

POST-MODULE ASSIGNMENT

Module 3: Foundation 2 – Asset Markets

Prof. Mark S. Seasholes

January 13 - 16, 2012 (Fri – Mon)

Module's Overall Assessment Scheme:

Pre-module assignment:	40%
In class work and participation:	10%
Post-module assignment:	50%

Post-Module Assignment Due Date and Time:

30-Jan-2012 Monday at 16:00 hours HK Time (equals 0300 hours NY Time)

Pre-Module Assignment Submission:

- You can submit your assignment via Blackboard® or email to Ms. Ruby Chau at rbychau@ust.hk. Please ensure that your name appears on all attachments.
- For submission via Blackboard®, a copy will be retained in your Blackboard® account and you can only submit once. If you would like to replace the submitted assignment with a revised version, please email it to Ms. Ruby Chau at rbychau@ust.hk.
- Please submit your assignment in PDF format.

Enquiries:

- If you have any questions, please contact the module's Teaching Assistant, Mr. Clark Liu at clarkliu@ust.hk.

Penalties for Late Submissions:

- Late for 1 calendar day: 5% will be deducted from the original score of the assignment.
- Late for 2 to 14 calendar days: 5% deduction for the first day plus 1% per subsequent day will be deducted from the original score.
- NO assignment will be accepted after 14 calendar days.
- Please refer to P.16 of the student handbook for details.

Important Notes for the Post-Module Assignment

- A. We have provided an answer sheet titled “Module 3 Post-Assignment Answer Sheet.” It is posted on Blackboard®. Students must put all answers on this answer sheet. Also, using the template helps the TA grade the work.
- B. We have provided an Excel workbook with numbers for some of the questions. Please download the spreadsheet from Blackboard®.
- C. In addition to the answer sheet, you may also turn in an Excel file. In the event an answer appears wrong (on the answer sheet), the TA will check the Excel to see if partial credit can be awarded.
- D. Students may use Excel and/or a financial calculator on this assignment. Students may consult class notes, the Hull textbook, and/or the BKM textbook.
- E. Each student must work alone on this assignment.
- F. In other words, students may not consult friends, colleagues, classmates, industry experts, etc. Please do not spend hours combing the internet for answers. Only the textbooks mentioned directly above may be used.

PART I: Multiple Choice (circle the correct answer)

- 1). Who guarantees that a futures contract will be fulfilled?
 - a The buyer
 - b The seller
 - c The broker
 - d The clearing house
 - e Nobody

- 2). Put-Call Parity
 - a Represents the proper relationship between put and future prices
 - b Always allows for arbitrage opportunities if violated
 - c May be violated by small amounts, but not enough to earn arbitrage profits, once transaction costs are considered
 - d All of above
 - e None of above

PART II: Short Answer Questions

- A. Suppose you have three stocks in your portfolio. You have allocated your money as shown below. If the risk free rate is 3.50% and the market risk premium ($r_m - r_f$) is 6.00%, what is the expected return of your portfolio? A: _____

Stock	Portfolio Weight	Equity Beta (β_E)	Expected Return (r_E)
1	50%	1.15	10.40%
2	40%	0.90	8.90%
3	10%	0.40	5.90%

- B. Which bond is yielding a higher rate of return?
 i) a Eurobond with a YTM = 5.72% EAR (annual compounding)
 ii) a U.S. bond with a YTM = 5.66% APR (semi-annual compounding)
 B: _____

- C. Which option costs more to buy? (suppose you want to buy one of these)
 i) A one-year European put option on HSBC stock with strike price = HK\$60
 ii) A one-year European put option on HSBC stock with strike price = HK\$65
 C: _____

- D. What is the variance of the following portfolio?
 note: “ $E[r]$ ” is the expected return on the asset and
 “ σ ” is the standard deviation of returns.
 D: _____

asset	% of port.	$E[r]$	σ	corr w/ asset 1	corr w/ asset 2	corr w/ asset 3
1	50%	15%	10%	1.00	0.10	0.20
2	30%	8%	5%	0.10	1.00	0.30
3	20%	5%	15%	0.20	0.30	1.00

