MAY 2001

COURSE 6
MORNING SESSION

FINANCE AND INVESTMENTS

SECTION A—WRITTEN ANSWER

Course 6 Model Solutions

1.

(i) Asian Options

- used for equity index products, foreign currency and interest rate options.
- have to know type of averaging, time period of averaging, number of points to use (i.e. monthly, daily)
- payoff can be: for call option, $(Saverage - X)^+$ or $(S - Saverage)^+$
- payoff is normally based on the average price of the underlying asset during the life of the option

(ii) Look Back Options

- pay off depends on maximum or minimum of underlying assets during holding period
- call option payoff: $(K - S_{min})^+$ K is strike price
  - assure getting the lowest price asset possible during holding period
- put option payoff: $(S_{max} - S)^+$
- higher water mark pay off: $(S_{max} - K)^+$

(iii) Interest Rate Collars

- buy a cap, and sell a floor at lower strike price to compensate the purchase price of a cap
- to limit liabilities within the two strike price
- have protection from rising interest rate above cap strike price, giving up some gain potential by falling rate – if interest rate fall below floor strike price, have to pay (floor strike rate – Index rate) x notional amount
- if interest rates are within upstrike rate and floor strike rate, there will be no cash inflow or cash outflow

2.

(a) $E(r_T^2) = 0.6(4)^2 + 0.4(4)^2 = 16$

$=)\sigma_T^2 = 16-(4)^2 = 0$

let r_I = return on portfolio I

r_{II} = return on portfolio II

r_{III} = return on portfolio III

So, $E(r_I) = 17\%$

$E(r_{II}) = 0.75(17) + 0.25(4) = 13.75\%$

$E(r_{III}) = 0.75(17) + 0.25(a) = 15\%$

$r_I^2 = (1)^2(96) = 96 =)\sigma_I = \sqrt{96} = 9.8\%$

$r_{II}^2 = (0.75)^2(96) + (0.25)^2(0) + 2(0.75)(0.25)Cov(r_{AISC}, r_T)$

since $\sigma_T^2 = 0 =)Cr-(r_{AISC}r_T) = 0$

So $\sigma_{II}^2 = 54 =)0_{II} = \sqrt{54} = 7.35\%$

$\sigma_{III}^2 = 10.751^2(96) + (0.25)^2(24) + 2(0.75)(0.25)Cov(r_{ABCI}r_{DEF})$

Cov $(r_A, r_B) = E(r_A r_B) - C(r_A)C(r_B)$

$E(r_{ABC}r_{DEF}) = 0.6(25)(5) + 0.4(5)(15) = 105$

$=)Cov(r_{ABC}, r_{DEF}) = 105-(17)(9) = -48$

$=)\tau_{III}^2 = 54 + 1.5 - 18 = 37.5 =)\sigma_{III} = \sqrt{37.5} = 6.12$

Risk Neutral Investor

- judges portfolio by expected return only
- risk is not relent it is ignored in making decisions
- will choose portfolio I since it has highest return

Risk Averse Investor

- Evaluates portfolio by taking into account both risk and return.
- Greater returns are penalized depending on how much extra risk is taken on to achieve the higher return.
- Portfolio III is most likely choice since one can achieve with the lowest risk a good return.
- Portfolio III achieves lower risk for curbing stocks. ABC and DEF which are negatively correlated.

(b) use utility function $U = E(r_p) - 0.005A\sigma_p^2$

(i) risk-neutral invester
=) A = 0
=) looks for portfolio with brightest expected return and ignores risk

$E(r_I) > E(r_{III}) > E(r_{II})$

would choose Portfolio I

(ii) risk-averse
=) A > 0
=) look for maximum return with minimum risk

$E(r_I) > E(r_{III}) > E(r_{II})$

but

$r_I > r_{II} > r_{III}$

choose Portfolio III

standard deviation of Portfolio III = σ_3

$= \sqrt{w_{ABC}^2\sigma_{ABC}^2 + W_{DEF}^2\sigma_{DEF}^2 + 2W_{ABC}W_{DEF}COV(r_{ABC,}r_{DEF})}$

