



ZIMBABWE EZEKIEL GUTI UNIVERSITY

FACULTY OF BUSINESS ECONOMICS AND ACCOUNTING

DEPARTMENT OF BUSINESS ADMINISTRATION AND MANAGEMENT

EXAMINATION PAPER

COURSE CODE : CBM122
COURSE TITLE : Quantitative Analysis for
Business
SPECIAL REQUIREMENTS : Statistical Tables
Formulae Sheets
Graph Paper
DURATION : 3 Hours **06 JUL 2022**
LEVEL : 1.2
DATE :

INSTRUCTIONS TO CANDIDATES:

1. No cell phones are allowed in the examination venue.
2. Answer any **FOUR (4)** questions.
3. The number of marks for each question or part question is shown in brackets []
4. Use of non-programmable calculators is allowed.
5. Show all your workings in order to gain full marks.
6. Begin each answer on a new page.

QUESTION ONE

Marks in a class of 50 students were as follows:

37 47 32 26 21 41 38 41 50 45
52 46 37 45 31 40 44 48 46 15
30 40 36 32 47 37 47 50 40 45
51 52 38 26 41 33 38 39 37 32
40 38 50 38 48 41 36 41 41 53

- Construct a frequency distribution. [4 marks]
- Construct a histogram. [4 marks]
- Construct an ogive. [4 marks]
- Calculate mean, median and mode. [6 marks]
- Use your answers in (d) to draw a suitable graph showing the skewness of the frequency distribution. [2 marks]
- Calculate the coefficient of variation and comment [5 marks]

QUESTION TWO

- The government of Zimbabwe is considering carrying out a nationwide survey to ascertain the extent to which the COVID-19 pandemic has spread in the country.
 - Discuss reasons why a sample survey is preferred to a census. [10 marks]
 - Identify with justification, an appropriate sampling method for the study. [5 marks]
- What is the level of measurement for each of the following variables? Justify your answer.
 - Distance students travel to class. [2 mark]
 - Student scores on the first statistics test. [2 mark]
 - A classification of students by state of birth. [2 mark]
 - A ranking of students by freshman, junior, and senior. [2 mark]
 - Number of hours students study per week. [2 mark]

QUESTION THREE

The training manager of a company that assembles and exports pool pumps wants to know if there is a link between the number of hours spent by assembly workers in training and their productivity on the job. A random sample of 10 assembly workers was selected and their performances evaluated.

Number of hours spent	Productivity
20	40
36	70
20	44
38	56
40	60
33	48
32	62
28	54
40	63
24	38

Required

- a) Construct a scatter plot of the sample data and comment on the relationship between hours of training and output. [5 marks]
- b) Calculate a simple regression line, using the method of least squares, to identify a linear relationship between the hours of training received by assembly workers and their output (i.e. number of units assembled per day) and interpret the coefficients. [8 marks]
- c) Calculate the coefficient of determination between training hours received and worker output. Interpret its meaning and advise the training manager. [5 marks]
- d) Calculate the correlation coefficient of the training hours received and worker output. Interpret its meaning and advise the training manager. [5 marks]
- e) Estimate the average daily output of an assembly worker who has received only twenty-five hours of training. [2 marks]

QUESTION FOUR

- a. In an article about the cost of health care, Money magazine reported that a visit to a hospital emergency room for something as simple as a sore throat has a mean cost of \$328. Assume that the cost for this type of hospital emergency room visit is normally distributed with a standard deviation of \$92. Answer the following questions about the cost of hospital emergency room visits for this medical service:
 - i. The probability is 0.1 that the cost is greater than what number? [5 marks]
 - ii. If the cost to a patient is in the lower 18% of charges for this medical service, what was the cost of this patient's emergency room visit? [5 marks]
- b. A life insurance salesman believes that the mean age of people who buy their first life insurance plan is less than 35. To test his belief, he takes a random sample of 15 customers who have just purchased their first life insurance. Their ages are shown below and are assumed to be normally distributed.

42	43	28	34	30
36	25	29	32	33
27	30	22	37	40

 - i. Calculate the mean and standard deviation of the data. [5 marks]
 - ii. State the null hypothesis of the salesman's claim [1 mark]
 - iii. Test the hypothesis at the 1% significance level to determine whether or not the salesman's claim is correct and hence give a conclusion. [9 marks]

QUESTION FIVE

- a. Mary is investing a fixed amount of \$100000 into a fund every end of the year in

advance for 6 years. If the fund earns an interest of 8.5% per annum. Construct a schedule to show the value of the fund at the end of each year. [10 marks]

b. The firm's profit for selling Q units of a product can be approximated by

The following functions:

$$TR = 1300Q - 5Q^2 \text{ and } TC = Q^3 - 50Q^2 + 100Q + 80000.$$

a. What level of sales maximizes the profit? [10 marks]

