CONFIDENTIAL

UNIVERSITI KUALA LUMPUR BUSINESS SCHOOL

FINAL EXAMINATION

JANUARY 2016 SEMESTER

SUBJECT CODE	:	**EAB21403**
SUBJECT TITLE	:	**STATISTICS FOR BUSINESS**
LEVEL	:	**BACHELOR**
TIME / DURATION	:	**9:00AM – 12:00PM / 3 HOURS**
DATE	:	**30^{TH} MAY 2015**

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consists of NINE (9) questions.
4. **Answer ALL questions.**
4. Please write your answers on the answer booklet provided.
5. All questions must be answered in **English** (any other language is not allowed).
6. This question paper must not be removed from the examination hall.

THERE ARE SIX (6) PAGES OF QUESTIONS, FOUR (4) PAGES OF FORMULAS AND FOUR (4) PAGES OF TABLE, EXCLUDING THIS PAGE.

INSTRUCTION: Answer ALL Questions

Please use the answer booklet provided

Question 1

a. A student was interested in the cigarette smoking habits of college students and collected data from an unbiased random sample of students. The data is summarized in the following table:

Males who smoke	20
Males who do not smoke	30
Females who smoke	25
Females who do not smoke	50

What type of visualization is the best to illustrate the above data.? Explain.

b. A group of 100 students were surveyed about their interest in a new Economics major. Interest was measured in terms of high, medium, or low. In the study, 30 students responded high interest, 50 students responded medium interest, and 20 students responded low interest. What is the **best** way to illustrate the student interest? Explain.

c. A purchasing agent for a trucking company is shopping for replacement tires for their trucks from two suppliers. The suppliers' prices are the same. However, Supplier A's tires have an average life of 60,000 miles with a standard deviation of 10,000 miles. Supplier B's tires have an average life of 60,000 miles with a standard deviation of 2,000 miles. Which tire life much more predictable. Explain your answer.

(10 marks)

Question 2

A company's human resources department was interested in the average number of years that a person works before retiring. The sample of size 11 follows:

12	16	18	19	21	21	21	22	24	24	26

a. What is the mode?

b. What is the arithmetic mean?

c. What is the median?

d. Based on the values of the arithmetic mean, median, and mode, what is the most likely shape of the distribution?

(10 marks)

Question 3

For the following data,

1	5	6	6	6	7	7	7	8	8	8
8	8	9	9	9	9	9	9	9	9	

a. find the information required to construct a box plot.

b. what is the interquartile range?

c. are any of the observations an outlier?

(15 marks)

Question 4

a. What is the difference between a permutation and a combination?

b. When are two outcomes independent? Explain in terms of the rules of probability.

c. Each salesperson in a large department store chain is rated on their sales ability and their potential for advancement. The data for the 500 sampled salespeople are summarized in the following table.

		Potential for Advancement		
		Fair	Good	Excellent
Sales Ability	Below Average	16	12	22
	Average	45	60	45
	Above Average	93	72	135

What is the probability that a salesperson selected at random has above average sales ability and has excellent potential for advancement?

d. An automatic machine inserts mixed vegetables into a plastic bag. Past experience revealed that some packages were underweight and some were overweight, but most of them had satisfactory weight.

Weight	% Of Total
Underweight	2.5
Satisfactory	90.0
Overweight	7.5

What is the probability of selecting three packages that are overweight?

(15 [redacted])

Question 5

a. What kind of distributions are the binomial and Poisson probability distributions?

b. What is the shape describes a Poisson distribution?

c. Sweetwater & Associates write weekend trip insurance at a very nominal charge. Records show that the probability that a motorist will have an accident during the weekend and file a claim is 0.0005. Suppose they wrote 400 policies for the coming weekend, what is the probability that exactly two claims will be filed?

d. Sponsors of a local charity decided to attract wealthy patrons to its $500-a-plate dinner by allowing each patron to buy a set of 20 tickets for the gaming tables. The chance of winning a prize for each of the 20 plays is 50-50. If you bought 20 tickets, what is the chance of winning 15 or more prizes?

(10 [redacted])

Question 6

a. What is the purpose of measuring correlation?
b. Select a value for the correlation coefficient and provide a complete interpretation of the correlation coefficient using your selected value.
c. What is the difference between correlation coefficient and regression coefficient?
d. What is the purpose of transformations in regression analysis?