W_{ABC} = weight invested in stock ABC

W_{DEF} = weight invested in stock DEF

σ_{ABC}^2 = variance of stock ABC

σ_{DEF}^2 = variance of stock DEF

$$COV[Rabc, Rdef] = \sum_{S=1}^{n} \Pr(s) \cdot [Rabc - E[Rabc]][Rdef - [Rdef]]$$

$R_{ABC} = return\ of\ stock\ ABC$

$R_{DEF} = return\ of\ stock\ DEF$

$E[Rdef]$ = expected return of stock DEF

$R[rotc]$ = expected return of stock ABC

$= .6[25-17][5-9]+.4[5-17][15-9]$

$COV[Rabc, Rdef] = -.0048$

$\sigma_{DEF} = \sqrt{.6(5-9)^2+.4(15-9)^2}$

$= 4.9\%$ $\sigma^2_{DEF} = .0024$ $\sigma^2_{ABC} = .0096$

$\sigma_3 = \sqrt{.75^2(.0076)+.25^2(.0024)-2(.75)(.25)(.0048)}$

$= 6.12\%$

(a) expected return on portfolio

$= \sum_i w_i E(r_i)$ where W_i = weight of i-th security in portfolio

$E(r_p)$ $E(r_i)$ = expected return of i-th security

variance of portfolio

$= \sum_i W_i^2 r_i^2 + 2\sum_{i,j} W_i W_j Cov_1(r_i, r_j)$

$= \sigma_p^2$

let $r_{ABC} = return\ on\ stock\ ABC, r_{DEF} = return\ on\ stock\ DEF$

r_T = return on T-bills

$E(r_{ABC}) = 0.6(25) + 0.4(5) = 17\%$

$E(r_{DEF}) = 0.6(5) + 0.4(15) = 9\%$

$E(r_T) = 0.6(4) + 0.4(4) = 4\%$

Recall from probability,

$VAR(x) = E(x^2) - [E(x)]^2$
for random variable X

$E(r_{ABC}^2) = 0.6(25)^2 + 0.4(5)^2 = 385$

$=)\sigma_{ABC}^2 = 385 - (17)^2 = 96$

$E(r_{DEF}^2) = 0.6(5)^2 + 0.4(15)^2 = 105$

$=)\sigma_{DEF}^2 = 105 - (a)^2 = 24$

Expected return on any given portfolio

$$= \hat{\sum_{s=1}} \{\Pr(s) \cdot R(s)\}$$

where $\Pr(s)$ is probability of scenario

and $R(s)$ is return in a given scenario

Portfolio 1 = .6 x 25% + .4 x 5% = 17% — 100% invested in stock ABC

Portfolio 2 = .75 x 17% + .25 x 4% = 13.75% — 75% in stock DEF +25% in t-bills

Portfolio 3 = 75% invested in stock ABC
+25% in stock DEF

$E[R(DEF)] = .6\ x\ 5y + .4\ x\ 15\% = 9\%$

$E[Portfolio\ 3] = .25\ x\ 9\% + .75\ x\ 17\% = 15\%$

Standard Deviation of Portfolio 1 $= \sigma_1$

$$= \sqrt{\cdot \sum_{s=1}^{n} \{pr(s) \cdot [R(s) - E[R]^2\}}$$

$$= \sqrt{\{.6(25\% - 17\%)^2 + .4(5\% - 17\%)\}}$$

$$\sigma_1 = 9.8\%$$

Standard Deviation of Portfolio 2

$= \sigma_2 = \lambda \cdot \sigma_1 \quad \lambda =$ % invested in stock ABC

$= 75\% \; x \; 9.8\%$

$\sigma = 7.35\%$

3.

