Financial Market and Products

Financial Market and Products

- Time value of money
- Fixed Income Securities
- Forward and Future
- Commodities
- Options
- Foreign Currency Risk
- Swap

Financial Market and Products

- Mechanics of Option Pricing
- Exotic Options
- Mortgage Backed Security

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PV of a CF is: $C_T/(1+y)^T$
FV of the bond is: $PV*(1+y)^T$

If the Rate is Semi-annual the PV is: $C_T/(1+(y_s/2))^{2T}$
PV of an Annuity: C/y
where y = YTM

Principal Only strips: receives principal payments; sold at discount; increase in value as prepayment increases; inverse relationship with interest rates

Interest Only strips: receives interest payments; investor want prepayments to be slow; positive relationship with interest rates.

Continuously compounded interest rates
$R_c = m \ln(1+(R_m/m))$
$R_m = m(e^{R_c/m} - 1)$
where R_c: continuously compounded rate;
R_m: same rate with compounding m times per year.
Equivalent annual yield
$= [1+r/n]^n - 1$; Or $e^r - 1$

Q.
The EAY of a loan with a quoted rate of 8%, compounded quarterly is equivalent to the EAY of a loan with a continuously compounded quoted rate of:

Ans.
For quarterly compounded rate, EAY = $(1+0.08/4)^4 - 1 = 0.824$
For continuously compounded loan, we want to find the value of R_c that solves = ln(1.0824) = 0.0792

- **Repo rate** is the rate at which the banks can borrow money from the central bank of the country in order to avoid scarcity of funds.
- **LIBOR** is a daily reference rate based on the interest rates at which banks offer to lend unsecured funds to other banks in the London wholesale money market.
- The n-year **zero coupon rate** is the rate of interest earned on an investment that starts today and lasts for n years.
- The **Yield Curve** describes the yield differential among treasury issues of differing maturities.

B

Day count conventions

Actual/actual: T-bond
30/360: US corporate & municipal bond.
Actual/360: T-bills & other market instrument

Q.
The price of a 91-day T-bill is 8%. Find the dollar amount of interest paid over the 91 day period and the corresponding rate of interest.

Ans.
Dollar interest is $100*0.08*91/360 = $2.0222
Rate of interest = 2.022/(100-2.0222) = 2.064%

Types of Bonds:
- **Call feature/bond** – allows the issuer to redeem /pay-off the bond prior to maturity, usually at a premium
- **Retractable bonds** – allows the holder to sell the bonds back to the issuer before maturity
- **Extendible bonds** – allows the holder to extend the maturity of the bond
- **Sinking funds** – funds set aside by the issuer to ensure that the firm is able to redeem the bond at maturity
- **Convertible bonds** – can be converted into common stock at a pre-determined conversion price
- **Zero coupon Bond** – does not pay any coupon during the tenure of the bond
- **High Yield Bond** – low rating high risk bond with relatively high yield
- **Inflation Linked Bonds** – allows the holder to mitigate risk against inflation

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Bond portfolio structure

Barbell: manager uses bonds with short and long maturity
Bullet: manager buys bonds concentrated in the intermediate maturity range
If a bullet and a barbell have the same duration, the barbell portfolio have greater convexity and is related to the square of maturity

Q.
Which of the following is TRUE?
i. A barbell portfolio will have a smaller convexity than a bullet portfolio with

will be greater than the duration of a coupon bond of the same maturity.
iii. Duration and convexity are based, respectively, on the first and second derivatives of price with respect to yield.
iv. Convexity increases with the square of a bond's duration.
a) I and II. b) II and III. c)III only. d) I, III, and IV
Ans. B

Bond Price
C = coupon payment
T = Time to maturity
r = interest rate/required yield
F = value at maturity,/par value

$$P_0 = \sum_{t=1}^{T} \frac{C}{(1+r)^t} + \frac{F}{(1+r)^T}$$

Clean and dirty price

Clean price: Bond price without accrued interest
Dirty price: Includes accrued interest;
Flat price (Clean price) = Full price (Dirty price)- Accrued Interest

Q.
A US corporate bond (30/360 days convention with 10% coupon pays semiannually on Jan 1 and July 1. Assume that today is April, 1, 2005 and the bond matures on July, 1, 2015. Compute the Dirty price and Clean Price of the bond, if the required annual yield is 8%.
Ans.
Use Calculator, N=21, PMT = 50, 1/Y= 4, FV=1000,CPT = PV = 1,140.29; Then 90 days later, on April, 1, 2005, the DP = 1,140.29 *(1.04)^.5 = $1,162.87
CP = DP - AI (1000*.1*.25) = $1,162.87- $25 = 1,137.87

Duration & convexity

BA

Bond Yields:
Coupon yield: Coupon payment (C) divided by the face value = C / F
Current yield: Coupon payment (C) divided by the bond price = C / P0.
Yield to maturity: (YTM) is the discount rate which returns the market price of the bond, is also called IRR.

$$MP = \sum_{t=1}^{T} \frac{C}{(1+YTM)^t} + \frac{F}{(1+YTM)^T}$$

- When Bond sells at a discount: YTM > coupon yield.
- When Bond sells at a premium coupon yield > YTM.
- When bond sells at par: YTM = coupon yield.