b. Calculate the maximize profit for the firm [5 marks]

~~~~END OF PAPER~~~~

- iv. **Addition rule**
- a) If X, Y are non-mutually exclusive,  $P(X \cup Y) = P(X) + P(Y) - P(X \cap Y)$
  - b) If X, Y are mutually exclusive,  $P(X \cup Y) = P(X) + P(Y)$
- v. **Multiplication rule**
- a) If X, Y are dependent (conditional probability),  
 $P(X \cap Y) = P(X) \cdot P(Y|X) = P(Y) \cdot P(X|Y)$
  - b) If X, Y are independent,  $P(X \cap Y) = P(X) \cdot P(Y)$
- vi. **Law of Conditional Probability,  $P(X|Y) = \frac{P(X \cap Y)}{P(Y)} = \frac{P(X) \cdot P(Y|X)}{P(Y)}$**

**PROBABILITY DISTRIBUTION**

| Probability distribution                                            | Mean      | Variance  |
|---------------------------------------------------------------------|-----------|-----------|
| Binomial distribution<br>$P(x) = \frac{n!}{x!(n-x)!} p^x (q)^{n-x}$ | np        | npq       |
| Poisson distribution<br>$P(x) = \frac{\lambda^x e^{-\lambda}}{x!}$  | $\lambda$ | $\lambda$ |
| Standard normal distribution<br>$Z = \frac{x - \mu}{\sigma}$        | 0         | 1         |

**CONFIDENCE INTERVALS**

Mean of a single normal population

- i. If sample size is small (i.e.,  $n < 30$ ) and  $\sigma^2$  Unknown  
 $\bar{x} - t_{\alpha/2} (n-1) \frac{s}{\sqrt{n}} \leq \mu \leq \bar{x} + t_{\alpha/2} (n-1) \frac{s}{\sqrt{n}}$  or simply  $\bar{x} \pm t_{\alpha/2} (n-1) \frac{s}{\sqrt{n}}$
- ii. If sample size is large and  $\sigma^2$  unknown  
 $\bar{x} - Z_{\alpha/2} \frac{s}{\sqrt{n}} \leq \mu \leq \bar{x} + Z_{\alpha/2} \frac{s}{\sqrt{n}}$  or simply,  $\bar{x} \pm Z_{\alpha/2} \frac{s}{\sqrt{n}}$
- iii. If variance,  $\sigma^2$  is known  
 $\bar{x} - Z_{\alpha/2} \frac{\sigma}{\sqrt{n}} \leq \mu \leq \bar{x} + Z_{\alpha/2} \frac{\sigma}{\sqrt{n}}$  or simply,  $\bar{x} \pm Z_{\alpha/2} \frac{\sigma}{\sqrt{n}}$

**TESTING OF HYPOTHESIS**

Tests on the mean of a single population

- i. If when  $\sigma^2$  is unknown and sample size is small ( $n < 30$ ), then the t Statistic is such that,  
 $t = \frac{\bar{x} - \mu_x}{\frac{s}{\sqrt{n}}}$
- ii. If when  $\sigma^2$  is known and sample size is large, then the z statistic is such that:  
 $z = \frac{\bar{x} - \mu_x}{\frac{\sigma_x}{\sqrt{n}}} = Z = \frac{\bar{x} - \mu_x}{\frac{\sigma}{\sqrt{n}}}$
- iii. If when  $\sigma^2$  is unknown and sample size is large, then the t statistic is approximately a standard normal random variable such that:  $z = \frac{\bar{x} - \mu_x}{\frac{s}{\sqrt{n}}}$

| Hypothesis to be tested                     | Distribution   | Reject $H_0$ if                                |
|---------------------------------------------|----------------|------------------------------------------------|
| $H_0: \mu = \mu_0$<br>$H_1: \mu \neq \mu_0$ | Z-distribution | $Z > Z_{\alpha/2}$<br>$Z < -Z_{\alpha/2}$      |
|                                             | T-distribution | $T > T_{\alpha/2}$<br>$T < -T_{\alpha/2}(n-1)$ |
| $H_0: \mu \leq \mu_0$<br>$H_1: \mu > \mu_0$ | Z-distribution | $Z > Z_{\alpha}$                               |
|                                             | T-distribution | $T > T_{\alpha}(n-1)$                          |
| $H_0: \mu \geq \mu_0$<br>$H_1: \mu < \mu_0$ | Z-distribution | $Z < -Z_{\alpha}$                              |
|                                             | T-distribution | $T < -T_{\alpha}(n-1)$                         |

Chi-square tests:  $\chi^2_{calc} = \sum \frac{(fo-fe)^2}{fe}$

**SIMPLE REGRESSION AND CORRELATION**

Fitted linear model:  $\hat{Y} = \hat{b}_0 + \hat{b}_1 X$

$\hat{b}_1 = \frac{n \sum XY - \sum X \sum Y}{n \sum X^2 - (\sum X)^2}$

$\hat{b}_0 = \bar{Y} - \hat{b}_1 \bar{X}$

Covariance,  $Cov(X, Y) = \frac{\sum(XY)}{n} - \bar{X} \bar{Y}$

Correlation coefficient,  $r = \sqrt{R^2} = \frac{n \sum XY - \sum X \sum Y}{\sqrt{[n \sum X^2 - (\sum X)^2][n \sum Y^2 - (\sum Y)^2]}}$

$$\text{Coefficient of determination, } R^2 = \left( \frac{n \sum XY - \sum X \sum Y}{\sqrt{(n \sum X^2 - (\sum X)^2)(n \sum Y^2 - (\sum Y)^2)}} \right)^2$$

### TIME SERIES ANALYSIS

Fitted Trend Line:  $Y = a + bX$

$$b = \frac{n \sum XY - \sum X \sum Y}{n \sum X^2 - (\sum X)^2}$$

$$a = \bar{Y} - b \bar{X}$$

### BUSINESS CALCULATIONS

Quadratic formula:  $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

#### Differentiation

- i. if  $f(x) = x^n$  then  $f'(x) = nx^{n-1}$ ; if  $y = x^n$  then  $\frac{dy}{dx} = nx^{n-1}$
- ii. Rule 1: The constant rule. If  $h(x) = cf(x)$  then  $h'(x) = cf'(x)$  for any constant  $c$ .
- iii. Rule 2: The sum rule. If  $h(x) = f(x) + g(x)$  then  $h'(x) = f'(x) + g'(x)$
- iv. Rule 3: The difference rule. If  $h(x) = f(x) - g(x)$  then  $h'(x) = f'(x) - g'(x)$
- v. Rule 4: The chain rule. If  $y$  is a function of  $u$ , which is itself a function of  $x$ , then

$$\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$$

- vi. Rule 5: The product rule. If  $y = uv$  then  $\frac{dy}{dx} = u \frac{dv}{dx} + v \frac{du}{dx}$

- value. Rule 6: The quotient rule. If  $y = \frac{u}{v}$  then  $\frac{dy}{dx} = \frac{v \frac{du}{dx} - u \frac{dv}{dx}}{v^2}$

- viii. Implicit differentiation:  $\frac{dy}{dx} = -\frac{fx}{fy}$

Simple interest:

$$FV = \text{Principal} \times \text{Rate} \times \text{Time}$$

Compound interest:

$$FV = A(1+i)^n$$

Future Value of an Ordinary Annuity:  $FV = R \left[ \frac{(1+i)^n - 1}{i} \right]$

Regular deposit:

$$R = \frac{FVi}{(1+i)^n - 1}$$

Present Value of an Ordinary Annuity:  $PV = R \left[ \frac{1 - (1+i)^{-n}}{i} \right]$

Regular payment:

$$R = \frac{PVi}{1 - (1+i)^{-n}}$$

Remaining Balance:

$$B = R \left[ \frac{1 - (1+i)^{-(n-x)}}{i} \right]$$

Net Present Value:

$$NPV = \sum_{j=0}^n \frac{R_j}{(1+i)^j}$$

Internal Rate of Return:

$$IRR = a + \left[ \frac{NPV_a}{NPV_a - NPV_b} \right] (b-a) \%$$

# APPENDIX 1

## Binomial Distribution

| $n$ | $x$ | .01   | .05   | .10   | .15   | .20   | .25   | $P$   | .30   | .35   | .40   | .45   | .50   |
|-----|-----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1   | 0   | .9900 | .9500 | .9000 | .8500 | .8000 | .7500 | .7000 | .6500 | .6000 | .5500 | .5000 | .5000 |
|     | 1   | .0100 | .0500 | .1000 | .1500 | .2000 | .2500 | .3000 | .3500 | .4000 | .4500 | .5000 | .5000 |
| 2   | 0   | .9801 | .9025 | .8100 | .7225 | .6400 | .5625 | .4900 | .4225 | .3600 | .3025 | .2500 | .2500 |
|     | 1   | .0198 | .0950 | .1800 | .2550 | .3200 | .3750 | .4200 | .4550 | .4800 | .4950 | .5000 | .5000 |
|     | 2   | .0001 | .0025 | .1100 | .0225 | .0400 | .0625 | .0900 | .1225 | .1600 | .2025 | .2500 | .2500 |
| 3   | 0   | .9703 | .8574 | .7290 | .6141 | .5120 | .4219 | .3430 | .2746 | .2160 | .1664 | .1250 | .1250 |
|     | 1   | .0294 | .1354 | .2430 | .3251 | .3840 | .4219 | .4410 | .4436 | .4320 | .4084 | .3750 | .3750 |
|     | 2   | .0003 | .0071 | .0270 | .0574 | .0960 | .1406 | .1890 | .2289 | .2880 | .3341 | .3750 | .3750 |
|     | 3   | .0000 | .0001 | .0010 | .0034 | .0080 | .0156 | .0270 | .0429 | .0640 | .0911 | .1250 | .1250 |
| 4   | 0   | .9606 | .8145 | .6561 | .5220 | .4096 | .3164 | .2401 | .1785 | .1296 | .0915 | .0625 | .0625 |
|     | 1   | .0388 | .1715 | .2916 | .3685 | .4096 | .4219 | .4116 | .3845 | .3456 | .2995 | .2500 | .2500 |
|     | 2   | .0006 | .0135 | .0486 | .0975 | .1536 | .2109 | .2646 | .3105 | .3456 | .3675 | .3750 | .3750 |
|     | 3   | .0000 | .0005 | .0036 | .0115 | .0256 | .0469 | .0756 | .1115 | .1536 | .2005 | .2500 | .2500 |