(10 [redacted]

Question 7

A copier company sell copier to business of all sizes throughout the country. Salmiah was recently promoted to the position of a national sales manager. At the upcoming sales meeting , the sales representative from all over the country will be in attendance . She would like to impress upon them the importance of making that extra sales call each day. She decides to gather some information on the relationship between the number of sales calls and the number of copier sold. She select the random samples of 15 sales representatives and determines the number of sales calls they made last month and the number of copiers they sold. The Gretl output on regression is reported below.

OLS, using observations 1-15
Dependent variable: sale

	Coefficient	*Std. Error*	*t-ratio*	*p-value*
const	16.2133	5.18552		
calls	0.31375	0.0496167		

Mean dependent var	46.33333	S.D. dependent var	15.44422
Sum squared resid	819.2933	S.E. of regression	7.938675
R-squared	0.754654	Adjusted R-squared	0.735781
F(1, 13)	39.98631	P-value(F)	0.000026
Log-likelihood	−51.28702	Akaike criterion	106.5740
Schwarz criterion	107.9901	Hannan-Quinn	106.5590

Base on the above output, answer the following questions:

a. Write out the regression equation
b. How many sales would you expect for 100 calls made
c. Determine and interpret the coefficient of determination
d. Determine the correlation coefficient. Interpret it value . How do you determine the sign of the correlation coefficient. ?
e. Conduct a test of hypothesis to determine if there is a significant relationship between the calls and the sales . Use the 0.1 significance level and a two tailed test.

(15 marks

Question 8

a. A company wants to estimate next year's total revenue. Why is an interval estimate preferred to a point estimate?

b. The proportion of public accountants who have changed companies within the last three years is to be estimated within 3% .The 95% level of confidence is to be used. A study conducted several years ago revealed that the percent of public accountants changing companies within 3 years was 21.
   i. To update this study, how many public accountants should be studied?
   ii. How many publics accountants should be contacted if no previous estimate of the population proportion are available?

c. A random sample of 85 supervisors revealed that they worked an average of 6.5 years before being promoted. The population standard deviation was 1.7 years. Using the 0.95 degree of confidence, what is the confidence interval for the population mean?

(10 marks)

Question 9

What is the rationale that you need to study this subject (Statistics for Business) in your program.

(5 marks)

[Total: 100 Marks]

END OF QUESTION PAPER

KEY FORMULAS Lind, Marchal, and Wathen • *Statistical Techniques in Business & Economics, 16th edition*

CHAPTER 3

- Population mean

$$\mu = \frac{\Sigma x}{N} \quad [3\text{–}1]$$

- Sample mean, raw data

$$\bar{x} = \frac{\Sigma x}{n} \quad [3\text{–}2]$$

- Weighted mean

$$\bar{x}_w = \frac{w_1x_1 + w_2x_2 + \cdots + w_nx_n}{w_1 + w_2 + \cdots + w_n} \quad [3\text{–}3]$$

- Geometric mean

$$GM = \sqrt[n]{(x_1)(x_2)(x_3)\cdots(x_n)} \quad [3\text{–}4]$$

- Geometric mean rate of increase

$$GM = \sqrt[n]{\frac{\text{Value at end of period}}{\text{Value at start of period}}} - 1.0 \quad [3\text{–}5]$$

- Range

$$\text{Range} = \text{Maximum value} - \text{Minimum value} \quad [3\text{–}6]$$

- Population variance

$$\sigma^2 = \frac{\Sigma(x - \mu)^2}{N} \quad [3\text{–}7]$$

- Population standard deviation

$$\sigma = \sqrt{\frac{\Sigma(x - \mu)^2}{N}} \quad [3\text{–}8]$$

- Sample variance

$$s^2 = \frac{\Sigma(x - \bar{x})^2}{n - 1} \quad [3\text{–}9]$$

- Sample standard deviation

$$s = \sqrt{\frac{\Sigma(x - \bar{x})^2}{n - 1}} \quad [3\text{–}10]$$

- Sample mean, grouped data

$$\bar{x} = \frac{\Sigma fM}{n} \quad [3\text{–}11]$$

- Sample standard deviation, grouped data

$$s = \sqrt{\frac{\Sigma f(M - \bar{x})^2}{n - 1}} \quad [3\text{–}12]$$

CHAPTER 4

- Location of a percentile

$$L_p = (n + 1)\frac{P}{100} \quad [4\text{–}1]$$

- Pearson's coefficient of skewness

$$sk = \frac{3(\bar{x} - \text{Median})}{s} \quad [4\text{–}2]$$

- Software coefficient of skewness

$$sk = \frac{n}{(n - 1)(n - 2)}\left[\Sigma\left(\frac{x - \bar{x}}{s}\right)^3\right] \quad [4\text{–}3]$$

