vrije Universiteit amsterdam

Faculty of Economics and Business Administration

Exam:	Investments
Code:	E_EBE3_INVES
Examinator:	Dr. Teodor Dyakov
Co-reader:	Dr. Leonard Wolk
Date:	July 6, 2017
Time:	12:00
Duration:	2 hours and 45 minutes
Calculator allowed:	Yes
Graphical calculator allowed:	Yes
Number of questions:	20 multiple choice questions and 3 open-ended
Type of questions:	Open/ multiple choice
Answer in:	English

Remarks: Be concise and complete in your answers (including calculations). Always explain the answers to the open questions, even if not explicitly called for. Use your time efficiently, using the maximum number of points per question as a guideline.

Credit score:	3 points for the multiple-choice part and 4 for the open-ended part.
Grades:	The grades will be made public on: July 19
Inspection:	Thursday, July 20 2017 at 9.00. Room: TBA.
Number of pages:	(10 (including front page))

Good luck!

PART 1 (MULTIPLE CHOICE QUESTIONS; 20 questions providing 3 points at maximum)

Read the questions and answers carefully and write down your answer on your answer sheet. Your final score is determined as (number of correct answers - 3)*3/17. Negative scores for this part of the exam are set to zero.

1. When a distribution is positively skewed, _____.
A. standard deviation overestimates risk
B. standard deviation correctly estimates risk
C. standard deviation underestimates risk
D. the tails are fatter than in a normal distribution
E. the tails are skinnier than in a normal distribution

When a distribution is positively skewed standard deviation overestimates risk.

You invest €1000 in a risky asset with an expected rate of return of 0.17 and a standard deviation of 0.40 and a T-bill with a rate of return of 0.04.

2. What percentages of your money must be invested in the risky asset and the risk-free asset, respectively, to form a portfolio with an expected return of 0.11?
A. 53.8% and 46.2%
B. 75% and 25%
C. 62.5% and 37.5%
D. 46.2% and 53.8%
E. Cannot be determined.

3. Efficient portfolios of N risky securities are portfolios that
A. are formed with the securities that have the highest rates of return regardless of their standard deviations.
B. have the highest rates of return for a given level of risk.
C. are selected from those securities with the lowest standard deviations regardless of their returns.
D. have the highest risk and rates of return and the highest standard deviations.
E. have the lowest standard deviations and the lowest rates of return.

Portfolios that are efficient are those that provide the highest expected return for a given level of risk.

4. Covariances between security returns tend to be
A. positive because of regulations.
B. negative because of regulations.
C. positive because of economic forces that affect many firms.
D. negative because of investors' irrationalities.
E. cannot be determined.

Economic forces such as business cycles, interest rates, and technological changes tend to have similar impacts on many firms.

5. The risk-free rate is 4 percent. The expected market rate of return is 11 percent. If you expect CAT with a beta of 1.0 to offer a rate of return of 11 percent, you should
A. buy CAT because it is overpriced.
B. sell short CAT because it is overpriced.
C. sell stock short CAT because it is underpriced.
D. buy CAT because it is underpriced.
E. hold CAT because it is fairly priced.

11% = 4% + 1.0(11% - 4%) = 11.0%; therefore, CAT is fairly priced.

6. Which statement is **not** true regarding the market portfolio?
A. It includes all publicly traded financial assets.
B. It lies on the efficient frontier.
C. All securities in the market portfolio are held in proportion to their market values.
D. It is the tangency point between the capital market line and the indifference curve.
E. It lies on a line that represents the expected risk-return relationship.

The tangency point between the capital market line and the indifference curve is the optimal portfolio for a particular investor.

7. A zero-investment portfolio with a positive expected return arises when _____.
A. an investor has downside risk only
B. the law of prices is not violated
C. the opportunity set is not tangent to the capital allocation line
D. a risk-free arbitrage opportunity exists
E. a risk-free arbitrage opportunity does not exist

When an investor can create a zero-investment portfolio (by using none of the investor's own funds) with a possibility of a positive profit, a risk-free arbitrage opportunity exists.

8. The weak form of the efficient market hypothesis contradicts
A. technical analysis, but supports fundamental analysis as valid.
B. fundamental analysis, but supports technical analysis as valid.
C. both fundamental analysis and technical analysis.
D. technical analysis, but is silent on the possibility of successful fundamental analysis.
E. None of the above is correct.