(a)

- Place an order with a broker
- Broker borrows the security from one of the accounts he manages and sells it
- Proceeds plus additional cash/collateral are kept by the broker
- Enough of cash or securities owned by the investor have to be deposited to satisfy initial margin requirement

$$\frac{equity}{value\ of\ stock} = initial\ margin$$

- Dividends due have to be paid from the account to the owner of the stock
- As stock price changes so does investor's equity

equity = account value – stock value

- If margin = $\frac{equity}{stock\ value}$ falls below specified maintenance margin, investor will get a call and either will need to add cash/collateral or some securities will be bought back
- Position may be closed by buying back stock and returning them to the owner.

- Investor sells short if he believes that price will fall (so can buy back cheaper). Short sales are allowed only after up movement in price. Investor is exposed to increase in price. May place a stop-loss order to limit its potential losses.

(b)

- January 1 sold 100 shares for 60 a piece
  = 6,000
  deposited 3,000 cash with the broker

- January 31 bought back 100 shares for 58 a piece
  = 5,800

returned dividends of 100
total cost 5,900

Received 3,100 back from the broker (9,000-5,900)

Made a profit of 100 on 3,000 investment

(c)

$$\left(\frac{3{,}100}{3{,}000}\right)^{12} - 1 = 48.2\% \leftarrow \textit{annualized effective}$$

On January 15 investor equity decreases to:
9,000 - 100 x 63 – 100 = 2,600

At this point margin $= \dfrac{2{,}600}{6{,}300} = 41.3\% > 40\%$

No margin call was necessary.

4.

a) non-call-life yield curve = on-the-run Treasury yield + credit spread

Maturity	Treasury Yield	Credit Yield	Non-call-life Yield
1	4.00%	0.20%	4.20%
2	5.20%	0.50%	5.70%
3	5.40%	0.60%	6.00%

Market Price = $\sum CF_t / (1+y)^t$

Price of 2 yr. Bond = $(0.055)(100)(1.057)+[(0.055)(100)+100]/(1.057)^2 = 99.632$

Price of 3 yr. Bond = 100, since coupon = yield

r_L = 6.369% and r_{LL} = 5.071% from chart above, σ =.13.

Binomial model: $r_H = r_L\, e^{2\sigma}, r_{HL} = r_{LL}\, e^{2\sigma}, r_{HH} = r_{LL}\, e^{4\sigma}$

$r_H = 6.369\%\, e^{2(0.13)} = 8.260\%$

$r_{HL} = 5.071\%\, e^{2(0.13)} = 6.577\%$

$r_{HH} = 5.071\%\, e^{4(0.13)} = 8.530\%$

A
V0
0
4.20%

B
V1
6.75
8.26%
V2
6.75
6.37%

C
V3
6.75
8.53%
V4
6.75
6.58%
V5
6.75
5.07%

D
100
6.75
100
6.75
100
6.75
100
6.75

V3 $= 106.75/1.0853 = 98.36$

V4 $= 106.75/1.06577 = 100.162$

V5 $= 106.75/1.05071 = 101.598$

V1 $= 0.5 \times (V3 + 6.75 + V4 + 6.75)/1.0826$

$= 0.5 \times (98.36 + 6.75 + 100.162 + 6.75)/1.0826$

$= 97.923$

V2 $= 0.5 \times (V4 + 6.75 + V5 + 6.75)/1.06369$

$= 0.5 \times (100.162 + 6.75 + 101.598 + 6.75)/1.06369$

$= 101.185$

V0 $= 0.5 \times (V1 + 6.75 + V2 + 6.75)/1.042$

$= 0.5 \times (97.923 + 6.75 + 101.185 + 6.75)/1.042$

$= 102.019$

b)

$V5b = 100 + 1\%$ call premium $= 101$

$V4 < 101$, therefore not called.

