Reading 5: Time Value of Money

1. Interest Rate (i)
   - i = Rf + Inf P + Default Risk P + Liquidity P + Maturity P
   - Nominal Rf i rate = Real Rf i Rate + Inf P
   - i rate as a growth rate = g = $\left(\frac{FV_N}{PV}\right)^{\frac{1}{N}}$-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= $FV_N \left(1+\frac{r_s}{m}\right)^{-m\times N}$ $where\ r_s = stated\ ann\ i - rate$
   - $FV_N = PV(1+r)^N$
   - FV (for more than one Compounding per year) = $FV_N = \left(1+\frac{r_s}{m}\right)^{m\times N}$
   - FV (for Continuous Compounding) = $FV_N = PVe^{r_s\times N}$
   - Solving for N = $\frac{LN\left(\frac{FV}{PV}\right)}{LN(1+r)}$ (where LN = natural log)

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

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

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

Reading 6: Discounted Cash Flow Applications

1. NPV = $\sum_{t=1}^{n}\frac{CF_t}{(1+r)^t} - cf_0$

2. IRR (when project's CFs are perpetuity) = NPV = - I_O + $\frac{\overline{CF}}{IRR}$ = 0

3. HPR = $\frac{(P_1 - P_0 + D_1)}{P_0}$

4. MMWR = $\sum_{i=0}^{T}\frac{CF}{(1+IRR)^t} = 0$ (IRR represents the MWR)

5. TWR:
   - TWR (when no external CF) = r_{TWR} = HPR = $r_t = \frac{MV_1 - MV_0}{MV_0}$
   - TWR (for more than one periods) = $r_{TWR} = [(1+r_{t,1})\times(1+r_{t,2})\times\ldots(1+r_{t,n})] - 1$
   - Annualized TWR (when investment is for more than one year) = $\left[(1+R_1)(1+R_2 \ldots + (1+R_n))\right]^{\frac{1}{n}}-1$
   - TWR (for the year) = $r_{TWR} = [(1+R_1)\times(1+R_2)\times\ldots(1+R_{365})] - 1$ where $R_1 = \frac{MV_1 - MV_0}{MV_0}$

6. Bank Discount Yield = BDY = r_{BD} = $\frac{360}{n}\frac{Par-Price}{Par}$ therefore Price = Par $\left(1-\frac{n\times r_{BD}}{360}\right)$

7. Holding Period Yield = HPY = $\frac{(P_1 - P_0 + D_1)}{P_0}$

8. Effective Annual Yield = EAY = $(1 + HPY)^{365/t} - 1$ (Rule: EAY > BDY)

9. Money Market Yield (or CD equivalent Yield) r_{MM}:
   - r_{MM} = HPY × $\left(\frac{360}{t}\right)$
   - $r_{MM} = (r_{BD}) \times \frac{Face\ Value\ of\ the\ Treasury\ Bill}{Purchase\ Price}$

- $r_{MM} = \frac{360\,(r_{BD})}{360-(t)(r_{BD})}$ (Rule: $r_{MM} > r_{BD}$)

