# YLIOPISTOTENTTILOMAKEPOHJA / UNIVERSITY EXAM TEMPLATE

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| **Opintojakson koodi and nimi / The code and the name of the course:** **724208A Portfolio Theory** | |
| **Tiedekunta / Faculty: OBS / OYKKK** | |
| **Tentin pvm / Date of exam: 06.6.2016** | **Tentin kesto tunteina / Exam in hours: 4** |
| **Tentin nro / No. of the exam: Summer exam** (Tentti, 1. uusinta, 2. uusinta / Exam, 1. retake, 2. retake) | **Opintopistemäärä / Credit units: 5** |
| **Tentaattori(t) / Examiner(s): Andrew Conlin** | **Sisäinen postios. / Internal address: 6OyKKK** |
| **Sallitut apuvälineet / The devices allowed in the exam:** ☒ Nelilaskin / Standard calculator ☒ Funktiolaskin / Scientific calculator ☒ Ohjelmoitava laskin / Programmable calculator ☐ Muu materiaali, tarkennettu alla / Other material, specified below: | |
| **Tenttiin vastaaminen / Please answer the questions:** ☒ Suomeksi / in Finnish ☒ Englanniksi / in English | |
| **Kysymyspaperi on palautettava / Paper with exam questions must be returned:** ☐ Kyllä / Yes ☒ Ei / No | |

The exam consists of 10 quantitative questions (2 points each) and 5 short-answer essay questions (4 points each). You need 20 points to pass the exam. There is a formula sheet attached. You may answer in English or Finnish. If you answer in Finnish, use yleiskieli. **WRITE CLEARLY and SHOW YOUR WORK** (no credit for answers if you do not show your work!)

Part 1 Quantitative questions

1. Assume the CAPM model. The risk-free rate is 0.5%. Stock Y has $E(r_Y) = 12.2\%$ and $\beta_Y = 1.8$. If Stock Z has $E(r_Z) = 6.35\%$, what is the $\beta$ for Stock Z?

Questions 2-4 use the following information:

Stock A has $E(r_A) = 11\%$ and $\sigma_A = 0.30$. Stock B has $E(r_B) = 4\%$ and $\sigma_B = 0.15$. The covariance between A and B is $Cov(r_A, r_B) = 0.01125$ The risk free rate is 1.5%. Your level of risk aversion is 2.

2. What are the weights of A and B in the minimum variance portfolio?

3. What are the weights in the optimal risky portfolio?

4. What are the weights of A, B, and the risk-free rate in the optimal complete portfolio?

5. Assume one risky asset and one risk-free asset. The risky asset has $E(r_p)=11\%$ and $\sigma_p=0.40$. The risk-free rate is 2.5%. Your risk aversion is 2. What is the expected return on your optimal complete portfolio?

6. You just bought 3 ETFs to make a portfolio. You bought 100 shares of SPY at $208.75; 50 shares of IWM at 113.50; and 200 shares of EWJ at 11.70. You plan to liquidate (i.e. sell all the shares) 1 year from now. If you receive the following prices SPY 191.20; IWM 95.90; and EWJ 13.10, what is the return on the portfolio?

Questions 7 and 8 are related.

7. You just bought 1000 shares of TSLA on margin. The price was 219€ per share. The initial margin is 50%. The maintenance margin is 30%. How low can the price go before you get a margin call?

8. The interest rate on the loan form your broker is 3%. Assume you sell the shares 1 year from now at a price of 245€. The company does not pay a dividend. What is the return on your investment?

9. You have a utility function of the form $U = E(r) - \frac{1}{2}A\sigma^2$. The risky portfolio has $E(r) = 9\%$ and $\sigma = 19\%$ The risk-free rate is 2%. If you have 83.1% of your money invested in the risky portfolio, what is your level of risk aversion?

10. Consider a multifactor model with two systematic risk factors $F_1$ and $F_2$. The factor risk premiums are 6% and 3% respectively. The risk-free rate is 0.5%. A well-diversified portfolio X has $\beta_{X,F1} = 1.75$ and $\beta_{X,F2} = 0.6$. What is the expected return on portfolio X?

