APPENDIX O (SELECTED QUESTIONS FROM OLD EXAMS)

Midterm 2

M2.I Short questions (10 points each)

1. **(CHAPTER IX).** Suppose JRV Corp is considering a project in Colombia (T=5 years), which requires an investment of COP 2000M (COP: Colombian peso). JRV is planning to use the usual 70/30 D/E split. Colombia has a 25% effective corporate tax rate. To calculate the cost of capital, JRV gathers the following data (all annualized):

   - JRV can borrow in Colombia at 8% and in the U.S. at 2.5%.
   - 5-year government (risk-free) rates: 6.5% in Colombia and 1.5% in the U.S.
   - Effective corporate tax rate in Colombia: 25%
   - Expected Colombian stock market return: 13%
   - U.S. stock market return: 8%
   - Beta of project: 1.3
   - E[ICol] = 5%
   - E[IUS] = 2%
   - Stock market volatility: 35% in Colombia, 15% in the U.S.
   - Bond market volatility: 26% in Colombia, 12% in the U.S.

a. Using WACC, calculate the cost of capital for the Colombian project.

\[ k_c = \frac{D}{E+D} \times k_d (1-t) + \frac{E}{E+D} \times k_e = 0.70 \times 0.08 \times (0.75) + 0.30 \times [0.065 + 1.3 \times (0.13 - 0.065)] = 0.08685 \]

b. Suppose JRV does not trust the expected return reported for Colombia and decides to use the Relative Equity Market Approach to estimate the Colombian risk premium \((k_m - k_f)\). Recalculate the cost of capital for the Colombian project.

\[ (r_M - r_f)_{Col} = (r_M - r_f)_{US} \times \frac{\sigma_{Col}}{\sigma_{US}} = (0.08 - 0.025) \times 0.35 / 0.15 = 0.12833 \]

\[ k_c = 0.70 \times 0.08 \times (0.75) + 0.30 \times [0.065 + 1.3 \times (0.15833)] = 0.12325 \]

c. JRV believes the project would not have full exposure to Colombian country risk, since 80% of its production would be exported to the U.S. Assume that exports contribute 18% to Colombian GDP. Recalculate the cost of equity and the cost of capital under this scenario.

\[ \lambda_{JRV-Col} = 0.20 / 0.82 = 0.2439 \]

\[ k_{e,COL} = r_{IUS} + \beta (r_M - r_f)_{US} + \lambda_{JRV-Col} (r_M - r_f)_{Col} = 0.1144 + 0.12833 \times 0.18 = 0.1444 \]

\[ k_c = 0.70 \times 0.08 \times (0.75) + 0.30 \times [0.065 + 1.3 \times (0.1444)] = 0.1178 \]
2. **(CHAPTER XIII)**. It is January 2. You are the manager of a Eurobond portfolio worth USD 28 million. You are worried about interest rate volatility in the next twelve months. The average duration of the portfolio is 7.8 years with an annual YTM of 6.8%. The December T-bond futures price is currently 108-25, with an annual yield of 7.2%, and the cheapest-to-deliver bond has a duration of 7.1 years.

A. Using December T-bond futures contracts, how should you hedge against changes in interest rates in the next 12 months?

B. Suppose interest rates decreased during the 12-month period the hedge was established. Was the decision to hedge justified?

**ANSWER:**

A. 

\[
N = \frac{[S \times D \times (1+YTM_T)]}{[F \times D_F \times (1+YTM_S)]} = \frac{[USD 28,000,000 \times 7.8 \times (1.072)]}{[USD 108,781.25 \times 7.1 \times (1.068)]}
\]

\[N = 283.83 \text{ contracts.} \Rightarrow \text{Short 284 contracts to hedge the Eurobond portfolio.}\]

B. Since interest rates decreased, the Eurobond portfolio’s value increased. A no-hedge strategy would have been more profitable. The hedge, however, was established to maintain the value of the portfolio and, therefore, the decision to hedge seems justified.

3. **(CHAPTER XIII)** It is June 15. A Treasury bond is trading at a price of 92'14 and has an 8% coupon payable on August 1 and February 1. Short-term interest rates as of June 15 are 5% for two-months or less and 5.5% for three months. Calculate the forward price of the bond (F) calculated to September 1.

**ANSWER:**

\[
\begin{array}{c|c|c|c}
P+A1 & C & 31 \text{ days} & F+A2 \\
\hline
0 & T_1=46 & & \\
\hline
P=92.4375 & & & \\
r_1 = .05 & & & \\
r_2 = .055 & & & \\
C = .08 & & & \\
T_1 = 15 + 31 = 46 & & & \\
T_2 = 15 + 31 + 31 = 77 & & & \\
A1 = .08/2 \times 134/181 \times 100 = 2.9613 & & & \\
A2 = .08/2 \times 31/184 \times 100 = 0.6739 & & & \\
F=(92.4375+2.9613)(1+.055x37/360) - .08/2x[(1+.055x77/360)/(1+.05x46/360)] - 0.6739 = 95.80695 & & & \\
\end{array}
\]
4. (CHAPTER XIII) Mr. Splinter, manager of One Foot Portfolio, has JPY \(1,500,000,000\) in a stock portfolio whose composition matches the Nikkei 225 and JPY \(2,000,000,000\) in a bond portfolio with a modified duration of 6.2 years. Mr. Splinter believes Japanese interest rates are going to be significantly reduced in the next three months by the Bank of Japan. He also expects the Japanese stock market to remain at the actual level for the next three months. Assume that the JGB CDB bond contract with a modified duration of 7.9 years, and it is trading at 93.50. The face value of JGB futures bonds is JPY \(10,000,000\). Assume the three-month Nikkei 225 is trading at 18015 (the multiplier is equal to USD 5, and the exchange rate is \(.0098\) USD/JPY). Assume transaction costs are high enough to prevent Mr. Splinter to change his portfolio allocation for three months. Calculate the number of T-bond futures contracts and stock index futures contracts needed to take advantage of the change in interest rates. (Specify which contracts he is going to sell and which contracts he is going to buy).