10. Bond Equivalent Yield = BDY = Semiannual Yield × 2

Reading 7: Statistical Concepts & Market Returns

1. Range = Max Value – Min Value
2. Class Interval = $i \geq \frac{H-L}{k}$ where
   - i = class interval
   - H = highest value
   - L = lowest value, k = No. of classes.
3. Absolute Frequency = Actual No of Observations (obvs) in a given class interval
4. Relative Frequency = $\frac{Absolute\ Frequency}{Total\ No\ of\ Obvs}$
5. Cumulative Absolute Frequency = Add up the Absolute Frequencies
6. Cumulative Relative Frequency = Add up the Relative Frequencies
7. Arithmetic Mean = $\frac{Sum\ of\ obvs\ in\ database}{No.of\ obvs\ in\ the\ database}$
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 = $\overline{X_w} = \sum_{i=1}^{n} w_i X_i$ = (w_1X_1+ w_2X_2+….+ w_nX_n)
11. Geometric Mean = GM = $\sqrt[n]{X_1 X_2 \ldots X_n}$ with $X_i \geq 0$ for i = 1,2,…n.
12. Harmonic Mean = H.M = $\overline{X_H} = \frac{n}{\sum_{i=1}^{n}\left(\frac{1}{X_i}\right)}$
13. Population Mean = $\mu = \frac{\sum_i^n X_i}{N}$ with $X_i > 0$ for i = 1,2,.,.,n.
14. Sample Mean = $\bar{X} = \frac{\sum_i^n X_i}{n}$ where n = number of observation in the sample
15. Measures of Location:
    - Quartiles = $\frac{Distribution}{4}$
    - Quintiles = $\frac{Distribution}{5}$
    - Deciles = $\frac{Distribution}{10}$,
    - Percentiles = $L_y = (n+1)\frac{y}{100}$
16. Mean Absolute Deviation = MAD = $\frac{\sum_{i=1}^{n}|X_t-\bar{X}|}{n}$
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 = $\sum_{For\ all\ X_i \leq \bar{X}} \frac{(X_i-\bar{X})^2}{n-1}$
22. Semi-deviation (Semi S.D) = $\sqrt{semivariance} = \sqrt{\sum_{For\ all\ X_i \leq \bar{X}} \frac{(X_i-\bar{X})^2}{n-1}}$
23. Target Semi-var = $\sum_{For\ all\ X_i \leq B} \frac{(X_i-B)^2}{n-1}$ where B = Target Value
24. Target Semi-Deviation = $\sqrt{target\ semivariance} = \sqrt{\sum_{For\ all\ X_i \leq B} \frac{(X_i-B)^2}{n-1}}$
25. Coefficient of Variation = CV = $\left(\frac{S}{\bar{X}}\right)$ where s= sample S.D and $\bar{X}$ = sample mean
26. Sharpe Ratio = $\frac{Mean\ Portfolio\ R - Mean\ Rf\ R}{S.D\ of\ Portfolio\ R}$
27. Excess Kurtosis = Kurtosis – 3

28. Geometric Mean R ≈ $Arithmetic\ Mean\ R - \frac{Variance\ of\ R}{2}$

Reading 8: Probability Concepts

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

2. Odds for event E = $\frac{Prob\ of\ E}{1-Prob\ of\ E}$

3. Odds against event E = $\frac{1-Prob\ of\ E}{Prob\ of\ E}$

4. Conditional Prob of A given that B has occurred = P(A\B) = $\frac{P(AB)}{P(B)}$ → P(B) ≠ 0.

5. Multiplication Rule (Joint probability that both events will happen):

   P(A and B) = P(AB) = P(A\B) × P(B)
   P(B and A) = P(BA) = P(B\A) × P(A)

6. Addition Rule (Prob that event A or B will occur):

   P(A or B) = P(A) + P(B) – P(AB)
   P(A 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) or if P(A\B) = P(A)
   - Multiplication Rule for two independent events = P(A & B) = P(AB) = P(A)× P(B)
   - Multiplication Rule for three independent events = P(A and B and C) = P(ABC) = P(A) × P(B) × P(C)

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

9. Total Probability Rule:
   P(A) = P(AS) + P(AS^C) = P(A\S)×P(S) + P(A\S^C)×P(S^C)
   P(A) = P(AS_1) + P(AS_2) +….+ P(AS_n) = P(A\$S_1$)×P($S_1$) + P(A\$S_2$)×P($S_2$)… P(A\$S_n$)×P($S_n$)

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

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

11. Cov (R_i R_j) = $\sum_{i=1}^{n}\left(p(R_i - ER_i)\right)\left(R_j - ER_j\right)$
    Cov (R_i R_j) = Cov (R_j R_i)
    Cov (R, R) = σ^2 (R)

12. Portfolio Var = σ^2 (R_p) = $\sum_{i=1}^{n}\sum_{j=1}^{n} w_i w_j Cov(R_iR_j)$
    σ^2 (R_p) = $w_1^2\sigma^2(R_1) + w_2^2\sigma^2(R_2) + w_3^2\sigma^2(R_3) + 2w_1w_2Cov(R_1,R_2) + 2w_1w_3Cov(R_1,R_3) + 2w_2w_3Cov(R_2,R_3)$

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

14. Correlation (b/w two random variables R_i, R_j) = $\rho(R_iR_j) = \frac{Cov\ (R_iR_j)}{\sigma R_i \times \sigma R_j}$

15. Bayes' Formula = $P(Event\backslash New\ Information) = \frac{P(New\ Information\backslash Event)}{P(New\ Information)} \times P(Prior\ prob.of\ Event)$

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

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

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

    where n = total no. of objects and r = no. of objects selected.

