CA Final – AFM Formula Sheet

❖ Risk Management

Variance : $\frac{\sum(x-\bar{x})^2}{n}$

where x is observation, n is number of observations and $\bar{x}$ is the mean of observations.

Standard Deviation : $\sigma = \sqrt{\text{Variance}}$

Covariance: $\sum \frac{(x-\bar{x})(y-\bar{y})}{n}$

Correlation : $\rho = \frac{\text{Cov(X,Y)}}{\sigma_x \sigma_y}$

Where, Cov (X,Y) is covariance

σ is Standard Deviation

Standard Deviation of portfolio:

$$\sigma_p = \sqrt{\sigma_1^2 + \sigma_2^2 + (2(\sigma_1\sigma_2\,\rho))}$$

Where σ_1 is standard deviation of 1st security and σ_2 is standard deviation of 2nd security in Rupee terms

Or,

$$\sqrt{w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + (2(w_1w_2\sigma_1\sigma_2\,\rho))}$$

Where w_1 & w_2 are the weights of respective securities & SDs are in %

Value at Risk (VAR) :

σ_px Portfolio Value x Cumulative Z score x $\sqrt{\text{N Days}}$

Where, Z score indicates how many standard deviation away from mean

Market Capitalisation: Total number of shares × Market price of share

❖ Advanced Capital Budgeting Decisions

Cash Flow after tax :
(R-C) × (1-T) + D × T
Where,
R is Revenue, C is Cost, T is Tax rate and D is Depreciation.

$\mathbf{Rn = Rr * (1 + P)}$ **[For Absolute]**
R_n is Nominal return,
R_r is Real return,
P is Expected Inflation Rate (%).

$\mathbf{(1{+}Rn) = (1 + Rr) * (1 + P)}$ **[For Rates]**
R_n is Nominal rate of return (%)
R_r is Real rate of return (%)
P is Expected Inflation Rate (%).

Statistical Methods of Incorporating Risk in Capital Budgeting :

1. **Probability weighted Cashflows:**

Expected Value :$\sum Pi\ NCFi$

Where, Pi is the probability and NCF_i is the Net Cash flows.

2. **Variance :** $\frac{\sum(x-\bar{x})^2}{n}$

$= \sum Pi\ (x - \bar{X})^2$

Where x is Net cash flow, $\bar{x}$ is the expected net cashflow and Pi is the probability.

Variance as per Hillier's Model :

$$\sigma^2 = \sum(1 + r)^{-2i}\,\sigma^2{}_i$$

Where,

1+r is the discount rate and i is the time period.

3. **Standard Deviation :** $\sqrt{\sigma^2} = \sqrt{Variance}$

4. **Coefficient of Variation :** $\frac{\text{Standard Deviation}}{\text{Expected Cashflow}}$

Conventional Methods of Incorporating Risk in Capital Budgeting:

1. **Risk Adjusted Discount Rate**
$\text{RADR} = R_f + \beta(R_m - R_f)$ or
$\text{RADR} = R_f + \text{Risk Premium}$

Where,R_m is Market return R_f is Risk free rate of return and β is beta

2. **Certainty Equivalent**
(α): $\frac{Certain\ Cashflows}{Expected\ Risky\ Cashflows}$

NPV= $\sum \frac{\alpha \times NCF}{(1+k)^n}$ **-** Initial Investment

Where, α is Risk Adjustment factor, NCF is net cash flow without risk adjustment, K is Risk free rate and n is number of periods.

Expected Net Present Value (Multiple Periods):

ENPV = Sum of Present Value of Cashflows calculated Individually – Initial Investment

Replacement Decision :

Step 1: Net Cash flow = Cost of new Machine – (tax saving + market value of old machine)
[usually a negative value]

Step 2: (Change in Sales +/- Change in Operating Cost – Change in Depreciation) × (1- Tax) + Change in Depreciation **Or**

(Change in Sales +/- Change in Operating Cost) ×(1- Tax) + (Change in Depreciation × Tax)

Step 3: Present Value of Cashflows = Present Value of Yearly Cash Flows + Present Value of Salvage

Step 4: NPV = Step 1 [cash outflow i.e -ve value] + Step 3 [cash inflow i.e +ve value]

Optimum Replacement Cycle :

Equivalent Annual Cost (EAC) = $\frac{\text{Present Value of Cash Outflow (PVCF)}}{\text{Present Value Annuity Factor(PVAF)}}$

Adjusted Present Value :

Base Case NPV (on unlevered cost of capital) + PV of tax benefits on interest

Profitability Index = $\frac{\text{Discount Cash inflow}}{\text{Initial Investment}}$

❖ Security Analysis

Gordon's Dividend Growth Model :

Current Stock Price(P) = $\frac{D1}{k-g}$

Where,

D_1 is value of next year dividend,

k is the minimum rate of return,

g is growth rate of dividend.

PE Multiple : $\frac{\text{Current Market Price}}{\text{Earnings per share}}$

Confidence Index :

$$\frac{\text{Avg yield on high grade bond}}{\text{Avg yield on low grade bond}}$$

Arithmetic Moving Average :

$AMA_{n,t} = 1/n\ [P_t + P_{t-1} + \ldots + P_{t-(n-1)}]$

Where,

N is number of total periods and t is period.

Exponential Moving Average:

$EMA_t = aP_t + (1\text{-}a)\ (EMA_{t-1})$

Where, a(exponent) = $\frac{2}{n+1}$

N Is number of days, P_t is price of today and EMA_{t-1} is previous day EMA.

For Run tests,

Mean = $\frac{2n1n2}{n1+n2} + 1$,

where n1 and n2 are +ve and -Ve changes,

Variance =

$$\frac{2n1n2\ (2n1n2-n1-n2)}{(n1+n2)(n1+n2)\ (n1+n2-1)}$$

Number of runs : Runs lies between μ ± t(σ) , where

t is distribution with degree of freedom (DoF) & DoF – Number of price changes – 1

❖ Valuation of Debentures and Bonds

Bond Value :

$$P_0 = \sum_{t=1}^{n} \frac{C}{(1+y)^t} + \frac{M}{(1+y)^n}$$

Or,

$$P_0 = C\ (PVIFA_{\ y,n}) + M\ (PVIF_{\ y,n})$$

Where,

P_0 = Bond price; n = Maturity period; C = Coupon; y = YTM; M = Maturity value

Alternate Formula :

$$P_o = \frac{C}{y} x \left[1 - \frac{1}{(1+y)^n}\right] + \frac{M}{(1+y)^n}$$

Bond value (when coupon payments are semi-annual) :

$$P_o = \sum_{t=1}^{2n} \frac{\frac{C}{2}}{(1+\frac{y}{2})^t} + \frac{M}{\left(1+\frac{y}{2}\right)^{2n}}$$

Where,

2n = Maturity period expressed in terms of half-yearly periods; C/2 = Semi-annual coupon; y/2 = Discount rate applicable for half-year period

Bond Basic Value (between 2 coupon dates) :

$$\text{Present Value of } (A + \text{ Coupon}) - \text{Accrued Interest}$$

Where,

A = Bond price calculated as on next coupon date after payment of coupon

Present value of (A + Coupon)

$$= \frac{A + \text{Coupon}}{\left(1 + \frac{\text{Req. YTM}}{\text{No. of periods}}\right)^{\frac{\text{Time until next coupon}}{\text{Total coupon period}}}}$$

Accrued Interest

$$= \text{Face Value x } \frac{\text{Coupon rate}}{\text{No. of periods}} \text{ x } \frac{\text{Time elapsed}}{\text{Total coupon period}}$$

Current Yield: $\frac{\text{Coupon}}{\text{Current market price}}$

Yield To Maturity (YTM) :

$$LR + \frac{\text{NPV at LR}}{\text{NPV at LR} - \text{NPV at HR}} \text{ x (HR} - \text{LR)}$$

Where,

LR = Lower Rate; HR = Higher Rate

YTM (Approximate Formula) :

$$\frac{C + \frac{(F-P)}{n}}{\frac{F+P}{2}}$$

Where,

C is coupon, F is face value, P is market price of bond/issue Price, n is years to maturity

Yield To Call :

$$P_o = \sum_{t=1}^{n} \frac{C}{(1+y)^t} + \frac{\text{Call price}}{(1+y)^n}$$

Where y is Yield to Call and n is Call period

Yield To Put :

$$P_o = \sum_{t=1}^{n} \frac{C}{(1+y)^t} + \frac{\text{Put price}}{(1+y)^n}$$

Where y is Yield to Put and n is Put period

Macaulay Duration :

$$\frac{\sum_{t=1}^{n} \frac{t \text{ x } c}{(1+i)^t} + \frac{n \text{ x } M}{(1+i)^n}}{P}$$

Where, t is Time; c is Coupon; I is Interest rate; P is Principal; n is Maturity and M is Maturity value

Or

$$\frac{1+y}{y} - \frac{(1+y)+t(c-y)}{C((1+y)^t - 1) + y}$$

Where, Y is yield to maturity & C is coupon rate per priod

Modified Duration:

$$= - \frac{\text{Macaulay Duration}}{(1 + \frac{\text{YTM}}{n})}$$

Where,
YTM is Yield to Maturity; n is Number of compounding periods per year
Or,

$$\frac{\frac{C}{y^2}\left(1 - \frac{1}{(1+y)^n}\right) + \frac{n \text{ x } \left(M - \frac{C}{y}\right)}{(1+y)^{n+1}}}{P}$$

Convexity adjustment:

$C^* \text{ x } \Delta y^2 \text{ x } 100$

Where,
C* is Convexity formula; Δy is Change in yield for which calculation is done

