Since I'm a student of Sanjay saraf sir therefore these summary notes will be even more helpful for Sanjay Saraf sir's students.

Basic Concepts (Summarised)

1) RF_{real} (3%) + Inflation (5%) = $RF_{nominal}$ (8.15%)
$(1.03 \times 1.05) - 1 = 0.0815 = 8.15\%$
factor × factor − 1.

2) Similarly: RA_{real} − Risk premium = RF_{real}
Solved by: $\frac{factor}{factor} - 1$

This is multiplicator model ∵ the various components of int rates are not allowed to be added.

3) I.V. (intrinsic value) of an asset = P.V of all the future CF's (Including redemption Amount), discounted at req. rate of return
If CF's are different → Use discounting factor
If " same → Use Annuity factor.

$P_0 > IV_0$ → go short / sale
$P_0 < IV_0$ → go long / purchase

4) Frequency of Compounding
1) divide the rate by 100
2) divide it by n → no. of times Compounded in a year.
(eg. if semi-annually - divide by 2).
3) Add 1.
4) Raise to the power = Time month ki rate.

$$\frac{1000}{\left(\frac{0.15}{12}+1\right)^{9/1}} = 894.29$$

5) $1.15^{5/12}$ Type 1.15 → √ 12 times → −1 → × $\frac{5}{12}$ → +1 → x = 12 times
(See eg on pg. 9-10)

6) Continuous Compounding! FV. 1000. 5m ZCB disc rate 12% compounded continuously
$(1+r)$ Replaced = e^x $\frac{1000}{(e^{.12})^{5/12}}$
actual 9% → 0.09
$(.12 \times 0.000224117206) + 1$ x = 12 times

7) Perpetuity. $\frac{A}{i}$ (annuity to continue forever)

8) Perpetual Growth $\frac{C_1}{i-g}$ $(g < i)$.

(see eg on pg. 15-16)

9) Return Measures.

$$HPY = \frac{D_1 + P_1 - P_0}{P_0} \times 100. \quad \text{for } n \text{ no. of months}$$

$$MMY = HPY \times \frac{12/365}{n/days}$$

$$EAY = \left[\left(1 + HPY\right)^{12/n} - 1\right] \times 100$$

10) Regular Annuity → $A \times PVAF(r, n)$

Annuity due → $A + A \times PVAF(r, n-1)$

11) Hidden rate calculated as

inflow = outflow

$$C_0 = \frac{C_1}{1+r} + \frac{C_2}{1+r^2} \cdots + \frac{C_n}{1+r^n}$$

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Application of statistics (Summarised)

1) CV (Coefficien of Variation) $\left(\frac{\overset{\text{Risk}}{SD}}{\underset{\text{Return}}{Mean}} \times 100\right)$

=> Risk as a percentage of return

2) Mean ($\bar{x}$) = $\frac{\Sigma x}{n}$ or ΣPx (where x = return)

3) S.D(σ) = $\sqrt{\frac{\Sigma(x-\bar{x})^2}{n}}$ or $\sqrt{\Sigma P(x-\bar{x})^2}$

4) Variance = SD^2 → Remove $\sqrt{\ }$ from SD's formulae

5) Covariance (x, y) → Joint deviation of x around $\bar{x}$ & y around $\bar{y}$.

(It is in %²) ← $Cov(x,y) = \frac{\Sigma(x-\bar{x})(y-\bar{y})}{n}$ or $\Sigma P(x-\bar{x})(y-\bar{y})$ or $\boxed{r \times \sigma_x \times \sigma_y}$

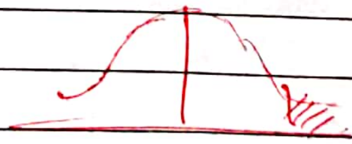
6) Correlation/ Coefficient of correlation (r)

↳ Strength of linear relationship b/w ~~the~~ 2 stocks

$$r = \frac{Cov(x,y)}{\sigma_x \sigma_y}$$

Lies b/w -1 & +1

7) Normal Distribution



$$Z = \frac{x-\mu}{\sigma}$$

8) Role of probability

See pg. 34, 35 (eg).

$$a^2 \times b^2 = (a \times b)^2$$

PORTFOLIO MANAGEMENT

part 1:

MPT (Modern Portfolio Technique).

(1) $E(R_p)$ = Weighted average

BUT σ_p $\leq$ weighted average.

$\because$ risk gets reduced in a portfolio known as "Benefit of diversification"

(= weighted avg S.D − Actual SD)

$$\sigma^2_p = \sqrt{W_A^2\sigma_A^2 + W_B^2\sigma_B^2 + 2W_A W_B \,Cov(A,B)}$$

Variance of portfolio = $weight_A^2 \times Var_A + weight_B^2 \times Var_B + 2 \times W_A \times W_B \times Covariance(A,B)$

$$Cov(A,B) = \frac{\sum(A-\bar{A})(B-\bar{B})}{N} \text{ or } \sum P(A-\bar{A})(B-\bar{B}) \text{ or } r_{AB} \times \sigma_A \times \sigma_B$$

$$\because r_{AB} = \frac{Cov(A,B)}{\sigma_A \times \sigma_B}$$

* Diversification benefit is given by 'r' i.e correlation
r_{AB} jitna zada −1 k close hoga, utna zada diversification benefit.

* Choice of individual stocks/portfolio is determined by
C.V. (coefficient of variation) = $\frac{S.D}{mean} \times 100$.
(lower the better).

* Covariance is written in $(\%)^2$ terms.
So if cov(A,B) is given as 0.12,
just multiply it with 10 000.
$Cov(A,B) = 0.12 \times 10\,000 = 120$.

