Risk and Return

Return and Risk based on Past-data :-

$$R_t = \frac{[P_t - P_{t-1} + Div_t]}{P_{t-1}} \times 100$$

Expected return, $\bar{R} = \frac{\Sigma R_i}{n}$

Expected Risk, $\sigma^2 = \frac{\Sigma (R_i - \bar{R})^2}{n-1}$ $\quad \sigma = \sqrt{\sigma 2}$

Return and Risk using probabilities :-

Expected Return $= \Sigma P_i R_i$

Expected Risk $(\sigma 2) = \Sigma P_i (R_i - \bar{R})^2$ $\quad \sigma = \sqrt{\sigma 2}$

A1 Annual Returns

Year	Annual Return	Return %
1988	$\frac{20.75 - 31.25 + 1.53}{31.25} \times 100$	-28.7
1989	$\frac{30.88 - 20.75 + 1.53}{20.75} \times 100$	56.2
1990	$\frac{67 - 30.88 + 2}{30.88} \times 100$	123.44 %
1991	$\frac{100 - 67 + 2}{67} \times 100$	52.24 %
1992	$\frac{154 - 100 + 3}{100} \times 100$	57 %

$\Sigma R_i = 260.19$

Expected return ; $\bar{R} = \frac{\Sigma R_i}{n} = \frac{260.19}{5}$

$= \boxed{52.04\ \%}$

Year	R_i (%)	$R_i - \bar{R}$	$(R_i - \bar{R})^2$
1988	-28.7	-80.79	6578.95
1989	56.2	4.16	17.31
1990	123.45	71.41	5099.39
1991	52.24	0.2	0.04
1992	57	4.96	24.60
	260.19		

Expected Risk

$$\sigma^2 = \frac{\Sigma (R_i - \bar{R})^2}{n-1}$$

$$= \frac{11660.29}{4}$$

$$\sigma^2 = 2915.07$$

$$\sigma = 53.99$$

$$\approx \boxed{54.1}$$

Range of returns $\rightarrow$ $\boxed{-1.96 \text{ to } 106.04}$

Since range is very big, we can consider this stock as risky

A4 ACC

Prob (P_i)	Return (R_i)	P_iR_i	$R_i - \bar{R}$	$(R_i - \bar{R})^2$	$P_i(R_i - \bar{R})^2$
0.5	1.94	0.97	-0.463	0.214	0.107
0.4	2.74	1.096	0.337	0.114	0.046
0.1	3.37	0.337	0.967	0.935	0.094
		2.403			0.247

Expected return $= \bar{R} = \Sigma P_i R_i =$ 2.403

$$\sigma^2 = \Sigma P_i (R_i - \bar{R})^2 = 0.247$$

$$\sigma = 0.496$$

$$\approx \boxed{0.5\%}$$

Range of returns $\rightarrow$ 1.9 to 2.9

Hero

P_i	R_i	P_iR_i	$R_i - \bar{R}$	$(R_i - \bar{R})^2$	$P_i(R_i - \bar{R})^2$
0.5	5.1	2.55	-32.677	1067.33	533.67
0.4	74.92	29.968	37.143	1379.6	551.84
0.1	52.59	5.259	14.813	219.34	21.934
		37.777			1107.4

$\therefore$ Expected return = 37.777

$\therefore \sigma^2 = \Sigma P_i (R_i - \bar{R})^2 = 1107.4$

$\sigma = 33.28\%$

Range of hero > Range of ACC

$\therefore$ Hero is more riskier

Q5 (a) On the basis of expected returns

(b) On the basis of expected risk.

* **Expected Return and Risk of a portfolio (2-assets)**

* Expected Return $R_p = W_1R_1 + W_2R_2$

weights Returns

* Expected Risk $\sigma_p^2 = W_1^2\sigma_1^2 + W_2^2\sigma_2^2 + 2W_1W_2\sigma_1\sigma_2 r_{12}$

OR

$$\sigma_p^2 = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2 COV_{12}$$

$$COV_{12} = \sigma_1 \times \sigma_2 \times r_{12}$$

$$\sigma_p = \sqrt{\sigma_p^2}$$

A7

	X	Y
R_i	12%	15%
σ_i (S.D.)	15%	20%
	$W_1 = 0.4$	$W_2 = 0.6$

$R_p = W_1R_1 + W_2R_2 = (0.4 \times 12) + (0.6 \times 15) = 4.8 + 9 = \boxed{13.8\%}$

