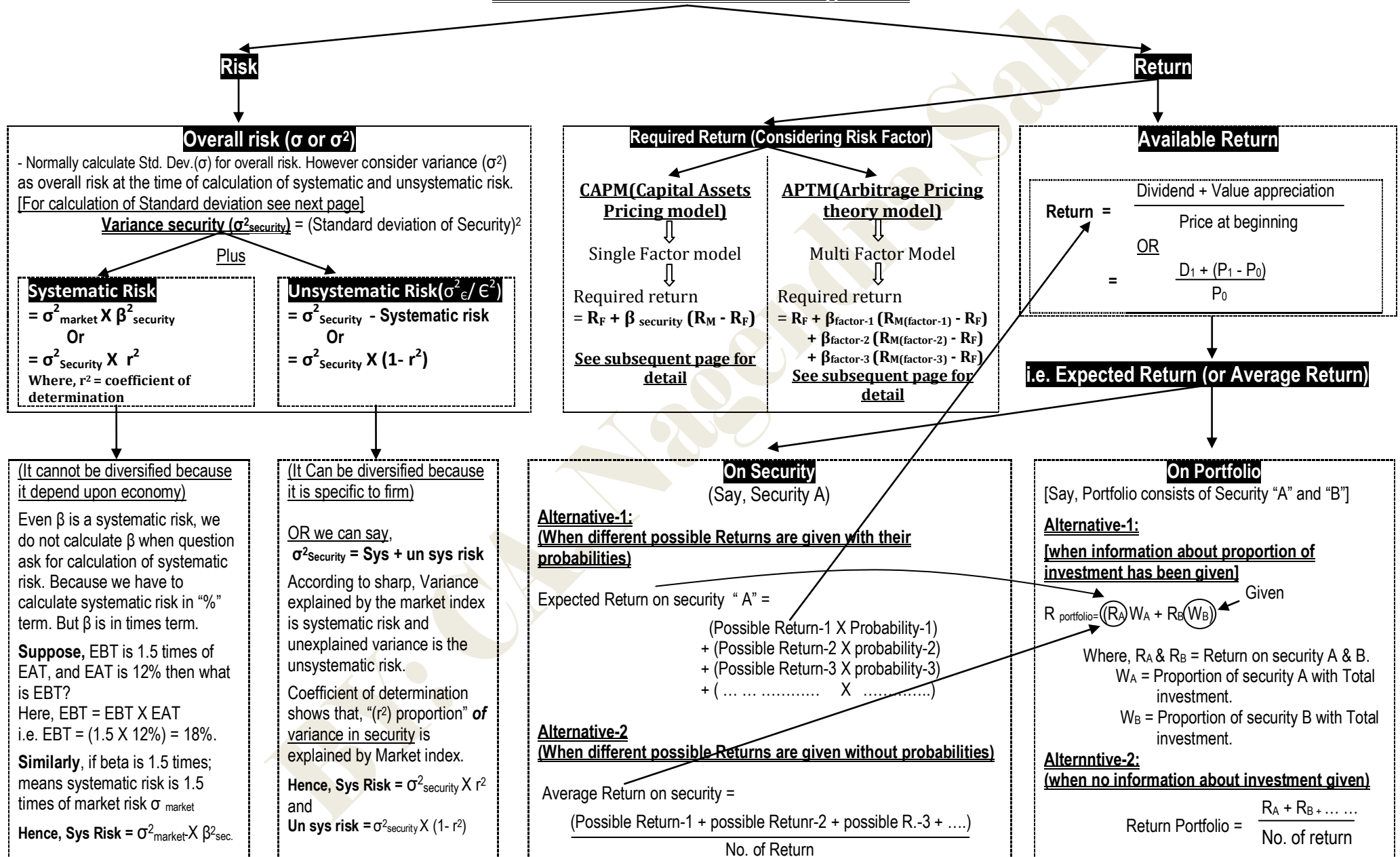
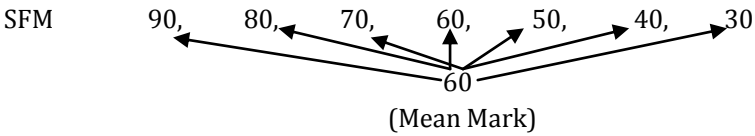