② Special Cases of Corelation

1.) For perfect Positive Corelation ($\gamma = +1$)

$\cancel{\sigma_p = \sqrt{\ }}$

$\sigma_p = W_A \sigma_A + W_B \sigma_B$

Not Risk of A + Risk of B

2) For perfect Negative Corelation ($\gamma = -1$)

$\sigma_p = W_A \sigma_A - W_B \sigma_B$

Constructing Risk free portfolio.

Condition 1) $\gamma = -1$

Condition 2) $W_A = \dfrac{\sigma_B}{\sigma_A + \sigma_B}$ $\left[\dfrac{\text{Dusre ka SD}}{\text{Dono(+) ka SD}}\right]$

③ Minimum Risk Portfolio of 2 Stocks [See next page also]

$W_A = \dfrac{\sigma_B^2 - Cov(A,B)}{\sigma_A^2 + \sigma_B^2 - 2\,Cov(A,B)}$ $\left[\dfrac{\text{Dusre ka var - Covariance}}{\text{Dono ka var - 2 Covariance}}\right]$

④ Equally weighted portfolio of N identical Stocks.

let i = any one stock
& j = any other stock

[So, identical Stocks, E(R) of i = E(R) of j
SD of i = SD of j
$\gamma_{i,j}$ is same
Cov(i,j) is same.]

$\boxed{\sigma_p^2 = \dfrac{\text{var - Covariance}}{N} + \text{Covariance}}$

$\sigma_p^2 = \dfrac{\sigma^2 - Cov(i,j)}{N} + Cov(i,j).$

Sharpe Ratio = $\dfrac{E(R) - R_f}{\sigma}$ (Higher the better)

As $N \longrightarrow \infty$, σ_p is lowest & Sharp ratio is highest

= Most diversified portfolio or market portfolio.

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Minimum Variance Portfolio (MVP).

$$\boxed{r_{A,B} < \frac{\text{Lower SD}}{\text{Higher SD}}} \xrightarrow{\text{Yes}} \text{MVP is possible}$$

↓ No

MVP is possible only by short selling (i.e. only if short selling is allowed) ∵ it will result into

$W_A < 0$ (or) $W_A > 1$.

(5) Concept of Negative Rate!

possible → (i) if we short sell a security

(or) (ii) borrow at Rf.

Ensure $\Sigma W_i = 1$.

If some amount is borrowed at Rf.

$E(R_p) = W_A \times E(R)_A + W_B \times E(R)_B - W_{Rf} \times Rf.$

σ_p = No change.

(∵ SD of risk free rate = 0.).

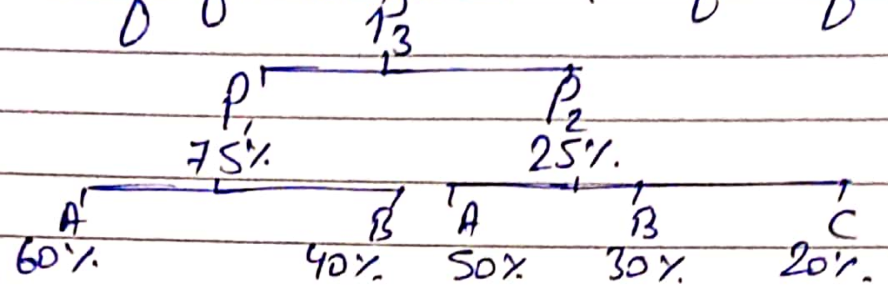
Q.) How the funds will be compensated for the risk undertaken? = Sharpe Ratio = $\frac{E(R) - Rf}{\sigma}$.

* Construct = find weights.

* If Rf is given in the question,
to compare portfolios, we will calculate 'Sharpe Ratio' instead of 'C.V.'.

* $\sigma = \sqrt{\Sigma P(x - \bar{x})^2}$

(6) fund of funds. (i.e. Portfolio of portfolios).



(construct this table to find weights).

(7) MATRIX Approach.

Return Score + Risk score + Liquidity score +? = Combined Score

$$\frac{\text{Actual } E(R)}{\text{Desired } E(R)} \times 100 + \frac{\text{Desired SD}}{\text{Actual SD}} \times 100 + \frac{\text{Desired no. of days}}{\text{Actual no. of days}} \times 100 = \text{Combined Score}(\%)$$

portfolio with the highest combined score is optimum

(8) Utility Maximisation Approach.

$$U = f\left[E(R_p)^+, \sigma_p^-\right]$$

(Positive function of return & negative function of risk)

- Given a no. of portfolios with $E(R_p)$ & σ_p.

Step 1.> Eliminate the inefficient ones by comparing $E(R_p)$ & σ_p

Step 2.> case i) No other info. → Calculate C.V & decide.

case ii) Rf given → Calculate sharpe ratio

case iii) Specific formula for utility given → Calculate utility.

(9) Corner Theorem

Portfolios that lie on the efficient frontier are known as ⇒ Minimum Variance set ⇒ Corner portfolios

for such portfolios, their is a liner relationship b/w weights of any 2 pair of stocks

eg.> Pg 78 / Q-31. Sum of weights of stock A & B is same for every portfolio given

(10) Sums based on statistics

	Ex-post	Ex-ante
Mean ($\bar{x}$)	$\frac{\Sigma x}{n}$	Σpx
σ_x	$\sqrt{\frac{\Sigma (x-\bar{x})^2}{n}}$	$\sqrt{\Sigma p(x-\bar{x})^2}$
Cov(x, y)	$\frac{\Sigma (x-\bar{x})(y-\bar{y})}{n}$	$\Sigma p(x-\bar{x})(y-\bar{y})$

Here, x and y are RETURNS and not prices. So if prices are given in the question, we first need to convert them into returns

Return(%) = $\frac{\text{change in price}}{\text{beginning price}} \times 100$ (or) $\frac{\text{Div} + \text{change in price}}{\text{beg price}} \times 100$

$\Rightarrow \underset{(\text{Return})}{\bar{x}} = \frac{\text{C.Y. price} - \text{P.Y. price}}{\text{P.Y. price}}$

- See Q-37, pg-90, pg-64 FAQ Ambiguous.

fm42:

CMT (Capital Market Theory)

Leading to CAPM (Capital Asset Pricing Model.) by Sharpe.

