**School of Business and Economics**

**Exam: Finance**
**Code: E_IBA2_FIN**

Examinator: Dr. M.B.J. Schauten
Co-reader: Prof. Dr. M.J. van den Assem

Date: 23 December 2021
Time: 15.30 – 17.30 hrs
Duration: 2 hours

Calculator allowed: yes
Graphical calculator allowed: no
Scrap paper allowed: yes
Open book exam: no

Type of questions: 16 multiple choice and 3 open questions
Answer in: English

Remarks:
Answer the **multiple choice questions** by filling the corresponding box. For each question, only one answer is correct (a, b, c or d). Answer all questions (giving no answer = giving a wrong answer). The answers to the **open questions** should be written in the space below the open questions. Numbers are in European (Dutch) format with decimal commas, and dots separating thousands (e.g. 1.234.567,89).

If you have to show a calculation when answering an open question, use "SQRT" followed by the number for the square root of that number (e.g. SQRT(4) for the square root of 4). For an exponent, use the "^" character followed by the exponent (e.g. 3^2 for 3 to the power 2). For multiplication use "×" or “*” and for dividing use ":" or "/". For addition and subtraction use "+" and "-" as usual. It is also allowed to describe your computation in words.

Credit score:
The maximum score for the mc questions is 72 points. To determine the score we take into account the expected number of correct answers when answers are given randomly. The maximum score for the open questions is 18 points. The final grade for this exam is: [total number of points + 10] / 10.

Grades:
At the latest the grades will be made public on 13 January 2022.
Inspection: tba

**By taking this exam, you confirm that:**
- You are the student who should participate in this exam;
- You will make this exam individually, without assistance of others, without using prohibited resources, as stipulated in the exam instructions and the SBE Regulations and Guidelines;
- You will adhere to academic standards and conduct, throughout the exam.

If you have **not** signed up for this exam, you will not receive a result. Through VUweb you can object to the fact that you can no longer sign up after the expiry of the registration deadline (and

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1.
Assume a world according to the assumptions of the model of Hirshleifer. In this world Marie has an income at t = 0 of €200,00 ($CF_0$) and at t = 1 of €306,00 ($CF_1$). The risk-free interest rate is 2,00%. At t = 0 Marie consumes €250,00 ($C_0$) and invests €180,00 in real investment projects. The net present value of the real investment projects is €130,00.

**Question**: The consumption at t = 1 ($C_1$) is closest to

a. €388
b. €395
c. €406
d. €416

Answer: a
Wealth at t = 0 is:
$CF_0 + CF_1/(1+r) + NPV = C_0 + C_1/(1+r)$

$CF_0 + CF_1/(1+r) + NPV = 200 + 306/1,02 + 130 = 630$
$C_0 + C_1/(1+r) = 630 \rightarrow C_1 = (630 – C_0) \times (1+r) = (630 – 250) \times (1,02) = 387,60$

Or

$C_1 = CF_1$ + revenues + amount lent plus interest / - borrowed amount plus interest
At t = 0 Marie borrows: C0 + investment in real projects – CF0 = 250 + 180 – 200 = 230
NPV = -180 + PV(revenues) = 130 → PV(revenues) = 130 + 180 = 310 → revenues are: 310 × 1,02 = 316,20
$C_1 = CF_1$ + revenues + amount lent plus interest / - borrowed amount plus interest = 306 + 316,20 – 230 × 1,02 = 306 + 316,20 - 234,60 = 387,60

2.
Assume a world according to the assumptions of the model of Hirshleifer. In this world Alphonso has the opportunity to invest €200,00 in real projects. The internal rate of return of the real investment projects is 40,00%. The income of Alphonso at t = 0 is €0,00 ($CF_0$) and at t = 1 €204,00 ($CF_1$). Alphonso decides to consume 100% of his wealth at t = 1. The risk-free interest rate is 2,00%.

