CAPITAL ASSET PRICING MODEL

RETURN

1. Return in respect of an observation is given by the following formula

$$R = \frac{(P_1 - P_0) + D_1}{P_0}$$

Where R = Return from the investment during this period
P_0 = Current market price
P_1 = Year end market price
D_1 = Dividend received during the period

2. Expected Return of a stock is the weighted average return of the various observations with probability of occurrence being the assigned weight

$$EV = \Sigma_1^n PxR$$

$$EV = (MOV + 4 \times RV + MPV) / 6$$

Where P = Probability
R = Value
MOV = Most optimistic Value
RV = Realistic Value
MPV = Most pessimistic value

RISK

3. Risk of a stock is the standard deviation of the stock and is given by the following formula

Standard Deviation (σ) $= \sqrt{\sum_{i=1}^{n} P_i \, d_i^2}$

Where P = Probability
d = Deviation
n = Number of observations

4. If the probabilities are not given it can be assumed to be uniform
5. Alternatively the following formula can be used

Standard Deviation (σ) $= \sqrt{\sum_{i=1}^{n} P_i \, d_i^2}$

Where P = Probability
d = Deviation
n = Number of observations

DIVERSIFCATION

6. Diversification reduces risk. It does not increase return. If you are looking for return, pick the best stock and stay with it. If you are looking to reduce risk, invest in a portfolio of stocks

PORTFOLIO

7. Risk of a two security portfolio is given by the following formula

$$\sigma_P = \sqrt{\left[(\sigma_x)^2 (w_x)^2\right] + \left[(\sigma_y)^2 (w_y)^2\right] + \left[2 \times (\sigma_x) \times (\sigma_y) \times (w_x) \times (w_y) \times (Cor_{xy})\right]}$$

Where
$(\sigma_x)^2$ = Variance of Security X
$(\sigma_Y)^2$ = Variance of Security Y
(w_x) & (w_y) = Proportion of investment in security X & Y
(Cor_{xy})= Correlation Coefficient of security X and Y

8. Return of a portfolio is the weighted average return of the securities forming the portfolio with market value of each stock being the assigned weight

$\Sigma_1^n PxR$ Where P = probability
R = value

9. Risk of a portfolio is NOT the weighted average risk of the security constituting the portfolio. The only exception is when the correlation is plus 1
10. Risk of a multi security portfolio is computed using the matrix approach.
11. Risk reduction means the extent to which the risk of a portfolio is less than the weighted average risk of the securities constituting the portfolio.
12. It is possible to identify the portfolio combination at which risk is lowest. This is given by the following formula

$$W_x = \frac{\sigma_y^2 - \text{cov } XY}{\sigma_x^2 + \sigma_y^2 - 2 \text{ cov } XY}$$

DOMINANCE

13. Security A is said to dominate Security B if
    a. It gives higher return for same risk
    b. It carries lower risk for same return
14. Stocks which are dominated are called inefficient stocks. Stocks which are not dominated are called efficient stocks. Only efficient stocks are selected by a portfolio manager.
15. Although a particular stock may be dominated it could at times still form part of portfolio in such a way that the portfolio itself is not dominated.

NON DIVERSIFIABLE RISK

16. Beyond a point diversification ceases to be important. However there is no empirical evidence as to at what number of stocks in the portfolio does diversification cease to be relevant
17. Risk which can be reduced through diversification is called diversifiable risk or Non Systematic risk

18. Risk which cannot be reduced through diversification is called NON diversifiable risk or Systematic risk
19. The numerator in the Beta formula is non-diversifiable risk. The difference between total risk and non-diversifiable risk is diversifiable risk

BETA

20. Beta is a measure of non-diversifiable risk. It is the ratio of non-diversifiable risk to variance of the market index
21. There are three formulae for the computation of Beta

$$\beta = \frac{\sum XY - n\,\overline{X}\,\overline{Y}}{\sum Y^2 - n\overline{Y}^2}$$

$$\beta = \frac{\text{Covariance}_{jm}}{\text{Variance}_m}$$

$$\beta = \frac{\sigma_j}{\sigma_m} \text{ x } \text{Corr}_{jm}$$

Where
X = Return (%) from stock X
Y = Return (%) from the stock market as a class
n = Number of observations
$\overline{X}$ = Arithmetic mean of rate of return from the stock
$\overline{Y}$ = Arithmetic mean of rate of return from the market
Covariance_{jm} = Covariance between stock and market
Variance_m = Variance of the market
σ_j = Standard deviation of stock
σ_m = Standard deviation of market returns
corr_{jm} = Correlation between returns from stock and stock market

