Reading 6: Time Value of Money

1. Interest Rate (i)
   - \( i = \text{RF} + \text{Inf P} + \text{Default Risk} \)
   - \( \text{P + Liquidity P + Maturity P} \)
   - Nominal RF rate = Real RF rate + Inf P
   - \( i \) rate as a growth rate = \( g = \left( \frac{FV}{PV} \right)^{\frac{1}{N}} - 1 \)

2. PV and FV of CF =
   - \( PV = \frac{FV}{(1+r)^N} \)
   - PV of Perpetuity = \( \frac{PMT}{r} \)
   - PV (for more than one Compounding per year) = \( PV = FV \left( 1 + \frac{r_j}{m} \right)^{-m \times N} \)
     where \( r_j = \text{stated ann } i - \text{rate} \)
   - \( FV_N = PV (1 + r)^N \)
   - FV (for more than one Compounding per year) = \( FV_N = \left( 1 + \frac{r_j}{m} \right)^{m \times N} \)
   - FV (for Continuous Compounding) = \( FV_N = PV e^{r \times N} \)
   - Solving for \( N = \frac{LN \left( \frac{FV}{PV} \right)}{LN(1+r)} \) (where LN = natural log)

4. Stated & Effective Rates
   - Periodic i Rate = \( \frac{\text{Stated Ann i Rate}}{\text{No of Compounding Periods in One Year}} \)
   - Effective (or Equivalent) Ann Rate (EAR = EFF%) = \( 1 + \frac{\text{Periodic i Rate}^m}{m} - 1 \)
   - EAR (with Continuous Compounding) = \( \text{EAR} = e^{r} - 1 \)

5. PV & FV of Ordinary Annuity
   - \( PV_{OA} = \sum_{t=1}^{n} \frac{PMT}{(1+r)^t} = PMT \left[ \frac{1 - \left( \frac{1}{1 + r} \right)^N}{r} \right] \)
   - \( FV_{OA} = \sum_{t=1}^{n} \left( PMT_t(1+r) \right)^{N-t} = PMT \left[ \frac{(1 + r)^N - 1}{r} \right] \)
   - Size of Annuity Payment = \( PMT = \frac{PV}{PV \text{ of Annuity Factor}} \)
   - PV of Annuity Factor = \( \frac{1 - \left( \frac{1}{1 + \frac{r}{m}} \right)^{m \times N}}{r} \)

6. PV & FV of Annuity Due
   - \( PV_{AD} = PMT \left[ \frac{1 - \left( \frac{1}{1 + r} \right)^N}{r} \right] + PMT \text{ at } t = PV_{OA} + PMT \)
   - \( FV_{AD} = PMT \left[ \frac{(1+r)^N - 1}{r} \right] (1+r) = FV_{OA} \times (1+r) \)

Reading 7: Statistical Concepts & Market Returns

1. Range = Max Value – Min Value
2. Class Interval = \( i \geq \frac{H-L}{k} \) where
   - \( i = \text{class interval} \)
   - \( H = \text{highest value} \)
   - \( L = \text{lowest value, } k = \text{No. of classes} \)

3. Absolute Frequency = Actual No of Observations (obvs) in a given class interval
4. Relative Frequency = \( \frac{\text{Absolute Frequency}}{\text{Total No of Obs}} \)
5. Cumulative Absolute Frequency = Add up the Absolute Frequencies
6. Cumulative Relative Frequency = Add up the Relative Frequencies
7. Arithmetic Mean = \( \frac{\text{Sum of obvs in database}}{\text{No.of obs in the database}} \)
8. Median = Middle No (when observations are arranged in ascending/descending order)
   - For Even no of obvs locate median at \( \frac{n}{2} \)
   - For Odd no. of obvs locate median at \( \frac{n+1}{2} \)
9. Mode = obvs that occurs most frequently in the distribution
10. Weighted Mean = \( \bar{X}_w = \sum_{i=1}^{n} w_i X_i = \) \( w_1X_1 + w_2X_2 + \ldots + w_nX_n \)
11. Geometric Mean = \( GM = n \sqrt[n]{X_1X_2 \ldots X_n} \) with \( X_i \geq 0 \) for \( i = 1,2,\ldots,n \)
12. Harmonic Mean = \( H.M = \bar{X}_H = \frac{n}{\sum_{i=1}^{n} \left( \frac{1}{X_i} \right)} \)
13. Population Mean = \( \mu = \frac{\sum_{i=1}^{n} X_i}{n} \) with \( X_i > 0 \) for \( i = 1,2,\ldots,n \).

14. Sample Mean = \( \bar{X} = \frac{\sum_{i=1}^{n} X_i}{n} \) where \( n = \) number of observation in the sample

15. Measures of Location:
   - Quartiles = \( \frac{\text{Distribution}}{4} \)
   - Quintiles = \( \frac{\text{Distribution}}{5} \)
   - Deciles = \( \frac{\text{Distribution}}{10} \)
   - Percentiles = \( L_j = (n + 1) \frac{j}{100} \)

16. Mean Absolute Deviation = \( \text{MAD} = \frac{\sum_{i=1}^{n} |X_i - \bar{X}|}{n} \)

17. Population Var = \( \sigma^2 = \frac{\sum_{i=1}^{n} (X_i - \mu)^2}{n} \)

18. Population S.D = \( \sqrt{\sigma^2} = \sqrt{\frac{\sum_{i=1}^{n} (X_i - \mu)^2}{n}} \)

19. Sample Var = \( s^2 = \frac{\sum_{i=1}^{n} (X_i - \bar{X})^2}{n-1} \)

20. Sample S.D = \( s = \sqrt{\frac{\sum_{i=1}^{n} (X_i - \bar{X})^2}{n-1}} \)

21. Semi-var = \( \sum_{\text{for all } X_i < 0} \frac{(X_i - \bar{X})^2}{n-1} \)

22. Semi-deviation (Semi S.D) = \( \sqrt{\text{semivariance}} = \sqrt{\sum_{\text{for all } X_i < 0} \frac{(X_i - \bar{X})^2}{n-1}} \)

23. Target Semi-var = \( \sum_{\text{for all } X_i \leq B} \frac{(X_i - B)^2}{n-1} \)
   where \( B = \) Target Value

24. Target Semi-Deviation = \( \sqrt{\text{target semivariance}} = \sqrt{\sum_{\text{for all } X_i \leq B} \frac{(X_i - B)^2}{n-1}} \)

25. Coefficient of Variation = \( \text{CV} = \left( \frac{s}{\mu} \right) \)
   where \( s = \) sample S.D and \( \mu = \) sample mean

26. Sharpe Ratio = \( \frac{\text{Mean Portfolio Return} - \text{Mean RF Return}}{\text{S.D of Portfolio Return}} \)

27. Excess Kurtosis = Kurtosis – 3

28. Geometric Mean \( R \approx \frac{\text{Variance of } R}{2} \)

Reading 8: Probability Concepts

1. Empirical Prob of an event \( E = P(E) = \frac{\text{Prob of event } E}{\text{Total Prob}} \)

2. Odds for event \( E = \frac{\text{Prob of } E}{1 - \text{Prob of } E} \)

3. Odds against event \( E = \frac{1 - \text{Prob of } E}{\text{Prob of } E} \)

4. Conditional Prob of \( A \) given that \( B \) has occurred = \( P(A|B) = \frac{P(AB)}{P(B)} \rightarrow P(B) \neq 0 \)

5. Multiplication Rule (Joint probability that both events will happen):
   \[ P(A \text{ and } B) = P(AB) = P(A|B) \times P(B) \]
   \[ P(B \text{ and } A) = P(BA) = P(B|A) \times P(A) \]

6. Addition Rule (Prob that event \( A \) or \( B \) will occur):
   \[ P(A \text{ or } B) = P(A) + P(B) - P(AB) \]
   \[ P(A \text{ or } B) = P(A) + P(B) \] (when events are mutually exclusive because \( P(AB) = 0 \)

7. Independent Events:
   - Two events are independent if:
     \[ P(B|A) = P(B) \text{ or if } P(A|B) = P(A) \]
   - Multiplication Rule for two independent events = \( P(A \& B) = P(A) \times P(B) \)
   - Multiplication Rule for three independent events = \( P(A \text{ and } B \text{ and } C) = P(ABC) = P(A) \times P(B) \times P(C) \)

8. Complement Rule (for an event \( S \)) = \( P(S^C) = 1 \) (where \( S^C \) is the event not \( S \))

9. Total Probability Rule:
   \[ P(A) = P(AS) + P(A \text{ and } S^C) = P(A|S) \times P(S) + P(A|S^C) \times P(S^C) \]

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Bayes’ Formula =  

\[ P(A) = P(AS_1) + P(AS_2) + \ldots + P(AS_n) = P(A|S_1)P(S_1) + P(A|S_2)P(S_2) + \ldots + P(A|S_n)P(S_n) \]

(where \( S_1, S_2, \ldots, S_n \) are mutually exclusive and exhaustive scenarios)

10. Expected \( R = E(w_iR_i) = w_iE(R_i) \)

11. \( \text{Cov}(R_i, R_j) = \sum_{i=1}^{n} \left( p(R_i - ER_i) \right) \left( R_j - ER_j \right) \)

\( \text{Cov}(R_i, R_j) = \text{Cov}(R_j, R_i) \)

\( \text{Cov}(R, R) = \sigma^2(R) \)

12. Portfolio Var = \( \sigma^2(R_p) = \sum_{i=1}^{n} \sum_{j=1}^{n} w_iw_j\text{Cov}(R_i, R_j) \)

\( \sigma^2(R_p) = w_1^2\sigma^2(R_1) + w_2^2\sigma^2(R_2) + \ldots \)

13. Standard Deviation (S.D) = \( \sqrt{w_1^2R_1^2 + w_2^2R_2^2 + w_3^2R_3^2} \)

14. Correlation (b/w two random variables \( R_i, \) \( R_j \)) = \( \rho(R_i, R_j) = \frac{\text{Cov}(R_i, R_j)}{\sigma_{R_i}\sigma_{R_j}} \)

15. Bayes’ Formula = \[ P(\text{Event}|\text{New Information}) = \frac{P(\text{Event} | \text{New Information}) P(\text{New Information})}{P(\text{New Information} \text{ Event}) \times P(\text{Prior prob. of Event})} \]

16. Multiplication Rule of Counting = \( n \) factorial = \( n! = n(n-1)(n-2)(n-3) \ldots 1 \)

17. Multinomial Formula (General formula for labeling problem) = \( \frac{n!}{n_1!n_2! \ldots n_k!} \)

18. Combination Formula (Binomial Formula) = \( \binom{n}{r} = \frac{n!}{(n-r)!r!} \)

where \( n \) = total no. of objects and \( r \) = no. of objects selected.

19. Permutation = \( nP_r = \frac{n!}{(n-r)!} \)

### Reading 9: Common Probability Distributions

1. Probability Function (for a binomial random variable) \( p(x) = p(X=x) = \binom{n}{x}p^x(1-p)^{n-x} \)

\( \text{for } x = 0,1,2,\ldots, n \)

- \( x \) = success out of \( n \) trials
- \( n-x \) = failures out of \( n \) trials
- \( p \) = probability of success
- \( 1-p \) = probability of failure
- \( n \) = no of trials.

