MAY 2000

COURSE 6
MORNING SESSION

FINANCE AND INVESTMENTS

SECTION A—WRITTEN ANSWER

ILLUSTRATIVE SOLUTIONS

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Question #1

(a) (i) $= 40(1.06)^3 + 40(1.06)^2 + 40(1.06) + 40 = \$174.98$

(ii) $\text{MV of Bond} = \frac{40}{1.06} + \frac{40}{(1.06)^2} + \frac{40}{(1.06)^3} + \frac{1040}{(1.06)^4} = \$930.70$

(iii) Total Return = Capital appreciation + Accumulated interest
$= -69.3 + 174.98 = 105.68$

$\%\text{ Return} = \left(\frac{105.68}{1000}\right) = 10.57\%$

$\text{Annual Eff. Yield} = (1.1057)^{1/4} - 1 = 2.54\%$

(b) Total Annual Return is less than original yield due to the increase in interest rates and the positive duration of the bond.

The increase in reinvestment returns somewhat offset the decrease in market value.

The longer the holding period, the better the return would have been.

If held for 7 years (duration of bond) the increased reinvestment returns would have exactly offset the decrease in market value and given you the initial return of 4% annual.

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Question #2

(a) Cash-Flow Matching

- This is the process by which we have an asset maturing (payable) to use at the same time as our liability is due.
- Can be a difficult task matching all cash flows.
- May have to rebalance if asset defaults.

To do this, you must understand:

(i) Nature of your liabilities

- In order to cash-flow match, you'd have to know what liabilities you have, when they are payable, the amount.
- Example would be a group of retired lives (pensioners). We know that we have to pay them off each month and the amount is usually fixed.
- This could also be used for a block of defined vesteds. You know when they will retire and how much they will receive.
- Difficult to apply to an active group.

(ii) Constraints of cash-flow matching

- Call risk. If you are backing your liabilities with callable bonds and they get called, you may not have sufficient funds to pay them off.
- Type of issuer.
- Diversification. Thus, if the sector or group of securities happens to default, you won't lose considerable money and be unable to make payments.
- Credit. You want to have good credit securities backing your assets to prevent default risk.
- Liquidity. Need liquidity in order to make any required payment.

(iii) Cash Flow

- The cash flow on your assets will be value of assets at beginning + interest income + reinvestment income = required payment.

(iv) Reinvestment Rate

- The rate which you assumed your asset cash flows will be reinvested at.
- Need to be conservative to ensure the payments of liabilities. If we have an aggressive reinvestment rate, we may not have enough assets to pay for liabilities.

(v) Optimization Techniques

- We could use some sort of linear programming to ensure that we have the optimal

combination to pay off our liabilities.
- Quadratic programming.
- Stepwise regression.

(vi) Pricing the Bonds
- If we've supported our assets with bonds, it's important to ensure that they are priced correctly. We may want to get an independent firm to assist with the pricing.
- Defaults are the most important concern.
- Downgrades.

(vii) Re-optimization
- Assets default, or
- Our liabilities cash flow changes (e.g., if a pensioner dies) it may be necessary to rebalance our cash-flow matching.

(viii) Active Management
- There is some active management in cash-flow matching, as if we can find another security with the same characteristics as our current security, yet with a higher yield, we would definitely switch to the higher yielding security.

(b) Combination Strategies

(i) Active/Passive. Here we may have a portion of our portfolio which we will actively manage and another portion which we'll be passive with → (use index funds or adopt a buy-and-hold strategy).

(ii) Active/Immunization
- Have an active portion and another percentage you immunize.
- Immunize by:

$$PV(\text{Assets}) \geq PV(\text{Liabilities})$$

$$\text{Duration}(\text{Asset}) = \text{Duration}(\text{Liabilities})$$

(iii) Contingent Immunization. Here we have a lower bound for our return and as soon as that lower bound is reached, we switch our portfolio to a completely immunized portfolio from a completely active portfolio.

(iv) Horizon Strategies. Here we use cash-flow matching up to the "horizon" and then immunize the portfolio from the "horizon" point on.

