University of Waterloo
Final Examination

Term: Fall 2008

Last Name _____ **First Name** _____

UW Student ID Number _____

Course Abbreviation and Number	AFM 372
Course Title	Math Managerial Finance 2
Instructor	Alan Huang

Date of Exam	December 12
Time Period	Start time: 4:00 pm End time: 6:30
Number of Exam Pages	17 pages (including cover sheet, additional scratch sheet, formula & table sheets)
Exam Type	Closed Book
Additional Materials Allowed	Calculator (any form of calculator may be used)

MARKING SCHEME:

Question	**Score**	**Question**	**Score**
I. (30 points)		III.1 (11 points)	
II.(9 points)		III.2 (7 points)	
		III.3 (11 points)	
		III.4 (11 points)	
		III.5 (14 points)	
		III.6 (7 pts)	
Total **100**			

Instructions for Part III (Calculations):

1. Show process to get partial credit;
2. If the correct number has more than four decimal points, please specify dollar amount to 2-decimal places (e.g., $1.23), percentage to 2-decimal places (e.g., 11.15%), and all other numbers to 4 decimal places (e.g., 0.8333).
3. Feel free to tear the formula sheet and table pages (the last two pages) from the exam book.

I. Multiple choice questions: Circle one answer that is the best. (Questions 1 to 10 are worth 1 point each, and questions 11 to 20 are worth 2 points each.)

1. In an efficient market when a firm makes an announcement of a new product or product enhancement with superior technology providing positive NPV, the price of the stock will:

A) rise gradually over the next few days.
B) decline gradually over the next few days.
C) rise on the same day to the new price.
D) stay at the same price, with no net effect.
E) drop on the same day to the new price.

2. Relating to dividend, which of the following lists events in chronological order from earliest to latest?

A) Date of Record, Declaration Date, Ex-Dividend Date
B) Date of Record, Ex-Dividend Date, Declaration Date
C) Declaration Date, Date of Record, Ex-Dividend Date
D) Declaration Date, Ex-Dividend Date, Date of Record
E) Ex-Dividend Date, Date of Record, Declaration Date

3. Management's first step in any issue of securities to the public is:

A) to file a registration form with the OSC.
B) to distribute copies of the preliminary prospectus.
C) to distribute copies of the final prospectus.
D) to obtain approval from the board of directors.
E) to prepare the tombstone advertisement.

4. A corporation has 2000 shares outstanding, and 6 directors are up for election. The stock features cumulative voting. At least how many shares do you have to own to guarantee electing yourself to one position on the board of directors (ignoring possible ties)?

A) 1000. B) 334. **C) 286.** D) 1715. E) 343.

5. An operating lease's primary characteristics are:

A) fully amortized, lessee maintain equipment and there is not cancellation clause.
B) not fully amortized, lessor maintains equipment and there is a cancellation clause.
C) fully amortized, lessor maintain equipment and there is a cancellation clause.
D) not fully amortized, lessee maintains equipment and there is not cancellation clause.

6. If the volatility of the underlying asset decreases, then the:

A) value of the put option will increase, but the value of the call option will decrease.
B) value of the put option will decrease, but the value of the call option will increase.
C) value of both the put and call option will increase.
D) value of both the put and call option will decrease.
E) value of both the put and call option will remain the same.

7. Which of the following statements is true?

A) American options are options on securities of U. S. corporations, and the options are traded on American exchanges. European options are options on securities of U.S. corporations, but the options are traded on European exchanges.
B) American options are options on securities which are traded on American exchanges. European options, also traded on American exchanges, are options on European corporations.
C) American options give the holder the right to the dividend payment. European options do not.
D) American options may be exercised anytime up to expiration. European options may be exercised only at expiration.
E) None of the above.

8. Which of the following would not describe the difference between warrants and call options?

A) Warrants are issued by firms whereas call options are issued by individuals.
B) Call options have an exercise price whereas warrants do not.
C) Exercising of warrants creates dilution whereas exercising all options does not.
D) When call options are exercised existing shares trade hands whereas if warrants are exercised new stock must be issued.
E) None of the above.