- E. You have a portfolio containing one call option with exercise price \$70, one call option with exercise price \$120, one put option with exercise price \$40 and one put option with exercise price \$200. What is the payout of the portfolio if the underlying asset is selling for \$98 at maturity? (Hint: You do not need to draw the payout diagram).
 E: _____

F. What is the modified duration of a five-year, zero-coupon bond when the bond's yield (YTM) is 6.30% EAR ?

F: _____

G. A non-dividend paying stock recently closed at \$86.25. You want to write a one-year forward contract such that no money needs to change hands today. The risk free rate is 2.5%. You think the forward price (delivery price) should be 88.4063

Your friend thinks the delivery price is ridiculously low because both you and he believe the stock is expected to return 12% over the next year. He is willing to set the delivery price at \$95.00 and he will not require any money to change hands (today).

Outline a series of trades such that you make arbitrage profits.

H. What is the expected return on a stock with these characteristics _____

r_f	=	2.5%		
$E[r_m]$	=	8.5%	β_{mkt}	= 1.20
HML	=	4.0%	β_{HML}	= 0.35
SMB	=	2.0%	β_{SMB}	= -0.42

PART III: Longer Answer Questions

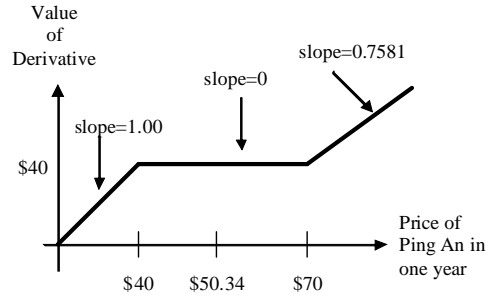
Longer Answer Question #1

This exercise uses monthly US stock market index data. We have provided this data in the associated Excel file. The data fields are: date, price of the value-weighted index with dividends reinvested, price of the value-weighted index without dividends reinvested, and the consumer price index (to be used for calculating inflation).

- A. Calculate the monthly real returns of the stock index with dividends (VWD).
- B. Calculate overview statistics for the real returns from Part A over the whole time period:
- | | |
|--------------------|-------|
| Arithmetic average | _____ |
| Geometric average | _____ |
| Standard deviation | _____ |
- C. Write out a formula for the monthly dividends paid (called “ D_t ”). The monthly dividends paid can be inferred from the monthly indices with and without dividend reinvested. Your formula should read “ $D_t = \text{_____}$ ”

Longer Answer Question #2

You want to buy a one-year derivative security which depends on Ping An’s stock price. The derivative has a payoff diagram as shown below. Note, the payoff diagram only shows how much the derivative pays out at maturity. Also note, that Ping An recently closed at HK\$50.34.



- A. Using the four main building blocks (components), how can we create the derivative?
- For each building block, specify whether we should “BUY” or “SELL”
 - Specify the number of components to be bought or sold
 - You may choose “CALLS”, “PUTS”, “RISKLESS BONDS”, “UNDERLYING ASSET”
 - Please note the strike price (exercise price) of any call or put option
 - If you choose a riskless bond, please note the face value of the bond

HINT: You may buy or sell fractions of any of the components.

Component #1: _____

Component #2: _____

Component #3: _____ (if necessary)

Component #4: _____ (if necessary)

Component #5: _____ (if necessary)

- B. Given the market prices (quoted today) of options below, how much _____ would you have to pay for this derivative security (use four decimal places) ?

1 share of Ping An stock	50.34	Riskless bond w/ \$40 face:	38.77
1 yr call on Ping An w/ K=0:	50.34	1 yr put on Ping An w/ K=0:	<< 0.01
1 yr call on Ping An w/ K=20:	30.96	1 yr put on Ping An w/ K=20:	< 0.01
1 yr call on Ping An w/ K=30:	21.48	1 yr put on Ping An w/ K=30:	0.21
1 yr call on Ping An w/ K=40:	13.21	1 yr put on Ping An w/ K=40:	1.64
1 yr call on Ping An w/ K=50:	7.26	1 yr put on Ping An w/ K=50:	5.39
1 yr call on Ping An w/ K=60:	3.67	1 yr put on Ping An w/ K=60:	11.49
1 yr call on Ping An w/ K=70:	1.75	1 yr put on Ping An w/ K=70:	19.26

- C. Go back to Part A. Using a different combination of the four building blocks (components), how can we create the derivative?
- For each building block, specify whether we should “BUY” or “SELL”
 - You may choose “CALLS”, “PUTS”, “RISKLESS BONDS”, “UNDERLYING ASSET”
 - Please note the strike price (exercise price) of any call or put option
 - If you choose a riskless bond, please note the face value of the bond

HINT: You may buy or sell fractions of any of the components.