The weak form of the efficient market hypothesis contradicts technical analysis, but is silent on the possibility of successful fundamental analysis.

9. According to Roll, the only testable hypothesis associated with the CAPM is
A. the number of ex post mean-variance efficient portfolios.
B. the exact composition of the market portfolio.
C. whether the market portfolio is mean-variance efficient.
D. the SML relationship.
E. None of the above is correct.

According to Roll, the only testable hypothesis about the CAPM is that the market portfolio is mean-variance efficient.

The following data are available relating to the performance of Monarch Stock Fund and the market portfolio:

	Monarch	Market Portfolio
Average Return	16%	12%
Standard Deviation of Returns	26%	22%
Beta	1.15	1.00
Residual Standard Deviation	1%	0%

The risk-free return during the sample period was 4%.

10. Calculate Sharpe's measure of performance for Monarch Stock Fund.
A. 1.00%
B. 46.00%
C. 44.00%
D. 50.00%
E. None of the above is correct

(16 - 4)/26 = .46

11. A coupon bond that pays interest semi-annually has a par value of €1,000, matures in 6 years, and has a yield to maturity of 9%. The intrinsic value of the bond today will be _____ if the coupon rate is 9%.
A. €922.78
B. €924.16
C. €1,075.80
D. €1,000.00
E. None of the above is correct.

FV = 1000, PMT = 45, n = 12, i = 4.5, PV = 1000.00

12. The "break-even" interest rate for year *n* that equates the return on an *n*-period zero-coupon bond to that of an *n-1*-period zero-coupon bond rolled over into a one-year bond in year *n* is defined as

A. the forward rate.
B. the short rate.
C. the yield to maturity.
D. the discount rate.
E. None of the above is correct.

The forward rate for year n, fn, is the "break-even" interest rate for year n that equates the return on an n-period zero- coupon bond to that of an n-1-period zero-coupon bond rolled over into a one-year bond in year n.

The following is a list of prices for zero coupon bonds with different maturities and par value of $1,000.

Maturity (Years)	Price
1	$943.40
2	$881.68
3	$808.88
4	$742.09

13. What is the yield to maturity on a 3-year zero coupon bond?

A. 6.37%
B. 9.00%
C. 7.33%
D. 10.00%
E. None of the above is correct.

$(1000/808.81)^{1/3} - 1 = 7.33\%$

14. The duration of a coupon bond

A. does not change after the bond is issued.
B. can accurately predict the price change of the bond for any interest rate change.
C. will decrease as the yield to maturity decreases.
D. All of these are correct.
E. None of the above is correct.

Duration changes as interest rates and time to maturity change, can only predict price changes accurately for small interest rate changes, and increases as the yield to maturity decreases.

15. Holding other factors constant, which one of the following bonds has the smallest price volatility?
A. 5-year, 0% coupon bond
B. 5-year, 12% coupon bond
C. 5 year, 14% coupon bond
D. 5-year, 10% coupon bond
E. Cannot tell from the information given.

Duration (and thus price volatility) is lower when the coupon rates are higher.

16. The potential loss for a writer of a naked call option on a stock is
A. limited.
B. unlimited.
C. larger the lower the stock price.
D. equal to the call premium.
E. None of the above is correct.

If the buyer of the option elects to exercise the option and buy the stock at the exercise price, the seller of the option must go into the open market and buy the stock (in order to sell the stock to the buyer of the contract) at the current market price. Theoretically, the market price of a stock is unlimited; thus the writer's potential loss is unlimited.

17. A protective put strategy is
A. a long put plus a long position in the underlying asset.
B. a long put plus a long call on the same underlying asset.
C. a long call plus a short put on the same underlying asset.
D. a long put plus a short call on the same underlying asset.
E. None of the above is correct.

If you invest in a stock and purchase a put option on the stock you are guaranteed a payoff equal to the exercise price; thus the protection of the put.

18. If the hedge ratio for a stock call is 0.50, the hedge ratio for a put with the same expiration date and exercise price as the call would be _____.
A. 0.30
B. 0.50
C. -0.60
D. -0.50
E. -.17

Call hedge ratio = N(d1); Put hedge ratio = N(d1) - 1; 0.5 - 1.0 = -0.5.