**ANSWER:**
- Number of 3-mo. JGB contracts to buy to increase One Foot Portfolio’s bond position by JPY \(1.5B\).

\[
N = 6.2 \left(\frac{\text{JPY} \ 3.5B - \text{JPY} \ 2.0B}{7.9 \times 0.9350 \times 0.01B}\right) = 125 \text{ contract} \Rightarrow \text{buy 125 JGBs futures}
\]

- Now, take a JPY \(1.5B\) short position in stocks, using 3-mo Nikkei futures.

\[
N = \frac{\text{JPY} \ -1.5B}{18,015 \times 5/0.0098} = -163.2 \text{ contracts} \Rightarrow \text{Short 163 Nikkei futures.}
\]

5. (CHAPTER XIV) Suppose that the term structure of interest rates is flat in the United States and Peru. The dollar interest rate is 6% per year while the Peruvian nuevo sol interest rate (PEN) is 15%. The current exchange rate is USD \(1 =\) PEN \(2.25\). Under the terms of a swap agreement, Banco Wiese, a financial institution, pays 10% per year in PEN and receives 5% in USD. The principals in the two currencies are USD \(10\) million and PEN \(22\) million. Payments are exchanged every year. The swap will last two more years. What is the value of the swap to Banco Wiese?

**ANSWER:**
- \(i_{\text{USD}} = .06\)
- \(i_{\text{PEN}} = .15\)
- \(S_t = .4444\ \text{USD/PEN}\)

\[
\begin{align*}
\text{Banco Wiese} & \quad \text{PEN 2.2M} \quad \text{Swap Dealer} \\
\text{USD 0.5M} & \\
B_{\text{USD}} & = \text{USD 0.5M}/(1.06) + \text{USD 10.5/(1.06)^2} = \text{USD 9,816,661} \\
B_{\text{PEN}} & = \text{PEN 2.2M}/(1.15) + \text{PEN 24.2/(1.15)^2} = \text{PEN 20,211,721} \\
\text{Value of Swap (Banco Wiese)} & = B_{\text{USD}} 9,816,661 \ - \text{PEN 20,211,721} \times .4444\ \text{USD/PEN} = \text{USD 833,674}
\end{align*}
\]

0.3
6. (CHAPTER XIV) CEMEX is a leading Mexican construction company. CEMEX has USD 200 million of short-term debt. CEMEX has decided to refinance the USD short-term debt with a straight 2-year 11% Euro-USD bond. Each bond has denomination of USD 1,000. Market competitive pressures have recently driven down the commissions paid for issuing straight bonds to 1½%. An investment bank approaches CEMEX and offers to issue a similar straight bond, but with tradeable four-year currency warrants attached giving entitlement to European USD/MXP calls. Each bond of USD 1,000 has a detachable warrant giving the holder the right to receive the difference between (1) the USD equivalent of MXP 10,000 at the rate of 0.09 USD/MXP and (2) the USD equivalent of MXP 10,000 at the then prevailing exchange rate. To value the USD/MXP put, you should use the Black-Scholes formula with the following inputs: the exchange rate is .10 USD/MXP, the strike price USD is .09 USD/MXP, the USD risk-free rate is 6%, MXP risk-free rate is 10%, and the annual USD/MXP volatility during the past four years was 20.60%.

A. Following standard market practices, calculate the cost of funds.

B. Discuss the advantages and disadvantages of the proposed 2-year CEMEX bond.

C. Propose a solution to reduce currency risk.

ANSWER:

A.  
- Currency warrants (using the Black-Scholes formula for currency options):

\[
\text{Call} = C = S e^{-r_{fx} T} N(d1) - X e^{-rdT} N(d2)
\]

\[
d1 = \frac{\ln\left(\frac{S}{X}\right) + (r_{fx} - rd) T}{\sigma \sqrt{T}}
\]

\[
d2 = \frac{\ln\left(\frac{S}{X}\right) + (r_{fx} + rd) T}{\sigma \sqrt{T}}
\]

\[
C = .10 x e^{10x4} \times 0.5293 - .09 x e^{-0.06x4} \times 0.3674 = USD .0095 per MXP
\]

\[
P = C - S e^{-r_{fx} T} + X e^{-rdT} = USD .0132 per MXP.
\]

Warrant price: USD 0.0132 per MXP, or USD 132 per bond (13.2% per bond).

- Cost of funds

\[
T = 2 \text{ years.}
\]

Issue price = 100% + 13.2% = 113.20%

CFs: net receipt at issue = USD 200,000,000 (1.132 - .0150) = USD 223,400,000

annual coupon payments = USD 22,000,000.

principal repayment = USD 200,000,000.

Cost of funds (including commissions) = 4.73%

B.  
- Advantage: Very low cost of funds. The cost of funds is 627 bps below the usual cost of funds for CEMEX.

- Disadvantage: CEMEX is involved in a currency play. The USD/MXP puts have a moderate probability of being exercised at maturity, since they are already in-the-money.

C. A solution to minimize currency risk is to sell a 4-year USD/MXP forward contract. Using IRPT, we obtain
F_{1,4} = .0862 USD/MXP. Therefore, if CEMEX sells MXP forward at this rate, CEMEX fixes the USD cost of its currency play (sells MXP 2,000,000,000 for USD 172,400,000).