* Calculating portfolio risk at diff. correlation coefficient

$$\sigma_p^2 = W_1^2\sigma_1^2 + W_2^2\sigma_2^2 + 2W_1W_2\sigma_1\sigma_2 r_{12}$$

$r_{12} = +1$

$\sigma_p^2 = (0.4)^2(15)^2 + (0.6)^2(20)^2 + (2 \times 0.4 \times 0.6 \times 15 \times 20 \times 1)$

$= 36 + 144 + 144$

$\sigma_p^2 = 324$

$\sigma_p = \sqrt{324} = \boxed{18\%}$

$r_{12} = 0.5$

$\sigma_p^2 = (0.4)^2(15)^2 + (0.6)^2(20)^2 + (2 \times 0.4 \times 0.6 \times 15 \times 20 \times 0.5)$

$= 36 + 144 + 72$

$\sigma_p^2 = 252$

$\sigma_p = \sqrt{252} = \boxed{15.87\%}$

$r_{12} = 0$

$\sigma_p^2 = 36 + 144 + (2 \times 0.4 \times 0.6 \times 15 \times 20 \times 0)$

$= 36 + 144$

$= 180$

$\sigma_p = \sqrt{180} = \boxed{13.42\%}$

$r_{12} = -0.5$

$\sigma_p^2 = 36 + 144 + (2 \times 0.4 \times 0.6 \times 15 \times 20 \times -0.5)$

$= 36 + 144 - 72$

$= 108$

$\sigma_p = \sqrt{108} = \boxed{10.39\%}$

$r_{12} = -1$

$\sigma_p^2 = 36 + 144 - 144$

$= 36$

$\sigma_p = \sqrt{36}$

$= \boxed{6\%}$

A8 Part - II

Reduce $\sigma_p = 15\%$ $\sigma_p^2 = 225$ $r_{12} = ?$

$\sigma_p^2 = W_1^2\sigma_1^2 + W_2^2\sigma_2^2 + 2W_1W_2\sigma_1\sigma_2 r_{12}$

$\sigma_p^2 \to 225$, $r_{12} \to ?$

All

P_i
0.1
0.4
0.2
0.1
0.2

P_i	R_x	R_y	P_iR_x	P_iR_y	$R_x - \bar{R_x}$	$P_i(R_x-\bar{R_x})^2$	$R_y - \bar{R_y}$	$P_i(R_y-\bar{R_y})^2$	$P_i(R_x-\bar{R_x})(R_y-\bar{R_y})$
0.1	20	14	2	1.4	19.1				
0.4	-16	-20	-6.4	-8	-16.9	36.48	13.8	19.04	26.36
0.2	14	18	2.8	3.6	13.1	114.24	-20.2	163.22 ~~19.42~~	136.55
0.1	9	12	0.9	1.2	8.1	34.32	17.8	63.37	46.64
0.2	8	10	1.6	2	7.1	6.56	11.8	13.92	9.52
			0.9	0.2		10.08	9.8	19.21	13.92
						201.68		278.76	233.03

$\bar{R_x} = 0.9 \qquad \bar{R_y} = 0.2$

$\sigma_x^2 = \Sigma P_i(R_x - \bar{R_x})^2 = 201.68 \qquad \Rightarrow \sigma_x = \sqrt{201.68} = 14.2$

$\sigma_y^2 = 278.76 \qquad \sigma_y = \sqrt{278.76} = 16.7.$

(a)

$COV_{12} = \Sigma P_i(R_x - \bar{R_x})(R_y - \bar{R_y})$

$= \boxed{233.03}$

$r_{12} = \dfrac{COV_{12}}{\sigma_1 \times \sigma_2} = \dfrac{233.03}{14.2 \times 16.7} = \boxed{0.98}$

(b) $R_p = (0.5 \times 0.9) + (0.5 \times 0.2) = \boxed{0.55\%}$

$\sigma_p^2 = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\sigma_1\sigma_2 r_{12}$

$= (0.5)^2(14.2)^2 + (0.5)^2(16.7)^2 + 2(0.5)(0.5)(14.2)(16.7)(0.98)$

$=$

(c). $\sigma_p = 25$ give

$\sigma_p^2 = 625. \quad r_{12} = ?$

Q9, 10, 12, ~~13~~. HW.

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* Capital Asset Pricing Model (CAPM)

Return of a portfolio $R_p = R_f + \beta (R_m - R_f)$

R_f ↑ Risk free ~~return~~ rate; β ↑ Systematic Risk coefficient; R_m ↑ market return

→ Market → Index (Sensex (BSE-30), Nifty (50), Bank Nifty etc.)
↓
$\beta = 1$

Stock x has $\beta = 1.5$

If the return as per CAPM < Required return, stock is undervalued. If the return as per CAPM > required return, stock is overvalued.