Convexity Formula : $\frac{V_+ + V_- - 2V_0}{2V_0\,(\Delta y)^2}$

Where, V_+ is Price of Bond if yield increases by Δy
V_- = Price of Bond if yield decreases by Δy
V_0 = Initial Price of bond; Δy = Change in Yield

Alternate Formula:

$$\frac{\sum_{t=1}^{n} \frac{t(t+1)C}{(1+y)^{t+2}} + \frac{n(n+1)M}{(1+y)^{n+2}}}{P}$$

In simple terms,

$$\text{Convexity} = \frac{1}{P\,(1+y)^2} \text{ x } \sum_{t=1}^{n} \frac{CF_t \text{ x } t \text{ x } (t+1)}{(1+y)^t}$$

Conversion Value of Debenture :
Price per equity share x Converted no. of shares per debenture

Value of Warrant : $(MP - E) \text{ x } n$
Where,
MP is Current Market Price of Share
E is Exercise Price of Warrant
n is No. of equity shares convertible with one warrant

Yield on Treasury Bills:

$$\frac{\text{FV} - \text{Issue Price}}{\text{Issue Price}} \text{ x } \frac{365}{\text{Maturity}}$$

Yield on Commercial Bills/ Certificate of Deposit/ Commercial Paper:

$$\frac{\text{FV} - \text{Sale Value}}{\text{Sale Value}} \text{ x } \frac{365}{\text{Maturity}}$$

Dirty Price = Clean Price + Accrued Interest

Start Proceeds in Repo

$$\text{Nominal Value x } \frac{\text{Dirty Price}}{100} \text{ x } \frac{100 - \text{Initial Margin}}{100}$$

Repayment at Maturity in Repo

$$\text{Start Proceeds x } \left(1 + \text{Repo Rate x } \frac{\text{No, of days}}{360}\right)$$

❖ Valuation Equities

Expected Return :

(R_x) = $R_f + \beta_x (R_m - R_f)$

Where,
R_x is expected return on equity
R_f is risk-free rate of return
β_x is beta of "x"
R_m is expected return of market

Equity Risk Premium :

$(R_x - R_f) = \beta_x (R_m - R_f)$

Equity Valuation for a holding period of one year

$$P_0 = \frac{D_1 + P_1}{1 + K_e}$$

Where,
D_1 – Dividend at the end of year 1, P_1- Price at the end of Year 1 & K_e – Cost of Equity.

Valuation of Equity – Zero Growth

$$P_0 = \frac{D}{K_e}$$

Where, D is Dividend at the end of year 1.

Valuation of Equity – Constant Growth

$$P_0 = \frac{D_1}{K_e - g}$$

Where, $D_1 = D_0(1+g)$, g is growth rate

Valuation of Equity – Two Stage Growth

$$P_0 = \left[\frac{D_0(1+g_1)}{(1+K_e)} + \frac{D_0(1+g_1)^2}{(1+k_e)^2} + \ldots\ldots + \frac{D_0(1+g_1)^n}{(1+k_e)^n}\right] + \frac{P_n}{(1+k_e)^n}$$

$$P_n = \frac{D_0\,(1+g_1)^n(1+g_2)}{(K_e - g_2)}$$

Where,
D_0 is Dividend Just Paid,
g_1 is Finite or Super Growth Rate
g_2 is Normal Growth Rate
K_e is Req. Rate of Return on Equity
P_n is Price of share at the end of Super Growth.

H Model

$$P_0 = \frac{D_0 \times \frac{t}{2} \times (g_S - g_L)}{(K_e - g_L)} + \frac{D_0(1+g_L)}{(K_e - g_L)}$$

Where,
g_s is super normal growth rate
g_L is normal growth
t is time period

Gordon's Model (Earnings Approach)

$$P_0 = \frac{EPS_1\,(1-b)}{(K_e - br)}$$

Where,
P_0 is Price per share
b is Retention ratio
r is Return on Equity
br is Growth Rate (g)

Gordon's Model (Dividend Approach)

$$P_0 = \frac{D_1}{(K_e - br)}$$

Where,
D1 is dividend at the end of yr 1

Earnings Growth Model

$$P_0 = \frac{E_1}{(ROE - g)}$$

Walter's Model

$$P_0 = \frac{D_0 + (E-D)\frac{r}{K_e}}{(K_e)}$$

Where, E is earning per share and D is dividend per share for the just concluded year

PE or Multiple Approach

Value of an Equity Share = EPS X PE Ratio

Enterprise Value (EV)

$$EV = \frac{FCFF1}{K-g}$$

Where,
FCFF is Free cash flow to firm
k is Weighted Average cost of Capital
g is Growth rate

Theoretical Ex-Right Price (TERP)

$$TERP = \frac{nP_0 + S}{n + n_1}$$

Where,
n is Number of existing equity shares,
P_0 is Price of Share Pre-Right Issue,
S is Subscription amount raised from Right Issue &
n_1 is No. of new shares offered

Value of Right

Value =

$$\frac{TERP - \text{Subscription price per share}}{n}$$

Value of Preference Share :

$$\frac{D_1}{(1+r)^1} + \frac{D_2}{(1+r)^2} + \ldots\ldots + \frac{D_n + \text{Maturity Value}}{(1+r)^n}$$

Where,
D_1 is Dividend at the end of Year 1
D_2 is Dividend at the end of Year 2
D_n is Dividend at the end of Year n
r – Cost of Preference Shares

❖ Portfolio Management

Expected Return :

$$(\bar{X}) = \sum_{i=1}^{n} X_i p(X_i)$$

Where,
X_i is Possible Returns of a security,
P (X_i) is Related probability &
$\bar{X}$ is Expected Return

Variance :

$$(\sigma^2) = \sum_{i=1}^{n} (X_i - \bar{X})^2 . p(X_i)$$

Where, σ^2 is Variance

Standard Deviation :

$$SD = \sqrt{\text{variance}} = \sqrt{\sigma^2} = \sqrt{\frac{\sum_{i=1}^{n}(X_i - \bar{X})^2}{n}}$$

Covariance :

$$\text{Cov}(X, Y) = \sum_{I=1}^{n} (X_i - \bar{X})(Y_i - \bar{Y})/n$$

Where,
X is security 1
$\bar{X}$ is Mean of security 1
Y is security 2
$\bar{Y}$ is Mean of security 2
n is no. of observations

Correlation Coefficient

$$r_{XY} = \frac{\text{Cov}(X, Y)}{\sigma_X . \sigma_Y}$$

Where,
σ_X is standard deviation of X
σ_Y is standard deviation of Y

Beta Under Correlation Method

$$\beta = \frac{r_{im}\sigma_i}{\sigma_m} \text{ Or } \frac{\text{Cov}(i,m)}{(\sigma_m)^2}$$

Where,
β is Beta (degree of dependency of returns / ri
σi – standard deviation of Individual security return

σm is standard deviation of market return
r is correlation of individual security return (i) and market return (m)

Beta Under Regression Method

$$\beta = \frac{(n\sum xy - \sum x \sum y)}{n\sum x^2 - (\sum x)^2}$$

Or,

$$\beta = \frac{\sum xy - n\bar{x}\bar{y}}{\sum x^2 - n\bar{x}^2}$$

where,
x is independent market return
y is dependent stock return

Beta (Slope of line) :

$$y = \alpha + \beta x$$

Where,
α – alpha, intercept value
β –Beta, Slope of the line

Portfolio Return :

$$E(R)_p = \sum R_i w_i$$

Where,
$E(R)_p$ is Portfolio Return
R_i is Return on Stock
w_i is Weightage of stock in the portfolio

Portfolio Risk:

$$(\sigma p)^2 = w_i^2.(\sigma_i)^2 + w_j^2.(\sigma_j)^2 + 2\sigma_i\sigma_j r_{ij} w_i w_j$$

$$= w_i^2.(\sigma_i)^2 + w_j^2.(\sigma_j)^2 + 2\mathrm{Cov}(i,j) w_i w_j$$

Where,
i is security 1 & j is security 2
σp is Portfolio risk
$(\sigma p)^2$ is Portfolio variance
σ_i is Standard deviation of security 1
σ_j is Standard deviation of security 2
w_i is Weight of security 1 in portfolio
w_j is Weight of security 2 in portfolio

r_{ij} is correlation between security 1 and 2

Portfolio Risk with different correlation coefficient :

when r is 0, (σ_p)

$$= \sqrt{w_1^2.(\sigma_1)^2 + w_2^2(\sigma_2)^2}$$

when r is +1, $(\sigma_p) = (w_1\sigma_1 + w_2\sigma_2)$
when r is − 1, $(\sigma_p) = (w_1\sigma_1 - w_2\sigma_2)$

Covariance :

$$\mathrm{Cov}(x,y) = r_{xy}.\sigma_x\sigma_y$$

Where,

r_{xy} – correlation between x and y

Standard Deviation of portfolio :

$$\sigma_p{}^2 = \sum_{i=1}^{n}\sum_{j=1}^{n} x_i x_j . r_{ij} . \sigma_i . \sigma_j$$

Or,

$$\sigma_p{}^2 = \sum_{i=1}^{n}\sum_{j=1}^{n} x_i x_j . \sigma_{ij}$$

Where,
x_i: weightage of security 1 in portfolio
x_j: weightage of security 2 in portfolio
r_{ij} is correlation between security 1 and 2

Variance of portfolio for 3 Securities :

$$\sigma^2 = [2\sigma_y\sigma_z w_y w_z r_{yz}] + [2\sigma_x\sigma_y w_x w_y r_{xy}] + [2\sigma_x\sigma_z w_x w_z r_{xz}] + [(\sigma_x)^2(w_x)^2 + (\sigma_y)^2(w_y)^2 + (\sigma_z)^2(w_z)^2]$$