**Question**: The consumption at t = 1 ($C_1$) is closest to

a. €260
b. €270
c. €280
d. €290

Answer: c
NPV = -200 + revenues/(1+IRR) = 0 → revenues = 200 × (1+IRR) = 200 ×1,4 = 280
At t = 0 Alphonso has to borrow 200 to finance his real investment projects.
$C_1 = CF_1$ + revenues – borrowed amount plus interest = 204 + 280 – 200 × 1,02 = 280

Check:
Wealth at t = 0 is:
$CF_0 + CF_1/(1+r) + NPV = C_0 + C_1/(1+r)$
$CF_0 + CF_1/(1+r) + NPV = 0 + 204/(1,02) – 200 + 280 / 1,02 = 274,51$
$C_0 + C_1/(1+r) = 280/1,02 = 274,51$

3.
Assume a world that satisfies the assumptions of the CAPM. Entrepreneur Jacobus wants to invest €200 million in the manufacturing of electric trucks. The project is expected to generate a cash flow of €15 million at t = 1 and of €25 million at t = 2. After year 2 the cash flow increases by 2,00% per year to infinity. The risk free interest rate is 2,00%. The asset beta of the project is 1,5 and the market risk premium 4,00%.

**Question**: Which of the following statements is **true**?

a. 0% < IRR < 5%
b. 5% < IRR < 10%
c. 10% < IRR < 15%
d. 15% < IRR < 20%

Answer: c
If r = 10%, NPV = - 200 + 15 / (1+r) + [25 / (r-g)] / (1+r) = 97,7273
If r = 15%, NPV = - 200 + 15 / (1+r) + [25 / [(r-g)] / (1+r) = -19,732
It follows that 10% < IRR < 15%

NB:
r = rf + asset beta × MRP = 2% + 1,5 × 4,00% = 8%
NPV = - 200 + 15 / (1+r) + 25 / (r-g) / (1+r) = 199,69

4.
Assume a perfect capital market. Entrepreneur FONTEIN has the opportunity to invest in two projects. The projects are mutually exclusive. Each project can be executed only once. The expected cash flows in euros of both projects and the internal rate of return (IRR) of project A are presented in the table below. The cost of capital of both projects is 15,00%. Entrepreneur FONTEIN aims to maximize shareholder value.

**Table 1**: Expected cash flows and IRR of project A and B in euros

| t = | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| $CF_t$ Project A | -100,00 | 0,00 | 0,00 | 0,00 | 200,00 |
| $CF_t$ Project B | -100,00 | 150,00 | 0,00 | 0,00 | 0,00 |
| | | | | | |
| IRR Project A | 18,92% | | | | |
| IRR Project B | ? | | | | |

**Question**: Which of the following statements is **true**?

a. Entrepreneur FONTEIN prefers project A because the NPV of A is higher than the NPV of project B.
b. Entrepreneur FONTEIN prefers project A because the IRR of A is higher than the IRR of project B.
c. The IRR of project B is 25%.
d. Entrepreneur FONTEIN prefers project B.

Answer: d
.
NPV A = $-100 + 200 / 1{,}15^4 = 14{,}35$
NPV B = $-100 + 150 / 1{,}15 = 30{,}43$
Calculation IRR project B (not necessary):
NPV B = $-100 + 150 / (1+IRR) = 0 \rightarrow IRR = 150/100 - 1 = 50\%$

5.
Entrepreneur ARLAA is a producer of DAIRY PRODUCTS and uses machines to produce them. ARLAA wants to know what the optimal lifetime of a machine is, two years or four years. The purchase price of the machine is €20.000. Of course, the firm could also consider to replace the machine each year or each three years but it has decided to ignores these options for now.

Option 1: buy the machine at t = 0 and replace the machine each two years
Option 2: buy the machine at t = 0 and replace the machine each four years

If the machine is replaced after two years, the machine will still earn €10.000 on sale, if the machine is replaced after four years it will be €2.000. The operational cash flow from the production and sale of DAIRY PRODUCTS amounts to €8.000 per year. Assume the productivity of new machines is the same as that of old machines. Ignore inflation. The cost of capital is 10,00%. Assume ARLAA aims to maximize shareholder value and that there are no taxes.

**Question**: Which of the following statements is **true**?

a. ARLAA will prefer option 1 over option 2.
b. ARLAA is indifferent between option 1 and option 2.
c. The net present value of buying the machine once and using it for two years is €2.248.
d. The net present value of buying the machine once and using it for four years is €6.725

Answer: d
The net present value of buying the machine and using it for two years only is:
$-20.000 + 8.000 / 1,1 + (8.000 + 10.000) / 1,1^2 = €2.148,76$

The net present value of buying the machine and using it for four years only is
$-20.000 + 8.000 / 1,1 + 8.000 / 1,1^2 + 8.000 / 1,1^3 + (8.000+2.000) / 1,1^4 = €6.724,95$

Both options have a different life. If we correct for this we get:
NPV option 1: $2.148,76 + 2.148,76 / 1,1^2 = 3.924,59$
NPV option 2: 6.724,95

ARLAA prefers option 2.