* Calculation of β, covariance, correlation, SR & USR

Based on probabilities	Based on historical data
Stock Return $= R_i$	Expected return of stock $\bar{R_i} = \frac{\Sigma R_i}{n}$
Market Return $= R_m$	
Expected Return of stock $= \Sigma P_i R_i$	Expected return of market $\bar{R_m} = \frac{\Sigma R_m}{n}$
Expected Return of market $= \Sigma P_i R_m$	
Variance of stock $\sigma_i^2 = \Sigma P_i (R_i - \bar{R_i})^2$	Variance of stock $\sigma_i^2 = \frac{\Sigma (R_i - \bar{R_i})^2}{n-1}$
Variance of market $\sigma_m^2 = \Sigma P_i (R_m - \bar{R_m})^2$	Variance of mkt $\sigma_m^2 = \frac{\Sigma (R_m - \bar{R_m})^2}{n-1}$
$COV_{(i,m)} = \Sigma P_i (R_i - \bar{R_i})(R_m - \bar{R_m})$	$COV_{(i,m)} = \frac{\Sigma (R_i - \bar{R_i})(R_m - \bar{R_m})}{n-1}$
$\beta_i = \frac{COV_{(i,m)}}{\sigma_m^2}$ $\boxed{OR}$ $\beta_i = \frac{r_{i,m} \times \sigma_i}{\sigma_m}$	→ Same
$r_{i,m} = \frac{COV(i,m)}{\sigma_i \times \sigma_m}$	→ Same

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* Calculation of $\underline{\text{Systematic Risk}}$ & $\underline{\text{Unsystematic Risk}}$
(SR) (USR)

Total Risk (σ_i^2) = Systematic Risk + Unsystemic Risk

$\sigma_i^2 = \beta_i^2 \sigma_m^2 + \sigma_{ei}^2$

= (Residual)

$\therefore$ USR = TR − SR

$= \sigma_i^2 - (\beta_i^2 \sigma_m^2)$

Diversified but cannot be hedged

Can be hedged but cannot be diversified.

Q13

P_i	R_i	R_m	P_iR_i	P_iR_m	$R_i-\bar{R}$	$P_i(R_i-\bar{R})^2$	$R_m-\bar{R_m}$	$P_i(R_m-\bar{R_m})^2$
	XYZ	MKT						
0.4	20	16	8	6.4	7.8	24.34	4.2	7.06
0.4	13	12	5.2	~~[illegible]~~ 4.8	0.8	0.26	0.2	0.02
0.2	−5	3	−1	+0.6	−17.2	59.17	−8.8	15.49
			12.2	11.8		83.77		22.52

$\bar{R} = \Sigma P_iR_i = 12.2\%$ (required return)

$\bar{R_m} = \Sigma R_iR_m = 11.8\%$ ~~(Required Return)~~

$\sigma_i^2 : \Sigma P_i(R_i - \bar{R_i})^2 = 83.77 \quad \sigma_i = \sqrt{83.77} = 9.15\%$

$\sigma_m^2 = \Sigma P_i(R_m - \bar{R_m})^2 = 22.57 \quad \sigma_m = \sqrt{22.57} = 4.75\%$

$COV_{i,m} = \Sigma P_i(R_i - \bar{R_i})(R_m - \bar{R_m}) = 43.42$

$P_i(R_i-\bar{R_i})(R_m-\bar{R_m})$
13.104
0.064
30.272
43.44

$\beta = \dfrac{COV_{i,m}}{\sigma_m^2} = \dfrac{43.44}{22.57} = 1.93$

Expected return as per CAPM, $R_i = R_f + \beta(R_m - R_f)$

$= 7 + 1.93(11.8 - 7) = \boxed{16.26\%}$

As expected return as per CAPM (16.26%) > ~~\%~~ 12.2%
(Req. return)
the XYZ stock is overvalued.
Hence investment is not wise.

