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:	June 1, 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: June 14
Inspection:	Thursday, June 15 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. If a distribution has "fat tails" it exhibits
A. positive skewness
B. negative skewness
C. a kurtosis of zero
D. high kurtosis
E. positive skewness and negative kurtosis

Kurtosis is a measure of the tails of a distribution or "fat tails."

2. You invest €234 in a risky asset with an expected rate of return of 0.11 and a standard deviation of 0.20 and a (risk-free) Treasury Bill with a rate of return of 0.03. What percentages of your money must be invested in the risk-free asset and the risky asset, respectively, to form a portfolio with a standard deviation of 0.08?
A. 30% and 70%
B. 50% and 50%
C. 60% and 40%
D. 40% and 60%
E. Cannot be determined.

0.08 = x(0.20); x = 40% in risky asset.

3. The unsystematic risk of a specific security
A. is likely to be higher in an increasing market
B. results from factors unique to the firm
C. depends on market volatility
D. cannot be diversified away
E. is uncorrelated with the company CEO's grade in the course "Investments"

Unsystematic (or diversifiable or firm-specific) risk refers to factors unique to the firm. Such risk may be diversified away; however, market risk will remain.

4. Which of the following measures of risk best highlights the potential loss from extreme negative returns?
A. Standard deviation
B. Variance
C. Fama-French alpha
D. Value at Risk (VaR)
E. Sharpe measure

Only VaR measures potential loss from extreme negative returns.

5. The single-index model
A. greatly reduces the number of required calculations, relative to those required by the Markowitz model.
B. reduces our understanding of systematic versus nonsystematic risk.
C. greatly increases the number of required calculations, relative to those required by the Markowitz model.
D. cannot be applied in practice.
E. is inconsistent with the CAPM.

The single index model greatly reduces the number of calculations

6. The capital asset pricing model DOES NOT assume
A. all investors are price takers.
B. all investors have the same holding period.
C. investors have heterogeneous information about expected returns.
D. all investors are mean-variance efficient.
E. Investments are limited to those that are publicly traded.

The CAPM assumes investors have the same information.

7. Consider the single factor APT. Portfolios A and B have expected returns of 14% and 18%, respectively. The risk-free rate of return is 7%. Portfolio A has a beta of 0.7. If arbitrage opportunities are ruled out, portfolio B must have a beta of _____.
A. 0.45
B. 1.00
C. 1.10
D. 1.22
E. 1.33

A: 14% = 7% + 0.7F; F = 10; B: 18% = 7% + 10b; b = 1.10.

8. Standard deviation and beta both measure risk, but they are different in that
A. beta measures both systematic and unsystematic risk.
B. beta measures only systematic risk while standard deviation is a measure of total risk.
C. beta measures only unsystematic risk while standard deviation is a measure of total risk.
D. beta measures both systematic and unsystematic risk while standard deviation measures only systematic risk.
E. beta measures total risk while standard deviation measures only nonsystematic risk.

Standard deviation and beta both measure risk, but they are different in that beta measures only systematic risk while standard deviation is a measure of total risk.

9. There is a news report that a devastating tsunami has just hit the Philippines. In an efficient market one would expect the price of government bonds issued by the Philippines to
A. drop immediately.
B. remain unchanged.
C. increase immediately.
D. gradually decline for the next several weeks.
E. gradually increase for the next several weeks.

In an efficient market the price of the stock should drop immediately when the bad news is announced. A gradual change is a violation of the EMH.

10. Consider the regression equation: $r_i - r_f = g_0 + g_1 b_1 + g_2 s^2(e_i) + e_{it}$ where: $r_i - r_f$ = the average difference between the monthly return on stock i and the monthly risk-free rate; b_i = the beta of stock I; $s^2_{(ei)}$ = a measure of the nonsystematic variance of the stock i. If you estimated this regression equation and the CAPM was valid, you would expect the estimated coefficient g_0 has to be
A. 0
B. 1
C. equal to the risk-free rate of return
D. equal to the average difference between the monthly return on the market portfolio and the monthly risk-free rate
E. 3.14159265359

In this model, the coefficient, g_0 represents the excess return of the security, which would be zero if the CAPM held.