Note: Buying 2 calls @ 50 plus selling 1 call @ 50 is the same as simply buying 1 call at 50. Such answers won't count.

Component #1: _____

Component #2: _____

Component #3: _____ (if necessary)

Component #4: _____ (if necessary)

Component #5: _____ (if necessary)

Given the market prices (quoted today) of options shown on the previous page, how much would you have to pay for the new components ? _____

Does put-call parity hold within a few cents? (Yes or No) _____

- D. Explain why this derivative is marketed as a convertible bond that yields 4.0% (EAR) with a dampened upside. You must have a calculation that shows where the 4.0% comes from.
 Note: Due to possible round-off errors, you may not get exactly 4.0%. That's OK.

Longer Answer Question #3

Maude and Harold are looking over the shape the U.S. zero coupon yield curve had taken over the years. The zero coupon yield curve is made from plotting zero coupon bond rates ($r_{f,t}$ or spot rates) as a function of maturity. After Harold collects the following data, he states: “The yield curve can be upward sloping as it is today in the U.S. or it can be downward sloping as it was during the Volcker years. In fact, it can even be humped shaped or scooped shaped.”

<u>upward sloping</u>		<u>downward sloping</u>		<u>humped</u>		<u>scooped</u>	
r_1	4.00%	r_1	8.00%	r_1	4.00%	r_1	8.00%
r_2	5.00%	r_2	7.00%	r_2	5.00%	r_2	7.00%
r_3	6.00%	r_3	6.00%	r_3	6.00%	r_3	6.00%
r_4	7.00%	r_4	5.00%	r_4	5.00%	r_4	7.00%
r_5	8.00%	r_5	4.00%	r_5	4.00%	r_5	8.00%

A. Is Harold correct in his assertion ? _____
 (“yes” , “no”, or “can’t tell”)

After checking Harold’s data, Maude notices something fishy and tells Harold: “I think you have to be more careful with your assertions. The yield curve can’t just go in any old direction. In fact, here are three yield curves that would result in arbitrage profits.”

<u>yield curve #1</u>		<u>yield curve #2</u>		<u>yield curve #3</u>	
r_1	8.00%	r_1	4.00%	r_1	8.00%
r_2	7.00%	r_2	6.00%	r_2	6.00%
r_3	4.00%	r_3	8.00%	r_3	3.00%
r_4	3.50%	r_4	6.00%	r_4	6.00%
r_5	3.00%	r_5	4.00%	r_5	8.00%

B. Is Maude correct in her assertion ? _____
 (“yes” , “no”, or “can’t tell”)

C. Prove that Maude's yield curves allow arbitrage profits. Do this for each yield curve by writing down a series of trades that result in a risk less profit. Your answer should be very clear and read like this:

- borrow \$100 for XX years at X.XX% rate
repay \$XXX in XX years
- lend \$100 for XX years at X.XXX% rate.
receive \$XXX in XX years
- explain how these actions generate risk free profits.

Hint: do all trades for either \$100 today or \$100 face amounts.