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R_i	R_m	$R_i - \bar{R}$	$(R_i - \bar{R_i})^2$	$(R_m - \bar{R_m})$	$(R_m - \bar{R_m})^2$	$(R_i - \bar{R_i})(R_m - \bar{R_m})$
18	15	9	81	9	81	81
9	7	0	0	1	1	0
20	16	11	121	10	100	110
-10	-13	-19	361	-19	361	361
5	4	-4	16	-2	4	8
12	7	3	9	1	1	3
			588		548	

$\bar{R_i} = \frac{\Sigma R_i}{n} = \frac{54}{6} = 9\%$

$\bar{R_m} = \frac{\Sigma R_m}{n} = \frac{36}{6} = 6\%$

$\sigma_i^2 = \frac{(\Sigma R_i - \bar{R_i})^2}{n-1} = \frac{588}{5} = 117.6$

$\sigma_m^2 = \frac{\Sigma (R_m - \bar{R_m})^2}{n-1} = \frac{548}{5} = 109.6$

$\sigma_i = \sqrt{117.6} = \boxed{10.84\%}$

$\sigma_m = \sqrt{109.6} = \boxed{10.47\%}$

(i) $COV_{(i,m)} = \frac{\Sigma (R_i - \bar{R_i})(R_m - \bar{R_m})}{n-1}$

$= \frac{563}{5} = \boxed{112.6}$

$r_{i,m} = \frac{COV_{(i,m)}}{\sigma_i \times \sigma_m}$

$= \frac{112.6}{10.84 \times 10.42}$

$= \boxed{0.99}$

(ii) $\beta_i = \frac{COV_{(i,m)}}{\sigma_m^2} = \frac{112.6}{109.6}$

$= \boxed{1.03}$

OR

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

$= \frac{0.99 \times 10.84}{10.42} = \boxed{1.03}$

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(iii) Total risk of stock S = 10.84% (σ_i)

$\therefore$ Variance $= \sigma_i^2 = 117.6$

$\sigma_i^2 = S.R. + U.S.R.$

Systematic Risk $= \beta_i^2 \sigma_m^2$

$= (1.03)^2 (10.47)^2$

$= 116.27$

17
2

R_i	R_m	$R_i - \bar{R_i}$	$R_m - \bar{R_m}$	$(R_i - \bar{R_i})^2$	$(R_m - \bar{R_m})^2$	$(R_i - \bar{R_i})(R_m - \bar{R_m})$
29	-10	15.2	-14	231.04	256	-212.8
31	24	17.2	20	295.84	400	344
10	11	-3.8	7	14.44	49	-26.6
6	-8	-7.8	-12	60.84	144	93.6
-7	3	-20.8	-1	432.64	1	20.8
69	20			1034.8	790	219

$\bar{R_i} = \frac{\Sigma R_i}{n} = \frac{69}{5} = 13.8$

$\bar{R_m} = \frac{\Sigma R_m}{n} = \frac{20}{5} = 4$

$COV_{(i,m)} = \frac{219}{4} = 54.75$

$\beta_i = \frac{COV_{im}}{\sigma_m^2} = \frac{54.75}{197.5} = \boxed{0.28}$

$\sigma_i^2 = \frac{\Sigma (R_i - \bar{R_i})^2}{n-1}$

$= \frac{1034.8}{4}$

$\sigma_i^2 = 258.7$

$\boxed{\sigma_i = 16.08\%}$

$\sigma_m^2 = \frac{\Sigma (R_m - \bar{R_m})^2}{n-1}$

$= \frac{790}{4}$

$= 197.5$

$\sigma_m = 14.05\%$

(a) Regression line of dependent variable on independent variable

Regression line of Y on X

$y = \alpha + \beta x + e$ ← Residual error

↑ alpha ↑ Beta

$\alpha = \bar{R_i} - \beta(\bar{R_m})$

$= 13.8 - (0.28 \times 4)$

$= \boxed{12.68}$

$\therefore y = 12.68 + 0.28x$ ← (Return of ~~Xerox~~ S&P500)

↑

Return of ~~S&P500~~ Xerox

Regression equation $y = 12.68 + 0.28X$

(d) Return of xerox = 17.7 %

Market return = 14 %

Putting values in regression eqn, $y = 12.68 + 0.28(14)$

$= 12.68 + 3.92$

Return of Xerox in Yr 6. $= \boxed{16.6\%}$

No not suggested by Regression line

(e) Total variance of xerox $\sigma_i^2 = 258.7$

(ii) Proportion explained and not explained by Market

→ Proportion of Total risk which can be explained is calculated by r^2 (coefficient of determination)

Proportion which cannot be explained is $1-r^2$

$$r = \frac{COV_{(i,m)}}{\sigma_m \times \sigma_i} = \frac{54.75}{14.05 \times 16.08} = \boxed{0.25}$$

$r^2 = (0.25)^2 = 0.0625 \times 100 = 6.25\%$ proportion that is explained by S&P500

$1 - r^2 = 0.9375 \times 100 = 93.75\%$ proportion not explained by S&P500

* Capital Budgeting techniques / Proposal Appraisal Techniques

→ Payback period

Initial investment (Yr 0)	- 10L
Yr 1	1L
2	4L
3	3L
4	2L
5	3L

P.B Period = 4yrs

→ Discounted Payback period.