Where, x, y & z are Security 1, 2 & 3 respectively

Slope of Capital Market Line (CML):

$$\frac{R_m - R_f}{\sigma_m}$$

Where,
R_m is Market return

R_f is Risk free rate of return
σ_m is Market risk (SD of market)
Slope is reward per unit of risk borne

Expected return of the portfolio (using CML):

$$E(R_p) = R_f + \left(\frac{R_m - R_f}{\sigma_m}\right).\sigma_p$$

Where, σ_p is Portfolio risk

Expected return of the portfolio (using CAPM):

$$E(R) = R_f + \beta(R_m - R_f)$$

Expected return of the stock – Sharpe Model :

$$R_i = \alpha_i + \beta_i R_m + \epsilon_i$$

Where,
R_i is Expected return on a security i
α_i is intercept of the straight line or alpha co-efficient
β_i is slope of straight line or beta co-efficient
R_m is rate of return on market index
ϵ_i is error term

Expected risk of the stock – Sharpe Model :

$$(\sigma_i)^2 = (\beta_i)^2.(\sigma_m)^2 + (\sigma_{\epsilon_i})^2$$

Where,

$(\sigma_i)^2$ is variance of the security
β_i is slope of straight line or beta co-efficient
$(\sigma_m)^2$ is market variance
$(\sigma_{\epsilon_i})^2$ is Variance of errors

Covariance between securities – Sharpe Model :

$$(\sigma_{ij}) = (\beta_i).(\beta_j)(\sigma_m)^2$$

Risk (SD) of portfolio – Sharpe Model:

$$(\sigma_p)^2 = \left[\sum_{i-1}^{n} x_i\beta_i\right]^2.(\sigma_m)^2$$

$$+\left[\sum_{i-1}^{n}(x_i)^2\,(\sigma_{\epsilon_i})^2\right]$$

Return of the portfolio – Sharpe Model:

$$E=\sum_{i-1}^{n} x_i(\alpha_i+\beta_i R_m)$$

Alpha of the portfolio :

$$\alpha_p=\sum_{i=1}^{n} x_i\alpha_i$$

Where,

x_i is weightage of 'x' security in portfolio

α_i is intercept of the straight line or alpha co-efficient

Beta of the portfolio:

$$\beta_p=\sum_{i=1}^{n} w_i\beta_i$$

Expected return using SML :

$$E_R = R_f+\sigma_{im}\left[\frac{R_m-R_f}{(\sigma_m)^2}\right]$$

Expected return – Arbitrage Pricing theory : $E_R = R_f+\lambda_1\beta_1+\lambda_2\beta_2 \dots \lambda_n\beta_n$ **Or,**

$$E_R = R_f+(AV_1-EV_1)\beta_1+(AV_2-EV_2)\,\beta_2\dots\dots(AV_n-EV_n)\beta_n$$

Where, λ *is* Risk premium for the factors like GDP, inflation, interest rate, etc

(AV_n-EV_n) – Surprise Factor due to change in Value of Factor

Weight to achieve Minimum Variance Portfolio :

$$W_A=\frac{[\,\sigma_B{}^2-r_{AB}\sigma_A\sigma_B]}{\sigma_A{}^2+\sigma_B{}^2-2r_{AB}\sigma_A\sigma_B}$$

Relationship of weight of securities in Minimum Variance Portfolio :

$WB = 1-WA$

Sharpe 's Optimal Portfolio :

Calculation of cutoff point (C*):

$$\frac{\sigma_m{}^2.\sum_{i=1}^{n}\frac{(R_i-R_f)\beta_i}{\sigma_{ei}{}^2}}{1+\sigma_m{}^2\sum_{i=1}^{n}\frac{\beta_i{}^2}{\sigma_{ei}{}^2}}$$

Highest C value is taken as cut off point (C*)

Calculation of weights :

$$\frac{Z_i}{\sum_{i=1}^{n} Z_i}$$

Where, $Z_i=\left(\frac{\beta i}{\sigma ei^2}\right)\times\left[\frac{Ri-Rf}{\beta i}-C*\right]$

σ_m^2 *is* Variance of the market

$\Sigma_{ei}{}^2$is Stock's unsystematic risk

Sharpe Ratio: $S=\frac{R_p-R_f}{\sigma_p}$

Treynor Ratio: $T=\frac{R_p-R_f}{\beta_p}$

Jensen Alpha : $\text{Alpha}(\alpha)=A(R)-E(R)=R_p-(R_f+\beta(R_m-R_f))$

Where, Jensen's Alpha is α

A(R) is Actual return

E(R) is Expected Return as per CAPM

❖ Mutual Funds

NAV per unit :
Net Assets of the Scheme)/(No. of units outstanding) Where,
net assets of the scheme =
Market value of Investments + Receivables + Other accrued income + Other assets – Accrued expenses – Other payables – Other liabilities

Tracking Error (TE) :

$$\sqrt{\frac{\Sigma(d-\bar{d})^2}{n-1}}$$

Where,
d is Differential return
d' or $\bar{d}$ is Average differential return
n = No. of observation

❖ Derivative Analysis and Valuation – Futures

Basis : Spot Price – Futures Price

Annual Compounding :
$A = P(1+r/100)^t$
Where,
A is Compounded amount,P is Principal amount,r is Rate of interest & t is Time period

Interval Compounding :
$A = P(1+r/n)^{nt}$
Where, n is no of intervals

Continous Compounding :
$P \times e^{rt} = X$
Where,
e is Euler's Number and X is Future Value

Futures Price :
$F = S \times e^{(r-y)t}$
Where,
F is Future Value ,S is Spot Value & y is Dividend Yield

Contract Value : Lots size × Futures Price

Beta : $\frac{\Delta \text{ in value of stock}}{\Delta \text{ in value of INDEX}}$

Value of futures contracts to be hedged : Portfolio Value x Beta of the portfolio

❖ Derivative Analysis and Valuation - Options

Long call payoff : Max (0, (S_T – X))
Where,
S_T – Spot price at Maturity Date
X – Strike Price

Short call payoff : Min((X – S_T), 0)

Long put payoff : Max(0, (X - S_T))

Short put payoff : Min((S_T - X), 0))

Delta (Δ):
$$\frac{\text{Change in the price of the option}}{\text{Change in the price of the stock}}$$

Gamma (γ): $\frac{\text{Change in Delta}}{\text{Change in Stock Price}}$

Theta (θ) :
$$\frac{\text{Change in the price of the option}}{\text{Change in time period}}$$

Vega (V) :
$$\frac{\text{Change in the price of the option}}{\text{Change in Volatility by 1\%}}$$

Rho (ρ):
$$\frac{\text{Change in the price of the option}}{\text{Change in Interest rate by 1\%}}$$

Put Call Parity :
C + (K x e^{-rt}) = P + S_0
Where,
C is Value of call
K is Strike price
e^{-rt} is Present Value
P is Value of Put
S_0 is Spot price

Binomial Model :

Probability : $p = \frac{e^{rt} - d}{u - d}$

Where,

$u = \frac{Su}{S0}$

S_u is spot going up & S_0 is current spot

$d = \frac{Sd}{S0}$

S_d is spot going down

Present Value :
$$\frac{(P) \times (Cu) + (1-P) \times (Cd)}{e^{rt}}$$

Black Scholes Merton Method

C = S_0 e^{-yt} N(d_1) – K e^{-rt} N(d_2)

$$d1 = \frac{\ln\left(\frac{S_0}{K}\right) + \left(r - y + \frac{\sigma 2}{2}\right)T}{\sigma\sqrt{T}}$$

d_2 = d1 – $\sigma\sqrt{T}$

y = dividend yield

where, C is Call Value , S_0 is Spot

N(d1) - hedge ratio of shares of stock to Options.

K e^{-rt} N(d2) – borrowing equivalent to PV of the exercise price times an adjustment factor of N(d2)

Futures price of Commodity :

(S_0) x $e^{(r+s-c)t}$

Where,
S_0 is Spot price
r is Rate of interest
s is Storage cost
c is convenience yield
t is time.

❖ Foreign Exposure and Risk Management

Relationship between direct and indirect quote:
Direct Quote = 1/(Indirect Quote)

% Spread $= \frac{\text{Ask} - \text{Bid}}{\text{Bid}} \times 100$

Forward Rate = Spot Rate ± Premium/Discount

Forward Premium % =
$$\frac{\text{Forward Premium}}{\text{Spot Rate}} \times 100$$

Forward Premium (Annualised) :
$$\frac{\text{Forward Premia}}{\text{Spot Rate}} \times \frac{12}{\text{Given Period}} \times 100$$

Forward Rate as per Covered Interest Parity :

= Current spot rate (Direct Q) x
$$\frac{\text{1+ Current domestic interest rate}}{\text{1+ Interest rate of foreign market}}$$

Expected Future Spot Rate as per Uncovered Interest Parity:

= Current spot rate (Direct Q) x
$$\frac{1 + \text{ Current domestic interest rate}}{1 + \text{ Interest rate of foreign market}}$$

Purchasing Power Parity (Absolute Form) :

Spot Rate
$$= \alpha \times \frac{\text{Price level in domestic market}}{\text{Price level in foreign market}}$$

Where,
α = Sectoral constant for adjustment

Purchasing Power Parity (Relative Form) :

Expected Spot Rate =
Current Spot Rate (Direct Q) x
$$\frac{\text{1+Domestic Inflation Rate}}{\text{1+ Foreign Inflation Rate}}$$

International Fisher Effect :
$$\frac{\text{Expected Spot Rate}}{\text{Current Spot Rate}} = \frac{\text{1+ Domestic interest rate}}{\text{1+Interest rate in Foreign market}}$$