19. Permutation = ${}^{n}P_r = \frac{n!}{(n-r)!}$

Reading 9: Common Probability Distributions

1. Probability Function (for a binomial random variable) p(x) = p(X=x) = $\binom{n}{x}p_x(1-P)^{n-x} = = \frac{n!}{(n-x)!x!p^x(1-p)^{n-x}}$ (for x = 0,1,2….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)
$= \begin{cases} \frac{1}{b-a} \; for \; a \leq x \leq b = \\ 0 \end{cases}$
F(x) = $\frac{x-a}{b-a} for \; a < x < b$

3. Normal Density Funct = $f(x) =$
$\frac{1}{\sigma\sqrt{2\pi}} exp\left(\frac{-(x-\mu)^2}{2\sigma^2}\right)$ for $-\infty < x < +\infty$

4. Estimations by using Normal Distribution:

- Approximately 50% of all obsv fall in the interval $\mu \pm \frac{2}{3}\sigma$
- Approx 68% of all obvs fall in the interval $\mu \pm \sigma$
- Approx 68% of all obvs fall in the interval $\mu \pm 2\sigma$
- Approx 68% of all obvs fall in the interval $\mu \pm 3\sigma$
- More precise intervals for 95% of the obvs 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)
$z =$
$standard \; normal \; random \; variable =$
$\frac{X-\mu}{\sigma}$ (when X is normally distributed)

6. Roy's Safety-Frist Criterion = SF Ratio = $\frac{[E(R_P)-R_L]}{\sigma_P}$

7. Sharpe Ratio = = $\frac{[E(R_P)-R_f]}{\sigma_P}$

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

9. Mean (μ_L) of a lognormal random variable = exp (μ + 0.50σ^2)

10. Variance (σ_L^2) of a lognormal random variable = exp (2μ+ σ^2) × [exp (σ^2) – 1].

11. Log Normal Price = S_T = S_0exp ($r_{0,T}$)
Where, exp = e and $r_{0,t}$ = 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,
$R_{t, t+1}$ = holding period return on the stock from t to t + 1.

13. Continuously compounded return associated with a holding period from t to t + 1:
$r_{t, t+1}$= ln(1 + holding period return) *or*
$r_{t, t+1}$ = ln(price relative) = ln (S_{t+1} / S_t) = ln (1 + $R_{t,t+1}$)

14. Continuously compounded return associated with a holding period from 0 to T:

$R_{0,T}$= ln (S_T / S_0) *or* $r_{0,T} = r_{T-1,T} + r_{T-2,T-1} + \cdots + r_{0,1}$

Where,
$r_{T-I, T}$ = One-period continuously compounded returns

15. When one-period continuously compounded returns (i.e. $r_{0,1}$) are IID random variables.

$E(r_{0,T}) = E(r_{T-1,T}) + E(r_{T-2,T-1}) + \cdots + E(r_{0,1}) = \mu T \; And$

$Variance = \sigma^2(r_{0,T}) = \sigma^2 T$

S.D. = σ ($r_{0,T}$) = $\sigma\sqrt{T}$

16. Annualized volatility = sample S.D. of one period continuously compounded returns × $\sqrt{T}$

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 $= \sqrt{\frac{\sigma^2}{n}}$

3. Standard Error of the sample mean:
   - When the population S.D (σ) is known $= \sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$
   - When the population S.D (σ) is not known $= s_{\bar{X}} = \frac{s}{\sqrt{n}}$ where s = sample S.D estimate of s = $\sqrt{sample\ variance} = \sqrt{s^2}\ where\ s^2 = \frac{\sum_{i=1}^{n}(X_i - \bar{X})^2}{n-1}$

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

5. New Adjusted Estimate of Standard Error = (Old estimated standard error × fpc)

6. Construction of Confidence Interval (CI) = Point estimate ± (Reliability factor × Standard error)

   - CI for normally distributed population with <u>known</u> variance $= \bar{x} \pm z_{a/2}\frac{\sigma}{\sqrt{n}}$
   - CI for normally distributed population with <u>unknown</u> variance $= \bar{x} \pm z_{a/2}\frac{S}{\sqrt{n}}$ where S = sample S.D.