|     | 4   | .0000 | .0000 | .0001 | .0005 | .0016 | .0039 | .0081 | .0150 | .0256 | .0410 | .0625 | .0625 |
| 5   | 0   | .9510 | .7738 | .5905 | .4437 | .3277 | .2373 | .1681 | .1160 | .0778 | .0503 | .0312 | .0312 |
|     | 1   | .0480 | .2036 | .3280 | .3915 | .4096 | .3955 | .3602 | .3124 | .2592 | .2059 | .1562 | .1562 |
|     | 2   | .0010 | .0214 | .0729 | .1382 | .2048 | .2637 | .3087 | .3364 | .3456 | .3369 | .3125 | .3125 |
|     | 3   | .0000 | .0011 | .0081 | .0244 | .0512 | .0879 | .1323 | .1811 | .2304 | .2757 | .3125 | .3125 |
|     | 4   | .0000 | .0000 | .0004 | .0022 | .0064 | .0146 | .0284 | .0488 | .0768 | .1128 | .1562 | .1562 |
|     | 5   | .0000 | .0000 | .0000 | .0001 | .0003 | .0010 | .0024 | .0053 | .0102 | .0185 | .0312 | .0312 |
| 6   | 0   | .9415 | .7351 | .5314 | .3771 | .2621 | .1780 | .1176 | .0754 | .0467 | .0277 | .0156 | .0156 |
|     | 1   | .0571 | .2321 | .3543 | .3993 | .3932 | .3560 | .3025 | .2437 | .1866 | .1359 | .0938 | .0938 |
|     | 2   | .0014 | .0305 | .0984 | .1762 | .2458 | .2966 | .3241 | .3280 | .3110 | .2780 | .2344 | .2344 |
|     | 3   | .0000 | .0021 | .0146 | .0415 | .0819 | .1318 | .1852 | .2355 | .2765 | .3032 | .3125 | .3125 |
|     | 4   | .0000 | .0001 | .0012 | .0055 | .0154 | .0330 | .0595 | .0951 | .1382 | .1861 | .2344 | .2344 |
|     | 5   | .0000 | .0000 | .0001 | .0004 | .0015 | .0044 | .0102 | .0205 | .0369 | .0609 | .0938 | .0938 |
|     | 6   | .0000 | .0000 | .0000 | .0000 | .0001 | .0002 | .0007 | .0018 | .0041 | .0083 | .0156 | .0156 |
| 7   | 0   | .9321 | .6983 | .4783 | .3206 | .2097 | .1335 | .0824 | .0490 | .0280 | .0152 | .0078 | .0078 |
|     | 1   | .0659 | .2573 | .3720 | .3960 | .3670 | .3115 | .2471 | .1848 | .1306 | .0872 | .0547 | .0547 |
|     | 2   | .0020 | .0406 | .1240 | .2097 | .2753 | .3115 | .3177 | .2985 | .2613 | .2140 | .1641 | .1641 |

| n  | x     | .01   | .05   | .10   | .15   | .20   | .25   | p     | .30   | .35   | .40   | .45   | .50   |
|----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 8  | 3     | .0000 | .0036 | .0230 | .0617 | .1147 | .1730 | .2269 | .2679 | .2903 | .2918 | .2734 | .2734 |
|    | 4     | .0000 | .0002 | .0026 | .0109 | .0287 | .0577 | .0972 | .1442 | .1935 | .2388 | .2734 | .2734 |
|    | 5     | .0000 | .0000 | .0002 | .0012 | .0043 | .0115 | .0250 | .0466 | .0774 | .1172 | .1641 | .1641 |
|    | 6     | .0000 | .0000 | .0000 | .0001 | .0004 | .0013 | .0036 | .0084 | .0172 | .0320 | .0547 | .0547 |
|    | 7     | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0002 | .0006 | .0016 | .0037 | .0078 | .0078 |
|    | 0     | .9227 | .6634 | .4305 | .2725 | .1678 | .1002 | .0576 | .0319 | .0168 | .0084 | .0039 | .0039 |
|    | 1     | .0746 | .2793 | .3826 | .3847 | .3355 | .2670 | .1977 | .1373 | .0896 | .0548 | .0312 | .0312 |
|    | 2     | .0026 | .0515 | .1488 | .2376 | .2936 | .3115 | .2065 | .2587 | .2090 | .1569 | .1094 | .1094 |
| 9  | 3     | .0001 | .0054 | .0331 | .0839 | .1468 | .2076 | .2541 | .2786 | .2787 | .2568 | .2188 | .2188 |
|    | 4     | .0000 | .0004 | .0046 | .0185 | .0459 | .0865 | .1361 | .1875 | .2322 | .2627 | .2734 | .2734 |
|    | 5     | .0000 | .0000 | .0004 | .0026 | .0092 | .0231 | .0467 | .0808 | .1239 | .1719 | .2188 | .2188 |
|    | 6     | .0000 | .0000 | .0000 | .0002 | .0011 | .0038 | .0100 | .0217 | .0413 | .0403 | .1094 | .1094 |
|    | 7     | .0000 | .0000 | .0000 | .0000 | .0001 | .0004 | .0012 | .0033 | .0079 | .0164 | .0312 | .0312 |
|    | 8     | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0002 | .0007 | .0017 | .0039 | .0039 |
|    | 0     | .9135 | .6302 | .3874 | .2316 | .1342 | .0751 | .0404 | .0207 | .0101 | .0046 | .0020 | .0020 |
|    | 1     | .0830 | .2985 | .3874 | .3679 | .3020 | .2253 | .1556 | .1004 | .0605 | .0339 | .0176 | .0176 |
| 10 | 2     | .0034 | .0629 | .1722 | .2597 | .3020 | .3003 | .2668 | .2162 | .1612 | .1110 | .0703 | .0703 |
|    | 3     | .0001 | .0077 | .0446 | .1069 | .1762 | .2336 | .2668 | .2716 | .2508 | .2119 | .1641 | .1641 |
|    | 4     | .0000 | .0006 | .0074 | .0283 | .0661 | .1168 | .1715 | .2194 | .2508 | .2600 | .2461 | .2461 |
|    | 5     | .0000 | .0000 | .0008 | .0050 | .0165 | .0389 | .0735 | .1181 | .1672 | .2128 | .2461 | .2461 |
|    | 6     | .0000 | .0000 | .0001 | .0006 | .0028 | .0087 | .0210 | .0424 | .0743 | .1160 | .1641 | .1641 |
|    | 7     | .0000 | .0000 | .0000 | .0000 | .0003 | .0012 | .0039 | .0098 | .0212 | .0407 | .0703 | .0703 |
|    | 8     | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0004 | .0013 | .0035 | .0083 | .0176 | .0176 |
|    | 9     | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0003 | .0008 | .0020 | .0020 |
| 11 | 0     | .9044 | .5987 | .3487 | .1969 | .1074 | .0563 | .0282 | .0135 | .0060 | .0025 | .0010 | .0010 |
|    | 1     | .0914 | .3151 | .3874 | .3474 | .2684 | .1877 | .1211 | .0725 | .0403 | .0207 | .0098 | .0098 |
|    | 2     | .0042 | .0746 | .1937 | .2759 | .3020 | .2816 | .2335 | .1757 | .1209 | .0763 | .0439 | .0439 |
|    | 3     | .0001 | .0105 | .0574 | .1298 | .2013 | .2503 | .2668 | .2522 | .2150 | .1665 | .1172 | .1172 |
|    | 4     | .0000 | .0010 | .0112 | .0401 | .0881 | .1460 | .2001 | .2377 | .2508 | .2384 | .2051 | .2051 |
|    | 5     | .0000 | .0001 | .0015 | .0085 | .0264 | .0584 | .1029 | .1536 | .2007 | .2340 | .2461 | .2461 |
|    | 6     | .0000 | .0000 | .0001 | .0012 | .0055 | .0162 | .0368 | .0689 | .1115 | .1596 | .2051 | .2051 |
|    | 7     | .0000 | .0000 | .0000 | .0001 | .0008 | .0031 | .0090 | .0212 | .0425 | .0746 | .1172 | .1172 |
| 12 | 8     | .0000 | .0000 | .0000 | .0000 | .0001 | .0004 | .0014 | .0043 | .0106 | .0229 | .0439 | .0439 |
|    | 9     | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0005 | .0016 | .0042 | .0098 | .0098 |
|    | 10    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0003 | .0010 | .0010 |
|    | 0     | .8953 | .5688 | .3138 | .1673 | .0859 | .0422 | .0198 | .0088 | .0036 | .0014 | .0005 | .0005 |
|    | 1     | .0995 | .3293 | .3835 | .3248 | .2363 | .1549 | .0932 | .0518 | .0266 | .0125 | .0054 | .0054 |
|    | 2     | .0050 | .0867 | .2131 | .2866 | .2953 | .2581 | .1998 | .1395 | .0887 | .0513 | .0269 | .0269 |
|    | 3     | .0002 | .0137 | .0710 | .1517 | .2215 | .2581 | .2568 | .2254 | .1774 | .1259 | .0806 | .0806 |
|    | 4     | .0000 | .0014 | .0158 | .0536 | .1107 | .1721 | .2201 | .2428 | .2365 | .2060 | .1611 | .1611 |
| 12 | 5     | .0000 | .0001 | .0025 | .0132 | .0388 | .0803 | .1321 | .1830 | .2207 | .2360 | .2256 | .2256 |
|    | 6     | .0000 | .0000 | .0003 | .0023 | .0097 | .0268 | .0566 | .0985 | .1471 | .1931 | .2256 | .2256 |
|    | 7     | .0000 | .0000 | .0000 | .0003 | .0017 | .0064 | .0173 | .0379 | .0701 | .1128 | .1611 | .1611 |
|    | 8     | .0000 | .0000 | .0000 | .0000 | .0002 | .0011 | .0037 | .0102 | .0234 | .0462 | .0806 | .0806 |
|    | 9     | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0005 | .0018 | .0052 | .0126 | .0269 | .0269 |
|    | 10    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0002 | .0007 | .0021 | .0054 | .0054 |
|    | 11    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0002 | .0005 | .0005 |
|    | 0     | .8864 | .5404 | .2824 | .1422 | .0687 | .0317 | .0138 | .0057 | .0022 | .0008 | .0002 | .0002 |