2. Probability Density Function (pdf) = \( f(x) \)

\[ f(x) = \begin{cases} \frac{1}{b-a} & \text{for } a \leq x \leq b \\ 0 & \text{otherwise} \end{cases} \]

\( F(x) = \begin{cases} \frac{x-a}{b-a} & \text{for } a < x < b \\ 0 & \text{otherwise} \end{cases} \)

3. Normal Density Function = \( f(x) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right) \)

for \( -\infty < x < +\infty \)

4. Estimations by using Normal Distribution:

- Approximately 50% of all obsv fall in the interval \( \mu \pm \frac{\sigma}{2} \)
- Approx 68% of all obsv fall in the interval \( \mu \pm \sigma \)
- Approx 95% of all obsv fall in the interval \( \mu \pm 2\sigma \)
- Approx 99% of all obsv fall in the interval \( \mu \pm 3\sigma \)
- More precise intervals for 95% of the obsv are \( \mu \pm 1.96\sigma \) and for 99% of the observations are \( \mu \pm 2.58\sigma \).

5. Z-Score (how many S.Ds away from the mean the point \( x \) lies) \( z = \frac{x-\mu}{\sigma} \) (when \( X \) is normally distributed)

6. Roy’s Safety-Frist Criterion = SF Ratio = \( \frac{\text{E}(R_p) - R_f}{\sigma_p} \)

7. Sharpe Ratio = \( \frac{\text{E}(R_p) - R_f}{\sigma_p} \)

8. Value at Risk = VAR = Minimum $ loss expected over a specified period at a specified prob level.

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9. Mean (\(\mu\)) of a lognormal random variable 
   \[\text{exp}(\mu + 0.5\sigma^2)\]

10. Variance (\(\sigma_L^2\)) of a lognormal random variable 
    \[\text{exp}(2\mu + \sigma^2) \times \text{[exp}(\sigma^2) - 1]\]

11. Log Normal Price = \(S_T = S \text{exp}(r_{0,T})\)
    Where, \(\text{exp} = e\) and \(r_{0,t} = \text{Continuously compounded return from 0 to T}\)

12. Price relative = End price / Beg price = \(S_{t+1} / S_t = 1 + R_{t, t+1}\)
    where,
    \(R_{t, t+1} = \text{holding period return on the stock from } t \text{ to } t + 1\).

13. Continuously compounded return
    associated with a holding period from \(t\) to \(t + 1\):
    \[\text{ln}(1 + \text{holding period return}) \text{ or } \text{ln}(S_{t+1}/S_t) = \text{ln}(1 + R_{t, t+1})\]

14. Continuously compounded return
    associated with a holding period from 0 to \(T\):
    \[\text{ln}(S_T/S_0) \text{ or } r_{0,T} = r_{T-1,T} + r_{T-2,T-1} + \cdots + r_{0,1}\]
    Where, \(r_{t,T} = \text{One-period continuously compounded returns}\)

15. When one-period continuously compounded returns (i.e. \(r_{0,1}\)) are IID random variables.
    \[E(r_{0,T}) = E(r_{T-1,T}) + E(r_{T-2,T-1}) + \cdots + E(r_{0,1}) = \mu T \quad \text{And}\]
    \[\text{Variance} = \sigma^2(r_{0,T}) = \sigma^2T\]
    S.D. = \(\sigma (r_{0,1}) = \sigma \sqrt{T}\)

16. Annualized volatility = sample S.D. of one period continuously compounded returns \(\times \sqrt{T}\)

**Reading 10: Sampling and Estimation**

1. Var of the distribution of the sample mean
   \[\frac{\sigma^2}{n}\]

2. S.D. of the distribution of the sample mean
   \[\frac{\sigma^2}{\sqrt{n}}\]

3. Standard Error of the sample mean:
   - When the population S.D (\(\sigma\)) is known
     \[\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}\]
   - When the population S.D (\(\sigma\)) is not known
     \[\sigma_{\bar{x}} = \frac{s}{\sqrt{n}} \text{ where } s = \text{sample S.D estimate of } s\]

\[\text{Standard error of sample mean} = \sqrt{\frac{\text{sample variance}}{n}} = \sqrt{s^2} \text{ where } s^2 = \frac{\sum_{i=1}^{n}(X_i - \bar{X})^2}{n-1}\]

4. Finite Population Correction Factor = fpc
   \[= \sqrt{\frac{N-n}{N-1}} \text{ where } N = \text{population}\]

5. New Adjusted Estimate of Standard Error
   \[= (\text{Old estimated standard error } \times \text{fpc})\]

6. Construction of Confidence Interval (CI) = Point estimate \(\pm\) (Reliability factor \(\times\) Standard error)
   - CI for normally distributed population with known variance \(\bar{x} \pm z_{a/2} \frac{\sigma}{\sqrt{n}}\)
   - CI for normally distributed population with unknown variance \(\bar{x} \pm z_{a/2} \frac{s}{\sqrt{n}}\)
   where \(S = \text{sample S.D.}\)

**Reading 11: Hypothesis Testing**

1. Test Statistic = \[\frac{\text{Sample Statistic} - \text{Hypothesized Value of pop parameter}}{\text{standard error of sample statistic}}\]

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2. Power of Test = 1 - Prob. of Type II Error

3. \[ z = \frac{\bar{x} - \mu_0}{\sigma / \sqrt{n}} \] (when sample size is large or small but pop S.D is known)

4. \[ z = \frac{\bar{x} - \mu_0}{s / \sqrt{n}} \] (when sample size is large but pop S.D is unknown where s is sample S.D)

5. \[ t_{n-1} = \frac{\bar{x} - \mu_0}{s / \sqrt{n}} \] (when sample size is large or small and pop S.D is unknown and pop sampled is normally or approximately normally distributed)

6. Test Statistic for a test of diff b/w two pop means (normally distributed, pop var unknown but assumed equal)

\[
t = \frac{(X_1 - X_2) - (\mu_1 - \mu_2)}{S_p} \left( \frac{1}{n_1} + \frac{1}{n_2} \right)^{1/2}
\]

where \( S_p^2 = \text{pooled estimator of common variance} = \frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2} \) when \( df = n_1 + n_2 - 2 \).

7. Test Statistic for a test of diff b/w two pop means (normally distributed, unequal and unknown pop var unknown)

\[
t = \frac{(X_1 - X_2) - (\mu_1 - \mu_2)}{S_p} \left( \frac{1}{n_1} + \frac{1}{n_2} \right)^{1/2}
\]

In this df calculated as

\[
df = \frac{(\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2})^2}{\frac{(\frac{S_1^2}{n_1})^2}{n_1} + \frac{(\frac{S_2^2}{n_2})^2}{n_2}}
\]

8. Test Statistic for a test of mean differences (normally distributed populations, unknown population variances)

- \[ t = \frac{d - \mu_{40}}{s d} \]
- sample mean difference = \( \bar{d} = \frac{1}{n} \sum_{i=1}^{n} d_i \)
- sample variance = \( S_d^2 = \frac{\sum_{i=1}^{n} (d_i - \bar{d})^2}{n-1} \)
- sample S.D = \( S_d \)
- sample error of the sample mean difference = \( s d = \frac{s d}{\sqrt{n}} \)

9. Chi Square Confidence Interval for variance

Lower limit = \( L = \frac{(n-1)s^2}{x_{a/2}^2} \) and Upper limit = \( U = \frac{(n-1)s^2}{x_{1-a/2}^2} \)

10. F-test (test concerning differences between variances of two normally distributed populations) \( F = \frac{S_1^2}{S_2^2} \)

\( S_1^2 = 1st \ sample \ var \ with \ n_1 \ obs \) \( S_1^2 = 2nd \ sample \ var \ with \ n_2 \ obs \)

\[ df_1 = n_1 - 1 \ \text{numerator df} \]

\[ df_2 = n_2 - 1 \ \text{denominator df} \]

11. Relation between Chi Square and F-distribution \( F = \frac{x_1^2/m}{x_2^2/n} \) where:

- \( X_1^2 \) is one chi square random variable with one m degrees of freedom
- \( X_2^2 \) is another chi square random variable with one n degrees of freedom

12. Spearman Rank Correlation \( r_s \)

\[
1 - \frac{6 \sum_{i=1}^{n} d_i^2}{n(n^2 - 1)}
\]
Reading 12: Topics in Demand & Supply Analysis

1. \( Q^d_x = f(P_x, I, P_Y) \)

Price Elasticity of Demand = \( E^d_{Px} = \frac{\% \Delta \text{ in Quantity Demanded}}{\% \Delta \text{ in Price}} = \left( \frac{\Delta Qdx}{P_x} \right) \left( \frac{\Delta Px}{Qdx} \right) \)

2. \( E^d = \frac{\% \Delta \text{ in Quantity Demanded}}{\% \Delta \text{ in Income}} = \left( \frac{\Delta Qdx}{I} \right) \left( \frac{\Delta I}{Qdx} \right) \)

3. Cross Elasticity = \( E^d_{xy} = \frac{\% \Delta \text{ in Quantity Demanded of Good X}}{\% \Delta \text{ in Price of Good Y}} \)

4. Total cost of production = \( TC = (w)(L) + (r)(K) \)

5. \( TR = (P)(Q) \)

6. \( MR = \frac{\Delta TR}{\Delta Q} \)

7. \( MR = \frac{(P)(\Delta Q)}{\Delta Q} + \frac{(Q)(\Delta P)}{\Delta Q} = P + Q \frac{\Delta P}{\Delta Q} \)

Reading 13: The Firm & Market Structures

1. In perfect competition, Marginal revenue = Avg. Revenue = Price = Demand

2. Marginal Revenue = Price \times \left( 1 - \frac{1}{\text{Price Elasticity of Demand}} \right)

3. Concentration Ratio = \frac{\text{Sum of sales values of the largest 10 firms}}{\text{Total Market Sales}}

4. Herfindahl-Hirschman Index = Sum of the squares of the market shares of the top N companies in an industry

Reading 14: Aggregate Output, Prices & Economic Growth

1. Nominal GDP \_1 = Prices in year t \times Quantity produced in year t

2. Real GDP \_1 = Prices in the base year \times Quantity produced in year t

3. Implicit price deflator for GDP or GDP deflator = \frac{\text{value of current yr output at current yr prices}}{\text{value of current yr output at base yr prices}} \times 100

4. Real GDP = [(Nominal GDP / GDP deflator) \div 100]

5. GDP deflator = \frac{\text{Nominal GDP}}{\text{Real GDP}} \times 100

6. GDP = Consumer spending on final goods & services + Gross private domestic investment + Govt. spending on final goods & services + Govt. gross fixed investment + Exp – Imp + Statistical discrepancy

7. Net Taxes = Taxes – Transfer payments

8. GDP = National income + Capital consumption allowance + Statistical discrepancy

9. National Income = Compensation of employees + Corp & Govt enterprise profits before taxes + Interest income + Unincorporated business net income + rent + indirect business taxes less subsidies

10. Total Amount Earned by Capital = Profit + Capital Consumption Allowance

11. PI = National income – Indirect business taxes – Corp income taxes – Undistributed Corp profits + Transfer payments

12. Personal disposable income (PDI) = Personal income – Personal taxes OR GDP (Y) + Transfer payments (F) – (R/E + Depreciation) – direct and indirect taxes (R)

13. Business Saving = R/E + Depreciation

14. Household saving = PDI - Consumption expenditures - Interest paid by consumers

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15. Business sector saving = Undistributed corporate profits + Capital consumption allowance