$V4b = V4$ and $V1b = V1$ (not callable in any event)

V2b $= 0.5 \times (V4b + 6.75 + V5b + 6.75)/1.06369$

$= 0.5 \times (100.162 + 6.75 + 101 + 6.75)/1.06369$

$= 100.904$

V0b $= .05 \times (V1b + 6.75 + V2b + 6.75)/1.042$

$= 0.5 \times (97.923 + 6.75 + 100.904 + 6.75)/1.042$

$= 101.844$

Value of call option = Value of optionless bond – Value of callable bond

$= 102.019 - 101.884$

$= 0.135$

c)

A bond with an attached warrant is a convertible bond.
Non-convertible bonds require a higher yield to maturity than convertibles; convertible bonds allow lower interest cost for issuer.
Convertible bonds often allow less restrictive covenants (debt agreements) for issuer.
There is capital structure uncertainty with convertibles.
Convertibles are typically subordinated debt issues; convertible debt holder is exposed to the risk of expropriation that comes with the issuance of new debt.
Convertibles offer downside protection that bonds can offer during bad economic times, while allowing one to share in the upside potential of common stock.
Convertible bonds are attractive for investors whose ability to take equity risk is constrained.

5.

(a)

(i)

Currency Selection:

- this is the extra return from currency appreciation on manager's portfolio over that of the EAFE by weighting the amount of investment in the three territories differently than that by EAFE

i.e. $gain_{curr} = \sum_{i=1}^{3} return\ on\ equity\ index_i x(Manager\ weight\ i - EAFE\ weight\ i)$

where

i = 1 = Europe
i = 2 = Australia
i = 3 = Far East

(ii)

Country selection:

- This is the extra return gained in each territory (country) by weighting the amount of investment in the 3 territories differently than that by EAFE.

i.e. $gain_{curr} = \sum_{i=1}^{3} return\ on\ equity\ index_i\ x(Manager\ weight\ i - EAFE\ weight\ i)$

(iii)

Stock selection:

- This is the extra return by picking stocks differently in each territory than that represented by the index

i.e.

$$gain_{stock} = \sum_{i=1}^{3} Manager's\ weight_i\ x\ (Manager's\ return_i - Equity\ Index\ \mathrm{Re}turn_i)$$

(iv)

Cash/Bond Selection:

- This is the extra return by allocating different portions into cash/bond

(b)

sub x = 0.4, z = 0.4 to 1
then 0.4 - y + 3(0.4) = 1.4
y = 0.2

∴ weight in Europe = 40%
weight in Australia = 20%
weight in Far East = 40%

6.

(a)

(i) Immunization – technique of maintaining a positive surplus as interest rates change
- match effective duration of assets and liabilities
- convexity of assets greater than convexity of liabilities

(ii) Contingent Immunization
- actively manage the assets as long as the immunizable safety net is not violated.
- shift to immunization immediately if safety reached

(iii) Dedicated Portfolio
- expected asset and liaibility cash flows are matched
- must specify reinvestment rate

(b)

(i) Immunization
- durations change at different rates over time
- durations change due to interest rate moves
- asset and liabilities present values change

(ii) Contingent Immunization
- must have a plan in place for immunization if safety net violated
- monitor return closely to immunize promptly

(iii) Dedicated Portfolio
- little room for active management since the cash flows must be matched
- asset quality, and asset cash flow uncertainty is a consideration
- liability cash flows are well defined

(c)

(i) Immunization
- cheaper than dedication
- use effective duration for interest sensitive cash flows
- only good for small changes in interest rates
- only good for parallel yield curve shifts
- need to rebalance constantly

(ii) Contingent Immunization
- may not reach safety return due time to shift portfolio to immunization
- management makes portfolio decisions to get a bigger spread
- formula can be used to determine active portion

(iii)

Dedicated Portfolio
- costs more due to lower returns and conservative reinvestment rate used
- embedded options should not be used
- protects from reinvestment and interest risk
- impossible to match cash flows exactly

7.