11. You invest 55% of your money in security A with a beta of 1.4 and the rest of your money in security B with a beta of 0.9. The beta of the resulting portfolio is

A. 1.466
B. 1.157
C. 0.968
D. 1.082
E. 1.175

0.55(1.4) + 0.45(0.90) = 1.175.

12. A coupon bond pays annual interest, has a par value of €1,000, matures in 4 years, has a coupon rate of 8.25%, and has a yield to maturity of 8.64%. The current yield is defined as the bond's annual coupon payment divided by the bond price and is equal to

A. 8.65%
B. 8.45%
C. 7.95%
D. 8.36%
E. None of these is correct.

FV = 1000, n = 4, PMT = 82.50, i = 8.64, PV= 987.26; €82.50/€987.26 = 8.36%.

13. Consider the following forward rates obtained from risk-free government bonds:

Year	1-Year Forward Rate
1	5.8%
2	6.4%
3	7.1%
4	7.3%
5	7.4%

What would the yield to maturity be on a four-year risk-free zero coupon bond purchased today?

A. 5.80%
B. 7.30%
C. 6.65%
D. 7.25%
E. None of these is correct.

$[(1.058)\ (1.064)\ (1.071)\ (1.073)]^{1/4} - 1 = 6.65\%$

14. Holding other factors constant, the interest-rate risk of a coupon bond is higher when the bond's:
A. term-to-maturity is lower.
B. coupon rate is lower.
C. yield to maturity is higher.
D. term-to-maturity is lower and yield to maturity is higher.
E. None of these is correct.

The longer the maturity, the greater the interest-rate risk. The lower the coupon rate, the greater the interest-rate risk. The lower the yield to maturity, the greater the interest-rate risk. These concepts are reflected in the duration rules; duration is a measure of bond price sensitivity to interest rate changes (interest-rate risk).

15. Identify the bond that has the longest duration (NOTE: no calculations necessary).
A. 20-year maturity with an 8% coupon.
B. 20-year maturity with a 12% coupon.
C. 20-year maturity with a 0% coupon.
D. 10-year maturity with a 15% coupon.
E. 12-year maturity with a 12% coupon.

The lower the coupon, the longer the duration. The zero-coupon bond is the ultimate low coupon bond, and thus would have the longest duration.

16. An American put option can be exercised
A. any time on or before the expiration date.
B. only on the expiration date.
C. any time in the indefinite future.
D. only after dividends are paid.
E. only on the last date of each month up to the expiration date.

American options can be exercised on or before expiration date.

17. The gamma of an option is
A. the volatility level for the stock that the option price implies.
B. the continued updating of the hedge ratio as time passes.
C. the percentage change in the stock call option price divided by the percentage change in the stock price.
D. the sensitivity of the delta to the stock price.
E. the volatility level for the stock that the option price implies and the percentage change in the stock call option price divided by the percentage change in the stock price.

The gamma of an option is the sensitivity of the delta to the stock price.

18. Portfolio A consists of 600 shares of stock and 300 calls on that stock. Portfolio B consists of 685 shares of the same stock. The call delta is 0.3. Which portfolio has a higher monetary exposure to a change in the stock price?

A. Portfolio B.
B. Portfolio A.
C. The two portfolios have the same exposure.
D. A if the stock price increases and B if it decreases.
E. B if the stock price decreases and A if it increases.

300 calls (0.3) = 90 shares + 600 shares = 690 shares; 685 shares = 685 shares.

19. Other things equal, the price of a call option on common stock is negatively related to the following factor

A. the stock price.
B. the time to expiration.
C. the stock volatility.
D. the exercise price.
E. none of the above is correct.