6.
Assume a perfect capital market. Bond A is default-risk free and has a coupon of 0,00%. Bond B is also default-risk free. Bond B's coupon is 5,00%. The price of bond B is equal to €1.000.00, The term structure of interest rates is flat. The nominal value of both bonds is €1.000,00 and their maturity is 4 years.

**Question**: Which of the following statements is **false**?

a. The yield to maturity of bond B is 5,00%.
b. The yield to maturity of bond B is equal to that of A.
c. The price of bond A is lower than that of bond B.
d. The 1-year spot rate ($r_1$) is lower than 5,00%.

Answer: d

a. True. If the price is equal to the nominal value, then the yield is equal to the coupon. Since the yield is equal to the weighted average of the spot rates, we also know that all (the term structure is flat) spot rates are equal to 5%.
b. True. Since the term structure of interest rates is horizontal, the yield of B equals 5,00%, as does the yield of A.
c. True. A's coupon is lower than B's, it follows that A's price is lower than B's.
d. False. See b.

7.
Assume a perfect capital market. In this world, consider three bonds. Bond A has a coupon of 0,00%, bond B has a coupon of 5,00% and bond C of 6,00%. The remaining maturity of bond A is 1 year, of bond B 2 years and of bond C 3 years. The bonds are bullets and free of default risk. The nominal value of the bonds is €1.000,00. The price of bond A is €980,39. The 1-year forward rate for year 2 ($_1f_2$) is 4,00%. The 3-year spot rate is 5,00%.

**Question**: The price of bond C is closest to

a. €988
b. €998
c. €1.031
d. €1.039

Answer: c

$P_A = 980,39 = 1.000/(1+r_1) \rightarrow r_1 = 1.000/980,39 - 1 = 2,00\%$

$P_C = 60 / (1+r_1) + 60 / (1+r_1)(1+{}_1f_2) + 1.060/(1+r_3)^3$
$P_C = 60 / (1,02) + 60 / (1,02)(1,04) + 1.060/((1,05)^3 =$ €1.031,05

8.
Assume a perfect capital market. In this world, consider three bonds. Bond A has a coupon of 1,00%, bond B has a coupon of 1,00% and bond C of 8,00%. The remaining maturity of bond A is 4 years and that of both bond B and bond C is 6 years. All bonds are bullets and free of default risk. The nominal value of the bonds is €1.000,00. Assume a horizontal term structure of interest rates. The one-year spot rate ($r_1$) is 3,00%.

**Question**: Which of the following statements is **true**?

a. The duration of B is greater than that of C.
b. The duration of A is greater than that of B.
c. The modified duration of C is equal to the duration of C × $(1+r_1)$.
d. The modified duration of A is 4,00.

Answer: a

a. True. If the maturities are equal, the duration of the bond with the relatively low coupon is greater than that of the bond with the relatively high coupon.

Calculation is not required. For the enthusiast:
$P_B = CF_1/(1+y)) + CF_2/(1+y)^2 + CF_3/(1+y)^3 + CF_4/(1+y)^4 + CF_5/(1+y)^5 + CF_6/(1+y)^6 =$
$10/(1{,}03) + 10/(1{,}03)^2 + 10/(1{,}03)^3 + 10/(1{,}03)^4 + 10/(1{,}03)^5 + 1.010/(1{,}03)^6 = 891{,}66$

$P_C = CF_1/(1+y)) + CF_2/(1+y)^2 + CF_3/(1+y)^3 + CF_4/(1+y)^4 + CF_5/(1+y)^5 + CF_6/(1+y)^6 =$
$80/(1{,}03) + 80/(1{,}03)^2 + 80/(1{,}03)^3 + 80/(1{,}03)^4 + 80/(1{,}03)^5 + 1.080/(1{,}03)^6 = 1.270{,}86$

Duration B = $1/P_0 \times [(CF_1/(1+y)) \times 1 + (CF_2/(1+y)^2) \times 2 + (CF_3/(1+y)^3) \times 3 +$
$(CF_4/(1+y)^4) \times 4 + (CF_5/(1+y)^5) \times 5 + (CF_6/(1+y)^6) \times 6] = 5{,}84$
Duration C = $1/P_0 \times [(CF_1/(1+y)) \times 1 + (CF_2/(1+y)^2) \times 2 + (CF_3/(1+y)^3) \times 3 +$
$(CF_4/(1+y)^4) \times 4 + (CF_5/(1+y)^5) \times 5 + (CF_6/(1+y)^6) \times 6] = 5{,}12$

b. False. Because the maturity of A is lower than that of B while the coupons are the same it follows that the duration of A is lower than that of B.
c. False. The modified duration of C is equal to the duration of C / (1+y).
d. False. The modified duration is < 4.