(a) Credit Risk
Risk that loans within the CMBS are in default
Prepayment risk when loans payoff early
Extension risk as loans do not always pay off as scheduled

(b) Obtain loans that have debt service coverage ratios which are favorable (ie high)
Obtain loans that have loan-to-value ratio which are favorable (ie low)
Select expert loan servicers (improve probability of collecting monies due)
Diversify by using loans in different areas and different property types (ie apartment, office, retail etc.)
Attack repayment risk by using the following mechanisms:
- prepayment lockout – borrower contractually prohibited from prepaying loan during lockout period
- yield maintenance – borrower "makes whole" lender based upon present value of cash flows
- defeasance – Treasuries replace building as collateral

Attack extension risk problems with the following mechanisms:
- Internal tail provision – required borrower to provide evidence that effort to refinance is underway prior to balloon date
- external tail provision – maturity of CMBS is set longer than maturity of underlying loans to allow delays in refinancing

(c)

(i) 10 is a small number of loans not very diversify
Diversify geographically or by industry type
High LTV – higher levered
Low DSCR
Balloon loans create possibility of not being able to refinance loans and going into delinquency and/or default

(ii) Add more loans to diversify through larger number of loans, size and maturity
Diversify geographically – add more locations so localized real estate downturn will not seriously impact overall portfolio credit quality
Diversify by property type – ie add office, multi-family, industrial and retail
Add loans with lower LTV's (e.g. <80%)
Increase DSCR multiples
Look for loans with lock-out provisions
Look for loans without balloon payments or stagger portfolio payments through time

COURSE 6—FINANCE AND INVESTMENTS

AFTERNOON SESSION

WRITTEN ANSWER

8.

Passive Buy-and-Hold strategy
Involves purchasing and holding a security to maturity
Cash proceeds from coupons or redemptions are reinvested in similar securities
Changes in market value **(capital gains/losses)** are ignored
Interest rate forecasting is ignored
Need to analyze the quality of the securities to minimize the risk of default
Assets with embedded options are less appropriate
Quasi-passive indexation strategy
Select the target bond market index
Transaction costs will cause tracking error
Three approaches
Exact Replication (difficult to do)
Sampling
Securities are selected randomly from the bonds making up the index
Probably fewer than 40 securities can closely replicate index
May not be appropriate with broader indexes
Stratified
Three steps
Segment the securities in the index into homogeneous classes (Sector, Quality, Maturity)
Select one security from each class to include in the portfolio
Manager may exercise some judgment in selecting the security from each class
Determine the amount to be held in each security selected
Use quadratic programming **(Optimization)** to match
Duration
Distribution of maturities
Amount held in each of the sectors of the index

9.

Determine which bond combination will match liabilities, start with last years,

(i) Buy 250 face of the 5 year bond
- will provide 250 face + 25 (250 x 10%) coupon in year 5 for a total of $275
- will provide $25 coupon in preceding years

→ years 4 & 5 fully matched

→ remaining unmatched liabilities
year 3 = 214 - 25 = 189
year 2 = 123 - 25 = 98
year 1 = 43 - 25 = 18

(ii) Buy 175 face of the 3 year bond
- provides 175 face + 14 (175 x 8%) coupon in year 3 for a total of $189
- provides $14 coupon in years 1 & 2

→ remaining = year 3 cash flow matched

→ remaining unmatched liabilities
year 2 = 98 – 14 = 84
year 3 = 18 – 14 = 4

(iii) Buy 80 face of 2 year bond
- pays 80 face and 4 (80 x 5%) coupon in year 2 for a total of $84
- pays $4 coupon in year 1
→ all remaining liability cash flows matched

∴ buy $240 par of 5-year bonds
$175 par of 3-year bonds
$ 80 par of 2-year bonds

$$\text{Price of Bonds} = \sum_t \frac{CF_t}{(1.07)^t}$$

$$\text{Price of 2-year bond} = \frac{5}{1.07} + \frac{105}{(1.07)^2} = 96.38$$

$$\text{Price of 3-year bond} = \frac{8}{1.07} + \frac{8}{(1.07)^2} + \frac{108}{(1.07)^3} < 102.62$$

$$\text{Price of 5-year bond} = \frac{10}{1.07} + \frac{10}{(1.07)^2} + \frac{10}{(1.07)^3} + \frac{10}{(1.07)^4} + \frac{110}{(1.07)^5} = 112.30$$

∴ Price of matched portfolio =

$$250 \text{ x } \left(\frac{112.30}{100}\right) + 175\left(\frac{102.62}{100}\right) + 80\left(\frac{96.38}{100}\right) = 537.44$$

10.