| 1  | .1074 | .3413 | .3766 | .3012 | .2062 | .1267 | .0712 | .0368 | .0174 | .0075 | .0029 | .0029 |       |
| 2  | .0060 | .0988 | .2301 | .2924 | .2835 | .2323 | .1678 | .1088 | .0639 | .0339 | .0161 | .0161 |       |
| 3  | .0002 | .0173 | .0852 | .1720 | .2362 | .2581 | .2397 | .1954 | .1419 | .0923 | .0537 | .0537 |       |
| 4  | .0000 | .0021 | .0213 | .0683 | .1329 | .1936 | .2311 | .2367 | .2128 | .1700 | .1208 | .1208 |       |
| 5  | .0000 | .0002 | .0038 | .0193 | .0532 | .1032 | .1585 | .2039 | .2270 | .2225 | .1934 | .1934 |       |
| 6  | .0000 | .0000 | .0005 | .0040 | .0155 | .0401 | .0792 | .1281 | .1766 | .2124 | .2256 | .2256 |       |

BINOMIAL DISTRIBUTION

| n  | x     | .01   | .05   | .10   | .15   | .20   | .25   | p     | .30   | .35   | .40   | .45   | .50   |
|----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 13 | 7     | .0000 | .0000 | .0000 | .0006 | .0033 | .0115 | .0291 | .0791 | .1009 | .1489 | .1934 | .1208 |
|    | 8     | .0000 | .0000 | .0000 | .0001 | .0005 | .0024 | .0078 | .0199 | .0420 | .0762 | .1208 | .1934 |
|    | 9     | .0000 | .0000 | .0000 | .0000 | .0001 | .0004 | .0015 | .0048 | .0125 | .0277 | .0537 | .1061 |
|    | 10    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0002 | .0008 | .0025 | .0068 | .0161 | .0329 |
|    | 11    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0003 | .0010 | .0029 |
|    | 12    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0002 |
|    | 0     | .8775 | .5133 | .2542 | .1209 | .0550 | .0238 | .0097 | .0037 | .0013 | .0004 | .0001 | .0001 |
|    | 1     | .1152 | .3512 | .3672 | .2774 | .1787 | .1029 | .0540 | .0259 | .0113 | .0045 | .0016 | .0005 |
|    | 2     | .0070 | .1109 | .2448 | .2937 | .2680 | .2059 | .1388 | .0836 | .0453 | .0220 | .0095 | .0349 |
|    | 3     | .0003 | .0214 | .0997 | .1900 | .2457 | .2517 | .2181 | .1651 | .1107 | .0660 | .0349 | .0873 |
|    | 4     | .0000 | .0028 | .0277 | .0838 | .1535 | .2097 | .2337 | .2222 | .1845 | .1350 | .0873 | .1571 |
|    | 5     | .0000 | .0003 | .0055 | .0266 | .0691 | .1258 | .1803 | .2154 | .2214 | .1989 | .1571 | .2095 |
|    | 6     | .0000 | .0000 | .0008 | .0063 | .0230 | .0559 | .1030 | .1546 | .1968 | .2169 | .2095 | .1571 |
| 7  | .0000 | .0000 | .0001 | .0011 | .0058 | .0186 | .0442 | .0833 | .1312 | .1775 | .2095 | .1571 |       |
| 8  | .0000 | .0000 | .0001 | .0001 | .0011 | .0047 | .0142 | .0336 | .0656 | .1089 | .1571 | .1089 |       |
| 9  | .0000 | .0000 | .0000 | .0000 | .0001 | .0009 | .0034 | .0101 | .0243 | .0495 | .0873 | .1571 |       |
| 14 | 10    | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0006 | .0022 | .0065 | .0162 | .0349 |       |
|    | 11    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0003 | .0012 | .0036 | .0095 |       |
|    | 12    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0005 | .0016 |       |
|    | 13    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 |       |
|    | 0     | .8687 | .4877 | .2288 | .1028 | .0440 | .0178 | .0068 | .0024 | .0008 | .0002 | .0001 |       |
|    | 1     | .1229 | .3593 | .3559 | .2539 | .1539 | .0832 | .0467 | .0181 | .0073 | .0027 | .0009 |       |
|    | 2     | .0081 | .1229 | .2570 | .2912 | .2501 | .1802 | .1134 | .0634 | .0317 | .0141 | .0056 |       |
|    | 3     | .0003 | .0259 | .1142 | .2056 | .2501 | .2402 | .1943 | .1366 | .0845 | .0462 | .0222 |       |
|    | 4     | .0000 | .0037 | .0349 | .0998 | .1720 | .2202 | .2290 | .2022 | .1549 | .1040 | .0611 |       |
|    | 5     | .0000 | .0004 | .0078 | .0352 | .0860 | .1468 | .1963 | .2178 | .2066 | .1701 | .1222 |       |
|    | 6     | .0000 | .0000 | .0013 | .0093 | .0322 | .0734 | .1262 | .1759 | .2066 | .2088 | .1833 |       |
|    | 7     | .0000 | .0000 | .0002 | .0019 | .0092 | .0280 | .0618 | .1082 | .1574 | .1952 | .2095 |       |
|    | 8     | .0000 | .0000 | .0000 | .0003 | .0020 | .0082 | .0232 | .0510 | .0918 | .1398 | .1833 |       |
| 9  | .0000 | .0000 | .0000 | .0000 | .0003 | .0018 | .0066 | .0183 | .0408 | .0762 | .1222 |       |       |
| 15 | 10    | .0000 | .0000 | .0000 | .0000 | .0000 | .0003 | .0014 | .0049 | .0136 | .0312 | .0611 |       |
|    | 11    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0002 | .0010 | .0033 | .0093 | .0222 |       |
|    | 12    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0005 | .0019 | .0056 |       |
|    | 13    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0002 | .0009 |       |
|    | 14    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 |       |
|    | 0     | .8601 | .4633 | .2059 | .0874 | .0352 | .0134 | .0047 | .0016 | .0005 | .0001 | .0000 |       |
|    | 1     | .1303 | .3658 | .3432 | .2312 | .1319 | .0668 | .0305 | .0126 | .0047 | .0016 | .0005 |       |
|    | 2     | .0092 | .1348 | .2669 | .2856 | .2309 | .1559 | .0916 | .0476 | .0219 | .0090 | .0032 |       |
|    | 3     | .0004 | .0307 | .1285 | .2184 | .2501 | .2252 | .1700 | .1110 | .0634 | .0318 | .0139 |       |
|    | 4     | .0000 | .0049 | .0428 | .1156 | .1876 | .2252 | .2186 | .1792 | .1268 | .0780 | .0417 |       |
|    | 5     | .0000 | .0006 | .0105 | .0449 | .1032 | .1651 | .2061 | .2123 | .1859 | .1404 | .0916 |       |
|    | 6     | .0000 | .0000 | .0019 | .0132 | .0430 | .0917 | .1472 | .1906 | .2066 | .1914 | .1527 |       |
|    | 7     | .0000 | .0000 | .0003 | .0030 | .0138 | .0393 | .0811 | .1319 | .1771 | .2013 | .1964 |       |
| 8  | .0000 | .0000 | .0000 | .0005 | .0035 | .0131 | .0348 | .0710 | .1181 | .1647 | .1964 |       |       |
| 9  | .0000 | .0000 | .0000 | .0001 | .0007 | .0034 | .0116 | .0298 | .0612 | .1048 | .1527 |       |       |
| 16 | 10    | .0000 | .0000 | .0000 | .0000 | .0001 | .0007 | .0030 | .0096 | .0245 | .0515 | .0916 |       |
|    | 11    | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0006 | .0024 | .0074 | .0191 | .0417 |       |
|    | 12    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0004 | .0016 | .0052 | .0139 |       |
|    | 13    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0003 | .0010 | .0032 |       |
|    | 14    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0005 |       |
|    | 15    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 |       |
|    | 0     | .8515 | .4401 | .1853 | .0743 | .0281 | .0100 | .0033 | .0010 | .0003 | .0001 | .0000 |       |
| 1  | .1376 | .3706 | .3294 | .2097 | .1126 | .0535 | .0228 | .0087 | .0030 | .0009 | .0002 |       |       |
| 2  | .0104 | .1463 | .2745 | .2775 | .2111 | .1336 | .0732 | .0353 | .0150 | .0056 | .0018 |       |       |

| n  | x     | .01   | .05   | .10   | .15   | .20   | .25   | p     | .30   | .35   | .40   | .45   | .50   |  |
|----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--|
| 16 | 3     | .0005 | .0359 | .1423 | .2285 | .2463 | .2079 | .1465 | .0888 | .0468 | .0215 | .0085 |       |  |
|    | 4     | .0000 | .0061 | .0514 | .1311 | .2001 | .2252 | .2040 | .1553 | .1014 | .0572 | .0278 |       |  |
|    | 5     | .0000 | .0008 | .0137 | .0555 | .1201 | .1802 | .2099 | .2008 | .1623 | .1123 | .0667 |       |  |
|    | 6     | .0000 | .0001 | .0028 | .0180 | .0550 | .1101 | .1649 | .1982 | .1983 | .1684 | .1222 |       |  |
|    | 7     | .0000 | .0000 | .0004 | .0045 | .0197 | .0524 | .1010 | .1524 | .1889 | .1969 | .1746 |       |  |
|    | 8     | .0000 | .0000 | .0001 | .0009 | .0055 | .0197 | .0487 | .0923 | .1417 | .1812 | .1964 |       |  |