20. A speculative trader who has a _____ position in wheat futures believes the price of wheat will _____ in the future.

A. long; increase
B. long; decrease
C. short; increase
D. long; stay the same
E. short; stay the same

The trader holding the long position (the person who will purchase the goods) will profit from a price increase. Profit to long position = Spot price at maturity - Original futures price.

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. (0.3 points)

Both the Capital Asset Pricing Model (CAPM) and the Arbitrage Pricing Theory (APT) derive a capital market equilibrium, albeit under different assumptions. Discuss the main differences between the two theories.

Both the CAPM and the APT are market equilibrium models, which examine the factors that affect securities' prices. In equilibrium, there are no overpriced or underpriced securities. In both models, mispriced securities can be identified and purchased or sold as appropriate to earn excess profits.

The CAPM is based on the idea that there are large numbers of investors who are focused on risk-return dominance. Under the CAPM, when a mispricing occurs, many individual investors make small changes in their portfolios, guided by their degrees of risk aversion. The aggregate effect of their actions brings the market back into equilibrium. 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. (0.3 points)

There are three forms of market efficiency – weak, semi-strong, and strong. What is meant by these three forms? Discuss one possible way to empirically test one form of the efficient market hypothesis (Note: there are many possible ways to test each form of market efficiency, please outline just one test for one of the forms).

The weak form of the efficient markets hypothesis (EMH) states that stock prices immediately reflect market data. The semistrong form of the EMH states that stock prices include all public information. The strong form of the EMH states that all information (public and private) is immediately reflected in stock prices.

The book and the slides discuss various ways to test for market efficiency, every correctly discussed way will be accepted.

Part c. (0.6 points)

Motivated by the ICAPM and the observation that small stocks typically have higher returns than large stocks, you apply a multifactor model where you consider SMB (the return of small minus large stocks) as systematic source of risk that describe investors' investment opportunity set. You therefore consider the following asset pricing model:

$$r_i = \alpha_i + \beta_i * r_m + \gamma_i * SMB + \epsilon_i$$

Where r_i is the excess return of stock i, r_m is the excess return on the market. The variances of the two factors are σ_m and σ_{smb}. The variance of the idiosyncratic risk is σ_ϵ for all stocks i (i.e. it is the same). Assume that the idiosyncratic risks are uncorrelated, and that the two factors are uncorrelated as well. Now consider two stocks $i = \{1,2\}$.

i) Is the systematic risk of each of the two stocks dependent on the covariance between the systematic sources of risk with the idiosyncratic volatilities?

No, because according to the CAPM and its extensions the error terms are uncorrelated with the systematic sources of risk.

ii) Construct an equally-weighted portfolio of the two stocks. What is the non-systematic risk component? Compare it to the non-systematic component of each stock.

$$\sigma_p^2 = 0.5 * \sigma_\epsilon^2$$

iii) Construct a portfolio out of the two stocks that has exposure of 1.5 to the SMB factor. Give an analytical expression of its weights.

$$w_1 + w_2 = 1$$
$$\gamma_1 * w_1 + \gamma_2 * w_2 = 1.5$$

$$\Rightarrow w_1 = \frac{\gamma_2 - 1.5}{\gamma_2 - \gamma_1}; w_2 = \frac{1.5 - \gamma_1}{\gamma_2 - \gamma_1}$$

iv) If your asset pricing is the true model in the economy, would it apply to both individual assets and well-diversified portfolios and why?

Yes, in the ICAPM framework, every mispricing would cause investors to tilt their portfolios towards positive alpha stocks/portfolios and away from negative alpha stocks/portfolios. Thus, if the model is the true model in the economy, it should correctly price both individual assets and well-diversified portfolios

Part d. (0.4 points)

You want to evaluate three mutual funds. The market return is 6% and the risk free rate is 1%.

Below is the data for three funds.

Fund	Average Return	Standard Deviation	Beta
A	4%	6%	1.1
B	5%	8%	1
C	6%	10%	0.8

i) Provide the formula for Sharpe Ratio and calculate the Sharpe Ratios for the 3 funds. Based on your analysis so far, which fund performs best?

