Reading 23: Liability-driven and Index-based Strategies

1. Convexity = $\frac{Mac.Duration^2+Mac.Duration+Dispersion}{(1+Cash\ flow\ yield)^2}$
2. Future Contracts=N_f = $\frac{Liability\ Portfolio\ BPV-Asset\ portfolio\ BPV}{Futures\ BPV}$
3. Future BPV $\approx \frac{BPV_{CTD}}{CF_{CTD}}$
4. ABO = $\frac{m\times G\times w_0}{(1+r)^T}\times\left[\frac{1}{r}-\frac{1}{r\times(1+r)^Z}\right]$
5. PBO = $\frac{m\times G\times w_0\times(1+w)^T}{(1+r)^T}\times\left[\frac{1}{r}-\frac{1}{r\times(1+r)^Z}\right]$
6. $Effective\ Duration = \frac{(PV-)-(PV+)}{2\times\Delta Curve\times(PV_0)}$
7. Asset BPV + $\left[NP\times\frac{Swap\ BPV}{100}\right] = Liability\ BPV$
8. Asset BPV $\times\ \Delta Asset\ yields + Hedge\ BPV\ \times\ \Delta Hedge\ yields\ \approx\ Liability\ BPV\ \times\ \Delta Liability\ yields$

Reading 24: Yield Curve Strategies

1. Effective Portfolio Duration $\approx \frac{Notional\ portfolio\ value}{Portfolio\ equity}\times Duration$
2. Total return $\approx -1\times end.effective\ duration\times(end.YTM-beg.YTM)+beg.YTM$

Reading 25: Fixed Income Active Management: Credit Strategies

1. Excess Return = XR = $(s\ \times t)-(\Delta s\times SD)$
2. Expected XR = EXR = $(s\ \times t)-(\Delta s\times SD)-(t\times p\times L)$ where $p\times L = exp.probability\ of\ loss\ \times\ exp.loss$

Reading 26: Introduction to Equity Portfolio Management

Reading 27: Passive Equity Investing

1. HHI = $\sum_{i=1}^{n} {w_i}^2$
2. Effective # of shares = $\frac{1}{\sum_{i=1}^{n} {w_i}^2} = \frac{1}{HHI}$
3. $Tracking\ error_P = \sqrt{Var_{(R_p-R_b)}}$
4. Excess return $_p = R_p - R_b$

Reading 28: Active Equity Investing: Strategies

Reading 29: Active Equity Investing: Portfolio Construction

1. $R_A = \sum_{i=1}^{n} \Delta W_i R_i$

where,

R_i = return on society i

ΔW_i = active weight = diff. b/w portfolio weight and benchmark weight.

2. Ex post active return = $R_A = \sum\left(\beta_{pk}-\beta_{bk}\times F_k+(\alpha+\varepsilon)\right)$

where,

β_{pk} = sensitivity of the portfolio (p) to each rewarded factor (k)

β_{bk} = sensitivity of the benchmark to each rewarded factor

F_k = the return of each rewarded factor

3. Active Risk (σR_A) = $\sqrt{\frac{\sum_{t=1}^{T}(R_{AT})^2}{T-1}}$

where,

R_{AT} = active return at time t

4. E (R_A) = IC$\sqrt{BR_{\sigma R_A}}TC$

where,

IC = expected information coefficient

BR = Breadth

TC = Transfer coefficient

σR_A = Manager's active risk

5. Active Share = $\frac{1}{2}\sum_{i=1}^{n}\left|w_{p,i}-w_{b,i}\right|$

where,

w = weight, p= portfolio, b = benchmark

6. Active Risk of Portfolio $\sigma_{R_A} = \sqrt{\sigma^2\left(\sum\left(\beta_{pk}-\beta_{bk}\right)\times F_k\right)+\sigma_e^2}$

where,

σ_e^2 = idiosyncratic risk

7. Max $\left(\sum_{i=1}^{N}\frac{1}{3}Size_i + \frac{1}{3}Value_i + \frac{1}{3}Momentum_i\right)$

8. Total Portfolio Variance = $V_P = \sum_{i=1}^{n}\ \sum_{j=1}^{n}\ x_i x_j C_{ij}$

9. Contribution of each asset to portfolio variance $= CV_i = \sum_{j=1}^{n}\ x_i x_j C_{ij} = x_i C_{ip}$

10. $V_p = Var\left(\sum_{i=1}^{K}(\beta_{ip} \times F_i)\right) + Var(\varepsilon_p)$

11. Variance of the portfolio's active return = $AV_P = \sum_{i=1}^{n}\ \sum_{j=1}^{n}\ (x_i - b_i)(x_j - b_j)RC_{ij}$
where,
x_i = asset's weight,
b_i = benchmark weight
RC_{ij} = covariance of relative return b/w asset i and j.

12. $CAV_i = (x_i - b_i)RC_{ip}$
where, RC_{ij} = covariance of relative return b/w asset i and the portfolio.

13. Expected compounded geometric return = $R_g = R_a - \frac{\sigma^2}{2}$
where, R_a = arithmetic return and σ = expected volatility.

Reading 30: 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 31: 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 = $\frac{\text{Mean portf R} - \text{Rf}}{\text{S.D of portf R}}$

9. Sortino Ratio = $\frac{\text{Mean portf R} - \text{Min acceptable R}}{\text{Downside deviation}}$

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 32: 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. $\$\beta$ of stock portf = β of stock portf × MV of stock portf = β_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 33: 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 = $V_0 = S_0$