16. Total Expenditure = Household consumption (C) + Investments (I) + Government spending (G) + Net exports (X-M)

17. Private Sector Saving = Household Saving + Undistributed Corporate Profits + Capital Consumption Allowance

18. GDP = Household consumption + Private Sector Saving + Net Taxes

19. Domestic saving = Investment + Fiscal balance + Trade balance

20. Trade Balance = Exports – Imports


22. Average propensity to consume (APC) = 
   \[ \frac{\text{Aggregate Consumption}}{\text{Real Income}} \]

23. Quantity theory of money equation: 
   Nominal Money Supply \times \text{Velocity of Money} = \text{Price Level} \times \text{Real Income or Expenditure}

24. \% Δ in unit labor cost = \% Δ in nominal wages - \% Δ in productivity

25. Economic growth = Annual \% Δ in real GDP

26. Total Factor Productivity growth = Growth in potential GDP – [Relative share of labor in National Income \times (Growth in labor)] + [Relative share of capital in National Income \times (Growth in capital)]

27. Growth in potential GDP = Growth in technology + (Relative share of labor in National Income \times (Growth in labor)) + (Relative share of capital in National Income \times (Growth in capital))

28. Capital share = \text{Corporate profits + net interest income + net rental income} + \left( \frac{\text{depreciation}}{\text{GDP}} \right)

29. Labor share = \text{Employee Compensation} \times \frac{\text{GDP}}{100}

3. \text{Unit labor cost (ULC) indicator} = \frac{\text{Total labor compensation per hour per worker}}{\text{Output per hour per worker}}

4. \text{Velocity of money} = \frac{\text{Nominal GDP}}{\text{Money Supply}}

Reading 16: Monetary & Fiscal Policy

1. \text{Total Money created} = \frac{\text{New deposit}}{\text{Reserve Req}}

2. \text{Money Multiplier} = \frac{1}{\text{Reserve Req or reserve ratio}}

3. \text{Narrow money} = M1 = \text{currency held outside banks + checking accounts + traveller’s check}

4. \text{Broad money} = M2 = M1 + \text{time deposits + saving deposits}

5. M3 = M2 + \text{deposits with non-bank financial institution}

6. Quantity Theory of Money = M \times V = P \times Y \text{ where,}
   - M = \text{Quantity of money}
   - V = \text{Velocity of circulation of money}
   - P = \text{Average price level}
   - Y = \text{Real output}

Reading 15: Understanding Business Cycles

1. \text{Price index at time} t_2 = \text{Value of the Consumption Basket at} t_2 \times \frac{100}{\text{Value of the Consumption Basket at} t_1}

2. \text{Fisher Index} = \sqrt{100 \times I_L} \text{ (where, } I_L = \text{Laspeyres index and } I_P = \text{Paasche Index)}
7. Neutral Rate = Trend Growth + Inflation Target

8. Impact of Taxes and Government Spending: The Fiscal Multiplier
   The net impact of the government sector on AD:
   - G – T + B = Budget surplus or Budget deficit
     where, G = government spending, T = taxes, B = transfer benefits
   - Disposable income = Income – Net taxes = (1 – t) Income
     where, Net taxes = taxes – transfer payments, t = net tax rate

9. Fiscal Multiplier (in the absence of taxes) = 1/(1 - MPC)
   - MPS = 1 – MPC.
   - Total increase in income and spending = Fiscal multiplier × G

10. Fiscal Multiplier (in the presence of taxes)
    - MPC (with taxes) = MPC × (1 - t)
    - Fiscal multiplier = \( \frac{1}{1 - MPC \times (1 - t)} \)
    - Total ↑ in income and spending = Fiscal multiplier × G
    - Initial ↑ in consumption due to reduction in taxes = MPC × tax cut amount
    - Total or cumulative effect of tax cut = multiplier × initial change in consumption

11. Cumulative multiplier = \( \frac{\text{cumulative effect on real GDP over the two years}}{\text{% of GDP}} \)

Reading 17: International Trade & Capital Flows

1. Terms of trade = \( \frac{\text{Price of exports}}{\text{Price of imports}} \)

2. Terms of Trade (as an index number) = \( \frac{\text{Avg price of exports}}{\text{Avg price of imports}} \)

3. Net exports = Value of a country's (exports – imports)

4. Net welfare effect = consumer’s surplus loss + producer’s surplus gain + Govt. revenue

5. Closed Economy’s output = Y = C+I+G

6. Open Economy’s output = Y = C+I+G+(X-M)
   - Current Account Balance = X-M = Y- C+I+G

7. Consumption = Income + transfers – taxes – saving
   \( C = Y^d - S_p = Y + R - T - S_p \) And,
   CA = \( S_p - 1 + \text{Govt surplus (or Govt saving)} = S_p - 1 + (T - G - R)S_p + S_g = I + CA \)

where, \( S_g = \text{Govt savings} \)
\( S_p = I + CA - S_g \)
- Current Account Imbalance CA = Sp + Sg – I

Reading 18: Currency Exchange Rates

1. Foreign price level in domestic currency = \( S_{d/f} \times P_t \)

2. Real exchange rate \( _{(D/F)} \) = \( \frac{S_{d/f} \times P_t}{P_d} = S_{d/f} \times \left( \frac{P_t}{P_d} \right) \)

3. Real Exchange Rate \( _{\text{domestic/foreign}} = S_{d/f} \times \left( \frac{CPI_t}{CPI_d} \right) \)

4. Change in Real Exchange rate = \( \left( 1 + \frac{\Delta S_{d/f}}{S_{d/f}} \right) \times \frac{1 + \frac{\Delta P_t}{P_t}}{1 + \frac{\Delta P_d}{P_d}} - 1 \)

5. Direct Quote = \( \frac{1}{\text{Indirect Quote}} \)

6. Points on a forward rate quote = Fwd X-rate – Spot X-rate quote

7. Forward rate = Spot X-rate + \( \frac{\text{Forward points}}{10,000} \)

8. Forward premium/discount (in %) = \( \frac{\text{spot X-rate} + \text{(forward points/10,000)}}{\text{spot X-rate}} - 1 \)

9. To convert spot rate into a forward quote (when points are represented as %) = Spot
exchange rate × (1 + % premium or discount)

10. Arbitrage relationship is stated as follows:
   - 
   
   In case of indirect quote, Arbitrage relationship is: 
   
   \[ \frac{F_f}{S_f} = \left( \frac{1 + i_f}{1 + i_d} \right) \]
   
   • Forward rate as a % of spot rate = \[ F_S = \left( \frac{1 + i_f}{1 + i_d} \right) \]
   
   • Expected % change in the spot rate = \[ \frac{S_{t+1}}{S_t} - 1 = \% \Delta S_t = \left( \frac{1 - i_d}{1 + i_d} \right) \]
   
   • Forward points: \[ F_f/d - S_f/d = S_{f/d} \left( \frac{1 - i_d}{1 + i_d} \right) \tau \]
   
11. Return on hedged foreign investment (with a quoted forward rate) = \[ S_{f/d} \left( 1 + i_f \right) \]

12. Expected % change in the spot rate = \[ \frac{S_{t+1}}{S_t} - 1 = \% \Delta S_t = \left( \frac{1 - i_d}{1 + i_d} \right) \]
   
   • Forward points: \[ F_f/d - S_f/d = S_{f/d} \left( \frac{1 - i_d}{1 + i_d} \right) \tau \]

13. Relationship between the trade balance and expenditure/ saving decisions:
   
   \[ \text{Ex} - \text{Im} = (\text{Sav} - \text{Inv}) + (T - G) \]
   
   where T = taxes net of transfers
   
   G = government expenditures

14. Price elasticity of demand = \[ \varepsilon = \frac{\% \text{ change in quantity}}{\% \text{ change in price}} = \frac{\% \Delta Q}{\% \Delta P} \]

15. Expenditure (R) = Price × Quantity = P × Q
   - % \Delta in expenditure = \% \Delta R = \% \Delta P
   + \% \Delta Q = (1 - \varepsilon) \% \Delta P

16. Basic idea of Marshall-Lerner condition = \[ \omega_x \varepsilon_x + \omega_M (\varepsilon_M - 1) > 0 \]
   where,
   \[ \omega_x = \text{share of exports} \]
   \[ \varepsilon_x = \text{price elasticity of foreign demand for domestic country exports} \]
   \[ \omega_M = \text{share of imports} \]
   \[ \varepsilon_M = \text{price elasticity of domestic country demand for imports} \]

17. Trade balance = Income (GDP) – Domestic expenditure = Absorption

Reading 19: Introduction to Financial Statement Analysis

1. Gross Profit = Revenue – Cost of sales
2. Operating Profit or EBIT = Gross profit – Operating costs + Other operating income
3. Profit before tax = EBIT – Interest expense
4. Profit after tax = Profit before tax – Income tax expense

Reading 20: Financial Reporting Standards

1. Revenue recognized on Prorated basis = Total Amount of Cost
   Time of the contract

2. Revenue recognized under Percentage-of-Completion Method = % of Total cost spent by the firm × Total Contract Revenue

3. Revenue recognized when outcome cannot be reliably measured = Contract costs incurred

4. Revenue recognized under installment method = \( \left( \frac{\text{Profit}}{\text{Sales}} \right) \times \text{Cash receipt} \)

5. Wgtd Avg cost per unit = \( \frac{\text{Total Cost of Goods available for Sale}}{\text{Total units available for Sale}} \)

6. COGS using Wghtd Avg Cost = No of units sold × Wghtd Avg cost per unit

7. COGS using LIFO = Total cost – Value of ending inventory

8. Annual Depreciation Expense (using Straight-Line Method) = \( \frac{\text{Cost} - \text{Residual Value}}{\text{Estimated Useful Life}} \)

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9. Annual Depreciation Expense (Declining balance method) = \( \frac{100\%}{\text{Useful life}} \times \text{Acceleration factor (say 200% or 2)} \times \text{Net Book Value} \)

10. Basic EPS = \( \frac{\text{Net Income} - \text{Preferred Dividends}}{\text{Wght Avg No of shares outstanding}} \)

11. Diluted EPS for preferred stock = \( \frac{\text{Net Income}}{\text{(Wght Avg No of shares o/s+New common shares that would have been issued at conversion)}} \)

12. Diluted EPS for convertible debt = \( \frac{\text{Net Income} + \text{AT (on convertible debt–Preferred Div)}}{\text{(Wght Avg of shares o/s+Additional common shares that would have been issued at conversion)}} \)

13. Diluted EPS using Treasury Stock Method = \( \frac{(\text{Net Income}—\text{Preferred dividends})}{(\text{Wght Avg of shares} + (\text{New shares at option exercise} / \text{Shares purchased with Cash received upon exercise}) \times (\text{Proportion of Yr})} \)

14. Net Profit Margin = \( \frac{\text{Net Income}}{\text{Revenue}} \)

15. Gross Profit Margin = \( \frac{\text{Gross Profit}}{\text{Revenue}} \)

16. Comprehensive EPS = EPS + Other Comprehensive Income per share

**Reading 22: Understanding Balance Sheets**

1. Percentage of A/C Receivable estimated to be uncollectible = \( \frac{\text{Allowance for Doubtful A/C}}{\text{Gross amount of A/C Receivable}} \)

2. Net Identifiable Assets = Fair value of identifiable assets – Fair value of liabilities & contingent liabilities

3. Amortized cost of PPE = Historical cost – Accumulated depreciation – Impairment losses

4. Carrying value for PPE under revaluation model = Fair value at date of revaluation – Accumulated depreciation (if any)

5. Amortized cost of PPE = Historical cost – Accumulated depreciation – Impairment losses

6. Carrying value for PPE under revaluation model = Fair value at date of revaluation – Accumulated depreciation (if any)

