1. **Net Present Value**
   \[ NPV = CF_0 + \sum_{t=1}^{n} \frac{CF_t}{(1 + r)^t} \]
   Invest if: \( NPV > 0 \)
   Do not invest if: \( NPV < 0 \)

2. **Internal Rate of Return**
   \[ \sum_{t=0}^{n} \frac{CF_t}{(1 + IRR)^t} = 0 \]
   Invest if: \( IRR > r \)
   Do not invest if: \( IRR < r \)

3. **Average Accounting Rate of Return (AAR)**
   \[ \text{AAR} = \frac{\text{Average net income}}{\text{Average book value}} \]

4. **Profitability Index**
   \[ PI = \frac{\text{PV of future cash flows}}{\text{Initial Investments}} = 1 + \frac{NPV}{\text{Initial Investments}} \]
   Invest if: \( PI > 1.0 \)
   Do not invest if: \( PI < 1.0 \)

5. **Cost of Capital (WACC)**
   \[ \text{WACC} = w_d r_d (1 - t) + w_p r_p + w_e r_e \]
   where:
   - \( w_d = \) target debt proportion in total capital
   - \( r_d = \) the before-tax marginal tax rate
   - \( t = \) the company’s marginal tax rate
   - \( w_p = \) target preferred stock proportion in total capital
   - \( r_p = \) the marginal cost of preferred stock
   - \( r_e = \) the marginal cost of equity
   - \( w_e = \) target common stock proportion in total capital

6. **Capital Asses Pricing Model Approach**
   \[ E(R_i) = R_f + \beta_i [E(R_M) - R_f] \]
   where:
   - \( \beta_i = \) the return correlation of stock \( i \) to changes in the market return
   - \( E(R_M) = \) the expected return on the market
   - \( E(R_f) = \) the expected market risk premium

7. **Dividend Discount Model Approach**
   \[ V_0 = \frac{D_1}{(1 + r_e)} + \frac{D_2}{(1 + r_e)^2} + \ldots \]
   where:
   - \( V_0 = \) the intrinsic value of a share
   - \( D_t = \) the share's dividend at the end of period \( t \)
   - \( r_e = \) the cost of equity

8. \[ P_0 = \frac{D_1}{r_e - g} \]

9. \[ r_e = \frac{D_1}{P_0} + g \]
10. \[ \beta_{asset} = \beta_{equity} \left( \frac{1}{1 + \left(1 - t \right) \frac{D}{E}} \right) \]

11. **Country equity premium** = Sovereign yield spread

   \[
   \text{Annualized standard deviation of equity index}
   \]

   \[
   \text{Annualized standard deviation of the sovereign bond market in terms of the development market currency}
   \]

12. The cost of preferred stock is the preferred stock dividend divided by the current preferred stock price:

   \[ r = \frac{D_p}{P_p} \]

13. We can estimate the growth rate in the dividend discount model by using published forecasts of analysts or by the sustainable growth rate:

   \[ g = \left(1 - \frac{D}{EPS}\right) \text{ROE} \]

14. **Current Ratio** = \[ \frac{\text{Current assets}}{\text{Current liabilities}} \]

15. **Quick Ratio** = \[ \frac{\text{Cash} + \text{Short-term marketable investments} + \text{Receivables}}{\text{Current liabilities}} \]

16. **Accounts receivable turnover** = \[ \frac{\text{Credit Sales}}{\text{Average receivables}} \]

17. **Inventory turnover** = \[ \frac{\text{Cost of goods sold}}{\text{Average inventory}} \]

18. **Number of days of receivables** = \[ \frac{\text{Accounts receivable}}{\text{Average day's sales on credit}} = \frac{\text{Accounts receivable}}{\text{Sales on credit} / 365} \]

19. **No. of days of inventory** = \[ \frac{\text{Inventory}}{\text{Average day's cost of goods sold}} = \frac{\text{Inventory}}{\text{Cost of goods sold} / 365} \]

20. **Operating cycle** = Number of days of inventory + Number of days of receivables

21. **Net operating cycle** = Number of days of inventory + Number of days of receivables - Number of days of payables
22. Money Market yield = \( \frac{\text{Face value} - \text{Purchase price}}{\text{Purchase price}} \times \frac{360}{\text{Number of days to maturity}} \)

23. Bond Market yield = \( \frac{\text{Face value} - \text{Purchase price}}{\text{Purchase price}} \times \frac{365}{\text{Number of days to maturity}} \)

