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: uses (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.

![Figure 1.3: Profit to Trader A and Trader B in Problem 1.24](image)

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 \( F = 1,200 \cdot e^{(0.05 \cdot 1)} = 1,261.53 \)
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 \cdot e^{(0.05 \cdot 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:

<table>
<thead>
<tr>
<th>Stock</th>
<th>Shares</th>
<th>Price</th>
<th>Value</th>
<th>Beta</th>
</tr>
</thead>
<tbody>
<tr>
<td>FV</td>
<td>30,000</td>
<td>34</td>
<td>1,020,000</td>
<td>1.25</td>
</tr>
<tr>
<td>GC</td>
<td>25,000</td>
<td>22</td>
<td>550,000</td>
<td>1.00</td>
</tr>
<tr>
<td>YH</td>
<td>20,000</td>
<td>17</td>
<td>340,000</td>
<td>0.80</td>
</tr>
</tbody>
</table>

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 \( F = 400 \times e^{(0.1-0.04)(4/12)} = 408.08 \) 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: \( AI = 6 \times 98/181 = 3.2468 \) (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