

**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI - K. K. BIRLA GOA CAMPUS**

**Second Semester 2022-23, Comprehensive Examination**

**Course Title:** Security Analysis and Portfolio Management      **Course No.:** ECON F412, FIN F313

**Examination Date:** 19-05-2023 (AN)

**Max Marks:** 80

**Instructions: Use of calculators are allowed. This is an CLOSED-book examination. Please write with a blue pen. Answers are to be presented in the required format wherever mentioned for evaluation.**

**Section A: CROSSWORD**

(Each word carries 1 mark)

**The max time is 30 minutes [17\*1 = 17M]**

**Down**

1. A-----sale is a transaction in which the seller sells overpriced stock that he/she does not own but borrows from another investor through a broker.
2. The ----- theorem suggests that investment and financing are two different decisions.
3. -----is a high price range in which selling activity is sufficient to stop a price rise.
4. -----of returns is the measure of the degree to which rates of return move together relative to the individual mean values over time.
5. -----risk is the risk that a bond is repaid early, and an investor has to find a new place to invest with the risk of lower returns.
6. Property, plants and equipment are examples of -----assets and claims on such assets are examples of financial assets.
7. The ----- line is the 9-day moving average of the MACD line itself and is an estimated valuation for the movement of the oscillator that makes bullish and bearish MACD turns easier to see.
8. -----measure represents the average excess return of the portfolio above that predicted by an asset pricing model.

**Across**

9. ----- risk is the risk that the market price of a bond will fall with the rise in market interest rate.
10. A -----form EMH is when prices reflect all historical information only.
11. ----- is a low-price range in which buying activity is sufficient to stop a decline in price.
12. The market ----- in its' pure form means shifting funds between a market index portfolio and safe assets such as T-bills or money market funds depending on whether the market as a whole is expected to outperform the safe asset.
13. The ----- is a composite measure that considers both coupon and maturity of the bond to measure price sensitivity to interest rate changes.
14. The ----- measure is calculated as excess returns per unit of systematic risk.
15. The APT differs from the CAPM because the APT recognizes multiple -----risk factors.
16. Relative ----- index is a momentum oscillator indicator in technical analysis.
17. The parameter which demonstrates how the duration of a bond changes as the interest rate changes and measures the curvature in the relationship between bond prices and bond yields is -----.

**Section B:**

**Q1.** You are hired as a fixed-income portfolio manager. You have information about a corporate bond issued recently in the market. This is a green bond issued to fund projects with positive environmental benefits. The bond is an AAA-rated bond. The par value of the bonds is ₹1000. The characteristics of the bonds are provided below: -

You also have information on a Social bond.

**[5 marks]**

| Bond            | Time to maturity | Coupon rate p.a. | Payments |
|-----------------|------------------|------------------|----------|
| Social Bond (S) | 6 years          | 6%               | Annual   |
| Green bond (G)  | 4 years          | 8%               | Annual   |

The market interest rate (yield to maturity) is 8% p.a. for **Green bonds** and 6% p.a. for Social bonds at the time of issuance. **State Whether True/False**

- 1.1 The % change in price for 150 basis points increase in market interest rate using duration and convexity adjustment together for Green bond is between -ve 6% to -ve 3% \_\_\_\_\_
- 1.2 The interest rate risk of Green bond is higher than Social bond \_\_\_\_\_
- 1.3 Ceteris paribus, higher the coupon rate, higher is the interest rate risk \_\_\_\_\_
- 1.4 The annual convexity of Green bond is higher than Social bond \_\_\_\_\_
- 1.5 The Macaulay duration in years of Green bond is lower than Social bond \_\_\_\_\_

**Q 2.1.** Suppose there are 2 risky stocks, A and B. Stock A has an expected return of 4% and a standard deviation of return of 5%. The corresponding statistics for Stock B are 11% and 9%, respectively. The correlation coefficient between the returns of stocks A and B is -ve 0.5. An investor wants to achieve a standard deviation of 7% in his portfolio. What is the optimal portfolio (proportion invested in assets) for the investor and what is the expected return of this portfolio? There are no restrictions in the market. Solve with steps and answer in your answer sheet as the format given below. **[3\*2 = 6marks]**

| $W_A$ (% upto 2 decimal) | $W_B$ (% upto 2 decimal) | $E(R_p)$ (% upto 2 decimal) |
|--------------------------|--------------------------|-----------------------------|
|                          |                          |                             |

**Q 2.2)** Assume two stocks have the following characteristics: -

|   | Expected Return | Standard deviation |
|---|-----------------|--------------------|
| C | 16%             | 8%                 |
| S | 9%              | 5%                 |

The coefficient of correlation between the returns of the two stocks is 0.