7. Deferred tax liability = Taxable income < Reported Financial Statement Income before taxes

8. Deferred tax liability = Actual income tax payable in a period < Income tax expense

9. Vertical common-size balance-sheet = \( \frac{\text{Balance sheet Amount}}{\text{Total Assets}} \)

10. Current ratio = \( \frac{\text{Current Assets}}{\text{Current Liabilities}} \)

**Reading 23: Understanding Cash Flow Statements**

1. End Cash = Beg cash + Cash receipts (from operating, investing, and financing activities) – Cash payments (for operating, investing, and financing activities)

2. End A/c Receivable = Beg A/c Receivable + Revenues – Cash collected from customers

3. Cash received from customers = Revenue – Increase in a/c receivable

4. Purchases from suppliers = COGS + Increase in inventory

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5. Cash paid to suppliers = Cogs + Increase in inventory – Increase in a/c payable

6. End Inventory = Beg inventory + Purchases – COGS

7. End a/c payable = Beg a/c payable + Purchases – Cash paid to suppliers

8. Cash paid to employees = Salary and wages expense – Increase in salary and wages payable

9. End salary and wages payable = Beg salary and wages payable + Salary and wages expense – cash paid to employees

10. Cash paid for other operating expenses = Other operating expenses – Decrease in prepaid expenses – Increase in other accrued liabilities

11. Cash paid for interest = Interest expense + Decrease in interest payable

12. End Interest Payable = Beg interest payable + Interest expense – Cash paid for interest

13. Cash paid for income taxes = Income tax expense – Increase in income tax payable

14. Historical cost of equipment sold = Beg balance equipment + Equipment purchased – End balance equipment

15. Accumulated Dep on equipment sold = Beg balance accumulated dep + Dep expense – End balance accumulated dep

16. Cash received from sale of equipment = Historical cost of equipment sold – Accumulated dep on equipment sold + gain on sale of equipment


18. FCFF = Net income + Non-cash charges + Interest expense (1 – tax rate) – Cap exp – WC expenditures

19. FCFF = CFO + Interest expense (1 – Tax rate) – Cap exp

20. FCFE = CFO – Cap exp + Net borrowing

21. CF to revenue = CFO / Net Revenue

22. Cash ROA = CFO / Average Total Assets

23. Cash ROE = CFO / Average shareholders’equity

24. Cash to income = CFO / Operating Income

25. Cash flow per share = (CFO – Preferred Dividends) / No of common shares o/s

26. Debt Coverage = CFO / Total Debt

27. Interest Coverage = (CFO + Interest paid + Taxes paid) / Interest paid

28. Reinvestment = CFO / Cash paid for long-term assets

29. Debt payment = CFO / Cash paid for LT debt repayment

30. Dividend payment = CFO / Dividends paid

31. Investing and Financing = CFO / Cash outflows for investing and financing activities

Reading 24: Financial Analysis Techniques

1. Compound Growth Rate = \[ \left( \frac{\text{End Value}}{\text{Beg Value}} \right)^{\frac{1}{\text{No of periods}}} - 1 \]

2. Combined ratio = Losses and Expenses / NetPremium Earned

3. Operating ROA = Operating Income / Avg Total Assets

4. ROA = Net Income / Avg Total Assets or

   ROA = Net Income + Interest Expense (1 – Tax rate) / Avg Total Assets

5. Effective Tax Rate = Income Tax / Earnings before Tax
6. Vertical common size income statement = Income statement Item Revenue
7. Horizontal common size balance sheet = Balance sheet item in Year 2 Balance sheet item in Year 1
8. Inventory turnover = Cost of sales or cost of goods sold Avg Inventory
9. Days of Inventory on Hand (DOH) = No of Days in period Inventory Turnover
10. Receivables Turnover = Revenue Avg Receivables
11. Days of Sales Outstanding (DSO) = No of Days in Period Receivables turnover
12. Avg A/c Receivable Balance = Avg Days’ Credit Sales x DSO or Avg A/c Receivable Balance = Sales Sales Turnover = Sales DSO
13. Payables turnover = Purchases Avg trade payables
14. No of Days of Payables = No of Days in period Payables Turnover
15. WC Turnover = Revenue Avg WC
16. Fixed Asset Turnover = Revenue Avg Net Fixed Assets
17. Total Asset Turnover = Revenue Avg Total Assets
18. Pretax margin = Earnings before tax but after interest Revenue
19. Return on Total Capital = EBIT Short and long term debt and equity
   • ROE = Net Income Avg Total Equity
   • ROE = ROA x Leverage
   • ROE = Tax Burden x Interest Burden x EBIT Margin x Total Asset Turnover x Leverage
20. ROE = Net Income Avg Total Equity
21. Return on Common Equity = Net Income – Preferred Dividends Avg Common Equity
22. Coefficient of Variation of Operating Income = SD of Operating Income Avg Operating Income
23. Coefficient of Variation of Net Income = SD of Net Income Ave Net Income
24. Coefficient of Variation of Revenues = SD of Revenue Ave Revenue
25. Monetary Reserve Requirement (Cash Reserve Ratio) = Reserves held as Central Bank Specified Deposit Liabilities
26. Liquid Asset Requirement = Readily Marketable Securities Specified Deposit Liabilities
27. Net Interest Margin = Net Interest Income Total Interest Earning Assets
28. Sales per Square Meter = Revenue Total Retail Space in Square Meters
29. Average Daily Rate = Room Revenue No of Rooms Sold
30. Occupancy Rate = No of Rooms Sold No of Rooms available
31. EBIT Interest Coverage = EBIT Gross Interest
32. EBITDA Interest Coverage = EBITDA Gross Interest
33. FFO Interest Coverage = FFO + Interest Paid – Operating Lease Adjustments Gross Interest
34. Return on Capital = EBIT Avg Capital
   • EBIT = EBIT
   • Avg (Equity + Non current deferred taxes + debt)
35. FFO to Debt = FFO Total Debt
36. Free Operating CF to Debt = CFO–Cap Exp Total Debt
37. Discretionary CF to Debt = CFO–Cap exp–Dividends paid Total debt
38. Net CF to Capital expenditures = \( \frac{FPO - \text{Dividends}}{\text{Cap exp}} \)

39. Debt to EBITDA = \( \frac{\text{Total debt}}{\text{EBITDA}} \)

40. Total Debt to total debt plus Equity = \( \frac{\text{Total debt}}{\text{Total debt + Equity}} \)

41. Z-Score = \( 1.2 \times \left( \frac{CA - CL}{TA} \right) + 1.4 \times \left( \frac{RE}{TA} \right) + 3.3 \times \left( \frac{EBIT}{TA} \right) + 0.6 \times \left( \frac{MV \text{ of stock}}{BV \text{ of liabilities}} \right) + 1.0 \times \left( \frac{Sales}{TA} \right) \)

42. Segment margin = \( \frac{\text{Segment Profit (Loss)}}{\text{Segment Revenue}} \)

43. Segment turnover = \( \frac{\text{Segment Revenue}}{\text{Segment Assets}} \)

44. Segment ROA = \( \frac{\text{Segment Profit (Loss)}}{\text{Segment Assets}} \)

45. Segment Debt Ratio = \( \frac{\text{Segment Liabilities}}{\text{Segment Assets}} \)

**Reading 25: Inventories**

1. NRA = Estimated Selling Price – Estimated Costs of completion and disposal

2. Inventory amount net of valuation allowance = Carrying amount of Inventory – Write downs

3. (NRA – Normal Profit Margin) ≤ MV ≤ NRA

**Reading 26: Long-Lived Assets**

1. Dep Exp under Straight-line Method = 
\[
\frac{\text{Depreciable Cost}}{\text{Estimated Useful Life}} = \frac{\text{History Cost} - \text{Imputed Residual (salvage) Value}}{\text{Estimated Useful Life}}
\]

2. Dep Exp under Units-of-Production Method = Depreciable Cost \( \times \) 
\[
\frac{\text{Production in the Period}}{\text{Estimated Productive Capacity}}
\]

3. Carrying amount under cost model = 
\[
\text{Historical Cost} - \text{Accumulated Dep or Amortization}
\]

4. Carrying amount under revaluation model = 
\[
\text{Fair value at the date of revaluation} - \text{Any subsequent Accumulated Dep or Amortization}
\]

5. Impairment Loss (IFRS) = Recoverable Amount – Net Carrying Amount

Where, Recoverable amount = Max [(Fair value – Costs to sell; Value in Use)] and Value in use = PV of Expected Future CFs

6. Impairment Loss (US GAAP) = Asset’s Fair Value – Carrying Amount. If Carrying amount > Undiscounted Expected Future Cash Flows

**Reading 27: Income Taxes**

1. Deferred tax asset = Company’s taxable income > Accounting profit

2. Tax base of revenue received in advance = Carrying amount – Any amount of revenue that will not be taxed at a future date

3. Reported Effective Tax Rate = \( \frac{\text{Income Tax} \times \text{exp}}{\text{Pre tax income or Accounting Profit}} \)

4. Deferred tax liability = Carrying amount of asset > Tax base of asset

5. Deferred tax asset = Carrying amount of asset < Tax base of asset

6. Deferred tax asset = Carrying amount of liability > Tax base of asset

7. Deferred tax liability = Carrying amount of liability < Tax base of asset

8. Company’s tax expense (or credit) reported on its income statement = Income tax liability currently payable + \( \Delta \) in deferred tax asset / liability

Where,
- Income tax liability currently payable = Taxable income \( \times \) Tax rate

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9. The company’s tax expense (or credit) reported on its income statement = Taxes payable + (∆ Deferred tax liability - ∆ Deferred tax asset)

Where,
- Income Tax liability currently payable = Taxable income × Tax rate
- Deferred tax liability = (carrying amount – tax base) × tax rate
- Deferred tax asset = (tax base – carrying amount) × tax rate

10. Tax base of a liability = Carrying amount of the liability – Amounts that will be deductible for tax purposes in the future

Reading 28: Non-current (Long-term) Liabilities

Interest payment = Face value of a bond × Contractual rate.

