



ID number:

AS 201: Financial Mathematics – Final Exam

Monday, December 28th, 2015 (8 am – 11 am)

Exam guidelines:

- 1 – The exam is composed of 35 Questions
- 2 – Please show your work completely
- 3 – This is an individual work. If you are seen cheating, then you will be asked to leave the examination room and will be given ZERO.
- 4 – Only the following items are allowed inside the examination room:
 - SOA approved calculator (all calculators must be reset)
 - Pen or pencil
 - Sharpener
 - Eraser
- 5 – No breaks are allowed once the exam has started. No one is allowed to leave the examination room to go to the bathroom.
- 6 – Exam will end after three hours exactly. No extra time will be given.
- 7 – The exam proctor will not answer any questions and students are not allowed to ask any questions, neither.
- 8 – Cell phones must be turned off and given to the exam proctor



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Exercise # 1

The current price of a stock is 43. An investor buys the 1-year 43-strike call for 5.71 and sells the 1-year 43-strike put for 4.44. The stock pays no dividends. At the same time he buys the 1-year 47-strike put for 6.69 and sells the 1-year 47-strike call for 4.08.

Find the annual effective risk free rate r .

- A) 0.01 B) 0.015 C) 0.02 D) 0.025 E) 0.03

Exercise # 2

The current price of a stock is 50. A price of 6-month put options with strikes 45, 50 and 55 are given below.

Strike	Put Premium
45	0.68
50	2.32
55	5.29

The continuous risk-free rate is $r = 0.04$.

At what 6-month stock price does the purchased 45 strike put produce a higher profit than the 50-strike purchased put but a lower profit than the 55-strike long put.

- A) $S < 48.3$ B) $48.3 < S < 50.3$ C) $50.3 < S < 52$ D) $S > 52$ E) None of these

Exercise # 3

Which of the following are true?

- I) Forward contracts typically have less credit risk than futures contracts
 - II) Futures contracts are referred to as “Over-the counter.”
 - III) Forward contracts are always settled daily
- A) I only B) II only C) III only D) All E) None



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Exercise # 4

An investor wishes to enter into a 4-year interest rate swap to pay a fixed rate and receive a floating rate. The swap is based on the yield curve given below.

Year	1	2	3	4
Spot Rate	0.011	0.017	0.023	0.025

Which of the following is closest to the fixed rate he will pay?

- A) 2.32% B) 2.36% C) 2.4% D) 2.44% E) 2.48%

Exercise # 5

The current price of a stock is 50. The continuous risk-free rate is $r = 0.025$. The price of a 3-month 50-strike call is 3.14 and the price of a 3-month 50-strike put is 2.83. An investor writes two puts and buys 4 calls.

What is his minimum profit?

- A) -6.94 B) -56.94 C) -106.94 D) -206.94 E) there is no finite minimum

Exercise # 6

The current price of a stock is 40. The continuously compounded risk free rate and dividend rate are 0.03 and 0.01 respectively. The price of an at-the-money 3-month call is 2.48. An investor buys the at-the-money 3-month call and put to create a purchased straddle.

What is the minimum profit of the straddle?

- A) 0 B) -3.48 C) -3.51 D) -4.76 E) -4.8



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Exercise # 7

Which of the following has a finite maximum profit?

- I) A purchased put
 - II) A written put
 - III) A purchased call
 - IV) A written call
 - V) A short forward contract
- A) I, II B) I, II, III C) II, III, IV D) I, II, III, IV E) I, II, IV, V

Exercise # 8

The current price of a stock is 50 and the continuously compounded risk-free rate is $r=0.041$
The stock does not pay dividends. You contract for a three month forward sale at 50.515 and buy the stock for 50.

Which of the following is this position equivalent to?

- A) A reverse cash and carry hedge
- B) An arbitrage profit structure
- C) A synthetic call option
- D) Purchase of a 3-month bond with continuously compounded risk-free rate $r = 0.041$
- E) None of these

Exercise # 9

The current price of a stock is 100 and the continuously compounded risk free rate $r = 0.035$
A dividend will be paid semiannually for the next 4 years, beginning in 6 months. The first dividend will be 1 and each subsequent dividend will be 2% higher than the previous one.

Which of the following is closest to the price of a 4-year prepaid forward on this stock?

- A) 90 B) 91 C) 92 D) 93 E) 94



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Exercise # 10

Which of the following are reasons that firms might **not** use derivatives to manage financial risk?

- I) the firm fears that use of derivatives might lead to bankruptcy
- II) the firm does not have sufficient accounting expertise to deal with the reporting required
- III) the firm wants to increase its debt capacity and is afraid that derivatives will prevent this
- IV) transacting in derivatives may increase transaction costs

- A) I, II B) I, III C) II, III D) II, IV E) All

Exercise # 11

The following table gives zero-coupon bond prices and oil forward prices.