Portfolio (Bundle of Securities) Management



Standard Deviation (σ):

- Standard deviation (denoted by ' σ ' - pronounced as Sigma) is an average of deviation from mean (i.e. Given value minus Average/mean value). To avoid +ve or -ve sign the deviation is first squared and then taken square root at the time of calculation of Std. deviation.
- Deviation shows the variation in data. If more variation in given data, means more deviation in values and hence more standard deviation. Suppose one student have following chances that he will get following marks in SFM

- In above situation, standard deviation may be calculated by taking the average of deviation (variation) in Mark from mean Mark 60. If there is only one chance that he will get 60 marks in all situations, then the Standard deviation is NIL because no variation in Mark.
- High standard deviation shown high risk and low standard deviation shows low risk.
- If all the possible returns are equal, the σ would be Zero.

Standard Deviation (σ)

Of one Security [Say, security A]	of Portfolio [Say, Portfolio consists of Security "A" and "B"]
Alternative-1: <u>(When different possible Returns are given with their probabilities)</u> $SD (\sigma_{Sec}) = \sqrt{\sum (\text{Given returns} - \text{Average return})^2 \times \text{Prob.}}$ Alternative-2: <u>(When different possible Returns are given without their probabilities)</u> $SD (\sigma_{Sec}) = \sqrt{\frac{\sum (\text{Given returns} - \text{Average return})^2}{n}}$	Alternative-1: $\sigma_{\text{portfolio}} = \sqrt{(\sigma_A W_A)^2 + (\sigma_B W_B)^2 + 2 (\sigma_A W_A) (\sigma_B W_B) r_{AB}}$ Where, σ_A & σ_B = Standard deviation of security A and B, (Calculated using left side formula) W_A & W_B = Proportion of Security A and B (it is given), (if not given assume equal proportion) r_{AB} = Correlation coefficient of A with B. Alternative 2: <u>(when, $r_{AB} = +1$)</u> $\sigma_{\text{portfolio}} = (\sigma_A W_A) + (\sigma_B W_B)$ Alternative 3: <u>(when, $r_{AB} = -1$)</u> $\sigma_{\text{portfolio}} = (\sigma_A W_A) - (\sigma_B W_B)$

Standard deviation of portfolio (when portfolio consists of 3 securities-Say security A, B, C):

$$\sigma_{\text{portfolio}} = \sqrt{(\sigma_A W_A)^2 + (\sigma_B W_B)^2 + (\sigma_C W_C)^2 + 2 (\sigma_A W_A) (\sigma_B W_B) r_{AB} + 2 (\sigma_B W_B) (\sigma_C W_C) r_{BC} + 2 (\sigma_C W_C) (\sigma_A W_A) r_{CA}}$$

Coefficient of variation (CV): Coefficient of Variation measures risk per unit of return.

$$\text{Coefficient of variation (CV)} = \frac{\text{Standard deviation}}{\text{Average/expected return}}$$

Coefficient of Variation is used when there is confusion in selection of some securities from many.

For example: consider the following data and decide which security is better for investment.

	Security A	Security B	Security C
Return (R)	25%	20%	12%
Risk (σ)	22%	16%	10%

Portfolio Summary

We cannot easily decide which one is better because if we want more return, obviously we have to take more risk like security A. But we can take more appropriate decision on the basis of low Coefficient of Variation (CV).

	Security A	Security B	Security C
Coefficient of Variation(CV)	$(22/25) = 0.88$	$(16/20) = 0.8$	$(10/12) = 0.833$

Security B undertakes low proportionate risk i.e. 0.8% risk for generating 1% return. Hence security B is better.

