Reading 5: The Behavioral Finance Perspective

1. Expected utility (U) = Σ (U values of outcomes × Respective Prob)

2. Subjective expected U of an individual =Σ [u (xi) × Prob (xi)]

3. Bayes' formula = P (A|B) = [P (B|A) / P (B)]× P (A)

4. Risk premium = Certainty equivalent – Expected value

5. Perceived value of each outcome = = U = w (p_1) v (x_1) + w (p_2) v (x_2) + … + w (p_n) v (x_n)

6. Abnormal return (R) = Actual R – Expected R

Reading 8: Managing Individual Investor Portfolios

1. After-tax (AT)*Real* required return (RR) % $= \frac{\text{Client's required expenditures in Year n}}{\text{Net Investable Assets}} = \frac{\text{Projected needs in Year n}}{\text{Net Investable Assets}}$

2. AT*Nominal* RR % = $\frac{\text{Projected needs in Year n}}{\text{Net Investable Assets}}$ + Current Annual (Ann) Inflation (Inf) % = AT real RR% + Current Ann Inf% *Or*

   AT*Nominal* RR% = (1 + AT Real RR%) × (1 + Current Ann Inf %) – 1

3. Total Investable assets = Current Portfolio -Current year cash outflows + Current year cash inflows

4. Pre-tax income needed = AT income needed / (1-tax rate)

5. Pre-tax Nominal RR = (Pre-tax income needed / Total investable assets) + Inf%

<u>If Portfolio returns are tax-deferred:</u>

6. Pre-tax projected expenditure $ = AT projected expenditure $ / (1 – tax rate)

7. Pre-tax real RR % = Pre-tax projected expenditures $ / Total investable assets

8. Pre-tax nominal RR = (1 + Pre-tax real RR %) × (1 + Inflation rate%) – 1

<u>If Portfolio returns are NOT tax-deferred:</u>

9. AT real RR% = AT projected expenditures $ / Total Investable assets

10. AT nominal RR% = (1 + AT real RR%) × (1 + Inf%) – 1

11. Procedure of converting nominal, pre-tax figures into real, after-tax return:
    - Real AT R = [Expected total R – (Expected total R of Tax-exempt Invst × wt of Tax-exempt Invst)] × (1 – tax rate) + (Expected total R of Tax-exempt Invst × wt of Tax-exempt Invst) – Inf rate

      Or
    - Real AT R =[(Taxable R of asset class 1 × wt of asset class 1) + (Taxable R of asset class 2 × wt of asset class 2) + …+ (Taxable return of asset class n × wt of asset class n)] × (1 – tax rate) + (Expected total R of Tax-exempt Invst × wt of Tax-exempt Invst) – Infrate

Reading 9: Taxes and Private Wealth Management in a Global Context

1. Average tax rate = Total tax liability / Total taxable income

2. AT Return = r × $(1 – t_i)$

3. AT Future Accumulations after n years = $FVIF_i$= Initial Invst × $[1 + r (1 – t_i)]^n$

4. Tax drag ($) on capital accumulation = Acc capital without tax – Acc capital with tax

5. Tax drag (%) on capital accumulation = (Acc capital without tax – Acccapital with tax) / (Acc capital without tax – Initial investment)

6. Returns-Based Taxes: Deferred Capital Gains:

- AT Future Accumulations after n years = $FVIF_{cg}$= InitialInvst. × $[(1 + r)^n (1 – t_{cg}) + t_{cg}]$
- Value of a capital gain tax deferral = AT future accumulations in deferred taxes – AT future accumulations in accrued annually taxes

7. Cost Basis
   - Capital gain/loss = Selling price – Cost basis
   - AT Future Accumulation = $FVIF_{cgb}$= Initial Invst × $[(1 + r)^n (1 – t_{cg}) + t_{cg} – (1 – B) t_{cg}]$ =Initial Invst × $[(1 + r)^n (1 – tcg) + (tcg × B)]$
     Where, B = Cost basis
     tcg × B = Return of basis at the end of the Invst.horizon.
     When cost basis = initial Invst➔B=1, $FVIF_{cg}$=Initial investment × $[(1 + r)^n (1 – t_{cg}) + t_{cg}]$

8. Wealth-Based Taxes
   - AT Future Acc = $FVIF_w$ = Initial Invst $[(1 + r) (1 – t_w)]^n$
     Where, t_w = Ann wealth tax rate

9. Blended Taxing Environments
   a) Proportion of total return from Dividends (p_d) which is taxed at a rate of t_d.
      p_d = Dividends ($) / Total dollar return
   b) Proportion of total return from Interest income (p_i) which is taxed at a rate of t_i.
      p_i = Interest ($) / Total dollar return
   c) Proportion of total return from Realized capital gain (p_{cg}) which is taxed at a rate of t_{cg}.
      p_{cg} = Realized Capital gain ($) / Total dollar return
   d) Unrealized capital gain return: Total Dollar Return = Dividends + Interest income + Realized Capital gain + Unrealized capital gain
      Total realized tax rate = $[(p_i× t_i) + (p_d× t_d)+ (p_{cg}× t_{cg})]$

10. Effective Ann AT R = r* = $r (1 – p_it_i – p_dt_d – p_{cg}t_{cg})$ = r (1 – total realized tax rate)
    Where, r = Pre-tax overall return on the portfolio and r*= Effective ann AT R

11. Effective Capital Gains Tax = T* = $t_{cg} (1 – pi – p_d – p_{cg}) / (1 – p_it_i – p_dt_d – p_{cg}t_{cg})$

12. Future AT acc. = $FVIF_{Taxable}$ = Initial Invst $[(1 + r^*)^n (1 – T^*) + T^* – (1 – B) t_{cg}]$

13. Initial Invst $(1 + \text{Accrual Equivalent R})^n$= Future AT Acc

14. Accrual Equivalent R = $(\text{Future AT Acc / Initial Invst})^{1/n}– 1$

15. Accrual Equivalent Tax Rates = $r (1 – T_{AE}) = R_{AE}$

$$T_{AE} = 1 - \frac{R_{AE}}{R}$$

16. In Tax Deferred accounts (TDAs) Future AT Acc = $FVIF_{TDA}$ = Initial Invst$[(1 + r)^n (1 – T_n)]$
17. In Tax-exempt accounts $FVIF_{taxEx}$ = Initial Invst $(1 + r)^n$
    - $FVIF_{TDA} = FVIF_{taxEx} (1 – T_n)$

18. AT asset wt of an asset class (%) = AT MV of asset class ($) / Total AT value of Portfolio ($)

19. AT Initial invst in tax-exempt accounts = $(1 – T_0)$

20. FV of a pretax $ invested in a tax-exempt account = $(1 – T_0) (1 + r)^n$

21. FV of a pretax $ invested in a TDA = $(1 + r)^n (1 – T_n)$

22. Investors AT risk = S.D of pre-tax R (1 – Tax rate) = σ(1 – T)

23. Tax alpha from tax-loss harvesting (or Tax savings) =Capital gain tax with unrealized losses – Capital gain tax with realized losses *Or*
    Tax alpha from tax-loss harvesting = Capital loss × Tax rate

24. Pretax R taxed as a short-term gain needed to generate the AT R equal to long-term AT R = Long-term gain after-tax return / (1 –short-term gains tax rate)

