = \sum_{i=1}^{n} W_i R_i$$

where: W_i = the percent of the portfolio in asset i

$E(R_i)$ = the expected rate of return for asset i

$$\sigma_{port} = \sqrt{\sum_{i=1}^{n} w_i^2 \sigma_i^2 + \sum_{i=1}^{n} \sum_{\substack{j=1 \\ j!=1}}^{n} w_i w_j Cov_{ij}}$$

where :

σ_{port} = the standard deviation of the portfolio

W_i = the weights of the individual assets in the portfolio, where weights are determined by the proportion of value in the portfolio

σ_i^2 = the variance of rates of return for asset i

Cov_{ij} = the covariance between the rates of return for assets i and j, where $Cov_{ij} = r_{ij}\sigma_i\sigma_j$

Linear Factor Model:

Summary of Parameters

- α: $(m \times 1)$ intercepts for m assets
- B: $(m \times K)$ loadings on K common factors for m assets
- μ_f: $(K \times 1)$ mean vector of K common factors
- Ω_f : $(K \times K)$ covariance matrix of K common factors
- $\Psi = diag(\sigma_1^2, \ldots, \sigma_m^2)$: m asset-specific variances

$$\begin{aligned} E[\mathbf{x}_t] &= \boldsymbol{\mu}_x &&= \boldsymbol{\alpha} + B\boldsymbol{\mu}_f \\ Cov[\mathbf{x}_t] &= \boldsymbol{\Sigma}_x &&= B\boldsymbol{\Omega}_f B' + \boldsymbol{\Psi} \end{aligned}$$