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Information

Problem 1 (consists of questions 1 and 2)

Question **1**
Not yet answered
Marked out of 6.00

Explain in your own words why a large autocorrelation of an asset's daily returns contradicts the weak form of the efficient market hypothesis.

Question **2**
Not yet answered
Marked out of 4.00

Explain briefly why the situation would also contradict the strong form of the efficient market hypothesis.

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Problem 2 (consists of questions 3 and 4)

Consider the AR(1) stock price model, where the daily volatility is modelled using the AR(1) process. I.e., the daily log-return $X_t = \log(S_{t+1}/S_t)$ are given as

$X_t = \mu + \sigma_t Z_t, \quad \text{with } Z_t \sim \mathcal{N}(0,1) \text{ i.i.d.},$

and $(\sigma_t)_{t\in\mathbb{Z}}$ follows a stationary AR(1) process (independent of Z_t):

$\sigma_t = \alpha + \beta\sigma_{t-1} + \upsilon\varepsilon_t$

with $|\beta| < 1$ and $\varepsilon_t \sim \mathcal{N}(0,1)$ i.i.d.

Question **3**
Not yet answered
Marked out of 4.00

Which of the following statements is true for the returns X_t in the AR(1) model?

- a. Subsequent returns are dependent and correlated
- b. Subsequent returns are dependent, but uncorrelated.

Question **4**
Not yet answered
Marked out of 7.00

Explain what a volatility cluster is and how the AR(1) model can reproduce them.

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Problem 3 (consists of questions 5 to 7)

Question **5**
Not yet answered
Marked out of 5.00

You compare the empirical data with a lognormal and an AR(1) model, both fitted to the same data. You compute the value at risk at confidence level 99.9% and obtain the following values:

$\mathrm{VaR}^{e}_{99.9\%} = 6.1\%$

$\mathrm{VaR}_{99.9\%}(X_{\mathrm{LN}}) = 2.9\%$

$\mathrm{VaR}_{99.9\%}(X_{\mathrm{AR}}) = 5.9\%$

Here $\mathrm{VaR}^{e}_{99.9\%}$ denotes the empirical estimate of the value at risk, X_{LN} and X_{AR} the stochastic return of the fitted lognormal and AR(1) model, respectively.

Which conclusion can we take from these values?

- a. Both models underestimate daily losses
- b. Both models have a very good fit to the empirical data.
- c. The lognormal model underestimates daily losses, while the AR(1) model shows a good fit to the empirical data

Question **6**
Not yet answered
Marked out of 3.00

Which of the following scaling properties hold for any random variables X and $b > 0$?

- a. $\mathrm{SF}(X+1, b) = \mathrm{SF}(X, b)$
- b. $\mathrm{SF}(X, b+1) = \mathrm{SF}(X, b)$
- c. $\mathrm{SF}(X, b+1) = \mathrm{SF}(X, b) + 1$
- d. $\mathrm{SF}(2X, b/2) = \mathrm{SF}(X, b)$
- e. $\mathrm{SF}(2X, 2b) = 4\,\mathrm{SF}(X, b)$
- f. $\mathrm{SF}(2X, 2b) = \mathrm{SF}(X, b)$
- g. $\mathrm{SF}(X+1, b) = \mathrm{SF}(X, b) + 1$
- h. $\mathrm{SF}(2X, b/2) = 2\,\mathrm{SF}(X, b)$

Question **7**
Not yet answered
Marked out of 7.00

Explain your choice in one paragraph.