9. The buyer of a forward contract:

A) will be taking delivery of the good(s) today at today's price.
B) will be making delivery of the good(s) at a later date at that date's price.
C) will be making delivery of the good(s) today at today's price.
D) will be taking delivery of the good(s) at a later date at pre-specified price.
E) both a or d.

10. In percentage terms, higher coupon bonds experience a _____ price change compared with lower coupon bonds of the same maturity given a change in yield to maturity.

A) greater **B) smaller** C) similar D) smaller or greater E) none of the above.

11. Diamond Drill Inc. has 150,000 shares and 15,000 warrants outstanding. A warrant holder can purchase a new share of stock for five warrants and $5.00 per warrant. The stock is currently selling for $27 per share. If all warrants are exercised, what will your fraction of ownership be if you owned 20,000 shares originally?

A) 13.33%
B) 12.12%
C) 13.07% [= 20,000/(150,000 + 15,000/5)]
D) 14.04%
E) Without knowing the exercise price the percent can not be determined.

12. Suppose a stock can be purchased for $8, a put option with expiry of 1 year on the stock can be purchased for $1.38, and a call option with expiry of 1 year and same exercise price on the stock can be written for $1.00. If holding these positions in combination can guarantee a payoff of $10 at the end of the year, then what in the following must be the closest to the risk-free rate if no arbitrage opportunities exist?

A) 12.50%.
B) 5.50%.
C) 17.65%. [= 8 + 1.38 – 1 = 10 exp(-.1765*1)]
D) 33.33%.
E) 18.75%.

13. Assume the stocks on which these options are written pay no dividends. The following two puts have the same price. Which option is written on the stock with the lower price?

Put on	Time to Maturity (years)	**Exercise Price**	Volatility	riskfree rate	Price of option
Stock A	0.5	**50**	0.25	5%	$10
Stock B	0.5	**40**	0.25	5%	$10

A) A
B) B
C) Both stocks must have same price.
D) Not enough information

14. An investor with a long position in Canada bond futures will profit if

A) interest rates decline
B) interest rates increase
C) the prices of US bonds increase
D) the prices of T-bills increase
E) none of the above

15. For a particular stock the old stock price is $20, the ex-rights price is $15, and the number of rights needed to buy a new share is 2. Assuming everything else is constant, the subscription price is:

A) $5. B) $13. C) $17. D) $18. E) $20.

[20 – 15 = (20-X)/(2+1) => X = 5]

16. A corporation has cash flow in excess of investment needs and normal dividend payments. The corporation is considering two alternative uses of the excess funds. In Alternative 1, the corporation increases current dividends and pays out the excess cash flow as a special dividend. In Alternative 2, the corporation makes a three-year loan and uses the loan proceeds to pay dividends at the end of year three. The following information can be used in choosing between the alternatives. Stockholders can earn 5% after taxes on their investments. Stockholders have a 20% tax rate. The corporate tax rate is 30%. At what pretax return on the loan are stockholders indifferent between the alternatives?

A) 5%. **B) 7.14%.** C) 5.71%. D) 4.38%. E) 4%.

17. A firm wishes to issue a perpetual callable bond which is callable one year from now. The current interest rate is 7%. Next year, the interest rate will be 6.5% or 8.25% with equal probability. The bond is callable at a call price of $1,075, and it will be called if the interest rate drops to 6.5%. If the coupon were set to $70 what would the bond sell for?

A) $824.61. B) $898.82. **C) $964.25.** D) $1000.00. E) $1031.74.

18. XYZ company is selling for $30 at close of trading May 3. On May 4, XYZ goes ex-dividend; the dividend amount is $1. The price drop on the ex-dividend date is estimated to be only 90% of the dividend amount. A tax-exempt university pension fund can profit from the following transaction of 1 million shares: _____ 1 million shares of XYZ stock cum-dividend; wait till stock goes ex-dividend; close out the position at _____ per share; and collect or pay dividend depending on its position.

A) Buy; $29.1 B) Sell; $29.1 C) Buy; $30 D) Sell; $30

19. You bought XYZ stock at $11, and then wrote a covered call option with a $10 strike price on the stock for a premium of $2.00. What is the possible maximum profit from this synthetic strategy?