Reading 10: Estate Planning in a Global Context

1. Estate =Financial assets + Tangible personal assets + Immoveable property + Intellectual property

2. Discretionary wealth or Excess capital = Assets – Core capital

3. Core Capital (CC) Spending Needs = $\sum_{j-1}^{N} \frac{p(Survival_j) \times Spending_j}{(1+r)^j}$

4. Expected Real spending = Real annual spending × Combined probability

5. CC needed to maintain given spending pattern = Annual Spending needs / Sustainable Spending rate

6. Tax-Free Gifts = $RV_{TaxFreeGift} = \frac{[1+r_g(1-t_{ig})]^n}{[1+r_e(1-t_{ie})]^n(1-T_e)}$

7. Relative value of the tax-free gift = 1 / (1 – Te)

8. Taxable Gifts = $RV_{TaxableGift} = \frac{[1+r_g(1-t_{ig})]^n(1-T_g)}{[1+r_e(1-t_{ie})]^n(1-T_e)}$

9. Value of a taxable gift (if gift & asset (bequeathed) have equal AT R) = $(1 – T_g) / (1 – T_e)$

10. The relative after-tax value of the gift when the donor pays gift tax and when the recipient's estate will not be taxable (assuming $r_g = r_e$ and $t_{ig} = t_{ie}$):

$$RV_{TaxableGift} = \frac{FV_{Gift}}{FV_{Bequest}} = \frac{[1+r_g(1-t_{ig})]^n(1-T_g+T_gT_e)}{[1+r_e(1-t_{ie})]^n(1-T_e)}$$

11. Size of the partial gift credit = Size of the gift × T_gT_e

12. Relative value of generation skipping = 1 / $(1 – T_1)$

13. Charitable Gratuitous Transfers =

$$RV_{CharitableGift} = \frac{FV_{CharitableGift}}{FV_{Bequest}} = \frac{(1+r_g)^n + T_{oi}[1+r_e(1-t_{ie})]^n(1-T_e)}{[1+r_e(1-t_{ie})]^n(1-T_e)}$$

14. Credit method = T_C = Max $[T_R, T_S]$

15. Exemption method = $T_E = T_S$

16. Deduction method = $T_D = T_R + T_S – T_RT_S$

Reading 12: Lifetime Financial Advice: Human Capital, Asset Allocation, & Insurance

1. Human Capital $HC_0 = \sum_{t=1}^{N} \frac{w_t}{(1+r)^t}$

   extended model $HC_0 = \sum_{t=1}^{N} \frac{p(S_t)\, w_{t-1}(1+g_t)}{(1+r_f+y)^t}$

2. Income yield (payout) = $\frac{total\ ongoing\ annual\ income}{initial\ purchase\ price}$

Reading 13: Managing Institutional Investor Portfolio

Defined-Benefit Plans:

1. Funded Status of Pension Plan (PP) = MV of PP assets – PV of PP liabilities

2. Min RR for a fully-funded PP = Discount rate used to calculate the PV of plan liabilities

3. Desired R for a fully-funded PP = Discount rate used to calculate the PV of plan liabilities + Excess Target return

4. Net cash outflow = Benefit payments – Pension contributions

Foundations

5. Min R requirement (req) = Min Ann spending rate + InvstMgmtExp+ Expected Inf rate
   Or

Min Rreq = [(1 + Min Ann spending rate) × (1 + Invst Mgmt. Exp) × (1 + Expected Inf rate)] -1

6. Foundation's liquidity req = Anticipated cash needs (captured in a foundation's distributions prescribed by minimum spending rate*) + Unanticipated cash needs (not captured in a foundation's distributions prescribed) – Contributions made to the foundation.

   * It includes Minimum annual spending rate (including "overhead" expenses e.g. salaries) + Investment management expenses

Endowments

7. Ann Spending ($) = % of an endowment's current MV *Or*
   AnnSpending ($) = % of an endowment's avg trailing MV

8. Simple spending rule = Spending $_t$ = Spending rate × Endowment's End MV_{t-1}

9. Rolling 3-yr Avg spending rule =$Spending_t$ = Spending rate × Endowment's Avg MV of the *last 3 fiscal yr-ends i.e.*
   ➔ Spending $_t$ = Spending rate × (1/3) [Endowment's End MV_{t-1}+ Endowment's End MV_{t-2} + Endowment's End MV_{t-3}]

10. Geometric smoothing rule = $Spending_t$ = WghtAvg of the prior yr's spending adjusted for Inf + Spending rate × Beg MV of the *prior fiscal yr i.e.*
    ➔ Spending $_t$ = Smoothing rate × [$Spending_{t-1}$ × (1 + Inf_{t-1})] + (1 – Smoothing rate) × (Spending rate × Beg MV_{t-1} of the endowment)

11. Min ReqRoR = Spending rate + Cost of generating Invst R + Expected Infrate
    Or
    Min ReqRoR = [(1 + Spending rate) × (1 + Cost of generating Invst R) × (1 + Expected Inf rate)] -1

12. Liquidity needs = Ann spending needs + Capital commitments + Portfolio rebalancing expenses – Contributions by donor

13. Neutrality Spending Rate = Real expected R = Expected total R – Inf

Life Insurance Companies

14. Cash value = Initial premium paid + Any accrued interest on that premium

15. Policy reserve = PV of future benefits - PV of future net premiums

16. Surplus = Total assets of an insurance company - Total liabilities of an insurance company

Non-Life Insurance Companies

17. Combined Ratio = (Total amount of claims paid out + Insurer's operating costs) / Premium income

Banks

18. Net interest margin = $\frac{(Interest\ Income - Interest\ Expense)}{Avg\ Earning\ Assets} = \frac{Net\ Interest\ Income}{Avg\ Earning\ Assets}$

19. Interest spread = Avg yield on earning assets – Average percent cost of interest-bearing liabilities

20. Leverage-adjusted duration gap (LADG) = $D_A - (k \times D_L)$
    Where, k= MV of liabilities / MV of assets = L/A

21. Change in MV of net worth of a bank (resulting from interest rate shock) ≈ - LADG × Size of bank × Size of interest rate shock

Reading 14: Linking Pension Liabilities to Assets

1. Value of liability = $V_L = \sum_t \frac{B_t}{(1+r_t)^t}$

   where, B_t = Benefit payments at time t

2. Value of an asset = $V_B = \sum_t \frac{CF_t}{(1+r_t)^t}$

3. Intrinsic value of Future wage liability =

$$V_{L-FW} = \frac{B}{r-g} \times \frac{((1+g)^s - 1) \times ((1+r)^{d-s} - 1)}{(1+r)^d}$$

   where, s = yrs till retirement
   d = yrs till demise and subsequent termination of the obligation

Reading 15: Capital Market Expectations

1. Precision of the estimate of the population mean ≈ 1 / $\sqrt{\text{no of obvs}}$

2. Multiple-regression analysis: A = $\beta_0 + \beta_1$ B + β_2 C + ε

3. Time series analysis: A = $\beta_0 + \beta_1$ Lagged values of A + β_2 Lagged values of B + β_2 Lagged values of C + ε

4. Shrinkage Estimator = (Wt of historical estimate × Historical parameter estimate) + (Wt of Target parameter estimate × Target parameter estimate)

5. Shrinkage estimator of Cov matrix = (Wt of historical Cov × Historical Cov) + (Wt of Target Cov × Target Cov)

6. Vol in Period t $=\sigma^2_t = \beta\sigma^2_{t-1} + (1-\beta)\,\varepsilon^2_t$

7. Multifactor Model: R on Asset i = $R_i = a_i + b_{i1}F_1 + b_{i2}F_2 + \ldots + b_{iK}F_K + \varepsilon_i$

8. Value of asset at time t_0
   $=\sum_{t=1}^{\infty} \frac{CF\ at\ time\ t}{(1+Discount\ rate)^t}$

9. Expected RoR on Equity =
   $\frac{\text{Div per share at time 0 (1+LT g rate)}}{\text{Current share price}}$ + LT g rate
   = Div Yield + Capital Gains Yield