(a) Describe the features of collared floating rate securities

(i) A floater is a debt security whose coupon rate is reset at designated dates based on the value of some designated reference rate

Coupon Rate = Reference Rate ± Quoted Margin

A collared floater features both a cap and a floor

(ii) Features

Face amount – used to calculate the dollar value of the

Coupon payment. OR, monies received by issuer to be repaid with interest.

Reference rate – the interest rate that appears in a floater's coupon formula and is used to determine the coupon payment on each reset date, eg, LIBOR, T-Bill yields, Prime Rates, CD Rates, Foreign Exchange rates, Commodity Prices, Equity Indices, Inflation Indices

Quoted Margin – the permanent adjustment that the issue Agrees to make to the reference rate, eg, 50 basis points

Reset frequency – how often the coupon rate is reset based On the reference rate, eg, semi-annually, quarterly, monthly or weekly. "Adjustable-rate" or "Variable-rate" is typically used to refer to floaters whose coupon rates reset not more than annually, or are based on a longer-term interest rate.

Term to maturity – the number of years until the debt will cease and the borrower or issuer will redeem the issue by paying the face amount.

Cap – a restriction on the maximum coupon rate that will be paid on any reset date

Floor – a restriction on the minimum coupon rate that will be paid on any reset date.

May contain other features, such as call/put/ prepayment/stepped spread/range note/dual index

(b) Describe the price volatility characteristics of collared floaters and compare them to those of the collared inverse floaters.

1. Factors that affect a floater's price

Time remaining to the next coupon reset date

The longer the time to the next coupon reset date, the more a floater behaves like a fixed-rate security and the greater a floater's price fluctuation.

The shorter the time between coupon reset dates, the smaller the floater's potential price fluctuation.

For a floater in which neither the cap nor floor is binding, And for which the market does not demand a margin Different from the quoted margin, a floater that resets Daily will trade at par.

Changes in the market's required margin
Subsequent to its initial offering, if the market required a higher/lower margin, the floater's price will decrease/increase to reflect the current margin required.

The required margin for a particular issue depends on its credit quality, its liquidity, the margin available in competitive funding markets, the presence of any embedded or put options.

Whether or not the cap or floor is reached.

For a floater with a cap, once the coupon specified by the coupon formula rises above the cap rate, the floater then offers a below market coupon rate and will trade at a discount. As the prevailing market rate approaches the capped rate from below or exceeds it, the more the floater will trade like a fixed-rate security with a rate equal to the capped rate.

For a floater with a floor, once the coupon specified by the coupon formula falls below the floor rate, the floater then offers an above market coupon rate and will trade a premium. As the prevailing market rate approaches The floored rate from above or falls below, the more the floater will trade like a fixed-rate security with a rate equal to the floored rate.

However, a floater's coupon resets periodically thereby reducing in sensitivity to changes in rate OR floater interest rates increase, price decreases, but coupon increases to offset price decrease =>stable price.

2. Duration of Floaters

For a pure floater (with no embedded options, caps or floor)

The price behavior is similar to that of a zero-coupon

fixed-rate security with a term-to-maturity equal to the time remaining to the next coupon reset date.

Its duration will approximately be equal to the time remaining to the next coupon reset date.

Since the time remaining to the next coupon reset date for most floaters is small (less than 1 year), the duration of most floaters is also small, typically less than 1.