7. (CHAPTER XIV) Artesano Ltd., a Peruvian firm, produces copper bracelets. Artesano buys a quarter million pounds of copper a year. The price of a pound of copper in international markets is in USD. The manager of Artesano, Mr. Cobre, is uneasy about the short-term exchange rate exposure and decides to fix the price of a pound of copper in terms of soles (PEN) for two years. You work for Mr. Cobre. A commodity swap dealer offers a two-year mid-quote price of USD .85 per pound of copper (the dealer spread is USD .12). Two-year swap interest rates are available at a rate of 7% against 6-mo. LIBOR. Two-year PEN-for-USD currency swaps are available at a rate of 18% against 6-mo. LIBOR. The current exchange rate is 2.81 PEN/USD.
A. Present in an exhibit your proposed structured solution to Cobre's problem.
B. Determine the price of copper in terms of PEN.

**ANSWER:**

A. Structured Solution

B. Price of coffee in terms of PEN.
(1) Fixed semiannual payments to commodity swap dealer: $125,000 \times USD .91 = \text{USD 113,750}.
(2) Notional principal on a USD interest rate swap: USD 113,750 / .035 = USD 3,250,000.
(3) PV of CFs: PV(\text{USD 113,750}, .035, 4 \text{ periods}) = \text{USD 417,813}.
(4) Translate to PV of CFs PEN: \text{USD 417,813} \times 2.81 \text{ PEN/USD} = \text{PEN 1,174,053.9}
(5) Coupon on the fixed-rate side of PEN-for-USD swap:
8. (CHAPTER XIV) Laudrup F.C., a Danish fund, holds a British stock portfolio on which it earns a volatile equity return which is highly correlated with the FT-100 index (the U.K. stock index). This return is in GBP. The manager of Laudrup, Mr. Piazza, decides to have all foreign income in the form of fixed-rate DKK. You work for Mr. Piazza. Present in an exhibit your proposed structured solution to Mr. Piazza's problem.

ANSWER:

![Diagram showing the proposed structured solution](image)
9. (CHAPTER XIV) (Adapted from Riskpublications.com) During the first semester of the year 1999, the cost of swapping a medium term Eurobond to USD was 5bp to 6bp, which was considered too high for many USD borrowers. While increased EUR exposure was attractive for U.S. companies, the cost was considered too high. In June 1999, liquidity improved in the currency swap market and U.S. borrowers took advantage of the diminished costs between the EUR and USD. Simeone Insurance raises USD 4 billion annually to fund its programmes. It is a regular in the international markets, and swaps all debt back to floating dollars. On July 1, 1999, Simeone priced EUR 300 million of four-year EMTN debt via CSFB and ING Barings. The proceeds were swapped into floating USD. The Euronotes yielded 5.39% annually re-offered and 5.45% all-in-cost. With interest-rate swap bids around 5.41% at the time, Simeone could have achieved around Euribor plus 4bp. The basis (flexible-for-flexible) swap to USD was 1bp at most, and perhaps even flat. The borrower confirmed that LIBOR plus 5bp had been achieved --several basis points better than Simeone would have been able to hit just a week earlier. Draw a diagram showing the all the cash flows involved in the operation that allowed Simeone to borrow at LIBOR plus 5bps.

ANSWER:

```
+-----------------+     +-----------------+     +-----------------+
| Euronotes       |     | Currency Swap    |     | Interest Rate Swap|
| Holders         |     | Dealer           |     | Dealer           |

EUR 5.45%          LIBOR + 1bp       EUR 5.41%

Euribor            Simeone Insurance   Euribor

```

10. (CHAPTER XIV) Shell wants to increase its fixed-rate DEM debt, while UBS wants to increase its DEM floating-rate debt. Shell can borrow at 7.5% fixed or at FIBOR. UBS can borrow at 5.6% or at 1% below FIBOR. You are a swap dealer. Design an interest rate swap agreement between Shell and UBS that benefits both parties.

ANSWER:

- Swap deal:
  Shell issues floating debt at FIBOR and makes coupon payments to UBS at 6%
  UBS issues fixed-rate debt at 5.6% and makes (FIBOR-1) payments to Shell

- Cost of borrowings:
  Shell:  FIBOR + 6.0 – (FIBOR-1.0) = 7.0%  (< 7.5%)
  UBS:  5.6 + (FIBOR-1) – 6.0 = (FIBOR-1.40%)  (< FIBOR – 1%)
11. (CHAPTER XIV) Suppose the term structure in Switzerland and the U.S. is flat. The annual CHF interest rate is 4%, while the annual USD interest rate is 5.2%. Goyco Corp., a U.S. firm, has entered into a currency swap where it receives 5.5% annually in USD and pays 4.3% annually in CHF. The principals in the two currencies are USD 15 million and CHF 25 million. The swap will last for another four-years. The exchange rate is .60 USD/CHF.

A. Value this currency swap using the forward currency contract decomposition.

B.- Three years from now, the exchange rate is .70 USD/CHF. What is the market valuation of the last year of the swap exchanges for Goyco Corp.? (Recall that the market valuation is the present value of the difference between what is stipulated in the contract and the market valuation of those payments).