YTM: Bond prices go down when the YTM goes up and vice-versa.
Term to maturity – long maturity bonds have greater price volatility than short maturity bonds
Size of coupon – low coupon bonds have greater price volatility than high coupon bonds

Q.
A Fixed income instrument offers annual payment of $90 for 10 years. The current Value of the instrument is $ 950. Calculate YTM on this security.
Ans.
Use Financial calculator, N=10, PMT = 90, PV = -950; CPT = 1/Y = 9.81%

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BA

- Duration
- Duration hedging
- Characteristics of Duration
- Convexity

Duration : First derivative of the price/yield relationship; the longer (shorter) the duration, more (less) sensitive the bond's price to change in interest rates; can be used for linear estimates of bond price changes

Macaulay duration: Weighted average term to maturity of a bond's cash flows
Modified duration (D*): In case of n times compounded yield, the Macaulay Duration is not valid anymore & Modified duration is used

$$D^{*} = \frac{\text{Macaulay Duration}}{1 + (r / n)}$$

Where r is the yield to maturity of the bond, and n is the number of cash flows per year.

$$\text{Effective Duration} = \frac{(BV_{-\Delta y} - BV_{+\Delta y})}{2 * BV_{0} * \Delta y}$$

DV01: Dollar value of basis point is the absolute change in the bond price from one basis change in yield DV01 = $|$price at YTM_0 - price at $YTM_1|$

Duration Hedging:

1. Hedge ratio: [DV01 (per $100 of initial position)* beta]/ DV01 of hedging instrument)
2. Hedge ratio: $P*D_P/(F_C*D_F)$; where
   P = portfolio value;
   D_P = Duration of Portfolio;
   F_C = Future position with a contract;
   D_F = Duration of future contract

Q.
Using a semiannual compounding, compute DV01 for 10 yrs, 5% bond that is yielding 4.5%.
Ans.
Price at 4.49%: N=10*2, PMT = 5/2, 1/Y= 4.49/2, FV=100, CPT = PV
Price at 4.5%: N=10*2, PMT = 5/2, 1/Y= 4.5/2, FV=100, CPT = PV.
Please note: The PV is always negative value.

Q.
Royal Bank has a $25 million par position in a 5-year, zero-coupon bond that has a market value of $19,059,948. The modified duration of the bond is closest to:
Ans.
YTM of the bond is, PV = -19,059,948, N= 10, PMT = 0, 5.5.%.
Macaulay duration is equal to maturity for a zero-coupon bond, so modified duration = 5/(1+0.055/2) = 4.866 years.
Please note: while inserting PV type it as a negative value.

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Duration | Duration hedging | Characteristics of Duration | Convexity

Q.
Ceteris paribus, the duration of a bond is positively correlated with the bond's
A. time to maturity B. coupon rate
C. yield to maturity D. all of the above
Ans. A

Q.
Given the time to maturity, the duration of a zero coupon bond is higher when the discount rate is
A. higher
B. lower
C. equal to the risk free rate
D. independent of the discount rate
Ans.
Duration of the Zero Coupon Bond is its term to maturity.

Q.
Holding other factors constant, which one of the following bonds has the smallest price volatility?
a. 5-year, 20% coupon bond; b. 5-year, 12% coupon bond
c. 5 year, 14% coupon bond; d. 5-year, 0% coupon bond
Ans.
A.Higher the sensitivity of the bond to its interest rate, higher the volatility

- Maturity increases, duration increases;
- Coupon increases, duration decreases ;
- Yield decreases, duration increases.

Zero coupon bond :The duration is equal to the bond's term to maturity. Therefore, the longest durations are found in stripped bonds or zero coupon bonds. These bonds have the greatest interest rate elasticity.