Variance of one security:

Alternative-1:

(When different possible Returns are given with their probabilities)

$$\sigma^2_{\text{Sec}} = \sum (\text{Given returns} - \text{Average return})^2 \times \text{Prob.}$$

Alternative-2:

(When different possible Returns are given without their probabilities)

$$\sigma^2_{\text{Sec}} = \frac{\sum (\text{Given returns} - \text{Average return})^2}{n}$$

Co-variance between two securities: (Say, security A and Security B)

Alternative-1:

(When different possible Returns are given with their probabilities)

Co variance_(A,B) =

$$\frac{\sum (\text{Return}_A - \text{Average return}_A) \times (\text{Return}_B - \text{Average return}_B) \times \text{Probability}}{n}$$

Alternative-2:

(When different possible Returns are given without their probabilities)

Co variance_(A,B) =

$$\frac{\sum (\text{Return}_A - \text{Average return}_A) \times (\text{Return}_B - \text{Average return}_B)}{n}$$

Alternative-3

Using Correlation

$$\text{Co variance}_{(A,B)} = r_{(A,B)} \times \sigma_A \times \sigma_B$$

Correlation coefficient (r):

- The correlation coefficient measures the relationship of two securities.
- The value of Correlation Coefficient (r) must fall between -1 to +1.

Mathematically,

$$r_{A,B} = \frac{\text{Co variance}_{(A,B)}}{\sigma_A \times \sigma_B}$$

When r = +1 (i.e. Perfect positive correlation)

- It shows there is a perfectly strong positive relation between two securities. It means that the return of two securities go in same direction either increasing or decreasing.
- Portfolio risk will be maximum

When r = -1 (i.e. Perfect negative correlation)

- It shows there is a perfectly Strong inverse relation between two securities. It means that, the return of two securities go in opposite direction i.e. return on one security is increasing, the other is decreasing and vice versa.
- Portfolio risk will be minimum

When r = 0 (i.e. no correlation)

- It shows there is no relation between two securities. It will possible only when, out of two securities one security must be a risk free security.

Coefficient of Determination (r²):

$$r^2 = (\text{correlation coefficient})^2$$

According to sharp, Variance explained by the market index is systematic risk and unexplained variance is the unsystematic risk.

Coefficient of determination shows that, “(r²) proportion” of variance in security is explained by Market index.

Hence we can say that, Systematic risk = $r^2 \times \sigma^2_{\text{security}}$ and Unsystematic risk = $(1 - r^2) \times \sigma^2_{\text{security}}$

Portfolio Summary

Beta of a security/Market sensitivity index/Beta coefficient (β):

Beta is a measure of firm's systematic risk or non diversifiable risk. The sensitivity of a security to market movements is called Beta. In India, market is represented by SENSEX and NIFTY.

Beta of a security	Beta of a portfolio	Market Beta
Alternative-I (using co-variance of security with market) $\beta_{\text{security}} = \frac{\text{Co variance}(\text{security \& market})}{\sigma_{\text{Market}} \times \sigma_{\text{Market}}} = \frac{\text{Co variance}(\text{security \& market})}{\sigma^2_{\text{market}}}$ Alternative-II (using Correlation of security with market) $\beta_{\text{security}} = r_{\text{security with market}} \times \frac{\sigma_{\text{Security}}}{\sigma_{\text{Market}}}$ Alternative-III (use only in exceptional situation i.e. when market information is not given) (using co-variance of security A and Security B) $\beta_{\text{security A}} = \frac{\text{Co variance}_{(A,B)}}{\sigma_B \times \sigma_B} = \frac{\text{Co variance}_{(A,B)}}{\sigma^2_B} \quad \text{OR} \quad r_{A,B} \times \frac{\sigma_A}{\sigma_B}$	Alternative-I $\beta_{\text{portfolio}} = \beta_A W_A + \beta_B W_B$ Where: β_A, β_B = Beta security A and security B (calculated using left side formula) W_A, W_B = proportion of security A and Sec. B (given); (if not given-then assume equal proportion) Alternative-II $\beta_{\text{portfolio}} = \frac{\text{CAPM} - R_F}{(R_M - R_F)}$ (Above formula is derived from CAMP model)	Market beta is always assumed to be 1 The market beta is a benchmark against which we can compare beta for different securities and portfolio.

- ⇒ Low Beta reflects low risk and high Beta reflects high risk.
- ⇒ A security with beta greater than one is called as aggressive security; with beta less than one is called as defensive security and with beta equal to one is called as neutral security.