ANSWER:

A.-

\[
\begin{align*}
F_{t,1} &= .60 \text{ USD/CHF} \times (1.052)/(1.04) = .6069 \text{ USD/CHF} \\
F_{t,2} &= .60 \text{ USD/CHF} \times (1.052)^2/(1.04)^2 = .6139 \text{ USD/CHF} \\
F_{t,3} &= .60 \text{ USD/CHF} \times (1.052)^3/(1.04)^3 = .6210 \text{ USD/CHF} \\
F_{t,4} &= .60 \text{ USD/CHF} \times (1.052)^4/(1.04)^4 = .6282 \text{ USD/CHF}
\end{align*}
\]

Annual exchanges:

\[
\begin{align*}
\text{CHF 1.075M} & \quad \text{USD 0.825M} \\
\text{CHF 1.075M} & \quad \text{USD 0.825M}
\end{align*}
\]

\[
\begin{align*}
V_{1\text{-year}} &= \frac{\text{USD 0.825} - \text{CHF 1.075 M} \times .6069 \text{ USD/CHF}}{(1.052)} = \text{USD .164052} \\
V_{2\text{-year}} &= \frac{\text{USD 0.825} - \text{CHF 1.075 M} \times .6139 \text{ USD/CHF}}{(1.052)^2} = \text{USD .149143} \\
V_{3\text{-year}} &= \frac{\text{USD 0.825} - \text{CHF 1.075 M} \times .6210 \text{ USD/CHF}}{(1.052)^3} = \text{USD .135216} \\
V_{4\text{-year}} &= \frac{\text{USD 15.825} - \text{CHF 26.075 M} \times .6282 \text{ USD/CHF}}{(1.052)^4} = \text{USD -.453395}
\end{align*}
\]

Value of swap(Goyco) = \( V_{1\text{-year}} + V_{2\text{-year}} + V_{3\text{-year}} + V_{4\text{-year}} = \text{USD-.004984} \).

The value of the swap for Goyco is USD –4,984.

B.- Now, the swap has one year left to maturity.

\[
\begin{align*}
F_{t,1} &= .70 \text{ USD/CHF} \times (1.052)/(1.04) = .7081 \text{ USD/CHF} \\
V_{4\text{-year}} &= \frac{\text{USD 15.825} - \text{CHF 26.075 M} \times .7081 \text{ USD/CHF}}{(1.052)} = \text{USD –2.50771}
\end{align*}
\]

Goyco’s value of the swap in the last year of the agreement goes significantly up.
12. (CHAPTER XV) Consider a Swiss bank facing the following operations:
   a. Lend money to Unilever at LIBOR + 1%.
   b. Has the option of borrowing money at LIBOR + ½% with a cap of 10% or borrow at LIBOR + 2/3%.
   c. Sell a cap option at 10% to Roche for 5/8% a year.
   Should the bank engage in cap packaging?

   ANSWER:
   Bank’s net income:
   • Cap: (LIBOR+1) - min(LIBOR+1/2,10) + 5/8 – max(0,LIBOR-10)
     if LIBOR < 10% \( \Rightarrow (\text{LIBOR}+1) - (\text{LIBOR} +1/2) + 5/8 = 1.125 \)
     if LIBOR > 10% \( \Rightarrow (\text{LIBOR}+1) – 10 + 5/8 - (\text{LIBOR} -10) = 1.625 \)

   • No cap: (LIBOR+1) – (LIBOR+2/3) = 1/3

   YES! Swiss bank should engage in cap packaging.

13. (CHAPTER XV) On January 10, a Eurobank is offered HKD 200 million of twelve-month deposit by a
   customer at the bank's bid rate. The bank does not want to be exposed to gap risk.
   At the current market, the other rates are these:

<table>
<thead>
<tr>
<th></th>
<th>Cash bid</th>
<th>Cash asked</th>
<th>FRA bid</th>
<th>FRA asked</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 months</td>
<td>8.500</td>
<td>8.625</td>
<td>8.70</td>
<td>8.80</td>
</tr>
<tr>
<td>12 months</td>
<td>8.750</td>
<td>8.825</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   Do you advise the bank to take the twelve-month deposit? Show your calculations.

   ANSWER:
   From Jan 12 to Jan 12 \( \Rightarrow T=365. \)
   Financing Cost = HKD 200 M x 365/360 x .0875 = HKD 17,743,055.56

   From Jan 12 to Oct 12 \( \Rightarrow T=273. \) From Oct 12 to Jan 12 \( \Rightarrow T=92. \)
   Interest earned = HKD 200M x \([1 + .0850 \times 273/360] \times (1 + .0870 \times 92/360) - 1\] = HKD 17,624,958.

   Financing Cost > Interest earned \( \Rightarrow \) NO!
14. (CHAPTER LN XVII) You are a U.S. investor, whose U.S. portfolio tracks the U.S. market perfectly. You are considering investing in the following foreign stock markets:

<table>
<thead>
<tr>
<th>Market</th>
<th>Return</th>
<th>SD</th>
<th>$\beta_{WORLD}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mexico</td>
<td>.16</td>
<td>2.10</td>
<td>.62</td>
</tr>
<tr>
<td>U.K.</td>
<td>.09</td>
<td>1.05</td>
<td>.84</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>.14</td>
<td>1.50</td>
<td>.49</td>
</tr>
<tr>
<td>U.S.</td>
<td>.10</td>
<td>1.11</td>
<td>1.03</td>
</tr>
<tr>
<td>WORLD</td>
<td>.12</td>
<td>1.01</td>
<td>1.00</td>
</tr>
<tr>
<td>$R_F$</td>
<td>.05</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$R_F$ is the U.S. one-year Treasury Bill rate, that is, the risk free rate. $\beta_{WORLD}$ is the beta of the foreign market with the World Index.

(A) Based on a risk-adjusted performance measure (RVOL and RVAR), rank the performance of the four markets.