10. Nominal GDP = Real g rate in GDP + Expected long-run Inf rate

11. Earnings g rate = Nominal GDP g rate + Excess Corp g (for the index companies)

12. Expected RoR on Equity ≈ $\frac{D}{P}$ - ΔS + i + g + ΔPE

-ΔS = Positive repurchase yield
+ΔS = Negative repurchase yield
ΔPE = Expected Repricing Return

13. Labor supply g = Pop g rate + Labor force participation g rate

14. Expected income R = D/P - ΔS

15. Expected nominal earnings g R = i + g

16. Expected Capital gains R = Expected nominal earnings grate + Expected repricing R

17. Asset's expected return E (R_i) = Rf + $(RP)_1 + (RP)_2 + \ldots + (RP)_K$

18. Expected bond R [E (R_b)] = Real Rf + Inf premium + Default RP + Illiquidity P + Maturity P+ Tax P

19. Inf P = AvgInf rate expected over the maturity of the debt + P (or discount) for the prob attached to higher Inf than expected (or greater disinflation)

20. Inf P = Yield of conventional Govt. bonds (at a given maturity) – Yield on Inf-indexed bonds of the same maturity

21. Default RP = Expected default loss in yield terms + P for the non-diversifiable risk of default

22. Maturity P = Interest rate on longer-maturity, liquid Treasury debt - Interest rate on short-term Treasury debt

23. Equity RP = Expected ROE (e.g. expected return on the S&P 500) – YTM on a long-term Govt. bond (e.g. 10-year U.S. Treasury bond R)

24. Expected ROE using Bond-yield-plus-RP method = YTM on a LT Govt bond + Equity RP

25. Expected ROA E (R_i) = Domestic Rf R + (β_i) × [Expected R on the world market portfolio – Domestic Rf rate of R]

Where, β_i = The asset's sensitivity to R on the world mktportf = Cov (R_i, R_M) / Var (R_M)

26. Asset class RP_i= Sharpe ratio of the world market portfolio × Asset's own volatility (σ_i) × Asset class's correlation with the world mktportf ($\rho_{i,M}$)

$$RP_i = (RP_M / \sigma_M) \times \sigma_i \times \rho_{i,M}$$

Where, Sharpe Ratio of the world market portfolio = Expected excess R / S.D of the world mktportf→ represents systematic or non-diversifiable risk = RP_M / σ_M

27. RP for a completely segmented market (RP_i) = Asset's own volatility (σ_i) × Sharpe ratio of the world mktportf

28. RP of the asset class, assuming partial segmentation = (Degree of integration × RP under perfectly integrated markets) + ({1 - Degree of integration} × RP under completely segmented markets)

29. Illiquidity P = Required RoR on an illiquid asset at which its Sharpe ratio = mkt's Sharpe ratio – ICAPM required RoR

30. Cov b/w any two assets = Asset 1 beta × Asset 2 beta × Var of the mkt

31. Beta of asset 1 = $\left(\dfrac{\sigma_1 \times \rho(1,m)}{\sigma_m}\right)$

32. Beta of asset 2 = $\left(\dfrac{\sigma_2 \times \rho(2,m)}{\sigma_m}\right)$

33. GDP (using expenditure approach) = Consumption + Invst + Δ in Inventories + Govt spending + (Expo- Impo)

34. Output Gap = Potential value of GDP – Actual value of GDP

35. Neutral Level of Interest Rate = Target Inf Rate + Eco g

36. Taylor rule equation: $R_{optimal} = R_{neutral} + [0.5 \times (GDPg_{forecast} - GDPg_{trend})] + [0.5 \times (I_{forecast} - I_{target})]$

37. Trend g in GDP = g from labor inputs + g from Δ in labor productivity

38. g from labor inputs = g in potential labor force size + g in actual labor force participation

39. g from Δ in labor productivity = g from capital inputs + TFP g*
    - TFP g = g associated with increased efficiency in using capital inputs.

40. GDP g = α + β_1Consumer spending g + β_2Investment g

41. Consumer spending g = α + β_1Lagged consumer income g + β_2Interest rate

42. Investment g = α + β_1Lagged GDP g+ β_2Interest rate

43. Consumer Income g = Consumer spending growth lagged one period

Reading 16: Equity Market Valuation

1. Cobb-Douglas Production Function Y = $A \times K^{\alpha} \times L^{\beta}$

Where, Y = Total real economic output
A = Total factor productivity (TFP)
K = capital stock
α = Output elasticity of K
L = Labor input
β = Output elasticity of L

2. Cobb-Douglas Production Function Y (assuming constant R to Scale) = ln (Y) = ln (A) + αln (K) + (1 – α) ln (L)

Or

$$\frac{\Delta Y}{Y} \approx \frac{\Delta A}{A} + \alpha\frac{\Delta K}{K} + (1-\alpha)\frac{\Delta L}{L}$$

3. Solow Residual = %ΔTFP = %ΔY – α (%ΔK) – (1 – α) %ΔL

4. H-Model: Value per share at time 0 = $\frac{\text{D0}}{\text{Discount rate} - \text{LT sustainble Div g rate}} \times \Big[(1 + \text{LT sustainable Div g rate}) + \frac{\text{Super normal g period}}{2} \times (\text{ST higher Div g rate} - \text{LT sustainable Div g rate})\Big]$

5. Gordon g Div discount model: Value per share at time 0 = $\frac{(D_0)\times(1+g)}{r-g}$

6. Forward justified P/E = $\frac{\text{Intrinsic value}}{\text{Yr ahead expected Earnings}}$

7. Fed Model: $\frac{\text{Fwd Operating Earnings (E1)}}{\text{Index Level (P0)}}$ =Long-term US Treasury securities

8. Yardeni Model: = $\frac{E_1}{P_0} = y_B - d \times LTEG$

Where, E_1/P_0=Justified (forward) earnings yield on equities
y_B=Moody's A-rated corporate bond yield
LTEG= Consensus 5-yr earnings g forecast for the S&P 500
d=Discount or Weighting factor that represents the weight assigned by the market to the earnings projections

9. Yardeni estimated fair value of P/E ratio = $\frac{P_0}{E_1} = \frac{1}{y_B - d \times LTEG}$

10. Fair value of equity mkt under Yardeni Model (P_0) = $P_0 = \frac{E_1}{y_B - d \times LTEG}$

11. Discount/weighting factor (d) = $d = \frac{y_B - \frac{E_1}{P_0}}{LTEG}$

12. 10-year Moving Average Price/Earnings [P / 10-year MA (E)] = $\frac{\text{Real (or Inf-adjusted*)S\&P 500 } \textit{Price Index}}{\text{Moving Avg of preceding 10 yrs of Real or Inf adj Earnings}}$

*The stock index and reported earnings are adjusted for Inflation using the CPI

13. Real Stock Price Index $_t$ = (Nominal SPI_t × CPI $_{\text{base yr}}$) / CPI $_t$

14. Real Earnings $_t$ = (Nominal Earnings $_t$ × CPI $_{\text{base year}}$) / CPI $_{t+1}$

15. Tobin's q = $\frac{\text{MVof debt+MV of equity}}{\text{Replacement cost of assets}}$

Equity q = $\frac{\text{Equity MKt Cap}}{\text{Net Worth}} = \frac{\text{Price per share} \times \text{No of Shares O/S}}{\text{Replacment cost of assets} - \text{MV of liabilities}}$