RUPHUM

(1) Assumptions: (Imp Theory)

i.) Investors are Rational (i.e Risk averse)

ii) Utility Maximizers

iii) Markets are Perfect → (No Tax, No transaction cost, No restrictions on short selling, fully divisible securities. etc).

iv.) Unlimited lending & borrowing @ Rf.

v) Homogenous expectations

vi) Market is in equilibrium $P_0 = IV_0$ i.e $E(R) = R_e$.

(2) Market Portfolio: Def:— Portfolio comprising of all the risky assets ($N \rightarrow \infty$) i.e. the most diversified portfolio having the highest Sharpe Ratio.

In CMT, unlike MPT, we do not relate stocks with each other, instead, we relate each stock with the economy captured by Sensex.

Systematic Risk	Unsystematic Risk
(i) Risk related to the economy.	(i) Risk arising out of firms internal factor.
(ii) It cannot be killed by diversification	(ii) It can be killed by diversification.
(iii) Non diversifiable risk or mkt risk	(iii) Diversifiable risk or firm specific risk or residual risk or Idiosyncratic risk.
(iv) Affects all firms in same direction	
(v) Captured by β.	

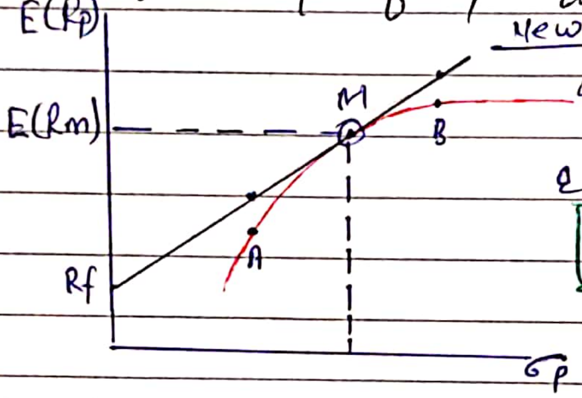
For an investor who invests in a single stock i.e. undiversified portfolio, S.D is important, & who invests in diversified portfolio β is important.

③ Combining Rf lending & borrowing with market.

$$E(R_p) = W_m E(R_m) + W_f R_f$$

$$\sigma_p = \boxed{W_m \sigma_m}$$

Q. DRAW efficient portfolio / efficient frontier.



Equation of new efficient frontier (under CMT)

$$\boxed{E(R_p) = R_f + (\text{Sharpe ratio}_M) \times \sigma_p}$$

In CAPM world, investors are rational & they want the highest sharpe ratio. So they invest in the market portfolio. ∵ Each investor has different risk tolerance level, they combine market portfolio with Rf lending & borrowing. This ensures their sharpe ratio remains the same. ★ If their own funds is same.

④ • $P_0 = \dfrac{E(CF_1)}{1+R_e} + \dfrac{E(CF_2)}{(1+R_e)^2} + \dots \dfrac{E(CF_n)}{(1+R_e)^n}$

• $R_e = R_f + \text{Risk Premium}$ (i.e, Systematic Risk premium)

CAPM is an additive mode

⑤ β. → Beta is the sensitivity of stock return to market return

If you get (−β) in examination, write the following comment!
∵ β is negative, this stock should be held in the portfolio to (act as a) hedge against the market risk.

* β of govt securities = 0, β of mkt portfolio = 1.

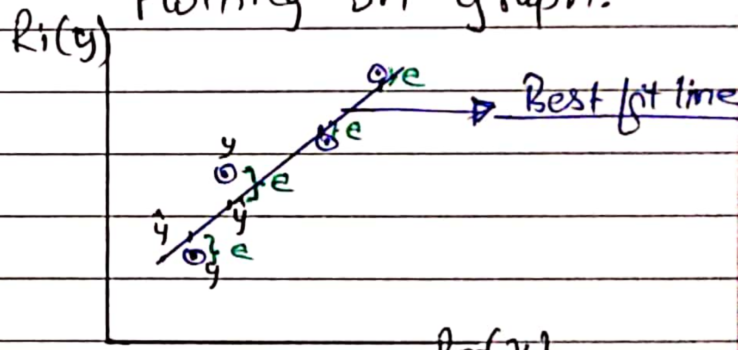
* Aggressive stocks ($\beta > 1$): Stocks having high business risk and high financial risk (high debt-equity ratio).
  Defensive stocks ($\beta < 1$): stocks having low business risk and low financial risk

R_m denotes mkt return (x)
R_i denotes stock return (y)

$$\boxed{\text{Slope} = \frac{y_2 - y_1}{x_2 - x_1}}$$

Period	$R_m(x)$	$R_i(y)$	slope
1	10%	15%	
			1.5
2	20%	30%	
			1.17
3	-10%	-5%	
			2.5
4	0	20%	

Plotting on graph.



y = actual Return on stock
$\hat{y}$ = Expected return on the stock as per best fit line.
$e = y - \hat{y}$ i.e. error term.

