PORTFOLIO MANAGEMENT

CLASS 5

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Date

always ignored but focus on CAPM

PART-II → CAPITAL MARKET THEORY (CMT) leads us to Capital Asset Pricing Model (CAPM)

CMT

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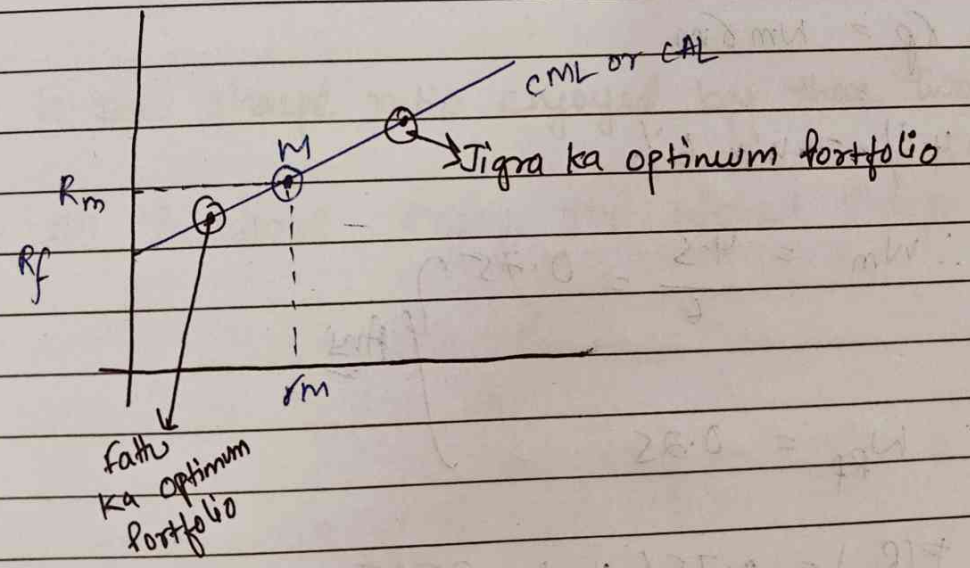
All investors are assumed to be rational (risk averse). So, they invest in the most diversified portfolio i.e. Market Portfolio & combine that with risk free lending (fattu) or risk free borrowing (Jigra) & everyone enjoys the highest Sharpe ratio $\left[\frac{R_m - R_f}{\sigma_m}\right]$ on the CAL or CML.

$$R_p = R_f + \left[\frac{R_m - R_f}{\sigma_m}\right]\sigma_p \quad \ldots(1)$$



These portfolios that lie on the CML are called Efficient Portfolios.

Combination of MKT & R_f

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$\sigma_p = W_m \sigma_m$ ∵ R_f ka sd = 0 ∴ only $W_m\sigma_m$

weighted avg

$$R_p = W_m R_m + (1 - W_m) R_f$$

Risky & Never came in Exam but given in RTP/MTP

Example :-

Assume that we live in the CMT or CAPM world :-

Risk free return = 5%
Expected return on mkt portfolio = 14%
S.d of market portfolio = 6%

Q No.1 Mr. X wants to construct an efficient portfolio with sd of 4.5%. Construct the portfolio and calculate expected return on the portfolio?

Soln :-

$\sigma_p = W_m \sigma_m$

$4.5\% = W_m \, 6\%$

$\therefore W_m = \frac{4.5}{6} = 0.75$

$\therefore W_{Rf} = 0.25$

Ans

$E(R_p) = 0.75 \times 14 + .25 \times 5$

$= 11.75\%$ (Ans) (Factly)

Q No. 2 Mr. Y wants to construct an efficient portfolio with Expected Return = 21%. Construct the Portfolio and find out Sd of the Portfolio.

Soln:- $E(Rp) = W_m \times R_m + (1-W_m) R_f$

$21 = W_m \times 14 + (1-W_m) 5$

$21 = 14W_M + 5 - 5W_M$

$16 = 9W_M$

$W_M = \frac{16}{9} = 1.78$ approx

$W_{Rf} = -0.78$ (short sell) / Risk free borrowing

$\sigma p = W_m \sigma_m$

$= 1.78 \times 6$

$= 10.67\%$ (Ans) (Jigra)

Q.N.3 What is the sharpe ratio enjoyed by these two investors on CML

Soln:- All investors enjoy the highest sharpe ratio

$= \frac{R_m - R_f}{\sigma_m}$

$= \frac{14-5}{6} = 1.5$

Q4. State the Equation of the CML or CAL?

$R_p = R_f +$ Sharpe ratio $\times \sigma_p$

$R_p = 5 + 1.5\sigma_p$ → same ans will come (11.75%)

→ Pricing model [Cap assets (stock) ka price kese nikalte hain]

CAPM — unsystematic risk is irrelevant (co. internal risk, diversifiable by DCF); only systematic risk is relevant (economy risk is imp, non-diversifiable).