24. Discount- basis yield = \( \frac{\text{Face value} - \text{Purchase price}}{\text{Face value}} \times \frac{360}{\text{Number of days to maturity}} \)

25. Cost of trade credit = \( 1 + \left( \frac{\text{Discount}}{1 - \text{Discount}} \right)^{\frac{365}{\text{Number of days beyond discount period}}} - 1 \)

26. Return on equity = \( \frac{\text{Net income}}{\text{Average shareholders' equity}} = \frac{\text{Net income}}{\text{Revenues}} \times \frac{\text{Average shareholders' equity}}{\text{Average total assets}} \)

27. Standard Deviation = \( \sigma^2 = \sum_{i=1}^{n} (R_i - E(R))^2 \times P_i \)

28. \( r_{ij} = \frac{\text{Cov}_{ij}}{\sigma_i \sigma_j} \)

where \( r_{ij} \) is the correlation coefficient of returns
\( \sigma_i \) is the standard deviation of \( R_{it} \)
\( \sigma_j \) is the standard deviation of \( R_{jt} \)

29. \( \sigma_{port} = \sqrt{w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2w_1 w_2 r_{12} \sigma_1 \sigma_2} \)

Derivatives and Alternative Investments

1. FRA payoff formula (from the perspective of the party going)

\[
\text{Notional Principal} = \left( \text{Underlying rate at expiration} - \text{Forward contract rate} \right) \left( \frac{\text{Days in underlying rate}}{360} \right) \times 1 + \frac{\text{Underlying rate at expiration}}{360} \left( \frac{\text{Days in underlying rate}}{360} \right)
\]

2. Minimum and Maximum Values of Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Minimum value</th>
<th>Maximum Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>European call</td>
<td>( c_0 \geq 0 )</td>
<td>( c_0 \leq S_0 )</td>
</tr>
<tr>
<td>American call</td>
<td>( C_0 \geq 0 )</td>
<td>( C_0 \leq S_0 )</td>
</tr>
<tr>
<td>European put</td>
<td>( p_0 \geq 0 )</td>
<td>( p_0 \leq X / (1 + r)^T )</td>
</tr>
<tr>
<td>American put</td>
<td>( P_0 \geq 0 )</td>
<td>( P_0 \leq X )</td>
</tr>
</tbody>
</table>
3. Put-call parity = \( c_0 + X / (1+r)^T = p_0 + s_0 \)

4. Appraisal price = \( \frac{\text{NOI}}{\text{Market cap rate}} \)

**Equity and Fixed income**

1. Dividend Discount Model (DDM)
   \[ V_j = \frac{D_1}{(1+k)} + \frac{D_2}{(1+k)^2} + \frac{D_3}{(1+k)^3} + \cdots + \frac{D_n}{(1+k)^n} = \sum_{t=1}^{n} \frac{D_t}{(1+k)^t} \]

2. Present value of Free Cash Flows to Equity
   \[ V_j = \sum_{t=1}^{n} \frac{\text{FCFE}_j}{(1+k)^t} \]

2. Justified/ Fundamental (P/E)
   \[ \frac{P_j}{E_{1}} = \frac{D_{1}}{E_{1}} (k - g) \]

4. (Shareholders’ equity)- (Total value of equity claims that are senior to common stock) = **Common shareholders’ equity**

5. (Common shareholders’ equity)/ (Number of common stock shares outstanding) = **Book value per share**

6. **Coupon rate** = Yield required by market \( \Rightarrow \) Price = Par value
   - Coupon rate < Yield required by market \( \Rightarrow \) Price < Par value (discount)
   - Coupon rate > Yield required by market \( \Rightarrow \) Price > Par value (premium)

7. **Price of callable bond** = Price of option-free bond – Price of embedded call option

8. **Price of putable bond** = Price of option-free bond + Price of embedded put option

9. **Taxable-equivalent yield** = \( \frac{\text{Tax - exempt yield}}{1 - \text{Marginal tax rate}} \)

10. Present value of an annuity = \( \text{Annuity payment} \times \left[ \frac{1}{1+i} + \frac{1}{(1+i)^2} + \cdots + \frac{1}{(1+i)^{\text{no. of periods}}} \right] \)

11. Valuing a Zero-Coupon Bond
    \[ \frac{\text{Maturity value}}{1 + i^{\text{no. of years} \times 2}} \]
    Where \( i \) is the semiannual discount rate