(v) Combination by Formula. We calculate the active percentage in our portfolio by the following formula:

$$\frac{(ITR - MR)}{ITR - WC}$$

ITR = Immunization target return.
MR = Minimum rates.
WC = Worst-case return.

(vi) Multiple Asset Performance.

- This is when we select the assets that are performing the best.
- Involves many transactions.
- The strategy will involve buying calls to purchase the different assets.
- Involves market timing.
- Switch from current portfolio to a higher yielding one.

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Question #3

(a) Immunization involves matching duration of assets and liabilities.

(i) By matching the effective duration of the asset and the liabilities, the market value of assets and liabilities will respond with the same sensitivity toward interest rates change and hence, its surplus will be immunized.

(ii) Three conditions need to be met to immunize this block of multiple liabilities:

- Effective duration of assets = effective deviation of liabilities.
- Present value of assets = Present value of liabilities
- Dispersion of assets > Dispersion of liabilities.

(b) Bond indexing compared to immunization:

- Bond indexing minimizes expectational inputs because it is a form of passive management.
- Bond indexing tries to match its rate of return to that of the index.
- Compared to immunization, bond indexing gives the company a greater control over its investment managers: it also lowers advisory and non-advisory fees.
- Transaction costs are lower because bond indexing involves mostly buy-and-hold, whereas immunization requires frequent transaction to rebalance the asset and liability duration.
- However, bond indexing limits the selection of securities because the investment manager is limited to the securities that are present in the index. On the other hand, immunization has no such restriction (except those placed by the company itself) and managers can take advantage of the more attractive assets in the market.
- There is always a danger that even though the portfolio return is matched to the bond index, it is not sufficient to meet the company's objectives. Bond indexing may not be the optimal portfolio.
- But there are disadvantages in immunization, e.g., it only assumes parallel yield changes, it requires frequent transactions, it focuses on instantaneous price change instead of future liability value.

(c) Organization Issues

(1) ALM Process

- The assets and liabilities should be coordinated effectively to minimize losses.
- The actuaries should understand this process and have well-defined responsibilities.
- Frequent communication among the managers is required.

(2) Investment Policy

- It should be stated in the investment policy a neutral position and the permissible deviation from this position.
- The managers should have written guidelines as to how to manage the portfolio.
- This policy should be frequently reviewed.

(3) ALM Expertise

- Makes sure that the managers handling this has a proven track record and the knowledge and expertise. They should also understand both the assets and liabilities side of the flexible premium life business.

(4) Segmentation of Assets

- Flexible premium life policies can be segmented into the insurance part and an investment portion.
- Different segments have different risk management strategies.
- Be careful not to over-segment the assets because this can result in reduced yield.

(5) Liability Pricing Practice

- When pricing, the assumptions should be realistic

Question #4

(a) Deal 1

	Bank of England	**U.S. Company**
Time 0	Gets $10,000,000 Gives ε12,500,000	Gets ε12,500,000 Gives $10,000,000

At the beginning, Notional Amounts are exchanged.
Exchanges are through a Broker-Dealer (B/D)

Time 1	Gets ε975,000 Gives $800,000	Gets $800,000 = $10,000,000 × 8% Gives ε1,000,000

All payments (all years are made through a B/D
Each year:

- U.S. Company gives ε1,000,000 = ε12,500,000 × 8% to B/D.
- Bank of England gets ε975,000 = ε12,500,000 × 7.8% from B/D.
- Bank of England gives, and U.S. Co. gets (via B/D), $10,000,000 × 12 month LIBOR

Time 2	Gets ε975,000 Gives $750,000	Gets $750,000 = $10,000,000 × 7.5% Gives ε1,000,000
Time 3	Gets ε975,000 Gives $1,200,000	Gets $1,200,000 = $10,000,000 × 12% Gives ε1,000,000

Also, at end, Notional amounts are exchanged back.