|    | 9     | .0000 | .0000 | .0000 | .0001 | .0012 | .0058 | .0185 | .0442 | .0840 | .1318 | .1746 |       |  |
|    | 10    | .0000 | .0000 | .0000 | .0000 | .0002 | .0014 | .0056 | .0167 | .0392 | .0755 | .1222 |       |  |
|    | 11    | .0000 | .0000 | .0000 | .0000 | .0000 | .0002 | .0013 | .0049 | .0142 | .0337 | .0667 |       |  |
|    | 12    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0002 | .0011 | .0040 | .0115 | .0278 |       |  |
|    | 13    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0002 | .0008 | .0029 | .0085 |       |  |
|    | 14    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0005 | .0018 |       |  |
|    | 15    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0002 |  |
|    | 16    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 |  |
|    | 17    | 0     | .8429 | .4181 | .1668 | .0631 | .0225 | .0075 | .0023 | .0007 | .0002 | .0000 | .0000 |  |
|    |       | 1     | .1447 | .3741 | .3150 | .1893 | .0957 | .0426 | .0169 | .0060 | .0019 | .0005 | .0001 |  |
| 2  |       | .0117 | .1575 | .2800 | .2673 | .1914 | .1136 | .0581 | .0260 | .0102 | .0035 | .0010 |       |  |
| 3  |       | .0006 | .0415 | .1556 | .2359 | .2393 | .1893 | .1245 | .0701 | .0341 | .0144 | .0052 |       |  |
| 4  |       | .0000 | .0076 | .0605 | .1457 | .2093 | .2209 | .1868 | .1320 | .0796 | .0411 | .0182 |       |  |
| 5  |       | .0000 | .0010 | .0175 | .0668 | .1361 | .1914 | .2081 | .1849 | .1379 | .0875 | .0472 |       |  |
| 6  |       | .0000 | .0001 | .0039 | .0236 | .0680 | .1276 | .1784 | .1991 | .1839 | .1432 | .1044 |       |  |
| 7  |       | .0000 | .0000 | .0007 | .0065 | .0267 | .0668 | .1201 | .1685 | .1927 | .1841 | .1484 |       |  |
| 8  |       | .0000 | .0000 | .0001 | .0014 | .0084 | .0279 | .0644 | .1134 | .1606 | .1883 | .1855 |       |  |
| 9  |       | .0000 | .0000 | .0000 | .0003 | .0021 | .0093 | .0276 | .0611 | .1070 | .1540 | .1855 |       |  |
| 10 |       | .0000 | .0000 | .0000 | .0000 | .0004 | .0025 | .0095 | .0263 | .0571 | .1008 | .1484 |       |  |
| 11 |       | .0000 | .0000 | .0000 | .0000 | .0001 | .0005 | .0026 | .0090 | .0242 | .0525 | .0944 |       |  |
| 12 |       | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0006 | .0024 | .0081 | .0215 | .0472 |  |
| 13 |       | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0005 | .0021 | .0068 | .0182 |  |
| 14 |       | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0004 | .0016 | .0052 |  |
| 15 |       | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0003 | .0010 | .0031 |  |
| 16 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |       |  |
| 17 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 |       |  |
| 18 | 0     | .8345 | .3972 | .1501 | .0536 | .0180 | .0056 | .0016 | .0004 | .0001 | .0000 | .0000 |       |  |
|    | 1     | .1517 | .3763 | .3002 | .1704 | .0811 | .0338 | .0126 | .0042 | .0012 | .0003 | .0001 |       |  |
|    | 2     | .0130 | .1683 | .2835 | .2556 | .1723 | .0958 | .0458 | .0190 | .0069 | .0022 | .0006 |       |  |
|    | 3     | .0007 | .0473 | .1680 | .2406 | .2297 | .1704 | .1046 | .0547 | .0246 | .0095 | .0031 |       |  |
|    | 4     | .0000 | .0093 | .0700 | .1592 | .2153 | .2130 | .1681 | .1104 | .0614 | .0291 | .0117 |       |  |
|    | 5     | .0000 | .0014 | .0218 | .0787 | .1507 | .1988 | .2017 | .1664 | .1146 | .0666 | .0327 |       |  |
|    | 6     | .0000 | .0002 | .0052 | .0301 | .0816 | .1436 | .1873 | .1941 | .1655 | .1181 | .0708 |       |  |
|    | 7     | .0000 | .0000 | .0010 | .0091 | .0350 | .0820 | .1376 | .1792 | .1892 | .1657 | .1214 |       |  |
|    | 8     | .0000 | .0000 | .0002 | .0022 | .0120 | .0376 | .0811 | .1327 | .1734 | .1864 | .1669 |       |  |
|    | 9     | .0000 | .0000 | .0000 | .0004 | .0033 | .0139 | .0386 | .0794 | .1284 | .1694 | .1855 |       |  |
|    | 10    | .0000 | .0000 | .0000 | .0001 | .0008 | .0042 | .0149 | .0385 | .0771 | .1248 | .1669 |       |  |
|    | 11    | .0000 | .0000 | .0000 | .0000 | .0001 | .0010 | .0046 | .0151 | .0374 | .0742 | .1214 |       |  |
|    | 12    | .0000 | .0000 | .0000 | .0000 | .0000 | .0002 | .0012 | .0047 | .0145 | .0354 | .0708 |       |  |
|    | 13    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0002 | .0012 | .0045 | .0134 | .0327 |       |  |
|    | 14    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0002 | .0011 | .0039 | .0117 |       |  |
|    | 15    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0002 | .0009 | .0031 |       |  |
| 16 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0006 |       |       |  |
| 17 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |       |  |
| 18 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 |       |  |
| 19 | 0     | .8262 | .3774 | .1351 | .0456 | .0144 | .0042 | .0011 | .0003 | .0001 | .0000 | .0000 |       |  |
|    | 1     | .1586 | .3774 | .2852 | .1529 | .0685 | .0268 | .0093 | .0029 | .0008 | .0002 | .0000 |       |  |
|    | 2     | .0144 | .1787 | .2852 | .2428 | .1540 | .0803 | .0358 | .0138 | .0046 | .0013 | .0003 |       |  |

BINOMIAL DISTRIBUTION

[APPENDIX 1

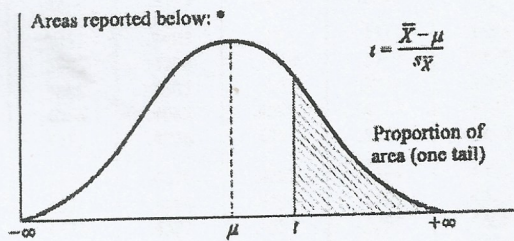
| n  | x     | .01   | .05   | .10   | .15   | .20   | .25   | p     | .30   | .35   | .40   | .45   | .50 |
|----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-----|
| 20 | 3     | .0008 | .0533 | .1796 | .2428 | .2182 | .1517 | .0869 | .0422 | .0175 | .0062 | .0018 |     |
|    | 4     | .0000 | .0112 | .0798 | .1714 | .2182 | .2023 | .1491 | .0909 | .0467 | .0203 | .0074 |     |
|    | 5     | .0000 | .0018 | .0266 | .0907 | .1636 | .2023 | .1916 | .1468 | .0933 | .0497 | .0222 |     |
|    | 6     | .0000 | .0002 | .0069 | .0374 | .0955 | .1574 | .1916 | .1844 | .1451 | .0949 | .0518 |     |
|    | 7     | .0000 | .0000 | .0014 | .0122 | .0443 | .0974 | .1525 | .1844 | .1797 | .1443 | .0961 |     |
|    | 8     | .0000 | .0000 | .0002 | .0032 | .0166 | .0487 | .0981 | .1489 | .1797 | .1771 | .1442 |     |
|    | 9     | .0000 | .0000 | .0000 | .0007 | .0051 | .0198 | .0514 | .0980 | .1464 | .1771 | .1762 |     |
|    | 10    | .0000 | .0000 | .0000 | .0001 | .0013 | .0066 | .0220 | .0528 | .0976 | .1449 | .1762 |     |
|    | 11    | .0000 | .0000 | .0000 | .0000 | .0003 | .0018 | .0077 | .0233 | .0532 | .0970 | .1442 |     |
|    | 12    | .0000 | .0000 | .0000 | .0000 | .0000 | .0004 | .0022 | .0083 | .0237 | .0529 | .0961 |     |
|    | 13    | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0005 | .0024 | .0085 | .0233 | .0518 |     |
|    | 14    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0006 | .0024 | .0082 | .0222 |     |
|    | 15    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0005 | .0022 | .0074 |     |
|    | 16    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0005 | .0018 |     |
|    | 17    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0003 |     |
|    | 18    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 |     |
|    | 19    | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 |     |
|    | 0     | .8179 | .3585 | .1216 | .0388 | .0115 | .0032 | .0008 | .0002 | .0000 | .0000 | .0000 |     |
|    | 1     | .1652 | .3774 | .2702 | .1368 | .0576 | .0211 | .0068 | .0020 | .0005 | .0001 | .0000 |     |
| 2  | .0159 | .1887 | .2852 | .2293 | .1369 | .0669 | .0278 | .0100 | .0031 | .0008 | .0002 |       |     |