Systematic Risk (also known as market risk / Un-diversifiable risk)

- ⇒ Systematic risk is the risk associated with aggregate market and it is due to factors that affect the entire market. Some of the factor is: ⇒ recession ⇒ Wars ⇒ Change in Taxation provision ⇒ foreign investment policy ⇒ Inflation etc.
- ⇒ This risk is beyond the control of investor and hence can not be mitigated through diversification.
- ⇒ We can say that the risk of failing CA Student due to the reduced “%” result by ICAI is Systematic risk for CA Student and it can not be reduced by students own effort.

For mathematical formula of Systematic risk see 1st page.

Unsystematic risk (also known as Specific risk/Unique risk/residual risk/diversifiable risk) [$\sigma^2_{\epsilon}/\epsilon^2/\sigma^2_{\epsilon}$]

- ⇒ Unsystematic risk is the risk specifically associated with company/industry and it is due to factors specific to a company/industry.
- ⇒ Some of the factor is: ⇒labour strike ⇒Product category ⇒marketing strategy ⇒research & development etc.
- ⇒ Unsystematic risk can be mitigated through portfolio diversification.
- ⇒ We can say that the risk of failing CA Student due to inadequate and unbalanced preparation of all subjects is Unsystematic risk for CA Student and it can be reduced.

For mathematical formula of Unsystematic risk see 1st page.

Portfolio risk (considering Sys. Risk and Un Sys. Risk)

Portfolio risk (or portfolio Variance) = Portfolio Systematic risk + Portfolio Unsystematic risk

$$= [\sigma^2_{\text{market}} \times \beta^2_{\text{portfolio}}] + [W_A^2 \sigma_{\epsilon}^2 + W_B^2 \sigma_{\epsilon}^2]$$

- ⇒ The Risk of one security is compensated with the risk of other security. Hence we use correlation coefficient (r) for calculation of Portfolio risk ($\sigma_{\text{Portfolio}}$).

Portfolio Summary

- ⇒ As far as Systematic risk of portfolio is concerned the correlation part is already taken into consideration in Beta (β) portfolio because, like correlation coefficient 'r', beta is also calculated from co-variance (and co-variance establishes the relationship between two securities).
- ⇒ However we have not considered correlation coefficient (r) for calculation of unsystematic risk of portfolio because 'r' explains only systematic risk and not unsystematic risk.

Sharpe's Optimal Portfolio (or cut-off point (C) for determining optimal portfolio)

When question gives the information of unsystematic risk then calculate cut-off point for determining the optimum portfolio.

Concept of cutoff point: Cut-off point is the minimum value of excess return (available return on security - R_F) to beta which will be acceptable for optimal portfolio (best portfolio). In other word, the securities which have selected in optimal portfolio have the higher 'excess return to beta value' than cut-off point. For example: If cutoff point is 8.5, then the securities which have more than 8.5 'excess return to beta value' is selected and the securities which have less than 8.5 'excess return to beta value' is rejected.

Steps for finding out the stocks to be included in the optimal portfolio:

- Find out 'excess return to beta' ratio for each stock.
- Rank them from highest to the lowest 'excess return to beta value'.
- Calculate Cut-off (C) **for each stock** using following formula: (remember formula point wise)
 - Calculate: $\text{excess return} \times \beta$ [i.e. (available return on security - R_F) $\times \beta$]
 - Calculate: $\frac{\text{excess return} \times \beta}{\sigma_e^2}$
 - Calculate: Cumulative $\frac{\text{excess return} \times \beta}{\sigma_e^2}$
 - Calculate: $\frac{\beta^2}{\sigma_e^2}$
 - Calculate: Cumulative $\frac{\beta^2}{\sigma_e^2}$
 - Calculate: **cut-off point (c)** = $\frac{\sigma_M^2 \times \text{point (iii) value}}{1 + \sigma_M^2 \times \text{point (v) value}}$
- The highest 'C' value among the all securities is a cut off point.
- Security above cutoff point in ranked sequence is selected for optimal portfolio.

Steps for calculation of the Proportion of investment for the stock selected above.

