Stockholm University
Department of Economics

Course name:	Financial Economics
Course code:	EC2206
Type of exam:	Main exam
Examiner:	Roine Vestman
Number of credits:	7.5
Date of exam:	2019-10-28
Examination time:	4 hours (15:00-19:00)
Aids:	Pocket calculator (not programmable)

Write your identification number on each answer sheet (the number stated in the upper right hand corner on your exam cover).

Start each new question on a new answer sheet.

Explain notions/concepts and symbols. If you think that a question is vaguely formulated, specify the conditions used for solving it. Only legible exams will be marked.

There are 100 points in total, including the credit question. The credit question is meant for students who did not hand in the problem set and for students who received less than 10 points and wish to improve. For students who handed in the problem set, the credit question only counts if it improves the total score. For the grade E a total of 45 points are required, for D 50 points, C 60 points, B 75 points and A 85 points.

Your results will be made available on your Ladok account (www.student.ladok.se) within 15 working days from the date of the examination.

Good luck!

Exam October 28, 2019 (Financial Economics, EC2206)

See formula sheet at the back. A pocket calculator is allowed as long as it is not connected to the internet or is programmable. Upon request, the memory of the calculator should be erased.

Question 1: Smaller questions (25 points)

These questions (a. to e.) can be answered independently.

a. Suppose that you have returns at monthly frequency on a portfolio and compute the portfolio's Sharpe ratio to 0.100 when using these returns. Assume that monthly returns are identically and independently distributed (i.i.d.). Compute the Sharpe ratio at quarterly frequency. (5 points)

b. Mikael Angberg from AP1 gave a guest lecture. Explain the tension between AP1's 10-year return target (3% per year) and the risk budget (approximately 10% volatility at annual frequency), presuming that Angberg is correct in that returns have some degree of long-term predictability (i.e., that the market price of risk varies over time). (5 points)

c. Eugene Fama formulated the joint hypothesis problem in the 1970s. Please explain it. (5 points)

d. We watched a discussion between Eugene Fama and Richard Thaler. Fama mentions that one particular risk factor (among Small-Minus-Big, High-Minus-Low, and Momentum) is particularly hard to reconcile with market efficiency. Which factor and why? (5 points)

e. In empirical sciences it is common to test a null hypothesis such as $H_0 : \alpha = 0$ where α can be, among other things, the effect of some medical treatment or the effect of some action.

   i. In this kind of hypothesis testing, what does a "false positive result" mean? (2 points)

   ii. Suppose that a researcher tests the null hypothesis multiple times, that is, $H_0 : \alpha_1 = 0$, $H_0 : \alpha_2 = 0$,...,$H_0 : \alpha_N = 0$. How does this affect the likelihood of obtaining a false positive result? You may find it helpful to draw analogies to the "lucky event issue" or to other empirical sciences. (2 points)

   iii. What kind of bearing does the insight from part (ii.) have on evaluations of actively managed mutual funds? (1 points)

Question 2: Bond pricing (20 points)

Consider a two-period corporate bond with the following characteristics. The bond was issued at $t = 0$ with face value $FV = 100$ at $t = 2$. In period $t = 1$ and $t = 2$ coupons of 5 are paid out ($c = 5$). We are in $t = 1$ and the the first coupon has just been paid. The price of the bond is 100.962.

a. Compute the yield to maturity on the bond. Round off appropriately. (5 points)

b. Suppose that the bond is callable at 100.8. The corporation (i.e., the bond issuer) is informed by an investment bank that it can issue a new one-period zero coupon bond worth 100.8 today for a face value of 104.832 in $t = 2$.

   i. What is the yield to maturity on this hypothetical bond? (5 points)

   ii. Should the bond issuer exercise the call option and finance it through the new bond, yes or no? Assume no transaction costs. Please provide calculations that motivate your answer. (5 points)

   iii. Assume that the investment bank charges a fee, $F = 0.20$, to be paid today (i.e., in $t = 1$) by the corporation. Should the corporation exercise the call? Provide motivating calculations. (5 points)

Question 3: The single-index model (18 points)

You are evaluating an equity index fund and get the following information from the fund prospectus:

Weight in market portfolio	0.95
Weight in cash	0.05
Management fee	F% per year

Your task is to show that we can expect that the fund has a market beta (β_i) of 0.95 and a risk-adjusted return (α_i) of $-F$%.

a. Write down an expression for the index fund's gross realized returns,
   $r_i = A_0 \cdot r_f + A_1 \cdot r_M - A_3 \cdot F + A_4 \cdot \varepsilon_i$, where you need to determine A_1, A_2, A_3, and A_4. (5 points)
   Hint 1: Assume that cash earns the return of the risk-free rate (r_f).
   Hint 2: Assume that the fund's tracking error is neglictible. To be precise,
   $std(r_i - 0.95 \cdot r_M) = 0$.

b. Subtract the risk-free rate (r_f) to obtain an expression for the index fund's excess realized returns, $R_i = r_i - r_f = ...$ (3 points)

c. Compute the fund's market beta (β_i) by proceeding in two steps:

   i. Compute the fund's covariance with the market portfolio, $cov(R_i, R_M)$. (2 points)

   ii. Use the formula for the slope coefficient in a bivariate regression: $\beta_i = \frac{cov(R_i,R_M)}{var(R_M)}$. (2 points)