12. **Current yield** = \( \frac{\text{Annual dollar coupon interest}}{\text{Price}} \)
13. Yield on an annual-pay basis
   \[ \left( 1 + \frac{\text{Yield on a bond - equivalent basis}}{2} \right)^2 - 1 \]

14. Spread for life
   \[ \left( \frac{100(100 - \text{Price})}{\text{Maturity}} + \text{Quoted margin} \right) \times \left( \frac{100}{\text{Price}} \right) \]

15. Z-spread = OAS + Option cost

16. \[ f_m = \left[ \frac{(1 + z_{m+1})^{m+t}}{(1 + z_m)^m} \right]^\frac{1}{t} - 1 \]

17. Effective duration = \( \frac{\text{Price if yields decline} - \text{Price if yields rise}}{2(\text{Initial price})(\text{Change in yield in decimal})} \)

18. Macaulay duration = \[ \frac{1}{(1 + \text{Yield}/k)} \left[ \frac{1 \times \text{PVCF}_1 + 2 \times \text{PVCF}_2 + \ldots + n \times \text{PVCF}_n}{k \times \text{Price}} \right] \]

19. Modified duration = \( \frac{\text{Macaulay duration}}{1 + \text{Yield}/k} \)

20. Portfolio Duration = \( w_1 D_1 + w_2 D_2 + w_3 D_3 + \ldots + w_k D_k \)

---

**Financial Reporting and Analysis**

1. **Assets** = Liabilities + Owners’ equity
   Revenue − Expenses = Net income (loss)

2. **Basic EPS** = \( \frac{\text{Net income} - \text{Preferred dividends}}{\text{Weighted average number of shares outstanding}} \)

3. **Diluted EPS** = \( \frac{\left( \text{Net income} + \text{After tax int rest on convertible debt} - \text{Preferred dividends} \right)}{\text{Weighted average number of shares outstanding} + \text{New common shares that could have been issued at conversion}} \)

4. **Diluted EPS** = \( \frac{(\text{Net income} - \text{Preferred dividends})}{\text{Weighted average number of shares outstanding} + \text{New shares that could have been issued at option exercise} - \text{Shares that could have been purchased with cash received upon exercise}} \)
5. Net profit margin = \( \frac{\text{Net income}}{\text{Revenue}} \)

6. Gross profit margin = \( \frac{\text{Gross profit}}{\text{Revenue}} \)

7. FCFF = NI + NCC + \( \text{Int} \times (1-\text{Tax rate}) \) - FCInv – WCInv

8. FCFF = CFO + \( \text{Int} \times (1-\text{Tax rate}) \) - FCInv

9. FCFF = CFO - FCInv + Net borrowing – Net debt repayment

10. Definitions of commonly Used Activity Ratios

<table>
<thead>
<tr>
<th>Activity Ratios</th>
<th>Numerator</th>
<th>Denominator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inventory Turnover</td>
<td>Cost of goods sold</td>
<td>Average inventory</td>
</tr>
<tr>
<td>Days of inventory on hand (DOH)</td>
<td>Number of days in period</td>
<td>Inventory turnover</td>
</tr>
<tr>
<td>Receivables turnover</td>
<td>Revenue</td>
<td>Average receivables</td>
</tr>
<tr>
<td>Days of sales outstanding (DSO)</td>
<td>Number of days in period</td>
<td>Receivables turnover</td>
</tr>
<tr>
<td>Payables turnover</td>
<td>Purchases</td>
<td>Average trade payables</td>
</tr>
<tr>
<td>Number of days payables</td>
<td>Number of days in period</td>
<td>Payables turnover</td>
</tr>
<tr>
<td>Working capital turnover</td>
<td>Revenue</td>
<td>Average working capital</td>
</tr>
<tr>
<td>Fixed asset turnover</td>
<td>Revenue</td>
<td>Average net fixed assets</td>
</tr>
<tr>
<td>Total asset turnover</td>
<td>Revenue</td>
<td>Average total assets</td>
</tr>
</tbody>
</table>