For bonds sold at a discount:
Amount of Bonds payable reported on the balance sheet = Face value – Discount

For bonds sold at a premium:
Amount of Bonds payable reported on the balance sheet = Face value + Premium

Bond Discount/Premium Amortization = Bond Discount or Premium / Number of Interest Periods

For Finance Lease:
Carrying amount of the leased asset = Initial recognition amount – Accumulated depreciation

Accumulated depreciation = Prior year’s accumulated depreciation + Current year’s depreciation expense

Interest expense = lease liability at the beginning of the period × interest rate implicit in the lease

Finance Lease from the Lessor’s Perspective:
Sales revenue = lower of the fair value of the asset and PV of the minimum lease payments
Cost of sales = Carrying amount of the leased asset – PV of the estimated unguaranteed residual value
Interest Revenue = Lease receivable at the beginning of the period × interest rate

Sales-Type Lease: It results when PV of lease payments > Carrying amount of the leased asset

Net interest expense/income accrued on the beg. net pension asset/liability:
Net interest expense = Beg. Net pension liability × Discount rate

Net Interest income = Beg. Net Pension asset × Discount rate

Reported pension expense = Pension costs – Expected return on Pension plan assets

Funded Status = PV of the DB obligations – Fair value of the plan assets

Debt-Capital Ratio = Total Debt / Total Shareholders’ Equity

Debt - Assets (or Total Debt) Ratio = Total Debt / Total assets

Debt-Equity Ratio = Total Debt / Total Shareholders’ Equity

Financial Leverage Ratio (or Leverage Ratio) = Average Total Assets

Interest Coverage (or Times interest earned) = Operating profit (EBIT) / Interest payments

Fixed charge coverage = EBIT + Lease payments / Interest Payments + Lease payments

Reading 29: Financial Reporting Quality
1. Company’s sales = Projected market share \times Projected total industry sales

2. Forecast amount of profit for a given period = Forecasted amount of sales \times Forecast of the selected profit margin

3. Retained CF (RCF) / Total debt = (operating CF before WC changes - dividends) / total debt

4. \frac{\text{Retained CF} - \text{Cap exp}}{\text{Total Debt}}

5. Inventory value adjusted to FIFO basis = End Inventory value under LIFO + End LIFO reserve balance

6. COGS adjusted to a FIFO basis = COGS under LIFO – (End LIFO reserve – Beg LIFO reserve)

7. Useful life of the company’s overall asset base that has passed = \frac{\text{Accumulated Dep}}{\text{Gross PPE}}

8. Avg age of the asset base = \frac{\text{Accumulated Dep}}{\text{Annual Dep expense}}

9. Remaining useful life of the asset = \frac{\text{Net PPE (net of accumulated dep)}}{\text{Annual dep expense}}

10. Avg depreciable life of the assets at installation = \frac{\text{Gross PPE}}{\text{Annual Dep expense}}

11. \% of asset base that is being renewed through new capital investment = \frac{\text{Capex}}{\text{Gross PPE + Capex}}

12. Adjusted BV = Total stockholders’ equity – Goodwill

13. Adjusted Price to BV ratio = \frac{\text{Price (market capitalization)}}{\text{Adjusted BV}}

14. Tangible B.V = Total stockholders’ equity – Goodwill – Other intangible assets

15. Price to tangible BV ratio = \frac{\text{Price}}{\text{Tangible BV}}

16. Adjusted debt-to-equity ratio = \frac{\text{Reported debt} + \text{PV of operating lease}}{\text{Reported Equity}}

17. Adjusted debt-to-asset ratio = \frac{\text{Reported debt} + \text{PV of operating lease}}{\text{Reported Asset} + \text{PV of operating lease}}

18. Adjusted Asset Turnover ratio = \frac{\text{Reported Avg total assets} + \text{PV of operating lease}}{\text{Sales}}

19. PV of future operating lease payments = \frac{\text{PV of capital lease payments}}{\text{Total Capital Lease payments}} \times \text{Total Future Operating Lease Payments}

20. Interest expense = \text{Interest} \times \text{PV of the lease payments}

21. Depreciation expense estimated on straight-line basis = \frac{\text{PV of the lease payments}}{\text{No of yrs of future lease payments}}

22. Adjusted Interest Coverage ratio = \frac{\text{(EBIT)} + \text{rent exp} \times -\text{Dep exp} \times \text{i payments} + \text{i expense} \times}{*\text{associated with the operating lease obligations}}

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Formula Sheet

CFA Level I 2020

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5. Value of a company = Value of company’s existing invst + Net PV of all of company’s future invst.

Reading 33: Cost of Capital

1. WACC = \( w_{\text{de}}(1-t) + w_{\text{pf}} + w_{\text{ce}} \)

2. Debt-to-Equity Ratio conversion into weight (i.e. Debt / (Debt + Equity) = \( \frac{\text{Debt}}{\text{Equity}} \) \( \frac{1}{1+\text{Debt/Equity}} \))

3. Optimal Capital Budget is the point where MC of capital = Marginal return from investing

4. After-tax cost of debt = Before-tax Marginal Cost of Debt \times (1 - firm’s marginal tax rate)

5. Preferred Stock Price per Share = \( \frac{\text{Pref Stock Div per Share}}{\text{Cost of Pref Stock}} \)

6. Expected Return on Stock I (under CAPM) = \( E(R) = R_f + \beta_i \times [E(RM) - R_f] \)

7. Expected Return on Stock I = \( E(R) = R_f + \beta_1 \times \text{(Factor risk premium)} + \beta_2 \times \text{(Factor risk premium)} + \ldots \)

8. Cost of Equity = \( r_e = \frac{D_1}{P_0} + g \)

9. Expected Growth Rate of Dividends
\( g = (1 - \frac{D_1}{EPS}) \times ROE \)

10. Company’s stock returns = \( R_{it} = \hat{a} + \hat{\beta}R_{mt} \)

11. Unlevered \( \beta \) of Comparable Company = \( \beta_{U, \text{compa}} = \frac{\beta_{L, \text{comparable}}}{1 + \left(1 - f_{\text{comparable}}\right)\frac{\mu_{\text{comparable}}}{\delta_{\text{comparable}}} \)}

12. Levered \( \beta \) of Project = \( \beta_{L, \text{proj}} = \frac{\beta_{U, \text{compa}}}{1 + \left(1 - t_{\text{proj}}\right)\frac{D_{\text{proj}}}{E_{\text{proj}}} \} \)

13. \( \beta_{\text{asset}} = \frac{\beta_{\text{equity}}}{1 + \left(1 - t_{\text{proj}}\right)\frac{D_{\text{proj}}}{E_{\text{proj}}} \} \)

14. \( \beta_{\text{equity}} = \beta_{\text{asset}} + \left(1 + \left(1 - t_{\text{proj}}\right)\frac{D_{\text{proj}}}{E_{\text{proj}}} \right) \)

15. Sovereign yield spread = Govt bond yield (denominated in developed country’s currency) – T.B yield on a similar maturity bond in developed country

16. Country equity premium = Sovereign yield spread \times \left[ \frac{\text{Ann SD of Equity index}}{\text{Ann SD of sovereign bond Mkt in terms of developed mkt currency}} \right]

17. Cost of equity = \( K_e = R_f + \beta[(E(RM) - R_f) + \text{CRP}] \)

18. Breakpoint = \( \frac{\text{Amount of capital at which source's cost of cap } \Delta}{\text{Prop of new cap raised from the source}} \)

19. Cost of Capital (hen flotation costs are in monetary terms) = \( r_e = \left( \frac{D_1}{P_0 - F} \right) + g \)

20. When FC are not tax deductible: NPV = PV of Cash Inflows – IO – [(FC in % × New Equity Capital) \times (1 – Marginal Tax Rate)]

21. If FC are tax deductible: NPV = PV of Cash Inflows – IO – [(FC in % × New Equity Capital) \times (1 – Marginal Tax Rate)]

22. Asset \( \beta \) = (Debt \( \beta \) \times Proportion of Debt) + (Equity \( \beta \) \times Proportion of Equity)

Reading 34: Measures of Leverage

1. Contribution Margin (CM) = (# of units sold) \times [(price per unit) - (variable cost per unit)]

2. Per unit CM = Price per unit - Variable cost per unit

3. Operating income = CM – Fixed Operating Costs

4. \( \text{DOL} = \frac{\% \Delta \text{ in Operating Income (EBIT)}}{\% \Delta \text{ in Units Sold}} \)
Reading 35: Working Capital Management

1. Operating cycle = No of days of inventory + No of days of receivables

2. Net operating cycle = No of days of inventory + No of days of receivables – No of days of payables

3. Money Market Yield = \[ \frac{\text{Face value} - \text{Purchase price}}{\text{Purchase price}} \times \frac{1}{360} \times \frac{1}{\text{No of days to maturity}} \]

4. Bond Equivalent Yield = \[ \frac{\text{Face value} - \text{Purchase price}}{\text{Purchase price}} \times \frac{1}{365} \times \frac{1}{\text{No of days to maturity}} \]

5. Discount-basis Yield = \[ \frac{\text{Face value} - \text{Purchase price}}{\text{Face Value}} \times \frac{1}{360} \times \frac{1}{\text{No of days to maturity}} \]

6. Wght Avg collection period = Wghts \times Avg no of days to collect accounts within each aging category

7. Float Factor = \[ \frac{\text{Avg Daily Float}}{\text{Avg Daily Deposit}} \]

8. Value of stretching payment = A/c payable \times Co.'s opportunity cost for ST funds

9. Cost of Trade Credit = \( 1 + \frac{\text{Discount}}{1 - \text{Discount}} \) \times n

where n = days beyond discount period

10. Cost of Line of Credit = Interest + Commitment fee

11. Bankers Acceptance Cost = \[ \frac{\text{Interest}}{\text{Net proceeds}} \times \frac{\text{Loan amount}}{\text{Net proceeds}} \times \text{Interest} \]

12. Commercial Paper Cost = \[ \text{Interest} + \text{Dealer's commission} + \text{Backup costs} \times \frac{\text{Loan amount}}{\text{Interest}} \]

13. Annualized cost = Cost \times 12

Reading 36: Market Organization & Structure

1. Total return to a Leveraged Stock Purchase = \[ \frac{\text{Remaining Equity} - \text{IO}}{10} \]

where,

Remaining Equity = IO – Purchase commission + (–) Trading g(l) – Margin i paid + Div received – Sales commission paid

OR

Remaining Equity = Proceeds on sale – Payoff loan – Margin i paid + Div received – Sales commission paid

2. ROE (based on leverage alone) = Leverage (in times) \times stock price return (in %)
3. Price of stock below which a margin call will take place (P):
   Initial margin (%) + (P - Initial Stock Price) = P
   Maintenance Margin Requirement (%)

4. Total cost of placement to the issuing firm in IPO ($) = Gross proceeds received by the issuing firm - Net proceeds received by the issuing firm

5. Total cost of placement to the issuing firm in IPO (%) = Net proceeds received by IF
   Gross proceeds received by IF
   where IF = Issuing firm

6. Max leverage ratio = \( \frac{\text{100\%}}{\% \text{ of Equity}} \)

7. Max leverage ratio for position financed by min margin requirement = \( \frac{1}{\text{Min margin requirement}} \)

Reading 37: Security Market Indices

1. Value of a price return index = \( \sum_{i=1}^{N} n_i P_i \)
   \( V_{PRI} = \frac{\sum_{i=1}^{N} n_i P_i}{D} \)
   For Single Period:

2. % Change in value of Price return of index
   \( \frac{V_{PRI} - V_{PRI0}}{V_{PRI0}} \)
   Portfolio = \( PR_i = \frac{P_{0i} - P_{1i}}{P_{0i}} \)

3. Price Return (Ind constituent security):PR
   \( = \frac{P_{0i} - P_{0i}}{P_{0i}} \)

4. Price return of the index:PR
   \( = \sum_{i=1}^{N} W_i \left( \frac{P_{0i} - P_{0i}}{P_{0i}} \right) \)

5. % Δ in value of Total return of Index
   \( \frac{V_{PRI} - V_{PRI0} + Inc_i}{V_{PRI0}} \)

6. Total return of each security = TR
   \( = \sum_{i=1}^{N} \left( \frac{P_{0i} - P_{1i} + Inc_i}{P_{0i}} \right) \)
   Total Return

7. Value of Price Return index at time t = \( V_{PRI(t)} = V_{PRI0} (1 + PR_{t1}) (1 + PR_{t2}) \ldots (1 + PR_{ti}) \)

8. Value of Total Return index at time t = \( V_{TR(t)} = V_{TR0} (1 + TR_{t1}) (1 + TR_{t2}) \ldots (1 + TR_{ti}) \)

9. Weight of security i under price weighting
   \( = \frac{\text{Price of security i}}{\text{Sum of all prices of constituent securities}} \)

10. Weight of security i under equal weighting
    \( = \frac{1}{\text{No of securities in the index}} \)

11. Weight of security i under market-cap weighting
    \( = \frac{\text{No of shares o/s of Si} \times \text{Share price of Si}}{\sum_{i=1}^{N} \text{(No of shares o/s of Si} \times \text{Share price of Si)}} \)
    \( \text{Where Si = Security i} \)

12. Weight of Si under Mkt Cap weighting
    \( = \frac{\text{Fraction of shares o/s mkt float} \times \text{of shares Si} \times \text{Share price of security i}}{\sum_{i=1}^{N} \text{(Fraction of shares o/s mkt float} \times \text{of shares o/s of Si} \times \text{Share price of security i)}} \)

13. Fundamental weight on security i
    \( = \frac{\text{Fundamental size measure of company i}}{\sum_{i=1}^{N} \text{(Fundamental size measure of company i)}} \)

*Book value, cash flow, revenues, earnings, dividends, & number of employees.