Year	1	2	3	4
Oil forward price	68	69	70	71
Zero coupon bond price	0.989	0.967	0.934	0.906

Find the level payment for a four year oil swap

- A) 68.24 B) 68.96 C) 69.46 D) 70.03 E) 70.76



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Exercise # 12

The current price of a stock is 34. The continuous risk-free rate $r = 0.03$. The table below gives prices of 6-month put and call options with various exercise prices.

Exercise K	34	29	39
Call	3.11	6.2	1.34
Put	2.6	0.76	5.76

An investor uses the 34-strike options to create purchased straddle and buys the 29-strike put and the 39-strike call to create a strangle. For what values of the stock price S is the straddle profit greater than the strangle profit?

- A) $30.33 < S < 37.67$
- B) $S < 30.33$ or $S > 37.67$
- C) $31.87 < S < 33.37$
- D) $S < 31.87$ or $S > 36.13$
- E) All S since the straddle profit always exceeds the strangle profit

Exercise # 13

The current price of a stock is 37 and the continuously compounded risk-free rate is 0.032. The stock does not pay dividends. A 3-month forward contract is available at a price of 37.35. At-the-money 3-month put and call options are available at prices of 2.693 and 1.988 respectively. Which of the following is true?

- A) an arbitrage profit of 0.053 can be earned by selling the forward contract, writing the put and buying the call
- B) an arbitrage profit of 0.053 can be earned by buying the forward contract, buying the put and writing the call
- C) an arbitrage profit of 0.047 can be earned by selling the forward contract, writing the put and buying the call
- D) an arbitrage profit of 0.047 can be earned by buying the forward contract, buying the put and writing the call
- E) There is no arbitrage



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Exercise # 14

A jeweler has contracted to sell silver ornament to a distributor for 22 in one year. The ornament requires one ounce of silver, and has a fixed production cost of 2 per ornament. The possible prices of silver in one year and their probabilities are given below.

Silver price per ounce	18	19	20
Probability	0.3	0.3	0.4

The jeweler also has the option of entering a forward contract which will guarantee the purchase of silver for 19 per ounce in one year.

What is the difference between the profit obtained using the forward hedge and the expected profit without hedging

- A) 0 B) 0.1 C) 0.2 D) 0.3 E) 0.4

Exercise # 15

The current price of a stock is 28. The continuous risk-free rate is 0.03. The table below gives prices of 6-month put and call options with various exercise prices.

Exercise K	28	24	32
Call	1.77	4.46	0.5
Put	1.57	0.28	4.26

An investor sells the 28-strike call and the 28-strike put, and buys the 24-strike put and the 32-strike call. Which of the following is the most probable reason the investor took this position?

- A) he thinks the price will stay near 28 and wishes to profit from low volatility
- B) he thinks the price will vary greatly from 28 and wishes to profit from high volatility
- C) he thinks the price will decline below 24 and wishes to profit from the decline
- D) he thinks the price will increase above 32 and wishes to profit from the increase
- E) None of these



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Exercise # 16

Stock A has current price of 40. A correctly priced 6-month forward contract has price 40.564.

Stock B has current price of 30. A correctly priced 6-month forward contract has price 30.271.

Both stocks pay dividends. The continuously compounded dividend rate for stock B is twice the continuously compounded dividend rate for stock A.

Find the continuously compounded risk-free rate r .

- A) 0.036 B) 0.038 C) 0.04 D) 0.041 E) 0.042

Exercise # 17

The current price of a stock is 30. A 3-month put option with strike $K = 31$ has premium 1.59. The continuous risk-free rate is $r = 0.04$. At what stock price does the **profit** for the written put equal the **payoff** of the purchased put?

- A) 29.9 B) 30 C) 30.1 D) 30.2 E) 30.3

Exercise # 18

The current price of a stock is 30. The table below gives prices of one year put and call options with various exercise prices.

Exercise K	30	29
Call	3.81	4.28
Put	3.22	2.72

Find the continuously compounded dividend rate for the stock

- A) 0.005 B) 0.01 C) 0.015 D) 0.02 E) 0.025



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Exercise # 19

An interest rate swap is based on the yield curve given below

Year	1	2	3	4
Spot rate	0.03	0.04	X	0.05

The fixed payment swap rate is $R = 0.04936$. Find the 3-year spot rate x

- A) 0.043 B) 0.044 C) 0.045 D) 0.046 E) 0.047

Exercise # 20

A farmer plans to produce 100,000 bushels of corn for sale in 6 months. His total cost of production will be 1.43 per bushel. He will hedge by buying 10,000 1.5-strike puts priced at 0.11 and selling 100,000 1.55-strike calls priced at 0.1.

What is his profit range in 6 months? Use interest rate $r = 0.03$

- A) -5,985 to 10,984
B) 5,989 to 10,984
C) -7,000 to 11,000
D) 7,000 to 11,000
E) -5,985 to 11,000

Exercise # 21

A 30 year 10,000 bond pays 3% annual coupons and matures at par. It is purchased to yield 5% for the first 15 years and 7% thereafter. Calculate the price of the bond.