11. Definitions of commonly Used Liquidity Ratios

<table>
<thead>
<tr>
<th>Liquidity Ratios</th>
<th>Numerator</th>
<th>Denominator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current ratio</td>
<td>Current assets</td>
<td>Current liabilities</td>
</tr>
<tr>
<td>Quick ratio</td>
<td>Cash + Short-term marketable investments + Receivables</td>
<td>Current liabilities</td>
</tr>
<tr>
<td>Cash ratio</td>
<td>Cash + Short-term marketable investments</td>
<td>Current liabilities</td>
</tr>
<tr>
<td>Defensive interval ratio</td>
<td>Cash + Short-term marketable investments + Receivables</td>
<td>Daily cash expenditures</td>
</tr>
<tr>
<td>Additional Liquidity Measures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash Conversion cycle</td>
<td>DOH + DSO – Number of days of payables</td>
<td></td>
</tr>
</tbody>
</table>

12. Definitions of commonly Used Solvency Ratios

<table>
<thead>
<tr>
<th>Solvency Ratios</th>
<th>Numerator</th>
<th>Denominator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt ratios</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Debt-to-assets ratio(^a)</td>
<td>Total debt(^b)</td>
<td>Total assets</td>
</tr>
<tr>
<td>Debt-to-capital ratio</td>
<td>Total debt(^b)</td>
<td>Total debt(^b) + Total shareholders’ equity</td>
</tr>
<tr>
<td>Debt-to-equity ratio</td>
<td>Total debt(^b)</td>
<td>Total shareholders’ equity</td>
</tr>
<tr>
<td>Financial leverage ratio</td>
<td>Average total assets</td>
<td>Average total equity</td>
</tr>
<tr>
<td>Coverage Ratios</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest coverage</td>
<td>EBIT</td>
<td>Interest payments</td>
</tr>
<tr>
<td>Fixed charge coverage</td>
<td>EBIT + Lease payments</td>
<td>Interest payments + Lease payments</td>
</tr>
</tbody>
</table>
13. Definitions of commonly Used Profitability Ratios

<table>
<thead>
<tr>
<th>Profitability Ratios</th>
<th>Numerator</th>
<th>Denominator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return on Sales</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Gross profit margin</td>
<td>Gross profit</td>
<td>Revenue</td>
</tr>
<tr>
<td>Operating profit margin</td>
<td>Operating income</td>
<td>Revenue</td>
</tr>
<tr>
<td>Pretax margin</td>
<td>EBT (earnings before tax but after interest)</td>
<td>Revenue</td>
</tr>
<tr>
<td>Net profit Income</td>
<td>Net Income</td>
<td>Revenue</td>
</tr>
</tbody>
</table>

Return on Investment

<table>
<thead>
<tr>
<th>Profitability Ratios</th>
<th>Numerator</th>
<th>Denominator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating ROA</td>
<td>Operating income</td>
<td>Average total assets</td>
</tr>
<tr>
<td>ROA</td>
<td>Net income</td>
<td>Average total assets</td>
</tr>
<tr>
<td>Return on total capital</td>
<td>EBIT</td>
<td>Short and long-term debt and equity</td>
</tr>
<tr>
<td>ROE</td>
<td>Net income</td>
<td>Average total equity</td>
</tr>
<tr>
<td>Return on common equity</td>
<td>Net income-preferred dividends</td>
<td>Average common equity</td>
</tr>
</tbody>
</table>

14. ROE = Net profit margin * Asset turnover * leverage

15. ROE = Tax burden * Interest burden * EBIT margin * Asset turnover * Leverage

Quantitative analysis

1. **Population Mean**: calculated as \( \mu_X = \frac{1}{N} \sum_{i=1}^{N} X_i \)

   Where there are \( N \) members in the population and each observation is \( X_i \quad i =1, 2, ...N \).

   Sum of all the deviations is zero.

2. **Sample Mean**: calculated as \( \bar{X} = \frac{1}{n} \sum_{i=1}^{n} X_i \)

3. **Weighted Mean**: calculated as \( \bar{X}_{weighted} = \sum_{i=1}^{n} w_i X_i \)

4. **Geometric Mean**: calculated as \( G = \sqrt[n]{X_1 \times X_2 \times X_3 \times \ldots \times X_n} \)

   Where there are \( n \) observations and each observation is \( X_i \).

5. **Mean Absolute Deviation**: is the average of the data’s absolute deviations from the mean.

   \( MAD = \frac{1}{n} \sum_{i=1}^{n} |X_i - \bar{X}| \)

6. **Population Variance**: is the average of the population’s squared deviations from the mean.

   \( \sigma^2 = \frac{1}{N} \sum_{i=1}^{N} (X_i - \mu)^2 \)

   The population standard deviation is simply the square root of the population variance.