Reading 38: Market Efficiency

Reading 39: Overview of equity Securities

FinQuiz.com
1. **Equity security’s Total Return** = 
   \[ \text{Sale Price of a share – Purchase Price of a share} + \text{cash/stock Div} \]
   \[ \text{Purchase price of a share} \]

2. **ROE in yr t** = 
   \[ \frac{\text{NI (for Ordinary Shareholders) in yr t}}{\text{Avg Total BV of Equity}} \]
   OR
   \[ \text{ROE} = \frac{\text{NI (for Ordinary Shareholders) in yr t}}{\text{Shareholders’ equity at beg of yr t}} \]

3. **MV of equity = Mkt price per share × Shares O/s**

4. **BV of equity per share = \( \frac{\text{Total SH’equity}}{\text{Shares O/s}} \)**

5. **Price-to-book ratio = \( \frac{\text{Market price per share}}{\text{BV of equity per share}} \)**

6. **ROE = Net profit margin × Asset turnover × Financial leverage = \( \frac{\text{(Net earnings)}}{\text{Net sales}} \times \frac{\text{Net sales}}{\text{Avg total assets}} \times \frac{\text{Avg total assets}}{\text{Avg common equity}} \)**

Reading 40: Introduction to Industry & Company Analysis

Reading 41: Equity Valuation: Concepts & Basic Tools

1. **Value of a share of stock today** = 
   \[ \sum_{t=1}^{\infty} \text{Expected dividend in yr t} \times (1 + \text{req ROR on stock})^{-t} \]
   If an investor intends to buy and hold a share for 1 yr:

2. **Value of a share of stock today** = 
   \[ \frac{\text{Expected Div in 1 yr} + \text{Expected selling price in 1 year}}{(1 + \text{req ROR on stock})^1} \]

3. **Value of a share of stock for n holding period or investment horizon** = 
   \[ \sum_{t=1}^{n} \text{Expected Div in yr t} \times (1 + \text{req ROR on stock})^{-t} \]
   Expected price in n periods = \[ \frac{\text{ROE in yr t}}{(1 + \text{req ROR on stock})^{n}} \]

4. **CFO = NI + Non-cash exp – Invst in WC**

5. **FCFE = CFO – FCInv + Net Borrowing**

6. **Value of a share for a non-div-paying stock** = 
   \[ \sum_{t=1}^{\infty} \frac{\text{FCFE in year t}}{(1 + \text{req ROR on stock})^{t}} \]

7. **Req RoR on share = \text{Current expected Rf rate} + \text{Beta} \times [\text{MRP}]**

8. **Value of a pref stock (non-callable, non-convertible)** = 
   \[ V_0 = \frac{D_0(1+g)}{r-g} = \frac{D_0(1+0)}{r-0} = \frac{D_0}{r} \]

9. **Value of a pref stock (non-callable, non-convertible) with maturity at time n** = 
   \[ V_0 = \sum_{t=1}^{n} \frac{D_0}{(1+r)^t} + \frac{F}{(1+r)^n} \]

Gordon Growth Model:

10. **Value of a share of stock** = 

\[ V_0 = \frac{D_0(1+g)}{r-g} = \frac{D_0}{r-g}, \quad g < r \]

11. **Sustainable dividend growth rate = \text{g} = \text{ROE} \times \text{b}**
    where \( b = \text{earnings retention rate} = (1 - \text{Dividend payout ratio}) \)

Two-stage valuation model:

12. **Value of share today** = \( V_0 = \sum_{i=1}^{n} \frac{D_0(1+g)^t}{(1+r)^t} + \frac{V_n}{(1+r)^n} \)
    \[ V_n = \frac{D_{n+1}}{r-g} \]
    \[ D_{n+1} = D_0(1+g)^n(1+g_r) \]

13. **Justified P/E** = \[ \frac{\text{P/E}}{\text{E1}} = \frac{\text{P/E1}}{r-g} = \frac{p}{r-g} \]

14. **EV = MV of stock + MV of debt – Cash and cash Equivalents**

15. **Asset-based value = Value of Equipment and inventory – Value of Liabilities**

Reading 42: Fixed Income Securities: Defining Elements

1. **Inf adj Principal amount of a zero-coupon-indexed bond** = \[ \text{[Par value} \times (1 + \text{CPI})] \]

2. **Inf adj coupon payment for an interest-indexed bond** = \[ \text{[(coupon rate} \times \text{Par value}) \times (1+\text{CPI})] \]
3. Inflation-adjusted principal amount of a capital-indexed bond
   \[ \text{PV} = \text{Par value} \times (1 + \text{CPI}) \]

4. Inflation adjusted coupon payment for a capital-indexed bond
   \[ \text{PV} = \text{Par value} \times (1 + \text{CPI}) \times \text{coupon rate} \]

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**Reading 43: Fixed Income Markets: Issuance, Trading & Funding**

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**Reading 44: Introduction to Fixed Income Valuation**

1. Amount of discount below par value = Present value of deficiency
2. Present value of deficiency = \[ \sum_{t=1}^{n} \frac{\text{Coupon rate} - \text{Market discount rate} \times \text{Par value}}{(1 + \text{Market discount rate})^t} \]
3. Bond price =
   \[ \text{PV} = \frac{\text{PMT}}{(1 + r)^1} + \frac{\text{PMT}}{(1 + r)^2} + \ldots + \frac{\text{PMT} + \text{FV}}{(1 + r)^N} \]
4. % Price change = \[ \frac{\text{New price} - \text{Old price}}{\text{Old price}} \]
5. Bond price (given sequence of spot rates)
   \[ \text{PV} = \frac{\text{PMT}}{(1 + Z_1)} + \frac{\text{PMT}}{(1 + Z_2)} + \ldots + \frac{\text{PMT} + \text{FV}}{(1 + Z_N)} \]
6. Full price of bond = Flat price of bond + Accrued interest
7. Accrued interest = \[ \text{AI} = \frac{r}{T} \times \text{PMT} \]
8. Full price of a fixed-rate bond between coupon payments = \[ \text{PV} = \text{Full price of bond} + \frac{\text{Accrued interest}}{\text{Flat price}} \]
9. Full price of a fixed-rate bond between coupon payments
   \[ \text{PV} \times (1 + r)^{1/T} \]
10. Interpolated yield (say for 3-year, given market discount rates for 2 and 5 yrs) = \[ \text{PV} = \text{Full price of 2 year bond} + \left( \frac{3 - \frac{2}{5}}{2} \right) \times \text{Full price of 5 year bond} - \text{Average yield for 2 year bonds} \]
11. \[ \left( 1 + \frac{\text{APR}_m}{m} \right)^m \times \left( 1 + \frac{\text{APR}_n}{n} \right)^n \]
12. Current yield = \[ \text{Current yield} = \frac{\text{Sum of coupon payments received over the year}}{\text{Flat price}} \]
13. Price of Floating-rate note = \[ \text{PV} = \frac{\text{PMT}}{(1 + Z_1)} + \frac{\text{PMT}}{(1 + Z_2)} + \ldots + \frac{\text{PMT} + \text{FV}}{(1 + Z_N)} \]
14. Price of Money Market Instrument =
   \[ \text{PV} = \text{FV} \times \left( 1 - \frac{\text{Days}}{\text{Year}} \times \text{DR} \right) \]
15. Market Discount Rate =
   \[ \text{DR} = \left( \frac{\text{Year}}{\text{Days}} \right) \times \left( \frac{\text{FV} - \text{PV}}{\text{FV}} \right) \]
16. Price of Money Market Instrument =
   \[ \text{PV} = \frac{\text{FV}}{\left( 1 + \frac{\text{Days}}{\text{Yr}} \times \text{AOR} \right)} \]
17. Add-on rate =
   \[ \text{AOR} = \left( \frac{\text{Yr}}{\text{Days}} \right) \times \left( \frac{\text{FV} - \text{PV}}{\text{PV}} \right) \]

---

Relation b/w two spot rates and Implied Forward Rate:

18. \[ (1 + z_A)^{\frac{1}{A}} \times (1 + \text{IFR}_{A,B,A})^{\frac{1}{B-A}} = (1 + z_B)^{\frac{1}{B}} \]

Z-spread over the benchmark spot curve:

Price of a bond =
\[ \text{PV} = \frac{\text{PMT}}{(1 + z_1 + Z)} + \frac{\text{PMT}}{(1 + z_2 + Z)} + \ldots + \frac{\text{PMT} + \text{FV}}{(1 + z_N + Z)} \]

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FinQuiz.com
19. OAS = Z-spread – Option value (bps per year)


21. Interpolated Spread = I-spread = YTM of the bond - Linearly interpolated yield to the same maturity on an appropriate reference curve

Reading 45: Introduction to Asset Backed Securities

1. Loan-to-value ratio (LTV) = \( \frac{\text{Amount of Mortgage}}{\text{Property Value}} \)

2. Monthly CF for a MPS = Monthly CF of underlying pool of mortgages - Servicing fee - Other fees

3. Pass-through rate = Mortgage rate on the underlying pool of mortgages – Servicing Fee - Other fees

4. SMM = Pre-pmt for month ÷ (Beg mortgage balance for month – Scheduled principal re-pmt for month)

5. CPR = 1 – (1 – SMM)^12

6. CF Construction (Monthly CF for MPS):

7. DSC ratio = \( \frac{\text{Property's annual NOI}}{\text{Debt service}} \)

Reading 46: Understanding Fixed Income Risk & Return

1. Interest-on-interest gain from compounding = Future value of reinvested coupons - Total amount of coupon payments

Where,

FV of Reinvested Coupons = \[ CR \times (1 + RR)^{n-1} + CR \times (1 + RR)^{n-2} + \ldots + CR \times (1 + RR)^{0} \]

Net interest = (Beg mortgage balance × Pass-through rate) / 12

Scheduled principal re-pmt = Mortgage pmt – Gross i-pmt

Gross i-pmt = (Beg mortgage balance × WAC) / 12

Pre-pmt for month = SMM × (Beg mortgage balance for month – Scheduled principal re-pmt for month)

Total principal re-pmt = Scheduled principal re-pmt + Prepayment

Beg mortgage balance for the following month = Beg mortgage balance for the month – Total Principal Pmt

Projected CF for MPS = Net i-pmt + Total principal re-pmt

7. Macaulay Duration =

\[
\text{MacDur} = \frac{\text{PMT} \times \left[ \frac{1}{1+r} \right] + \ldots + \left( \frac{1}{1+r} \right)^{N-1} \times \text{PMT} + \text{FV}}{\left( \frac{1}{1+r} \right) + \ldots + \left( \frac{1}{1+r} \right)^{N} \times \text{PV}}
\]