| 3  | .0010 | .0596 | .1901 | .2428 | .2054 | .1339 | .0716 | .0323 | .0123 | .0040 | .0011 |       |     |
| 4  | .0000 | .0133 | .0898 | .1821 | .2182 | .1897 | .1304 | .0738 | .0350 | .0139 | .0046 |       |     |
| 5  | .0000 | .0022 | .0319 | .1028 | .1746 | .2023 | .1789 | .1272 | .0746 | .0365 | .0148 |       |     |
| 6  | .0000 | .0003 | .0089 | .0454 | .1091 | .1686 | .1916 | .1712 | .1244 | .0746 | .0370 |       |     |
| 7  | .0000 | .0000 | .0020 | .0160 | .0545 | .1124 | .1643 | .1844 | .1659 | .1221 | .0739 |       |     |
| 8  | .0000 | .0000 | .0004 | .0046 | .0222 | .0609 | .1144 | .1614 | .1797 | .1623 | .1201 |       |     |
| 9  | .0000 | .0000 | .0001 | .0011 | .0074 | .0271 | .0654 | .1158 | .1597 | .1771 | .1602 |       |     |
| 10 | .0000 | .0000 | .0000 | .0002 | .0020 | .0099 | .0308 | .0686 | .1171 | .1593 | .1762 |       |     |
| 11 | .0000 | .0000 | .0000 | .0000 | .0005 | .0030 | .0120 | .0336 | .0710 | .1185 | .1602 |       |     |
| 12 | .0000 | .0000 | .0000 | .0000 | .0001 | .0008 | .0039 | .0136 | .0355 | .0727 | .1201 |       |     |
| 13 | .0000 | .0000 | .0000 | .0000 | .0000 | .0002 | .0010 | .0045 | .0146 | .0366 | .0739 |       |     |
| 14 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0002 | .0012 | .0049 | .0150 | .0370 |       |     |
| 15 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0013 | .0049 | .0148 |       |     |
| 16 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0003 | .0013 | .0046 |       |     |
| 17 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0002 | .0011 |       |     |
| 18 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0002 |       |     |
| 19 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 |       |     |
| 20 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 |       |     |
| 25 | 0     | .7778 | .2774 | .0718 | .0172 | .0038 | .0008 | .0001 | .0000 | .0000 | .0000 | .0000 |     |
|    | 1     | .1964 | .3650 | .1994 | .0759 | .0236 | .0063 | .0014 | .0003 | .0000 | .0000 | .0000 |     |
|    | 2     | .0238 | .2305 | .2659 | .1607 | .0708 | .0251 | .0074 | .0018 | .0004 | .0001 | .0000 |     |
|    | 3     | .0018 | .0930 | .2265 | .2174 | .1358 | .0641 | .0243 | .0076 | .0019 | .0004 | .0001 |     |
|    | 4     | .0001 | .0269 | .1384 | .2110 | .1867 | .1175 | .0572 | .0224 | .0071 | .0018 | .0004 |     |
|    | 5     | .0000 | .0060 | .0646 | .1564 | .1960 | .1645 | .1030 | .0506 | .0199 | .0063 | .0016 |     |
|    | 6     | .0000 | .0010 | .0239 | .0920 | .1633 | .1828 | .1472 | .0908 | .0442 | .0172 | .0053 |     |
|    | 7     | .0000 | .0001 | .0072 | .0441 | .1108 | .1654 | .1712 | .1327 | .0800 | .0381 | .0143 |     |
|    | 8     | .0000 | .0000 | .0018 | .0175 | .0623 | .1241 | .1651 | .1607 | .1200 | .0701 | .0322 |     |
|    | 9     | .0000 | .0000 | .0004 | .0058 | .0294 | .0781 | .1336 | .1635 | .1511 | .1084 | .0609 |     |
|    | 10    | .0000 | .0000 | .0000 | .0016 | .0118 | .0417 | .0916 | .1409 | .1612 | .1419 | .0974 |     |
|    | 11    | .0000 | .0000 | .0000 | .0004 | .0040 | .0189 | .0536 | .1034 | .1465 | .1583 | .1328 |     |
|    | 12    | .0000 | .0000 | .0000 | .0000 | .0012 | .0074 | .0268 | .0650 | .1140 | .1511 | .1550 |     |
|    | 13    | .0000 | .0000 | .0000 | .0000 | .0003 | .0025 | .0115 | .0350 | .0760 | .1236 | .1550 |     |
|    | 14    | .0000 | .0000 | .0000 | .0000 | .0000 | .0007 | .0042 | .0161 | .0434 | .0867 | .1328 |     |
| 15 | .0000 | .0000 | .0000 | .0000 | .0000 | .0002 | .0013 | .0064 | .0212 | .0520 | .0974 |       |     |

| <i>n</i> | <i>x</i> | .01   | .05   | .10   | .15   | .20   | .25   | <i>p</i> | .30   | .35   | .40   | .45   | .50   |
|----------|----------|-------|-------|-------|-------|-------|-------|----------|-------|-------|-------|-------|-------|
|          | 16       | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0004    | .0021 | .0088 | .0266 | .0609 |       |
|          | 17       | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001    | .0006 | .0031 | .0115 | .0322 |       |
|          | 18       | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000    | .0001 | .0009 | .0042 | .0143 |       |
|          | 19       | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000    | .0000 | .0002 | .0013 | .0053 |       |
|          | 20       | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000    | .0000 | .0000 | .0001 | .0016 |       |
|          | 21       | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000    | .0000 | .0000 | .0000 | .0004 |       |
|          | 22       | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000    | .0000 | .0000 | .0000 | .0001 |       |
| 30       | 0        | .7397 | .2146 | .0424 | .0076 | .0012 | .0002 | .0000    | .0000 | .0000 | .0000 | .0000 | .0000 |
|          | 1        | .2242 | .3389 | .1413 | .0404 | .0093 | .0018 | .0003    | .0000 | .0000 | .0000 | .0000 | .0000 |
|          | 2        | .0328 | .2586 | .2277 | .1034 | .0337 | .0086 | .0018    | .0003 | .0000 | .0000 | .0000 | .0000 |
|          | 3        | .0031 | .1270 | .2361 | .1703 | .0785 | .0269 | .0072    | .0015 | .0003 | .0000 | .0000 | .0000 |
|          | 4        | .0002 | .0451 | .1771 | .2028 | .1325 | .0604 | .0208    | .0056 | .0012 | .0002 | .0000 | .0000 |
|          | 5        | .0000 | .0124 | .1023 | .1861 | .1723 | .1047 | .0464    | .0157 | .0041 | .0008 | .0001 | .0001 |
|          | 6        | .0000 | .0027 | .0474 | .1368 | .1795 | .1455 | .0829    | .0353 | .0115 | .0029 | .0006 | .0006 |
|          | 7        | .0000 | .0005 | .0180 | .0828 | .1538 | .1662 | .1219    | .0652 | .0263 | .0081 | .0019 | .0019 |
|          | 8        | .0000 | .0001 | .0058 | .0420 | .1106 | .1593 | .1501    | .1009 | .0505 | .0191 | .0055 | .0055 |
|          | 9        | .0000 | .0000 | .0016 | .0181 | .0676 | .1298 | .1573    | .1328 | .0823 | .0382 | .0133 | .0133 |
|          | 10       | .0000 | .0000 | .0004 | .0067 | .0355 | .0909 | .1416    | .1502 | .1152 | .0656 | .0280 | .0280 |
|          | 11       | .0000 | .0000 | .0001 | .0022 | .0161 | .0551 | .1103    | .1471 | .1396 | .0976 | .0509 | .0509 |
|          | 12       | .0000 | .0000 | .0000 | .0006 | .0064 | .0291 | .0749    | .1254 | .1474 | .1265 | .0806 | .0806 |
|          | 13       | .0000 | .0000 | .0000 | .0001 | .0022 | .0134 | .0444    | .0935 | .1360 | .1433 | .1115 | .1115 |
|          | 14       | .0000 | .0000 | .0000 | .0000 | .0007 | .0054 | .0231    | .0611 | .1101 | .1424 | .1354 | .1354 |
|          | 15       | .0000 | .0000 | .0000 | .0000 | .0002 | .0019 | .0106    | .0351 | .0783 | .1242 | .1445 | .1445 |
|          | 16       | .0000 | .0000 | .0000 | .0000 | .0000 | .0006 | .0042    | .0177 | .0489 | .0953 | .1354 | .1354 |
|          | 17       | .0000 | .0000 | .0000 | .0000 | .0000 | .0002 | .0015    | .0079 | .0269 | .0642 | .1115 | .1115 |
|          | 18       | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0005    | .0031 | .0129 | .0379 | .0806 | .0806 |
|          | 19       | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001    | .0010 | .0054 | .0196 | .0509 | .0509 |
|          | 20       | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000    | .0003 | .0020 | .0088 | .0280 | .0280 |
|          | 21       | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000    | .0001 | .0006 | .0034 | .0133 | .0133 |