Reading 17: Asset Allocation

1. Req R = [(1 + Spending rate) × (1 + Expected Inf %) × (1 + Cost of earning Invst R)] – 1

2. Risk-adj Expected R = Expected return for mix 'm'* – (0.005 × Investor's risk aversion × Var of R for mix 'm'*)

3. Risk Penalty = 0.005 × Investor's risk aversion × Var of R for mix 'm'*
   **expressed as % rather than as decimals*

4. Safety First Ratio = $\frac{\text{Expected Portfolio R} - \text{Threshold level}}{\text{Portfolio S.D.}}$

5. Include asset in the portfolio when: $\frac{E(R_{new})-R_F}{\sigma_{new}} > \left[\frac{E(R_{new})-R_F}{\sigma_{new}}\right] Corr\left(R_{new}, R_p\right)$

6. Contribution of Currency risk = Vol of asset R in domestic ¢ – Vol of asset R in local ¢
   Where Vol = volatility

7. Funding Ratio = $\frac{\text{Market Value of Pension Assets}}{\text{Present Value of Pension Liabilities}}$

8. $U_m^{ALM} = E(SR_m) - 0.005 R_A \sigma^2(SR_m)$
   - U_m^{ALM}= Surplus objective function's expected value for a particular asset mix m, for a particular investor with the specified risk aversion.

- E (SR_m)= Expected surplus return for asset mix 'm' = $\frac{\Delta \text{ in asset value} - \Delta \text{ in liability value}}{\text{Initial Asset Value}}$
- σ^2 (SR_m) =Varof the surplus R for the asset mix m in %.
- R_A=Risk-aversion level

9. Human Capital (t) $=\sum_{j=t}^{T} \frac{\text{Expected Earnings at age j}}{(1+\text{discount rate})^{j-t}}$

   t = current age T = life expectancy

Reading 18: Currency Management: An Introduction

1. Bid Fwd rate = Bid Spot exchange (X) rate $+ \frac{\text{Bid Fwd points}}{10{,}000}$
2. Offer Fwd rate = Offer Spot X rate + $\frac{\text{Offer Fwdd points}}{10{,}000}$
3. FwdPrem/Disc % = $\frac{\text{spot X rate} - (\frac{\text{fwd pnts}}{10{,}000})}{\text{spot X rate}} - 1$
4. To convert spot rate into a forward quote when points are represented as %,

   Spot X rate × (1 + % prem)

   Spot X rate × (1 - % disct)
5. Mark-to-MV on dealer's position = $\frac{\text{Settlement day CF}}{1+\text{Disct rate} * \left(\frac{t}{T}\right)}$
6. CF at settlement = Original contract size × (All-in-fwd rate for new, offsetting fwd position – Original fwd rate)
7. Hedge Ratio = $\frac{\text{Nominal Value of derivatives contract}}{\text{MV of the hedged asset}}$
8. R_{DC} =$(1 + R_{FC})(1 + R_{FX})-1$
9. R_{DC} (for multiple foreign assets) =

   $$\sum_{i=1}^{n} \omega_i \left(1+R_{FC,i}\right)\left(1+R_{FX,i}\right)-1$$
10. Total risk of DC returns =

    $$= \sigma^2(R_{DC}) \approx \sqrt{\sigma^2(R_{FC}) + \sigma^2(R_{FX}) + [2\sigma(R_{FC})\sigma(R_{FX})\rho(R_{FC}, R_{FX})]}$$
11. % Δ in spot X rate ($\%\Delta S_{H/L}$) = Interest rate on high-yield currency (i_H) – Interest rate on low-yield currency (i_L)
12. Forward Rate Bias = $\frac{F_{P/B} - S_{P/B}}{S_{P/B}} = \frac{(i_P - i_B)\left(\frac{t}{360}\right)}{1+i_B\left(\frac{t}{360}\right)}$
13. Net delta of the combined position = Option delta + Delta hedge
14. Size of Delta hedge (that would set net delta of the overall position to 0) = Option's delta × Nominal size of the contract
15. Long Straddle = Long atm put opt (with delta of -0.5) + Long atm call opt (with delta of +0.5)
16. Short Straddle = Short ATM put opt (with delta of -0.5) + Short ATM call opt (with delta of +0.5)

    ATM = at the money

    opt = option
17. Long Strangle: Long OTM put option + Long OTM call opt

    OTM = out of the money
18. Long Risk reversal = Long Call opt + Short Put opt
19. Short Risk reversal = Long Put opt + Short Call opt
20. Short seagull position = Long protective (ATM) put + Short deep OTM Call opt + Short deep OTM Put opt
21. Long seagull position = Short ATM call + Long deep-OTM Call opt + Long deep-OTM Put opt
22. Hedge ratio = $\frac{\text{Principal face value of the derivatives contract used as a hedge}}{\text{Principal face of the hedged asset}}$

23. Min or Optimal hedge ratio = $\rho\ (R_{DC}; R_{FX}) \times \left[\frac{S.D\ (R_{DC})}{S.D\ (R_{FX})}\right]$

Reading 19: Market Indexes and Benchmarks

1. Periodic R (Factor model based) = Rp = $a_p + b_1F_1 + b_2F_2 + \ldots + b_KF_K + \varepsilon_p$

2. For one factor model Rp = $a_p + \beta_p R_I + \varepsilon_p$
   Where, R_I = periodic R on mktindex
   a_p = "zero factor"
   β_p = beta = sensitivity
   ε_p = residual return

3. MV of stock = No of Shares Outstanding × Current Stock Mkt Price

4. Stock wgt(float-weighted index) = Mkt-cap wght × Free-float adjustment factor

5. Price-weighted index (PWI) = $(P_1+P_2+\ldots+P_n)$ /n

Reading 20: Fixed-Income Portfolio Management – Part I

1. Steps to calculate PVdistribution (PVD) of CFs:

a) Wght of Index's total MV attributable to CFs in each period = $\frac{\text{PV of CFs from B index for specific period}}{\text{PV of Total CFs from B}}$
   where B = Benchmark

b) Contribution of each period's CFs to portfolio D = D of each period × Wght of index CFs in specific period

c) Benchmark's PVD = $\frac{\text{Cont of each period's CFs to portfolio D}}{\text{sum of all the periods' D cont}}$

2. Active R = Portfolio's R – B Index's R

3. Tracking Risk = S.D of Active R = $\left(\frac{\sum(\text{Active R} - \text{Mean Active R})^2}{n-1}\right)^{\frac{1}{2}}$

4. Semi-annual Total R = $\left(\frac{\text{Total Future Dollars}}{\text{Full Price of the Bond}}\right)^{\frac{1}{n}} - 1$

5. Dollar D = D × Portfolio Value × 0.01

6. Portfolio's Dollar D = Sum of dollar D of securities in portfolio

7. Rebalancing Ratio = $\frac{\text{Original Dollar D}}{\text{New Dollar D}}$

8. Cash required for rebalancing = (Rebalancing ratio – 1) × (total new MV of portfolio)

9. Controlling Position = Target Dollar D – Current Dollar D

10. Contribution of bond/sector to the portfolio D = $\left(\frac{\text{MV of bond or sector in the Portfolio}}{\text{Total Portfolio Value}}\right) \times$ Effective D of bond or sector

11. Spread D of a Portfolio = Market wgtdavg of the sector spread D of the individual securities

12. Net safety rate of return (Cushion Spread) = Immunized Rate – Min acceptable R

13. Dollar safety margin = Current bond portfolio value - PV of the required terminal value at new interest rate

14. Economic Surplus = MV of assets – PV of liabilities

15. Confidence Interval =Target Return +/- (k) × (S.D of Target R)

where, k = number of S.D around the expected target R

Reading 22: Fixed-Income Portfolio Management – Part II

1. D of Equity = $\frac{(\text{D of Assets} \times \text{Assets}) - (\text{D of Liab} \times \text{Liab})}{\text{Equity}}$