Convexity : Second derivative of the price/yield relationship. Price change for larger interest rates estimated by duration and convexity are more precise since convexity can capture the curvature

$$\text{Convexity Approximation} = \frac{P_+ + P_- - 2P_0}{2 * P_0 * (\Delta y)^2}$$

$$\frac{\Delta P}{P} = -D_m * \Delta y + \frac{(\Delta y)^2}{2} * \text{Convexity}$$

The convexity relationships imply that a larger price increase occurs with a yield decrease than a price decrease associated with an identical yield increase

Q.
Evaluate, at the same yield, the investment that is expected to have the greatest convexity is
a. 10 year zero- coupon bond
b. Portfolio with a duration of 10 yrs that contains a 5 year and a 15 year zero- coupon bond
c. 6% coupon bond of 10 year duration
d. Callable 6% coupon bond of 10 year duration
Ans. B

Q.
A bond has effective duration of 7.5 and a convexity of 104, if the yield rise by 82 bps, the price of the bond will:
Ans.
% price change = [-duration *Δy*100+ + *(1/2)*convexity*Δy^2 *100+ =Decrease by 5.8%

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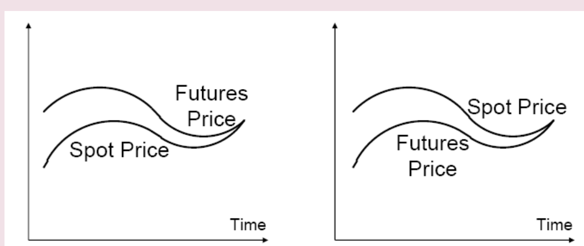
Futures Contracts: Agreement to buy or sell an asset for a certain price at a certain time. Its is traded on an exchange.
Forward Contracts : Forward contracts are similar to futures except that they are traded Over the Counter (OTC) **Spot rate**: A t-period spot rate is the Yield to Maturity of on a Zero Coupon Bond that matures in t-years.
Forward Rates: Forward rates are interest rate between two dates in future as implied by the spot rates
$F_{21} = (S_2T_2 - S_1T_1) / (T_2 - T_1)$, where
F_{21} = Forward rate b/w time T_2 and T_1
S_1 and S_2 = Spot rate for maturity T_1 and T_2 respectively
Backwardation: Spot price is higher than the future price (high convenience yield compared to the cost i.e. rate of interest) 2nd Graph.
Contago vice versa 1st Graph.
The cost of carry is the storage cost plus the interest costs less the income earned



Q.
If 1 & 1.5 years' spot rates are 1.8% and 2.2%, the 6-month forward rate on an investment that matures in 1.5 years is :
Ans.
(2.2%*1.5 - 1.8%*1)/0.5 = 3%

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Investment Asset

$F_0 = S_0\, e^{rt}$, for non yielding asset

$F_0 = S_0\, e^{(r-d)t}$, continuous dividend paying stock

$F_0 = (S_0 - I)e^{rt}$, discrete dividend paying stock,

Foreign Exchange

$F_0 = S_0\, e^{(r-rf)t}$, Currency Forward Commodity

$F_0 = S_0\, e^{(r-\delta)t,}$ for commodity with lease rentals

$F_0 = (S_0 + M)\, e^{rt}$, commodity with storage costs

$F_0 = S_0\, e^{(r+\lambda-c)t}$, commodity with convenience yields

Consumption Commodities

$F_0 <= (S_0 + M)\, e^{rt}$

Where r = annual interest rate,
t = Time period d= % of annual dividend
I = the PV of dividend received.
rf = foreign currency domestic risk free rate
M is the PV of storage costs
δ= lease rate (cost of borrowing the commodity)
c= % annual convenience yield (CY is the benefit of owing the consumable asset)
λ= % annual storage cost

Short selling involves selling securities that is not owned.

Q.
Current 1-year forward exchange rate is 1.200 USD /EUR. An American bank pays 2.4% annual interest rate on a 1-year deposit and a 4.0% annual interest rate on a 3-year USD deposit. A European bank pays a 1.5% annual interest rate for a 1-year deposit and a 2.0% annual interest rate for a 3-year EUR deposit. The forward exchange rate in USD per EUR for exchange 3 years from today is closest to:

Ans.
The 2 year forward rate in US = $\sqrt{[(1.04)^3 / 1.024]} - 1 = 4.81\%$
The 2 year forward rate in Europe = $\sqrt{[(1.02)^3 / 1.015]} - 1 = 2.25\%$
The forward exchange rate in USD per EUR for exchange three years: $1.2 * (1.0481^2) / (1.0225^2) = 1.261$

Arbitrage

1. If $F_0 > S_0 e^{rT}$, borrow loan, buy spot, sell forward today, deliver asset, repay loan at the end
2. If $F_0 < S_0 e^{rT}$, Short sell the asset, invest the proceeds at risk-free rate, buy forward today, collect loan buy asset under forward contract, deliver to cover short sale

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Forward Valuation

For non yielding asset : $f = (F_0 - K)\,e^{rt}$
For continuous yielding underlying :
$$f = S_0 e^{-dt} - Ke^{rt}$$
For discrete dividend paying stock :
$$f = S_0 - I - Ke^{rt}$$
K is delivery price in a forward contract
F_0 is forward price that would apply to the contract today