- Calculate Z value for selected Stock using following formula:
(Suppose Stock A, B and C is selected as per above formula) then,
$$Z_{\text{stock-A}} = \frac{\beta}{\sigma_e^2} \times (\text{excess return of stock A} - \text{Cut off point})$$
$$Z_{\text{stock-B}} = \frac{\beta}{\sigma_e^2} \times (\text{excess return of stock B} - \text{Cut off point})$$
$$Z_{\text{stock-C}} = \frac{\beta}{\sigma_e^2} \times (\text{excess return of stock C} - \text{Cut off point})$$
- Calculate Proportion of selected stock using following formula:
$$\text{Proportion of Stock A} = \frac{Z_{\text{Stock A}}}{\text{Total Z value}} \quad [\text{Total Z Value} = Z_A + Z_B + Z_C]$$
$$\text{Proportion of Stock B} = \frac{Z_{\text{Stock B}}}{\text{Total Z value}}$$
$$\text{Proportion of Stock C} = \frac{Z_{\text{Stock C}}}{\text{Total Z value}}$$

Capital Assets Pricing Model (CAPM)

CAPM (Capital Assets Pricing Model) provides the required rate of return on a stock after considering the risk involved in an investment. As CAPM considers only one risk factor (i.e. β), it is also known as single factor model.

On security	On Portfolio
Required return = Risk free return + Risk Premium = $R_F + \beta_{\text{security}} (R_M - R_F)$ Where, R_F = Return Risk free R_M = Return Market β_{security} = sensitivity of systematic risk (in time) $(R_M - R_F)$ = Market risk premium $\beta_{\text{security}} (R_M - R_F)$ = Risk premium Some time question use Risk premium word also for $(R_M - R_F)$. In this case you have to apply your own mind on the basis of requirement of question and availability of information.	Alternative-I Required return = $R_F + \beta_{\text{portfolio}} (R_M - R_F)$ Where, $\beta_{\text{portfolio}} = \beta_A W_A + \beta_B W_B$ (i.e. Weighted Average Beta) Alternative-II Req. $R_{\text{portfolio}} = R_{\text{sec-A}} \times W_A + R_{\text{Sec-B}} \times W_B + \dots$ Where $R_{\text{sec-A}}, R_{\text{Sec-B}}$ = Required return security (calculated using left side formula)

Under Valued and Over Valued Stocks

(a) When Req. Return CAPM < Expected/Available Return → Buy stocks

This is due to the stock being undervalued i.e. the stock gives more return than what investor desire.

(b) When Req Return CAPM > Expected/Available Return → Sell stocks

This is due to the stock being overvalued i.e. the stock gives less return than what investor desire.

(c) When Req Return CAPM = Expected/Available Return → Hold stocks

This is due to the stock being correctly valued i.e. the stock gives same return than what investor desire.

Arbitrage pricing theory model (APT)

APT (Arbitrage Pricing theory Model) also provides the required rate of return on a stock after considering the risk involved in an investment. It is similar to CAPM model. Only difference is that CAPM considers only one risk factor (i.e. β) but APTM considers more than one risk factor (some of risk factor is: 1. Inflation 2. Interest rate 3. Price book 4. Personal consumption etc.). As CAPM considers more than one risk factor, it is also known as multi factor model.

Required Return APTM

On Security	On Portfolio
Req. $R_{\text{security}} = R_F + \beta_{\text{factor-1}} (R_{M(F-1)} - R_F)$ + $\beta_{\text{factor-2}} (R_{M(F-2)} - R_F)$ + $\beta_{\text{factor-3}} (R_{M(F-3)} - R_F)$ Where, $\beta_{\text{factor-1}}, \beta_{\text{factor-2}}, \beta_{\text{factor-3}}$ = Sensitivity of <u>security</u> in relation to factor-1, factor-2 and factor-3 respectively. (We denote it by beta but it is not beta. Beta is sensitivity of stock in relation to systematic risk) $R_{M(F-1)}, R_{M(F-2)}, R_{M(F-3)}$ = Return Market in relation to factor-1, factor-2 and factor-3 respectively.	Alternative-I Req. $R_{\text{portfolio}} = R_F + \beta_{\text{port(F-1)}} (R_{M(F-1)} - R_F)$ + $\beta_{\text{port(F-2)}} (R_{M(F-2)} - R_F)$ + $\beta_{\text{port(F-3)}} (R_{M(F-3)} - R_F)$ Where, $\beta_{\text{port(F-1)}}, \beta_{\text{port(F-2)}}, \beta_{\text{port(F-3)}}$ = Sensitivity of <u>portfolio</u> in relation to factor-1, factor-2 and factor-3 respectively. (i.e. weighted average sensitivity of individual security) $R_{M(F-1)}, R_{M(F-2)}, R_{M(F-3)}$ = Return Market in relation to factor-1, factor-2 and factor-3 respectively. Alternative-II Req. $R_{\text{portfolio}} = R_{\text{sec-A}} \times W_A + R_{\text{Sec-B}} \times W_B + \dots$

