**Finance 436 – Futures and Options**
**Review Notes for Midterm Exam**

## Chapter 1

1. Derivative securities: concepts
2. Futures and forward contracts: definitions and comparison
   Exchange trading; contract size, delivery; default risk; marking to market
3. Options: concepts
4. Players in options and futures markets
   Hedgers: reduce price risk (uncertainty)
   Speculators: bet on price movement
   Arbitrageurs: look for risk-free profit
5. Applications
6. Examples discussed in class and assignments

## Chapter 2

1. Specification of futures contracts
   Opening vs. closing a futures position
   Long vs. short a futures position
   Underlying asset
   Contract size (will be given if needed)
   Delivery month; Daily price limit; Position limit
   Settlement price: concepts
   Open interest: concepts and calculations
2. Convergence of futures price to spot price: concepts and proof
3. Margins: concepts and calculations
   Initial margin; Maintenance margin; Margin call; Variation margin
4. Marking to market process: concepts and calculations
5. Orders and applications
   Market order; Limit order; Stop (stop-loss) order
   Stop-limit order; Day order; Open order
6. Cash settlement: concepts
7. Forward contracts: profit/loss diagrams
8. Examples discussed in class and assignments

## Chapter 3

1. Hedging: concepts
   Long hedging vs. short hedging
2. Basis risk: definitions and applications
3. Cross hedging
   Hedge ratio: definition, estimation, and implication
   Minimum variance hedge ratio: minimize the variance
   Optional number of contracts
4. Hedging with stock index futures: concepts and calculations
5. Examples discussed in class and assignments

## Chapter 4

1. Types of interest rates
2. Measuring interest rates: concepts and calculations
3. Zero rates: concepts
4. Forward rates: concepts and calculations
5. Term structure theories
6. Examples discussed in class and assignments

## Chapter 5

1. Investment assets vs. consumption assets
2. Continuous compounding ($e^{rT}$) and discounting ($e^{-rT}$)
3. Forward price for an asset with no income: $F = S*e^{rT}$ --- (5.1)
4. Forward price for an asset with a known cash income: $F = (S-I)*e^{rT}$ --- (5.2)
5. Forward price for an asset with a known dividend yield: $F = S*e^{(r-q)T}$ --- (5.3)
6. Valuing forward contracts: $f = (F-K)*e^{-rT}$ (long); $f = (K-F)*e^{-rT}$ (short)
7. Forward prices and futures prices: concepts
8. Stock index futures contracts and characteristics: ues (5.3)
9. Currency futures: use (5.3)
10. Commodity futures with and without storage cost
11. Cost of carry
12. Examples discussed in class and assignments

## Chapter 6

1. Day count convention
2. Quotations
3. T-bonds and T-bond futures contracts: concepts, applications, and calculations
   Cash price, quoted price, accrued interest, and cheapest to deliver
4. T-bills and T-bill futures contracts: concepts and applications
5. Duration and immunization: concepts and applications
6. Duration-based hedge ratio: concepts and applications
7. Examples discussed in class and assignments

## Chapter 7

1. Swaps: concepts
2. Comparative advantage
3. Interest-rate swaps: concepts and diagrams
4. Currency swaps: concepts and diagrams
5. The role of financial intermediary
6. Examples discussed in class and homework problems

## Sample Problems

**Chapter 1**

1. Problem 1-24

*Trader A enters into a forward contract to buy gold for $1,000 an ounce in one year. Trader B buys a call option to buy gold for $1,000 an ounce in one year. The cost of the option is $100 an ounce. What is the difference between the positions of the traders? Show the profit per ounce as a function of the price of gold in one year for the two traders.*

Answer: Trader A makes a profit of $S_T - 1{,}000$ and Trader B makes a profit of $\max(S_T - 1{,}000, 0) - 100$ where $S_T$ is the spot price of gold in one year. Trader A does better if $S_T$ is above $900 as indicated in Figure S1.3.