Forward Rate Agreements

Forward Rate Agreement (FRA) is an agreement to pay or receive a certain rate between two future dates :
$$FRA = N(F_0 - F_t)\,(T_2 - T_1)\,e^{-r(T_2 - t)}$$

FRA = Value of the FRA to receive fixed rate at time t
N = Notional Amount ;
F_t = Forward rate between time T_2 and T_1 quoted at time t
F_0 = Rate between time T_2 and T_1 quoted at time 0
r = Risk free rate

Q.
FRA that settles in 30 days, $1 million notional, based on 90-day LIBOR, Forward rate of 5%, Actual 90-day LIBOR at settlement is 6%
Ans.
ΔI = (6% - 5%) * (90/360)* $1m = $2,500
PV= 2,500 / (1 + (90/360)*6%) = $2,46

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Q.
Suppose the σ of short rate changes is 1.2%. Find the forward rate when the 8-year euro-dollar futures price quote is 94. The time to maturity is 8 yrs, whereas the maturity of the rate underlying the futures is 8.25 years. Find the convexity adjustment and hence the forward rate.
Ans.
Forward rate = [6% pa/360 (qtrly)]/ [365/90*log(1+.06/4)] - ½*0.0122*8 *8.25 = 5.563 %

Q.
A fund manager has $10 mn invested in a portfolio of government bonds with a duration of 6.80 years and wants to hedge against interest rate moves between Aug and Dec. How many Dec T-bond futures should manager use.
Ans.
The futures price is 93-02 or 93.0625 and the duration of the CTD bond is 9.2 years = (10,000,000*6.8) / (93,062.5*9.2) = 79.

Q.
If the quoted price for the June 2006 Eurodollar futures contract is 96.89, the value of one contract is closest to
Ans.
$992,225

Cheapest-to-deliver (CTD)
The party with the short position will have an option to deliver the CTD bond, a CTD bond is for which the following is the least:
Quoted spot price - (Quoted futures price x Conversion factor)

- **T Bill**: The cash Price is: (100 - Y)* 360/n where Y is the Quoted Price(QP)in the market.
- **T-Bill Futures quoted price Z** = 100 - (360/n)* (100 - Y)
- **The T-Bill futures cash invoice price** =10,000[100 - (n/360)*(100 - Z)]
- **T Bond Cash price** = QP +AI
- **T Bond Futures price** = (quoted futures price) × (conversion factor) +AI
- **Eurodollar Future**: is a future based on Eurodollar deposits.
- **Contract Price** = 10,000*[100 - 0.25*(100 - Q)]

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Forward and Future

- Future & Forward Prices
- Hedging using futures

Basis Risk: Arises out of two reasons

a) The properties of the underlying under the contract and the asset to be hedged are different

b) The maturity date of the future contract is different than the date at which asset is to be sold or bought

Basis = Spot price to asset to be hedged - Futures price of the contract

Strengthening of Basis = Basis increase is good for short hedge and bad for long hedge

Weakening of Basis = Basis declines is good for long hedge and bad for short hedge

Q.

Under which scenario is basis risk likely to exist?

a. A hedge (which was initially matched to the maturity of the underlying) is lifted before expiration.

b. The correlation of the underlying and the hedge vehicle is less than one and their volatilities are unequal.

c. The underlying instrument and the hedge vehicle are dissimilar.

d. All of the above are correct.

Ans. d.

Optimal hedge Ratio:

$$h^* = \frac{Cov(S,F)}{\sigma_F^2} = \rho * \frac{\sigma_S}{\sigma_F}$$

Where σ_S is the σ of spot price changes;

σ_F is the σ of futures price changes;

ρ is the correlation btw Spot & future prices

Hedging with Futures: (β * P)/ A where P is the value of the portfolio, A is the value of the assets underlying one futures contract

Q.

Current S & P 500 future is 1,167 and the manager wants to reduce the Beta from 1.20 to .85. Value of the portfolio is $5 mn and the index multiplier is 250, the stock index futures position taken is :

Ans.

Short 6 contracts

Q.