19. Options sellers who are delta-hedging would most likely
A. sell when markets are falling.
B. buy when markets are rising.
C. sell when markets are falling and buy when markets are rising.
D. sell whether markets are falling or rising.
E. buy whether markets are falling or rising.

Options sellers who are delta-hedging would most likely sell when markets are falling and buy when markets are rising.

20. A trader who has a _____ position in gold futures wants the price of gold to _____ in the future.
A. long; decrease
B. short; decrease
C. short; stay the same
D. short; increase
E. long; stay the same

Profit to short position = Original futures price - Spot price at maturity. Thus, the person in the short position profits if the price of the commodity declines in the future.

PART 2 (OPEN QUESTIONS; 3 questions providing 4 points at maximum)

Read the questions and answers carefully and write down your answer on your answer sheet.

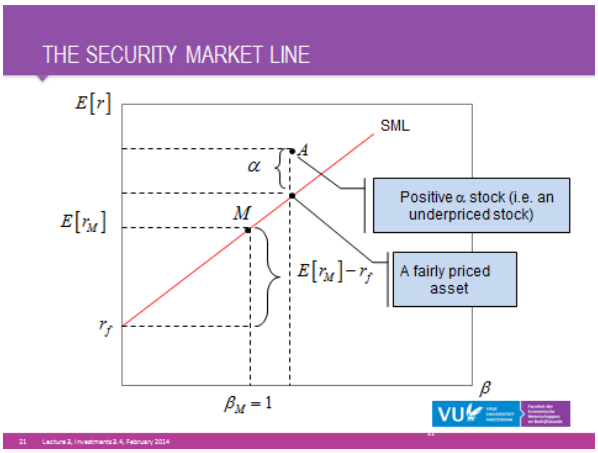
Question 1: Portfolio Construction and Asset Pricing (1.6 points)

Part a. (0.5 points)

Give the expression for the expected return – beta relationship of the CAPM. Plot a graphical interpretation. On the plot, also indicate the market portfolio and the risk-free rate. Where does a fairly priced portfolio of assets lie? Plot an example of an underpriced portfolio and explain why it is underpriced. What would be the mechanism that corrects for this mispricing, under the CAPM? What if instead of the CAPM, the APT holds? Is your graphical representation of the underpriced portfolio the same under the CAPM and the APT?

$$E[r_i] = r_f + \beta_{i(E[r_m]-r_f)}$$

You need to plot the SML, which plots E[r] vs . beta. It looks like that:



The market portfolio has a beta of 1. A fairly priced security lies on the SML. An underpriced security lies above the SML (it has a higher expected return that the one implied by the CAPM). The equilibrium effect, under the CAPM, would be that all investors slightly tilt their portfolios and assign a higher weight on the underpriced stock, which means a higher price and expected return down and return it to equilibrium.

The graphical representation under the APT is the same. Under the APT, each investor wants an infinite arbitrage position in the mispriced asset. Therefore, it would not take many investors to identify the arbitrage opportunity and act to bring the market back to equilibrium

Part b. (0.4 points)

One way to evaluate the performance of your manager is by performance attribution. Discuss the steps involved in this process.

The portfolio management decision process typically involves three choices: (1) allocation of funds across broad asset categories, such as stocks, bonds, and the money market; (2) industry (sector) choice within each category; and (3) security selection within each sector. The returns resulting from each of these decisions are measured against a benchmark return resulting from a passive, index-investment approach. The excess returns (if any) resulting from these decisions over and above those earned from a passive indexing strategy are attributed to the success of the portfolio manager.

Part c. (0.4 points)

Consider the following information about the performance of a fund and the market portfolio:

	Fund	Market portfolio
Average return	12%	9%
Standard deviation of returns	25%	20%
Beta	1.1	1

The risk free rate is 2%.

i. Calculate the Sharpe ratio of the fund and of the market portfolio.

   Sharpe ratio (fund) = (0.12 -0.02)/0.25 = 0.4; Sharpe ratio (market) = (0.09-0.02)/0.2 = 0.35

ii. Define the M2 performance measure, also giving a graphic interpretation. Hint: recall that it involves creating a hypothetical portfolio made up of a combination of the fund portfolio and a risk-free investment. What is the link between the M2 measure and the Sharpe ratio?