A) 11.00 B) 10.00 C) 2.00 **D) 1.00** E) Unkonwn

20. Which of the following violate(s) the semi-strong market efficiency?

I. By subscribing to the Value Line Investment Survey, an investor can earn at least 5% over that earned by the market on comparable risk investments.

II. A stock which has been fluctuating between $25 and $27 in the last three months suddenly rises to $40 per share right after management announces a new project that has a promising impact on the firm's expected future cash inflows.

III. The size effect stating that small stocks outperform large stocks on a risk-adjusted basis.

IV. Buying stocks on Fridays produces a higher return than buying stocks on Mondays.

A) None of the above.

B) All of the above.

C) I only.

D) I and III only.

E) I, III and IV only.

II. Short answer or true/false question.

1. Earlier this year, Bear Stearns, one of the top investment banks, needed to sell its mortgage assets to meet its debt obligations. Due to the sinking value of its mortgage assets, it had trouble meeting those debt payments. It turned to the Fed (the U.S. central bank), who in turn arranged a $29 billion loan guarantee against Bear's mortgage assets to prevent the firm from going bankrupt. Loan guarantee is "a statutory commitment by the federal government to pay part or all of a loan's principal and interest to a lender or the holder of a security in case the borrower defaults." In addition to the statutory commitment, the Fed has agreed to lend this $29 billion, collateralized against a portfolio of mostly sub-prime mortgage securities that Bear Stearns "marked to market." The loan would run for 10 years, with an interest rate of 2.5% per year, which was much below the market interest rate.

Opponents to the Fed's plan argue that it costs taxpayers $29 billion since Bear will go bankrupt. Supporters argue that the plan will not cost taxpayers since it is collateralized against the market value of Bear's mortgage assets and would be recovered in case of bankruptcy. Give your opinion on the cost of the Fed's plan based on the knowledge that you learned in this course. (5 pts.)

The cost in the above bailout is a put option plus interest subsidy. The loan guarantee transforms a risky debt to riskless debt—the difference between these two is a put option. In the Bear's case, the put option is written on the collateral of the sub-prime mortgage securities. Assume that the Fed has no recourse rights to other assets of Bear, the value of the sub-prime mortgage securities is the strike price of the put. Assume that the guarantee lasts for the same length as the loan, the time to maturity of this put is 10 years.

The lower than market interest rate of the loan granted by the Fed is apparently an interest subsidy.

In sum, the Fed gives a 10-year put and subsidized loan, both which could be costly even if they are collaterized. However, we should realize that the cost cannot exceed the loan itself, which is $29 billion.

Note: Identifying a put is worth 2.5 pts. Put some illustration on put terms is worth 1 pt. Identifying loan subsidy is worth 1 pts. Pointing out the maximum cost does not exceed $29 billion is worth .5 pt.

2. Assess whether the following statements is true, false, or uncertain. Justify your answer. All marks are based on the quality of your arguments. Use the back of the page is space is not enough. (4 pts)

I just bought a stock and a put on the stock. My friend Tom bought a call on the stock with the same strike and time to expiry. Although we both believe that the stock, put and call are all fairly priced, he claimed that his call will outperform my portfolio.

False. According to put-call parity, buying a stock and a put is equivalent to buying a call and holding some riskfree bond. The difference between my portfolio and Tom's is therefore I have debt in my portfolio. With positive amount of debt, my portfolio is less risky. If everything is fairly priced, his call would not outperform my portfolio on a risk-adjusted basis. Instead, his call is more risky.

III. Calculations

1. (11 pts) Jet Black, an oil company, is currently competing in an auction in Alberta to win the right to drill for crude oil on a large piece of land in one year. The current market price of crude oil is $60 per barrel, and the land is believed to contain 125,000 barrels of oil. If found, the oil would cost $10 million to extract. Treasury bills that mature in one-year yield a continuously compounded interest rate of 6.5%, and the standard deviation of the returns on the price of crude oil is 50%.

a) Use the B-S model to calculate the maximum bid that the company should be willing to make at the auction. In your calculation, keep four-decimal places in d_1 and d_2 and use the standard normal-distribution table attached. (8 pts)

Identify inputs: X = $10,000,000, S = 125,000 (60) = 7,500,000, T-t = 1, σ = 0.5, and *r* = 0.065. Call option.