Two measures are employed to estimate a floater's sensitivity to each component of the coupon formula.

Index duration is a measure of the floater's price sensitivity to changes in the reference rate, holding the quoted margin constant.

Spread duration is a measure of the floater's price sensitivity to changes in the quoted margin, holding the reference rate constant.

3. Price volatility of an inverse floater

Can be created by acquiring a fixed rate security (the collateral) and splitting it into a floater with X% of the collateral's face amount, and an inverse floater with (1-X)% of the collateral's face amount.

D(collateral) = X%*D(floater) + (100-X%)* D(inverse floater)

Because the duration of floaters is typically small, the duration of an inverse floater will accordingly be a multiple of the collateral from which it was created OR An Inverse floater's price volatility is higher than floater's. OR, Inverse floaters are more risky than floaters.

Effectively, the inverse floater is a leveraged position in the collateral OR Inverse Floater, interest rates decrease, price increases, but coupon increases to amplify price increase => volatile price.

Ownership of an inverse floater is equivalent to buying the collateral and funding it on a floating-rate basis, where the reference rate for the borrowing is equal to the reference rate for the inverse factor.

Other Risks (eg, Currency, Event, Sector, Regulatory, Tax)

(c) Describe the risk to an investor of investing in such a security

Cap Risk is the risk that the floater's value will decline because the cap is reached. OR, Cap Risk is incurred if the floater's rate is capped and the funding rate is not. OR, Cap Risk is the risk that interest above the cap rate will not be received.

Basic Risk is incurred when the floater's reference rate is not the same as the reference rate for funding of the floater.

Price Risk, Interest Rate Risk, Option Volatility Risk And definition

Liquidity Risk is the threat of an increase in the required margin due to a perceived deterioration in an issue's liquidity.

Credit Risk is the risk that there will be an increase in the credit spread required by the market due to credit quality concerns. OR, Credit Risk is the risk that the issue will not be able to or default on the coupon payments.

Call/Prepayment Risk is the risk that the Investor will have to reinvest the proceeds of an early redemption at lower interest rates or margins than existed in the floater.

Floor Risk is the risk that an issuer will have to pay more than the prevailing market interest rates. It is *not* a risk to the investor, but it is a risk to the issuer.

Put Risk is the risk that an issuer will have to redeem the issue at prices above the prevailing market values. It is *not* a risk to the investor, but it is a risk to the issuer.

11.

(a) 60 day r.f. discount factor

$$= \frac{\text{Price of 150-day T-bill}}{\text{Price of 60 day Future on 90 day T-bill}}$$

$$= \frac{975}{984}$$

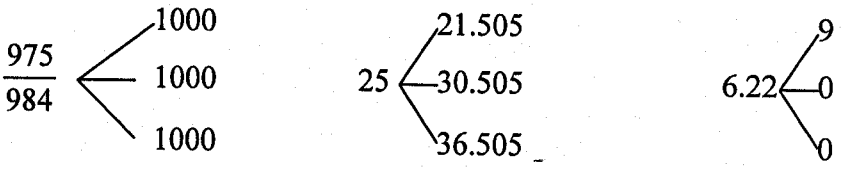
$$p = c + pv(k) - Se^{-\phi t}$$

$$p = 1 + \frac{975}{984}(30) - 25e^{-.12\left(\frac{60}{360}\right)}$$

$$= 6.22$$

(b) Arbitrage Free $\Leftrightarrow \exists$ *state – price vector*

<u>T-Bill</u> <u>Stock</u> <u>Put</u>



Determine solution's to:

$$\frac{975}{984} = 1000\ y_1 + 1000\ y_2 + 1000\ y_3$$

$$25 = 21.505\ y_1 + 30.505\ y_2 + 36.505\ y_3$$

$$6.22 = 9\ y_1 + 0\ y_2 + 0\ y_3$$

$$y_1 = .69111\ y_2 = .134\ y_3 = .166$$

Solve for y_1, y_2, y_3, all are >0 => state-price vector exists.