		PVIF	Disc CF
Initial outlay (Yr 0)	-10L		
1	1L ×	0	✓
2	4L ×	0	✓
3	3L ×	0	✓
4	3L	0	✓
5	3L	0	✓

DPBP

Q1 (a) Pay Back Period

Yrs	CFAT (cash flow after taxes)	Cummulative CF
0	-330	
1	90	90
2	120	210
3	380	590
4	420	1010
5	310	1320
6	240	1560
7	60	1620

CF Received by end of year 2	210 lacs
CF remaining	120 lacs
CF recd in 3rd year	380 lacs

$$\text{Pay-back period} = 2\text{ yrs} + \frac{\text{CF remaining}}{\text{CF received in } n^{th} \text{ year}}$$

$$= 2 + \frac{120}{380}$$

$$= 2 + 0.32$$

$$\therefore \text{PBP} = \boxed{2.32 \text{ years}}$$

(b) Discounted Pay Back period

Yrs	CFAT	PV factor @ 15%	P.V of CF / discounted CF	Cumulative CF
0	-330			
1	90	0.87	78.3	78.3
2	120	0.756	90.72	169.02
3	380	0.658	250.04	419.06
4	420	0.572	240.24	659.30
5	310	0.497	154.07	813.37
6	240	0.432	103.68	917.05
7	60	0.376	22.56	939.61

CF recd by end of year 2 = 169.02
CF remaining = 160.98
CF received in 3^{rd} yr = 250.04

Discounted PBP $= 2 + \frac{160.98}{250.04}$

$= 2 + 0.64$

$= \boxed{2.64 \text{ years}}$

* Net Present Value (NPV)

NPV = P.V. of cash inflows − P.V. of cash outflows (outlay / initial investment)

If NPV is +ve, accept project
If NPV is −ve, reject project

* Profitability Index (P.I)

$$P.I. = \frac{\text{PV of cash inflows}}{\text{P.V. of cash outflows}}$$

Decision criteria : If P.I. > 1, accept
If P.I. < 1, Reject

Q3

Yrs	CFAT	PV factor @ 12%	PV of CF	Cummulative CF
0	-10L	00		
1	1.5L	0.893	1.3395L	1.3395 L
2	2L	0.797	1.594L	2.9335 L
3	3L	0.712	2.136 L	5.0695 L
4	4.5L	0.636	2.862 L	7.9315 L
5	5L	0.567	2.835 L	10.7665 L
6	4L	0.507	2.028 L.	12.7945 L

CF in 4^{th} yr $\rightarrow$ 7.9315 L

Rema. CF $\rightarrow$ 2.0685 L

CF in 5^{th} yr $\rightarrow$ ~~9078506~~ 2.835 L

$\therefore$ DPBP $= 4 + \dfrac{2.0685}{2.835}$

$= \boxed{4.73 \text{ years}}$

NPV $=$ 12.7945 L $-$ 10 L

$=$ 2.7945 L

$= \boxed{2,79,450} > 0$ Accept the project

PI $= \dfrac{1279450}{1000000}$

$= \boxed{1.28} > 1$ Accept the project

Q2, 4 $\leftarrow$ PRACTICE

9, 10

* Internal Rate of Return (IRR)

Step 1. Avg. cashflow = $\frac{\text{Total cashflow}}{\text{no. of years}}$

Step 2. $\frac{\text{Initial investment}}{\text{Avg. cashflow}}$ = ( ) P.V.I.F.A

Step 3 Check answer of step-2 in PVIFA table for n years. The rate to which that value is connected, assume that rate as IRR.
→ Calculate NPV using IRR

Step 4 If NPV in step 3 is positive, calculate another NPV using higher rate and if NPV in step 3 is negative, calculate another NPV using lower rate
(Take diff of 4%)

Step 5 IRR = Lower rate + Diff b/w two rate $\left[\frac{\text{P.V @ lower rate} - \text{Initial investment}}{\text{P.V. @ lower rate} - \text{PV @ higher rate}}\right]$

Q5 (e) IRR of each project.

Project A Initial investment = 15 Cr.

Step 1 Avg CF = $\frac{4+4+3+4+5+4+2}{7} = \frac{26}{7}$ = 3.71 Cr.