|          | 22       | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000    | .0000 | .0002 | .0012 | .0055 | .0055 |
|          | 23       | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000    | .0000 | .0000 | .0003 | .0019 | .0019 |
|          | 24       | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000    | .0000 | .0000 | .0001 | .0006 | .0006 |
|          | 25       | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000    | .0000 | .0000 | .0000 | .0001 | .0001 |

\*Example:  $P(X = 3, n = 5, p = 0.30) = 0.1323$ .

# APPENDIX 5

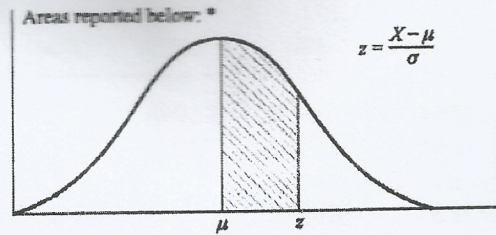
## Student's *t* Distribution



Proportions of Area for the *t* Distributions

| <i>df</i> | 0.10  | 0.05  | 0.025  | 0.01   | 0.005  | <i>df</i> | 0.10  | 0.05  | 0.025 | 0.01  | 0.005 |
|-----------|-------|-------|--------|--------|--------|-----------|-------|-------|-------|-------|-------|
| 1         | 3.078 | 6.314 | 12.706 | 31.821 | 63.657 | 18        | 1.330 | 1.734 | 2.101 | 2.552 | 2.878 |
| 2         | 1.886 | 2.920 | 4.303  | 6.965  | 9.925  | 19        | 1.328 | 1.729 | 2.093 | 2.539 | 2.861 |
| 3         | 1.638 | 2.353 | 3.182  | 4.541  | 5.841  | 20        | 1.325 | 1.725 | 2.086 | 2.528 | 2.845 |
| 4         | 1.533 | 2.132 | 2.776  | 3.747  | 4.604  | 21        | 1.323 | 1.721 | 2.080 | 2.518 | 2.831 |
| 5         | 1.476 | 2.015 | 2.571  | 3.365  | 4.032  | 22        | 1.321 | 1.717 | 2.074 | 2.508 | 2.819 |
| 6         | 1.440 | 1.943 | 2.447  | 3.143  | 3.707  | 23        | 1.319 | 1.714 | 2.069 | 2.500 | 2.807 |
| 7         | 1.415 | 1.895 | 2.365  | 2.998  | 3.499  | 24        | 1.318 | 1.711 | 2.064 | 2.492 | 2.797 |
| 8         | 1.397 | 1.860 | 2.306  | 2.896  | 3.355  | 25        | 1.316 | 1.708 | 2.060 | 2.485 | 2.787 |
| 9         | 1.383 | 1.833 | 2.262  | 2.821  | 3.250  | 26        | 1.315 | 1.706 | 2.056 | 2.479 | 2.779 |
| 10        | 1.372 | 1.812 | 2.228  | 2.764  | 3.169  | 27        | 1.314 | 1.703 | 2.052 | 2.473 | 2.771 |
| 11        | 1.363 | 1.796 | 2.201  | 2.718  | 3.106  | 28        | 1.313 | 1.701 | 2.048 | 2.467 | 2.763 |
| 12        | 1.356 | 1.782 | 2.179  | 2.681  | 3.055  | 29        | 1.311 | 1.699 | 2.045 | 2.462 | 2.756 |
| 13        | 1.350 | 1.771 | 2.160  | 2.650  | 3.012  | 30        | 1.310 | 1.697 | 2.042 | 2.457 | 2.750 |
| 14        | 1.345 | 1.761 | 2.145  | 2.624  | 2.977  | 40        | 1.303 | 1.684 | 2.021 | 2.423 | 2.704 |
| 15        | 1.341 | 1.753 | 2.131  | 2.602  | 2.947  | 60        | 1.296 | 1.671 | 2.000 | 2.390 | 2.660 |
| 16        | 1.337 | 1.746 | 2.120  | 2.583  | 2.921  | 120       | 1.289 | 1.658 | 1.980 | 2.358 | 2.617 |
| 17        | 1.333 | 1.740 | 2.110  | 2.567  | 2.898  | ∞         | 1.282 | 1.645 | 1.960 | 2.326 | 2.576 |

\*Example: For the shaded area to represent 0.05 of the total area of 1.0, value of *t* with 10 degrees of freedom is 1.812  
 Source: From Table III of Fisher and Yates, *Statistical Tables for Biological, Agricultural and Medical Research*, 6th ed., 1974, published by Longman Group Ltd., London (previously published by Oliver & Boyd, Edinburgh), by permission of the authors and publishers.



Proportions of Area for the Standard Normal Distribution

| <i>z</i> | .00   | .01   | .02   | .03   | .04   | .05   | .06   | .07   | .08   | .09   |
|----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0.0      | .0000 | .0040 | .0080 | .0120 | .0160 | .0199 | .0239 | .0279 | .0319 | .0359 |
| 0.1      | .0398 | .0438 | .0478 | .0517 | .0557 | .0596 | .0636 | .0675 | .0714 | .0753 |
| 0.2      | .0793 | .0832 | .0871 | .0910 | .0948 | .0987 | .1026 | .1064 | .1103 | .1141 |
| 0.3      | .1179 | .1217 | .1255 | .1293 | .1331 | .1368 | .1406 | .1443 | .1480 | .1517 |
| 0.4      | .1554 | .1591 | .1628 | .1664 | .1700 | .1736 | .1772 | .1808 | .1844 | .1879 |
| 0.5      | .1915 | .1950 | .1985 | .2019 | .2054 | .2088 | .2123 | .2157 | .2190 | .2224 |
| 0.6      | .2257 | .2291 | .2324 | .2357 | .2389 | .2422 | .2454 | .2486 | .2518 | .2549 |
| 0.7      | .2580 | .2612 | .2642 | .2673 | .2704 | .2734 | .2764 | .2794 | .2823 | .2852 |
| 0.8      | .2881 | .2910 | .2939 | .2967 | .2995 | .3023 | .3051 | .3078 | .3106 | .3133 |
| 0.9      | .3159 | .3186 | .3212 | .3238 | .3264 | .3289 | .3315 | .3340 | .3365 | .3389 |
| 1.0      | .3413 | .3438 | .3461 | .3485 | .3508 | .3531 | .3554 | .3577 | .3599 | .3621 |
| 1.1      | .3643 | .3665 | .3686 | .3708 | .3729 | .3749 | .3770 | .3790 | .3810 | .3830 |
| 1.2      | .3849 | .3869 | .3888 | .3907 | .3925 | .3944 | .3962 | .3980 | .3997 | .4014 |
| 1.3      | .4032 | .4049 | .4066 | .4082 | .4099 | .4115 | .4131 | .4147 | .4162 | .4177 |
| 1.4      | .4192 | .4207 | .4222 | .4236 | .4251 | .4265 | .4279 | .4292 | .4306 | .4319 |
| 1.5      | .4332 | .4345 | .4357 | .4370 | .4382 | .4394 | .4406 | .4418 | .4429 | .4441 |
| 1.6      | .4452 | .4463 | .4474 | .4484 | .4495 | .4505 | .4515 | .4525 | .4535 | .4545 |
| 1.7      | .4554 | .4564 | .4573 | .4582 | .4591 | .4599 | .4608 | .4616 | .4625 | .4633 |
| 1.8      | .4641 | .4649 | .4656 | .4664 | .4671 | .4678 | .4686 | .4693 | .4699 | .4706 |
| 1.9      | .4713 | .4719 | .4726 | .4732 | .4738 | .4744 | .4750 | .4756 | .4761 | .4767 |
| 2.0      | .4772 | .4778 | .4783 | .4788 | .4793 | .4798 | .4803 | .4808 | .4812 | .4817 |
| 2.1      | .4821 | .4826 | .4830 | .4834 | .4838 | .4842 | .4846 | .4850 | .4854 | .4857 |
| 2.2      | .4861 | .4864 | .4868 | .4871 | .4875 | .4878 | .4881 | .4884 | .4887 | .4890 |
| 2.3      | .4893 | .4896 | .4898 | .4901 | .4904 | .4906 | .4909 | .4911 | .4913 | .4916 |
| 2.4      | .4918 | .4920 | .4922 | .4925 | .4927 | .4929 | .4931 | .4932 | .4934 | .4936 |
| 2.5      | .4938 | .4940 | .4941 | .4943 | .4945 | .4946 | .4948 | .4949 | .4951 | .4952 |
| 2.6      | .4953 | .4955 | .4956 | .4957 | .4959 | .4960 | .4961 | .4962 | .4963 | .4964 |
| 2.7      | .4965 | .4966 | .4967 | .4968 | .4969 | .4970 | .4971 | .4972 | .4973 | .4974 |
| 2.8      | .4974 | .4975 | .4976 | .4977 | .4977 | .4978 | .4979 | .4979 | .4980 | .4981 |
| 2.9      | .4981 | .4982 | .4983 | .4983 | .4984 | .4984 | .4985 | .4985 | .4986 | .4986 |
| 3.0      | .4987 |       |       |       |       |       |       |       |       |       |
| 3.5      | .4997 |       |       |       |       |       |       |       |       |       |
| 4.0      | .4999 |       |       |       |       |       |       |       |       |       |

\*Example: For  $z = 1.96$ , shaded area is 0.4750 out of the total area of 1.0000.

**Present Value Table**

Present value of 1 i.e.  $(1 + r)^{-n}$

Where  $r$  = discount rate  
 $n$  = number of periods until payment

| Periods<br>(n) | Discount rate (r) |       |       |       |       |       |       |       |       |       |    |
|----------------|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|
|                | 1%                | 2%    | 3%    | 4%    | 5%    | 6%    | 7%    | 8%    | 9%    | 10%   |    |
| 1              | 0.990             | 0.980 | 0.971 | 0.962 | 0.952 | 0.943 | 0.935 | 0.926 | 0.917 | 0.909 | 1  |
| 2              | 0.980             | 0.961 | 0.943 | 0.925 | 0.907 | 0.890 | 0.873 | 0.857 | 0.842 | 0.826 | 2  |
| 3              | 0.971             | 0.942 | 0.915 | 0.889 | 0.864 | 0.840 | 0.816 | 0.794 | 0.772 | 0.751 | 3  |
| 4              | 0.961             | 0.924 | 0.888 | 0.855 | 0.823 | 0.792 | 0.763 | 0.735 | 0.708 | 0.683 | 4  |