What is the % investment in the two stocks in order to have a minimum variance portfolio? Short selling is allowed. What is the standard deviation achieved for the MVP? Solve with steps and answer in your answer sheet as the format given below. There are no restrictions in the market.

| $W_C$ (% upto 2 decimal) | $W_S$ (% upto 2 decimal) | $\sigma(R_p)$ (% upto 2 decimal) |
|--------------------------|--------------------------|----------------------------------|
|                          |                          |                                  |

**Q 2.3)** You are trying to analyse the performance of the actively managed fund. You have the following information about the fund, market index and treasury security.

|                      | Returns | Stdev of returns | beta |
|----------------------|---------|------------------|------|
| Fund                 | 32.00%  | 16%              | 1.5  |
| Market index         | 17.00%  | 14%              |      |
| 90-day Treasury-bill | 6.00%   | 0.00%            |      |

You gathered more insights into the fund and found that fund was not fully diversified. The manager had included certain securities which they expected to be real winners, but that led to a compromise on the diversification. Do you think their selection of winners was justified? Answer by calculating the alpha i.e. returns over and above a required return due to a relevant measure of risk when the fund is not fully diversified. Solve with steps and answer as the format given below, in your answer sheet.

| Alpha % | Justified/Not justified |
|---------|-------------------------|
|         |                         |

### **QUESTION – III (10 MARKS)**

You are hired as a fixed income portfolio manager. You have information about corporate bonds which are issued recently in the market. There is a green bond which is issued to fund projects with positive environmental benefits. The bonds issued were AAA-rated bonds. The par value of the bond is ₹1000. The characteristics of the bond are provided below: -

| Bond           | Time to maturity | Coupon rate p.a. | Payments    |
|----------------|------------------|------------------|-------------|
| Green bond (G) | 3 years          | 8%               | Semi-Annual |

The market interest rate (yield to maturity) is 9% p.a. for **Green bonds** at the time of issuance. You plan to invest in the bond.

The expected inflation is expected to rise and market interest rates are expected to rise by 350 basis points.

**Q3.1** (2 marks) Calculate Annual Modified Duration and annual Convexity for the Green bond.

**Q3.2** (2 marks) Calculate the % change in price with the adjustments of relevant measures for the Green bond for 350 basis points increase in market interest rates.

**Q3.3** (2 marks) Draw a graph showing the relationship of Bond price with Bond yield and the relevant measures. Show the underestimation and overestimation of prices due to the slope measure and the required adjustment needed for the same in the same graph.

**Q3.4** (4 marks) An insurance company wishes to shield its overall financial obligation from exposure to interest rate fluctuations. They wanted to fund the obligation using 2-year zero coupon bond (20% proportion investment for immunization), perpetual bond paying annual coupons (ytm being 9% p.a.) and the Green bond as in the Table above. The insurance company has an expected obligation of \$24000 in 7 years. What should the proportion invested in Green bond and Perpetual bond be to shield their obligation from market interest rate fluctuations? Note use annual Macaulay duration of Green bond for calculation.

### **QUESTION – IV (10 MARKS)**

You are trying to analyze the performance of the actively managed fund. You have the following information about the fund. The fund comprises stocks, bonds and some cash holdings. The Tables below provide information on the market value of these asset classes in the fund, the correlation of returns between asset classes, and their expected returns and standard deviation of returns. All values are annualized values. The correlation of returns of these asset classes with the market index (which is the benchmark index) is also provided.

The expected return of the market index was 8% p.a. and the standard deviation of returns of the market index was 24% p.a.

| Asset classes in Fund | Invested Market value (INR million) | Expected Return (%) | Standard deviation of returns (%) |
|-----------------------|-------------------------------------|---------------------|-----------------------------------|
| Stock                 | 1500                                | 18%                 | 25%                               |
| Bond                  | 800                                 | 9%                  | 12%                               |
| Cash                  | 600                                 | 6%                  | 0%                                |

| <b>Correlation matrix</b> | Stock   | Bond    | Cash | Market |
|---------------------------|---------|---------|------|--------|
| Stock                     | 1       | -ve 0.3 | 0    | 0.8    |
| Bond                      | -ve 0.3 | 1       | 0    | 0.2    |
| Cash                      | 0       | 0       | 1    | 0      |
| Market                    | 0.8     | 0.2     | 0    | 1      |

**Q4.1** (3 marks) Calculate the expected return and standard deviation of the fund's return.

**Q4.2** (4 marks) Calculate the beta of stock, bond and cash and present it in 3x1 matrix form.

Calculate the beta of the fund.

**Q4.3** (3 mark) Calculate the Jensen alpha for the fund if the relevant risk measure is just systematic risk (i.e. calculate returns over and above a required return due to systematic risk).

#### **Question V (20 MARKS)**

You are working as an intern at *XYZ Hedge fund*, and your task is to deliver a 20% return with minimum risk. 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 to achieve diversification. There is short selling allowed in the market.