2. R_p = Portfolio RoR = $\frac{\text{Profit on borrowed funds + Profit on Equity}}{\text{Amount of Equity}}$ =
   = $[B \times (r_F - k) + E \times r_F] / E$
   $= r_F + [\frac{B}{E} \times (r_F - k)]$

3. Dollar interest = $\frac{\text{Amount borrowed} \times \text{Repo rate} \times \text{Repo term}}{360}$

4. New bond MV = $\frac{\text{Dollar D of Old Bond}}{\text{Duration of New Bond}} \times 100$

5. New bond Par value = $\frac{\text{Dollar D of Old Bond}}{\text{New Dollar D per Bond}} \times 100$

6. Shortfall risk = $\frac{\text{No of obs below the Target R}}{\text{Total No of Observations}}$

7. Target dollar D = Current dollar D without futures + Dollar D of futures position

8. No of Futures Contracts = $\frac{\text{Target \$ D} - \text{Current \$ D without futures}}{\text{\$ D per futures contract}}$

9. Dollar duration of futures contract = $\frac{\text{\$ D of Cheapest to}}{\text{Deliver issue}} \times \text{CF for CTD Issue}$

10. Hedge Ratio = $\frac{\text{Factor exposure of the bond (portfolio) to be hedged}}{\text{Factor exposure of Hedging instrument}}$
or
Hedge Ratio = $\left[\frac{\text{Duration of the bond to be hedged} \times \text{Price of the bond to be hedged}}{\text{Duration of the CTD bond} \times \text{Price of the CTD}}\right] \times$ (Conversion factor for CTD bond)

11. Basis = Cash (spot) price – Futures price

12. Yield on bond to be hedged = a + (Yield Beta × yield on CTD Issue) + Error

13. Hedge ratio = $\frac{D_H P_H}{D_{CTD} P_{CTD}}$ × Conversion factor for CTD Issue × Yield Beta

14. Interest rate Swap (fixed-rate receiver/floating rate payer) = Long a fixed-rate bond + Short a floating-rate bond

15. \$ D of a swap for a fixed-rate receiver (floating rate payer) = \$ D of a fixed-rate bond − \$ D of a floating-rate bond
OR
\$ D of a swap for a fixed-rate receiver ≈ \$ D of a fixed-rate bond

16. Interest Rate Swap (*fixed-rate payer*/floating rate receiver) = Long a floating-rate bond + short a fixed-rate bond

17. \$ D of a swap for a fixed-rate payer = \$ D of a floating-rate bond − \$ D of a fixed-rate bond
OR
\$ D of a swap for a fixed-rate payer ≈ −\$ D of a fixed-rate bond

18. \$ D of a portfolio that includes a swap = \$ D of assets − \$ D of liabilities + \$ D of a swap position

19. D for an Option = Delta of Option × D of Underlying Instrument × (Price of underlying) / (price of Opt instrument) where Opt = Option

20. Payout to Opt Buyer or Opt value = MAX [(Strike value – Value at maturity), 0]

21. Credit spread call Opt value/Payoff = Max [(Spread at the opt maturity – Strike spread) × NP × Risk factor, 0]

22. Credit Forward Payoff = (Credit spread at the forward contract at maturity – Contracted credit spread) × NP× Risk factor

23. Change in Foreign bond Value (In terms of change in foreign yield only) = Duration × Δ Foreign yield × 100

24. Change in Foreign bond Value (when domestic rates change) = Duration × Yield beta × Δ Domestic yield × 100

25. Δ Yield $_{\text{Foreign}}$ = α + Yield beta or country beta (β) (Δ yield $_{\text{Domestic}}$) + ε

26. Estimated % Δ Value $_{\text{Foreign}}$ = Yield beta × Δ Domestic yield

27. D Cont of Domestic Bond = Wght of domestic bond in Portfolio × D of Domestic Bond

28. D Cont of Foreign Bond = Wght of foreign bond in Portfolio × D of Foreign Bond × Country beta

29. Portfolio D = D Cont of Domestic Bond + D Cont of Foreign Bond

30. Interest rate parity = $F = S_0 \times [(1+ i_D) \div (1 + i_F)]$

31. Forward Premium = $(F–S_0) / S_0 = (i_D– i_F) / (1 + i_F)$

32. Forward Premium (as first order linear approx) = $(F – S_0) / S_0 \approx i_D– i_F$

33. Unhedged R = Foreign bond R in local curr + curr return (or FC appreciation)

34. Hedged R (HR) = Foreign bond R in local curr + Forward discount (premium)

35. HR = Domestic risk-free rate + bond's local premium = HR = $i_d + (r_l - i_f)$

36. Bond's local risk premium = Bond's return - local risk-free rate $(r_l - i_f)$

37. Breakeven Spread change = $\frac{\% \ \Delta \text{ Price}}{D} \times 100$

Reading 23: Equity Portfolio Management

1. Active R = Portf's R – B's return
   B = benchmark
2. Tracking Risk (active risk) = ann S.D of active R

3. Information Ratio = $\frac{\text{Active R}}{\text{Tracking Risk or Active Risk}}$

4. Passive investment using Equity Index futures = Long cash + Long futures on the underlying index

5. Passive investment using Equity total return swaps = Long cash + Long swap on the index

6. R on Portf = $b_0 + (b_1 \times$ R on Index style 1) + ($b_2 \times$ R on Index style 2) +…. ($b_n \times$ R on Index style n) + ε

7. RoR of Equitized Mkt neutral strategy = (G/L on long & short securities positions + G/L on long futures position + Interest earned on cash from short sale) / Portfolio Equity
8. Active wgt = Stock's wgt in actively managed portf – Stock's wgt in B

9. Info Ratio ≈ Info Coefficient × $\sqrt{\text{Info Breadth}}$

10. Risk-adjusted Expected Active R= $U_A = r_A – \lambda_A \times \sigma^2_A$

11. Portfolio Active R = $\sum_{i=1}^{n}$ Wgt assigned to ith Mngr (hAi) × Active R of the ith Mngr (rAi)

12. Portfolio Active Risk = $\sqrt{\sum_{i=1}^{n} \text{Wgt assigned to ith Mnger}^2 \times \text{Active R of ith Manager}^2}$

13. Mngr's "true" active R = Mngr's R - Mngr's Normal B

14. Mnger's "misfit" active R = Mnger's normal B R - Investor's B

15. Total Active Risk = $\sqrt{(True\ Active\ Risk)^2 + (Misfit\ Active\ Risk)^2}$
    Where,
    True active risk = S.D of true active R
    Misfit risk = S.D of misfit active R

16. True Information Ratio = $\frac{\text{Mngr's True Active R}}{\text{Mngr's True Active risk}}$

17. Investors' net of fees alpha = Gross of fees alpha (or mngr's alpha) – Investment mgmt fees

Reading 24: Alternative Investments Portfolio Management

1. Minority interest discount ($) = marketable controlling interest value ($) × minority interest(%) discount = (investor's interest in equity × total equity value) × minority interest discount(%)

2. Marketable minority interest ($) = Marketable controlling interest value ($) – minority interest discount ($)

3. Marketability discount ($) = Marketable minority interest ($) × marketability discount (%)

4. Non-Marketable minority interest ($) = Marketable minority interest ($) - marketability discount ($)
5. Total R on Commodity Index = Collateral R + Roll R + Spot R

6. Monthly Roll R = Δ in futures contract price over the month - Δ in spot price over the month
7. Compensation structure of Hedge Funds (comprises of) Management fee (or AUM fee) + Incentive fee

8. Management fee= % of NAV (net asset value generally ranges from 1-2%)

9. Incentive fee = % of profits (specified by the investment terms)

10. Incentive fee (when High Water mark Provision) = (positive difference between ending NAV and HWM NAV) × incentive fee %.
11. Hedge Fund R = [(End value) – (Beg value)] / (Beg value)

12. Rolling R = $RR_{n,t} = (R_t + R_{t-1} + R_{t-2} + \ldots + R_{t-(n-1)}) / n$

13. Downside Deviation = = $\sqrt{\frac{\sum_{i=1}^{n}[min(r_t - r^*, 0)]^2}{n-1}}$
where, r = threshold*

14. Semi-deviation = = $\sqrt{\frac{\sum_{i=1}^{n}[min(r_t - avg.\ monthly\ return, 0)]^2}{n-1}}$
15. Sharpe ratio = (Annualized RoR – Annualized Rf rate) / Annualized S.D.