Portfolio Summary

Calculation of "optimum Weights" to minimize portfolio risk:

If correlation is "-1" i.e. perfect negative correlation, overall risk of portfolio can be brought to "nil"

And in this case proportion of one security =	$\frac{\sigma_{\text{one security}}}{\sigma_{\text{one security}} + \sigma_{\text{other security}}}$
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If correlation is other than "-1" i.e. say +0.5, -0.2, 0, +1 etc. overall risk can not be brought to nil but it can be **minimize**,

And in this case proportion of one security =	$\frac{\sigma^2_{\text{one security}} - \text{Co-variance (one with other)}}{\sigma^2_{\text{one security}} + \sigma^2_{\text{other security}} - 2 \text{ Co-variance (one with other)}}$
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Market line

To form a straight line there must be a two variable in an equation. Example "y = 8x + 4" is an example of one straight line where x and y are two variables.

Security market line (SML)

Security Market line is a graphical representation of CAPM.

Expression: Expected return = $R_F + \beta_{\text{security}} (R_M - R_F)$

$\uparrow$ $\uparrow$ $\uparrow$ $\uparrow$
 Variable fix Variable fix

i.e. Ans is in this form: Security market line = $10 + \beta \times 5$ [Assuming $R_F = 10\%$ and $(R_M - R_F) = 5\%$]

Capital Market Line (CML)

Expression: Expected return = $R_F + \underbrace{\frac{(R_M - R_F)}{\sigma_M}}_{\text{fix}} \times \sigma_{\text{security}}$

$\uparrow$ $\uparrow$ $\uparrow$ $\uparrow$
 Variable fix fix Variable

i.e. Ans is in this form: Capital market line = $10 + 5 \times \sigma$ [Assuming $R_F = 10\%$ and $\frac{(R_M - R_F)}{\sigma_M} = 5\%$]

Characteristic line

Expression:

Characteristic line (Expected return) = $\text{Alpha} + \beta_{\text{security}} \times R_M$

$\uparrow$ $\uparrow$ $\uparrow$ $\uparrow$
 Variable fix fix variable

i.e. Ans is in this form: Character line = $4 + 1.5 \times R_M$ [Assuming Alpha = 4 and $\beta_{\text{security}} = 1.5$]

Alpha:

Alpha represents the average return on a security/portfolio over and above that predicted by the capital asset pricing model (CAPM).

<u>On security</u>	<u>On Portfolio</u>
<u>Alternative-1:</u> (When Risk free return given) Alpha security = Available Return Security - Required return CAPM <i>i.e.</i> $R_{\text{security}} - \{R_F + \beta_{\text{security}} (R_M - R_F)\}$	(Say Portfolio consists of 2 securities A and B) <u>Alternative-1:</u> Alpha Portfolio = weighted average alpha <i>i.e.</i> $\alpha_{\text{portfolio}} = \alpha_A W_A + \alpha_B W_B$ Where, α_A, α_B = Alpha of Security A & B. (Calculated from left side formula)

Portfolio Summary

	W_A, W_B = weight of the security (either given or assume equal weight)
Alternative-2: (When Risk free return not given) Alpha security = $R_{\text{Security}} - [\beta_{\text{security}} \times R_M]$ i.e. Available return - $\{R_F + \beta_{\text{security}} (R_M - R_F)\}$	Alternative-2: $\alpha_{\text{portfolio}} = R_{\text{portfolio}} - [R_F + \beta_{\text{portfolio}} (R_M - R_F)]$ Where, $\beta_{\text{portfolio}} = \beta_A W_A + \beta_B W_B$ (i.e. Weighted Average Beta) $R_{\text{portfolio}} = R_{\text{sec-A}} \times W_A + R_{\text{sec-B}} \times W_B$