1. Pricing Model

P_0 or IV_0 = PV of (Exp) future CF's discounted @ R_e ∵ future CFs are uncertain

If CF are certain ↓ discounted @ R_f

$$= \frac{E(CF_1)}{1+R_e} + \frac{E(CF_2)}{(1+R_e)^2} + \dots + \infty$$

Required rate of return
= R_f + risk Premium (R_f)
= R_f + Systematic Risk Premium (SRP)

$$R_e = R_f + (R_m - R_f)\beta_e$$

→ Mkt jb V/ se change hoga to stock ki β_e se change hoga

SRP ⇒ Systematic Risk ke badle extra compensation required

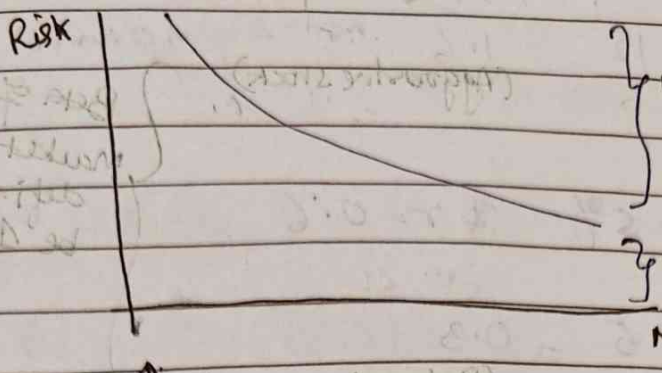
Risk = Systematic Risk + Unsystematic Risk

- Systematic Risk = Economy wide risk or Market Risk or Non-Diversifiable risk
- Unsystematic Risk = Company or Firm specific Risk or Diversifiable risk or Idiosyncratic Risk

Why unsystematic risk is irrelevant in CAPM World?

Because investors invest in a combination of market & Rf. Since market portfolio is fully diversified,

unsystematic risk gets cancelled and therefore irrelevant.



Please Refer to 'N' stock wala sum in the last class.

∴ $R_e = R_f + SRP$

Systematic Risk of a stock

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Isko Capture kaise karein?

⇓

β ⇒ Sensitivity of stock Return to Market Return

Jab R_m (Market) 1% change hoga, To stock ka return (R_i) kitne % change hoga?

$\beta = r \times$ Sd ratio → $\frac{\sigma_{stock}}{\sigma_{mkt}}$

stock return & market return

$$\beta = r_{im} \times \frac{\sigma_i}{\sigma_m}$$

Ex: $\sigma_m = 6\%$ $\sigma_i = 9\%$ & $r = 0.9$

stock $\beta_i = 0.9 \times \frac{9}{6} = 1.35$ (Aggressive Stock)

Ex: $\sigma_m = 6\%$, $\sigma_i = 12\%$ & $r = 0.8$

Stock B: $\beta_i = 0.8 \times \frac{12}{6} = 1.6$ (Aggressive stock) $\because > 1$

Ex: $\sigma_m = 10\%$ $\sigma_i = 5\%$ & $r = 0.6$

Stock C: $\beta_i = 0.6 \times \frac{5}{10} = 0.3$ (Defensive stock) $\because < 1$

Beta of the market is defined to be 1.

One more formula of "β"

$$\beta_i = r \times \frac{\sigma_i}{\sigma_m}$$

$$\therefore \beta_i = r \times \frac{\sigma_i \times \sigma_m}{\sigma_m \times \sigma_m}$$

$$\therefore \beta_i = \frac{\text{covariance}(i, m)}{\sigma_m^2}$$

Tone = Uppar mein stock ka market ke sath covariance
Neeche mein market ka variance

One more formula of β

β is slope = Rate of change of stock wrt. market

$$= \frac{Y_2 - Y_1}{X_2 - X_1}$$

$$= \frac{\Delta Y}{\Delta X}$$

$= \frac{\Delta R_i}{\Delta R_m}$ (ΔR_i → change in stock ka return)

⇒ When to use this?

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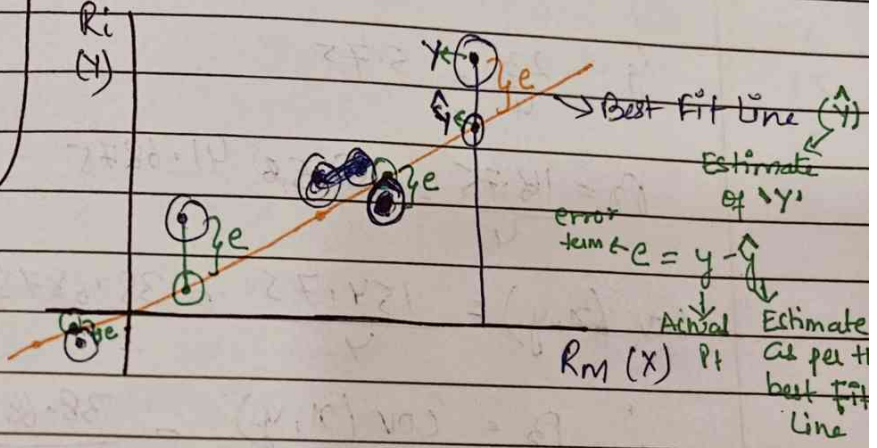
We use this only when two data points are given