**ANSWER:**

<table>
<thead>
<tr>
<th>Market</th>
<th>RVAR</th>
<th>RVOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mexico</td>
<td>.05236</td>
<td>.1774</td>
</tr>
<tr>
<td>UK</td>
<td>.0381</td>
<td>.0476</td>
</tr>
<tr>
<td>HK</td>
<td>.06</td>
<td>.1837</td>
</tr>
<tr>
<td>US</td>
<td>.045</td>
<td>.05</td>
</tr>
</tbody>
</table>

(B) Assume you add to your U.S. portfolio, which tracks the U.S. market, all markets with a higher RVOL than the U.S. RVOL. You give a weight of 10% to each foreign market in your expanded portfolio. What is the risk of your expanded portfolio? Is the risk of your expanded portfolio lower than before?

**ANSWER:**

Add Mexico and Hong Kong.

$$\beta_p = \sum_i \omega_i \beta_i = .80 \times (1.00) + .10 \times (0.62) + .10 \times (0.49) = .935 \text{ (lower \(\beta\))}$$
15. (CHAPTER LN XVII) Boyd Inc., a U.S. Mutual fund, plans to invest in a new market portfolio that will follow the Venezuelan market or the Colombian market. If the Venezuelan market portfolio is selected, it will constitute 45% of the firm's total funds. If the Colombian market portfolio is selected, it will constitute only 15% of the firm's total funds. Assume the U.S. risk free rate is 4%. You have the following data on expected returns for each project:

<table>
<thead>
<tr>
<th></th>
<th>Boyd</th>
<th>Venezuela</th>
<th>Colombia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected return</td>
<td>11%</td>
<td>25%</td>
<td>35%</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>20%</td>
<td>30%</td>
<td>55%</td>
</tr>
<tr>
<td>Correlation with existing Boyd's portfolio</td>
<td>1.00</td>
<td>.40</td>
<td>.10</td>
</tr>
<tr>
<td>Weight on overall portfolio</td>
<td>-</td>
<td>.45</td>
<td>.15</td>
</tr>
<tr>
<td>Beta</td>
<td>.90</td>
<td>1.20</td>
<td>1.40</td>
</tr>
</tbody>
</table>

A. Based on the Sharpe Ratio, which project would you recommend to Boyd?
B. Based on the Treynor Ratio, which project would you recommend to Boyd?
C. Is Boyd, under both criteria, better off without adding any project?

ANSWER:

1. Colombia

\[
E[r_{BOYD+Col}] = w_{EP}E[r_{BOYD}] + (1- w_{EP})E[r_{col}] = .85*.11 + .15*.35 = 0.146
\]

\[
\sigma^2_{BOYD+Col} = w_{BOYD}^2(\sigma_{BOYD}^2) + w_{Col}^2(\sigma_{Col}^2) + 2 w_{BOYD} w_{Col} \rho_{BOYD,Col} \sigma_{BOYD} \sigma_{Col}
= (.85)^2(.20)^2 + (.15)^2(.55)^2 + 2*.85*.15*.20*.55 = 0.0385
\]

\[
\beta_{BOYD+Col} = w_{BOYD} * \beta_{BOYD} + (1- w_{Col}) * \beta_{Col}
= .85*.90 + .15*1.40 = 0.975
\]

\[
SR_{BOYD+Col} = \frac{E[r_{BOYD+Col} - r_f]}{\sigma_{BOYD+Col}} = \frac{.146 -.04}{0.1962} = 0.5401
\]

\[
TR_{BOYD+Col} = \frac{E[r_{BOYD+Col} - r_f]}{\beta_{BOYD+Col}} = \frac{.146 -.04}{0.975} = 0.1087
\]

2. Venezuela

\[
E[r_{BOYD+Ven}] = 0.173
\]

\[
\sigma_{BOYD+Ven} = 0.2054
\]

\[
\beta_{BOYD+Ven} = 1.035
\]

\[
SR_{BOYD+Ven} = \frac{.173-.04)/0.2054 = 0.6475 > SR_{BOYD+Col} = 0.5401
\]

\[
TR_{BOYD+Ven} = (.173-.04)/1.035 = 0.1285 > TR_{BOYD+Col} = 0.1087
\]

A. Under the SR measure, the Venezuelan project is superior.
B. Under the SR measure, the Colombian project is superior.
C. Under both measures, Boyd is not better off without international diversification!
M2.II Long questions (20 points each)

1. (CHAPTER XV). Consider a three-year interest rate cap of 9% on annual (1 year) LIBOR. The cap amount is $10 million. The cap trades on January 28 for effect on January 30. \( v = .15 \). At the time the cap is purchased, offered rates on time deposit are:

<table>
<thead>
<tr>
<th>Period</th>
<th>Offered Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 year</td>
<td>8.25</td>
</tr>
<tr>
<td>2 year</td>
<td>8.50</td>
</tr>
<tr>
<td>3 year</td>
<td>8.75</td>
</tr>
</tbody>
</table>

Value the cap. (Hint: there are two options in the cap. To apply the Black-Scholes formula, check the Normal Table on the last page of this exam).