❖ Intl. Financial Management

Modified IRR i.e MIRR =

$$\sqrt[n]{\frac{FV\,(\text{Positive Cash Flows, Reinvestment rate})}{-PV\,(\text{Negative cash Flows, Finance rate})}}\ -1$$

Where, n is project life in years.

$$\mathbf{APV} = -I_0 + \sum_{t=1}^{n}\frac{X_t}{(1+K)^t} + \sum_{t=1}^{n}\frac{T_t}{(1+i_d)^t} + \sum_{t=1}^{n}\frac{S_t}{(1+i_d)^t}$$

Where,

I_0 is Present Value of Investment Outlay

$\frac{X_t}{(1+K)^t}$ is present value of operating cash flow

$\frac{T_t}{(1+i_d)^t}$ is present value of Interest Tax shields

$\frac{S_t}{(1+i_d)^t}$ is present value of Interest subsidies

❖ Int. Rate Risk Management

Settlement amount on FRA

$$\frac{N(RR-FR)\left(\frac{dtm}{DY}\right)}{\left[1+RR\left(\frac{dtm}{DY}\right)\right]}$$

Where,

N is notional principal amount

RR is Reference Rate prevailing on the contract settlement date

FR is Agreed-upon Forward Rate

dtm is days of loan (FRA Specified period)

DY is Total number of days (360 or 365 days)

Interest Rate Cap =

$$(N)\max(0, R_A - R_C)\,.\,\frac{dt}{\text{Days in year}}$$

Where,

N is notional principal amount of the agreement,

R_A is actual spot rate on the reset date

R_C is cap rate (expressed as a decimal)

dt is the number of days from the interest rate reset date to the payment date

Interest Rate Floor

$$=(N)\max(0, R_F - R_A)\,.\,\frac{dt}{\text{Days in year}}$$

Interest Rate Collar :

$$\text{Payment} = (N)[\max(0, R_A - R_C) - \max(0, R_F - R_A)].\frac{dt}{\text{Days in year}}$$

Interest Rate Swaps :

$$\text{Rate Payment} = N.(AIC).\frac{d_t}{360}$$

Where,

N is notional principal amount of the agreement,

AIC is All In Cost (Interest rate – fixed or floating)

dt is number of days from the interest rate to the settlement date

❖ Business Valuation

Beta of Assets : $\beta_a = \beta_e\left[\frac{E}{E+D(1-t)}\right] + \beta_d\left[\frac{D\,(1-t)}{E+D(1-t)}\right]$

Where,

β_a – Ungeared or Asset Beta

β_e – Geared or Equity Beta

β_d – Debt Beta

E – Equity

D is Debt

t is Tax rate

P/E to Growth Ratio:

$$\text{PEG Ratio} = \frac{\text{PE Ratio}}{g\,(\%)}$$

Where,

P is Market Price per share

E is Earnings per share

g is Growth rate of EPS

Enterprise Value:

$$EV = MC + D - C$$

Where,

MC is Market capitalization,

D is debt and C is Total Cash Equivalents.

Economic Value Added: EVA = $\text{NOPAT} - \text{Capital Charge} = \text{EBIT}\,(1-\text{tax rate}) - \text{Invested Capital} * \text{WACC}$

Where,

NOPAT = Net Operating Profit After Taxes

EBIT = Earnings before Interest and Tax

WACC = Weighted Average Cost of Capital

Invested Capital = Total Assets minus Non-Interest-Bearing Liabilities

Note: Adjust. EBIT and Invested Capital for non-cash charges (other than depreciation) like provisions for doubtful debts, P&L adjustments.

Market Value Added (MVA):

MVA = MV of E & D – Invested Capital

❖ Miscellaneous

Steps to compute $3^{(1/0)}$

1. Enter Value 3
2. Square root 12 times
3. Subtract 1
4. Divide by 10 (because 10^{th} Root)
5. Add 1
6. Press (X =)12 times
7. Gen answer 1.1161

E power value on calculator $e^{0.16}$

1. Enter Value 0.16
2. Divided by 4096
3. Add 1
4. X = 12 times
5. Final answer =1.17351

Computation of Common Log (base 10) on a Normal Calculator

Eg: Log 1.088235

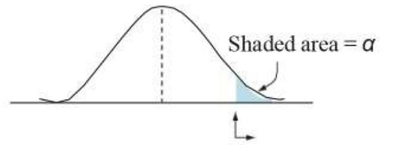
1. Enter Value = 1.088235
2. Square root 15 times
3. Subtract 1
4. Divide by 0.000070271
5. Get the log value = 0.03672

Computation of Natural Log (base e)

Eg: Log 1.088235

1. Enter Value = 1.088235
2. Square root 12 times
3. Subtract 1
4. Divide by 0.000244172
5. Get the log value = 0.084557

T-DISTRIBUTION TABLE



df/α =	.40	.25	.10	.05	.025	.01	.005	.001	.0005
1	0.325	1.000	3.078	6.314	12.706	31.821	63.657	318.309	636.619
2	0.289	0.816	1.886	2.920	4.303	6.965	9.925	22.327	31.599
3	0.277	0.765	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	0.271	0.741	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.267	0.727	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	0.265	0.718	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	0.263	0.711	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	0.262	0.706	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	0.261	0.703	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	0.260	0.700	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	0.260	0.697	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	0.259	0.695	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	0.259	0.694	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	0.258	0.692	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	0.258	0.691	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	0.258	0.690	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	0.257	0.689	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	0.257	0.688	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	0.257	0.688	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	0.257	0.687	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	0.257	0.686	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	0.256	0.686	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	0.256	0.685	1.319	1.714	2.069	2.500	2.807	3.485	3.768
24	0.256	0.685	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	0.256	0.684	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	0.256	0.684	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	0.256	0.684	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	0.256	0.683	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	0.256	0.683	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	0.256	0.683	1.310	1.697	2.042	2.457	2.750	3.385	3.646
35	0.255	0.682	1.306	1.690	2.030	2.438	2.724	3.340	3.591
40	0.255	0.681	1.303	1.684	2.021	2.423	2.704	3.307	3.551
50	0.255	0.679	1.299	1.676	2.009	2.403	2.678	3.261	3.496
60	0.254	0.679	1.296	1.671	2.000	2.390	2.660	3.232	3.460
120	0.254	0.677	1.289	1.658	1.980	2.358	2.617	3.160	3.373
inf.	0.253	0.674	1.282	1.645	1.960	2.326	2.576	3.090	3.291

COMMON LOGARITHM TABLE (BASE 10)

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
10	0000	0043	0086	0128	0170						4	9	13	17	21	26	30	34	38
						0212	0253	0294	0334	0374	4	8	12	16	20	24	28	32	37
11	0414	0453	0492	0531	0569						4	8	12	15	19	23	27	31	35
						0607	0645	0682	0719	0755	4	7	11	15	19	22	26	30	33
12	0792	0828	0864	0899	0934	0969					3	7	11	14	18	21	25	28	32
							1004	1038	1072	1106	3	7	10	14	17	20	24	27	31
13	1139	1173	1206	1239	1271						3	7	10	13	16	20	23	26	30
						1303	1335	1367	1399	1430	3	7	10	12	16	19	22	25	29
14	1461	1492	1523	1553							3	6	9	12	15	18	21	24	28
					1584	1614	1644	1673	1703	1732	3	6	9	12	15	17	20	23	26
15	1761	1790	1818	1847	1875	1903					3	6	9	11	14	17	20	23	26
							1931	1959	1987	2014	3	5	8	11	14	16	19	22	25
16	2041	2068	2095	2122	2148						3	5	8	11	14	16	19	22	24
						2175	2201	2227	2253	2279	3	5	8	10	13	15	18	21	23
17	2304	2330	2355	2380	2405	2430					3	5	8	10	13	15	18	20	23
							2455	2480	2504	2529	2	5	7	10	12	15	17	19	22
18	2553	2577	2601	2625	2648						2	5	7	9	12	14	16	19	21
						2672	2695	2718	2742	2765	2	5	7	9	11	14	16	18	21
19	2788	2810	2833	2856	2878						2	4	7	9	11	13	16	18	20
						2900	2923	2945	2967	2989	2	4	6	8	11	13	15	17	19
20	3010	3032	3054	3075	3096	3118	3139	3160	3181	3201	2	4	6	8	11	13	15	17	19
21	3222	3243	3263	3284	3304	3324	3345	3365	3385	3404	2	4	6	8	10	12	14	16	18
22	3424	3444	3464	3483	3502	3522	3541	3560	3579	3598	2	4	6	8	10	12	14	15	17
23	3617	3636	3655	3674	3692	3711	3729	3747	3766	3784	2	4	6	7	9	11	13	15	17
24	3802	3820	3838	3856	3874	3892	3909	3927	3945	3962	2	4	5	7	9	11	12	14	16
25	3979	3997	4014	4031	4048	4065	4082	4099	4116	4133	2	3	5	7	9	10	12	14	15
26	4150	4166	4183	4200	4216	4232	4249	4265	4281	4298	2	3	5	7	8	10	11	13	15
27	4314	4330	4346	4362	4378	4393	4409	4425	4440	4456	2	3	5	6	8	9	11	13	14
28	4472	4487	4502	4518	4533	4548	4564	4579	4594	4609	2	3	5	6	8	9	11	12	14
29	4624	4639	4654	4669	4683	4698	4713	4728	4742	4757	1	3	4	6	7	9	10	12	13
30	4771	4786	4800	4814	4829	4843	4857	4871	4886	4900	1	3	4	6	7	9	10	11	13
31	4914	4928	4942	4955	4969	4983	4997	5011	5024	5038	1	3	4	6	7	8	10	11	12
32	5051	5065	5079	5092	5105	5119	5132	5145	5159	5172	1	3	4	5	7	8	9	11	12
33	5185	5198	5211	5224	5237	5250	5263	5276	5289	5302	1	3	4	5	6	8	9	10	12
34	5315	5328	5340	5353	5366	5378	5391	5403	5416	5428	1	3	4	5	6	8	9	10	11
35	5441	5453	5465	5478	5490	5502	5514	5527	5539	5551	1	2	4	5	6	7	9	10	11
36	5563	5575	5587	5599	5611	5623	5635	5647	5658	5670	1	2	4	5	6	7	8	10	11
37	5682	5694	5705	5717	5729	5740	5752	5763	5775	5786	1	2	3	5	6	7	8	9	10
38	5798	5809	5821	5832	5843	5855	5866	5877	5888	5899	1	2	3	5	6	7	8	9	10
39	5911	5922	5933	5944	5955	5966	5977	5988	5999	6010	1	2	3	4	5	7	8	9	10
40	6021	6031	6042	6053	6064	6075	6085	6096	6107	6117	1	2	3	4	5	6	8	9	10
41	6128	6138	6149	6160	6170	6180	6191	6201	6212	6222	1	2	3	4	5	6	7	8	9
42	6232	6243	6253	6263	6274	6284	6294	6304	6314	6325	1	2	3	4	5	6	7	8	9
43	6335	6345	6355	6365	6375	6385	6395	6405	6415	6425	1	2	3	4	5	6	7	8	9
44	6435	6444	6454	6464	6474	6484	6493	6503	6513	6522	1	2	3	4	5	6	7	8	9
45	6532	6542	6551	6561	6571	6580	6590	6599	6609	6618	1	2	3	4	5	6	7	8	9
46	6628	6637	6646	6656	6665	6675	6684	6693	6702	6712	1	2	3	4	5	6	7	7	8
47	6721	6730	6739	6749	6758	6767	6776	6785	6794	6803	1	2	3	4	5	5	6	7	8
48	6812	6821	6830	6839	6848	6857	6866	6875	6884	6893	1	2	3	4	4	5	6	7	8
49	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981	1	2	3	4	4	5	6	7	8