Step 2. $\frac{\text{Initial investment}}{\text{Avg. cashflow}} = \frac{15\ Cr}{3.71\ Cr} = 4.043$

Step 3. Check 4.043 in PVIFA table for 7 yrs

Nearest value in PVIFA for 7 yrs = 4.039

∴ IRR₁ = 16%, NPV @ 16%

Yrs.	CFAT	PVIF @ 16%	PV of CF
1	4	0.862	3.448
2	4	0.743	2.972
3	3	0.641	1.923
4	4	0.552	2.208
5	5	0.476	2.38
6	4	0.41	1.64
7	2	0.354	0.708
		P.V =	15.279

NPV = P.V of cash inflow − PV of cash outflow
= 15.279 − 15
= $\boxed{0.279 \text{ Cr}}$

Step IV — As NPV in step 3 is +ve, we will calculate another f
NPV at higher rate (20%)

Yrs	CF	PVIF @ 20%	P.V. of CF
1	4	0.833	3.332
2	4	0.694	2.776
3	3	0.579	1.737
4	4	0.482	1.928
5	5	0.402	2.01
6	4	0.335	1.34
7	2	0.279	0.558
		P.V =	13.681

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NPV = PV of cash inflow − PV of cash outflow
= 13.681 − 15
= $\boxed{-1.319 \text{ Cr.}}$

Step II IRR = Lower rate + Diff. betn two rates $\left[\frac{\text{P.V @ lower rate − Initial investment}}{\text{P.V. @ lower rate − P.V. @ higher rate}}\right]$

$= 16 + 4\left[\frac{15.279 - 15}{15.279 - 13.687}\right]$

$= 16 + 4\left(\frac{0.279}{1.598}\right)$ = 16 + 4 (0.174)
= 16.698 %
≈ $\boxed{16.7\%}$ ← IRR.

Extra question

Project P

Yr	0	1	2	3	4	5
CF	(1000)	(1200)	(600)	(250)	2000	4000

MIRR P.V. of cash outflow Cost of capital = 12 %

Yr	CF	PVIF @ 12 %	PV
0	−1000	1	−1000
1	−1200	0.893	−1071.6
2	−600	0.797	−478.2
3	−250	0.712	−178
			2727.8

TV = 2000 × 1.12^1 + 4000
= 2240 + 4000
= 6240

PV of cash outflow = $\frac{TV}{(1+MIRR)^n}$

$2727.8 = \frac{6240}{(1+MIRR)^5}$

$\therefore (1+MIRR)^5 = \frac{6240}{2727.8}$

$= 2.288$

$\therefore 1+MIRR = (2.288)^{1/5}$

$1+MIRR = 1.18$

$\therefore MIRR = 0.18$ OR $\boxed{18\%}$

Project Q

Yr	0	1	2	3	4	5
CF	(1600)	200	400	600	800	100

$TV = (200)(1.12)^4 + 400(1.12)^3 + 600(1.12)^2 + 800(1.12)^1 + 200$

$= 200 + 896 + 752.64 + 561.97 + 314.7$

$= 2625.31$

$1600 = \frac{2625.31}{(1+MIRR)^n}$

$\therefore 1+MIRR = \left(\frac{2625.31}{1600}\right)^{1/5}$

$1+MIRR = 1.1044$

$\therefore MIRR = 0.1044$ OR $\boxed{10.44\%}$

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* Cost of capital (COC)

→ CoC is the minimum required rate of returns on funds which are invested in the project, and this minimum rate depends on risk of the project / cashflows.

→ Each project has a different risk and will have different cost of capital.

Balance sheet

	Liabilities		Assets		
					10,00,000
Sources of funds	Equity capital	500000	Plants & Machinery	✓	
	Debentures	200000	Land & Building	✓	
	Pref. shares	100000	Furnitures	✓	
	Loans	200000	Stock (Investory)	✓	
			Vehicles	✓	

* Cost of Debentures (K_d)

→ Cost of Irredeemable Debt (Perpetuity)

$$K_d = \frac{Int.(1-t)}{V}$$

Int = Interest in ₹
= Coupon Rate x Face value

V = Issue price at Par / Premium / Discount

t = Tax Rate

→ Cost of Reedemable Debt (Redeemed at Maturity)

$$K_d = \left[\frac{Int.(1-t) + \frac{F-P}{n}}{\frac{F+P}{2}} \right] \times 100$$

Int. = Int. in Rs.

t = Tax rate

F = redemption value at Par/Premium/discount

n = no. of years.

P = Market Price.