The points on the graph are trying to fall on an upward sloping straight line which shows the stocks are systematically influenced by the economy.
But the points are not exactly falling on the straight line due to the influence of internal factors.

Def:- Best fit Line is the one for which the sum of the squares of errorth term is least i.e. $\sum e^2$ is Minimum. Hence this method is known as the Least Square Method. (LSM).

As per LSM

$$\beta = \boxed{\frac{Cov(x,y)}{\sigma^2_x}} = \frac{r\,\cancel{\sigma_x}\,\sigma_y}{\sigma^2_x} \Rightarrow \beta = \boxed{\frac{r\,\sigma_y}{\sigma_x}}$$

Variance of mkt.

• See Q-54 > Pg.117, Pg-81 > FAQ • See Q-45 > Pg 103, Pg 83 >

(Regression line)

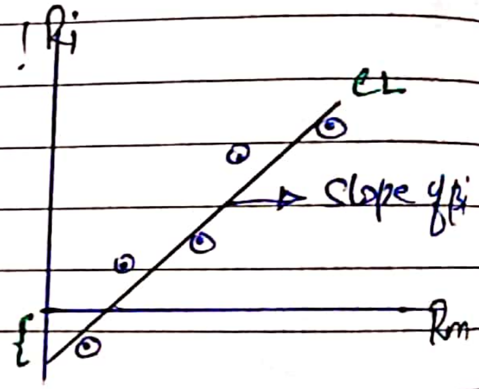
Def:- Characteristics Line: The best fit line b/w stock return & market return is known as the characteristics line (CL).

Equation of characteristics line:

$$\hat{R_i} = \alpha_i + \beta_i R_m$$

(Or)

$$\hat{y} = a + bx$$



Def:- Interpretation of α

- It is the intercept of the characteristics Line
- It is the expected return on stock ($\hat{y}$) when mkt return (Rm or X) is (

To calculate α, just put $\bar{x}$ & $\bar{y}$ in the equation of C.L.

$$\bar{y} = a + b\bar{x}$$

(b/f आ जाएगा)

* If only 2 data points are given, they will definitely fall on a straight line [ ] $\therefore \beta = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$.

(6) CAPM Model

Line	slope
CML	Sharpe Ratio.
CL	β.
SML	(Rm - Rf) β.

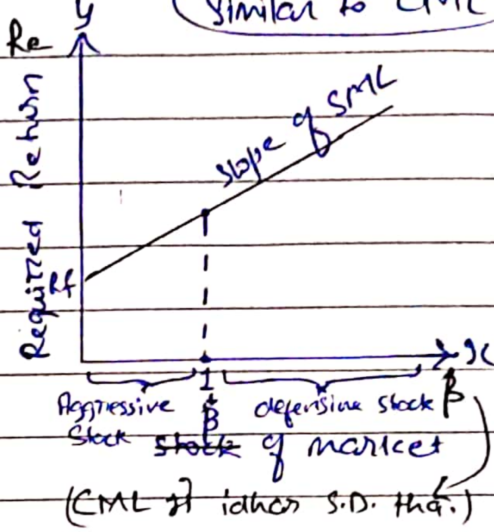
Regression Line

$\bar{y}(R_i) = a(\alpha) + b(\beta_i)\,\bar{x}(R_m)$

$Re(ER) = Rf + (Rm - Rf)\beta.$

Date :   Page : 13

Similar to CML



SML is given by

$$Re = Rf + (Rm - Rf)\beta.$$

$$y = a + bx$$

Where Rf = Risk free nominal rate of return i.e. Rf real + inflation premium.

$(Rm - Rf)$ = Market Risk Premium

$(Rm - Rf)\beta$ = Stock का risk premium.

Inflation premium is a part of both Rm and Rf. So if inflation changes, slope of SML i.e. Rm-Rf won't change.

$$IV_0 = PO_0 = \frac{D_1}{Re - g} = \frac{D_1}{ER - g}$$

$$\therefore ER = \left[\underbrace{\frac{D_1}{P_0}}_{\text{Dividend yield}} + \underbrace{g}_{\text{capital gain yield}}\right] \times 100 \quad \text{OR} \quad ER = \left[\frac{D_1 + (P_1 - P_0)}{P_0}\right] \times 100$$

Jab bhi price ki help se solve karenge tab hi ER niklega. And always assume market at equilibrium i.e $ER = Re$.

$$Re = Rf + (Rm - Rf)\beta.$$

= Opportunity cost i.e. return available elsewhere at the same risk.

$ER > Re \rightarrow P_0 < IV_0 \rightarrow$ Underpriced $\rightarrow$ go long (Purchase)

$ER < Re \rightarrow P_0 > IV_0 \rightarrow$ Over priced $\rightarrow$ go short (Sale)

$ER = Re \rightarrow P_0 = IV_0 \rightarrow$ Equilibrium $\rightarrow$ hold the stock.

$\alpha = ER - Re$. It represents abnormal return.

Remember: ER is calculated using P_0 while Re is calculated using β.

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There are 2 types of α

1.) α is the intercept of CL. $R_i = \alpha_i + \beta_i R_m$

$\hat{y} = a + bx$

Computed only when we are required to define CL.

2) α is abnormal return (ER-Re). Used to detect mispricings.

* If market is at equilibrium, $\beta = 1$.

• See: Q 17 > Pg. 56, Pg - 94 > • Q-3 > Pg - 36, Pg. 96 >

* Risk of portfolio relative to that of market is known as $\boxed{\beta p}$

βp = Weighted average.