16. Sortino Ratio = (Annualized RoR – Annualized Rf*) / Downside Deviation

17. Gain-to-loss Ratio = $\left(\frac{\text{No of months with+ve R}}{\text{No of months with−ve R}}\right) \times \left(\frac{\text{Avg up month R}}{\text{Avg down month R}}\right)$

18. Calmar ratio = Compound Annualized ROR / ABS* (Maximum Drawdown)

19. Sterling ratio= Compound Annualized ROR / ABS*
(Average Drawdown - 10%)
where, *ABS = Absolute Value

Reading 25: Risk Management

1. Delta Normal Method: VAR = E(R) – z-value (S.D)
   - Daily E(R) = Annual E(R) / 250
   - Daily S.D = Annual S.D. / $\sqrt{250}$
   - Monthly E(R) = Annual E(R) / 12
   - Monthly S.D = Annual S.D. / $\sqrt{12}$
   - Daily E(R) = Monthly E(R) / 22
   - Daily S.D = Monthly S.D. / $\sqrt{22}$
   - Annual VAR = Daily VAR×$\sqrt{250}$

2. Diversification effect = Sum of individual VARs – Total VAR

3. Incremental VAR=Portf's VAR inclu a specified asset – Portf's VAR exclu that asset.

4. Tail Value at Risk (TVAR) or Conditional Tail Expectation = VAR + expected loss in excess of VAR

5. Value $_{Long}$ = Spot $_t$ – [Forward / $(1 + r)^n$]

6. Swap Value$_{Long}$ = PV $_{inflows}$ – PV $_{outflows}$

7. Fwd contract value$_{Long}$= $\left[\frac{Spot\ Rate_{D/F}}{(1+RF_F)^{\frac{t}{Total\ time}}} - \frac{Fwd\ Rate}{(1+RF_D)^{\frac{t}{Total\ time}}}\right] \times NP$

8. Sharpe Ratio = $\frac{\text{Mean portf R−Rf}}{\text{S.D of portf R}}$

9. Sortino Ratio = $\frac{\text{Mean portf R−Min acceptable R}}{\text{Downside deviation}}$
10. Risk Adjusted R on Capital = $\frac{\text{Expected R on an invst}}{\text{capital at risk measure}}$

11. R over Max Drawdown = $\frac{\text{Expected Average R on an invst in a given yr}}{\text{max drawdown}}$

Reading 26: Risk Management Applications of Forward and Futures Strategies

1. $\beta = Cov_{SI} / \sigma^2_I$
   - Cov_{SI}= covariance b/w stock portf& index
   - σ^2_I= var of index.

2. \$β of stock portf = β of stock portf × MV of stock portf = $\beta_s S$

3. Future \$ $\beta = \beta_f \times f$
   where, β_f = Futures contract beta

4. Target level of beta exposure: $\beta_T S = \beta_s S + N_f \beta_f f$

$$N_f = \left(\frac{B_T - B_S}{B_f}\right)\left(\frac{S}{F}\right)$$

$$N_f = \frac{\text{Desired Beta Change}}{\text{Futures Beta}} \times \frac{\text{Portfolio Value}}{\text{Futures contract Price}}$$

   *Actual futures price = Quoted futures price × Multiplier

5. Reducing β to zero: $N_f = \left(\frac{-B_S}{B_f}\right)\left(\frac{S}{f}\right)$ and $\beta_T = 0$

6. Effective β = Combined position R in % / Market R in %

7. Synthetic Cash: Long Stock + Short Futures = Long risk-free bond

8. Synthetic Stock: Long Stock = Long Rf bond + Long Futures

9. Creating a Synthetic Index Fund:
   - No of futures contract = $N_f^* = \{V \times (1 + r)^T\} / (q \times f)$
     where,
     N_f^* = No of futures contracts
     q = multiplier
     V = Portfolio value
   - Amount needed to invest in bonds = $V^* = (N_f^* \times q \times f) / (1 + r)^T$
   - Equity purchased = $(N_f^* \times q) / (1 + \delta)^T$
     where, δ = dividend yield
   - Pay-off of N_f^* futures contracts = $N_f^* \times q \times (S_T - f)$
     where, S_T = Index value at time T

Reading 27: Risk Management Applications of Options Strategies

1. Covered Call = Long stock position + Short call position
   a) Value at expiration = $V_T = S_T - \max(0, S_T - X)$
   b) Profit = $V_T - S_0 + c_0$
   c) Maximum Profit = $X - S_0 + c_0$
   d) Max loss (when $S_T = 0$) = $S_0 - c_0$
   e) Breakeven = $S_T^* = S_0 - c_0$

2. Protective Put = Long stock position + Long Put position
   a) Value at expiration: $V_T = S_T + \max(0, X - S_T)$
   b) Profit = $V_T - S_0 - p_0$
   c) Maximum Profit = ∞
   d) Maximum Loss = $S_0 + p_0 - X$
   e) Breakeven = $S_T^* = S_0 + p_0$

3. Bull Call Spread = Long Call (lower exercise price) + Short Call (higher exercise price)
   a) Initial value = $V_0 = c_1 - c_2$
   b) Value at expiration: V_T = value of long call – Value of short call = $\max(0, S_T - X_1) - \max(0, S_T - X_2)$
   c) Profit = $V_T - c_1 + c_2$
   d) Maximum Profit = $X_2 - X_1 - c_1 + c_2$
   e) Maximum Loss = $c_1 - c_2$
   f) Breakeven = $S_T^* = X_1 + c_1 - c_2$

4. Bull Put spread = Long Put (lower XP) + Short Put (higher XP). Identical to the sale of Bear Put Spread
   XP = exercise price

5. Bear Put Spread = Long Put (higher XP) + Short Put (lower XP)
   a) Initial value = $V_0 = p_2 - p_1$
   b) Value at expiration: V_T = value of long put – value of short put = $\max(0, X_2 - S_T) - \max(0, X_1 - S_T)$
   c) Profit = $V_T - p_2 + p_1$
   d) Max Profit = $X_2 - X_1 - p_2 + p_1$
   e) MaxLoss = $p_2 - p_1$

f) Breakeven $=S_T^* = X_2 - p_2 + p_1$

6. Bear Call Spread = Short Call (lower XP) + Long Call (higher XP). Identical to the sale of Bull Call Spread.

7. Long Butterfly Spread (Using Call) = Long Butterfly Spread = Long Bull call spread + Short Bull call spread (or Long Bear call spread)

   Long Butterfly Spread = (Buy the call with XP of X_1 and sell the call with XP of X_2) + (Buy the call with XP of X_3 and sell the call with XP of X_2).