(b) Deal 2

	Local Bank	**U.S. Company**
Time 0	No initial swap of notional amounts.	No initial swap of notional amounts.
Time 0.5	Gets \$395,000 Gives \$350,000	Gets \$350,000 = \$10,000,000 × 7%/2 Gives \$400,000

All payments (all years) are made through a B/D.
Each ½ year:
- Company gives \$400,000 = \$10,000,000 × 7.9%/2 from B/D.
- Local Bank gets \$395,000 = \$10,000,000 × 7.9%/2 from B/D.
- Local Bank gives, and U.S. Co. gets (via B/D)
  \$10,000,000 × 6 months LIBOR/2 (subject to cap)

Time 1.0	Gets \$395,000 Gives \$345,000	Gets \$345,000 = \$10,000,000 × 6/9%/2 Gives \$400,000
Time 1.5	Gets \$395,000 Gives \$325,000	Gets \$325,000 = \$10,000,000 × 6.5%/2 Gives \$400,000
Time 2.0	Gets \$395,000 Gives \$500,000	Gets \$500,000 = \$10,000,000 × 10%/2 Gives \$400,000
Time 2.5	Gets \$395,000 Gives \$550,000	Gets \$550,000 = \$10,000,000 × 11%/2 Gives \$400,000

Cap of 11% on 6-month LIBOR rate applies in this period and the next.

Time 3.0	Gets \$395,000 Gives \$550,000	Gets \$550,000 = \$10,000,000 × 11%/2 Gives \$400,000

(c) Advantages and Disadvantages to U.S. Company

Deal 1:
- Advantage – U.S. Company guaranteed 12-month LIBOR w/o limitation.

- Advantage – By setting up swap, U.S. Company eliminates any exchange rate risk.
- Advantage – 12-month LIBOR payment is less volatile than the 6-month LIBOR.

Deal 2:

- Disadvantage – Lose potential yield due to 11% cap on interest rate.
- Advantage – Good for hedging a floating rate liability (ALM) … both deals are good for this.

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Question #5

(a)

1. Performance Record
   - Use market cycle (3-5 years)
   - Make sure all accounts included (not exclude lost accounts)
   - How much risk was taken to achieve return?

2. Reputation of firm and manager
   - Client satisfaction

3. Risk/Reward Characteristics
   - Risk = Standard deviation of returns

4. Investment Style (to match fund objectives)
   - Growth
   - Income
   - Balanced

5. Size of Firm
   - Benefits of small firm
     - Get more attention
     - Fewer people to communicate with
     - Trades may not affect market
   - Benefits of large firm
     - Lower transaction costs
     - Managers to review and research assets
   - Negatives – trades affect market and may not give fund attention it deserves.

6. Quality of Staff
   - Consider:
     - Turnover
     - Salary (high indicates better retention and possibly skill)
     - Education

(b)

1. Select investment objectives of fund.
2. Select investment policy

3. Send out questionnaires. Can use consultant to help prepare this and analyze date. Include questions about performance/style/firm.
4. Interview best managers who meet objectives (taking into account all selection criteria).
5. For performance measure, use entire market cycle (3-5 years). Compare to other managers with same style and risk.
6. Hire based on performance and criteria.
7. Select manager based on balance of all of the above.

(c) 1. Diversify: Assets must be diversified according to "prudent man" approach, in order to avoid losses if too much in one asset which "goes bad."

2. Impartiality: Between participants – must not give preference to one group of participants (retirees vs. active employees). Certain investment (safe) will benefit retirees more than active. Must balance needs of all.

3. Follow Statutory Constraints
   - Allowable investments
   - Reporting methods

4. Delegate Authority but Not Responsibility: Can delegate authority to investment managers but not responsibility. Must, therefore, review their decisions/performance.

5. Coordinate between investment managers, including making sure managers are not offsetting transactions which lead to higher costs.

6. Make property productive.

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Question #6

(a) At inception:

(i) At inception:

- Since the work force is young, a more aggressive portfolio is OK.
- Liquidity is only needed to pay out termination benefits; time horizon is long. However, the plan needs to make contributions and book expense so the manager should have made sure that the potential volatility of earnings compared to the aggressive nature or the investments was OK., i.e., a big loss in portfolio would require higher cash contributions and result in increased expense under FAS.
- Additionally, this portfolio allocation may not be "prudent" or diversified enough to provide protection to fiduciaries.
  -- The fiduciaries/investment committee should have assessed the risk return profile of the company.
- They are acting on behalf of the participants and invest so as to ensure payments of benefits.
- Better portfolio would have some exposure to bonds (20-40% -- some high yield), more diversified equities (small cap, international), had a smaller exposure to real estate.
- A large cash holding is not needed due to no benefit payments. Aggressive is OK; not diversified is not.