In August a fund manager has $10 million invested in a portfolio of government bonds with a duration of 6.80 years and wants to hedge against interest rate moves between August and December. The manager decides to use Dec T-bond futures. The futures price is 93-02 or 93.0625 and the duration of the cheapest to deliver bond is 9.2 years. The number of contracts that should be shorted is:

Ans.

$$\frac{10,000,000}{93,062.50} \times \frac{6.80}{9.20} = 79$$

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Commodities

The forward price on Any financial asset

$$F_{0,T} = S_0 e^{(r-\delta)T}$$

Difference b/w Commodities and Financial assets

1. Storage costs: Costs of storing the commodity
2. Carry markets: A market in which commodity is stored.
3. Lease rate: the amount of interest a lender of commodity needs.
4. Convenience yield: Holding an Excess amount of commodity for a non monetary return. The forward Price including the convenience yield

   $F_{0,T} \geq S_0 e^{(r+\lambda-c)T}$

   If storage costs are paid continuously And are proportional to the value of Commodity,

   $F_{0,T} = S_0 e^{(r+\lambda)T}$

The effective annual Lease rate

$$\delta_l = r - \frac{1}{T} \ln (F_{0,T} / S)$$

Where δ_l is continuous lease rate
r is the risk free rate

No arbitrage pricing

$$S_0 e^{(r+\lambda-c)T} \leq F_{0,T} \leq S_0 e^{(r+\lambda)T}$$

The upper bound depends on Storage costs but not on the Convenience yield. The lower bound adjusts for the Convenience yield.

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Time value of money

Fixed Income Securities

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Swap

It involves option pricing, factor affecting option pricing, American option, European option, put-call-parity, volatility smiles, Greeks, and Exotic option

Factors affecting an option price

Option price bounds

Rules for exercising American Option

Put Call Parity

Binomial Option pricing

Black Scholes-Merton Model

Option trading strategies

Greeks

Volatility smiles

Variable	c	p	C	P
S_0	+	-	+	-
K	-	+	-	+
T	?	?	+	+
σ	+	+	+	+
r	+	-	+	-
D	-	+	-	+

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Options:

Factors affecting an option price | Option price bounds | Rules for exercising American Option | Put Call Parity | Binomial Option pricing | Black Scholes-Merton Model | Option trading strategies | Greeks | Volatility smiles

Upper bound European/American call: $c <= S_0$; C<=S0
Upper bound European/American put: $p <= Xe^{-rT}$; P<=X
Lower bound European call on a non dividend paying stock
$c >= \max(S_0 - Xe^{-rT}, 0)$
Lower bound European put on a non dividend paying stock
$p >= \max(Xe^{-rT} - S_0, 0)$

Q.
If the current USD/AUD rate is 0.6650 (1 AUD=0.6650 USD) and the risk-free rates for the USD and AUD are 1.0% and 4.5% respectively, what is the lower bound of a 5-month European put option on the AUD with a strike price of 0.6880?
Ans.
Lower bound = 0.6880 x [exp-(0.01x 5/12)] -0.6650 x [exp-(0.045x 5/12]]
= 0.6880 x (0.9958) -0.6650 x (0.9814)=0.04

Q.
According to Put Call parity for European options, purchasing a put option on ABC stock will be equivalent to
a. Buying a call, buying ABC stock and buying a Zero Coupon bond.
b. Buying a call, selling ABC stock and buying a Zero Coupon bond.
c. Selling a call, selling ABC stock and buying a Zero Coupon bond.
d. Buying a call, selling ABC stock and selling a Zero Coupon bond
Ans. B

Early Exercise:
- It is never optimal to exercise an American call on a non-dividend paying stock before its expiration date
- American Put can be optimally exercised early if they are sufficiently in-the money
- An American call on a dividend paying stock may be exercised early if the dividend exceeds the amount of forgone interest

Q.
Early exercise of an option is more likely for:
i. European calls options on stocks paying large dividends.
ii. American call options on stocks paying small dividends.
iii. American call options close to maturity.
iv. American put options on stocks paying large dividends
a. I and IV. b. II and IV. c. III only. d. III and IV.
Ans. C

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Put Call Parity

$P+S_0=C+Xe^{-rT}$

Q.
Consider a 1 year European call option with a Strike price of $27.50 that is currently valued at $4.1 on a $25 stock. The 1 year risk free rate is 6%. Which of the following is the closest to the value of the corresponding put option

Ans.
$p = c + D - S_0 + X_e$
=5

Binomial Option pricing

- **Binomial Pricing**: At each step, it is assumed that the underlying instrument will move up or down by a specific factor (u or d) per step of the tree. So, if S is the current price, then in the next period the price will either be: $S_{up} = S*u$ and $S_{down} = S*d$; where $U=e^{\sqrt{\sigma}}$ and $D=1/U$.
- At each final node of the tree i.e. at expiration of the option the option value is simply its intrinsic, or exercise value. The following formula is applied at each node: European Option Payoff = [p x $Option_{up}$ + (1-p) x $Option_{down}$] x exp^{-rt}

Q:
Assume that a binomial interest-rate tree indicates a 6-month period spot rate of 2.5%, and the price of the bond if rates decline is 98.45, and if rates increase is 96. The risk-neutral probabilities respectively associated with a decline and increase in rates if the market price of the bond is 97 correspond to:

Ans.
[p*98.45 + (1-p)*96] / [1+ (0.025/2)] = 97

Black Scholes-Merton Model

$$c = S_0 N(d_1) - Xe^{-rT} N(d_2)$$

$$p = Xe^{-rT}[1 - N(d_2)] - S_0[1 - N(d_1)]$$

$$d_1 = \frac{\ln\left(\frac{S_0}{K}\right) + \left(r + \frac{\sigma^2}{2}\right) * T}{\sigma * \sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

Q.
The stock price is $25. A put option with a $20 strike price that expires in 6 months is available. $N(-d_1)$ = 0.0263 and $N(-d_2)$ = 0.0349. If the underlying stock exhibits an annual σ of 25%, & the continuously compounded risk-free rate is 4.5%, the BSM value of the put is:

Ans.
$p = Ke^{-rt} N(-d_2) - S_o N(-d_1) = \$0.03$

$N(d_1)$ is the delta of the option and therefore $S_0N(d_1)$ represents the current price of delta.
$N(d_2)$ is the probability that a call option will be exercised, 1- $N(d_2)$ is the probability that a put option will be exercised,

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Option trading strategies

- **Covered call**: Long stock plus short call
- **Protective Put**: Long stock plus long put, also called portfolio insurance
- **Bull spread**: Purchases call option with low Strike price, & subsidized the purchase with sale of a call option with a higher Strike price
- **Bear spread**: Purchase call with high strike price, short call with low strike price. Bear spread with puts involves buying put with high exercise price and selling put with exercise price. Both the option has same expiry date in bull and bear Spreads
- **Butterfly spread**: 3 different options. Buy 1 call with low exercise price, another with high exercise price, & short 2 calls with an exercise price in b/w. Butterfly buyer is betting the stock will stay near the price of the written calls
- **Calendar spread**: 2 options with different expiration. Sell a short dated option & buy a long dated option. Investor profits if stock price stays in a narrow range.
- **Long straddle**: Bet on volatility, buy a call & a put of same exercise price & expiration date. Profit is earned if stock price has a large change in either direction
- **Strangle**: Similar to straddle except purchased option is out-of-the money, so it cheaper to implement. Stock price have to move more to be profitable
- **Strips & Straps**: **Strip**: when downside move is expected to be more likely, buy two puts and one call of same strike and expiry. **Strap**: when upside move is expected to be more likely, buy two calls and one put of same strike and expiry.

Q.
Long on a Call and short on a put on the same stock with higher strike price and same maturity is called
a. Calendar Spread
b. Butterfly Spread
c. Bear Spread
d. Bull Spread
Ans. D

Q.
In a butterfly spread
a. Both the upside & downside are unlimited
b. Both the upside and downside are limited
c. The upside is unlimited, but downside is limited
d. The upside is limited, but downside is limited
Ans. B

Q.
An investor constructs a strap and buys 2 calls with Strike price of $40 at $3 each and One put with Strike price of $40 at $2. If the price of the underlying asset is $46, what is the Profit/Loss on the position?
Ans. 6

Financial Market and Products

- Time value of money
- Fixed Income Securities
- Forward and Future
- Commodities
- Options
- Foreign Currency Risk
- Swap

Options:

- Factors affecting an option price
- Option price bounds
- Rules for exercising American Option
- Put Call Parity
- Binomial Option pricing
- Black Scholes-Merton Model
- Option trading strategies
- Greeks
- Volatility smiles

Greeks:

- Delta
- Theta
- Gamma
- Vega
- Rho

Delta: estimates the change in value of an option for a unit change in stock price.
A delta of 0.5 means that price of a call option will change by $0.5 for $1 change in value of the stock.
Call options delta:
0 for deep out of money;
0.5 for at the money;
1 for deep in the money,
Put option delta:

- 1 deep in the money,
- 0.5 for at the money and
- 0 for deep out of money.

Delta of a option = δ_c/δ_s
Delta of a forward position is equal to 1
Delta of Future = e^{rt}

Theta: Time decay, most negative when option is at the money & close to expiration Theta is negative because as time passes the value of both calls and puts decreases..

Gamma: rate of change in delta as underlying stock price change (also Convexity); largest when option is ATM, which indicates that option price changes very fast as Stock price changes.
ITM options and OTM options have low gammas.
As the maturity nears, the option gamma increases.
Fixed coupon bonds, have positive convexity. Positive gamma is beneficial, it implies that value of the asset drops more slowly and increases more quickly.
Long positions in options, (calls or puts), create positive gamma

Delta Neutral Hedging:

- To completely hedge a short call position, purchase no. of shares of stock=delta*no. of options sold.
- Only appropriate for small changes in the value of underlying asset
- Gamma can correct hedging error by protecting against large movement in asset price
- Gamma neutral positions are created by matching portfolio gamma with an offsetting option position.

