Future Value

$FV_N=PV(1+r)^N$

FV(Compounding)

$$FV_N = PV\left(1+\frac{r}{m}\right)^{mN}$$

$$FV_N = PVe^{rN}$$

Effective annual rate (EAR)

$$EAR = \left(1+\frac{r}{m}\right)^{m} - 1$$

$$EAR = e^{r} - 1$$

FV (Equal CF)

$$FV_N = A\left|\frac{(1+r)^N - 1}{r}\right|$$

Present Value

$$PV = FV_N(1+r)^{-N}$$

PV (Compounding)

$$PV = FV_N\left(1+\frac{r}{m}\right)^{-mN}$$

PV (Equal CF)

$$PV = A\left|\frac{1-\frac{1}{(1+r)^N}}{r}\right|$$

PV (Perpetual annuity)

$$PV = A\sum_{t=1}^{\infty}\left[\frac{1}{(1+r)^t}\right]$$

$$PV = \frac{A}{r}$$

Growth rate

$$g = (FV_N/PV)^{1/N} - 1$$

$$g = \sqrt[N]{FV_N/PV} - 1$$

Periods

$$N = \frac{\ln(FV/PV)}{\ln(1+r)}$$

$$N = 72/r$$

NPV&IRR (Perpetuity)

$$NPV = -Invest + CF/IRR \qquad IRR = CF/Invest$$

NPV&IRR (Equal CF)

$$NPV = -Invest + A\left|\frac{1-(1+IRR)^{-N}}{IRR}\right|$$

Holding Period Return (HPR)

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

P_0 – initial investment

P_1 – price received at (EHP)

D_1 – cash paid by the investment at EHP

Money-weighted return (MWR)

PV(outflows) = PV(inflows)

$$r_{MW} = (1+IRR)^N - 1$$

Time-weighted return (TWR)

$$r_{TW} = [(1+HPR_1)\times \ldots \times (1+HPR_N)]^{1/N} - 1$$

Bank Discount Yield (BDY)

$$r_{BD} = \frac{D}{F}\times\frac{360}{t}$$

r_{BD} – annualized yield on bank discount basis

D = dollar discount, difference between F and P_0

F = face value of the T-bill

t = remaining days to maturity

Holding Period Yield (HPY)

$$HPY = \frac{P_1 - P_0 + D_1}{P_0}$$

P_0 – initial price

P_1 – price at maturity

D_1 – cash distribution at maturity (i.e. interest)

Effective Annual Yield (EAY)

$$EAY = (1+HPY)^{365/t} - 1$$

Money Market Yield (MMY)

$$r_{MM} = \frac{360\times r_{BD}}{360 - t\times r_{BD}} = HPY \times (360/t) = r_{BD}\times(F/P_0)$$

STATISTIC

The Sample mean

$$\bar{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

The Median

If ∑n= odd than, $\bar{X}_m = (n+1)/2$

If ∑n= even than, $\bar{X}_m = \frac{(n/2+(n+2)/2)}{2}$

The Mode

= max freq n

Weighted Mean

$$\bar{X}_w = \sum_{i=1}^{n} w_i X_i$$

Geometric mean

$$G = \sqrt[n]{X_1X_2X_3\ldots X_n} = (X_1X_2X_3\ldots X_n)^{\frac{1}{n}}$$

$$\ln G = \frac{1}{n}\ln(X_1X_2X_3\ldots X_n) = \frac{\sum_{i=1}^{n}\ln X_i}{n}$$

Geometric mean return

$$R_G = \sqrt[T]{(1+R_1)(1+R_2)\ldots(1+R_1)} - 1$$

$$R_G = \left|\prod_{t=1}^{T}(1+R_t)\right|^{\frac{1}{T}} - 1$$

Harmonic mean

$$\bar{X}_H = n\Big/\sum_{i=1}^{n}(1/X_i)$$

With X_i>0

Location of a percentile in an array

$$L_y = (n+1)\times\frac{y}{100}$$

y – Percentage point at which we are dividing the distribution

L_y – Location of the percentile P_y

Percentile calculation

$$P_{\%} = X_{n-1} + (L_y - N)\times(X_n - X_{n-1})$$

R = max value – min value

R - range

Mean Absolute Deviation

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

Population Variance

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

μ - population mean

N – size of population

Population Standard Deviation

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

Sample Variance

$$s^2 = \frac{\sum_{i=1}^{n}(X_i-\bar{X})^2}{n-1}$$

Sample Standard Deviation

$$s = \sqrt{\frac{\sum_{i=1}^{N}(X_i-\bar{X})^2}{n-1}}$$

Semivariance	Semideviation	Target semivariance	Target semideviation
$\sum_{for\ all\ X_i \le \bar{X}} (X_i - \bar{X})^2/(n-1)$	$\sqrt{\sum_{for\ all\ X_i \le \bar{X}} (X_i - \bar{X})^2/(n-1)}$	$\sum_{for\ all\ X_i \le B} (X_i - B)^2/(n-1)$	$\sqrt{\sum_{for\ all\ X_i \le B} \frac{(X_i - B)^2}{(n-1)}}$

Chebyshev's Inequality

For any distribution with finite variance, the proportion of the observations within *k* standard deviation of the arithmetic mean is at least $1-1/k^2$ for all $k>1$

Coefficient of variation (CV)	Sharp ratio	
$CV = s/\bar{X}$ s – sample standard deviation $\bar{X}$– sample deviation	$S_h = \frac{\bar{R}_p - \bar{R}_F}{s_p}$	$\bar{R}_p$ – mean return to the portfolio $\bar{R}_F$ – mean return to a risk free asset s_p – standard deviation of return on the portfolio

Sample Skewness	Excess Kurtosis
$S_K = \left[\frac{n}{(n-1)\times(n-2)}\right] \times \frac{\sum_{i=1}^{n}(X_i - \bar{X})^3}{s^3}$ If n > 100 than, $S_K = \left(\frac{1}{n}\right) \times \frac{\sum_{i=1}^{n}(X_i - \bar{X})^3}{s^3}$	$K_E = \left(\frac{n(n+1)}{(n-1)(n-2)(n-3)} \times \frac{\sum_{i=1}^{n}(X_i - \bar{X})^4}{s^4}\right) - \frac{3(n-1)^2}{(n-2)(n-3)}$ If n > 100 than, $K_E = \left(\frac{n^2}{n^3} \times \frac{\sum_{i=1}^{n}(X_i - \bar{X})^4}{s^4}\right) - \frac{3n^2}{n^2} = \left(\frac{1}{n} \times \frac{\sum_{i=1}^{n}(X_i - \bar{X})^4}{s^4}\right) - 3$

PROBABILITY

P(E)-probability of event E
P(A|B)-conditional probability of A given that B has occurred
P(AB)-the probability of A and B

Depended Events

Conditional Probability	Joined Probability	Probability that A or B or both occurs
$P(A\|B) = P(AB)/P(B), P(B) \neq 0$	$P(AB) = P(A\|B) \times P(B)$	$P(A\ or\ B) = P(A) + P(B) - P(AB)$

Independent Events

Conditional Probability	Joined Probability	Probability that A or B or both occurs
$P(A\|B) = P(A) or\ P(B)$	$P(AB) = P(A) \times P(B)$	$P(A\ or\ B) = P(A) + P(B) - P(AB)$
The Total Probability Rule $P(A) = P(AS) + P(AS^C)$ $P(A) = P(A\|S)P(S) + P(A\|S^C)P(S^C)$		