1. A Digital fund (DF)
2. A Venture advisor fund (VA)
3. A Pharma fund (PF)

You wanted to calculate the estimates of portfolio inputs to the optimization problem using a Fama-French 3-factor model. You calculated the estimates by running a multivariate regression.

$$R_i = a_i + Q_{i1} (R_m - R_f) + Q_{i2} \text{SMB} + Q_{i3} \text{HML} + e_i$$

Where  $R_i$  returns to asset  $i$ ,  $a_i$  is the intercept term in the equation for asset  $i$ ,

$Q_{iz}$  is sensitivity of return to asset  $i$  to factors,  $e_i$  is error term

The **monthly return** (i.e. premiums) related to risk factors such as *Market risk premium* was 0.5%. The monthly returns associated with SMB and HML were calculated from Table 5.1

Table 5.1: Returns information

| Returns    | Value stocks | Neutral stocks | Growth stocks |
|------------|--------------|----------------|---------------|
| Small size | 0.8%         | 0.6%           | 0.4%          |
| Big size   | 0.3%         | 0.5%           | 0.5%          |

The monthly standard deviation of returns for *Market risk premium* was 1.5%, *SMB* was 1.2%, and

*HML* was 1%. All factor returns and factor standard deviation are **monthly**

rates. The factor *correlation coefficients* are provided in Table 5.2

| Correlation         | Market risk premium | SMB    | HML    |
|---------------------|---------------------|--------|--------|
| Market risk premium | 1                   | -ve0.2 | -ve0.5 |
| SMB                 | -ve0.2              | 1      | 0.6    |
| HML                 | -ve0.5              | 0.6    | 1      |

Note: -ve means negative

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

$$R_i = \alpha_i + Q_{i1} * (R_m - R_f) + Q_{i2} SMB + Q_{i3} HML + e_i$$

The estimates of  $\alpha$ 's,  $\beta$ 's and error variance for all three funds are provided in Table 5.3 from the regression output ran with monthly returns.

Table 5.3: Regression Output (All significant)

| Funds (i) | $\alpha_i$ | $\beta_{i1}$ | $\beta_{i2}$ | $\beta_{i3}$ | error variance <sub>i</sub> |
|-----------|------------|--------------|--------------|--------------|-----------------------------|
| DF        | 0.2%       | 0.8          | -ve0.5       | 0.2          | 0.1%                        |
| VA        | 1.8%       | 0.3          | 0.2          | 0.4          | 0.04%                       |
| PF        | 0.6%       | 0.3          | 0.4          | 0.2          | 0.01%                       |

All **annualized values** to be calculated as APR monthly compounding

**Q5.1 (4 marks)** Calculate the **annualized return** for all three funds and write as a 3x1 matrix. Answers in % till 2 decimal places.

**Q5.2 (4 marks)** Calculate the **annualized** standard deviation of returns for all three funds as 3x1 matrix. Answers in % expressed in 2 decimal places.

**Q5.3 (4 marks + 3 marks + 1 marks)** Calculate the **annualized covariance** and **correlation coefficients** for the **three funds** 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.

**Q5.4 (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.

### Data for Q6

An insurance company wishes to shield its overall financial obligation from exposure to interest rate fluctuations. They wanted to fund the obligation using 3-year zero coupon bond and a perpetual bond paying fixed annual coupons (ytm being 7% p.a.). The insurance company has an expected obligation of \$24000 in 6 years.

**Q6.1. What should the proportion invested in perpetual bonds be for immunization? [3 marks]**

**Q6.2. After 1 year, the market interest rate for perpetual bond reduces by 100 basis points. What should the proportion invested in perpetual bonds be for immunization after 1 year has passed? (Note there will be reallocation as years remaining for expected obligation is 5 years now and time to maturity remaining for zero coupon bond will be 2 years.) [3marks]**

**Data for Q7**

You are trying to analyze the performance of the actively managed fund. You have the following information about the fund. The fund comprises stocks, bonds and some cash holdings. The Tables below provide information on the market value of these asset classes in the fund, the correlation of returns between asset classes, and their expected returns and standard deviation of returns. All values are annualized values. The correlation of returns of these asset classes with the market index (which is the benchmark index) is also provided.

The expected return of the market index was 7% p.a. and the standard deviation of returns of the market index was 20% p.a.

| Asset classes in Fund | Investment value in fund (INR million) | Expected Return (%) | Standard deviation of returns (%) |
|-----------------------|--|---------------------|-----------------------------------|
| Stock                 | 1000                                   | 15%                 | 25%                               |
| Bond                  | 750                                    | 8%                  | 12%                               |
| Cash                  | 550                                    | 6%                  | 0%                                |

| <b>Correlation matrix</b> | Stock   | Bond    | Cash | Market |
|---------------------------|---------|---------|------|--------|
| Stock                     | 1       | -ve 0.2 | 0    | 0.7    |
| Bond                      | -ve 0.2 | 1       | 0    | 0.2    |
| Cash                      | 0       | 0       | 1    | 0      |
| Market                    | 0.7     | 0.2     | 0    | 1      |

**Q 7.1** What is the Beta of the fund? **[3\*2 = 6 marks]**

**Q 7.2** What is the fund’s Sharpe measure, and did it overperform or underperform the market? (Remember: variance=  $w^T \Sigma w$ )

**Q 7.3** What is the fund’s Treynor measure, and did it overperform or underperform the market?

\*\*\*\*\*Good luck\*\*\*\*\*