Q.
An existing option short position is delta neutral, but has a -5,000 gamma exposure. An option is available that has a gamma of 2 and a delta of 0.7. What actions should be taken to create a gamma neutral position that will remain delta neutral?
a. Go long 2,500 options and sell 1,750 shares of the underlying stock.
b. Go short 2,500 options and buy 1,750 shares of the underlying stock.
c. Go long 10,000 options and sell 1,750 shares of the underlying stock.
d. Go long 10,000 options and buy 1,750 shares of the underlying stock
Ans.
A, - Gamma means we are short on options, to create a gamma-neutral portfolio (5000/2) = 2,500 long option. However this will change the position from delta-neutral portfolio to 2,500*.7 = 1,750 long delta. So sell 1,750 shares to be gamma and delta neutrality.

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    - Theta
    - Gamma
    - Vega
    - Rho
  - Volatility smiles
- Foreign Currency Risk
- Swap

Q.
At the money options close to the maturity tend to have a high
a. Rho b. Gamma c. NPV d. Vega
Ans. B

Q.
Which of the following have –Delta
a. Strangle b. Straddle c. Bear Spread d. Bull Spread
Ans. C

Vega: sensitivity of the option price to changes in the volatility of the underlying stock, highest for long-term ATM options. close to 0 when option is deep ITM or OTM; Vega decreases with maturity.

Rho: sensitivity of the option price to changes in the Risk free rate. Largest for ITM option "ITM" calls and Puts are most sensitive to changes in the rates than "OTM"

Q. True or False
a. Theta affects the value of a call and a put in similar way. **True**
b. Theta is more pronounced when the option is "in the money". **False**
c. Theta usually decreases in absolute terms as expiration approaches. **False**
d. It is possible for a European put option that is "in the money" to have a positive theta value. **True**
e. Rho for fixed income is small. **False**
f. Call option delta range from 0 to 1. **True**
g. A Vega of.1 suggests that for 1% increase in volatility, the option price will increase by $.10. **True**
h. Theta is the most negative for OTM options. **False**
i. Options are most sensitive to changes to volatility, when they are "At the money". **True**

Q.
An investor is looking to create an options' portfolio on XYZ stock that will have virtually zero Vega exposure while maximizing the ability to profit from increases in interest rates. If the current price of XYZ is $50, which of the following would accomplish his goals?
I. Sell a call with Strike price (SP) 50 II. Buy a call with a SP of 25.
III. Sell a put with a SP of $75. IV. Buy a put with a SP of $25.
a) I only b) II and III
c) II and IV d) III and IV
Ans. B

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    - **Currency option**: implied volatility is lower for ATM option than it is for away from the money option

      Equity option: have volatility skew, the volatility decreases as the strike price increases, i.e. volatility used to price a low-strike-price option is higher than that used to price a high-strike-price option
- Foreign Currency Risk
- Swap

Financial Market and Products

- Time value of money
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A net long (short) currency position means a bank faces the risk that the FX rate will fall(rise) versus the domestic currency.

a) On-Balance Sheet hedging: matched maturity and currency foreign asset-liability book.

b) Off-Balance Sheet hedging: enter into a position in a forward contract

Q.

A bank has a USD50mn portfolio available for investing. Cost of funds for the USD50mn is 4.5%. The bank lends 50% of the assets to domestic customers at an loan rate of 6.25%. The rest of the portfolio is lent to UK clients at 7%. The current exchange rate is USD1.642/GBP. At the same time, the bank sells a forward contract equal to the expected receipts one year from now. The forward rate is USD1.58/GBP. What is the weighted average return to the bank.

Ans.

The return from domestic customers is 6.25%,

The return from UK customers, $25,000,000/1.642 = GBP 15,225,335GBP*1.07 = GBP 16,291,108.

The bank sells a forward contract: GBP 16,291,108*1.58= USD 25,739,951

Earnings (USD 25,739,951 - 25,000,000)/ 25,000,000 = 2.96%

Weighted average return = 6.25%*0.5 + 2.96%*0.5 = 4.61%

Financial Market and Products

Time value of money | Fixed Income Securities | Forward and Future | Commodities | Options | Foreign Currency Risk | Swap

Swap: Comparative advantage | Interest rate swap | Currency Swap

Comparative advantage

Co.	Fixed Rate	Floating Rate
A	4%	L + 20
B	5%	L + 60

In this example, Company A has absolute advantage in fixed and floating rate. Assume B & A wants to raise money in a fixed and floating rate respectively, However, comparatively B has to pay 1% higher than A on fixed rate but only 0.4% higher than A on floating rate. Therefore B has comparative advantage in raising loan on floating rate interest and A in fixed rate.

