Queen Mary University of London

January Examination Period 2024

ECN382 Portfolio Management *Duration: 2 hours*

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Answer ALL questions

You are permitted to bring 20 x A4 pages of notes into your examination (i.e. 10 double-sided pieces of paper). These can be typed or handwritten and can include graphs and images. They can include material from any source.

Your notes must be stapled together and include your student ID number and the module code on the first page. You must submit your notes at the end of the examination with your answer booklet.

Calculators are permitted in this examination. Please state on your answer book the name and type of machine used. Complete all rough workings in the answer book and cross through any work that is not to be assessed.

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EXAM PAPERS MUST NOT BE REMOVED FROM THE EXAM ROOM

Examiner: Dr Debapriya Paul

Question 1

Factor 1 ($\tilde{F}_1$) and Factor 2 ($\tilde{F}_2$) in the economy describe the returns of stocks. Both factors are zero-mean and are uncorrelated. Consider the following factor model for the returns of four well-diversified assets:

$$\begin{aligned} R_1 &= -0.03 + 2\tilde{F}_1 + 2\tilde{F}_2 \\ R_2 &= -0.07 + 2\tilde{F}_1 + 1\tilde{F}_2 \\ R_3 &= 0.14 + 1\tilde{F}_1 + 4\tilde{F}_2 \\ R_4 &= -0.22 + 5\tilde{F}_1 + 3\tilde{F}_2 \end{aligned}$$

a) Determine the APT equation in this economy implied by assets 1 to 3. Show your step-by-step calculations. **[9 marks]**

b) The APT equation implied by assets 2 to 4 is given by:

$$\mathbb{E}\left[R_P\right] = 0.045 - 0.079\beta_1 + 0.045\beta_2$$

Is the economy arbitrage-free? Explain. If no, is asset 4 overpriced or underpriced relative to assets 1 to 3? How about asset 1 relative to assets 2 to 4? **[6 marks]**

c) Suppose an asset called D with Factor 1 loading of 2.7 and Factor 2 loading of 3.6 is introduced to the market and offers an expected return of -2.9%. Is there an arbitrage opportunity involving asset D? If yes, describe exactly how you would go about executing such an arbitrage strategy involving asset D and the relevant factor-replicating portfolios. (Hint: Check a strategy using assets 1, 2, 3, and D; separately, a strategy using assets 2, 3, 4 and D. Construct an arbitrage strategy using just one of these two strategies.) **[10 marks]**

Question 2

a) In standard mean-variance portfolio optimisations, what inputs are needed to compute investor optimal portfolios? Discuss what issues might arise from estimation errors in these inputs, and propose solutions. **[8 marks]**

b) You hold a passive market portfolio, which includes stocks A, B and C, among others. The following information, shown in Table 1 below, is available regarding these three stocks, as well as the universe of all stocks:

Table 1

	12-month Returns	B/M Ratio	Market Cap
Individual Stocks			
Stock A	48.2%	0.25	91.2
Stock B	14.8%	0.72	88.9
Stock C	16.4%	0.27	31.6
Overall Universe of Stocks			
10th percentile	-9.5%	0.09	37.8
Median	15.2%	0.26	90.4
90th percentile	45.0%	0.7	270.2

On the basis of this information, you are considering making active bets on stocks A, B and C.

i) Based on the information in Table 1, and in light of the anomalies discussed in this module, what views would you develop regarding the prospects for the returns of these stocks? In your answer, describe the direction of the views, the relative confidence you have in them, as well as any possible correlation between them.

(Note: no specific numerical values are needed here; answer the questions in qualitative terms in as much detail as possible)

ii) Describe how you would use the Black-Litterman model to implement the views you described in part (i). How would you expect your holdings in stocks A, B and C, as well as other stocks, to differ from your initial holdings once you implement the views?

[17 marks]

Question 3

Three actively managed funds, A, B and C, are available. Single Index Model (SIM) regressions for the three funds produce the following results:

$$\begin{aligned} r_A - r_f &= 0.02 + 1.2(r_M - r_f) + \varepsilon_A && \text{with} \quad R^2 = 59.02\% \\ r_B - r_f &= 1.1(r_M - r_f) + \varepsilon_B && \text{with} \quad R^2 = 45.66\% \\ r_C - r_f &= -0.01 + 0.9(r_M - r_f) + \varepsilon_C && \text{with} \quad R^2 = 64.57\% \end{aligned}$$

where R^2 refers to the regression R-squared. Assume alpha and beta estimates are persistent. It is also given that the excess return on the market has a mean of 6%, and with a standard deviation of 15%.

a) Compute the Sharpe Ratio, Treynor Ratio and Information Ratio for each of the three funds. **[10 marks]**

b) If you had to choose one of the three funds to constitute your entire portfolio of risky assets, which would you choose? **[2 marks]**

c) If you could invest in all of the funds A, B and C, and combine them with your passive market portfolio, what proportion of your active portfolio would each fund represent? What would be the Sharpe ratio of the optimal combination of A, B, C and the market portfolio? **[5 marks]**

d) When evaluating the performance of Fund C, you also run the following regression with Fund C's excess returns as a dependent variable:

$$r_C - r_f = \alpha_C + \beta_C (r_M - r_f) + \gamma_C (r_M - r_f)^2 + \varepsilon_C$$

You obtain the results shown in Table 2 below:

Table 2

Coefficient	Estimate	t-stat
α	0.005	2.47
β	0.5	9.83
γ	10.3	2.49

Interpret the terms in the regression specification, and what they are meant to capture in performance attribution. How would you evaluate the manager's performance in light of these results? In particular, what could explain the fact that the manager's measured alpha in the SIM regression was negative, whereas in the specification shown here it is positive? **[8 marks]**

Question 4

Consider the following two UK government bonds (gilts) in Table 3:

Table 3

Coupon Rate	Maturity (Years)	Price	Yield to Maturity
5.13%	2	100.54	4.838%
8.38%	10	114.34	6.410%

The bonds have a face value of £100 and pay semi-annual coupons. Yields and coupon rates are expressed as annualised rates (semi-annual APRs).

a) Compute the Macaulay duration of the 2-year bond. **[7 marks]**

b) Consider the two gilts described in Table 3. Describe qualitatively how you would invest in the bonds if you thought the yield curve would decline at all maturities, but more at the short end. **[6 marks]**

c) Suppose, instead, that you are confident that the yield curve will steepen, but relatively agnostic about the overall level of interest rates. Describe how you might invest to exploit this scenario. Specifically, construct a combination of the two bonds that profits from an increase in the 10-year yield relative to the 2-year, but is not affected by equal changes in yields of both maturities. Given that the duration approximation of the price change of the 2-year and 10-year bonds in response to a 1 basis point (1 basis point = 0.01%) increase in their yields is $-£0.0189$ and $-£0.0795$, respectively, what is the ratio of the number of 2-year bonds to 10-year bonds? Comment. **[12 marks]**

End of Paper