9.
Assume a perfect capital market under certainty. Consider in this market company SCHEPMAN. The expected dividend per share of SCHEPMAN at t = 1 is €10,00 and at t = 2 €7,50. From t = 2 the dividend per share increases by 3,00% per year to infinity (g = 3,00%); at t = 3 for example the dividend per share is €7,50 × 1,03. The interest rate is 5,00%.

**Question:**
At t = 0, the price of a SCHEPMAN share immediately after the dividend payment ($P_{ex\ at\ t = 0}$) is closest to

a. €337
b. €347
c. €357
d. €367

Answer: d
$P_0 = 10 / 1,05 + [(7,50) / (0,05 – 0,03)]/1,05 = 366,67$

10.
Assume a perfect capital market under certainty. Consider in this market the company NEUHAUS. The expected earnings per share of NEUHAUS at t = 1 are €10,00. The payout ratio is 60,00%. The retained earnings are used annually to make expansion investments. The return on these expansion investments (return on new investments, or 'roni') is 10,00% and constant over time. The dividend and investment policy remain unchanged. The rate of return required by the providers of equity is 10,00%.

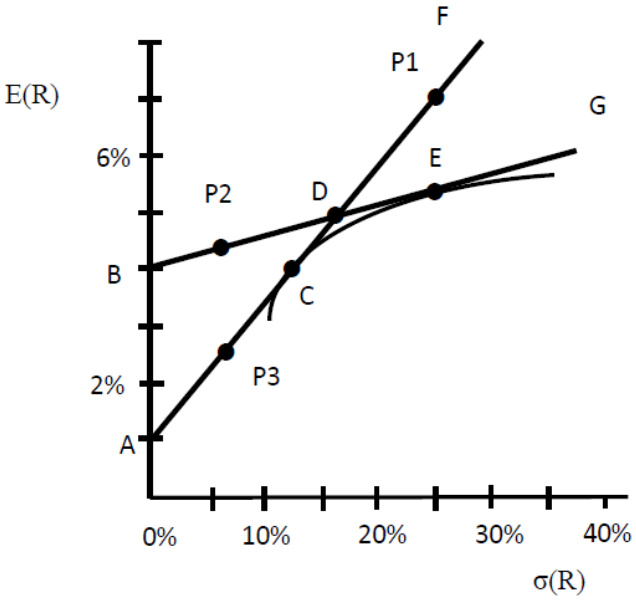
**Question**:
At t = 0, the price of a NEUHAUS share immediately after the dividend payment ($P_{ex\ at\ t=0}$) is closest to

a. €98
b. €100
c. €102
d. €104

Answer: b
g = retention-ratio × roni = (1- pay-out ratio) × roni = (1-60%) × 10% = 4,0%

$P_0 = div_1/(r-g) = (0,60 \times 10) / (0,1-0,04) = 100$

11.
Assume a world that satisfies the assumptions of portfolio theory. Consider the figure below. The curve through C and E is the efficient frontier of the risky securities. In this world, it is possible to lend against A and to borrow against B.




**Question**: Which of the following statements is **true**?

a. Portfolio P1 can be constructed in this world.
b. Portfolio P2 can be constructed in this world.
c. Portfolio P3 can be constructed by lending money at 1% and going long in D.
d. Point E lies on the efficient frontier.

Answer: d.

a. False. To compose P1, money must be borrowed at 1% and the borrowed money plus own money must be invested in C. However, it is not possible to borrow at 1%.
b. False. To construct P2, you have to lend money at 4% and take a long position in E. However, it is not possible to lend at 4%.
c. False. To construct P3, you have to lend money at 1% and take a long position in C. It is not possible to construct portfolio D.
d. True. The efficient frontier runs from A to C, then from C along the curve to E and then from E towards G.

12.
Assume a world that satisfies the assumptions of portfolio theory. Going short is allowed. In this world, only the two securities A and B are traded. The expected return of A is 10,00% and that of B is 30,00%. The standard deviation of the returns of both A and B is 20,00. The correlation coefficient between the returns of A and B is 0,75 ($\rho = 0,75$). MRP stands for minimum risk portfolio.