• See Q4 > Pg. 37, Pg. 97 > To advise regarding the possible change in portfolio composition, we should calculate α of each stock

• See: Q-14 > Pg. 52, Pg - 99 > & Q-80 > Pg-156, Pg -100 >

→ Similar sums with different solutions.

* If ER and β is given, we can find Rf and Rm using simultaneous equation. with $ER = Rf + (Rm - Rf)\beta$.

Types of portfolio management [Theory]

1.> PASSIVE

- Believes markets are efficient
- Invests in a diversified portfolio to kill U.R.
- It does not play with β (i.e. No mkt timing)
- Lower fees & lower transaction cost.
- Claims to replicate the benchmark (say Nifty)

2.) ACTIVE

(i.) Market Timer

- Believes that he can anticipate market ups & downs with reasonable accuracy.
- Whenever market is expected to rise, he increases βp by shifting funds from low β stocks to high β stocks • & vice-versa.

(ii.) Stock selector

- Goes long on underpriced stock ($+\alpha$) & short on overpriced stocks ($-\alpha$).
- High unsystematic risk.

• See Q-8, Q-9 > Pg. 44, 46, Pg-105, 106 >

* Unlevered beta [βu] v/s Levered beta [β_L]

(or) Asset beta (β_A) (or) Equity beta (βe)

Unlevered beta	Levered beta
• Firm Not using any debt in its capital structure.	• Firm using debt in its capital structure
• Only business risk	• Business as well as financial risk

$$\beta e = \beta_A \left[1 + \frac{D}{E}(1-t)\right]$$

Thought process!

If debt = 0, $\beta e = \beta_A$ & if debt > 0, SH's face business as well as financial risk. but also debt generates tax shield.

Application: Eg) Given: β_L of proxy Co. To find! β_L of pvt. co.

Step 1.) Deleveraging - using D/E ratio & tax rate of proxy Co. $\beta_u = \dfrac{\beta_L}{1+D/E(1-t)}$.

Step 2.) Releveraging - using D/E ratio & tax rate of pvt Co.

Date : Page

Note! The formula above assumed that β of debt = 0.
So, if it's given in the question that β of debt = 0, DON'T FREAK.

Instead if it is given that β of debt = say 0.4, We can't use the above formula then, we will use

$$W_D \beta_D + W_E \beta_E = \beta_A$$ [• See 1st eg on pg-113]

(Weight of debt × debt beta + Weight of equity × equity beta = Asset beta)

* For a mixed play or i.e. conglomorates i.e multiple business firm β_{u} of the firm = Weighted avg of β_u of component businesses

(Eg) β_u of firm = $W_{cement} \times \beta_{cement} + W_{steel} \times \beta_{steel}$)

• See 2nd eg. on pg-113. Imp.

• See Q-11, pg-48, pg-110

↳ ∵ $\beta_{y(stock)} = r \times \frac{\sigma_y}{\sigma_{x(mkt)}}$ ∴ $\beta_{co.} = r \times \frac{\sigma_{co.}}{\sigma_x}$

↳ Cost of equity = Return = Re.

↳ yeild/Return on debt = $R_f + (R_m - R_f)\beta$ of debt.

(7) $TR(\%)^2 = SR + UR$. (Stock level)

• TR of a stock = Variance of stock = $\boxed{\sigma^2 y}$

• SR of a stock = Variance of stock due to economy.
= $\boxed{\beta_y^2 \sigma_x^2}$ = beta of stock² × Variance of mkt.

• UR of a stock = Variance of stock due to internal factors

= Variance of error term

= $\boxed{\sigma^2_e}$ = SD of error term^2.

→ SR is what proportion of TR?

It is measured by r^2 i.e. coefficient of determination

$$\boxed{r^2 = \frac{SR}{TR}}$$

Where r = corelation b/w stock and market.

- See examples on pg-116.

Given in the question: UR of stock or firm specific risk = 7%

Interpretation = $\cancel{\sigma_e^2}$ SD of error term i.e. σ_e = 7%.

Pg-142 Q.72 Given: Regression line explains only 80% of the return in bharti's stock, Interpretation: $r^2 = 0.8$.

(8) TR = SR + UR (Portfolio level).

- $r_{AB} = r_{AM} \times r_{BM}$

  = Corelation of A with mkt × Corelation of B with mkt.

- UR of portfolio = $W_A^2 \times$ UR of A + $W_B^2 \times$ UR of B.

  $$\sigma^2_{e_P} = W_A^2 \times \sigma^2_{e_A} + W_B^2 \times \sigma^2_{e_B}$$

  ∵ internal factors are not correlated & so $Cov(e_A, e_B) = 0$

  This is not weighted avg

- SR of portfolio = beta of portfolio × Variance of market.

  $= \beta_P^2 \sigma^2_{mkt}$ — Same as SR of stock

- $Cov(A, B) = \beta_A \beta_B \sigma^2_{mkt}$ → as per Sharpe.

$$\sigma_p^2 = W_A^2 \times \sigma_A^2 + W_B^2 \times \sigma_B^2 + 2 W_A W_B \, Cov(A,B)$$

Sharpe — $\beta_A \beta_B \sigma_{mkt}^2$

Markowitz. — $r_{AB} \sigma_A \sigma_B$.

- See Q-25 (Pg. 67, Pg. 120)
  - ↳ Residual Variance = U.R = σ_e^2.
  - ↳ Variance of stock = 0.015 = TR of stock $(\%)^2$ = 150.
  - ↳ Firm specific var $(\%)^2$ = UR = σ_e^2
  - ↳ Variance of portfolio ≠ Summation of variance of stocks
    ≠ weighted avg of variances of stock
    but = $SR_p + UR_p = \sigma_p^2$.