Sharpe ratio = (return of the portfolio – risk free rate) / std. deviation

	SR
A	0.50
B	0.50
C	0.50

They all have the same score, so we can't really tell.

ii) Provide the formulas for Jensen's alpha and Treynor's measure and calculate the two measures for each fund. Based on your analysis, which fund performs best?

Treynor's measure = (return of the portfolio – risk free rate) / beta
Jensen's alpha = return of the portfolio – (risk free rate + beta * (return of the market – risk free rate))

	Jensen's Alpha	**Treynor**
A	-2.50%	0.03
B	-1.00%	0.04
C	1.00%	0.06

Fund C performs the best.

iii) Are there any differences in results between points i) and ii) ? What accounts for the differences (or lack of differences)?

Yes, the SR analysis cannot provide a conclusive evidence which fund performs better. Yet, both JA and TM show that fund C performs the best. JA and TM weigh performance relative to systematic risk taking, while SR benchmarks returns against volatility. Thus, fund C appears to be the best because it provides returns that are highest given exposure to systematic risk.

Question 2: Fixed Income Securities (1.2 points)

Part a. (0.3 points)

You purchased an annual coupon-paying bond *one year ago* with 6 years remaining to maturity at the time of purchase. The coupon interest rate is 10% and par value is €1,000. At the time you purchased the bond, the yield to maturity was 8%. If you sell the bond after receiving the first interest payment and the bond's yield to maturity has changed to 7%, what would be your annual total rate of return on holding the bond for that year?

One year ago: FV = 1000, PMT = 100, n = 6, i = 8, PV = 1092.46;

Today: FV = 1000, PMT = 100, n = 5, i = 7, PV = 1123.01;

HPR = (1123.01 -1092.46 + 100) / 1092.46 = 11.95%.

Part b. (0.6 points)

Consider the data on the following three annual-paying coupon bonds:

Bond	Maturity	Coupon	Yield	Face Value
A	2	0.07	0.04	1000
B	3	0.05	0.03	1000
C	4	0.05	0.05	1000

i) Compute the prices, duration and the modified duration of the three bonds.

For bond A:

P_A = 70/1.04 + 1070/1.04^2 =1056.58

D_A = 1*70/1.04/Pa + 2*1070/1.04^2/Pa = 1.94
D_A* = 1.94/(1+0.04) = 1.86

You can easily follow the steps for the other two bonds

	Price	Duration	Modified Duration
Bond A	1056.58	1.94	1.86
Bond B	1056.57	2.86	2.78
Bond C	1000.00	3.72	3.55

ii) You have a portfolio consisting of a long position in 3 bonds of type A, long position of 4 bonds of type B, and a long position of 5 bonds of type C. Calculate the duration and the modified duration of the portfolio.

Value of the portfolio: 3*Pa+4*Pb+5*Pc = 12396.04
Weights of the portfolio: w_A = 3*Pa/V= 0.26. Same principle for the other 2.

	Position	weights
Bond A	3	0.26
Bond B	4	0.34
Bond C	5	0.40

Portfolio duration=wa*Da + wb*Db + wc*Dc=2.97
Portfolio modified duration: D* = wa*D*a + wb*D*b + wc*D*c=2.85

iii) Using duration approximation, what is the change in the value of the portfolio if the yield curve shifts downwards by 100 basis points? And if it shifts downwards by 10 basis points? In which of the two cases the approximation will be more exact and why?

100bp: deltaP/P = -2.95*-0.01 = 0.29
10bp: deltaP/P = -0.03 (more exact as smaller yield change).

Part c. (0.3 points)

The shape of the term structure of interest rates is often explained via the expectations hypothesis. What is the relationship between forward rates and expected future short rates, according to this hypothesis? Given the usual upward sloping shape of the yield curve, can the expectations hypothesis be true in reality? Is there any empirical support for the expectations hypothesis and why?