Finally Statistics

Yrs	R_m	R_i
1	10%	6%
2	-2%	-4%
3	12%	9%
4	15%	12%
5		

→ Plot



This Best fit line is known as the characteristic line:

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

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

$\hat{R_i}$ ← $\hat{y}$ = a + bx → R_m

a → intercept

b → Beta

$$b = \rho \frac{\sigma_y}{\sigma_x} \quad \text{or} \quad \frac{cov(x,y)}{\sigma_x^2}$$

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

α = No significance

Ex:

Yrs	$R_m(x)$	$R_i(y)$	$x-\bar{x}$	$y-\bar{y}$	$(x-\bar{x})^2$	$(y-\bar{y})^2$	$(x-\bar{x})(y-\bar{y})$
1	10	6	1.25	0.25	1.5625	0.0625	0.3125
2	-2	-4	-10.75	-9.75	115.5625	95.0625	104.8125
3	12	9	3.25	3.25	10.5625	10.5625	10.5625
4	15	12	6.25	6.25	39.0625	39.0625	39.0625
	35	23			166.75	144.75	154.75

$\bar{x} = \frac{35}{4} = 8.75$

$\bar{y} = \frac{23}{4} = 5.75$

$\sigma_x = \frac{166.75}{4} = 41.6875$

$cov(x,y) = \frac{154.75}{4} = 38.6875$

$\therefore \beta = \frac{cov(x,y)}{\sigma_x^2} = \frac{38.6875}{41.6875}$

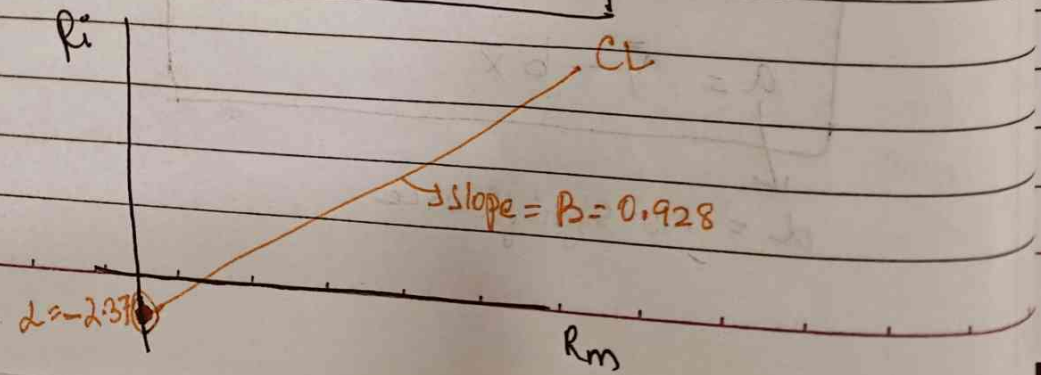
$\beta = 0.928 \rightarrow$ Defensive stock

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

$= 5.75 - 0.928 \times 8.75$

$= -2.37$

CL $\quad \hat{R_i} = -2.37 + 0.928 R_m$



Exante data

Ex:

Prob	Rm (x)	Ri (Y)
0.4	20%	10%
0.5	30%	40%
0.1	40%	60%

} Derive the equation of the CL

P	Rm(x)	Ri(Y)	Px	Py	$(x-\bar{x})$	$(Y-\bar{Y})$	$P(x-\bar{x})^2$	$P(Y-\bar{Y})^2$	$P(x-\bar{x})(Y-\bar{Y})$
0.4	20	10	8	4	-7	-20	19.6	160	56
0.5	30	40	15	20	3	10	4.5	50	15
0.1	40	60	4	6	13	30	16.9	90	39
			27	30			41	300	110

$\bar{x} = 27\%$ $\quad \sigma x^2 = 41$ $\quad Cov(x,y) = 110$

$\bar{y} = 30\%$ $\quad \sigma y^2 = 300$

$$\beta = \frac{Cov(x,y)}{\sigma x^2} = \frac{110}{41} = 2.68 \Rightarrow \text{aggressive Stock}$$

$$\alpha = \bar{y} - b\bar{x}$$
$$= 30 - 2.68 \times 27$$
$$= -42.36$$

CL = $\hat{R}_i = -42.36 + 2.68\, Rm$