CHAPTER 5

- Special rule of addition

$$P(A \text{ or } B) = P(A) + P(B) \quad [5\text{–}2]$$

- Complement rule

$$P(A) = 1 - P(\sim A) \quad [5\text{–}3]$$

- General rule of addition

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) \quad [5\text{–}4]$$

- Special rule of multiplication

$$P(A \text{ and } B) = P(A)P(B) \quad [5\text{–}5]$$

- General rule of multiplication

$$P(A \text{ and } B) = P(A)P(B|A) \quad [5\text{–}6]$$

- Bayes' Theorem

$$P(A_1|B) = \frac{P(A_1)P(B|A_1)}{P(A_1)P(B|A_1) + P(A_2)P(B|A_2)} \quad [5\text{–}7]$$

- Multiplication formula

$$\text{Total arrangements} = (m)(n) \quad [5\text{–}8]$$

- Number of permutations

$$_nP_r = \frac{n!}{(n - r)!} \quad [5\text{–}9]$$

- Number of combinations

$$_nC_r = \frac{n!}{r!(n - r)!} \quad [5\text{–}10]$$

CHAPTER 6

- Mean of a probability distribution

$$\mu = \Sigma[xP(x)] \quad [6\text{–}1]$$

- Variance of a probability distribution

$$\sigma^2 = \Sigma[(x - \mu)^2P(x)] \quad [6\text{–}2]$$

- Binomial probability distribution

$$P(x) = {_nC_x}\,\pi^x(1 - \pi)^{n-x} \quad [6\text{–}3]$$

- Mean of a binomial distribution

$$\mu = n\pi \quad [6\text{–}4]$$

- Variance of a binomial distribution

$$\sigma^2 = n\pi(1 - \pi) \quad [6\text{–}5]$$

- Hypergeometric probability distribution

$$P(x) = \frac{(_SC_x)(_{N-S}C_{n-x})}{_NC_n} \quad [6\text{–}6]$$

- Poisson probability distribution

$$P(x) = \frac{\mu^x e^{-\mu}}{x!} \quad [6\text{–}7]$$

- Mean of a Poisson distribution

$$\mu = n\pi \quad [6\text{–}8]$$

CHAPTER 7

- Mean of a uniform distribution

$$\mu = \frac{a + b}{2} \qquad [7\text{–}1]$$

- Standard deviation of a uniform distribution

$$\sigma = \sqrt{\frac{(b - a)^2}{12}} \qquad [7\text{–}2]$$

- Uniform probability distribution

$$P(x) = \frac{1}{b - a} \qquad [7\text{–}3]$$

if $a \le x \le b$ and 0 elsewhere

- Normal probability distribution

$$P(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\left[\frac{(x-\mu)^2}{2\sigma^2}\right]} \qquad [7\text{–}4]$$

- Standard normal value

$$z = \frac{x - \mu}{\sigma} \qquad [7\text{–}5]$$

- Exponential distribution

$$P(x) = \lambda e^{-\lambda x} \qquad [7\text{–}6]$$

- Finding a probability using the exponential distribution

$$P(\text{Arrival time} < x) = 1 - e^{-\lambda x} \qquad [7\text{–}7]$$

CHAPTER 8

- Standard error of mean

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} \qquad [8\text{–}1]$$

- z-value, μ and σ known

$$z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}} \qquad [8\text{–}2]$$

CHAPTER 9

- Confidence interval for μ, with σ known

$$\bar{x} \pm z\frac{\sigma}{\sqrt{n}} \qquad [9\text{–}1]$$

- Confidence interval for μ, σ unknown

$$\bar{x} \pm t\frac{s}{\sqrt{n}} \qquad [9\text{–}2]$$

- Sample proportion

$$p = \frac{x}{n} \qquad [9\text{–}3]$$

- Confidence interval for proportion

$$p \pm z\sqrt{\frac{p(1 - p)}{n}} \qquad [9\text{–}4]$$

- Sample size for estimating mean

$$n = \left(\frac{z\sigma}{E}\right)^2 \qquad [9\text{–}5]$$

- Sample size for a proportion

$$n = \pi(1 - \pi)\left(\frac{z}{E}\right)^2 \qquad [9\text{–}6]$$

CHAPTER 10

- Testing a mean, σ known

$$z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}} \qquad [10\text{–}1]$$