(ii) In 2000, need to dramatically change allocation due to:

- Retirees
- Longer service employees ready to retire with higher benefits

To pay retirees, need liquidity so cash and bonds (coupons) allocation should be increased. Can immunize or dedicate cash flows, if desired, for retiree portion to help protect/maintain surplus. Additionally, should increase bond exposure due to potentially longer-term, higher-benefit employees retiring soon. Once again, diversification is a must. What's important to the company? Presumably, they have decided that they don't like defined-benefit plans since switching to defined-contribution. Therefore, probably want to minimize cash and expense involved. Therefore, protecting surplus may be of utmost importance, in which case should immunize whole plan.

Summarized:

- Increased liquidity needs
- Maintenance of surplus

- Shorter time horizon
- Need to diversify.

(b) Option to transfer defined-benefit to defined-contribution plan. Consider:

- Model who will transfer (worst case?)
- Move to liquid assets.
- Raise cash.
- Shift entire portfolio from aggressive stance to conservative and diversify as well.
- Eliminate real estate, if possible, or dramatically reduce holding.
- Lock in retiree liability (dedication, immunization).
- Determine impact on surplus.

(d) Changes in investment policy with inception of DC plan:

- DB plan is remaining. However the majority of the people that stay in DB plan will be the long-service, close-to-retirement-age employees. Therefore, the investment policy needs to be revised to put a larger percentage of the assets in fixed securities (maybe GICs and some more money market instruments).
- For the DC plans. Need to have a separate investment policy. In order for fiduciary not to be held liable for diversification, need to:
  - Offer at least three investment options.
  - Allow the transfer of funds between investment options at least quarterly.
  - Provide information such as prospective on appropriate securities in accordance with Securities Act.

Question #7

(a) Household: Concerned with how to invest. Investment based on diversity of risk preferences, tax situation.

Business:

- Use investments to generate money to purchase real assets through borrowing or issuing stock.
- Want best price with lowest cost – simple securities.

Government:

- Need to raise funds to finance expenditures.
- High credit worthiness allows borrowing at low rates.
- Role is requesting their financial services industry.

Environmental Responses:

- Financial Intermediaries
  - Bring together investors and borrowers.
  - Allow for pooling of money, risk diversification, financial expertise.
- Investment Bankers:
  - Design and market securities.
- Financial Innovation and Derivatives:
  - Bundling/unbundling to transform simple securities to meet demands of investors – financial re-engineering.
  - Use derivatives to hedge risks of other assets.

(b) Agency Problems:

- Conflict between interest of shareholders (household) and company management (business).
- Managers may not run the business in the best interest of shareholders.
- Management controls perquisites – shareholders pay for them.

Control Features:

- Can buy and sell stock at anytime.
- Voting proportional to number of shares.
- Shareholders must approve major decisions.
- Much-audited financial information must be provided to shareholders.
- Shareholders elect Board of Directors.
- Board controls management.

Problems:

- Management can become shareholders – stock options.

- Poor management is threat to shareholders – proxy fights are expensive; paid for by shareholders.
- Takeover is biggest risk of poor management – but take-over fights can be expensive to shareholders.

COURSE 6—FINANCE AND INVESTMENTS

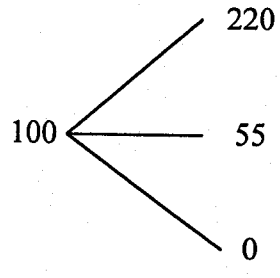
AFTERNOON SESSION

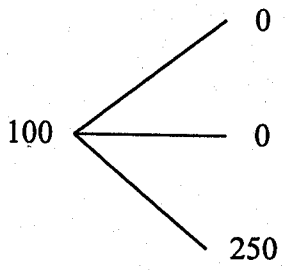
WRITTEN ANSWER

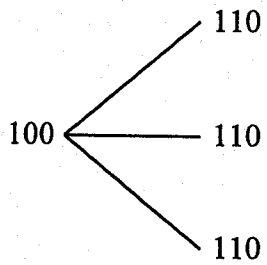
Question #8

Calculate ψ and Q.