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
50	6990	6998	7007	7016	7024	7033	7042	7050	7059	7067	1	2	3	3	4	5	6	7	8
51	7076	7084	7093	7101	7110	7118	7126	7135	7143	7152	1	2	3	3	4	5	6	7	8
52	7160	7168	7177	7185	7193	7202	7210	7218	7226	7235	1	2	2	3	4	5	6	7	7
53	7243	7251	7259	7267	7275	7284	7292	7300	7308	7316	1	2	2	3	4	5	6	6	7
54	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396	1	2	2	3	4	5	6	6	7
55	7404	7412	7419	7427	7435	7443	7451	7459	7466	7474	1	2	2	3	4	5	5	6	7
56	7482	7490	7497	7505	7513	7520	7528	7536	7543	7551	1	2	2	3	4	5	5	6	7
57	7559	7566	7574	7582	7589	7597	7604	7612	7619	7627	1	2	2	3	4	5	5	6	7
58	7634	7642	7649	7657	7664	7672	7679	7686	7694	7701	1	1	2	3	4	4	5	6	7
59	7709	7716	7723	7731	7738	7745	7752	7760	7767	7774	1	1	2	3	4	4	5	6	7
60	7782	7789	7796	7803	7810	7818	7825	7832	7839	7846	1	1	2	3	4	4	5	6	6
61	7853	7860	7868	7875	7882	7889	7896	7903	7910	7917	1	1	2	3	4	4	5	6	6
62	7924	7931	7938	7945	7952	7959	7966	7973	7980	7987	1	1	2	3	3	4	5	6	6
63	7993	8000	8007	8014	8021	8028	8035	8041	8048	8055	1	1	2	3	3	4	5	5	6
64	8062	8069	8075	8082	8089	8096	8102	8109	8116	8122	1	1	2	3	3	4	5	5	6
65	8129	8136	8142	8149	8156	8162	8169	8176	8182	8189	1	1	2	3	3	4	5	5	6
66	8195	8202	8209	8215	8222	8228	8235	8241	8248	8254	1	1	2	3	3	4	5	5	6
67	8261	8267	8274	8280	8287	8293	8299	8306	8312	8319	1	1	2	3	3	4	5	5	6
68	8325	8331	8338	8344	8351	8357	8363	8370	8376	8382	1	1	2	3	3	4	4	5	6
69	8388	8395	8401	8407	8414	8420	8426	8432	8439	8445	1	1	2	2	3	4	4	5	6
70	8451	8457	8463	8470	8476	8482	8488	8494	8500	8506	1	1	2	2	3	4	4	5	6
71	8513	8519	8525	8531	8537	8543	8549	8555	8561	8567	1	1	2	2	3	4	4	5	5
72	8573	8579	8585	8591	8597	8603	8609	8615	8621	8627	1	1	2	2	3	4	4	5	5
73	8633	8639	8645	8651	8657	8663	8669	8675	8681	8686	1	1	2	2	3	4	4	5	5
74	8692	8698	8704	8710	8716	8722	8727	8733	8739	8745	1	1	2	2	3	4	4	5	5
75	8751	8756	8762	8768	8774	8779	8785	8791	8797	8802	1	1	2	2	3	3	4	5	5
76	8808	8814	8820	8825	8831	8837	8842	8848	8854	8859	1	1	2	2	3	3	4	5	5
77	8865	8871	8876	8882	8887	8893	8899	8904	8910	8915	1	1	2	2	3	3	4	4	5
78	8921	8927	8932	8938	8943	8949	8954	8960	8965	8971	1	1	2	2	3	3	4	4	5
79	8976	8982	8987	8993	8998	9004	9009	9015	9020	9025	1	1	2	2	3	3	4	4	5
80	9031	9036	9042	9047	9053	9058	9063	9069	9074	9079	1	1	2	2	3	3	4	4	5
81	9085	9090	9096	9101	9106	9112	9117	9122	9128	9133	1	1	2	2	3	3	4	4	5
82	9138	9143	9149	9154	9159	9165	9170	9175	9180	9186	1	1	2	2	3	3	4	4	5
83	9191	9196	9201	9206	9212	9217	9222	9227	9232	9238	1	1	2	2	3	3	4	4	5
84	9243	9248	9253	9258	9263	9269	9274	9279	9284	9289	1	1	2	2	3	3	4	4	5
85	9294	9299	9304	9309	9315	9320	9325	9330	9335	9340	1	1	2	2	3	3	4	4	5
86	9345	9350	9355	9360	9365	9370	9375	9380	9385	9390	1	1	2	2	3	3	4	4	5
87	9395	9400	9405	9410	9415	9420	9425	9430	9435	9440	0	1	1	2	2	3	3	4	4
88	9445	9450	9455	9460	9465	9469	9474	9479	9484	9489	0	1	1	2	2	3	3	4	4
89	9494	9499	9504	9509	9513	9518	9523	9528	9533	9538	0	1	1	2	2	3	3	4	4
90	9542	9547	9552	9557	9562	9566	9571	9576	9581	9586	0	1	1	2	2	3	3	4	4
91	9590	9595	9600	9605	9609	9614	9619	9624	9628	9633	0	1	1	2	2	3	3	4	4
92	9638	9643	9647	9652	9657	9661	9666	9671	9675	9680	0	1	1	2	2	3	3	4	4
93	9685	9689	9694	9699	9703	9708	9713	9717	9722	9727	0	1	1	2	2	3	3	4	4
94	9731	9736	9741	9745	9750	9754	9759	9763	9768	9773	0	1	1	2	2	3	3	4	4
95	9777	9782	9786	9791	9795	9800	9805	9809	9814	9818	0	1	1	2	2	3	3	4	4
96	9823	9827	9832	9836	9841	9845	9850	9854	9859	9863	0	1	1	2	2	3	3	4	4
97	9868	9872	9877	9881	9886	9890	9894	9899	9903	9908	0	1	1	2	2	3	3	4	4
98	9912	9917	9921	9926	9930	9934	9939	9943	9948	9952	0	1	1	2	2	3	3	4	4
99	9956	9961	9965	9969	9974	9978	9983	9987	9991	9996	0	1	1	2	2	3	3	3	4

COMMON ANTI LOGARITHM TABLE (BASE10)