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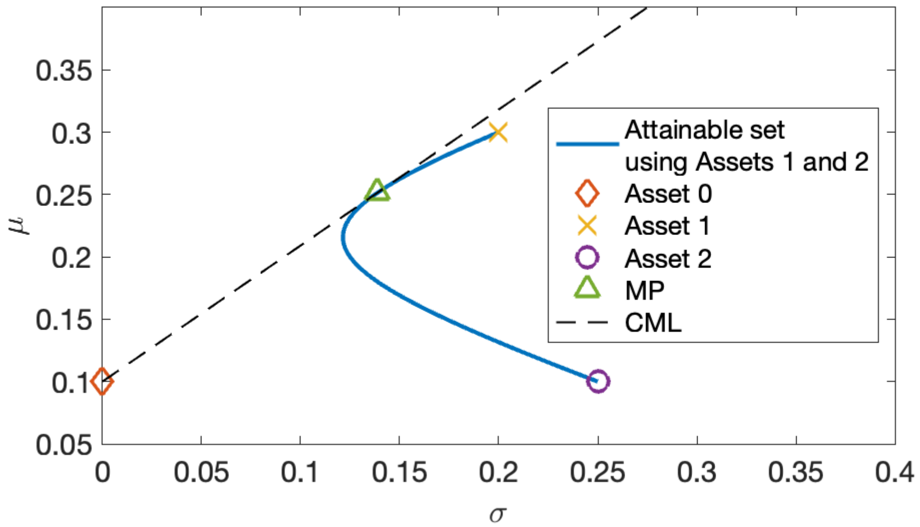
Problem 4 (consists of questions 8 to 10)

Consider two risky assets (Asset 1 and 2) and one riskfree asset (Asset 0). Shortselling is only permitted for Asset 0. The following diagram shows the three assets, the attainable set using Assets 1 and 2, the market portfolio and the capital market line.

The values are given as $\mu_0 = 0.1, \mu_1 = 0.3, \sigma_1 = 0.2, \mu_2 = 0.1, \sigma_2 = 0.25$ with a correlation $\rho = -0.4$. The market portfolio is given as $\mu_{MP} = 0.25, \sigma_{MP} = 0.14$.



Question **8**
Not yet answered
Marked out of 5.00

Which of the following statements are correct?
(Select ALL that apply)

Select one or more:

- ☐ a. Even though Asset 2 is dominated by Asset 1 it contributes to efficient portfolios as it helps diversify risk.
- ☐ b. As the market portfolio is constructed from Asset 1 and Asset 2 only, it is independent of Asset 0.
- ☐ c. The capital market line is the efficient frontier for portfolios investing in all three assets
- ☐ d. The efficient frontier for investments in Assets 1 and 2 is the part of the attainable set between the minimum variance portfolio and Asset 1.
- ☐ e. The ability to short sell assets 1 or 2 would change the capital market line.

Question **9**
Not yet answered
Marked out of 10.00

Consider a portfolio $(\sigma_\mathrm{P}, \mu_\mathrm{P})$ consisting only the two risky assets. Optimise your portfolio by maximising $\mu_\mathrm{P} - \sigma_\mathrm{P}^2$. State the weights, σ_P, and μ_P. Remember that shortselling of Assets 1 and 2 is not permitted and clearly justify your answer.

Question **10**
Not yet answered
Marked out of 5.00

Find the portfolio P' consisting of the three assets with $\sigma_{\mathrm{P}'} = 0.21$ and the largest possible return $\mu_{\mathrm{P}'}$. Note that shortselling is only permitted for Asset 0. Submit return $\mu_{\mathrm{P}'}$ and explain your calculation.

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Problem 5 (consists of questions 11 to 15)

Consider a market where all assumptions of the CAPM with the risk-free interest rate $\mu_0 = 2\%$ are satisfied. We observe that the expected return of the market portfolio is $\mu_{\text{MP}} = \mathbb{E}(R_{\text{MP}}) = 7\%$ and its standard deviation is $\sigma_{\text{MP}} = \sqrt{\text{Var}(R_{\text{MP}})} = 14\%$.

Question **11**

Not yet answered

Marked out of 3.00

Given an efficient portfolio with $\beta = 2$. Compute its expected return μ and standard deviation σ.