The expectations hypothesis is the most commonly accepted theory of term structure. The theory states that the forward rate equals the market consensus expectation of future short-term rates. Thus, yield to maturity is determined solely by current and expected future one-period interest rates. An upward sloping, or normal, yield curve would indicate that investors anticipate an increase in interest rates. An inverted, or downward sloping, yield curve would indicate an expectation of decreased interest rates. A horizontal yield curve would indicate an expectation of no interest rate changes.

Normally, the yield curve is upward curve is upward sloping, which implies that on average, interest rates are increasing over time. That of course cannot be true. However, decreases in the slope of the yield curve do seem to predict decreases in future short rates, meaning that there is indeed some level of empirical support for this hypothesis.

Question 3: Derivatives (1.2 points)

Part a. (0.3 points)

Discuss marking to market and margin accounts in the futures market. How would the volatility of the underlying affect the margin requirement?

When opening an account, the trader establishes a margin account. The margin deposit may be cash or near cash, such as T-bills. Both sides of the contract must post margin. The initial margin could be between 5 and 15% (just an example, no numbers needed to get full points) of the total value of the contract. The clearinghouse recognizes profits and losses at the end of each trading day; this daily settlement is marking to market, thus proceeds accrue to the trader's account immediately; maturity date does not govern the realization of profits or losses. The more volatile the asset, the higher the margin requirement.

Part b. (0.3 points)

What is meant by “implied volatility”? What is the relationship between implied volatility and option premiums?

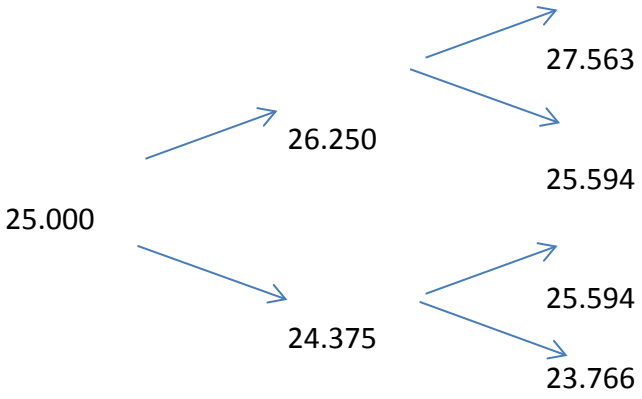
Implied volatility refers to the underlying’s standard deviation necessary for the observed option prices to be consistent with the Black-Scholes formula. In other words, implied volatility

is a measure of the estimation of the future variability for the asset underlying the option contract. The higher the implied volatility is, the higher the option premium for both calls and puts.

Part c. (0.6 points)

Bitterballen Corporation currently trades at €25 per share. Consider the binomial tree for the evolution of the stock price of Bitterballen Corporation over the period of 12 months, assuming two steps (t=0, t=1, t=2). The annual risk free rate is 3%, and the price of Bitterballen Corporation can increase by 5% or decrease by 2.5% each period.

i) Draw the binomial tree for (t=0, t=1, t=2)



ii) Calculate the risk-neutral probabilities of an upward movement and that of a downward movement. Do they differ at each node of the tree and why?

The risk-neutral probability of an upward move is calculated as $Q = \frac{S_0*(1+r_f)-S_1^d}{S_1^u-S_1^d} = 0.53$.

The risk neutral probabilities are the same at each nod of the three, because they use the exact same discounting at each point in time.

iii) You are worried that the price of Bitterballen Corporation may not increase as much as possible over the next 1 year. Thus, you consider buying a European put option with a strike price of €26 that matures in 1 year. Calculate the option's premium.
At time t=2 the option payoffs at each end of the three are calculated as

$$C_i = \max(0, X - S_i)$$

We then use the calculated risk-neutral probabilities to save recursively:

$$C_0 = Q\frac{C_1^u}{1+rf} + (1-Q)\frac{C_1^d}{1+rf}$$