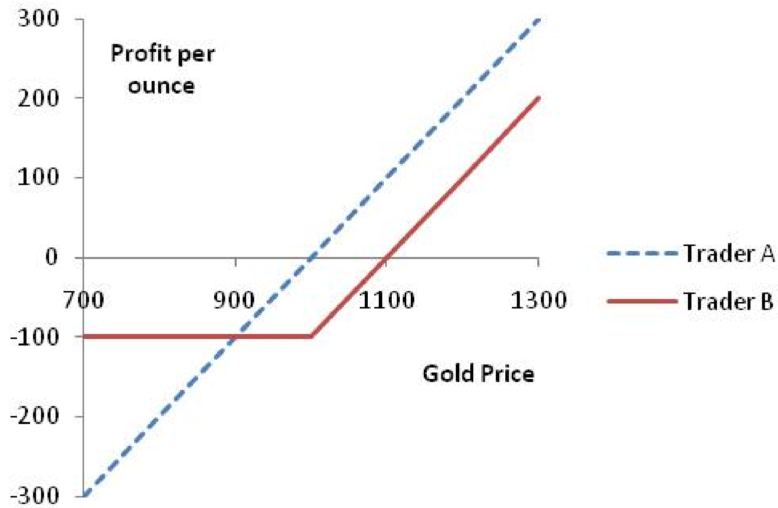


Figure1.3**:** Profit to Trader A and Trader B in Problem 1.24

2. Assume that the spot price for gold is $1,200 per ounce and the gold futures contract for one year delivery is trading at $1,270. The risk-free interest rate is 5% per year. Can you arbitrage? How?

Answer: Theoretical futures price F = 1,200*$e^{(0.05*1)}$ = $1,261.53
Since the actual futures price in the market is $1,270 > $1,261.53, it is overpriced so you can arbitrage
Today:
(1) Borrow $120,000 at 5% for one year to buy 100 ounces of gold at $1,200
(2) Sell a futures contract on gold at $1,270 per ounce (one year delivery)
In one year:
(1) Make the delivery and collect $127,000
(2) Repay the loan (principle plus interest) $126,153 = 120,000*$e^{(0.05*1)}$
(3) Take risk-free profit = $847

**Chapter 2**

1. Quiz 2.3

Answer: For a short position, if price drops, you gain; if price goes up, you lose
Margin call: lose more than $1,000 or price goes up by more than 20 cents (5,000 ounces per contract)

2. Quiz 2.4

Answer: For a long position, if price drops, you lose; if price goes up, you gain

3. Problem 2.11

Answer: Margin call: to lose more than $1,500 if the futures price drops by more than 10 cents per pound (since the contract size is 15,000 pounds)
Making $2,000 total or $1,000 per contact: if the price rises by 6.67 cents per pound

**Chapter 3**

1. Quiz 3.6

Answer: see the textbook

2. Quiz 3.7

Answer: see the textbook

3. Consider the following stock portfolio:

| Stock | Shares | Price | Value | Beta |
|---|---|---|---|---|
| FV | 30,000 | 34 | 1,020,000 | 1.25 |
| GC | 25,000 | 22 | 550,000 | 1.00 |
| YH | 20,000 | 17 | 340,000 | 0.80 |

If the S&P 500 index currently is standing at 1,000 ($250 time the index is the contract size), how many futures contracts must be bought or sold to hedge 50% of the market risk of this portfolio? How about reducing beta by 75%?

Beta of the portfolio (value weighted average) = 1.098; F = 1,000*250 = $250,000
S = 1,020,000 + 550,000 + 340,000 = $1,910,000
Optimal contract size N* = 1.098*(1,910,000/250,000) = 8.39 contracts, a 50% hedge (or to reduce the portfolio beta to 0.55) means shorting 4 S&P 500 index futures contracts
To reduce beta by 75% (meaning to reduce the beta to 0.27) implies shorting 6 futures contracts

**Chapter 4**

1. Quiz 4.4

Answer: see the textbook

2. Quiz 4.5

Answer: see the textbook

**Chapter 5**

1. Quiz 5.3

Answer: see the textbook

2. Quiz 5.4

Answer: see the textbook

3. Problem 5.12

*Suppose that the risk-free interest rate is 10% per annum with continuous compounding and that the dividend yield on a stock index is 4% per annum. The index is standing at 400, and the futures price for a contract deliverable in four months is 405. What arbitrage opportunities does this create? How can you arbitrage?*

Answer: Theoretical futures price F = $400*e^{(0.1-0.04)(4/12)}$ = 408.08 and the actual futures price in the market F = 405 < 408.08, which is undervalued

Arbitrage:
Today: buy futures contracts at 405; short sell stock index at 400 and deposit short sale proceeds at 10% for four months
After four months: collect 413.56; take the delivery and pay 405; return the asset plus dividend (5.37); arbitrage profit = 413.56 – 405 – 5.37 = 3.19, PV of profit = $3.08

**Chapter 6**

1. Quiz 6.2

Answer: see the textbook

2. Problem 6.9

Answer: AI = 6*98/181 = 3.2468 (there are 98 days between January 27 and May 5 and there are 181 days between January 27 and July 27)
Cash price = 110.5312 + 3.2468 = 113.7798

3. Problem 6.10

Answer: Bond 1: net cost = 2.178
Bond 2: net cost = 2.652
Bond 3: net cost = 2.946
Bond 4: net cost = 1.874
Bond 4 is the cheapest to deliver

**Chapter 7**

1. Quiz 7.1

Answer: see the textbook

2. Quiz 7.3

Answer: see the textbook