Beta of a firm/Assets Beta/ Project Beta:

Situation-I (For Single Project)

Balance sheet of a company

Liabilities	Assets
Equity **** Single Project (say project A) **** Debt ****	

<u>Beta equity</u>	<u>Beta debt</u>	<u>Beta Project (also known as beta firm or beta Asset)</u>
⇒ Beta equity is a <u>risk of equity share holder</u> in relation to the investment in the company. ⇒ Beta equity is always greater than Beta Assets. However when there is not debt in capital structure then Beta equity is equal to beta assets.	⇒ Beta debt is a <u>risk of debt holder</u> in relation to the investment in the company ⇒ β_{debt} is assumed to be “zero” <u>unless otherwise stated</u>. Because Investor in debt earns the fixed interest rate whether company earns profit or loss. (However, in real world, it is not true that β_{debt} is risk free because many company make default in repayment of debt and interest.)	⇒ Beta asset shows the <u>overall risk of a company</u> related to the business operation. ⇒ β_{Asset} is a weighted average beta of the β_{equity} and β_{debt}. ⇒ Overall beta of the firm (β_{Asset}) is not being affected by the capital structure. It means change in proportion of the equity and debt will not affect β_{Asset}.

- ⇒ If two companies belong to the same industry (for example, Vodafone and Airtel from telecommunication industry) then β_{Asset} of these two companies will be same. However their beta equity (β_{equity}) and beta debt (β_{debt}) may be different at different capital structure.
- ⇒ β_{Asset} is a weighted average beta of the β_{equity} and β_{debt} .

Mathematically we can express it as below:

$$\beta_{\text{Asset}} = \left[\beta_{\text{equity}} \times \frac{\text{Equity}}{\text{Equity} + \text{Debt} (1 - \text{Tax})} \right] + \left[\beta_{\text{debt}} \times \frac{\text{Debt} (1 - \text{Tax})}{\text{Equity} + \text{Debt} (1 - \text{Tax})} \right]$$

↓ Proportion of equity
↓ Proportion of debt

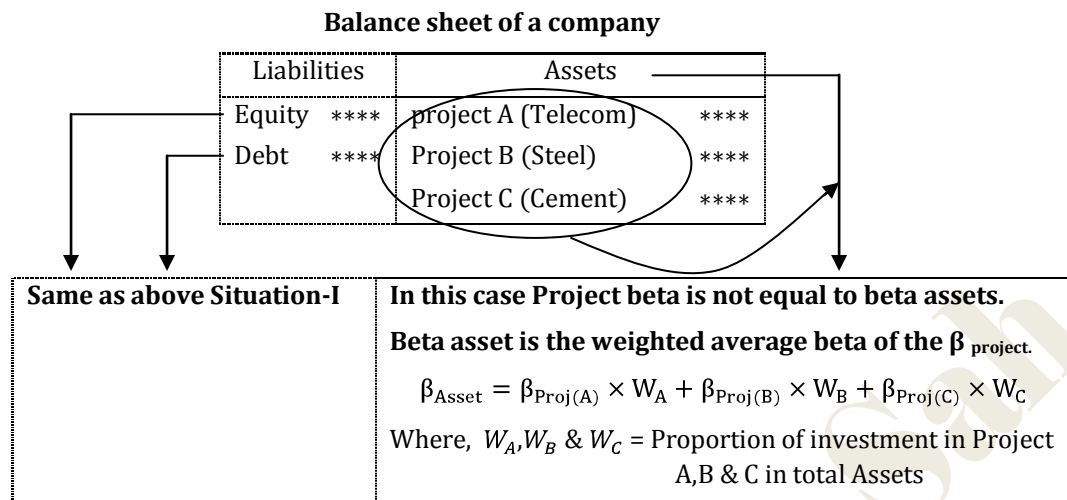
We can say, $\beta_{\text{Asset}} = \left[\beta_{\text{equity}} \times \frac{\text{Equity}}{\text{Equity} + \text{Debt} (1 - \text{Tax})} \right] + 0$ [if question doesn't specify β_{debt} and we assume "0"]

Beta Equity is also calculated from the same formula expressed above if Beta assets is Known.