**Question**: The expected return of the MRP is closest to

a. 13%
b. 15%
c. 17%
d. 20%

Answer: d

$X_A$ = (variance $R_B$ – cov($R_A$,$R_B$))/((variance $R_A$) + (variance $R_B$) – 2 × cov($R_A$,$R_B$))
= (0,20^2 – (0,75×0,20×0,20)) / (0,20^2 + 0,20^2 – (2×0,75×0,20×0,20)) = 0,5

E(R) = 0,5 × 10% + 0,5 × 30% = 20%

13.

Assume a world that satisfies the assumptions of the standard CAPM. The expected return of portfolio X is 6,00%. The correlation coefficient of the returns of X with the returns of market portfolio M is 0,60. The expected return of efficient portfolio Y is 10,00% and its beta is 1,00. The risk of M expressed by the standard deviation of the return is 21,00%. The market risk premium is 6,00%.

**Question**: Which of the following statements is **true**?

a. The risk-free interest rate is 5%.
b. The beta of X is ¼.
c. The systematic risk of Y expressed as the standard deviation of the return is lower than 21%.
d. The systematic risk of X expressed as the standard deviation of the return is lower than 21%.

Answer: d

a. False. E(RY) = Rf + beta × MRP = 14% → Rf = 10% - beta × 6% = 10% - 1,0 × 6% = 4%
b. False. E(RX) = Rf + beta × MRP = 6% → beta = (6%-Rf)/MRP = (6%-4%)/0,06 = 1/3
c. False. The systematic risk of Y is beta × risk of M = 1 × 21% = 21%
d. True. The systematic risk of X is beta × risk of M = 1/3 × 21% = 7%.

14.
Assume a world that meets the assumptions of the CAPM. The asset beta of company JACOBA is 1,00. The beta of the interest-bearing debt is 0,20. Company JACOBA is financed 50% of its market value with equity and 50% with interest-bearing debt. The risk-free interest rate is 2,00% and the market risk premium is 5,00%.

**Question**: The return required by the equity providers is closest to

a. 8%
b. 9%
c. 10%
d. 11%

Answer: d

Beta assets = E/(E+D) × beta E + D/(E+D) × beta D = 1,0 → beta E = [1,0 – (D/(E+D) × beta D)]/ E/(E+D) = [1,0 – (0,5 × 0,2)]/ 0,5 = 1,8

$R_E$ = Rf + beta E × MRP = 2% + 1,8 × 5,00% = 11,00%

15.

**Question**: Which of the following statements is **true**?

a. In a market that is efficient in the strong form of the EMH, every security traded has the same expected return.
b. A market that is efficient in the semi-strong form of the EMH is by definition also efficient in the weak form.
c. In a market that is efficient in the weak form of the EMH, it can make sense to invest using ‘technical analysis’ in order to systematically obtain abnormal returns.
d. A market that is efficient in the semi-strong form of the EMH is by definition also efficient in the strong form.

Answer: b

16.
Company B acquires company T. The market value of B as an independent entity is €325 million. The market value of B's debt is €75 million and that of its equity is €250 million. The market value of T as a stand-alone entity is €300 million. The market value of the debt of T is €250 million and that of its equity €50 million. See the table below for a summary.

**Table**: Data of enterprises B and T as stand-alone entities

| | Company B | Company T |
|---|---|---|
| Market value equity | €250 million | €50 million |
| Market value debt | €75 million | €250 million |
| Total value company | €325 million | €300 million |

The acquisition of T by B is financed by issuing new B shares. The synergies amount to €80 million. In addition, the combination of the two companies reduces the value of B's debt by €2 million and increases that of T by €14 million.

**Question**: The market value of B's equity immediately after the acquisition of T is the closest:

a. €300 million
b. €350 million
c. €368 million
d. €370 million

Answer: c

| | Debit | | Credit |
|---|---|---|---|
| Market value B | €325 mln | Equity value | €368 mln |
| Market value T | €300 mln | Debt value | €73 mln + €264 mln = €337 mln |
| Synergies | €80 mln | | |
| Total value company | €705 mln | | €705 mln |

On the following pages is part B: **the open questions**.

**Part B: Open questions (18 points)**

17. (6 points)
Assume a perfect capital market. In this market, bonds A and bonds B, both issued by the company DEN DOLLER, are traded. Both bonds have a nominal value of €1.000,00 and are not free from default risk.