   where, $X_1 < X_2 < X_3$ and Cost of X_1 (c_1) > Cost of X_2 (c_2) > Cost of X_3 (c_3)

   a) Value at expiration: $V_T = \max(0, S_T - X_1) - 2\max(0, S_T - X_2) + \max(0, S_T - X_3)$
   b) Profit $= V_T - c_1 + 2c_2 - c_3$
   c) Max Profit $= X_2 - X_1 - c_1 + 2c_2 - c_3$
   d) Maximum Loss $= c_1 - 2c_2 + c_3$
   e) Two breakeven points
      i. Breakeven $=S_T^* = X_1$ + net premium $= X_1 + c_1 - 2c_2 + c_3$
      ii. Breakeven $= S_T^* = 2X_2 - X_1 -$ Net premium $= 2X_2 - X_1 - (c_1 - 2c_2 + c_3) = 2X_2 - X_1 - c_1 + 2c_2 - c_3$

8. Short Butterfly Spread (Using Call) = Selling calls with XP of X_1 and X_3 and buying two calls with XP of X_2.
   - Max Profit $= c_1 + c_3 - 2c_2$

9. Long Butterfly Spread (Using Puts) = (Buy put with XP of X_3 and sell put with XP of X_2) + (Buy the put with XP of X_1 and sell the put with XP of X_2)
   where, $X_1 < X_2 < X_3$ and Cost of X_1 (p_1) < Cost of X_2 (p_2) < Cost of X_3 (p_3)

10. Short Butterfly Spread (Using Puts) = Short butterfly spread = Selling puts with XPs of X_1 and X_3 and buying two puts with XP of X_2.
    - Max Profit $= p_3 + p_1 - 2p_2$

11. For zero-cost collar
    a) Initial value of position $= V_0 = S_0$
    b) Value at expiration: $V_T = S_T + \max(0, X_1 - S_T) - \max(0, S_T - X_2)$
    c) Profit $= V_T - V_0 = V_T - S_0$
    d) Max Profit $= X_2 - S_0$
    e) Max Loss $= S_0 - X_1$
    f) Breakeven $=S_T^* = S_0$

12. Straddle = Buying a put and a call with same strike price on the same underlying with the same expiration; both options are at-the-money.

    a) Value at expiration: $V_T = \max(0, S_T - X) + \max(0, X - S_T)$
    b) Profit $= V_T - p_0 - c_0$
    c) Max Profit $= \infty$
    d) Max Loss $= p_0 + c_0$
    e) Breakeven $= S_T^* = X \pm (p_0 + c_0)$

13. Short Straddle: Selling a put and a call with same strike price on the same underlying with the same expiration; both options are at-the-money.
    - Adding call option to a straddle "Strap".
    - Adding put option to a straddle "Strip".

14. Long Strangle = buying the put and call on the same underlying with the same expiration but with *different exercise prices.*

15. Short Strangle = selling the put and call on the same underlying with the same expiration but with *different exercise prices*.

16. Box-spread = Bull spread + Bear spread

17. Long Box-spread= (buy call with XPof X_1 and sell call with XP of X_2) + (buy put with XP of X_2 and sell put with XP of X_1).

    a) Initial value of the box spread = Net premium $= c_1 - c_2 + p_2 - p_1$.
    b) Value at expiration: $V_T = X_2 - X_1$
    c) Profit $= X_2 - X_1 - (c_1 - c_2 + p_2 - p_1)$
    d) Max Profit = same as profit
    e) Max Loss = no loss is possible given fair option prices

f) Breakeven $=S_T^* =$ no break-even; the transaction always earns Rf rate, given fair option prices.

18. Pay-off of an interest rate Call Option= (NP) × max (0, Underlying rate at expiration – X-rate) × $\left(\frac{\text{Days in underlying rate}}{360}\right)$

19. Pay-off of an interest rate Put Option= (NP) × max (0, X-rate - Underlying rate at expiration) × $\left(\frac{\text{Days in underlying rate}}{360}\right)$

20. Loan Interest payment = NP × (LIBOR on previous reset date + Spread) × $\left(\frac{\text{Days in settlement period}}{360}\right)$

21. Cap Pay-Off = NP × (0, LIBOR on previous reset date – X rate) × $\left(\frac{\text{Days in settlement period}}{360}\right)$

22. Floorlet Pay-Off = NP × (0, X rate - LIBOR on previous reset date) × $\left(\frac{\text{Days in settlement period}}{360}\right)$

23. Effective Interest = Interest received on the loan + Floorlet pay-off

24. Delta $= \frac{\text{Change in Option Price}}{\text{Change in Underlying Price}} = \frac{\Delta C}{\Delta S}$

25. Size of the Long position = Nc / Ns = - 1 / (ΔC / ΔS) = -1 / Delta

where, Nc = No of call options
Ns = No of stocks

26. Hedging using non-identical option:

a) One option has a delta of Δ1.
b) Other option has a delta of Δ2.
c) Value of the position = $V = N_1 c_1 + N_2 c_2$
where, N =option quantity & c =option price
d.) To delta hedge: Desired Quantity of option 1 relative to option 2 $= \frac{\text{Delta of option 2}}{\text{Delta of option 1}}$

$$N_1 / N_2 = - \Delta c_2 / \Delta c_1$$

27. Gamma $= \frac{\text{Change in delta}}{\text{Change in underlying price}}$

28. Gamma hedge = Position in underlying + Positions in two options

29. Vega $= \frac{\text{Change in Option price}}{\text{Change in Volatility of the underlying}}$

Reading 28: Risk Management Applications of Swap Strategies

1. NP of a swap (to manage D of portf.) = $NP = V_P \left(\frac{MD_{target} - MD_B}{MD_{swap}}\right)$

2. Inverse Floater Coupon rate = b – LIBOR

3. When LIBOR > b, inverse floater issuer should buy an interest rate cap with the following features:
   - exercise rate of b
   - NP = NP of inverse floater
   - Each caplet expires on the interest rate reset date of the swap/loan
   - Whenever Libor > b, Caplet pay-off = (L – b) × NP

4. Synthetic Dual-currency Bond = Ordinary bond issued in one currency Currency swap (with no principal payments)

Reading 29: Execution of Portfolio Decisions

1. Bid-ask Spread = Ask price – Bid price

2. Inside/Mkt bid-ask spread = Inside/Mkt Ask Price – Inside/Mkt Bid Price

3. Mid-Quote $= \frac{\text{Mkt Bid Price} + \text{Mkt Ask Price}}{2}$

4. Effective Spread = 2 × (Actual Execution Price – MidQuote)

5. Avg Effective Spread (ES) = $\frac{\text{ES of order 1} + \text{ES of order 2} + \cdots + \text{ES of order n}}{n}$

6. Share Volume Wgtd (VW) ES = [(V of shares traded for order 1 × ES of order 1) + (V of shares traded for order 2 × ES of order 2) +⋯+ (V of shares traded for order n × ES of order n)/n

7. VW Avg price = Avg P (security traded during the day)
   Where, weight is the fraction of the day's volume associated with the trade

8. Mkt-adj Implementation Shortfall (IS) = I cost – Predicted R estimated using Mkt model
9. Trade Size relative to Available Liquidity $= \frac{\text{Order size}}{\text{Avg daily volume}}$

10. Realized profit/loss = Execution price – Relevant decision price

11. Delay costs $= \frac{\text{No of shares actually traded}}{\text{Total No of shares in an order}} \times \frac{\text{Actual trading price on Day t} - \text{CP on day t}-1}{\text{Benchmark (closing)price on day } t_0}$
    where CP = closing price