Arbitrage trades for yield curve #1

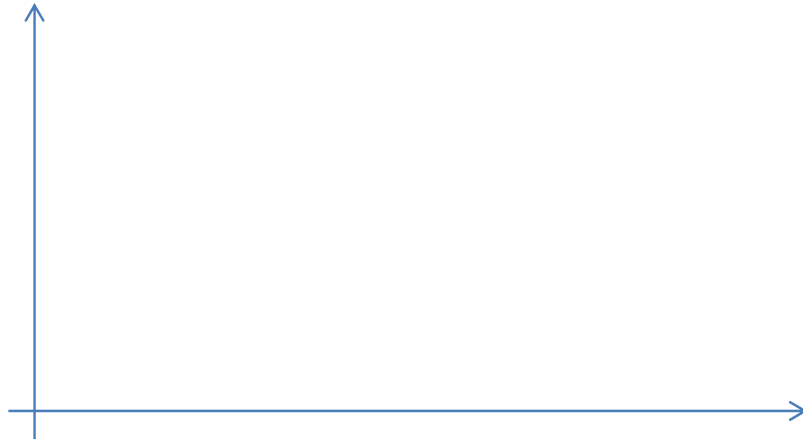
Arbitrage trades for yield curve #2

Arbitrage trades for yield curve #3

Longer Question #4

You friend Jenny recently had a large inheritance in the form of ABC Corp. stock. It seems Jenny's grandmother had started ABC Corp. and passed the family holdings onto Jenny in the form of a trust fund. Your friend knows something about diversification and is worried about having all her inheritance tied up in one stock. In fact, Jenny wants to buy a house in one year and doesn't want the value of her holdings to vary much. The trust fund prohibits the stock from being sold for at least one year.

- A. Draw the payoff diagram associated with holding one share of ABC Corp. stock for one year. The stock is currently trading at \$27.00 per share, does not pay dividends, and is not remotely likely to pay dividends during the next year. Today is 15-Jan-2012



- B. On the diagram above, please also draw the payoff diagram associated with holding a one-year, riskless T-Bill with a face value of \$20. Please make sure the stock and T-Bill are clearly labeled so there is no ambiguity.

- C. We have provided a list of available calls and puts on ABC stock:

European Call Options		European Put Options	
Strike price @ 10	\$ 17.4307	Strike price @ 10	\$ 0.0001
Strike price @ 15	12.6631	Strike price @ 15	0.0172
Strike price @ 20	8.1543	Strike price @ 20	0.2931
Strike price @ 25	4.5405	Strike price @ 25	1.4639
Strike price @ 30	2.2135	Strike price @ 30	3.9216

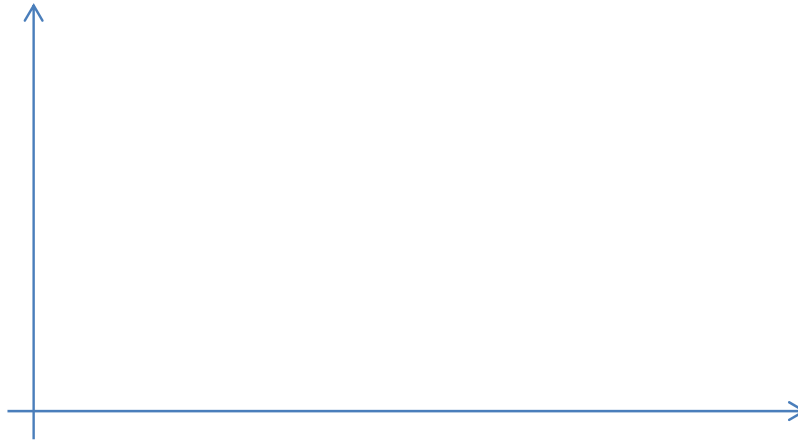
How can Jenny turn her holdings of stock into a zero-coupon T-Bill with a face value of \$20? That is, we want to add long and/or short positions in call and/or puts to the stock payoff diagram to make the T-Bill payoff diagram. Remember that Jenny is currently long the stock. Please list the components clearly below:

- D. If the stock currently is trading for \$27.00 per share, how much does it cost to make a synthetic zero-coupon T-Bill with a face value of \$20.00? Make sure to add the price of the stock to the price(s) of any call and/or put options you might have chosen in Part C. There is no need to normalize prices in this question.
- E. What is the one year riskless rate? This question can be answered using Part D. For this question only, please show your work and don't use Excel.

- F. Of course, ABC Corp. doesn't issues riskless debt—this is something the U.S. Government can do. Bonds issued by ABC Corp. have a chance of defaulting. That is, a one-year bond might promise to repay \$20 in good times (the face value is \$20). However in bad times, bond holders will only recover a fraction of the promised amount.

Suppose the recovery amount is related to the stock price. If the stock price in one year is \$20 or higher, the bond holders are paid in full. For every dollar the stock price ends the year below \$20, the bonds holders are paid \$1 less than face value (they lose money in the bankruptcy/restructuring arrangements.)