The remaining maturity of bond A is 2 years and the coupon of bond A is 0%. Due to the probability of default, the cash flow per bond A at t = 2 is expected by investors to be €960,00. The risk premium demanded by investors is 2,00%. The 1-year spot rate ($r_1$) is not given. The price at t = 0 is €900,00

The remaining maturity of bond B is 1 year and the coupon of bond B is 4%. Due to the probability of default, the cash flow per bond B at t = 1 is expected by investors to be €1.010,00. The required rate of return by investors is 8,00%.

**Questions**

a. Calculate the yield to maturity of bond A. Round your answer to one decimal place (e.g. 6,4%). Show your calculation. (3 points)

b. Calculate the price of a bond B. Round your answer to two decimal places (for example €1,23). Show your calculation. (3 points)

Answers:
a.
$P_A$ = promised CF at $_{t = 2}$ / $(1+\text{yield})^2$ = $1.000/(1+\text{yield})^2$ = 900 →
yield = $(1.000/900)^{0,5}$ – 1 = 5,41%

b.
$P_B$ = expected CF $_{t = 1}$ / (1+r) = 1.010/(1,08) = 935,19

18. (6 points)
Consider a world in which the standard assumptions of the CAPM hold. The risk free interest rate is 2,0% ($R_F$ = 2,0%). Furthermore, three risk-bearing securities A, B, and C are traded with the following characteristics:

| Security | E(R) | Number of outstanding shares | Current price per share |
|---|---|---|---|
| A | 8,0% | 50.000 | € 5,00 |
| B | 12,0% | 25.000 | € 10,00 |
| C | 14,0% | 25.000 | € 20,00 |

In this world the wealth of investor X is €20.000 (his equity is €20.000). X borrows €10.000 and invests €30.000 in market portfolio M. The standard deviation of the returns of M is 21,0%.

a. Calculate the expected return of M. Round your answer to 2 decimals (e.g. 1,23%). Showing your calculations is not necessary. (3 points)

b. Determine the level of risk of the portfolio of investor X. Round your answer to 2 decimals (e.g. 1,23%). Showing your calculations is not necessary. (3 points)

Answers:
a.

| **Security** | **# of outstanding shares i × Pi (= Market cap. i)** | **Market cap. i / Market cap. M** | **(Market cap. i / Market cap. M) × E(Ri)** |
|---|---|---|---|
| | | | |
| A | € 250.000,00 | 0,25 | 0,02 |
| B | € 250.000,00 | 0,25 | 0,03 |
| C | € 500.000,00 | 0,50 | 0,07 |
| | € 1.000.000,00 | 1,00 | 0,12 |

b.
$\sigma(R_X) = |X_M| \times \sigma(R_X) = 1,5 \times 21\% = 31,5\%$

19. (6 points)

Consider a world in which the assumptions of the portfolio theory hold and where *short selling* is allowed. In this world only two securities are traded, security A and B. The following data is known:

| | A | B |
|---|---|---|
| E(R) | 20% | 30% |
| σ(R) | 20% | 30% |

The correlation coefficient between the returns of security A and B is -1,00.

**Questions**:

a. Calculate the expected return of the minimum risk portfolio (MRP), i.e. the portfolio with the lowest risk. Round your answer to 2 decimals (e.g. 1,23%). Showing your calculations is not necessary. (3 points)

b. Calculate the expected return of a portfolio that consists of a short position of €1.000 in A and a long position of €2.000 in B. Round your answer to 2 decimals (e.g. 1,23%). Showing your calculations is not necessary. (3 points)

Answers:

a.

$$x_A{}^* = \frac{\sigma_B^2 - \sigma_A\sigma_B\rho_{A,B}}{\sigma_A^2 + \sigma_B^2 - 2\sigma_A\sigma_B\rho_{A,B}} = \frac{0{,}30^2 - 0{,}20 \times 0{,}30 \times -1}{0{,}20^2 + 0{,}30^2 - 2 \times 0{,}20 \times 0{,}30 \times -1} = 0{,}6$$

$E(R_P) = X_A \times E(R_A) + X_B \times E(R_B) = 0{,}6 \times 20\% + 0{,}4 \times 30\% = 24\%$

b.

Equity = -1.000 + 2.000 = 1.000

$X_A$ = -1.000/1.000 = -1

$X_B$ = 2.000/1.000 = 2

$E(R_P) = X_A \times E(R_A) + X_B \times E(R_B) = -1 \times 20\% + 2 \times 30\% = 40\%$