Bank account pays 10%.







(a) $110\psi_1 + 110\psi_2 + 110\psi_3 = 100$

$220\psi_1 + 55\psi_2 + 0\psi_3 = 100$

$0\psi_1 + 0\psi_2 + 250\psi_3 = 100 \Rightarrow \psi_3 = 0.40$

$$\frac{100 - 55\psi_2}{220} = \psi_1$$

$$110\left(\frac{100 - 55\psi_2}{220}\right) + 110\psi_2 + 110(0.4) = 100$$

$$50 - 27.5\psi_2 + 110\psi_2 + 44 = 100$$

$$82.5\psi_2 = 6$$

$$\psi_2 = \frac{12}{165} = \frac{4}{55}$$

$$\psi_1 = \frac{100 - 55\left(\frac{4}{55}\right)}{220} = \frac{96}{220} = \frac{24}{55}$$

State price vector if $\sum \psi_i = \frac{1}{1+i}$ and all strictly positive.

$$\psi_1 + \psi_2 + \psi_3 = \frac{24}{55} + \frac{4}{55} + \frac{22}{55} = \frac{50}{50}$$

$$\frac{1}{1+i} = \frac{1}{1.1} = \frac{50}{55}$$

The state price vector is $\begin{bmatrix}\psi_1 & \psi_2 & \psi_3\end{bmatrix} = \begin{bmatrix}\frac{24}{55} & \frac{4}{55} & \frac{22}{55}\end{bmatrix}$.

(b) Since the state price vector exists, the risk neutral probabilities also exist.

$$Q = (1+i)\psi$$

$$= (1+0.10)\begin{bmatrix}\frac{24}{55} & \frac{4}{55} & \frac{22}{55}\end{bmatrix}$$

$$= \begin{bmatrix}\frac{24}{50} & \frac{4}{50} & \frac{22}{50}\end{bmatrix}$$

$$\sum Q = 1 = \frac{24}{50} + \frac{4}{50} + \frac{22}{50}$$

$\therefore$ the risk neutral probabilities are $Q = \begin{bmatrix}\frac{24}{50} & \frac{4}{50} & \frac{22}{50}\end{bmatrix}$.

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Question #9

(a) Common Methods of IPO Underwriting:

- Firm Commitment – Investment bank actually buys the shares from the issuing company, then resells them in the market.
  - Risk is assumed by the investment banker in exchange for a spread between the price they buy at and the price they sell at.
  - IPO price will tend to be low for safety.
- Best Efforts – Investment bank doesn't actually buy the shares, just help market it to potential investors.
  - Issuing firm holds risk if not all shares are sold.
  - No spread, so investment bank makes money from commissions and fees.
  - Investment bank (or multiple) provide expertise in setting the share price.

(b) Determination of IPO Price:

- Syndicate of investment bankers is formed (one is the leader)
- Based on road show interest from potential investors, current market conditions, and their expertise with similar situations, they suggest a price.
- Factors include: economy; perceived interest; market conditions.
- Can be constantly changing, right up to the time of the IPO.
- Price is a trade-off
  - If too high, not all shares will sell (bad if firm commitment).
  - If too low, issuing company won't raise as much money.
- IPO prices have tended to be underpriced.

(c) The Margin Process:

- For Long Purchases:
  - Shares are bought with a combination of the investor's money and a margin loan.
  - Initial margin is a set limit, 50%.
  - From that time on, the margin percentage = Equity/Market Value.

$$\text{Equity} = (\text{Market Value of the Stock}) - (\text{Initial Loan Amount})$$

  - Margin call if margin percentage drops below the required maintenance margin.

- For Short Sales:
  - Shares are sold with the proceeds from the sale adding to equity while the market value of the stock is subtracted.

$$\text{Equity} = \begin{pmatrix}\text{Market Value}\\ \text{of Long Stock}\end{pmatrix} + \begin{pmatrix}\text{Initial}\\ \text{Proceed}\end{pmatrix} - \begin{pmatrix}\text{Market Value}\\ \text{of Short Stock}\end{pmatrix}$$

$$\text{Margin } \% = \left(\frac{\text{Equity}}{\text{Market Value of Short Stock}} \right)$$

– The initial short position requires that the initial account value (long stock or cash) be a minimum percentage (50%) of the stock being sold short.