* Cost of term ~~loat~~ loan (K_t)

$$K_t = Int. Rate (1-t)$$

* Cost of Preference Shares (K_p)

→ Irredeemable Preference Shares

$$K_p = \frac{Div.}{P_0} \times 100$$

D_0 = Div. Rate x Face Value

P_0 = Price at par/premium/discount

→ Reedemable Preference Shares

$$K_p = \left[\frac{Div. + \frac{F-P}{n}}{\frac{F+P}{2}} \right] \times 100$$

F = Redemption value at par/premium/discount

P = Market price

n = no. of years.

* Cost of Equity (k_e)

* Dividend Model

$$k_e = \left[\frac{D_1}{P_0} + g\right] \times 100$$

D_1 = Expected dividend (Next yr)

↓

$D_1 = D_0(1+g)$

P_0 = Share Price

g = growth rate (in decimals)

* Earnings Model

$$k_e = \frac{EPS}{P_0} \times 100$$

EPS = Earnings Per Share

$= \frac{\text{Profit after taxes}}{\text{No. of equity share}}$

P_0 = price of the share

* CAPM model

$$K_e = R_f + \beta(R_m - R_f)$$

R_f = Risk free rate

R_m = Market return

β = β-co-efficient

* Concept of floatation cost

→ Floatation cost is cost incurred by a company while issuing securities.

→ It is a one-time cost incurred at the time of issue.

→ Examples of floatation cost : → Underwriting commission

→ Brokerage

→ Issue charges etc.

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→ This floatation cost (F) is given, is to be subtracted from price of security.

In debentures = V − F
Pref. shares = Issue Price − f
Equity shares = P_0 − F

COC sums

(1) Cost of debt (K_d) = 10%

(2) 15% irredeemable debentures (Perpetual) no. of debentures = 10K
Face value = 100 ₹ t = 50% = 0.5

Commission = 1.5%
Brokerage = 0.5%
Other charges = ₹10,000.

Int = 15% × 100 (F.V.) = ₹15

Floatation costs = Commission = 1.5% × 100 = ₹1.5
Brokerage = 0.5% × 100 = ₹0.5
Other charges = $\frac{10k}{10k}$ = Re. 1

1.5 + 0.5 + 1 = ₹3

(i) Issued at Par

$K_d = \left[\frac{Int(1-t)}{V-F}\right] \times 100$

$= \left(\frac{(15)(1-0.5)}{100-3}\right) \times 100$

= 7.73%

(ii) Issued at 10% disc.

V = 100 − 10% = 90

$K_d = \left(\frac{15(1-0.5)}{90-3}\right) \times 100$

= 8.62%

(iii) Issued @ 10% prem

V = 100 + 10% = 110

$K_d = \left(\frac{15(1-0.5)}{110-3}\right) \times 100$

$K_d = \boxed{7.10\%}$

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(3) Face Value / Redemption at Par = ₹100

Interest = 10% = 10% × 100 = 10 ₹

$n = 7$ yrs

$P = 93$

$t = 50\% = 0.5$

$$K_d = \frac{Int(1-t) + \frac{F-P}{n}}{\frac{F+P}{2}} \times 100$$

$$= \left[\frac{10(1-0.5) + (100-93)/7}{\frac{100+93}{2}}\right] \times 100$$

$$= \boxed{6.22\%}$$

(4) Face Value / Redemption at Par = ₹100

Int = 10% = 10 ₹

$n = 10$ yrs

P = Issue Price $(1-f)$ = $100(1-0.04)$ = 96

$t = 0.55$

$$K_d = \left[\frac{Int.(1-t) + \frac{F-P}{n}}{\frac{F+P}{2}}\right] \times 100$$

$$= \left[\frac{\quad}{\quad}\right] \times 100$$

$$\boxed{K_d = }$$

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⑤ Irredeemable Pref. shares.

10% Pref share @ ₹100 par.

$\therefore$ Div = $10\% \times 100 = ₹10$.

Floatation cost is 4%

$P = 100(1-0.04) = 96$

i) $k_p = \frac{Div}{P_0} \times 100 = \frac{10}{96} \times 100 = \boxed{10.42\%}$

ii) 5% premium

$P = (100 + 5\%)(1-0.04)$
$= 100.8$

$k_p = \frac{10}{100.8} \times 100 = \boxed{9.92\%}$

iii) 5% discount

$P = (100 - 5\%)(1-0.04)$
$= 91.2$

$k_p = \frac{10}{91.2} \times 100 = \boxed{10.96\%}$

⑥ Reedemable Pref. share.

Div = 11% of 100 = ₹11

n = 10 yrs.