CAPM

22. The required return from a stock is given by the following CAPM formula

$$R_j = R_f + \beta \text{ x } (R_m - R_f)$$

Where R_j = CAPM return
R_f = Risk free rate of return
β = Beta of the security
R_m = Return from the market

ALPHA

23. Alpha is the extent to which the actual return of a stock in the past have been greater than the return mandated under the capital asset pricing model

Alpha (α) = Actual Return – CAPM return

24. The alpha of a stock is the average of the alphas of a series of observations.

CAPM AND GEARING

25. The overall beta of a company is the weighted average beta of the assets or projects constituting the company
26. The overall beta of a company is also the weighted average beta of the liabilities constituting the company also known as Liability Beta
27. Hence the Asset Beta of a company equals its liability Beta
28. The Asset Beta of all companies operating in the same business risk class is same and hence the starting overall Asset Beta is the beta of an unlevered company

$$\beta_A = \beta_g = \beta_U = \beta_{(debt)} \frac{Debt}{Value} + \beta_{(Equity)} \frac{Equity}{Value}$$

Where β_A = Beta of asset
β_g = Beta geared
β_u = Beta ungeared
Value = Debt + Equity

29. Where taxes are involved "D" in the formula will be replaced with D*(1-T). The broad formulae are as under'

$$\beta_A = \beta_g = \beta_U = \beta_{(debt)} \frac{D\ (1\text{-}T)}{S+D(1\text{-}T)} + \beta_{(Equity)} \frac{Equity}{S + D(1 - T)}$$

Where β_A = Beta of asset
β_g = Beta geared
β_u = Beta ungeared

LINES AND OTHER MODELS

30. **The Security Market line** captures the relationship between the beta of a stock and the return from the stock. It plots the return of the stock for various levels of non-systematic risk
31. The x-axis represents the risk (beta), and the y-axis represents the expected return. The market risk premium is determined from the slope of the SML.
32. The security market line is a useful tool in determining whether an asset being considered for a portfolio offers a reasonable expected return for risk. Individual securities are plotted on the SML graph. If the security's risk versus expected return is plotted above the SML, it is undervalued because the investor can expect a greater return for the inherent risk. A security plotted below the SML is overvalued because the investor would be accepting less return for the amount of risk assumed.
33. This line graphs the systematic, or market, risk versus return of the whole market at a certain time and shows all risky marketable securities. It is also called the "characteristic line"
34. **The Capital Market line** captures the relationship between the standard deviation of a stock and the return from the stock.

It plots the return of the stock for various levels of risk. The CML is used in the CAP model to illustrate the rates of return for efficient portfolios depending on the risk-free rate of return and the level of risk (standard deviation) for a particular portfolio. The CML is derived by drawing a tangent line from the intercept point on the efficient frontier to the point where the expected return equals the risk-free rate of return.

35. The CML is considered superior to the efficient frontier since it takes into account the inclusion of a risk-free asset in the portfolio. The CAPM demonstrates that the market portfolio is essentially the efficient frontier.
36. The CML replaces Beta in the CAP Model with the ratio of SD of portfolio to SD of market.
37. Risk return ratio is the ratio of risk premium on a stock to beta of a stock. In an equilibrium market this should be same for all securities
38. Individual securities do not lie on CML They have some unsystematic risk.
39. CML assumes no unsystematic risk. All of that is taken care of by diversification
40. **The Characteristic Line:** A line formed using regression analysis that summarizes a particular security or portfolio's systematic risk and rate of return. The rate of return is dependent on the standard deviation of the asset's returns and the slope of the characteristic line, which is represented by the asset's beta. A characteristic line of a stock is the same as the security market line. The slope of the line, which is a measure of systematic risk, determines the risk-return trade-off.
41. Individual securities as also portfolio of securities will lie in the SML because of the EMH which says that all securities will yield return commensurate with their risk.

    $\alpha + \beta$ x Risk premium from Index

42. Market Model

a. There is no risk free rate

b. Market risk affects the entire return of a security not just risk premium

   Expected Return = $\alpha + (\beta \times R_m)$

c. Since there is no risk free rate, the SML formula is reduced to $\beta \times R_m$. To this we add the historical α to get an estimate of the rate of return

43. Excess Return Model

a. Expected return considering risk free return

   $\alpha - R_f$ x (1-Port β) + CAPM return + Error estimate

44. Multi factor model

a. More than one factor can drive the return of a stock

   Expected return = $R_f + \beta$ of GNP x (GNP – R_f) + β of Inflation x (Inflation – R_f)