12.

(1) Objectives of the business
Quantitative or qualitative

(2) Description of Liabilities
Long-term or short-term, interest rate sensitivity, cash flow volatility, embedded option, impact of aggregating various liabilities type

(3) Risk Tolerance
Involve surplus change
Usually qualitative

(4) Marketability/Liquidity
Have enough cash flow for unforecasted surrenders or attractive investment opportunity
Should consider:
Termination probability
Net cash flow
Industry Outlook
Early retirement window

(5) Accounting regulatory and tax rules.
What include in income
MCCSR
Investment limits imposed by regulators
Volatility of surplus affect the plan expense

(6) Asset Mix Target
Target on: Asset Mix, Liquidity, asset/liability measure, credit rate, MECSR., police portfolio report:
long term asset mix, risk-free portfolio, basis for analyzing investment manager's performance.

(7) Portfolio Management Constraints
Asset type, quality, style, concentration unit, asset/liability constraints, permissible assets.

(8) Performance goals and objectives
Difference between goals of fund and goals of managers
Compare certain asset shares with appropriate passive portfolio
Use attribution analysis
Monitor compliance with policy
Change management style
Compare managers to peers

(9) Procedures and Authorization
Clarify role of individuals

Standard approval limit of buying asset
Review police annually
Coordinate subsidiaries

13.

(a) Maturity uncertainty since debt can be recalled when interest rates are low.
Price risk – Price of callable bond will be directed when interest rates decrease (negative convexity).
Reinvestment risk: When debt is called, investor will have to reinvest proceeds at lower interest rate.
Waste of time and investment costs.

(b) If refinance tax adjusted saving on coupon of $(12 - 8.5) \times 0.65 = 2.275\%$ yr.
Expenses tax adjusted $= 0.5 \times 0.65 = 0.325\%$
Call premium tax adjusted: $10 \times 0.65 = 6.5\%$

$\therefore .65 + 0.325 = 2.75\, a_{\overline{10}|}$

$a_{\overline{10}|} = 3$

$I = 31\%$.

Should Reference.

14.

(a) value of callable bond = value of straight bond – value of call option.
Value of call option = 106-104 = 2

(b) Exercise price
Time to expiry
Level of risk-free interest rates
Current bond price
Interest rate volatility
Credit worthiness of the issuer
Features of a callable bond

(c) OAS is spread to treasury curve which equates theoretical price to market price

The effect is similar to a parallel shift of the curve by amount of OAS

OAS = yield-to-maturity spread less call option yield in basis points

OAS may be used to compare the investment with a similar non-callable bond having the same effective maturity but OAS alone does not provide sufficient information to determine whether the bond is rich or cheap

(d) Effective duration of GIC is close to that of the callable bond which is good because they are closely immunized but only for small changes in interest rate.

When interest rates decline a lot the value of the call option increases. The value of the bond approaches that of the non-callable 3-year bond and the duration shortens to that of the 3-year non-callable bond. The bond will likely be called subjecting the insurer to substantial reinvestment risk (will have to reinvest at lower rates) applicable to the Coupon payments and call proceeds.

When interest rates rise a lot the value of the call option decreases and the value of bond approaches that of non-callable 10-year bond.
The duration lengthens.
It is not likely that bond will not be called, so it
May have to be sold at a loss to pay GIC outflow in year 5 (disinvestment or price risk).

The callable bond is not a suitable asset for the GIC business because there is a risk of loss whether rates increase or decrease even thought the effective durations match. A more suitable investment should be found.

ANSWER KEY

MAY 2001 COURSE 6

1. B
2. B
3. C
4. C
5. C

6. B
7. A
8. D
9. E
10. D

11. C
12. D
13. B
14. E
15. D

16. B
17. E
18. D
19. D
20. C

21. D
22. C
23. B
24. D
25. C

26. C
27. A
28. E
29. C&D
30. D

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