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
00	1000	1002	1005	1007	1009	1012	1014	1016	1019	1021	0	0	1	1	1	1	2	2	2
.01	1023	1026	1028	1030	1033	1035	1038	1040	1042	1045	0	0	1	1	1	1	2	2	2
.02	1047	1050	1052	1054	1057	1059	1062	1064	1067	1069	0	0	1	1	1	1	2	2	2
.03	1072	1074	1076	1079	1081	1084	1086	1089	1091	1094	0	0	1	1	1	1	2	2	2
.04	1096	1099	1102	1104	1107	1109	1112	1114	1117	1119	0	1	1	1	1	2	2	2	2
.05	1122	1125	1127	1130	1132	1135	1138	1140	1143	1146	0	1	1	1	1	2	2	2	2
.06	1148	1151	1153	1156	1159	1161	1164	1167	1169	1172	0	1	1	1	1	2	2	2	2
.07	1175	1178	1180	1183	1186	1189	1191	1194	1197	1199	0	1	1	1	1	2	2	2	2
.08	1202	1205	1208	1211	1213	1216	1219	1222	1225	1227	0	1	1	1	1	2	2	2	3
.09	1230	1233	1236	1239	1242	1245	1247	1250	1253	1256	0	1	1	1	1	2	2	2	3
.10	1259	1262	1265	1268	1271	1274	1276	1279	1282	1285	0	1	1	1	1	2	2	2	3
.11	1288	1291	1294	1297	1300	1303	1306	1309	1312	1315	0	1	1	1	2	2	2	2	3
.12	1318	1321	1324	1327	1330	1334	1337	1340	1343	1346	0	1	1	1	2	2	2	2	3
.13	1349	1352	1355	1358	1361	1365	1368	1371	1374	1377	0	1	1	1	2	2	2	3	3
.14	1380	1384	1387	1390	1393	1396	1400	1403	1406	1409	0	1	1	1	2	2	2	3	3
.15	1413	1416	1419	1422	1426	1429	1432	1435	1439	1442	0	1	1	1	2	2	2	3	3
.16	1445	1449	1452	1455	1459	1462	1466	1469	1472	1476	0	1	1	1	2	2	2	3	3
.17	1479	1483	1486	1489	1493	1496	1500	1503	1507	1510	0	1	1	1	2	2	2	3	3
.18	1514	1517	1521	1524	1528	1531	1535	1538	1542	1545	0	1	1	1	2	2	2	3	3
.19	1549	1552	1556	1560	1563	1567	1570	1574	1578	1581	0	1	1	1	2	2	3	3	3
.20	1585	1589	1592	1596	1600	1603	1607	1611	1614	1618	0	1	1	1	2	2	3	3	3
.21	1622	1626	1629	1633	1637	1641	1644	1648	1652	1656	0	1	1	2	2	2	3	3	3
.22	1660	1663	1667	1671	1675	1679	1683	1687	1690	1694	0	1	1	2	2	2	3	3	3
.23	1698	1702	1706	1710	1714	1718	1722	1726	1730	1734	0	1	1	2	2	2	3	3	4
.24	1738	1742	1746	1750	1754	1758	1762	1766	1770	1774	0	1	1	2	2	2	3	3	4
.25	1778	1782	1786	1791	1795	1799	1803	1807	1811	1816	0	1	1	2	2	2	3	3	4
.26	1820	1824	1828	1832	1837	1841	1845	1849	1854	1858	0	1	1	2	2	3	3	3	4
.27	1862	1866	1871	1875	1879	1884	1888	1892	1897	1901	0	1	1	2	2	3	3	3	4
.28	1905	1910	1914	1919	1923	1928	1932	1936	1941	1945	0	1	1	2	2	3	3	4	4
.29	1950	1954	1959	1963	1968	1972	1977	1982	1986	1991	0	1	1	2	2	3	3	4	4
.30	1995	2000	2004	2009	2014	2018	2023	2028	2032	2037	0	1	1	2	2	3	3	4	4
.31	2042	2046	2051	2056	2061	2065	2070	2075	2080	2084	0	1	1	2	2	3	3	4	4
.32	2089	2094	2099	2104	2109	2113	2118	2123	2128	2133	0	1	1	2	2	3	3	4	4
.33	2138	2143	2148	2153	2158	2163	2168	2173	2178	2183	0	1	1	2	2	3	3	4	4
.34	2188	2193	2198	2203	2208	2213	2218	2223	2228	2234	1	1	2	2	3	3	4	4	5
.35	2239	2244	2249	2254	2259	2265	2270	2275	2280	2286	1	1	2	2	3	3	4	4	5
.36	2291	2296	2301	2307	2312	2317	2323	2328	2333	2339	1	1	2	2	3	3	4	4	5
.37	2344	2350	2355	2360	2366	2371	2377	2382	2388	2393	1	1	2	2	3	3	4	4	5
.38	2399	2404	2410	2415	2421	2427	2432	2438	2443	2449	1	1	2	2	3	3	4	4	5
.39	2455	2460	2466	2472	2477	2483	2489	2495	2500	2506	1	1	2	2	3	3	4	5	5
.40	2512	2518	2523	2529	2535	2541	2547	2553	2559	2564	1	1	2	2	3	4	4	5	5
.41	2570	2576	2582	2588	2594	2600	2606	2612	2618	2624	1	1	2	2	3	4	4	5	5
.42	2630	2636	2642	2649	2655	2661	2667	2673	2679	2685	1	1	2	2	3	4	4	5	6
.43	2692	2698	2704	2710	2716	2723	2729	2735	2742	2748	1	1	2	3	3	4	4	5	6
.44	2754	2761	2767	2773	2780	2786	2793	2799	2805	2812	1	1	2	3	3	4	4	5	6
.45	2818	2825	2831	2838	2844	2851	2858	2864	2871	2877	1	1	2	3	3	4	5	5	6
.46	2884	2891	2897	2904	2911	2917	2924	2931	2938	2944	1	1	2	3	3	4	5	5	6
.47	2951	2958	2965	2972	2979	2985	2992	2999	3006	3013	1	1	2	3	3	4	5	5	6
.48	3020	3027	3034	3041	3048	3055	3062	3069	3076	3083	1	1	2	3	4	4	5	6	6
.49	3090	3097	3105	3112	3119	3126	3133	3141	3148	3155	1	1	2	3	4	4	5	6	6

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
.50	3162	3170	3177	3184	3192	3199	3206	3214	3221	3228	1	1	2	3	4	4	5	6	7
.51	3236	3243	3251	3258	3266	3273	3281	3289	3296	3304	1	2	2	3	4	5	5	6	7
.52	3311	3319	3327	3334	3342	3350	3357	3365	3373	3381	1	2	2	3	4	5	5	6	7
.53	3388	3396	3404	3412	3420	3428	3436	3443	3451	3459	1	2	2	3	4	5	6	6	7
.54	3467	3475	3483	3491	3499	3508	3516	3524	3532	3540	1	2	2	3	4	5	6	6	7
.55	3548	3556	3565	3573	3581	3589	3597	3606	3614	3622	1	2	2	3	4	5	6	7	7
.56	3631	3639	3648	3656	3664	3673	3681	3690	3698	3707	1	2	3	3	4	5	6	7	8
.57	3715	3724	3733	3741	3750	3758	3767	3776	3784	3793	1	2	3	3	4	5	6	7	8
.58	3802	3811	3819	3828	3837	3846	3855	3864	3873	3882	1	2	3	4	4	5	6	7	8
.59	3890	3899	3908	3917	3926	3936	3945	3954	3963	3972	1	2	3	4	5	5	6	7	8
.60	3981	3990	3999	4009	4018	4027	4036	4046	4055	4064	1	2	3	4	5	6	6	7	8
.61	4074	4083	4093	4102	4111	4121	4130	4140	4150	4159	1	2	3	4	5	6	7	8	9
.62	4169	4178	4188	4198	4207	4217	4227	4236	4246	4256	1	2	3	4	5	6	7	8	9
.63	4266	4276	4285	4295	4305	4315	4325	4335	4345	4355	1	2	3	4	5	6	7	8	9
.64	4365	4375	4385	4395	4406	4416	4426	4436	4446	4457	1	2	3	4	5	6	7	8	9
.65	4467	4477	4487	4498	4508	4519	4529	4539	4550	4560	1	2	3	4	5	6	7	8	9
.66	4571	4581	4592	4603	4613	4624	4634	4645	4656	4667	1	2	3	4	5	6	7	9	10
.67	4677	4688	4699	4710	4721	4732	4742	4753	4764	4775	1	2	3	4	5	7	8	9	10
.68	4786	4797	4808	4819	4831	4842	4853	4864	4875	4887	1	2	3	4	6	7	8	9	10
.69	4898	4909	4920	4932	4943	4955	4966	4977	4989	5000	1	2	3	5	6	7	8	9	10
.70	5012	5023	5035	5047	5058	5070	5082	5093	5105	5117	1	2	4	5	6	7	8	9	11
.71	5129	5140	5152	5164	5176	5188	5200	5212	5224	5236	1	2	4	5	6	7	8	10	11
.72	5248	5260	5272	5284	5297	5309	5321	5333	5346	5358	1	2	4	5	6	7	9	10	11
.73	5370	5383	5395	5408	5420	5433	5445	5458	5470	5483	1	3	4	5	6	8	9	10	11
.74	5495	5508	5521	5534	5546	5559	5572	5585	5598	5610	1	3	4	5	6	8	9	10	12
.75	5623	5636	5649	5662	5675	5689	5702	5715	5728	5741	1	3	4	5	7	8	9	10	12
.76	5754	5768	5781	5794	5808	5821	5834	5848	5861	5875	1	3	4	5	7	8	9	11	12
.77	5888	5902	5916	5929	5943	5957	5970	5984	5998	6012	1	3	4	5	7	8	10	11	12
.78	6026	6039	6053	6067	6081	6095	6109	6124	6138	6152	1	3	4	6	7	8	10	11	13
.79	6166	6180	6194	6209	6223	6237	6252	6266	6281	6295	1	3	4	6	7	9	10	11	13
.80	6310	6324	6339	6353	6368	6383	6397	6412	6427	6442	1	3	4	6	7	9	10	12	13
.81	6457	6471	6486	6501	6516	6531	6546	6561	6577	6592	2	3	5	6	8	9	11	12	14
.82	6607	6622	6637	6653	6668	6683	6699	6714	6730	6745	2	3	5	6	8	9	11	12	14
.83	6761	6776	6792	6808	6823	6839	6855	6871	6887	6902	2	3	5	6	8	9	11	13	14
.84	6918	6934	6950	6966	6982	6998	7015	7031	7047	7063	2	3	5	6	8	10	11	13	15
.85	7079	7096	7112	7129	7145	7161	7178	7194	7211	7228	2	3	5	7	8	10	12	13	15
.86	7244	7261	7278	7295	7311	7328	7345	7362	7379	7396	2	3	5	7	8	10	12	13	15
.87	7413	7430	7447	7464	7482	7499	7516	7534	7551	7568	2	3	5	7	9	10	12	14	16
.88	7586	7603	7621	7638	7656	7674	7691	7709	7727	7745	2	4	5	7	9	11	12	14	16
.89	7762	7780	7798	7816	7834	7852	7870	7889	7907	7925	2	4	5	7	9	11	13	14	16
.90	7943	7962	7980	7998	8017	8035	8054	8072	8091	8110	2	4	6	7	9	11	13	15	17
.91	8128	8147	8166	8185	8204	8222	8241	8260	8279	8299	2	4	6	8	9	11	13	15	17
.92	8318	8337	8356	8375	8395	8414	8433	8453	8472	8492	2	4	6	8	10	12	14	15	17
.93	8511	8531	8551	8570	8590	8610	8630	8650	8670	8690	2	4	6	8	10	12	14	16	18
.94	8710	8730	8750	8770	8790	8810	8831	8851	8872	8892	2	4	6	8	10	12	14	16	18
.95	8913	8933	8954	8974	8995	9016	9036	9057	9078	9099	2	4	6	8	10	12	15	17	19
.96	9120	9141	9162	9183	9204	9226	9247	9268	9290	9311	2	4	6	8	11	13	15	17	19
.97	9333	9354	9376	9397	9419	9441	9462	9484	9506	9528	2	4	7	9	11	13	15	17	20
.98	9550	9572	9594	9616	9638	9661	9683	9705	9727	9750	2	4	7	9	11	13	16	18	20
.99	9772	9795	9817	9840	9863	9886	9908	9931	9954	9977	2	5	7	9	11	14	16	18	20