7. Student's t distribution
   $\mu = \bar{X} \pm t_{a/2}\frac{S}{\sqrt{n}}$

8. Z-ratio = $Z = \frac{\bar{x} - \mu}{\sigma / \sqrt{n}}$

9. t-ratio = $t = \frac{\bar{x} - \mu}{s / \sqrt{n}}$

Reading 11: Hypothesis Testing

1. Test Statistic = $\frac{\textit{Sample Statistic Hypothesized Value of pop parameter}}{\textit{standard error of sample statistic}^{*}}$

   *when Pop S.D is unknown, the standard error of sample statistic is give by $S_{\bar{X}} = \frac{s}{\sqrt{n}}$

   *when Pop S.D is unknown, the standard error of sample statistic is give by $\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$

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

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

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

5. $t_{n-1} = \frac{\bar{X} - \mu_0}{\frac{s}{\sqrt{n}}}$ (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 = $\frac{(\bar{X_1} - \bar{X_2}) - (\mu_1 - \mu_2)}{\left(\frac{S_p^2}{n_1} + \frac{S_p^2}{n_2}\right)^{1/2}}$ where S_p^2 = pooled estimator of common variance = $\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}$ where $df = n_1 + n_2 -$ 2.

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

   t = $\frac{(\bar{X_1} - \bar{X_2}) - (\mu_1 - \mu_2)}{\left(\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}\right)^{1/2}}$ In this df calculated as

   $$df = \frac{\left(\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}\right)^2}{\frac{\left(\frac{S_1^2}{n_1}\right)^2}{n_1} + \frac{\left(\frac{S_2^2}{n_2}\right)^2}{n_2}}$$

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

   - $t = \frac{\bar{d} - \mu_{d0}}{s\bar{d}}$

- sample mean difference = $\overline{d}$ = $\frac{1}{n}\sum_{i=1}^{n} d_i$
- sample variance = $S_d^2 = \frac{\sum_{i=0}^{n}(d_1-\bar{d})^2}{n-1}$
- sample S.D = $\sqrt{S_d^2}$
- sample error of the sample mean difference = $s\,\overline{d} = \frac{S_d}{\sqrt{n}}$

8. Chi Square Test Statistic (for test concerning the value of a normal population variance) $X^2 = \frac{(n-1)S^2}{\sigma_0^2}$ where $(n-1) = df \; and \; S^2 = sample \; variance = \frac{\sum_{i=0}^{n}(X_i-\bar{X})^2}{n-1}$

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 = $\frac{S_1^2}{S_2^2}$

$S_1^2 = 1st\; sample\; var\; with\; n_1\; obs$
$S_1^2 = 2nd\; sample\; var\; with\; n_2\; obs$
$df_1 = n_1 - 1\; numerator\; df$
$df_2 = n_2 - 1\; denominator\; df$

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

$$= 1 - \frac{6\sum_{i=1}^{n} d_1^2}{n(n^2-1)}$$

- For small samples rejection points for the test based on r_s are found using table.
- For large sample size (e.g. n>30) t-test can be used to test the hypothesis i.e.

$$t = \frac{(n-2)^{1/2} r_s}{(1-r_s^2)^{1/2}}$$

Reading 12: Technical Analysis

1. Relative Strength Analysis = $\frac{\textbf{Price of asset}}{\textbf{Price of the Benchmark Asset}}$

2. Price Target for the
- Head and Shoulders = Neckline – (Head – Neckline)
- Inverse Head and Shoulders = Neckline + (Neckline– Head)

3. For the Double Tops Pattern:
- Height = Highest high – Lowest Low
- Price target = Lowest Low – Height of the pattern

4. For the Double Tops Pattern:
- Height = Highest high – Lowest Low
- Price target = Highest High + Height of the pattern