- A) 5,858 B) 6,172 C) 5,637 D) 6,418 E) 4,862

Exercise # 22

Goerge borrows X for 20 years at a nominal rate of 12% convertible monthly, to be repaid with equal payments at the end of each month. The outstanding balance immediately after the 10th payment is 297,000. How much total interest will Gierge pay for this loan?

- A) 793,243 B) 658,660 C) 300,175 D) 487,854 E) 493,069



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Exercise # 23

Suppose a total of 30 semiannual payments of amount 5 are made starting exactly 6 years from today. Assuming an annual effective rate of 6%, what is the future value at a time 30 years from today. Assume that after the payments are complete, the investment is left in the same account earning interest.

- A) 708 B) 411 C) 243 D) 399 E) 450

Exercise # 24

Andy deposits X into an account that earns 10% annual effective interest for 3 years and then a nominal interest rate of 5% convertible semiannually for the 3 years after that. If, after the 6 years, his future value is 200,000, how much interest did he earn during the 3rd year?

- A) 15,678 B) 18,750 C) 129,571 D) 24,200 E) 56,130

Exercise # 25

An association had an initial balance of 200 on Jan 1 and also had deposits of 25 on March 31st, June 30th, and September 30th. The association had a withdrawal of 30 on Feb 28th, a withdrawal of 60 on June 30th, and ended with a balance of 250 on Dec 31st. Calculate their dollar weighted rate of return.

- A) 32.1% B) 42.99% C) 35.62% D) 19.18% E) 23.34%

Exercise # 26

At time $t = 0$, Mark puts a one-time deposit of 1,000 into a fund crediting interest at an annual effective rate of i .

At time $t = 2$, Lewis puts a one-time deposit of 1,000 into a different fund crediting interest at a force $\delta_t = \frac{1}{3+t}$

At time $t = 18$, the amount in each fund will be equal. Calculate i .

- A) 2.9% B) 5.3% C) 8.3% D) 9.4% E) 10.5%



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Exercise # 27

An annuity due has 40 quarterly payments of 50 followed immediately by a perpetuity with quarterly payments of X. Find X, if the present value is 2000, at an annual effective rate of 16%

- A) 194 B) 151 C) 157 D) 179 E) 167

Exercise # 28

An n-year 1000 par value bond with 8% annual coupons has an annual effective yield of i . The book value of the bond at the end of year 3 is 1099.84 and the book value at the end of year 5 is 1087.27. What is the effective yield interest rate?

- A) 6.7% B) 5.9% C) 7.3% D) 6.2% E) 5.5%

Exercise # 29

The time weighted return for the fund with the transactions in the table below is 12%. What is the dollar weighted rate of return?

Date	Value before transaction	Transaction deposit	Transaction withdrawal
1/1/2015	980		
6/1/2015	1010	30	
10/1/2015	1055		X
12/31/2015	1060		

- A) 12.25% B) 1.53% C) 12% D) 11.78% E) 5.12%

Exercise # 30

Suppose that Julia finances a 315,000 mortgage for 25 years at a nominal rate of 6.5% convertible monthly. Julia will be making monthly payments with her first payment due one month from receiving the loan. Suppose Julia adds 125 to each financed payment to pay off the loan faster. What is the dollar amount of Julia's last payment?

- A) 918 B) 936 C) 2,252 D) 1,254 E) 923



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Exercise # 31

You are buying a perpetuity with annual payments as follow:

- i) payments of X at the end of the 1st year and every 3 years thereafter
- ii) payments of X+1 at the end of the 2nd year and every 3 years thereafter
- iii) payments of X+2 at the end of the 3rd year and every 3 years thereafter

The interest rate is 5% convertible semiannually. If the present value is 38.86, calculate X

- A) 0.98 B) 1 C) 1.2 D) 1.23 E) 1.25

Exercise # 32

Use the following table to represent spot rates. Calculate the total future value at time 5 of a payment of 3000 made today and a payment of 3000 made at time 3. Assume that the payment at time 3 will be invested at today's forward rates.

Term (years)	Annual Yield (%)
1	6
2	6.1
3	6.4
4	6.8
5	7.5

Exercise # 33

Let $d^{(4)} = 0.02$. Calculate the total amount of interest earned at the end of 13 years on a deposit account at this rate if semiannual deposits of 500 are made at the beginning of each 6-month period.

- A) 1,777 B) 1,926 C) 1,905 D) 1,845 E) 1,521



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Exercise # 34

At the beginning of the year, a student organization started an account with a deposit of 3000

At the end of each month, the student organization deposited dues of 100. At the end of the 5th and 7th month, withdrawals of 500 were made. The amount in the account at the end of the year is 3750.

Calculate the dollar-weighted rate of return for the student's organization account during the year.

- A) 16.7% B) 17.2% C) 13.3% D) 18% E) 83%

Exercise # 35

For call and put options on a stock with price S_0 and strike price K , you are given information on the difference between $C - P$ call and put prices. For $T = 0.5$, $C - P = 2.99$. For $T = 0.25$, $C - P = 2.5$.

You are given $r = 0.04$ and dividend rate = 0. Find K

- A) 48.52 B) 49.74 C) 50.82 D) 51.7 E) 52.95