Cover page

Department of Economics

Examination paper for FIN3009 Asset Pricing and Portfolio Management

Examination date: 29.05.2024

Examination time (from-to): 15:00 – 19:00

Permitted examination support material: C
Mathematical manuals:
Knut Sydsæter, Arne Strøm og Peter Berck (2006) Matematisk formelsamling for økonomer, 4utg. Gyldendal akademiske.
Knut Sydsæter, Arne Strøm, og Peter Berck(2005): Economists' mathematical manual, Berlin.

Approved calculator:
Casio FX-82CW, Casio FC100 V2, Casio fx-82ES PLUS og Casio fx-82EX, Citizen SR-270X og Citizen SR-270X College, Hewlett Packard HP30S

Academic contact during examination: Snorre Lindset
Phone:95162391

Academic contact present at the exam location: No

OTHER INFORMATION

Get an overview of the question set before you start answering the questions.

Read the questions carefully and make your own assumptions. If a question is unclear/vague, make your own assumptions and specify them in your answer. The academic person is only contacted in case of errors or insufficiencies in the question set. Address an invigilator if you suspect errors or insufficiencies. Write down the question in advance.

Hand drawings/tablet*: The questions can be answered directly in Inspera and/or on handwritten sheets or tablet.

***Hand drawings:** At the bottom of the question you will find a seven-digit code. Fill in this code in the top left corner of the sheets you wish to submit. We recommend that you do this during the exam. If you require access to the codes after the examination time ends, click "Show submission".

***Tablet:** Save the file on your computer and upload the file in the file-upload task at the end of the exam.

File upload: 15 minutes are added for file upload. The time is included in the time shown at the top left of the test, and the time is reserved for file upload.

Weighting: *Problem 1: 25%, problem 2: 45%, problem 3: 30%*

Notifications: If there is a need to send a message to the candidates during the exam (e.g. if there is an error in the question set), this will be done by sending a notification in Inspera. A dialogue box will appear. You can re-read the notification by clicking the bell icon in the top right-hand corner of the screen.

Withdrawing from the exam: If you become ill or wish to submit a blank test/withdraw from the exam for another reason, go to the menu in the top right-hand corner and click “Submit blank”. This cannot be undone, even if the test is still open.

Access to your answers: After the exam, you can find your answers in the archive in Inspera. Be aware that it may take a working day until any hand-written material is available in the archive.

1 Problem set

Skriv ditt svar her

Format

Words: 0

Maks poeng: 10

2 File Upload

If you have used the tablet to draw, upload your file here:

Last opp filen her. Maks én fil.

Alle filtyper er tillatt. Maksimal filstørrelse er **50 GB**.

Velg fil for opplasting

Maks poeng: 10

Question 1
Attached

Retake-exam in FIN3009 Investments and Portfolio Management (Spring 2024)

Make the assumptions you find necessary. The weighting of the problems is only indicative.

Problem 1 (25%) (Short answers are rewarded)

a) Why is it reasonable to expect a negative correlation between changes in stock-price volatility and stock returns?

b) The 'Oil-fund strategy' for portfolio rebalancing was discussed in the first lecture. Explain this strategy.

c) What investor preferences could give rise to the 'Oil-fund strategy'?

d) Explain why the 'Oil-fund strategy' is short volatility.

e) Empirical research finds that volatility is an important risk factor. What sign would you expect the risk premium for this risk factor to have?

Problem 2 (45%)

You are given the following information about the returns on three assets: The variance-covariance matrix for the returns is given by

$$\Sigma = \begin{bmatrix} 0.04 & 0.00 & 0.00 \\ 0.00 & 0.09 & 0.00 \\ 0.00 & 0.00 & 0.16 \end{bmatrix}.$$

The expected returns are given in the vector

$$\bar{R} = \begin{bmatrix} 0.08 \\ 0.10 \\ 0.12 \end{bmatrix}.$$

Let $\bar{1}$ be a 3×1-vector of ones.

a) Show that the inverse of Σ is given by

$$\Sigma^{-1} = \begin{bmatrix} 25.00 & 0.00 & 0.00 \\ 0.00 & 100/9 & 0.00 \\ 0.00 & 0.00 & 6.25 \end{bmatrix}.$$

We have the following formulas:

$$\begin{aligned} A &= \bar{R}'\Sigma^{-1}\bar{1} \\ B &= \bar{R}'\Sigma^{-1}\bar{R} \\ C &= \bar{1}'\Sigma^{-1}\bar{1} \\ D &= BC - A^2 \\ g &= (1/D)(B\Sigma^{-1}\bar{1} - A\Sigma^{-1}\bar{R}) \\ h &= (1/D)(C\Sigma^{-1}\bar{R} - A\Sigma^{-1}\bar{1}) \\ \bar{w}_p &= g + hE[r_p]. \end{aligned}$$

b) Find the portfolio weights if the investor wants to minimize the portfolio variance and have an expected portfolio return of $E[r_p] = 0.10$.

c) Calculate the portfolio variance.

d) Find the portfolio weights for the minimum variance portfolio.

There exists a portfolio z whose return correlation with portfolio p is zero (portfolio p is the portfolio from problem b) with $E[r_p] = 0.10$). This portfolio has expected return $E[r_z] = A/C - (D/C^2)/(E[r_p] - A/C)$.

e) Find the portfolio weights for portfolio z.

f) Calculate the return variance for portfolio z.

g) Show numerically that the return correlation between portfolios p and z is zero.

Problem 3 (30%)

Let the price process for a stock under the physical probability measure P be given as the solution to the stochastic differential equation

$$dS_t = \mu S_t dt + \sigma S_t dW_t, \quad S_0 > 0,$$

where μ and σ are constants and W is a standard Brownian motion. There exists a derivative asset with value $G(S_t, t)$.

a) Use Itô's Lemma to find dG.

b) Consider the portfolio with value $\pi_t = G(S_t, t) + aS_t$. Determine a such that the portfolio π is (instantaneously) risk-free.

c) For the risk-free portfolio in problem b), show that

$$d\pi_t = \Big(\frac{\partial G}{\partial t} + \frac{1}{2}\sigma^2 S_t^2 \frac{\partial^2 G}{\partial S^2}\Big)dt.$$

d) Using a from problem b), what is the portfolio value π_t?

e) Use your answer to question d) and the fact that portfolio π is risk-free to find another expression for $d\pi_t$. *Hint:* Remember that for the bank account, we have $dB_t = rB_t dt$.

f) Equate the two expressions you now have for $d\pi_t$ and show that you get a partial differential equation on the form (this equation is known as the Black and Scholes PDE)

$$\frac{\partial G}{\partial t} + rS_t \frac{\partial G}{\partial S} + \frac{1}{2}\sigma^2 S_t^2 \frac{\partial^2 G}{\partial S^2} - rG_t = 0.$$