5. Height of a Triangle = Price at the start of (downward slopping trend line –upward sloping trend line)

6. Flags and Pennants Pattern
- Flag Price Target = Price level at which [flag ends – (trend starts –flag starts to form)]
- Pennant Price Target = Price level at which [pennant ends – (trend starts – pennant starts to form)]

7. Simple Moving Average = $\frac{\boldsymbol{P_1+P_2+P_3 \ldots + P_n}}{\boldsymbol{N}}$

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

- ROC = $\frac{Today's\;\Delta - \Delta\; n\; periods\; ago}{\Delta\; n\; periods\; ago} \times 100$
- Momentum Oscillator Value M = (V-V_x) × 100
(where V = most recent closing price and V_x = closing price x days ago)
- Alternate Method to calculate M = $\frac{V}{V_x} \times 100$

9. Relative Strength Index = RSI = 100 − $\frac{100}{1+RS}$ where
RS = $\frac{\sum(Up\ changes)}{\sum(|Down\ changes|)}$

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

- $\%K = 100\left(\frac{C-L14}{H14-L14}\right)$ where:
C = latest closing price, L14 = lowest price in last 14 days, H14 is highest price in last 14 days
- $\%D$ = Average of the last three $\%K$ values calculated daily.

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

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

13. Arms Index TRIN i.e. Trading Index (Type of Flow of funds Indicator) =
$Arm\ Index\ or\ TRIN = \frac{No.of\ Advan\ Issues \div No.of\ Declin\ Issues}{Volume\ of\ Advan\ Issues \div Volume\ of\ Declin\ Issues}$

Reading 13: Demand & Supply Analysis: Introduction

1. Slope of the demand curve = $\frac{\Delta \text{ in Price}}{\Delta \text{ in Quantity Demanded}}$

2. Slope of the supply curve = $\frac{\Delta \text{ in Price}}{\Delta \text{ in Quantity Supplied}}$

3. Consumer Surplus = Value that a consumer places on units consumed – Price paid to buy those units
   - Area (for calculating Consumer Surplus) = ½ (Base × Height) = ½ (Q_0 × P_0)

4. Producer Surplus = Total revenue received from selling a given amount of a good – Total variable cost of producing that amount
   - Total revenue = Total quantity sold × Price per unit
   - Area (for calculating Producer Surplus) = ½ (Base × Height) = ½ {(Q_0) × (P_0 – intercept point on y-axis**)}

   ***where supply curve intersects y-axis*

5. Total Surplus = Consumer surplus + Producer surplus

6. Total Surplus = Total value – Total variable cost

7. Society Welfare = Consumer surplus + Producer surplus

8. Price Elasticity of Demand = $\frac{\%\,\Delta \text{ in Quantity Demanded}}{\%\,\Delta \text{ in Price}}$

$$\frac{\%\Delta Q}{\%\Delta P} = \frac{\dfrac{Q_2 - Q_1}{\frac{1}{2}(Q_1 + Q_2)}}{\dfrac{P_2 - P_1}{\frac{1}{2}(P_1 + P_2)}}$$

9. Income Elasticity of Demand = $\frac{\%\,\Delta \text{ in Quantity Demanded}}{\%\,\Delta \text{ in Income}}$ =

$$\frac{\%\Delta Q}{\%\Delta I} = \frac{\dfrac{Q_2 - Q_1}{\frac{1}{2}(Q_1 + Q_2)}}{\dfrac{I_2 - I_1}{\frac{1}{2}(I_1 + I_2)}}$$

10. Cross Elasticity = $\frac{\%\,\Delta \text{in Quantity Demanded of Good X}}{\%\,\Delta \text{ in Price of Good Y}}$

Reading 14: Demand & Supply Analysis: Consumer Demand

1. Marginal Utility = $\frac{\Delta \text{ in Total Utility}}{\Delta \text{ in Quantity Consumed}}$

2. Equation of Budget Constraint Line = (P_X × Q_X) + (P_Y × Q_Y)

3. Slope of Budget Constraint Line = $\frac{\Delta \text{ in } Q_Y}{\Delta \text{ in } Q_X} = \frac{P_X}{P_Y}$