Note: 1. When tax is not given in question we ignore the tax component in above formula.

2. Debt equity ratio means: $\frac{\text{Debt}}{\text{Equity}}$ (It doesn't mean $\frac{\text{Debt}}{(\text{Equity} + \text{Debt})}$). Suppose Debt equity ratio is given as 0.8. It means Debt is 0.8 and equity is 1.00 and it doesn't mean proportion of debt is 0.8 and hence proportion of debt is $\frac{0.8}{0.8 + 1.00}$

Situation-II (For more than one Project)



Proxy Beta

Balance sheet of Telecom Company (T Ltd)

Liabilities		Assets	
Equity	****	project A (Telecom) existing business	****
Debt	****	Project B (Steel) Thinking for expansion	****

When "T Ltd" uses beta Assets of "S Ltd." for calculation of beta Assets of steel business of "T Ltd" (i.e. $\beta_{\text{Proj-B}}$) then it is called proxy beta.

In this case, β_{Asset} of steel business of T Ltd. = β_{Asset} of S Ltd.

Balance sheet of steel company (S Ltd)

Liabilities		Assets	
Equity	****	Project A (Steel)	****
Debt	****		

Note:

Normally Beta Assets of all the company in same industry (in our example Steel industry) is same.

However, some time we have to adjust $\beta_{\text{Project-B}}$ of T Ltd when risk of steel business of T ltd and S ltd is different, even both are in same business operation (i.e. steel business).

⇒ For example: Suppose: β_{Asset} of S Ltd = 2 times. T Ltd has revenue sensitivity of 1.5 times that of S Ltd. S Ltd has operating gearing ratio of 1.8 and operating gearing ratio in T Ltd at 2.00. Calculate $\beta_{\text{Project B}}$ of T Ltd.

We know more return means more risk. T Ltd is more revenue sensitivity it means, risk of T Ltd is more than risk of S Ltd. [Hence, $\beta_{\text{Project B}}$ of T Ltd after adjustment of revenue sensitivity = 2×1.5 times]

Operating gearing ratio means Operating leverage. More Operating leverage means involvement of more Operating fixed cost in business. More Fixed cost means more Risk. Here operating gearing ratio of T Ltd is more than Operating Gearing of S Ltd, it means T Ltd have more risk than S Ltd.

[Hence, $\beta_{\text{Project B}}$ of T Ltd after adjustment of operating gearing = $2 \times \frac{2}{1.8}$]

Therefore, $\beta_{\text{Project B}}$ of T Ltd after adjustment of both factor = $2 \times 1.5 \times \frac{2}{1.8} = 3.33$

Measures for evaluation of performance of portfolio/security or mutual fund

1. Sharpe Ratio (also known as Reward to variability):

$$\text{Sharp Ratio} = \frac{\text{Return Portfolio/security} - \text{Return on risk free investment}}{\sigma_{\text{Portfolio/security}}}$$

Portfolio Summary

- Higher a Sharpe ratio, the better a portfolio's/security's performance (returns)

2. Treynor Ratio(also known as Reward to volatility):

$$\text{Treynor Ratio} = \frac{\text{Return Portfolio/security} - \text{Return on risk free investment}}{\beta_{\text{Portfolio/security}}}$$

- Higher a Treynor ratio, the better a portfolio's/security's performance (returns)

3. Jensen's Alpha

Jensen's Alpha = Available return - Required Return (Same as the above formula)

- If alpha is positive = fund shows better performance.
- If alpha is zero = fund shows required performance.
- If alpha is Negative = fund shows under performance.

Modern portfolio theory/Harry Markowitz model/Mean Variance Analysis/Rule of dominance in case of Portfolio

Harry Markowitz is regarded as the father of modern portfolio theory. He given the technique for selection of right portfolio from a range of different assets.

Efficient portfolio is one which:

- (i) Gives same expected return but undertakes low risk.
- (ii) Undertakes same risk but gives higher expected return.
- (iii) Gives higher expected return and undertakes higher risk.

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3. Average return on security (when prob. Not given)
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5. Standard deviation of security
6. Standard deviation of portfolio
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