Draw the payoff diagram of a one year, zero-coupon risky bond issued by ABC Corp.



- G. What is the promised YTM of the risky debt? When calculating YTM, assume you will get paid the full face value in one year.

- H. What is ABC Corp's credit spread? _____

Longer Question #5

Note: This question is about the returns to short selling and is a bit difficult. Please try your best.

On January 1, 2008, you borrow 10,000 IBM shares from State Street (lender) with contract terms shown below. Immediately after borrowing the shares, you sell them in the open market for a price of \$115.23 per share. We will assume there are no transaction fees in this question and the sales price is the value that the lender uses for all calculations.

You repurchase the 10,000 shares one month later at a price of \$113.02 per share and return the shares to State Street. Your cost of capital (discount rate) is 8.00% quoted as an effective annual rate or EAR.

Contract terms:

- You must deposit cash worth 102% of the daily market value of the shares with lender.
- The deposit cash is marked-to-market and settled daily.
- The lender pays you Fed Funds on value of your deposit.
- The Fed Funds rate is currently 4.5% (EAR).
- You pay the lender a “rebate rate” of 15bp based on the value of your deposit.
- Like the Fed Funds rate, assume the rebate rate is quoted as an EAR.
- You are responsible for paying any dividends to lender.
- The loan of shares may be recalled by the lender at any time.

For the purposes of the first sub-parts of this question, assume the cash-deposit is marked-to-market only once and at the end of the month. Luckily, there are no dividends during this period. Use the convention that positive (+) numbers are cash in and negative (-) numbers are cash out.

A. What was your initial outlay (net \$ invested) ? A. _____

B. What is your net cash flow at the end of the month ? B. _____

C. What is your profit in \$ taking into account your cost of capital ? C. _____

Understanding possible risks is key to managing your equity portfolio. Please look over the problem on short selling and list the top three risks you face with a transaction of this type. Consider that cash is marked-to-market daily and you may hold the position for a couple of months. Please make sure to list the risks in order of importance (put what you think is your biggest risk on top, followed by what you think is your second largest risk; etc.)

Credit will be given by listing three large and important risks. Partial credit only for minor risks. No credit for items that are not risks.

D1. _____

D2. _____

D3. _____

Longer Answer Question #6

This question asks you to use stock return data and regression analysis. If your version of Excel does not have regressions, please find one that does.

A. Using the fund data in the associated workbook, please calculate the following:

Fidelity Magellan Fund's 1-factor Alpha α _____

Fidelity Magellan Fund's 1-factor (market) Beta β (mkt) _____

The R-squared from the above regression _____

B. Using the fund data in the associated workbook, please calculate the following:

Fidelity Magellan Fund's Fama-French 3-factor Alpha α _____

Fidelity Magellan Fund's Fama-French 3-factor Betas β (mkt) _____

β (smb) _____

β (hml) _____

The R-squared from the above regression _____

C. Using the fund data in the associated workbook, please calculate the following:

Fidelity Magellan Fund's 4-factor Alpha (include Momentum as a 4th factor) α _____

Fidelity Magellan Fund's 4-factor Betas β (mkt) _____

β (smb) _____

β (hml) _____

β (mom) _____

The R-squared from the above regression _____

Longer Answer Question #7

Warning: This question is more difficult as it requires some advanced Excel work. Please do your best.

A. Calculate the expected return of Hewlett Foundation's portfolio. We have provided data in the associated workbook. There are nine (9) asset classes. For each asset class, we have the portfolio weight and the expected return.

B. Using your answer to part A, what is the expected excess return of the portfolio? This is just the expected return in excess of the risk free rate.

C. What is the portfolio's variance? This is difficult as you need to use the formula: $\sigma^2 = w'\Sigma w$

Here: w' is the 1×9 row vector containing the portfolio weights

Σ is the 9×9 covariance matrix

w is the 9×1 column vector containing the (same) portfolio weights

You'll need to use: $\sigma^2 = \text{mmult}(\text{mmult}(w', \Sigma), w)$

“mmult” is Excel notation for matrix multiply

D. What is the portfolio's Sharpe Ratio ?