- Testing a mean, σ unknown

$$t = \frac{\bar{x} - \mu}{s/\sqrt{n}} \qquad [10\text{–}2]$$

- Type II error

$$z = \frac{\bar{x}_c - \mu_1}{\sigma/\sqrt{n}} \qquad [10\text{–}3]$$

CHAPTER 11

- Variance of the distribution of difference in means

$$\sigma^2_{\bar{x}_1 - \bar{x}_2} = \frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2} \qquad [11\text{–}1]$$

- Two-sample test of means, known σ

$$z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}} \qquad [11\text{–}2]$$

- Pooled variance

$$s_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2} \qquad [11\text{–}3]$$

- Two-sample test of means, unknown but equal σ^2s

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{s_p^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \qquad [11\text{–}4]$$

- Two-sample tests of means, unknown and unequal σ^2s

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \qquad [11\text{–}5]$$

- Degrees of freedom for unequal variance test

$$df = \frac{[(s_1^2/n_1) + (s_2^2/n_2)]^2}{\frac{(s_1^2/n_1)^2}{n_1 - 1} + \frac{(s_2^2/n_2)^2}{n_2 - 1}} \qquad [11\text{–}6]$$

- Paired t test

$$t = \frac{\bar{d}}{s_d/\sqrt{n}} \qquad [11\text{–}7]$$

CHAPTER 12

- Test for comparing two variances

$$F = \frac{s_1^2}{s_2^2} \qquad [12\text{–}1]$$

- Sum of squares, total

$$\text{SS total} = \Sigma(x - \bar{x}_G)^2 \qquad [12\text{–}2]$$

- Sum of squares, error

$$SSE = \Sigma(x - \bar{x}_G)^2 \quad [12\text{–}3]$$

- Sum of squares, treatments

$$SST = SS\ total - SSE \quad [12\text{–}4]$$

- Confidence interval for differences in treatment means

$$(\bar{x}_1 - \bar{x}_2) \pm t\sqrt{MSE\left(\frac{1}{n_1} + \frac{1}{n_2}\right)} \quad [12\text{–}5]$$

- Sum of squares, blocks

$$SSB = k\Sigma(\bar{x}_b - \bar{x}_G)^2 \quad [12\text{–}6]$$

- Sum of squares error, two-way ANOVA

$$SSE = SS\ total - SST - SSB \quad [12\text{–}7]$$

CHAPTER 13

- Correlation coefficient

$$r = \frac{\Sigma(x - \bar{x})(y - \bar{y})}{(n-1)s_x s_y} \quad [13\text{–}1]$$

- Test for significant correlation

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \quad [13\text{–}2]$$

- Linear regression equation

$$\hat{y} = a + bx \quad [13\text{–}3]$$

- Slope of the regression line

$$b = r\frac{s_y}{s_x} \quad [13\text{–}4]$$

- Intercept of the regression line

$$a = \bar{y} - b\bar{x} \quad [13\text{–}5]$$

- Test for a zero slope

$$t = \frac{b - 0}{s_b} \quad [13\text{–}6]$$

- Standard error of estimate

$$s_{y \cdot x} = \sqrt{\frac{\Sigma(y - \hat{y})^2}{n-2}} \quad [13\text{–}7]$$

- Coefficient of determination

$$r^2 = \frac{SSR}{SS\ Total} = 1 - \frac{SSE}{SS\ Total} \quad [13\text{–}8]$$

- Standard error of estimate

$$s_{y \cdot x} = \sqrt{\frac{SSE}{n-2}} \quad [13\text{–}9]$$

- Confidence interval

$$\hat{y} \pm t s_{y \cdot x}\sqrt{\frac{1}{n} + \frac{(x - \bar{x})^2}{\Sigma(x - \bar{x})^2}} \quad [13\text{–}10]$$

- Prediction interval

$$\hat{y} \pm t s_{y \cdot x}\sqrt{1 + \frac{1}{n} + \frac{(x - \bar{x})^2}{\Sigma(x - \bar{x})^2}} \quad [13\text{–}11]$$