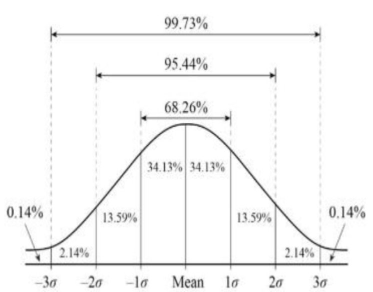
Natural Logarithm Table (Base e)

ln	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
1.0	0.0000	0.0100	0.0198	0.0296	0.0392	0.0488	0.0583	0.0677	0.0770	0.0862	100	99	98	97	96	95	94	93	92
1.1	0.0953	0.1044	0.1133	0.1222	0.1310	0.1398	0.1484	0.1570	0.1655	0.1740	90	90	89	88	87	87	86	85	84
1.2	0.1823	0.1906	0.1989	0.2070	0.2151	0.2231	0.2311	0.2390	0.2469	0.2546	83	82	82	81	80	80	79	78	78
1.3	0.2624	0.2700	0.2776	0.2852	0.2927	0.3001	0.3075	0.3148	0.3221	0.3293	77	76	75	75	74	74	73	73	72
1.4	0.3365	0.3436	0.3507	0.3577	0.3646	0.3716	0.3784	0.3853	0.3920	0.3988	71	71	70	70	69	69	68	68	67
1.5	0.4055	0.4121	0.4187	0.4253	0.4318	0.4383	0.4447	0.4511	0.4574	0.4637	66	66	66	65	65	64	64	63	63
1.6	0.4700	0.4762	0.4824	0.4886	0.4947	0.5008	0.5068	0.5128	0.5188	0.5247	62	62	62	61	61	60	60	60	59
1.7	0.5306	0.5365	0.5423	0.5481	0.5539	0.5596	0.5653	0.5710	0.5766	0.5822	59	58	58	58	57	57	57	56	56
1.8	0.5878	0.5933	0.5988	0.6043	0.6098	0.6152	0.6206	0.6259	0.6313	0.6366	55	55	55	54	54	54	54	53	53
1.9	0.6419	0.6471	0.6523	0.6575	0.6627	0.6678	0.6729	0.6780	0.6831	0.6881	52	52	52	52	51	51	51	51	50
2.0	0.6931	0.6981	0.7031	0.7080	0.7129	0.7178	0.7227	0.7275	0.7324	0.7372	50	50	49	49	49	49	48	48	48
2.1	0.7419	0.7467	0.7514	0.7561	0.7608	0.7655	0.7701	0.7747	0.7793	0.7839	48	47	47	47	47	46	46	46	46
2.2	0.7885	0.7930	0.7975	0.8020	0.8065	0.8109	0.8154	0.8198	0.8242	0.8286	45	45	45	45	45	44	44	44	44
2.3	0.8329	0.8372	0.8416	0.8459	0.8502	0.8544	0.8587	0.8629	0.8671	0.8713	43	43	43	43	43	42	42	42	42
2.4	0.8755	0.8796	0.8838	0.8879	0.8920	0.8961	0.9002	0.9042	0.9083	0.9123	42	41	41	41	41	41	41	40	40
2.5	0.9163	0.9203	0.9243	0.9282	0.9322	0.9361	0.9400	0.9439	0.9478	0.9517	40	40	40	39	39	39	39	39	39
2.6	0.9555	0.9594	0.9632	0.9670	0.9708	0.9746	0.9783	0.9821	0.9858	0.9895	38	38	38	38	38	38	38	37	37
2.7	0.9933	0.9969	1.0006	1.0043	1.0080	1.0116	1.0152	1.0188	1.0225	1.0260	37	37	37	37	36	36	36	36	36
2.8	1.0296	1.0332	1.0367	1.0403	1.0438	1.0473	1.0508	1.0543	1.0578	1.0613	36	36	35	35	35	35	35	35	35
2.9	1.0647	1.0682	1.0716	1.0750	1.0784	1.0818	1.0852	1.0886	1.0919	1.0953	34	34	34	34	34	34	34	34	34
3.0	1.0986	1.1019	1.1053	1.1086	1.1119	1.1151	1.1184	1.1217	1.1249	1.1282	33	33	33	33	33	33	33	33	32
3.1	1.1314	1.1346	1.1378	1.1410	1.1442	1.1474	1.1506	1.1537	1.1569	1.1600	32	32	32	32	32	32	32	31	31
3.2	1.1632	1.1663	1.1694	1.1725	1.1756	1.1787	1.1817	1.1848	1.1878	1.1909	31	31	31	31	31	31	31	31	30
3.3	1.1939	1.1969	1.2000	1.2030	1.2060	1.2090	1.2119	1.2149	1.2179	1.2208	30	30	30	30	30	30	30	30	30
3.4	1.2238	1.2267	1.2296	1.2326	1.2355	1.2384	1.2413	1.2442	1.2470	1.2499	29	29	29	29	29	29	29	29	29
3.5	1.2528	1.2556	1.2585	1.2613	1.2641	1.2669	1.2698	1.2726	1.2754	1.2782	29	28	28	28	28	28	28	28	28
3.6	1.2809	1.2837	1.2865	1.2892	1.2920	1.2947	1.2975	1.3002	1.3029	1.3056	28	28	28	28	27	27	27	27	27
3.7	1.3083	1.3110	1.3137	1.3164	1.3191	1.3218	1.3244	1.3271	1.3297	1.3324	27	27	27	27	27	27	27	26	26
3.8	1.3350	1.3376	1.3403	1.3429	1.3455	1.3481	1.3507	1.3533	1.3558	1.3584	26	26	26	26	26	26	26	26	26
3.9	1.3610	1.3635	1.3661	1.3686	1.3712	1.3737	1.3762	1.3788	1.3813	1.3838	26	26	25	25	25	25	25	25	25
4.0	1.3863	1.3888	1.3913	1.3938	1.3962	1.3987	1.4012	1.4036	1.4061	1.4085	25	25	25	25	25	25	25	25	24
4.1	1.4110	1.4134	1.4159	1.4183	1.4207	1.4231	1.4255	1.4279	1.4303	1.4327	24	24	24	24	24	24	24	24	24
4.2	1.4351	1.4375	1.4398	1.4422	1.4446	1.4469	1.4493	1.4516	1.4540	1.4563	24	24	24	24	24	24	23	23	23
4.3	1.4586	1.4609	1.4633	1.4656	1.4679	1.4702	1.4725	1.4748	1.4770	1.4793	23	23	23	23	23	23	23	23	23
4.4	1.4816	1.4839	1.4861	1.4884	1.4907	1.4929	1.4951	1.4974	1.4996	1.5019	23	23	23	23	22	22	22	22	22
4.5	1.5041	1.5063	1.5085	1.5107	1.5129	1.5151	1.5173	1.5195	1.5217	1.5239	22	22	22	22	22	22	22	22	22
4.6	1.5261	1.5282	1.5304	1.5326	1.5347	1.5369	1.5390	1.5412	1.5433	1.5454	22	22	22	22	22	21	21	21	21
4.7	1.5476	1.5497	1.5518	1.5539	1.5560	1.5581	1.5602	1.5623	1.5644	1.5665	21	21	21	21	21	21	21	21	21
4.8	1.5686	1.5707	1.5728	1.5748	1.5769	1.5790	1.5810	1.5831	1.5851	1.5872	21	21	21	21	21	21	21	21	20
4.9	1.5892	1.5913	1.5933	1.5953	1.5974	1.5994	1.6014	1.6034	1.6054	1.6074	20	20	20	20	20	20	20	20	20
5.0	1.6094	1.6114	1.6134	1.6154	1.6174	1.6194	1.6214	1.6233	1.6253	1.6273	20	20	20	20	20	20	20	20	20
5.1	1.6292	1.6312	1.6332	1.6351	1.6371	1.6390	1.6409	1.6429	1.6448	1.6467	20	20	20	19	19	19	19	19	19
5.2	1.6487	1.6506	1.6525	1.6544	1.6563	1.6582	1.6601	1.6620	1.6639	1.6658	19	19	19	19	19	19	19	19	19
5.3	1.6677	1.6696	1.6715	1.6734	1.6752	1.6771	1.6790	1.6808	1.6827	1.6845	19	19	19	19	19	19	19	19	19
5.4	1.6864	1.6882	1.6901	1.6919	1.6938	1.6956	1.6974	1.6993	1.7011	1.7029	19	18	18	18	18	18	18	18	18
5.5	1.7047	1.7066	1.7084	1.7102	1.7120	1.7138	1.7156	1.7174	1.7192	1.7210	18	18	18	18	18	18	18	18	18
5.6	1.7228	1.7246	1.7263	1.7281	1.7299	1.7317	1.7334	1.7352	1.7370	1.7387	18	18	18	18	18	18	18	18	18
5.7	1.7405	1.7422	1.7440	1.7457	1.7475	1.7492	1.7509	1.7527	1.7544	1.7561	18	17	17	17	17	17	17	17	17
5.8	1.7579	1.7596	1.7613	1.7630	1.7647	1.7664	1.7681	1.7699	1.7716	1.7733	17	17	17	17	17	17	17	17	17
5.9	1.7750	1.7766	1.7783	1.7800	1.7817	1.7834	1.7851	1.7867	1.7884	1.7901	17	17	17	17	17	17	17	17	17
6.0	1.7918	1.7934	1.7951	1.7967	1.7984	1.8001	1.8017	1.8034	1.8050	1.8066	17	17	17	17	17	17	16	16	16
6.1	1.8083	1.8099	1.8116	1.8132	1.8148	1.8165	1.8181	1.8197	1.8213	1.8229	16	16	16	16	16	16	16	16	16
6.2	1.8245	1.8262	1.8278	1.8294	1.8310	1.8326	1.8342	1.8358	1.8374	1.8390	16	16	16	16	16	16	16	16	16