(d) Alternative Actions when Faced With A Margin Call:

- Investor A could add cash (make a deposit) to his account to bring the margin % up to 35%.

Investor A has 480 shares with a margin loan of $12,000.

$$\underset{\text{(Stock @ \$30)}}{\text{Margin } \%} = \frac{480(\$30) - \$12{,}000}{480(\$30)} = \frac{2400}{14{,}400} = 16.6\%$$

$$14{,}400 \times 0.35 = 5040 - 2400 = 2640$$

Must add $2,640.

- Or he could sell some of his shares until his margin % was at least 35%.

(e) $$\text{Margin } \% = \frac{\underset{\text{(Initial cash in account)}}{12{,}000} + \underset{\text{(Sell short 480 shares @ \$50)}}{24{,}000} - \text{MV of Short Stock}}{\text{MV of Short Stock}}$$

Maintenance Margin = 40%.

$$0.40 = \frac{36{,}000 = \underset{\text{(stock price)}}{480}}{\underset{\text{(stock price)}}{480}}$$

$$\underset{\text{(Stock price)}}{192} = 36{,}000 + \underset{\text{(Stock price)}}{480}$$

$$\underset{\text{(Stock price)}}{672} = 36{,}000$$

Stock price = $53.57.

Investor B will get a margin call if stock price rises to $53.57.

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Question #10

(a)

(i) Floating Rate Notes:
- Coupon payments vary with short-term index.
- Usually contain puts.
- Better when interest rates or index go up because coupons will be reset based on index.

(ii) Principal Only Strips:
- For MBS, these are securities that are based only on principal payments (interest portion stripped off)
- Very risky
- Good if pre-payments are high because principal will be returned faster.
- Bought at a discount.

(iii) High-Yield Securities:
- Very risky
- Usually unsecured
- Great potential profit, but also great risk.

Examples:
- High-yield bank loans
- Regular, fixed-interest loans – High coupon ("Plain vanilla")
- Rule 144A, (illegible) companies to sell debt and private placement before registering with SEC
- Bond/stock warrant.

NOTE: "Warrant" option usually to buy stock from a company – company creates new shares.
- Extendible securities
- Split coupon – (No interest in first year)
- Payment in-kind (Pay in debt)
- Step-up.

(b) Support a 5-Year GIC with Option to Surrender if Interest Rates Change.

Floating Rate Notes:
- If interest rates go up, people will surrender GICs or avoid buying to invest in better yielding securities.
- Floating rate will allow you to credit higher rates on new GICs if based on interest

rate market.

- Concerns with Security:
  - For a GIC, it would be better to lock in a fixed rate above the crediting rate, rather than buy a floating rate.
  - Safety Net: If interest rates drop below crediting rate, individual will not surrender GIC and company will credit more than it will earn.

- Principal-Only Strips:
  - If interest rates drop, more people will refinance, causing yield to go up.
  - If interest rates go up, less will refinance, causing less of a return.

- Analyze Advantage:
  - If interest rate drops, GICs will not be surrendered and high yields will be earned.
  - Good scenario.

- Analyze Disadvantage:
  - If interest rates increase, GIC will be surrendered and might raise liquidity concerns and lack of earnings.
  - Since GICs are mostly risk adverse, PO might be too risky.

- High-Yield Securities (Concerns with using high-yield)
  - High risk might not be adequate for GIC
  - Uncertain return and large risk might not meet GIC crediting rate.
  - Liquidity might be poor if large numbers of GICs are surrendered and high-risk securities are defaulting.
  - Delayed interest payments of some high-yield securities could cause losses between earned rate and crediting rate of GIC.

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Question #11

I. Studies have shown that low P/E stocks have higher returns than high P/E stocks over long holding periods.

II. Analysis from EMH Viewpoint
- Observed out-performance held true even if returns adjusted for Beta → P/E may act as additional descriptor of risk.
- This result would appear to violate the EMH.