OR

\[
\text{MacDur} = \frac{\text{PMT} \times \left[ \frac{1}{1+r} \right] + \ldots + \left( \frac{1}{1+r} \right)^{N-1} \times \text{PMT} + \text{FV}}{\left( \frac{1}{1+r} \right) + \ldots + \left( \frac{1}{1+r} \right)^{N} \times \text{PV}}
\]

FinQuiz.com
Money Duration Adjusted

8. Modified D = \frac{MacDur}{1+r}

9. Annualized Modified D = \frac{\text{Modified Duration}}{\text{Periodicity of payment in a year}}

10. \% \Delta PV_{Full} = - \text{AnnModDur} \times (\Delta Yield)

11. Approx Modified D = \frac{(PV_{-}) - (PV_{0})}{2 \times (\Delta Yield) \times (PV_{0})}

12. Approx Mac Dur = \text{Approx Mod Dur} \times (1 + r)

13. Effective D = \frac{(PV_{-}) - (PV_{0})}{2 \times (\Delta Curve) \times (PV_{0})}

14. Macaulay D for a Zero-coupon bond = \frac{N - r}{T}

15. Macaulay D for a Perpetual bond = (1 + r) / r

16. Avg Mod D for the Portf = \left( \text{Mod D of Bond 1} \times \frac{MV_{of Bond 1}}{Total MV_{of Portf}} \right) + \left( \text{Mod D of Bond 2} \times \frac{MV_{of Bond 2}}{Total MV_{of Portf}} \right) + ... + \left( \text{Mod D of Bond N} \times \frac{MV_{of Bond N}}{Total MV_{of Portf}} \right)

17. Money D = Annualized Mod D \times Full Bond Price

18. \Delta Full price of Bond (in currency units) \approx - Money D \times \Delta in annual YTM

19. PVBP = \frac{(PV_{-}) - (PV_{0})}{2}

20. Basis Point Value (BPV) = Money duration \times 0.0001 (1 bp)

21. Bloomberg’s Risk Statistic = PVBP \times 100

22. \%\Delta PV_{Full} = (-\text{AnnModDur} \times \Delta Yield) + \left[ \frac{1}{2} \times \text{AnnConvexity} \times (\Delta Yield)^{2} \right]

23. Approx. Convexity Adjustment = \frac{(PV_{-}) + (PV_{0}) - [2 \times (PV_{0})]}{(\Delta Yield)^{2} \times (PV_{0})}

24. Convexity of a zero coupon bond = \frac{N - (t/T)}{[N + 1 - (t/T)]} \times \frac{1}{(1 + r)^{2}}

25. Money Convexity vs Money Duration = \Delta PV_{Full} \approx - (\text{MoneyDur} \times \Delta Yield) + \left[ \frac{1}{2} \times \text{MoneyCon} \times (\Delta Yield)^{2} \right]

26. Money Convexity of bond = Annual Convexity \times Full Price

27. Effective Convexity = \left[ (PV_{-}) + (PV_{0}) - [2 \times (PV_{0})] \right] \div \left( (\Delta Curve)^{2} \times (PV_{0}) \right)

28. Duration Gap = Bond’s Macaulay Duration – Investment Horizon

**Reading 47: Fundamentals of Credit Analysis**

1. Expected Loss = Default Probability \times Loss Severity given Default

2. Operating Profit Margin = \frac{Operating Income}{Revenue}

3. EBITDA = Operating Income + Dep + Amort

4. FCF = CFO – Cap exp – Div

5. Capital expenditures = Additions to P&E + Additions to product rights & intangibles – Proceeds of sale of P&E

6. Total debt = ST debt + Current portion of LT debt + LT debt

7. Capital = Debt + Equity
8. Yield on Corp Bond = Rf rate + Expected Inf rate + Maturity P + Liquidity P+ Credit spread

9. Yield spread = Liquidity P + Credit spread

10. Return impact for smaller spread $\Delta \% \Delta$ in price $\approx$ -Modified Duration $\times$ $\Delta$Spread

11. Return impact for larger spread $\Delta \% \Delta$ in price $\approx$ - ($\text{Modified } D \times \Delta$Spread) + $\frac{1}{2}\text{Convexity} \times (\Delta$Spread)$^2$

12. Secured debt leverage = Total secured debt / EBITDA

13. Senior unsecured leverage = Secured debt + Senior unsecured debt / EBITDA

14. Total Leverage = Total debt / EBITDA

15. Net Leverage = Total debt – Cash / EBITDA

Reading 48: Derivatives Markets and Instruments

1. Value of the contract to the ‘Long’ at expiration = $S_T - F_0(T)$

2. Value of the contract to the ‘Short’ at expiration = $F_0(T) - S_T$

3. Margin % in stock market = $\frac{\text{MV of Stock} - \text{MV of Debt}}{\text{MV of Stock}}$

4. Margin Call:
   - Long position: Price ↓ that would trigger a margin call = IM req – MM req
   - Short position: Price↑ that would trigger a margin call = IM req – MM req

5. TED spread = LIBOR – T-Bill rate

6. At expiration (for option Buyer):
   - Value of Call option = $C_T = \text{Max}(0, S_T - X)$
   - Profit from Call option = $\text{Max}(0, S_T - X) - C_0$
   - Value of Put option = $P_0 = \text{Max}(0, X - S_T)$
   - Profit from Put option = $\text{Max}(0, X - S_T) - P_0$

7. At expiration (for option Seller):
   - Profit from Call option = $-\text{Max}(0, S_T - X) + C_0$
   - Profit from Put option = $-\text{Max}(0, X - S_T) + P_0$

8. To eliminate arbitrage opportunity:
   Forward Price should be = Spot Price $\times (1 + i \text{ rate } \%)^t$

Reading 49: Basics of Derivative Pricing & Valuation

1. Pricing of risky assets = $S_0 = \frac{E(ST)}{(1+r))^T}$

2. Commodity = $F_{0,T} = S_0 e^{(r-\delta)T}$
   where, $\delta$ = Convenience yield – Cost of carry

3. $S_0 = \frac{E(ST)}{(1+r))^T} - \theta + y$
   where, $\theta$ (theta) = PV of the costs and $y$ (gamma) = PV of benefits

4. Arbitrage and Derivatives = Underlying asset + Opposite position in derivative = Underlying payoff – Derivative payoff = Rf return

5. Pricing and Valuation of Forward Contracts:
   - At Expiration $F(0, T) = S_0 (1 + r)^T$ or $S_0 = F(0, T) / (1+r)^T$
   - Value of forward (long) during contract life (where $t < T$) = $V_t(0, T) = S_t - F(0, T) / (1+r)^{T-t}$
   - Value of forward (short) during contract life (where $t < T$) = $V_t(0, T) = F(0, T) / (1+r)^{T-t} - S_t$
   - Value of forward (long) at expiration (where $t = T$) = $V_T(0, T) = S_T - F(0, T)$
   - Value of forward (long) at initiation (where $t = 0$) = $V_t(0, T) = S_0 - F(0, T) / (1+r)^T - 0$
   - Forward price of an asset with benefits and/or costs = $(S_0 - y + \theta) (1 + r)^T = S_0 (1 + r)^T - (\gamma - \theta) (1+ r)^T$

FinQuiz.com
6. FRAs: An example of 3 x 9 FRA (read as three by nine):
- Contract expires in 90 days
- Underlying loan settled in 270 days
- Underlying rate is 180-day LIBOR
- For Synthetic FRA (take long position in a 300-day Euro$ T.D and short position in a 30-day Euro$ T.D
- For synthetic forward position in a 90-day zero-coupon that begins in 30 day (buy 120 day & sell 30 day (zero coupon bonds)

7. Pricing and Valuation of Swap Contract (a fixed for floating swap contract):
- Fixed Periodic rate = \[ R_N = \frac{1 - Z_N}{Z_1 + Z_2 + \ldots + Z_N} \]
- Where \( Z_n \) are n period zero coupon bonds (i.e. $1 discount factors)
  \[ Z_n = \frac{1}{1 + (L_n \times days / 360)} \]
- Value of a fixed rate side (per $1 NP) = \( V_{fixed \ rate} = [Fixed \ payment \times (Z_1 + Z_2 + \ldots + Z_N)] + (1) \times Z_1 \)
- Value of a floating rate side (per $1 NP) = \( V_{floating \ rate} = (1 + 1^{st} \ floating \ payment) \times Z_1 \)

Pricing and valuation of Options:

8. Payoff of Call options:
- At expiration call option = \( C_T = \text{Max} (0, S_T - X) \)
- Profit (call buyer) = \( \text{Max} (0, S_T - X) - c_0 \)
- Profit (call seller) = \( -\text{Max} (0, S_T - X) + c_0 \)

9. Payoff of Put options:
- \( p_T = \text{Max} (0, X - S_T) \)
- Profit (put buyer) = \( \text{Max} (0, X - S_T) - p_0 \)
- Profit (put seller) = \( -\text{Max} (0, X - S_T) + p_0 \)

10. Max Profit/Loss for Option writer/holder:
- \( \text{Max profit of option seller/writer} \rightarrow \text{Option premium} \)
- \( \text{Max loss of option seller/writer} \rightarrow \text{Option premium} \)
- \( \text{Max loss of option holder} \rightarrow \text{Option premium} \)

Put-Call Parity

11. Protective Put
- \( \text{Value PP} = p_0 + S_0 \)
- Payoff at expiration (put out-of-the-money) = \( S_T \)

12. Fiduciary Call
- \( \text{Value FC} = c_0 + \frac{X}{(1 + r)^T} \)
- Payoff at expiration (when call out-of-the-money) = \( X \)
- Payoff at expiration (call in-the-money) = \( X + (S_T - X) = S_r \)

13. Put-Call Parity (to avoid arbitrage) = \( c_0 + \frac{X}{(1 + r)^T} = p_0 + S_0 \)
- \( \text{Synthetic long position in a call} = C = p_0 + S_0 - \frac{X}{(1 + r)^T} \)
- \( \text{Synthetic long position in a put} = p_0 = c_0 - S_0 + \frac{X}{(1 + r)^T} - p_0 \)
- \( \text{Synthetic long position in an underlying} = S_0 = c_0 + \frac{X}{(1 + r)^T} - p_0 \)
- \( \text{Synthetic long position in a riskless bond} = \frac{X}{(1 + r)^T} = p_0 + S_0 - c_0 \)

14. Put-Call-Forward Parity = \( F_0(T) / (1 + r)^T \)
- \( p_0 = c_0 + \frac{X(1 + r)^T}{(1 + r)^T} \)

15. Valuing a callable bond using Binomial Model:
• \( R_u = R_d \times e^{2\sigma \sqrt{t}} \)
• Value at time 0 = \( V_u = hS_0 - c_0 \)
• Value at time 1 will either \( V_1^+ = hS_1^+ - c_1^+ \) or \( V_1^- = hS_1^- - c_1^- \)
• If the portfolio was hedged, then \( V^+ \) would equal \( V^- \).

\[
V_1^+ = V_1^- \\
\Rightarrow hS_1^+ - c_1^+ = hS_1^- - c_1^- \\
\Rightarrow h = \frac{c_1^+ - c_1^-}{S_1^+ - S_1^-}
\]

• Value of the call = \( c_0 = \frac{\pi c_1^+ + (1 - \pi)c_1^-}{1 + r} \)
where \( \pi = \frac{1 + r - d}{u - d} \)
• Value of the put = \( p_0 = \frac{\pi p_1^+ + (1 - \pi)p_1^-}{1 + r} \)