Interest rate swap

- One party pays fixed and other pays depending on the floating reference rate (LIBOR is the reference rate)
- At inception, the value of a swap is 0.
- After inception, the value for the swap is the difference b/w the PV of the remaining fixed & floating rate payments.
  V swap to pay fixed $= B_{float} - B_{fixed}$
  V swap to receive fixed $= B_{fixed} - B_{float}$

Q.
A bank entered into a 5-year $150 million annual-pay LIBOR-based interest rate swap three years ago as the fixed rate payer at 5.5%. The relevant discount rates (continuously compounded) for 1 year and 2-year obligations are currently 5.75% and 6.25%, respectively. A payment was just made. The value of the swap is closest to:

Ans.
Fixed rate Coupon = $150* 0.055 = $8.25 million;

$B_{fixed} = 8.25e^{-0.0575} + 158.25e^{-0.0625*2} = \$147.44$

$B_{floating} = \$150$ million;

Value of Swap = $150 - $147.44 million = $2.56 million

Q.
Which of the following regarding the payoff of a 1-period risky swap to a risk-free counterparty paying a fixed amount and receiving a variable is (are) TRUE?

i. The payoff profile is the same as a short position on a put option and a long position on a call.
ii. The payoff profile is the same as a long position on a put option and a short position on a call.
iii. If the correlation between the risky counterparty and the variable payment declines, the potential payoff is unaffected.
iv. If the correlation between the risky counterparty and the variable payment declines, the potential payoff is affected.

a) I only b) II only c) II and III d) I and IV

Ans. D

Financial Market and Products

Time value of money | Fixed Income Securities | Forward and Future | Commodities | Options | Foreign Currency Risk | Swap

Swap:
- Comparative advantage
- Interest rate swap
- Currency Swap

Currency Swap:

Exchange payments in 2 different currencies; payment can be fixed or floating; If a swap has a positive value to one counterparty that party is exposed to credit risk.

Q.
Bank One enters into a 5-year swap contract with Mervin Co. to pay LIBOR in return for a fixed 8% rate on a nominal principal of $100 million. Two years from now, the market rate on 3-year swaps at LIBOR is 7%; at this time Mervin Co. declares bankruptcy and defaults on its swap obligation. Assume that the net payment is made only at the end of each year for the swap contract period. What is the market value of the loss incurred by Bank One as result of the default?

a.$1.927 million b.$2.245 million c.$2.624 million d.$3.011 million

Ans.
C; At the new swap rate, the replacement cost on the swap is $1 million a year discounted at 7% for each of the 3 years, which is $2.624 million.

Q.
Which of the following swap positions can be used to transform a floating-rate asset into a fixed-rate asset?

a. Receive the floating-rate leg and receive the fixed-rate leg of a plain vanilla interest-rate swap.
b. Pay the fixed-rate leg and receive the floating-rate leg of a plain vanilla interest-rate swap.
c. Pay the floating-rate leg and pay the fixed-rate leg of a plain vanilla interest-rate swap.
d. Pay the floating-rate leg and receive the fixed-rate leg of a plain vanilla interest-rate swap.

Ans. D

Financial Market and Products

Mechanics of Option Pricing

Types of Options:
Call Option
Put Option

Underlying Assets:
Stock Option
Currency Option
Index Option
Future Option

Non Standard Products:
- FLEX Options
- ETF Options
- Weekly Options
- Binary Options
- CEBOs
- DOOM Options

Exotic Options

Non Standard Features:
- **Bermuda Option**: Early Exercise may be restricted to certain dates
- **Lock out period:** Early Exercise allowed during only a part of the life of the option

Types of Exotic Options:
- GAP Options
- Forward Start Option
- Cliquet Options
- Chooser Options
- Barrier Options
- Binary Option
- Look-back Options
- Shout Options
- Asian Options
- Exchange Options
- Rainbow Options
- Volatility/ Variance swaps

Static Option Replication
- Deals with hedging of exotic option position
- Involves searching for a portfolio of actively traded regular options whose value matches the value of the exotic option on some boundary
- Shorting this portfolio will hedge the exotic option position

Mortgage Backed Security

Types of MBS:
- **Agency fixed rate and pass trough's**

Excess Servicing = Loan rate – servicing fees – guarantee fees – pass through loan coupon rate
- **Agency Adjustable Rate Pools and Pass Trough's**
- **Private Label Pools and Pass Trough's**
- **Agency Mortgage Strips**
- **Private Label Mortgage Strips**

Dollar roll transactions:
A dollar roll transaction occurs when an MBS market maker buys position for one settlement months and sells those same positions for another month at the same time.

Dollar Roll to Trade Special:
When the price drop
Is large enough resulting in financing cost to be less than the implied cost of funds, then the dollar roll is trading special.

Thank you!

Contact:

E: help@edupristine.com

Ph: +1 347 647 9001