Floatation costs $= \frac{3000}{1000} = ₹3$

F = 100 − 5% disc = 95 ₹

P = 95 − 3 (floatation cost)
= 92

$k_p = \left[\frac{Div. + \frac{F-P}{n}}{\frac{F+P}{2}}\right] \times 100$,

$= \left[\frac{11 + \frac{95-92}{10}}{\frac{95+92}{2}}\right] \times 100$

$= \boxed{12.09\%}$

(b) Irredeemable Pref shares

$k_p = \frac{Div}{P} \times 100$

$= \frac{11}{92} \times 100$

$= \boxed{11.96\%}$

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(7) $P_0 = 50 \quad D_1 = 2 \quad g = 8\%$

$$K_e = \left[\frac{D_1}{P_0} + g\right] \times 100$$

$$= \left[\frac{2}{50} + 0.08\right] \times 100$$

$$= \boxed{12\%} = K_e$$

(8) $P_0 = 100$
$F = 4\%$
$D_1 = 6$
$g = 5\%$

$$\therefore K_e = \left[\frac{D_1}{P_0 - F} + g\right] \times 100$$

$$= \left[\frac{6}{96} + 0.05\right] \times 100$$

$$= \boxed{11.25\%}$$

(9) Earnings of company = 3.6L
No. of shares = 30,000
$P_0 = 100$

New equity of 9L at 10% disc. @ ₹ 90 (100 − 10%)

New shares $= \frac{9L}{90}$

$= 10K$

$\therefore$ Total shares $= 30K + 10K$
$= 40K$

Floatation cost = 6%

$P_0 = 90(1 - 0.06)$
$= \boxed{84.6}$

$$EPS = \frac{\text{Earnings (PAT)}}{\text{No. of equity shares}} = \frac{3.6L}{40K} = \boxed{9}$$

$$K_e = \frac{EPS}{P_0} \times 100$$

$$= \frac{9}{84.6} \times 100 = \boxed{10.64\%}$$

(10) $P_0 = 120$ $g = 5\% = 0.05$ $D_0 = 30$; $D_1 = D_0(1+g)$

$= 30(1+g)$

$= 31.5$

$$K_e = \left[\frac{D_1}{P_0} + g\right] \times 100$$

$$= \left[\frac{31.25}{120} + 0.05\right] \times 100 = \boxed{31.25\%}$$

(11) $R_f = 8.5\%$ $\beta = 2$ $R_m = 15\%$

$$K_e = R_f + \beta(R_m - R_f)$$
$$= 8.5 + 2(6.5)$$
$$= 13 + 8.5$$
$$= \boxed{21.5\%}$$

(12) <u>Cost of retained earnings (K_r)</u>

$$K_r = K_e(1-f)(1-t)$$
$$= 10(1-0.03)(1-0.3)$$
$$= 9.7 \times 0.7$$
$$= \boxed{6.79\%}$$

<u>Try first 6 problems from "Cost of Capital Sums" (PDF).</u>

* Weightage Average cost of capital (WACC)

Q7 WACC as per book value weights

Source	Amount	Weights	Cost of capital	Weighted cost
Pref. shares	2L	$\frac{2L}{10L} = 0.2$	12%	2.4%
Eq. share capital	3L	0.3	15%	4.5%
Retained earnings	1.5L	0.15	15%	2.25%
Debentures	3.5L	0.35	10%	3.5%
	10L	1		12.65% ⇒ WACC

Q8 a) Calculation of WACC as per book value (BV)

Equity dividend = 20%   Face value = 100   Tax Rate = 50% = 0.5

$K_e = \frac{D_1}{P_0} = \frac{20₹}{100} \times 100 = \boxed{20\%}$

K_d = Int. Rate (1 − t) = 12% (1 − 0.5) $\boxed{= 6\%}$

K_t = Int (1 − t) = 16% (1 − 0.5) = $\boxed{8\%}$

WACC	Amount	Weights	Cost	Weighted cost
Eq. capit.	400	$4/20 = 0.2$	20%	4%
12% Debentures	600	$6/20 = 0.3$	6%	1.8%
16% Term Loan	1000	$10/20 = 0.5$	8%	4%
	2000			9.8% ⇒ WACC as per BV weights

b & c) $K_e = \frac{D_1}{P_0} \times 100 = \frac{20}{150} \times 100 = 13.33\%$ $K_d = 6\%$ $K_t = 8\%$

WACC	Amount	Weights	Cost	Weighted cost
eq. cap	400	0.2	13.33%	2.67%
12% debentures	600	0.3	6%	1.8%
16% Term loan	1000	0.5	8%	4%
	2000			8.47% ⇒ WACC