(3 pts)

$$C_t = S_t N(d_1) - X e^{-r(T-t)} N(d_2)$$

$$\text{where } d_1 = \frac{\ln(S_t/X) + (r + \frac{1}{2}\sigma^2)(T-t)}{\sigma\sqrt{T-t}} \qquad \text{and } d_2 = d_1 - \sigma\sqrt{T-t}$$

d1	-0.1954
d2	-0.6954

N(d1) = N(-0.1954) = 0.54 N(-0.20) + .46 N(-0.19) = 0.54(0.5-0.0793) + .46(0.5-0.0753) = 0.4225

(d1 and N(d1)---1.5 pts)

N(d2) = N(-0.6954) = 0.54 N (-0.70) + .46 N(-0.69) = 0.54(0.5 - .2580) + .46(0.5-0.2549) = 0.2434

(d2 and N(d2) --- 1.5 pts)

PV(X) =	9,370,674.63
C =	$888,205.27

(Call price: 2 pts)

b) Suppose that Jet Black succeeded in the auction and secured the drilling right. Now one year has elapsed and the oil price is $100 per barrel. The Alberta provincial government just extended Jet Black's drilling right to infinity (i.e., Jet Black can drill any time in the forever future). If Jet Black has not started drilling yet, would it start to drill now? Show your reasoning. (3 pts)

No, it won't. In this case, the time-to-expiry is infinity for the call option held by Jet Black. With infinity time-to-expiry, the call option value approaches the spot price, which is $100 dollar per barrel. However, if it exercises the option, it get only the intrinsic value of $2.5m(125,000 * 100 – 10,000,000 = $2,500,000) and lose out on the time value.

(It's better for Jet Black to sell the rights than exercising.)

2. (7 pts) XYZ Company pays no dividends and its stock currently sells for $50 per share. The continuously compounded risk free annual interest rate is 10%. Its equity structure includes 100,000 common shares and 10,000 warrants. Each warrant gives its owner the right to purchase 3 shares of common stock at an exercise price of $45. The warrant expires 1 year from now.

a) What is the lower bound for the price of the warrant? (3 pts)

The call lower bound is: $C_t \geq \max[0, 50 - 45e^{-.10(1)}] \Rightarrow C_t \geq 9.2823$

The warrant lower bound is therefore:

$$W_t \geq 3\frac{100{,}000}{100{,}000 + 3 \times 10{,}000} 9.2823 = \$21.42$$

b) If the warrant actually sells for $15, is there an arbitrage opportunity? If yes, show how you can make arbitrage profits. (4 pts)

The call is selling for $15, which is below the lower bound. Yes, there is arbitrage opportunity.

The following table illustrates the arbitrage opportunity:

		Future cash Flows	
	Cash Flows Today	S_T <45	S_T >45
Short sell 3 stocks	+150	$-3S_T$	$-3S_T$
Buy PV of 3 times $45 of bonds	-122.15	135	135
Buy a warrant	-15.00	0	$3(S_T - 45)$
Total	$12.84	$135-3S_T>0$	0

Note that if there exists dilution effect, it only make $(135-3S_T)$ larger.

3. (11 pts) This morning you agreed to buy a two-year Government of Canada bond six months from today. The bond carries a 6% coupon rate with semiannual coupon payments, and has a $1,000 face value.

a) The expected spot rates of interest for the life of the bond are listed below. These rates are semiannual rates.