ANSWER:

Option #1: \( f = \left( \frac{1 + .085 \times 365 \times 2/360}{1 + .0825 \times 365/360} - 1 \right) \times 360/365 = .080746 \).

\[ df = \left( 1 + .085 \times 365 \times 2/360 \right) = 1.17236. \]

\[ d_1 = -.648347 \Rightarrow N(d_1) = .25838 \]
\[ d_2 = -.798347 \Rightarrow N(d_2) = .21233 \]

\[ \text{call} = \frac{1}{1.17236} \times \left[ 8.0746 \times (.25838) - 9 \times (.21233) \right] = .149531 \]

\[ \text{Value} = .149531/100 \times 365/360 \times \text{USD 10,000,000} = \text{USD 15,160.803} \]

Option #2: \( f = \left( \frac{1 + .0875 \times 365 \times 3/360}{1 + .085 \times 365 \times 2/360} - 1 \right) \times 360/365 = .07890 \).

\[ df = \left( 1 + .0875 \times 365 \times 3/360 \right) = 1.26615. \]

\[ d_1 = -.51440 \Rightarrow N(d_1) = .303486 \]
\[ d_2 = -.72653 \Rightarrow N(d_2) = .233756 \]

\[ \text{call} = \frac{1}{1.26615} \times \left[ 7.89 \times (.303486) - 9 \times (.233756) \right] = .22961 \]

\[ \text{Value} = .22961/100 \times 365/360 \times \text{USD 10,000,000} = \text{USD 23,279.703} \]

Value of cap = Value option #1 + Value option #2 = \text{USD 15,160.803} + \text{USD 23,279.703} = \text{USD 38,440.51}
2. **(CHAPTER XIII).** Consider the two deliverable French government bonds (BTNs) in Table 1. You want to determine on July 1, 1999, the cheapest to deliver BTN against the Sep.1, 1999 MATIF’s BTN futures contract. Assume a 7% short rate.

### Table 1

<table>
<thead>
<tr>
<th>Maturity</th>
<th>Coupon</th>
<th>cf</th>
<th>Future</th>
<th>Price</th>
<th>bpv</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sep. 15, 2008</td>
<td>9%</td>
<td>1.3625</td>
<td>93'08</td>
<td>126'05</td>
<td>.051</td>
</tr>
<tr>
<td>Mar. 15, 2009</td>
<td>8%</td>
<td>1.1837</td>
<td>93'08</td>
<td>109'01</td>
<td>.092</td>
</tr>
</tbody>
</table>

B.- Now, consider a French issued Eurobond with a basis point value of .240. What is the number of LIFFE’s BTN futures contracts needed to hedge EUR 40,000,000 in face value of the Eurobond on July 1, 1999?

**Answer:**

\[
P + A_1 \quad F + A_2' \quad C \\
0 \quad T_2 = 62
\]

- **Sep 15, 2008**
  - Coupon = .09 (It’s a French bond, annual coupon payments. See Table IX.E)
  - \( A_1 = 0.09 \times \frac{288}{365} \times 100 = 7.10137 \) (Day count actual/365. See Table IX.E)
  - \( A_2' = \text{accrued interest from 7/1 to 9/1} = 0.09 \times \frac{62}{365} \times 100 = 1.52877 \)
  - \( F = (126.1563 + 7.10137) \times (1 + 0.07 \times 62/360) - 1.52877 = 133.3354 \) (No coupon payment from 7/1 (t=0) to 9/1.)
  - \( I = Z \times \text{cf} = 93.25 \times 1.3625 = 127.0531 \)
  - \( \text{BAC} = F - I = 133.3354 - 127.0531 = 6.2823 \)

- **Mar 15, 2009**
  - Coupon = .08
  - \( A_1 = 0.08 \times \frac{107}{365} \times 100 = 2.34521 \)
  - \( A_2' = \text{accrued interest from 7/1 to 9/1} = 0.08 \times \frac{62}{365} \times 100 = 1.35891 \)
  - \( F = (109.0313 + 2.34521) \times (1 + 0.07 \times 62/360) - 1.35891 = 112.3348 \)
  - \( I = Z \times \text{cf} = 93.25 \times 1.1837 = 110.380025 \)
  - \( \text{BAC} = F - I = 112.3348 - 110.380025 = 2.0575 \) (Cheapest to Deliver!)

B.-

hedge ratio = \(-\frac{\text{bpv bond}}{\text{bpv CDB}}\)\text{xcf} = \(-0.240 / 0.092\) x 1.1837 = -3.0879

Number of contracts = \(\text{EUR} 40,000,000 \times \frac{-3.0879}{\text{EUR} 100,000} = -1235.16 \) contracts.

That is, I need to short 1,235 contracts.
3. (CHAPTER XV) Consider a nine-month interest rate floor of 6% on 3 mo. LIBOR. The floor amount is $10 million. The floor trades on August 27 for effect on September 1. Assume $\nu = 0.10$. At the time the floor is purchased, offered rates on time deposit are:

<table>
<thead>
<tr>
<th>Period</th>
<th>Offered Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 month</td>
<td>6.05</td>
</tr>
<tr>
<td>6 month</td>
<td>6.30</td>
</tr>
<tr>
<td>9 month</td>
<td>6.65</td>
</tr>
</tbody>
</table>

Value the floor.

**ANSWER:**

Option #1: 

\[
f = \frac{1 + \nu \times 91/360}{1 + \nu \times 60/360} - 1 \times 360/90 = 6.4541
\]

\[
df = 1 + \nu \times 91/360 = 1.03167
\]

\[
d1 = 1.48601 \quad \Rightarrow \quad N(d1) = .93136
\]

\[
d2 = 1.43608 \quad \Rightarrow \quad N(d2) = .92451
\]

\[
call = \frac{1}{df} \times [6.4541 \times (.93136) - 6 \times (.92451)] = 0.44971
\]

\[
put = call + \frac{1}{df} \times (X - f) = .0096383
\]

\[
Value = .0096383/100 \times 90/360 \times USD\ 20,000,000 = USD\ 481.92
\]