Part 2 Write maximum 2 paragraphs (tekstikappale) per question. Write complete ideas; do NOT just list vocabulary words.

1. Leveraged ETFs offer 2x or even 3x the daily returns of the SP500. Explain why holding a leveraged ETF for a long period of time (e.g. for 2 years or more) may or may not be a good idea. (hint: think about what leverage does to your returns).
2. Over the last 50 years, commodities have provided a lower return than stocks, but commodities also have a higher variance than stocks. Why should anyone hold commodities in their portfolio?
3. Give a precise definition of the efficient frontier and explain how we use the efficient frontier when constructing the optimal complete portfolio.
4. Can mutual fund managers beat the market? Discuss the views both for and against.
5. What is the disposition effect and why is it a bad way for investors to behave?

## Formula Sheet - *Kaavakokoelma*

$$(1+R)=(1+r)(1+i)$$

$$APR=\frac{(1+EAR)^{T}-1}{T}$$

$$\sigma^2 = \sum_s p(s)[r(s) - E(r)]^2, \quad \sigma = \sqrt{\sigma^2}$$

$$Cov(r_i, r_j) = \sum_s p(s)[r_i(s) - E(r_i)][r_j(s) - E(r_j)]$$

$$S = \frac{E(r_P) - r_f}{\sigma_P}$$

$$y^* = \frac{E(r_P) - r_f}{A\sigma_P^2}$$

$$E(r_p) = \sum_{i=1}^{n} w_i E(r_i)$$

$$\sigma_p^2 = \sum_{i=1}^{n}\sum_{j=1}^{n} w_i w_j Cov(r_i, r_j)$$

$$Cov(r_i, r_j) = \rho_{ij}\sigma_i\sigma_j$$

$$w_{A_{Min}} = \frac{\sigma_B^2 - Cov(r_A, r_B)}{\sigma_A^2 + \sigma_B^2 - 2Cov(r_A, r_B)}; w_{B_{Min}} = 1 - w_{A_{Min}}$$

$$w_A = \frac{[E(r_A) - r_f]\sigma_B^2 - [E(r_B) - r_f]Cov(r_A, r_B)}{[E(r_A) - r_f]\sigma_B^2 + [E(r_B) - r_f]\sigma_A^2 - [E(r_A) - r_f + E(r_B) - r_f]Cov(r_A, r_B)}; w_B = 1 - w_A$$

$$E(R_i) = \alpha_i + \beta_i E(R_M)$$

$$\sigma_{i_{or}P}^2 = \beta_{i_{or}P}^2 \sigma_M^2 + \sigma^2(e_{i_{or}P})$$

$$Cov(r_i, r_j) = \beta_i \beta_j \sigma_M^2$$

$$\alpha_P = \sum_{i=1}^{n} w_i \alpha_i; \quad \beta_P = \sum_{i=1}^{n} w_i \beta_i; \quad \sigma^2(e_P) = \sum w_i^2 \sigma^2(e_i)$$

$$w_i^0 = \frac{\alpha_i}{\sigma^2(e_i)} \quad \rightarrow \quad w_i = \frac{w_i^0}{\sum_{i=1}^{n} w_i^0}$$

$$w_A^0 = \frac{\alpha_A / \sigma^2(e_A)}{E(R_M) / \sigma_M^2} \quad \rightarrow \quad w_A^* = \frac{w_A^0}{1 + (1 - \beta_A) w_A^0}$$

$$S_P^2 = S_M^2 + \left[\frac{\alpha_A}{\sigma(e_A)}\right]^2$$

$$E(r_i) = r_f + \beta_i \left\lfloor E(r_M) - r_f \right\rfloor$$

$$\beta_i = \frac{Cov(r_i, r_M)}{\sigma_M^2}$$

$$E(r_P) = r_f + \beta_{P1}\left\lfloor E(r_1) - r_f \right\rfloor + \beta_{P2}\left\lfloor E(r_2) - r_f \right\rfloor + \ldots$$