III. Analysis from Dreman Viewpoint
- Investor overreaction hypothesis – Investors overvalue best stocks (high P/E) and undervalue worst stocks (low P/E).
- Analysis forecasts poor due to:
  - Tendency to extrapolate from past earnings
  - Behavioral influences
  - Peer and institutional pressures.
- Trigger events – great positive impact on low P/E stocks
  - Positive earnings surprise for low P/E stocks
  - Negative earnings surprise for high {P/E stocks).
- Reinforcing even – small impact on low P/E stocks
  - Negative earnings for low P/E stocks
  - Positive earnings surprise for high P/E stocks.

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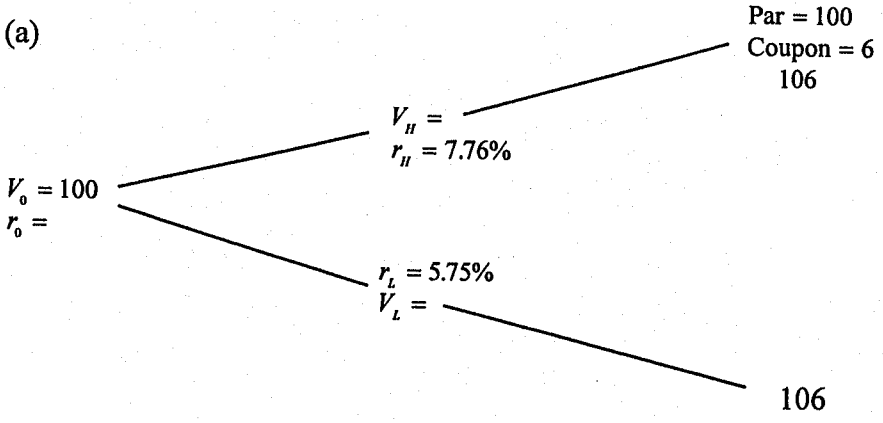
Question #12

(a)



$$r_H = r_L e^{0.25} = (0.0575)e^{0.30} = 7.76\%$$

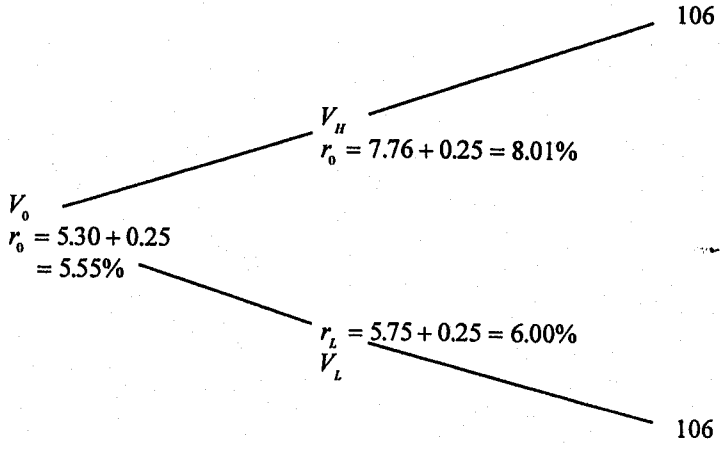
$$V_L = \frac{106}{r_L} = 100.236$$

$$V_H = \frac{106}{r_H} = 98.365$$

$$V_0 = 100 = 0.5\left(\frac{100.236+6+98.365+6}{1+r_0}\right)$$

$$\therefore r_0 = 5.30\%$$

$OAS = 0.25\%$ = Constant spread to add to all rates.



$$V_H = \frac{106}{1.0801} = 98.14$$

$$V_L = \frac{106}{1.06} = 100.00$$

$$V_0 = 0.5\left(\frac{100+6+100+6}{1.055}\right) = \$100.43 \text{ Market Price}$$

But this is <100. $\therefore$ put option will be exercised set value to 100.

(b) Modified Duration

- Measures sensitivity of bond's price to changes in yield to maturity.
- Assumes yield curve is flat.
- Assumes cash flows independent of interest rates.

This bond is "putable" with cash flows that change with changes in interest rates. Therefore, modified duration is an inappropriate measure for this bond.

Effective Duration

This is the correct measure for this bond as it compensates for cash flows that change due to interest rate changes.