* S.D of returns on mkt index = 22% → σ_{mkt} = 22.
* SD of portfolio (σ_p) = $\sqrt{TR_p}$

- See Q76 (Pg. 147, Pg. 125)
  - ↳ $r_{(x,m)}$ (stock, mkt) $= \dfrac{Cov(x,m)}{\sigma_x \sigma_m}$ (V. Imp.) (V.V. Imp)
  - ↳ Looking at the question, we will have to determine by our own discretion whether it is is a question of sharpe's theory or Markowitz & accordingly apply the formula for Cov(A,B)

* As per sharpe, we have 2 formulas to calculate SD of portfolio

(i) $\sigma_p = \sqrt{W_x^2 \times \sigma_x^2 + W_y^2 \times \sigma_y^2 + 2 \times W_x \times W_y \times \beta_x \times \beta_y \times \sigma_{mkt}^2}$

(ii) $\sigma_p = \sqrt{TR_p}$.

- See Q. 81 (Pg. 157, Pg. 127) (ICAI, ambiguous)

* Sensitivity of return of portfolio/stock relative to that of mkt (Or)
* Risk of the portfolio/stock relative to that of market.
→ β of the portfolio (β_p) / β of stock (β_s)

Eg.) Price of 91 days money market interest treasury bill equal to ₹ 98.20 (i.e F.V. = ₹100).

$$\rightarrow R_f = \frac{100-98.2}{98.2} \times 100 \times \frac{365}{91} = \underline{7.35\%}$$

Homework Questions:

- See Q-49 > Pg-110
- See Q-10 > Pg-48
- See Q-26 > Pg-69
- See Q-22 > Pg-64

- See Q-29 > Pg-75 in book

↳ Given: R_i (Return on a stock) & R_m (Ret. on mkt Portfolio) for the past few years.

Required: (i) CL or Regression Line
(ii) TR, SR, UR.

①	②	③	④	⑤	⑥	⑦
$R_i = y$	$R_m = x$	$y-\bar{y}$	$x-\bar{x}$	$(y-\bar{y})^2$	$(x-\bar{x})^2$	$(y-\bar{y})(x-\bar{x})$

(i) $\boxed{\beta_i =} \frac{Cov(y,x)}{Var\, x}$ where $Cov(y,x) = \frac{(y-\bar{y})(x-\bar{x})}{n}$

& $Var\, x = \underline{TR_{mkt}} = \boxed{\sigma_x^2 =} \frac{(x-\bar{x})^2}{n}$

$\alpha = \bar{y} - \beta\bar{x}$

(ii) $\boxed{SR} = \beta_i^2 \sigma_x^2$ $\qquad \boxed{UR} = TR - SR$

Date : Page :

part - 3

APT (Arbitrage Pricing Theory)

APT Equation : $Re = Rf + MRP \times \beta$.

Where MRP = Market Risk Premium.

APM

$$Re = Rf + FRP_1 \cdot \beta_1 + FRP_2 \cdot \beta_2 + \dots + FRP_k \cdot \beta_k.$$

Where,

$\beta_1, \beta_2, \beta_k$ = Sensitivity of stock with respect to factor $f_1, f_2, \dots f_k$.

& FRP = Factor Risk Premium

Interpretation: If there is a portfolio with $\beta = 1$. Return of that portfolio over & above Rf is FRP.

① Sum based on APT equation

- See Q 83 > Pg. 160, Pg - 134

↳ There are 2 ways to calculate $E(R_p)$

1) Calculate E(R) of individual stocks using APT equation and do weighted average.

$$Re = Rf + FRP_1 \cdot \beta_1 + FRP_2 \, \beta_2.$$

Constant for each stock — Different for each stock

2) Calculate β_{1p}, β_{2p} as weighted avg of Beta's of stocks. Calculate $E(R_p)$ using β_{1p} & β_{2p}.

↳ If any factor is given by beta, then it denotes market & ∴ its FRP = MRP (Mkt Risk Prem) & its $\beta = 1$ (by default).

② Finding missing figures using Subtraction model

- See Q-78 > Pg-152, Pg-135 >

↳ Asked ! To calculate T.R of portfolio = $\sigma^2 p$.

$\sigma^2 p$ = SR_p + UR_p.

UR_p = $W_A^2 \times UR_{Stock A} + W_B^2 \times UR_{Stock B} + \dots$

OR if weights are equal.

$$UR_p = \frac{UR_A + UR_B + \dots UR_{stock\ n}}{n^2}$$

$UR_{stock} = \sigma^2_y - B_y^2 \sigma_x^2$

→ Portfolio is invested in with margin of 40%.

→ own funds in portfolio = 40%.

- Always see carefully the sequence of the question. Like A pehle dia hai ya B.

- Expected premium of factor = FRP.

(3) Out of syllabus but once asked that too wrong.

A(R) i.e. Act. Ret under APT = $E(R) + B_1 \times SH_1 + B_2 \times SH_2 + e$

SH (Shock) = Actual Value (%) - Expected Value (%)

See Q-2 > Pg-35, Pg-140 >

↳ In the question Rf was given insted of E(R) & e was not given. So we solved the question accordingly using Rf in place of E(R) & ignored e.

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Arbitrage portfolio = No investment, No risk & Positive Return.

(4) Common typical sum on arbitrage.
- See Q-84 > Pg 163, Pg 141 >

↳ Short sell 2 shares each of A & B so as to buy 1 share of C - (which is the only share having positive returns in all economic scenarios).
Calculate $\mathcal{E}(R_p)$ in all three economic scenarios.