Reading 50: Introduction to Alternative Investments
1. Total Return = Alpha R + Beta R
2. Asset Based Valuation = Co value = Co’s assets value – Co’s liabilities value

Real Estate Valuation
3. Direct Cap Approach → Valuation of a property = \( \frac{NOI}{Capitalization\ Rate} \) where
4. Income Based Approach → FFO = NI + Dep exp on R.E + Def Tax charges – Gains from sales of R.E + losses from sale of R.E
5. AFFO = FFO – Recurring Cap exp
6. Asset based Approach → REIT’s NAV = Estimated MV of REIT’s total assets – Value of REIT’s total liabilities.
7. Pricing of Commodity Futures Contracts:
   Futures price ≈ Spot price \( (1 + r) + \) Storage costs – Convenience yield
8. Roll yield = Spot price of a commodity – Futures contract price
   or
   Roll yield = Futures contract price with expiration date ‘X’ – Futures contract price with expiration date ‘Y’.
9. Returns on a passive investment in commodity futures = Return on the collateral + RP or convenience yield net of storage costs.
10. Sharpe ratio = \((\text{Investment return} - \text{Rf return}) / \text{S.D. of return}\)
11. Sortino Ratio = \((\text{Annualized RoR} - \text{Annualized Rfe rate}) / \text{Downside Deviation}\)

Reading 51: Portfolio Management: An Overview
1. NAV of bond mutual fund = \( \sum \text{(value of each bond in the portfolio)} / \text{No of shares} \)
2. New Shares that need to be created = \( \frac{\text{Amount to be Invested in the Fund}}{\text{NAV or Total value of a Mutual Fund}} \)
3. New NAV of the Fund = NAV or Total value of a Mutual Fund + Amount to be invested in the Fund
4. No of shares need to be retired = \( \frac{\text{Amount to be withdrawn from the Fund}}{\text{NAV or Total value of a Mutual Fund}} \)

Reading 52: Portfolio Risk & Return: Part I
1. Total Return = Capital Gain (or Loss) + Dividend Yield
2. Capital Gain = \( \frac{P_t - P_{t-1}}{P_{t-1}} \)
3. Dividend Yield = \( \frac{D_t}{P_0} - 1 \)
4. 3-Yr HPR = \[(1 + R_1) \times (1 + R_2) \times (1 + R_3)]^{1/3} - 1 \]
5. Arithmetic mean (AM) \( R = \bar{R}_t = \frac{\sum_{i=1}^{R_i + R_{i+1} + \ldots + R_{i+n}}}{n} = \frac{1}{t} \sum_{t=1}^{T} R_{it} \)

6. Geometric R for n periods = \( \bar{R}_{rit} = [(1 + R_1)(1 + R_2) \ldots (1 + R_n)]^{1/n} - 1 \)

7. IRR = \( \sum_{t=0}^{T} \frac{CF \text{ at Time } t}{(1 + IRR)^t} = 0 \)

8. Annual Return (Ann R):
   - Ann R = (1 + Quarterly R) \(^4 - 1\)
   - Ann R = (1 + Monthly R) \(^12 - 1\)
   - Ann R = (1 + Weekly R) \(^52 - 1\)
   - Ann R = (1 + Daily R) \(^365 - 1\)
   - Weekly R = (1 + Daily R) \(^5 - 1\)
   - Weekly R = (1 + Annual R) \(^152 - 1\)

9. Portf R (for Two Assets) = (Wght of Asset 1 \( \times \) R of Asset 1) + (Wght of Asset 2 \( \times \) R of Asset 2)

10. Gross R = R - Trading exp - other exp directly related to the generation of returns.
11. Net R = Gross R - All managerial and administrative exp
12. After-tax nominal R = Total R - Any allowance for taxes on realized gains
13. (1 + Nominal R) = (1 + Real RF R) \( \times \) (1 + Inf) \( \times \) (1 + RP)
14. (1 + Real R) = (1 + Real RF R) \( \times \) (1 + RP)

15. (1 + Real R) = \( \frac{(1 + \text{Nominal R})}{(1 + \text{Inf})} \)
16. Var of a Single Asset = \( \sigma^2 = \frac{\sum_{t=1}^{T} (R_t - \mu)^2}{T} \)
17. Sample Variance = \( s^2 = \frac{\sum_{t=1}^{T} (R_t - \bar{R})^2}{T-1} \)
18. Cov of R b/w two assets = \( \text{Cov} (R_i, R_j) = \rho_{ij} \sigma_i \sigma_j \)
19. Portfolio Var = \( \sigma_p^2 = \omega_1^2 \sigma_1^2 + \omega_2^2 \sigma_2^2 + 2 \omega_1 \omega_2 \rho_{12} \sigma_1 \sigma_2 \)
20. Portfolio S.D. = \( \sqrt{\text{Portfolio Variance}} \)
21. Cov b/w asset 1 & asset 2 = Correlation of Return b/w two assets \( \times \) S.D. of asset 1 \( \times \) S.D. of asset 2
22. Correlation of Return b/w two assets = \( \text{Covariance of Return b/w two assets} \)
23. 1 + Expected Return = \( 1 + E(R) = (1 + r_c) \times (1 + E(\pi)) \times (1 + E(RP)) \)
24. Utility of an Invest = Expected Return - \( \left( \frac{1}{2} \times \text{Risk Aversion Coefficient} \times \text{Var of Invest} \right) \)
25. Expected R of Portfolio = \( E(R_P) = \omega_1 R_1 + (1 - \omega_1) E(R_i) \)

26. Risk of Portfolio = \( \sigma_p^2 = \sigma_1^2 + \sigma_2^2 + (1 - w_2^2) \sigma_2^2 + 2 \omega_1 (1 - \omega_1) \rho_{12} \sigma_1 \sigma_2 = (1 - \omega_2^2) \sigma_1^2 + \sigma_p = (1 - w_1) \sigma_1 \)
27. Capital Allocation Line (CAL) = \( E(R_P) = R_f + \frac{(E(R_i) - R_f)}{\sigma_i} \)
28. Portfolio Risk = \( \omega_1^2 \sigma_1^2 + \omega_2^2 \sigma_2^2 + 2 \omega_1 \omega_2 \rho_{12} \sigma_1 \sigma_2 \)
29. In portfolio of many asset =
   - \( E(R_P) = \sum_{i=1}^{N} \omega_i E(R_i) \)
   - \( \sigma_P = \frac{\sigma^2}{N} + \frac{(N-1)}{N} \text{Cov} \)
   - \( \sigma_p = \sqrt{\sigma_p^2} \)
30. New Asset should be included in the Portf only if \( \frac{E(R_{new}) - E(R)}{\sigma_{new}} > \frac{E(R_{new}) - R_f}{\sigma_p} \times \rho_{new, p} \)

Reading 53: Portfolio Risk & Return: Part II

1. Total Risk = Systematic risk + Nonsystematic risk = \( \beta^2 \sigma^2 + \sigma^2 \epsilon \)
2. Total risk of for a well-diversified portfolio = Systematic risk = \( \beta \times \sigma_m \)
3. Multi-Factor Model: \( E(R_i) - R_f = \sum_{j=1}^{N} \beta_{ij} E(F_j) + \beta_{i0} [E(R_m) - R_f] + \sum_{j=2}^{N} \beta_{ij} E(F_j) \)
4. Single-Index Model: \( R_i - R_f = \beta_i (R_m - R_f) + \epsilon_i \)
5. Factor weight associated with each factor =
   Total Security Risk
   Total Market Risk

6. \[ E(R_p) = R_f + \beta_p[R_m - R_f] = R_t + (w_1\beta_1 + w_2\beta_2)[E(R_m) - R_f] \]

7. Asset’s Beta =
   \[ \frac{\text{Correlation between asset and market} \times \text{S.D of Asset}}{\text{S.D of Market}} \]

8. Portfolio Beta = \( \sum_{i=1}^{n} w_i\beta_i; \sum_{i=1}^{n} w_i = 1 \)

9. Sharpe Ratio = \( \frac{R_p - R_f}{\sigma_p} \)

10. Treynor Ratio = \( \frac{R_p - R_f}{\beta_p} \)

11. \( M^2 = (R_p - R_f)^2_{\text{market}} - (R_m - R_f)^2 \)

12. Jansen’s Alpha = \( \alpha_p = R_p - \left[ R_f + \beta_p(R_m - R_f) \right] \)

13. Security Characteristic Line (SCL) = \( R_t = R_f + \alpha_t(L_m - R_f) \)

14. Weight of Non-market security should be proportional to

\[ \frac{\alpha_i}{\sigma_i^2} \]

15. Total Weight of Non-market security should be proportional to

\[ \frac{\sum_{i=1}^{n} w_i \alpha_i}{\sum_{i=1}^{n} w_i \sigma_i^2} \]

16. Information Ratio = \( \frac{\text{Alpha of Security } i}{\text{Nonsystematic Risk of Security } i} \)

17. Expected Return of Portfolio (under Arbitrage Pricing Model) = \( E(R_p) = R_F + \lambda_1\beta_{p,1} + \cdots + \lambda_k\beta_{p,k} \)

18. Return on an Asset in excess of 1-Month T-Bill Return (under four factor model) =

\[ E(R_{it}) = \alpha_i + \beta_{it}LKT + \beta_{i,SMB}SMB_t + \beta_{i,HML}HML_t + \beta_{i,UMD}UMD_t \]

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Reading 54: Basics of Portfolio Planning & Construction

1. Investor’s Expected Utility from Portfolio
   \( U_p = E(R_p) - \lambda\sigma^2_p \)

2. Tactical Asset Allocation (TAA) Return contribution = Actual return of the portfolio – Return that would have been earned if the asset class weights were equal to the policy weights

Reading 55: Introduction to Risk Management

3. Simple Moving Average = \( \frac{P_1 + P_2 + P_3 + \cdots + P_n}{N} \)

4. Momentum Oscillator (or Rate of Change Oscillator ROC):

   - Momentum Oscillator Value \( M = (V - V_x) \times 100 \) (where \( V \) = most recent closing price and \( V_x \) = closing price \( x \) days ago)
   - Alternate Method to calculate \( M = \frac{V}{V_x} \times 100 \)

5. Relative Strength Index = \( RSI = 100 - \frac{100}{1 + RS} \) where

\[ RS = \frac{\sum \text{(up changes)}}{\sum \text{(down changes)}} \]

6. Stochastic Oscillator (composed of two lines %K and %D):

   - \( %K = 100 \left( \frac{C - L_{14}}{H_{14} - L_{14}} \right) \) where:
     \( C \) = latest closing price, \( L_{14} \) = lowest price in last 14 days, \( H_{14} \) = highest price in last 14 days

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FinQuiz.com
- $\%D = \text{Average of the last three } \%K \text{ values calculated daily.}$

7. Put/Call Ratio (Type of Sentiment Indicators) = $\frac{\text{Volume of Put Options Traded}}{\text{Volume of Call Options Traded}}$

8. Short Interest Ratio (Type of Sentiment Indicators) = $\frac{\text{Short Interest}}{\text{Average Daily Trading Volume}}$

9. Arms Index TRIN i.e. Trading Index (Type of Flow of funds Indicator) = $\frac{\text{No. of Advan issues} \div \text{No. of Declin issues}}{\text{Volume of Advan issues} \div \text{Volume of Declin issues}}$

Reading 57: Fintech in Investment Management