Reading 6: 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)

3. 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 = $e^{r_s}-1$

4. 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 = $\frac{1-\frac{1}{\left[1+\left(\frac{rs}{m}\right)\right]^{m\times N}}}{\frac{rs}{m}}$

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

Reading 7: Statistical Concepts & Market Returns

1. Range = Max Value – Min Value

2. Class Interval = i ≥ $\frac{H-L}{k}$ 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 = $\overline{X_w} = \sum_{i=1}^{n} w_iX_i$ = (w_1X_1+ w_2X_2+….+ w_nX_n)

11. Geometric Mean = GM = $\sqrt[n]{X_1X_2\ldots X_n}$ 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 = $\sum_{For\ all\ X_i \le \bar{X}} \frac{(X_i-\bar{X})^2}{n-1}$

22. Semi-deviation (Semi S.D) = $\sqrt{semivariance} = \sqrt{\sum_{For\ all\ X_i \le \bar{X}} \frac{(X_i-\bar{X})^2}{n-1}}$

23. Target Semi-var = $\sum_{For\ all\ X_i \le B} \frac{(X_i-B)^2}{n-1}$ where B = Target Value

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

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) = $\frac{P(AB)}{P(B)} \rightarrow P(B) \neq 0$.

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) + $P(A|S^C)$×$P(S^C)$