(5) Sum on arbitrage • See eg on pg - 142
↳ Construct a hypothetical portfolio (D) from lowest beta stock (A) & highest β stock (C) such that β_p of D = β of stock (B)
[$\mathcal{E}(R)$ of portfolio D - $\mathcal{E}(R)$ of B] is the arbitrage profit we will earn by short selling B and investing in portfolio D.
Law of one price states that if 2 portfolios / securities have equal risk, they must have identical returns.. This is violated here.
Arbitrage involves short selling B & investing the proceeds in D such that Net inv = 0
Net β = 0
& Arbitrage profit = $\mathcal{E}(R)D - ERB$.

part - 4

C^* (Sharpe's optimisation Approach)

Given: General - • σ^2_{mkt} • R_f Specific - • $E(R_i)$ • β_i • $\sigma^2_{e_i}$

Required: Construct optimum portfolio i.e stocks to be chosen & weights to be provided.

Step 1.) Make a table to rank the stocks as per Treynor Ratio (T.R) $= \dfrac{R_i - R_f}{\beta_i}$ (Same as sharpe's ratio)

Step 2.) Calculate C^* (i.e. optimum cut off) as the maximum C_i

$$C_i = \frac{\sigma^2_{mkt} \cdot \Sigma\, kuch_1}{1 + (\sigma^2_{mkt} \cdot \Sigma\, kuch_2)}$$

(both the summations are in cumulative terms.)

$kuch_1 = \dfrac{(R_i - R_f)\beta}{\sigma^2_{e_i}}$ $kuch_2 = \dfrac{\beta^2}{\sigma^2_{e_i}}$ {Shortcut: T.R × $Kuch_2$ = $Kuch_1$}

(1.)	(2.) → T.R	(3.) → kuch 2	(4.) → kuch 1	(5)	(6)	(7) → C_i
Stocks in order of rank	$\dfrac{R_i - R_f}{\beta_i}$	$\dfrac{\beta_i^2}{\sigma^2_{e_i}}$	(2) × (3)	Cumulative of (3)	Cumulative of (4)	$\dfrac{\sigma^2_m \times (6)}{1 + \sigma^2_m (5)}$

C_i follows a pattern ( ), so if you get 1st $C_i = 6.2$, 2nd $C_i = 6.5$, 3rd $C_i = 6.1$ (Stop) → $C^* = 6.5$.

Step 3.) Chosen stocks = Stocks with TR > C^*

Step 4.) Make a table to calculate $W_i = \dfrac{Z_i}{\Sigma Z}$

where $Z_i = \dfrac{\beta_i}{U.R}\left[T.R - C^*\right]$

$= \dfrac{\beta_i}{\sigma^2_{e_i}}\left[\dfrac{R_i - R_f}{\beta_i} - C^*\right]$

Z_i	W_i
$= \dfrac{\beta_i}{U.R.}\left[T.R - C^*\right]$	$= \dfrac{Z_i}{\Sigma Z}$
ΣZ	$\Sigma W = 1$

• See eg on pg - 144.

part - 5

Efficient Market Hypothesis

Theory:

1) Efficient Market or Random Walk

Market in which there are large no. of investors who are actively & independently carrying out stock research such that
→ Current price reflects all information.
→ • New information comes to the market on random basis
• & affects stock prices instinctly.
In other words, stock prices follow 'Brownian Motion' i.e 'Motion of a particle'. We call it random walk theory.

2) Types of Market Efficiency (as per FAMA).

Strong – Technical, ~~Strong~~ fundamental & even insider information useless
Semi - Strong – Technical as well as fundamental analysis
Weak – Technical analysis useless.

3) Insider Trading

– Trading on the basis of insider information.
(Material + Non Public)
– Illegal and Punishable. However requires efficient media & regulation to curb insider trading.

Practical ⇒ Tests of Market Efficiency

1) Auto correlation test (Less imp). • See Q- 88 / Pg 170, Pg 149

Only if correlation b/w past price changes (i.e r_{xy}. where x = say change in prices for the 1st 10 days in the past and Y = say next 10 days in the past) = 0. → Markets are weakly efficient & technical analysis is useless [within ±0.2] [Time period will be given in the question]

2.) **Serial Correlation test** (less imp) . Same as <1>
The only difference is, here x & y : % change in share price.

3.) **Runs Test** (very important) • See Q-89) Pg-173 & 151)

Date	Price		Runs.
Given	Given 55	–	→ ①
	4	+	→ ②
	6	+	
	8	–	→ ③
	7		

• Focuses on direction & not magnitude of change
• Rise/fall in price $\xrightarrow{\text{represented by}}$ +/–
• Series of price change in the same directⁿ = run
n_1 = No. of pluses n_2 = No. of minus
n = no. of runs

$$\text{Mean no. of runs } (\mu) = \frac{2 \cdot n_1 \cdot n_2}{n_1 + n_2} + 1$$

$$\text{SD}(\sigma) \text{ of the no. of runs.} = \sqrt{\frac{(\mu-1)\cdot(\mu-2)}{\underbrace{n_1 + n_2 - 1}_{}}} \rightarrow \text{df (degrees of freedom)}$$

Inefficient (Lower limit) Efficient (Upper Limit) Inefficient
$\boxed{\mu - t\sigma}$ $\boxed{\mu + t\sigma}$

where t is derived from the t distribution table corresponding to → df (degrees of freedom) = $n_1 + n_2 - 1$.
→ level of significance.