Time from Today	Semiannual rate
6 months	0.048
12 months	0.050
18 months	0.052
24 months	0.055
30 months	0.057

What is the forward price of the bond? (5 pts)

Forward price = P

Coupon payment = 1000 * 6% * ½ = 30

$$P = \left[\frac{30}{(1.050)^2} + \frac{30}{(1.052)^3} + \frac{30}{(1.055)^4} + \frac{1030}{(1.057)^5} \right] \times 1.048 = 857.86 \times 1.048 = 899.03$$

Note to marker: They may assume annual coupon payments. In that case, the answer would be:

$$P = \left[\frac{60}{(1.052)^3} + \frac{1060}{(1.057)^5} \right] \times 1.048 = 895.97$$

b) Assume that the forward contract is traded on CBOT and is therefore a futures contract. You bought one contract, which consists of 100 bonds. When you entered into the contract (day 1), the futures price is $900 (per bond). The initial margin is $5,000, and the maintenance margin is $3,500. The following shows the daily prices of the futures in the next 5 days: $890 (day 2), $884 (day 3), $888 (day 4), $916 (day 5), and $899 (day 6). (1) What is your daily profit/loss at days 2 and 3? (2) Do you, and if you do, when do you receive margin call and what you need to do? (3) What's your ultimate gain/loss if you close out your position at day 6? (6 pts, each subquestion is worth 2 pts.)

(1) Day 2 cash flow: (890 – 900)*100 = -1,000.

Day 3 cash flow: (884 – 890) * 100 = -600

(2) At day 3, my margin balance will be 5,000 -1,000 – 600 = 3,400 < 3,500. I will receive a margin call. I need to inject cash of 1,600 so that my margin balance will be the initial margin.

(3) My ultimate gain/loss will be (899 – 900) * 100 = $-100.

4. (11 pts) Zvan Construction Inc. is considering leasing an earth-moving machine. The cost of the machine is $100,000. The machine is in CCA Class 10, which has a 30% CCA rate. Zvan has no other assets in Class 10. The interest rate (before tax) is 6%. The machine will be used for four years. Assume that any CCA tax shield and any tax consequences arising from asset disposal (e.g. terminal loss, recaptured depreciation) occur at the end of the year. Further assume that this is an operating leasing.

a) Suppose that there will be four annual lease payments (starting immediately) in the amount of $25,000, payable at the beginning of the year. Zvan faces a corporate tax rate of 40% and will consistently be in a tax-paying position. If at the end of the lease term the machine is worthless, what is the NPV of the lease to Zvan? (6 pts)

INPUTS	
Asset cost	100,000
Interest rate	6%
Lease rental payment	25000
Tax rate	40%
CCA rate	30%

Year	0	1	2	3	4
Depreciation schedule		15000	25500	17850	12495
Residual					29,155
After-tax cash flows from leasing					
After-tax rental payment	-15000	-15000	-15000	-15000	
After-tax cashflows from buying the asset					
Asset cost	-100,000				
Depreciation tax shield		6000	10200	7140	4998
Residual tax shield					11662
Net cash from buying	-100,000	6,000	10,200	7,140	16,660
Differential cashflow					
Lease minus buy	85,000	-21,000	-25,200	-22,140	-16,660
Discount rate	6%(1-.4) = 3.6%				
NPV	$6,877.16				

Question 4 cont'd:

b) Suppose instead that Zvan faces a corporate tax rate of 0% but the economic residual of the machine is 20% at the end of the lease term. The economic residual is also the residual guarantee set by the lessor. What is the reservation lease payment of Zvan? (5 pts)

After-tax cashflows from buying the asset

Year	0	1	2	3	4
Asset cost	-100,000				
Depreciation tax shield		0	0	0	0
Residual cashflow after-tax					20,000
Net cash from buying	-100,000	0	0	0	20,000

Let lease payment to be X (Annuity in advance, 4 times discount at 6%). Set NPV to be zero:

$- X*A^{4}_{0.06} * (1.06) + 100{,}000 - 20{,}000/(1.06)^{4}$

=> X = $22,912.64

5. (14 pts) Omega Biotech is a venture capital backed firm with no debt. Currently (prior to the following FDA approval) its equity is valued at $60 million with 40% held by the venture capital and 60% held by its founders. Its number of shares outstanding is 1 million. Assume that markets are efficient.

Today Omega announced that one of its trail drugs won the FDA approval and the production and marketing of the drug will commence soon. It costs $10 million to produce and market the drug, which is expected to yield an NPV of $20 million. The management is considering several ways to finance this cost and needs your help. (Unless otherwise stated, subquestions a)-d) are independent of each other.)

a) If Omega is going to offer new shares for subscription through an IPO, and assume that there is no issuing costs, at what price and how many shares should be offered? (3 pts)

If markets are efficient, the FDA approval will add $20 million value to Omega's equity.