6.3	1.8405	1.8421	1.8437	1.8453	1.8469	1.8485	1.8500	1.8516	1.8532	1.8547	16	16	16	16	16	16	16	16	16
6.4	1.8563	1.8579	1.8594	1.8610	1.8625	1.8641	1.8656	1.8672	1.8687	1.8703	16	16	16	16	16	15	15	15	15
6.5	1.8718	1.8733	1.8749	1.8764	1.8779	1.8795	1.8810	1.8825	1.8840	1.8856	15	15	15	15	15	15	15	15	15
6.6	1.8871	1.8886	1.8901	1.8916	1.8931	1.8946	1.8961	1.8976	1.8991	1.9006	15	15	15	15	15	15	15	15	15
6.7	1.9021	1.9036	1.9051	1.9066	1.9081	1.9095	1.9110	1.9125	1.9140	1.9155	15	15	15	15	15	15	15	15	15
6.8	1.9169	1.9184	1.9199	1.9213	1.9228	1.9242	1.9257	1.9272	1.9286	1.9301	15	15	15	15	15	15	15	15	15
6.9	1.9315	1.9330	1.9344	1.9359	1.9373	1.9387	1.9402	1.9416	1.9430	1.9445	14	14	14	14	14	14	14	14	14
7.0	1.9459	1.9473	1.9488	1.9502	1.9516	1.9530	1.9544	1.9559	1.9573	1.9587	14	14	14	14	14	14	14	14	14
7.1	1.9601	1.9615	1.9629	1.9643	1.9657	1.9671	1.9685	1.9699	1.9713	1.9727	14	14	14	14	14	14	14	14	14
7.2	1.9741	1.9755	1.9769	1.9782	1.9796	1.9810	1.9824	1.9838	1.9851	1.9865	14	14	14	14	14	14	14	14	14
7.3	1.9879	1.9892	1.9906	1.9920	1.9933	1.9947	1.9961	1.9974	1.9988	2.0001	14	14	14	14	14	14	14	14	14
7.4	2.0015	2.0028	2.0042	2.0055	2.0069	2.0082	2.0096	2.0109	2.0122	2.0136	14	13	13	13	13	13	13	13	13
7.5	2.0149	2.0162	2.0176	2.0189	2.0202	2.0215	2.0229	2.0242	2.0255	2.0268	13	13	13	13	13	13	13	13	13
7.6	2.0281	2.0295	2.0308	2.0321	2.0334	2.0347	2.0360	2.0373	2.0386	2.0399	13	13	13	13	13	13	13	13	13
7.7	2.0412	2.0425	2.0438	2.0451	2.0464	2.0477	2.0490	2.0503	2.0516	2.0528	13	13	13	13	13	13	13	13	13
7.8	2.0541	2.0554	2.0567	2.0580	2.0592	2.0605	2.0618	2.0631	2.0643	2.0656	13	13	13	13	13	13	13	13	13
7.9	2.0669	2.0681	2.0694	2.0707	2.0719	2.0732	2.0744	2.0757	2.0769	2.0782	13	13	13	13	13	13	13	13	13
8.0	2.0794	2.0807	2.0819	2.0832	2.0844	2.0857	2.0869	2.0882	2.0894	2.0906	12	12	12	12	12	12	12	12	12
8.1	2.0919	2.0931	2.0943	2.0956	2.0968	2.0980	2.0992	2.1005	2.1017	2.1029	12	12	12	12	12	12	12	12	12
8.2	2.1041	2.1054	2.1066	2.1078	2.1090	2.1102	2.1114	2.1126	2.1138	2.1150	12	12	12	12	12	12	12	12	12
8.3	2.1163	2.1175	2.1187	2.1199	2.1211	2.1223	2.1235	2.1247	2.1258	2.1270	12	12	12	12	12	12	12	12	12
8.4	2.1282	2.1294	2.1306	2.1318	2.1330	2.1342	2.1353	2.1365	2.1377	2.1389	12	12	12	12	12	12	12	12	12
8.5	2.1401	2.1412	2.1424	2.1436	2.1448	2.1459	2.1471	2.1483	2.1494	2.1506	12	12	12	12	12	12	12	12	12
8.6	2.1518	2.1529	2.1541	2.1552	2.1564	2.1576	2.1587	2.1599	2.1610	2.1622	12	12	12	12	12	12	12	12	12
8.7	2.1633	2.1645	2.1656	2.1668	2.1679	2.1691	2.1702	2.1713	2.1725	2.1736	11	11	11	11	11	11	11	11	11
8.8	2.1748	2.1759	2.1770	2.1782	2.1793	2.1804	2.1815	2.1827	2.1838	2.1849	11	11	11	11	11	11	11	11	11
8.9	2.1861	2.1872	2.1883	2.1894	2.1905	2.1917	2.1928	2.1939	2.1950	2.1961	11	11	11	11	11	11	11	11	11
9.0	2.1972	2.1983	2.1994	2.2006	2.2017	2.2028	2.2039	2.2050	2.2061	2.2072	11	11	11	11	11	11	11	11	11
9.1	2.2083	2.2094	2.2105	2.2116	2.2127	2.2138	2.2148	2.2159	2.2170	2.2181	11	11	11	11	11	11	11	11	11
9.2	2.2192	2.2203	2.2214	2.2225	2.2235	2.2246	2.2257	2.2268	2.2279	2.2289	11	11	11	11	11	11	11	11	11
9.3	2.2300	2.2311	2.2322	2.2332	2.2343	2.2354	2.2364	2.2375	2.2386	2.2396	11	11	11	11	11	11	11	11	11
9.4	2.2407	2.2418	2.2428	2.2439	2.2450	2.2460	2.2471	2.2481	2.2492	2.2502	11	11	11	11	11	11	11	11	11
9.5	2.2513	2.2523	2.2534	2.2544	2.2555	2.2565	2.2576	2.2586	2.2597	2.2607	11	11	10	10	10	10	10	10	10
9.6	2.2618	2.2628	2.2638	2.2649	2.2659	2.2670	2.2680	2.2690	2.2701	2.2711	10	10	10	10	10	10	10	10	10
9.7	2.2721	2.2732	2.2742	2.2752	2.2762	2.2773	2.2783	2.2793	2.2803	2.2814	10	10	10	10	10	10	10	10	10
9.8	2.2824	2.2834	2.2844	2.2854	2.2865	2.2875	2.2885	2.2895	2.2905	2.2915	10	10	10	10	10	10	10	10	10
9.9	2.2925	2.2935	2.2946	2.2956	2.2966	2.2976	2.2986	2.2996	2.3006	2.3016	10	10	10	10	10	10	10	10	10
10.0	2.3026	2.3036	2.3046	2.3056	2.3066	2.3076	2.3086	2.3096	2.3106	2.3115	10	10	10	10	10	10	10	10	10

CUMULATIVE STANDARD NORMAL DISTRIBUTION TABLE										
Z	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
-	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.10	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.20	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6064	0.1064	0.6103	0.6141
0.30	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.40	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.50	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.60	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.70	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.80	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.90	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.00	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.10	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.20	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.30	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.40	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.50	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.60	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.70	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.80	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.90	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.00	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.10	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.20	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.30	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.40	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.50	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.60	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.70	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.80	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.90	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.00	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990

1.645 – 95.0% of cumulative area from left – Lower limit of right 5% Tail
1.960 – 97.5% of cumulative area from left – Lower limit of right 2.5% Tail
2.326 – 99.0% of cumulative area from left – Lower limit of right 1% Tail
2.576 – 99.5% of cumulative area from left – Lower limit of right 0.5% Tail
3.090- 99.9% of cumulative area from left – Lower limit of right 0.1% Tail
3.291- 99.95% of cumulative area from left – Lower limit of right 0.05% Tail



Area under normal curve (Both tails)
1 SD on either side – 68.26% of area under the curve is covered
2 SD on either side – 95.44% of area under the curve is covered
3 SD on either side – 99.73% of area under the curve is covered
1.645 SD on either side – 90% of are under curve is covered
1.960 SD on either side – 95% of are under curve is covered
2.576 SD on either side – 99% of are under curve is covered