12. Missed Trade Opp Cost = $\frac{\text{No of shares not traded}}{\text{Total no of shares in an order}} \times \frac{\text{Cancellation price} - \text{Original B price}}{\text{Original B price}}$
    where B = benchmark

13. IC = Commissions & Fees as % + Realized profit or loss + Delay costs + Missed trade opp costs

14. Estimated Implicit Costs for "Buy" = Trade Size × (Trade Price – B Price)

15. Estimated Implicit Costs for "Sale" = Trade Size × (B Price - Trade Price)

Reading 30: Monitoring and Rebalancing

1. Buy and Hold Strategy:
- Portfolio value = Investment in stocks + Floor value
- Portfolio R = % in stock × R on stocks

- Cushion = Investment in stocks = Portfolio value – Floor value

2. Target Investment in Stocks under Constant Mix Strategy = Target proportion in stocks × Portfolio Value

3. Target Investment in Stocks under Constant Proportion Strategy = Target proportion in stocks × (Portfolio Value – Floor value)

Reading 31: Evaluating Portfolio Performance

1. Account's rate of return during evaluation period 't'
   - when there are no external cash flows = $\frac{\text{MV (end of period)} - \text{MV (beg of period)}}{\text{MV (beg of period}}$
   - when a contribution received (start of the period) = $\frac{\text{MV (end of period)} - (\text{MV (beg of period)} + \text{contribution})}{\text{MV (beg of period)} + \text{Contribution}}$
   - when a withdrawal is made (start of the period) = $\frac{\text{MV (end of period)} - (\text{MV (beg of period)} - \text{contribution})}{\text{MV (beg of period)} - \text{Contribution}}$
   - when a contribution is received at the end of the evaluation period = $\frac{(\text{MV (end of period)} - \text{contribution}) - \text{MV (beg of period)}}{\text{MV (beg of period)}}$
   - when a withdrawal is made at the end of the evaluation period = $\frac{(\text{MV (end of period)} + \text{contribution}) - \text{MV (beg of period)}}{\text{MV (beg of period)}}$

2. TWR (when no external CFs) = $\frac{\text{Mkt value at end of period} - \text{Mkt value at beginning of period}}{\text{Mkt value at beginning of period}}$

3. TWR (entire evaluation period) = $(1 + r_{t,1}) \times (1 + r_{t,2}) \times \ldots \times (1 + r_{t,n}) - 1$

4. MWR = $MV_1 = MV_0(1+R)^m + CF_1(1+R)^{m-L(1)} + \ldots + CF_n(1+R)^{m-L(n)}$
   where,
   m = No of time units in evaluation period
   L(i) = No of time units by which the i^{th} CF is separated from beg of evaluation period

5. Compound g rate or geometric mean R = $(1 + r_{t,1}) \times (1 + r_{t,2}) \times \ldots \times (1 + r_{t,n})^{1/n} - 1$
   Where, n = No of yrs in measurement period

6. Style = Manager's B portf - Mrkt index

7. Active Mgmt = Manager's portf – B

8. Portf R = MrkeIndex + Style + Active Mgmt

9. Periodic R on an a/c (factor-based model) $= \alpha p + (b_1 \times F_1) + (b_2 \times F_2) + \ldots + (b_k \times F_k) + \varepsilon p$

10. Benchmark coverage = $\frac{\text{MV of securities that are present in both B \& } portf}{\text{Total MV of portf}}$

11. Active position = Wght of a security in an account - Wght of the same security in B

12. Value-added R on a long-short portf = Portf R – B

13. RoR for a long-short portf = $\frac{\text{P/L resulting from hedge fund strategy}}{\text{Amount of assets at risk}} =$

14. $\frac{\text{P/L resulting from hedge fund strategy}}{\text{Absolute value of all (long positions + short positions)}}$

15. Fundamental rule of Active Mgmt: Impact = (active) wght × R

16. Δ in value of fund = Total amount of net contributions

17. Ending value of a fund under the Net Contributions investment strategy = Beginning value + Net contributions

18. Δ in Fund's value = End value of a fund under the Rf asset Invst strategy – Begvalue (i.e. ending value of the fund under the Net Contributions investment strategy)

19. R-metric perspective: Incremental R contribution of the Asset Category investment strategy = $\sum_{i=1}^{A} W_i \times (R_{Ci} - R_f)$

20. Value-metric perspective: Incremental contribution of the Asset Category investment strategy = Sum [(Each asset category's policy proportion of the Fund's beg value and all net external cash inflows) × (Asset category's B RoR - Rf rate)]

21. Aggregate manager B R under B level invstmnt strategy = Wghtd* Avg of IndMngr's B R

22. Return-metric perspective: Incremental return contribution of the B strategy = $\sum_{i=1}^{A} \sum_{j=1}^{M} W_i \times W_{ij} \times (r_{Bij} - r_{Ci})$

23. Value-metric perspective: Incremental contribution of the B strategy = Sum [each manager's policy proportion of the total fund's beg value and net external cash inflows × (manager's B R – R of manager's asset category)]

24. Misfit R or Style bias = R generated by the aggregate of the managers' B - R generated by the aggregate of the asset category B

25. Return to the Investment managers level = Sum (active managers' returns – their benchmark returns)

26. Return-metric perspective: Contribution of the Investment Managers strategy = $r_{IM} = \sum_{i=1}^{A} \times \sum_{j=1}^{M} W_i \times W_{ij} \times (r_{Aij} - r_{Bij})$

27. Allocation Effects incremental contribution = Fund's ending value - Value calculated at the Investment Managers level

28. Value-added/active return = Portf R – B R

29. Security-by-security analysis: $r_i = \sum_{i=1}^{n} [(W_{pi} - W_{Bi}) \times (r_i - r_B)]$

30. Value-added return under Holdings-based or "buy-and-hold" attribution= $\sum_{j=1}^{S} W_{pj} \times r_{pj} - \sum_{j=1}^{S} W_{Bj} \times r_{Bj}$

31. Value-added Return = Pure sector allocation + Allocation/selection interaction + Within sector selection

32. Pure sector Allocation = $\sum_{i-1}^{n} (W_{pj} - W_{Bj}) \times (r_{Bj} - r_B)$

33. Within sector Selection = $\sum_{j=1}^{S} W_{Bj} (r_{Pj} - r_{Bj})$

34. Allocation/selection Interaction = $\sum_{i-1}^{n} (W_{Pj} - W_{Bj}) \times (r_{Pi} - r_{Bj})$

35. Interest rate Mgmt contribution = Agg R(re-priced securities) - R of entire Treasury universe
36. Sector/quality return = Gross R - External interest rate effect - Interest rate Mgmt effect

37. Security selection effect for each security = Total R of a security - all the other components.

38. Portf security selection effect = Mkt value WghtdAvg of all individual security selection effects

39. Trading activity = Total Portf R – (Interest rate mgmt effect + sector/quality effect + security selection effect)

40. Alpha = $\alpha = r_P - [r_f + \beta_P(r_M - r_f)]$

41. Treynor's measure = $T_A = \frac{\bar{R}_A - \bar{r}_f}{\hat{\beta}_A}$

42. Sharpe ratio =$\frac{\bar{R}_A - \bar{r}_f}{\hat{\sigma}_A}$

43. $M^2 = \bar{r}_f + \left[\frac{R_A - \bar{r}_f}{\hat{\sigma}_A}\right]\hat{\sigma}_M$

44. Information ratio = $IR_A = \frac{\bar{R}_A - \bar{R}_B}{\hat{\sigma}_{A-B}}$