Option #2: 

\[
f = \frac{1 + \nu \times 272/360}{1 + \nu \times 181/360} - 1 \times 360/90 = 7.1206
\]

\[
df = 1 + \nu \times 272/360 = 1.05024
\]

\[
d1 = 2.4668 \quad \Rightarrow \quad N(d1) = .99318
\]

\[
d2 = 2.3964 \quad \Rightarrow \quad N(d2) = .99172
\]

\[
call = \frac{1}{df} \times [7.1206 \times (.99318) - 6 \times (.99172)] = 1.06806
\]

\[
put = call + \frac{1}{df} \times (X - f) = .0010829
\]

\[
Value = .0010829/100 \times 91/360 \times USD\ 20,000,000 = USD\ 54.75
\]

Value of floor = Value option #1 + Value option #2 = USD 536.67
4. (CHAPTER XV) On November 5, a swap dealer wants to price a one-year fixed-for-floating interest rate swap against the 3-month LIBOR, that starts on March 97. The fixed rate will be paid semiannually and is quoted bond basis. Find the swap coupon rate. Get the appropriate rates from the attached WSJ clip.

ANSWER:

<table>
<thead>
<tr>
<th></th>
<th>Price</th>
<th>Implied LIBOR</th>
<th>#days covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar 97</td>
<td>94.64</td>
<td>5.36</td>
<td>92</td>
</tr>
<tr>
<td>Jun</td>
<td>94.69</td>
<td>5.31</td>
<td>92</td>
</tr>
<tr>
<td>Sep</td>
<td>94.64</td>
<td>5.36</td>
<td>91</td>
</tr>
<tr>
<td>Dec</td>
<td>94.49</td>
<td>5.51</td>
<td>91</td>
</tr>
</tbody>
</table>

(1) Swap is 12-mo. Then, n=4. Need to calculate Implied 1-yr LIBOR
\[ f_{0,12} = \left[ (1+.0536x(92/360)) x (1+.0531x(92/360)) x (1+.0536x(91/360)) x (1+.0551x(91/360)) \right]^{360/366} - 1 \\
= .0549373 \text{ (money market basis).} \\

(2) Converts this money market rate to its effective equivalent.

\[ FRE_{0,12} = .0549373 \times (365/360) = .055703. \text{ (bond basis)} \]

(3) K=2 (semiannual payments) equivalent semiannual bond basis.

\[ SC = [(1.055703)^{1/2} - 1] \times 2 = .054948 \text{ (semianual bond basis)} \]

Therefore the swap coupon mid-rate is 5.50%. ¶
Platini Co., one of the largest French perfume manufacturers in the world, wants to refinance debt amounting to GBP 100 million. An investment bank suggests issuing a straight bond with equity warrants attached. The investment bank has the following data available:

GBP gilts yields: 2-year 4.99 (s.a.); 3-year 5.75 (s.a.)
FRF government bond yield: 1-year 6.5% (p.a.)
Platini GBP-Eurobond yield: GBP gilts + 90 bps
Current Platini's share price ($P_0$): FRF 75
Historic dividend yield: 3.00%
Historic stock price volatility: 2-year 15.50%; 3 year 17.00%.
Outstanding warrants
  - Outstanding life: 2½ years
  - Current price ($W_0$): FRF 7.40 (GBP 0.73)
  - Exercise price (X): FRF 90
  - Current exchange rate: 10.10 FRF/GBP (.099 GBP/FRF).

Given the current tight market conditions, the investment bank suggests:

1. For the warrants: an equity content of 100%, an exercise ratio equal to 1, and a 3-year warrant (X=FRF 85).
2. For the bond: a 2-year full-coupon bond, denominations of GBP 5,000, and an issue price of 100%.

Total commissions are 2%. Due to competitive pressures, the investment bank decides to forgo 1% of the selling concession.

The investment bank also assumes a conversion exchange rate based on the current exchange rate.

Following usual market practices:

i.- Write down the following generic terms for the issue:

Amount of equity raised: GBP 100,000,000 x 1 x 10.10 FRF/GBP= FRF 1,010,000,000
Number of shares created on exercise: FRF 1,010,000,000/FRF 85 = 11,882,353.
Number of warrants per bond: 11,882,353 x 1/20,000 = 594.11765
Value of the warrants attached to each bond of GBP 5,000:
  - 594.11765 x FRF 12 = FRF 7,129.41 = GBP 705.81
  - (705.81/5,000 = 14.12% of nominal amount of each bond)

ii.- Calculate the information required below to complete the pro forma of Platini's issue:

1. The bond
   - Coupon: 5 7/16 (≈5.41%)
   - Yield: 5.95%
   - Issue price: 100 (but bonds are sold at 99)
2. The warrants
Price of warrant: FRF 12
Exercise price: FRF 85
Period of exercise: 3-yr
Exercise premium: 14.12
Global premium: 29.33 (=[85+12)/75])
Issue price (bond and warrants): 114.12 (100 + 14.12)
Cost of funds (based on total issue price less commissions): -0.006 (negative!)

ANSWER:
• Pricing the new warrants:
  a) outstanding warrants’ global premium: GP = (90 + 7.40)/75 = 1.299 (≈ 30%)
  b) new warrants: theoretical price (Black-Scholes): FRF 11.25
                GP-implied price: W_{new} = 75x(1.30) - 85 = FRF 12.40

⇒ Any price between 12.40 and 11.25 is fine. Say, we fix W_{new} = FRF 12.