Course 6 – May 2000 – Illustrative Solutions

Question #13

(a) Liquidity is the ability to meet normal and adverse cash needs without problems, that is, without affecting surplus too much or losing too much value on the sale of securities.

(b)
- Separate assets and liabilities.
- Assets available in one day/one month.
- Liabilities required in one day/one month.
- Use the maximum required and minimum available.
- Net assets available = assets available – liabilities required.
- $\text{Liquidity Ratio} = \dfrac{\text{Net Assets Available}}{\text{Total Liquidity Needs}}$
- Evaluate under normal circumstances and under stress.

(a) Company-specific events:
- Downgrade of the company by rating agencies – Policyholders will go get their money back, which will only make the situation worse.
- Rumor of financial problems (even if false) – same problem as above.
- Loss of a source of revenue/liquidity.
- Reports below expectations (i.e., reported earnings or dividend). – Investors will think company is in trouble.

Industry-wide events:
- Problem with a big insurance company – Policyholders will be concerned.
- Perceived problems with a certain product – Everyone will want to get money out of this product in all companies.
- Sudden change in customer demand – Companies need time to adjust themselves.
- Macro-level economic and political instability – A change in the regulatory environment could cause problems.

(b) Sources of cash:
- Existing cash position.
- Short-term securities in money market.
- Issuance of commercial paper.
- Get a line of credit with bank – Might be refused if company has real problems.
- Sell marketable securities.
- Securitize unmarketable securities.
- Repurchase agreements.
- Cash flow from operations.

Company could also ad to its policies:

- Surrender fees.
- Surrender values adjusted to market.
- Delays in GICs.

Can also use reinsurance, offer separate account for concerned DC plan participants – polling and selling private placements.

Most important:
- Keep regulators and rating agencies informed regularly.
- Control public view of situation.
- Inform agents.

Course 6 – May 2000 – Illustrative Solutions

Question #14

(a) Liquidity premium hypothesis:

- Long-term bonds have a higher duration and, therefore, they are more sensitive to interest rate changes.
- Investors require a liquidity premium to accept this higher level of risk.
- The liquidity premium increases with maturity but at a decreasing rate.

  Graph 1: Hypothesis gives no explanation.
  Graph 2: Hypothesis gives no explanation.
  Graph 3: As maturity increases, the liquidity premium increases but at a decreasing rate.

(b) Pure or unbiased expectations:

- Forward interest rates are shown in spot rates:

$$S_1 = f_0$$
$$(1+S_2)^2 = (1+f_0)(1+f_1)$$
$$(1+S_3)^3 = (1+f_0)(1+f_1)(1+f_2)$$

- Investors expect the same return from differing maturity strategies.
- Graph 1: Future interest rates will increase and then decrease.
- Graph 2: Future interest rates will decrease.
- Graph 3: Future interest rates will increase.

(c) Market Segmentation:

Graph 2:

- Investors have their segment that they prefer and they cannot be drawn from it.
- Hypothesis acknowledges some overlap between ST investor (banks) and long-term investors (insurance companies).
- ST rates are more volatile.
- Banks prefer to borrow money to individuals and business and will invest only the excess.
- When economy is doing well, business borrow from banks. Banks have little excess funds to invest, which increases supply of ST investments, which increases rates relative to LT – Banks have less money to invest than insurance companies.

Graph 3:

- When economy slacks off:
  - Less borrowing (loans being paid off)
  - Banks have more money to invest in ST securities
  - Decreases supply
  - Increases security prices and decreases ST yields w/change to LT.
- Banks have more money to invest than insurance companies.

Graph 1:

- Banks and insurance companies have about the same amount of money to invest, but there is a void in the investing market.

**** END OF EXAMINATION 6 ****

Course 6
May 2000

Multiple-Choice Answer Key

1	B
2	B
3	C
4	D
5	E
6	B
7	E
8	A
9	D
10	C
11	C
12	A
13	E
14	D
15	E
16	A
17	A
18	A
19	B
20	B

21	A
22	C
23	C
24	C
25	B
26	A
27	D
28	D
29	B
30	B
31	B
32	A
33	D
34	C
35	B
36	D
37	E
38	A
39	C
40	A
41	E
42	A