Per share price after the announcement: ($60+$20)/1 = $80/share.

Offer price: $80.

Shares offered: $10m/$80 = 125,000 shares.

b) How would you answer to a) change if there is an underwriting spread of 7% and there are no other costs in the IPO issuance? Assume that the issuance costs are all borne by the existing shareholders. (3 pts)

Amt. needs to be raised: $10m/(1-0.07) = 10,752,688.17
Cost: 10,752,688.17 - $10m = 752,688.17

New share price before offering: ($80m – 752,688.17)/1m = $79.25

Shares offered: $10,752,688/$79.25 = 135,685.

Question 5 cont'd:

c) If the management decides at a 2:1 rights offering (i.e., 2 old shares for 1 new share), what is the subscription price (assume there is no issuance cost)? And assume that the rights are transferable, how much can the founders sell for the rights they are holding? (4 pts)

Amt. needs to be raised: $10m

# of shares offered: $1m/2 = 0.5m

Subscription price = $10m/0.5m = $20

Rights price:

$$R_0 = \frac{M_0 - S}{N + 1}$$

= (80-20)/(2+1) = $20

The founders have 60% or .6m shares, or .6m rights. Proceeds from selling rights: $20 (.6m) = $12m.

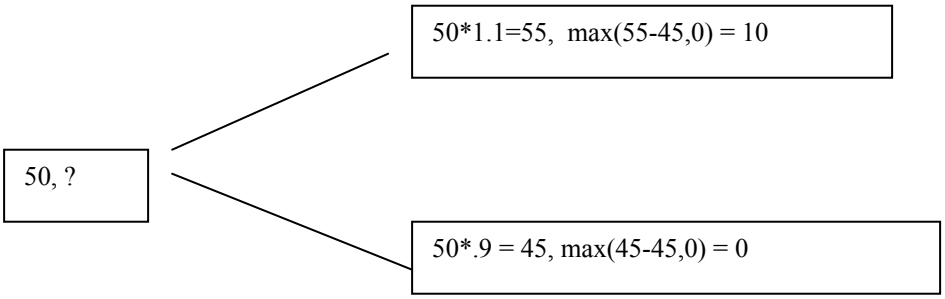
d) The management decides to issue warrants to finance the cost. Each warrant will give the holder the right to buy 1 share in one year at a price of $90 per share. Suppose that an otherwise similar call for the firm is valued at $20, how many warrants do the firm need to issue (assume there is no issuance cost)? (4 pts)

Let N_w be the warrant #.

$$N_w W = N_w \frac{N}{N + N_w} C = N_w \frac{1m}{1m + N_w} 20 = 10m$$

=> N_w = 1m

6. Consider a one-period binomial model. The current price of a stock is $50. A call option written on the stock has an exercise price of $45 and will expire in 6 month. You expect that 6-month from now the stock can either go up or down by 10% with equal probability. Assume that the stock will not pay a dividend over the next year. What is the change in the call price if the effective annual risk free rate changes from 10.25% to 12.36%? (5 pts) What is the intuition for your results, i.e. the impact of interest rate on call price? (2 pts)



Δ = (10-0)/(55-45) = 1

- Original riskfree rate period:
  Since annual rate is .1025 and one period is 6-month, so the riskfree rate for a period =

  $$\sqrt{1+.1025}-1=0.05$$

  B = (10 – 55) / (1 + 0.05) or = (0 - 45) / (1 +0.05) = - 42.86

  Call price = 1*50 – 42.86 = $ 7.14

- After change: riskfree rate for a period: $\sqrt{1+.1236}-1=0.06$

  B = (10 – 55) / (1 + 0.06) or = (0 - 45) / (1 +0.06) = -42.45

  Call price = 1*50 – 42.45 = $ 7.55

- Change: 7.55-7.14 = 0.41

- Increase in interest rate increases call price. Intuition: You now need to borrow less in order to replicate the call, therefore increase the value of the call.