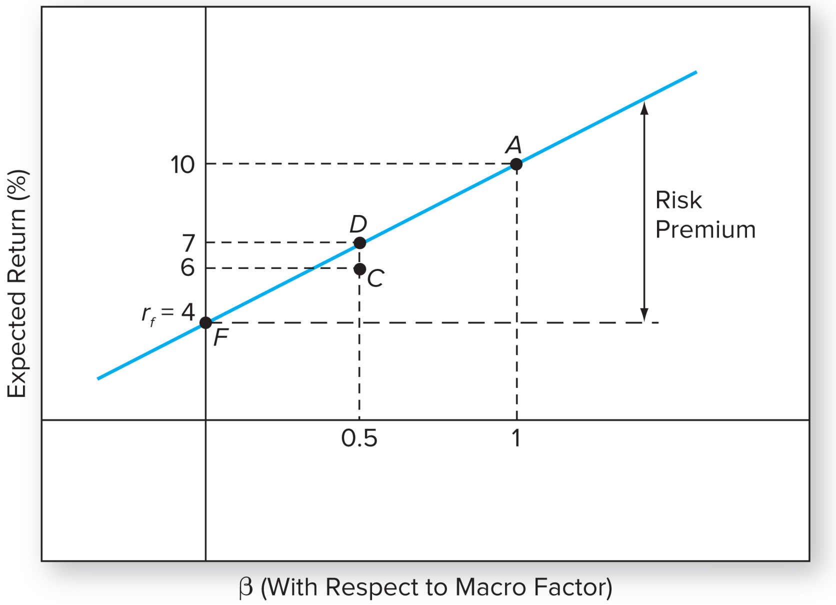
d. Compute the fund's alpha (α_i) by proceeding in two steps:

   i. Express the fund's expected excess return, $E[R_i]$, as function of the fee and the expected market excess return. (2 points)

   ii. To solve for the fund's alpha, use the formula for the intercept coefficient in a bivariate regression: $\alpha_i = E[R_i] - \beta_i E[R_M]$. (2 points)

e. Draw a graph with the expected return-beta relationship and position the index fund relative to the axes and to the security market line (SML). (2 points)

Question 4: Arbitrage pricing theory (7 points)



a. Assume that arbitrage pricing theory works. The figure above is taken from Bodie et al., chapter 10. Describe a portfolio consisting of A, C, and F such that an arbitrage is earned. (4 points)

b. Describe the Fama-French 3-factor model, including its factor structure (and the positions in each factor) and its pricing equation. (3 points)

Question 5: Financial Crises (20 points)

This is an essay question. Nevertheless, please be brief and to the point. **Your total answer should not exceed 2 pages.**

a. Describe how traditional securitization of mortgage backed securities worked in, say, the 1990s. (Who were the main players? What kind of mortgages were securitized? Illustrate with a value chain.) Then contrast to how securitization evolved in the early 2000s in the boom phase of the financial crisis. Describe the main differences and the appearing moral hazards. (10 points)

b. Why are central banks the natural lender of last resort? Under which three conditions can it lend to a financial entity? (5 points)

c. In chapter 20 of Mankiw's text book, six common features of a financial crisis are listed. Describe these features very briefly without necessarily making references to any specific crisis. (5 points)

Question 6: Questions for credit score (10 points)

Credit question. These questions should only be answered by students who either did not hand in the problem set or by students who received a score below 10 on the problem set and wish to try to improve. In the latter case, the best of the two scores will be counted.

a. Bond pricing. A stream of pay-outs c in the next T periods is called an annuity. Derive the following expression for its value: $\frac{c}{r}\left[1 - \frac{1}{(1+r)^T}\right]$ where r is the market interest rate. For a full score (5 points), start by deriving the value of a perpetuity. For a partial score (2 points), take the value of a perpetuity as a given from the formula sheet. (5 points)

b. Consider two random variables x and y. Let $var(x) = var(y) = \sigma^2$. Derive the upper and lower bound on $var(x + y)$. (5 points)

Formula sheet – Financial Economics (EC2206)

- The variance of a random variable x: $var(x) = E[(x - E[x])^2]$
- The covariance of two random variables x and y: $cov(x, y) = E[(x - E[x])(y - E[y])]$
- The variance of the sum of two random variables: $var(x + y) = var(x) + var(y) + 2 \cdot cov(x, y)$
- Covariances are additive: cov(x,z)+cov(y,z)=cov(x+y,z)
- The Sharpe ratio of a security: $\frac{E[r-r_f]}{std(r)}$
- For two risky assets with excess returns R_E and R_D, the optimal risky portfolio P is given by:

$$\begin{aligned} w_D &= \frac{E[R_D]\sigma_E^2 - E[R_E]cov(R_D, R_E)}{E[R_D]\sigma_E^2 + E[R_E]\sigma_D^2 - [E[R_D] + E[R_E]]cov(R_D, R_E)} \\ w_E &= 1 - w_D \end{aligned}$$

- The single-index model and the information ratio:
  - If $\beta_A = 1$ the weight in the active portfolio equals $w_A^0 = \frac{\alpha_A/\sigma_{e,A}^2}{E[R_M]/\sigma_M^2}$.
  - Otherwise $w_A^* = \frac{w_A^0}{1+(1-\beta_A)w_A^0}$.
  - The weight of each security in the active portfolio is $\frac{\alpha_i/\sigma_{e_i}^2}{\Sigma\alpha_i/\sigma_{e_i}^2}$.
  - The Sharpe ratio of the risky portfolio equals: $S_P = \sqrt{S_M^2 + [\frac{\alpha_A}{\sigma e,A}]^2}$.
- The equation $x^2 + px + q = 0$ has solutions $x = -\frac{p}{2} \pm \sqrt{(\frac{p}{2})^2 - q}$
- Bond pricing:
  - Given a market rate r, the value of a perpetuity that pays a coupon c forever is: $\frac{c}{r}$
  - The value of an annuity with coupons c and duration T is: $\frac{c}{r}\left[1 - \frac{1}{(1+r)^T}\right]$