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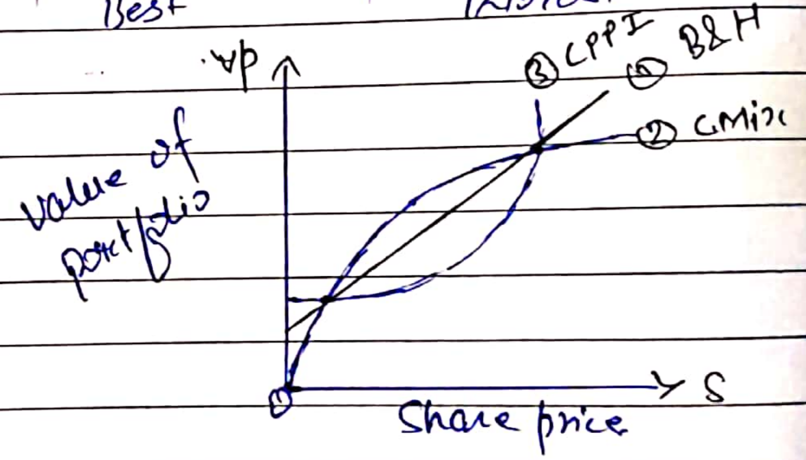
part - 6

Revised Portfolio Theory.

There are 3 portfolio revision techniques :- ① Buy & Hold. ② Constant Mix ③ Constant proportion portfolio insurance (CPPI)

Features:	Buy & Hold.	Constant Mix	CPPI
1) Shape of pay-off.	Linear	Concave	Convex
2) Price rises	do Nothing	Sell Shares	Buy shares
3) Price falls	do Nothing	Buy Shares	Sell shares
4) Floor (if S=0, vp=?)	Yes	No (0).	Yes
5) Trending mkt (u-u-u-u or d-d-d-d)	Mediocre	Worst	Best
6) Flat Mkt (u-d-u-d)	Mediocre	Best	Worst



Practical

1) Sum on CPPI

Amt to be invested in Equity $\boxed{(E) = m(A - F)}$

where A = Total Assets to be managed

F = floor (if max 10% girega, then f = 90%)

m = Multiplier. (given in question).

Amt to be invested in bond (B) = A - E

How to solve? • See Q-35 > Pg. 86, Pg - 154

↳ Step 1.) Initial allocation b/w equity and bond

Step 2.) Make table | Particulars | 10 days later | Further 10 days later

At each rebalancing date :

① Revalue Equity.

② If Rf given, Amt to be invested in bond & floor will grow at Rf.

③ Accordingly apply the formula i.e $E = m(A-F)$ in order to revise the portfolio.

Eg.> Given ! $\boxed{Rf = 8\%}$ p.a. compounded $\boxed{\text{quarterly.}}$
Rebalancing is to be done every quarter..
At the time of each rebalancing, we will increase the bond & floor amount by $\boxed{2\%}$

2> Sum on C, Mix (or constant ratio plan).

In this type of sum

Step 1> Split total assets into equity & bond in 1:1.

Step 2> When value of equity portfolio (known as the aggressive portfolio) changes, revalue the same & accordingly the total value also changes.

Step 3> Rebalance the portfolio back to 1:1 ratio.

Loop

It is always asked to compare C mix with Buy & Hold where the entire amount is invested in equity. So make one last column to show the buy & hold strategy also.

• See Q-36> Pg 88, Pg. 195>

① Months	② NAV	③ Aggressive portfolio	④ Conservative portfolio	⑤ Total	⑥ Action taken	⑦ No. of sh held	⑧ (E) Buy & Hold

• See Q-28> Pg. 72, Pg-196> formula based good question.

• See Q-90, Q-91> Pg-176, 177 in book

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part 7

Securities Market Index

(Till Now i.e in old syllabus, only theory has been asked)

Theory.

Defn An Index is a sample of securities which is used to represent the performance of :

- a market (Like Nifty represents performance of Indian equity market)
- a sector (Eg. info tech index)
- an asset class (i.e. bond index, property index, commodity index)

There are 2 steps in the construction of an index

Step 1.> Choice of securities

Step 2.> Weights and computation of formula

Practical

There are 3 types of index :

① Price Weighted Index

Index at every subsequent period = $\frac{100}{\text{Base avg}} \times$ Current avg.

$\left(\text{base avg} = \frac{\Sigma P_0}{N}, \text{ current avg} = \frac{\Sigma P_1}{N}\right)$

② Equally weighted Index

Subsequent index = $100 + \frac{\Sigma R(\text{Return})}{N}$ $\left(R = \frac{P_1 - P_0}{P_0} \times 100\right)$

③ Market Cap weighted Index

Same as ① but here base ~~avg~~ m.cap = $\Sigma(\text{no. of sh.} \times P_0)$ and current ~~avg~~ m.cap = $\Sigma(\text{no. of sh} \times P_1)$.

In the case of Nifty & sensex, we take free float market cap i.e excluding promoters & other strategic holding.

Eg:- Securities	n (No. of Shares)	P_0	P_1	V_0 $(n \times P_0)$	V_1 $(n \times P_1)$ ← Mkt Cap.	$R = \frac{P_1 - P_0}{P_0} \times 100$
A	10 cr.	500	550	5000 cr	5500 cr	10 %
B	1000 cr	50	55	50000 cr	55000 cr	10 %
C	1 cr	10	9	10 cr	9 cr	-10 %
		560	614	55010 cr	60509 cr	10%
		÷ 3	÷ 3			÷ 3
		186.67	204.67			3.33%

Subsequent Index ⇒

(1) Price weighted $= \frac{100 \times 204.67}{186.67} = \underline{\underline{109.67}}$

(2) Equally weighted $= 100 + 3.33 = \underline{\underline{103.33}}$

(3) Mkt cap weighted $= \frac{100 \times 60509}{55010} = \underline{\underline{109.99 \approx 110}}$