   The M2 measure gives the excess return of a hypothetical portfolio over the market. The hypothetic portfolio is a linear combination of the risk-free asset and the managed portfolio, and has the same volatility as the market portfolio.

iii. Calculate the weights of the hypothetical portfolio used to calculate the M2 measure. Obtain its return.

Weight(risk-free) = 1-0.2/0.25 = 0.2; weight(managed portfolio) = 1-0.2 = 0.8.
Return(hypothetic portfolio) = 0.8*0.12+0.2*0.02 = 0.1

iv. Calculate the M2 measure for the fund.

M2 = 0.1-0.09 = 0.01

Part d. (0.3 points)

Consider the multifactor APT. There are two independent economic factors, F1 and F2. The risk-free rate of return is 6%. The following information is available about two well-diversified portfolios:

Portfolio	B on F_1	β on F_2	Expected Return
A	1.0	2.0	19%
B	2.0	0.0	12%

Assume that no arbitrage opportunities exist. Compute the risk premium on factor F_1 and the risk premium on factor F_2.

2A: 38% = 12% + 2.0(RP1) + 4.0(RP2); B: 12% = 6% + 2.0(RP1) + 0.0(RP2); 26% = 6% + 4.0(RP2); RP2 = 5; A: 19% = 6% + RP1 + 2.0(5); RP1 = 3%.

Question 2: Fixed Income Securities (1.2 points)

Part a. (0.4 points)

Discuss the meaning, usage, similarities and differences between the following 2 couples of concepts:

i. duration of a bond and delta of an option

Duration measures the interest rate sensitivity of the bond price. The option delta measures the stock price sensitivity of the option. Both are linear approximations. The delta of the option gives the fractions of stocks needed to build a hedge portfolio; while this is not the case with duration (explicit duration matching is needed).

ii. convexity of a bond and gamma of an option

Convexity measures the second order effect of interest rate changes on the bond price, while the gamma measures the second order effect of stock price changes on the option price.

Part b. (0.4 points)

Explain what the following terms mean: spot rate, short rate, and forward rate. Which of these is (are) observable today?

The n-period spot rate is the yield to maturity on a zero-coupon bond with a maturity of n periods. The short rate for period n is the one-period interest rate that will prevail in period n. The forward rate for period n is the short rate that would satisfy a "break-even condition" equating the total returns on two n-period investment strategies. The first strategy is an investment in an n-period zero-coupon bond. The second is an investment in an n-1 period zero-coupon bond "rolled over" into an investment in a one-period zero. Spot rates and forward rates are observable today, but because interest rates evolve with uncertainty, future short rates are not.

Part c. (0.4 points)

Consider the following forward rates: $f_1 = 3\%$, $f_2 = 2.4\%$, and $f_3 = 1.4\%$.

i. Express the prices of zero-coupon bonds with maturities of 1, 2, and 3 years using the forward rates. The face value of each bond is 1000 euro. Solve for them.

$P_1 = 1000/(1+f_1) = 970.87$, $P_2 = 1000/((1+f_1)*(1+f_2)) = 948.12$, $P_3 = 1000/((1+f_1)*(1+f_2)*(1+f_3))$ 935.05.

ii. Explain how you can obtain the zero-yield curve, using the forward rates. That is, provide the formulas for computing the yields of zero-coupon bonds with maturities 1, 2, 3.

$z_1 = f_1$
$(1+z_2)^2 = (1+f_1)*(1+f_2)$
$(1+z_3)^3 = (1+f_1)*(1+f_2)*(1+f_3)$

iii. Calculate the yield curve

Solving this system above yields: $z_1 = 0.030$, $z_2 = 0.027$, $z_3 = 0.023$.

iv. Comment on the shape of the derived yield curve. Based on the expectations and liquidity preference theories, do you expect an increase in interest rates?

The yield curve is downward sloping. According to the expectations theory, a downward sloping curve indicates that investors anticipate a decrease in interest rates. According to liquidity preference theory, a downward sloping curve does not necessarily imply an anticipation for a decrease in interest rates.

Question 3: Derivatives (1.2 points)

Part a. (0.3 points)

Which of the variables affecting option pricing is not directly observable? How is it usually calculated in order to be used by, say, the Black-Scholes formula? If this variable is estimated to be higher or lower (using option pricing) than the variable actually is, then how is the option valuation affected?