7. **Sample Variance**: is the average of the sample data’s squared deviations from the sample mean.

   \( s^2 = \frac{1}{(n-1)} \sum_{i=1}^{n} (X_i - \bar{X})^2 \)
8. Covariance describes the co-movement between 2 random numbers, given as:
\[ \text{Cov}(X_1, X_2) = \sigma_{12} \]
\[ \text{Cov}(X, Y) = E[(X - \mu_X)(Y - \mu_Y)] \]
\[ \text{Cov}(X, Y) = E(XY) - \mu_X \mu_Y \]

9. Correlation coefficient is a unit-less number, which gives a measure of linear dependence between two random variables.
\[ p(X_1, X_2) = \frac{\text{Cov}(X_1, X_2)}{\sigma_{1} \sigma_{2}} \]

10. Portfolio Expected Return:
\[ E(r_p) = w_A r_A + (1-w_A) r_B \]
Portfolio Variance:
\[ \sigma_{p}^2 = w_A^2 \sigma_A^2 + (1-w_A)^2 \sigma_B^2 + 2w_A(1-w_A)\text{Cov}(r_A, r_B) \]
OR
\[ \sigma_{p}^2 = w_A^2 \sigma_A^2 + (1-w_A)^2 \sigma_B^2 + 2w_A(1-w_A)p_{AB}\sigma_A \sigma_B \]

11. Coefficient of variation
\[ CV = \frac{s}{\mu} \]

12. Sharpe measure
\[ SM = \frac{(\bar{r}_p - \bar{r}_f)}{\sigma_p} \]

13. Addition Rule
Used to Get Compound Probabilities for Union of Events:
\[ P(A \text{ OR } B) = P(A \cup B) = P(A) + P(B) - P(A \cap B) \]
For Mutually Exclusive Events:
\[ P(A \text{ OR } B) = P(A \cup B) = P(A) + P(B) \]

14. Sum Rule & Bayes’ Theorem
\[ P(B) = P(A \cap B) + P(A' \cap B) = P(B/A)P(A) + P(B/A')P(A') \]
\[ P(A / B) = \frac{P(B / A)P(A)}{P(B / A)P(A) + P(B / A')P(A')} \]
Out of a group of 100 patients being treated for chronic back trouble, 25% are chosen at random to receive a new, experimental treatment as opposed to the more usual muscle relaxant-based therapy which the remaining patients receive. Preliminary studies suggest that the probability of a cure with the standard treatment is 0.3, while the probability of a cure from the new treatment is 0.6.

15. Discrete Probability Distributions
Probability distribution for a Binomial random variable is given by:
\[ P(X = x) = \binom{n}{x} p^x (1-p)^{n-x} \]

16. Normal Distribution Random Variable
General Normal random variable \[ X \sim N(\mu, \sigma^2) \]
\[ X \] can be standardized to a Standard Normal random variable.
\[ Z = \frac{X - \mu}{\sigma} \]
17. Confidence Intervals

$$X = \mu_x \pm Z \sigma_x$$

The standard error of the mean ($s_x$) is given by:

$$s_x = \frac{s}{\sqrt{n}}$$

18. Errors in Estimation

**Type I and Type II Errors**

- **Type I error** occurs if the null hypothesis is rejected when it is true.
- **Type II error** occurs if the null hypothesis is not rejected when it is false.

**Significance Level**

$$\alpha \rightarrow \text{Significance level}$$

- The upper-bound probability of a Type I error
- 1 - $\alpha \rightarrow \text{confidence level}$
- The complement of significance level

19. The sample variance for a pooled estimator is given as

$$s^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$$

20. Hypothesis Tests for Variances

**Hypothesis Test of Variances**

- **Test for Single Population Variance**
  - Example Hypothesis
    - $H_0: \sigma^2 = \sigma_0^2$
    - $H_1: \sigma^2 \neq \sigma_0^2$
  - Chi-Square Test Statistic
    - $\chi^2_{(n-1)} = \frac{(n-1)s^2}{\sigma_0^2}$

- **Test for Two Population Variances**
  - Example Hypothesis
    - $H_0: \sigma_1^2 = \sigma_2^2$
    - $H_1: \sigma_1^2 \neq \sigma_2^2$
  - F-test Statistic
    - $F_{\alpha / 2, n_1 - 1, n_2 - 1} = \frac{s_1^2}{s_2^2}$

In testing for variances, there are two different tests, because sum of two chi-squares is not a chi-square.