First, enter the expected return μ with two significant digits. For example $\mu = 55\%$ should be submitted as 0.55.

Answer:

Question **12**

Not yet answered

Marked out of 2.00

Now enter the standard deviation with two significant digits. For example $\sigma = 55\%$ should be submitted as 0.55.

Answer:

Question **13**

Not yet answered

Marked out of 5.00

How is the portfolio constructed?

Question **14**

Not yet answered

Marked out of 5.00

Given a portfolio with $\sigma = 17.5\%$. Which range can the expected return μ obtain.

Submit the upper bound $\mu_{\max}$, such that $\mu \leq \mu_{\max}$ with three significant digits. E.g. for $\mu \leq 5.55\%$ submit 0.0555.

Answer:

Question **15**

Not yet answered

Marked out of 7.00

Use the CAPM formula

$\mu_P - \mu_0 = \beta(\mu_{MP} - \mu_0)$

and the formula for the variance

$\sigma_P^2 = \beta^2\sigma_{MP}^2 + \mathrm{Var}(\varepsilon_P),$

where ε_P denotes the specific risk, to explain diversifiable and non-diversifiable risks and their rewards under the CAPM model.

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Question **16**
Not yet answered
Marked out of 4.00

Problem 6 (consists of question 16 only)

Consider a factor model with three fundamental factors F_1, F_2, F_3, which are pairwise independent. The factor loadings are based on a company's industry and geographic location. More precisely $\beta_1 = 1$ for companies of the electrical engineering industry, otherwise $\beta_1 = 0$; $\beta_2 = 1$ for companies of the education industry, otherwise $\beta_2 = 0$; $\beta_3 = 1$ for companies with their main operations in the UK, otherwise $\beta_3 = 0$.

Consider two companies, A and B, both have their main operations in the UK. Companies A is in the electrical engineering industry, while Company B in education. This means that their returns are given as
$X_A = F_1 + F_3 + \varepsilon_A$,
$X_B = F_2 + F_3 + \varepsilon_B$,
with $\varepsilon_A, \varepsilon_B$ pairwise independent and independent of F_1, F_2, F_3.

Given $\mathbb{E}(F_1) = 8\%$, $\mathbb{E}(F_2) = 2.5\%$ and $\mathbb{E}(F_3) = 3.0\%$, $\mathbb{E}(\varepsilon_A) = \mathbb{E}(\varepsilon_B) = 0$ as well as
$\text{Var}(F_1) = 0.15$, $\text{Var}(F_2) = 0.65$, $\text{Var}(F_3) = 0.65$, $\text{Var}(\varepsilon_A) = 0.10$, $\text{Var}(\varepsilon_B) = 0.03$.
Compute the covariance between the returns of company A and B.

Submit the result with two significant digits.

Answer:

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Problem 7 (consists of questions 17 to 19)

Question **17**
Not yet answered
Marked out of 6.00

Consider the parametrised utility function $u_a(x) = 1 - e^{ax}$. For which values of $a \in \mathbb{R}$ is u_a a risk-averse utility function on $\mathbb{R}$. Explain your reasoning in one paragraph.

Question **18**
Not yet answered
Marked out of 7.00

Now consider a risk-seeking investor and a lottery with return $L \sim \mathcal{N}(\mu, 1)$ with an unknown expectation $\mu \in \mathbb{R}$. Determine the maximal range for μ, such that the expected utility is non-negative for all risk-seeking utility functions with $u(0) = 0$. Explain your reasoning in one paragraph.

Question **19**
Not yet answered
Marked out of 5.00

In behavioural finance, often S-shaped utility function are considered, which are neither risk-seeking, risk-averse or risk-neutral. To which of the following functions does this apply?

- a. $u(x) = x$
- b. $u(x) = \frac{x}{\sqrt{|x|}}$, with $u(0) = 0$
- c. $u(x) = x^2$
- d. $u(x) = \log(|x|)$ with $u(0) = 0$

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