• Pricing the new bond:
  a) Convert s.a. yield on a p.a. yield: (1+.0499/2)^2-1=.0505.
     YTM (p.a) = 5.05 + 0.90 = 5.95. ⇒ coupon=5.95 (if bond sold at P=100).
  b) P=99, then coupon is reset at 5.41% or 5 7/16.
6. (Chapter LN XVII) Mr. Fleichman is an investor of foreign nationality who has an account with a small Luxembourg bank. He does not pay taxes on his account. He only cares about U.S. dollar returns. Table 1 contains information about his account for June 1998 and for June 1999. The Cicely Index Fund has a passive approach and tracks the FT-Actuaries World Index, which has risen 2.8% last year. You should answer the following question:

i. What is the total return on his portfolio?

ii. What are the sources of this return, i.e., how much is capital appreciation, yield and currency movements?

iii. How good is the manager in selecting securities?

iv. Would you recommend Mr. Fleichman to change to the Cicely Index Fund?

ANSWER:

(i) USA

\[
\begin{align*}
P_0 &= 82,950 \\
P_1 &= 84,275 \quad \Rightarrow \quad p_{USA} &= .0159740 \\
D_1 &= 5,260 \quad \Rightarrow \quad d_{USA} &= .0634117 \quad \Rightarrow \quad r_{USA} = .0793852 \\
s_{USA} &= 0 \quad \Rightarrow \quad c_{USA} = 0
\end{align*}
\]

(ii) JAPAN

\[
\begin{align*}
P_0 &= 19,150,050 \\
P_1 &= 19,550,000 \quad \Rightarrow \quad p_{JAP} &= .02088770 \\
D_1 &= 0 \quad \Rightarrow \quad d_{JAP} = 0 \quad \Rightarrow \quad r_{JAP} = -.06264 \\
s_{JAP} &= -0.08181 \quad \Rightarrow \quad c_{USA} = -.0835217
\end{align*}
\]

(iii) GERMANY

\[
\begin{align*}
P_0 &= 297,600 \\
P_1 &= 301,500 \quad \Rightarrow \quad p_{JAP} &= .01310484 \\
D_1 &= 20,100 \quad \Rightarrow \quad d_{JAP} = .0675403 \quad \Rightarrow \quad r_{JAP} = -.127225 \\
s_{JAP} &= 0.04310 \quad \Rightarrow \quad c_{USA} = -.0465795
\end{align*}
\]

\[
r = \sum_j \omega_j r_{JD} = \sum_j \omega_j (p_j + d_j + c_j) = .1779 x (.0793852) + .4518 x (-.06264) + .3702 x (.27225) = .0329208
\]

\[
(ii) \quad r = \sum_j \omega_j p_j + \sum_j \omega_j d_j + \sum_j \omega_j c_j = .017130 + .036284 + (.020498) = .032921
\]

(iii) Security selection = \( \sum_j \omega_j (p_j - I_j) = -.01272 \)

(iv) Yes, the Cicely Fund outperformed the World Index (3.28% > 2.80%). The security selection performance, however, was not very good. The success of the Cicely Fund was based on country selection.
<table>
<thead>
<tr>
<th>Security</th>
<th>Number of securities</th>
<th>Market Price</th>
<th>Dividend per share</th>
<th>Total (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.S.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AT&amp;T (USD)</td>
<td>1,000</td>
<td>50.250</td>
<td></td>
<td>50,250</td>
</tr>
<tr>
<td>GTE (USD)</td>
<td>500</td>
<td>30.000</td>
<td></td>
<td>15,000</td>
</tr>
<tr>
<td>NY Times (USD)</td>
<td>800</td>
<td>22.125</td>
<td></td>
<td>17,700</td>
</tr>
<tr>
<td>Japan</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mitsubishi (JPY)</td>
<td>1,000</td>
<td>6,500</td>
<td></td>
<td>71,500</td>
</tr>
<tr>
<td>Sony (JPY)</td>
<td>2,200</td>
<td>5,750</td>
<td></td>
<td>139,150</td>
</tr>
<tr>
<td>Germany</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBenz (DEM)</td>
<td></td>
<td>3,000</td>
<td>90.00</td>
<td>156,600</td>
</tr>
<tr>
<td>Bonds</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government 7%</td>
<td>30,000</td>
<td>92%</td>
<td></td>
<td>16,008</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>466,208</td>
</tr>
</tbody>
</table>

JPY 1 = USD .0110  
DEM 1 = USD .5800  
DEM Bond Index = 100

<table>
<thead>
<tr>
<th>Security</th>
<th>Number of securities</th>
<th>Market Price</th>
<th>Dividend</th>
<th>Total (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.S.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AT&amp;T (USD)</td>
<td>1,000</td>
<td>51.325</td>
<td>3.51</td>
<td>54,835</td>
</tr>
<tr>
<td>GTE (USD)</td>
<td>500</td>
<td>30.500</td>
<td>2.22</td>
<td>16,360</td>
</tr>
<tr>
<td>NY Times (USD)</td>
<td>800</td>
<td>22.125</td>
<td>0.80</td>
<td>18,340</td>
</tr>
<tr>
<td>Japan</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mitsubishi (yen)</td>
<td>1,000</td>
<td>6,900</td>
<td></td>
<td>69,690</td>
</tr>
<tr>
<td>Sony (yen)</td>
<td>2,200</td>
<td>5,750</td>
<td></td>
<td>127,765</td>
</tr>
<tr>
<td>Germany</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBenz (DEM)</td>
<td></td>
<td>91.00</td>
<td>6.00</td>
<td>176,055</td>
</tr>
<tr>
<td>Bonds</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government 7%</td>
<td>30,000</td>
<td>95%</td>
<td>2,100</td>
<td>18,513</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>481,558</td>
</tr>
</tbody>
</table>

JPY 1 = USD .0101  
DEM 1 = USD .6050

US. Index = 100  
Japan Index = 100  
German Index = 100

0.19
DM Bond Index = 101

German Index = 101