The volatility of the underlying stock is not directly observable, but can be estimated from historic data. If the implied volatility is lower than the actual volatility of the stock, the option will be undervalued, as the higher the implied volatility, the higher the price of the option. Investors often use the implied volatility of the stock, i.e., the volatility of the stock implied by the price of the option. If investors think the actual volatility of the stock exceeds the implied volatility, the option would be considered to be underpriced. If actual volatility appears to be higher than the implied volatility, the "fair price" of the option would exceed the actual price.

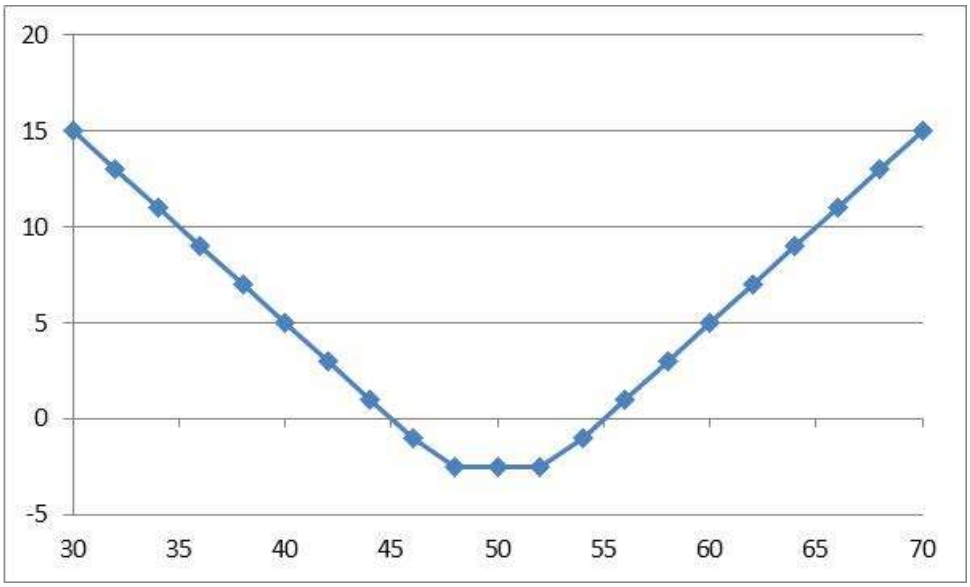
Part b. (0.4 points)

Construct an options strategy that allows an investor to benefit from large upward or downward price moves of the underlying asset, while limiting his losses otherwise. Assume that the current price is €50 and that the investor aims at limiting his loss to €2.5 when the price of the underlying moves by 5% in either direction. For higher price volatility the investor wants to assure an upward potential. The premium for both a put and a call is €1.25 each.

i. What options will you use to construct such a strategy? Specify type and strike price.

ii. Draw a profit diagram of the option strategy, considering the premium paid or received for the options.

Long one put at 47.5, long one call at 52.5. Below is the profit diagram



Part c. (0.5 points)

You are evaluating a stock that is currently selling for €45 per share. Over the investment period of 1 year you think that the stock price might get as low as €35 or as high as €55. There is a call option available on the stock with an exercise price of 45. The annual interest rate is 1%. Answer the following questions about hedging your position in the stock. Assume that you will buy one share.

i. What is the hedge ratio (Hint: use the option pay-offs and the stock prices for the high and the low scenarios)?

(10 - 0)/(55 - 35) = 1/2. [If the stock price ends at 55 the call is worth 10; if it ends at 35 the call is worth 0.]

ii. How much would you borrow to purchase the stock? (Hint: make sure the value of your stock portfolio at the end of the holding period is non-negative)

Borrow the present value of the anticipated minimum stock price = €35/1.01 = €34.65

iii. What is the amount of your net investment in the stock?

45 – 34.65 = 10.35

iv. How many call options will you combine with the stock to construct the perfect hedge? Will you buy the calls or sell the calls?

Since the hedge ratio is 1/2 buy one stock and sell two call options.

v. What must the price of one call option be?

The value of the stock portfolio equals the value of two calls. The net investment in the stock portfolio is €10.35 so this must equal the value of the two calls. €10.35 = 2C, and C = €5.17.