| 5              | 0.951             | 0.906 | 0.863 | 0.822 | 0.784 | 0.747 | 0.713 | 0.681 | 0.650 | 0.621 | 5  |
| 6              | 0.942             | 0.888 | 0.837 | 0.790 | 0.746 | 0.705 | 0.666 | 0.630 | 0.596 | 0.564 | 6  |
| 7              | 0.933             | 0.871 | 0.813 | 0.760 | 0.711 | 0.665 | 0.623 | 0.583 | 0.547 | 0.513 | 7  |
| 8              | 0.923             | 0.853 | 0.789 | 0.731 | 0.677 | 0.627 | 0.582 | 0.540 | 0.502 | 0.467 | 8  |
| 9              | 0.914             | 0.837 | 0.766 | 0.703 | 0.645 | 0.592 | 0.544 | 0.500 | 0.460 | 0.424 | 9  |
| 10             | 0.905             | 0.820 | 0.744 | 0.676 | 0.614 | 0.558 | 0.508 | 0.463 | 0.422 | 0.386 | 10 |
| 11             | 0.896             | 0.804 | 0.722 | 0.650 | 0.585 | 0.527 | 0.475 | 0.429 | 0.388 | 0.350 | 11 |
| 12             | 0.887             | 0.788 | 0.701 | 0.625 | 0.557 | 0.497 | 0.444 | 0.397 | 0.356 | 0.319 | 12 |
| 13             | 0.879             | 0.773 | 0.681 | 0.601 | 0.530 | 0.469 | 0.415 | 0.368 | 0.326 | 0.290 | 13 |
| 14             | 0.870             | 0.758 | 0.661 | 0.577 | 0.505 | 0.442 | 0.388 | 0.340 | 0.299 | 0.263 | 14 |
| 15             | 0.861             | 0.743 | 0.642 | 0.555 | 0.481 | 0.417 | 0.362 | 0.315 | 0.275 | 0.239 | 15 |
| (n)            | 11%               | 12%   | 13%   | 14%   | 15%   | 16%   | 17%   | 18%   | 19%   | 20%   |    |
| 1              | 0.901             | 0.893 | 0.885 | 0.877 | 0.870 | 0.862 | 0.855 | 0.847 | 0.840 | 0.833 | 1  |
| 2              | 0.812             | 0.797 | 0.783 | 0.769 | 0.756 | 0.743 | 0.731 | 0.718 | 0.706 | 0.694 | 2  |
| 3              | 0.731             | 0.712 | 0.693 | 0.675 | 0.658 | 0.641 | 0.624 | 0.609 | 0.593 | 0.579 | 3  |
| 4              | 0.659             | 0.636 | 0.613 | 0.592 | 0.572 | 0.552 | 0.534 | 0.516 | 0.499 | 0.482 | 4  |
| 5              | 0.593             | 0.567 | 0.543 | 0.519 | 0.497 | 0.476 | 0.456 | 0.437 | 0.419 | 0.402 | 5  |
| 6              | 0.535             | 0.507 | 0.480 | 0.456 | 0.432 | 0.410 | 0.390 | 0.370 | 0.352 | 0.335 | 6  |
| 7              | 0.482             | 0.452 | 0.425 | 0.400 | 0.376 | 0.354 | 0.333 | 0.314 | 0.296 | 0.279 | 7  |
| 8              | 0.434             | 0.404 | 0.376 | 0.351 | 0.327 | 0.305 | 0.285 | 0.266 | 0.249 | 0.233 | 8  |
| 9              | 0.391             | 0.361 | 0.333 | 0.308 | 0.284 | 0.263 | 0.243 | 0.225 | 0.209 | 0.194 | 9  |
| 10             | 0.352             | 0.322 | 0.295 | 0.270 | 0.247 | 0.227 | 0.208 | 0.191 | 0.176 | 0.162 | 10 |
| 11             | 0.317             | 0.287 | 0.261 | 0.237 | 0.215 | 0.195 | 0.178 | 0.162 | 0.148 | 0.135 | 11 |
| 12             | 0.286             | 0.257 | 0.231 | 0.208 | 0.187 | 0.168 | 0.152 | 0.137 | 0.124 | 0.112 | 12 |
| 13             | 0.258             | 0.229 | 0.204 | 0.182 | 0.163 | 0.145 | 0.130 | 0.116 | 0.104 | 0.093 | 13 |
| 14             | 0.232             | 0.205 | 0.181 | 0.160 | 0.141 | 0.125 | 0.111 | 0.099 | 0.088 | 0.078 | 14 |
| 15             | 0.209             | 0.183 | 0.160 | 0.140 | 0.123 | 0.108 | 0.095 | 0.084 | 0.074 | 0.065 | 15 |

## Annuity Table

Present value of an annuity of 1 i.e.  $\frac{1 - (1 + r)^{-n}}{r}$

Where  $r$  = discount rate  
 $n$  = number of periods

| Periods<br>(n) | Discount rate (r) |        |        |        |        |       |       |       |       |       |    |
|----------------|-------------------|--------|--------|--------|--------|-------|-------|-------|-------|-------|----|
|                | 1%                | 2%     | 3%     | 4%     | 5%     | 6%    | 7%    | 8%    | 9%    | 10%   |    |
| 1              | 0.990             | 0.980  | 0.971  | 0.962  | 0.952  | 0.943 | 0.935 | 0.926 | 0.917 | 0.909 | 1  |
| 2              | 1.970             | 1.942  | 1.913  | 1.886  | 1.859  | 1.833 | 1.808 | 1.783 | 1.759 | 1.736 | 2  |
| 3              | 2.941             | 2.884  | 2.829  | 2.775  | 2.723  | 2.673 | 2.624 | 2.577 | 2.531 | 2.487 | 3  |
| 4              | 3.902             | 3.808  | 3.717  | 3.630  | 3.546  | 3.465 | 3.387 | 3.312 | 3.240 | 3.170 | 4  |
| 5              | 4.853             | 4.713  | 4.580  | 4.452  | 4.329  | 4.212 | 4.100 | 3.993 | 3.890 | 3.791 | 5  |
| 6              | 5.795             | 5.601  | 5.417  | 5.242  | 5.076  | 4.917 | 4.767 | 4.623 | 4.486 | 4.355 | 6  |
| 7              | 6.728             | 6.472  | 6.230  | 6.002  | 5.786  | 5.582 | 5.389 | 5.206 | 5.033 | 4.868 | 7  |
| 8              | 7.652             | 7.325  | 7.020  | 6.733  | 6.463  | 6.210 | 5.971 | 5.747 | 5.535 | 5.335 | 8  |
| 9              | 8.566             | 8.162  | 7.786  | 7.435  | 7.108  | 6.802 | 6.515 | 6.247 | 5.995 | 5.759 | 9  |
| 10             | 9.471             | 8.983  | 8.530  | 8.111  | 7.722  | 7.360 | 7.024 | 6.710 | 6.418 | 6.145 | 10 |
| 11             | 10.368            | 9.787  | 9.253  | 8.760  | 8.306  | 7.887 | 7.499 | 7.139 | 6.805 | 6.495 | 11 |
| 12             | 11.255            | 10.575 | 9.954  | 9.385  | 8.863  | 8.384 | 7.943 | 7.536 | 7.161 | 6.814 | 12 |
| 13             | 12.134            | 11.348 | 10.635 | 9.986  | 9.394  | 8.853 | 8.358 | 7.904 | 7.487 | 7.103 | 13 |
| 14             | 13.004            | 12.106 | 11.296 | 10.563 | 9.899  | 9.295 | 8.745 | 8.244 | 7.786 | 7.367 | 14 |
| 15             | 13.865            | 12.849 | 11.938 | 11.118 | 10.380 | 9.712 | 9.108 | 8.559 | 8.061 | 7.606 | 15 |
| (n)            | 11%               | 12%    | 13%    | 14%    | 15%    | 16%   | 17%   | 18%   | 19%   | 20%   |    |
| 1              | 0.901             | 0.893  | 0.885  | 0.877  | 0.870  | 0.862 | 0.855 | 0.847 | 0.840 | 0.833 | 1  |
| 2              | 1.713             | 1.690  | 1.668  | 1.647  | 1.626  | 1.605 | 1.585 | 1.566 | 1.547 | 1.528 | 2  |
| 3              | 2.444             | 2.402  | 2.361  | 2.322  | 2.283  | 2.246 | 2.210 | 2.174 | 2.140 | 2.106 | 3  |
| 4              | 3.102             | 3.037  | 2.974  | 2.914  | 2.855  | 2.798 | 2.743 | 2.690 | 2.639 | 2.589 | 4  |
| 5              | 3.696             | 3.605  | 3.517  | 3.433  | 3.352  | 3.274 | 3.199 | 3.127 | 3.058 | 2.991 | 5  |
| 6              | 4.231             | 4.111  | 3.998  | 3.889  | 3.784  | 3.685 | 3.589 | 3.498 | 3.410 | 3.326 | 6  |
| 7              | 4.712             | 4.564  | 4.423  | 4.288  | 4.160  | 4.039 | 3.922 | 3.812 | 3.706 | 3.605 | 7  |
| 8              | 5.146             | 4.968  | 4.799  | 4.639  | 4.487  | 4.344 | 4.207 | 4.078 | 3.954 | 3.837 | 8  |
| 9              | 5.537             | 5.328  | 5.132  | 4.946  | 4.772  | 4.607 | 4.451 | 4.303 | 4.163 | 4.031 | 9  |
| 10             | 5.889             | 5.650  | 5.426  | 5.216  | 5.019  | 4.833 | 4.659 | 4.494 | 4.339 | 4.192 | 10 |
| 11             | 6.207             | 5.938  | 5.687  | 5.453  | 5.234  | 5.029 | 4.836 | 4.656 | 4.486 | 4.327 | 11 |
| 12             | 6.492             | 6.194  | 5.918  | 5.660  | 5.421  | 5.197 | 4.988 | 4.793 | 4.611 | 4.439 | 12 |
| 13             | 6.750             | 6.424  | 6.122  | 5.842  | 5.583  | 5.342 | 5.118 | 4.910 | 4.715 | 4.533 | 13 |
| 14             | 6.982             | 6.628  | 6.302  | 6.002  | 5.724  | 5.468 | 5.229 | 5.008 | 4.802 | 4.611 | 14 |
| 15             | 7.191             | 6.811  | 6.462  | 6.142  | 5.847  | 5.575 | 5.324 | 5.092 | 4.876 | 4.675 | 15 |