CHAPTER 14

- Multiple regression equation

$$\hat{y} = a + b_1x_1 + b_2x_2 + \cdots + b_kx_k \quad [14\text{–}1]$$

- Multiple standard error of estimate

$$s_{y \cdot 123\ldots k} = \sqrt{\frac{\Sigma(y - \hat{y})^2}{n - (k+1)}} = \sqrt{\frac{SSE}{n - (k+1)}} \quad [14\text{–}2]$$

- Coefficient of multiple determination

$$R^2 = \frac{SSR}{SS\ total} \quad [14\text{–}3]$$

- Adjusted coefficient of determination

$$R^2_{adj} = 1 - \frac{\dfrac{SSE}{n-(k+1)}}{\dfrac{SS\ total}{n-1}} \quad [14\text{–}4]$$

- Global test of hypothesis

$$F = \frac{SSR/k}{SSE/[n - (k+1)]} \quad [14\text{–}5]$$

- Testing for a particular regression coefficient

$$t = \frac{b_i - 0}{s_{b_i}} \quad [14\text{–}6]$$

- Variance inflation factor

$$VIF = \frac{1}{1 - R_j^2} \quad [14\text{–}7]$$

CHAPTER 15

- Test of hypothesis, one proportion

$$z = \frac{p - \pi}{\sqrt{\dfrac{\pi(1-\pi)}{n}}} \quad [15\text{–}1]$$

- Two-sample test of proportions

$$z = \frac{p_1 - p_2}{\sqrt{\dfrac{p_c(1-p_c)}{n_1} + \dfrac{p_c(1-p_c)}{n_2}}} \quad [15\text{–}2]$$

- Pooled proportion

$$p_c = \frac{x_1 + x_2}{n_1 + n_2} \quad [15\text{–}3]$$

- Chi-square test statistic

$$\chi^2 = \sum\left[\frac{(f_o - f_e)^2}{f_e}\right] \quad [15\text{–}4]$$

- Expected frequency

$$f_e = \frac{(\text{Row total})(\text{Column total})}{\text{Grand total}} \quad [15\text{–}5]$$

CHAPTER 16

- Sign test, $n > 10$

$$z = \frac{(x \pm .50) - \mu}{\sigma} \quad [16\text{–}1]$$

- Wilcoxon rank-sum test

$$z = \frac{W - \frac{n_1(n_1 + n_2 + 1)}{2}}{\sqrt{\frac{n_1 n_2(n_1 + n_2 + 1)}{12}}} \quad [16\text{–}4]$$

- Kruskal-Wallis test

$$H = \frac{12}{n(n+1)}\left[\frac{(\Sigma R_1)^2}{n_1} + \frac{(\Sigma R_2)^2}{n_2} + \cdots + \frac{(\Sigma R_k)^2}{n_k}\right] - 3(n+1) \quad [16\text{–}5]$$

- Spearman coefficient of rank correlation

$$r_s = 1 - \frac{6\Sigma d^2}{n(n^2 - 1)} \quad [16\text{–}6]$$

- Hypothesis test, rank correlation

$$t = r_s\sqrt{\frac{n-2}{1 - r_s^2}} \quad [16\text{–}7]$$

CHAPTER 17

- Simple index

$$P = \frac{p_t}{p_0}(100) \quad [17\text{–}1]$$

- Simple average of price relatives

$$P = \frac{\Sigma P_i}{n} \quad [17\text{–}2]$$

- Simple aggregate index

$$P = \frac{\Sigma p_t}{\Sigma p_0}(100) \quad [17\text{–}3]$$

- Laspeyres' price index

$$P = \frac{\Sigma p_t q_0}{\Sigma p_0 q_0}(100) \quad [17\text{–}4]$$

- Paasche's price index

$$P = \frac{\Sigma p_t q_t}{\Sigma p_0 q_t}(100) \quad [17\text{–}5]$$

- Fisher's ideal index

$$\sqrt{(\text{Laspeyres' price index})(\text{Paasche's price index})} \quad [17\text{–}6]$$

- Value index

$$V = \frac{\Sigma p_t q_t}{\Sigma p_0 q_0}(100) \quad [17\text{–}7]$$

- Real income

$$\text{Real income} = \frac{\text{Money income}}{\text{CPI}}(100) \quad [17\text{–}8]$$

- Using an index as a deflator

$$\text{Deflated sales} = \frac{\text{Actual sales}}{\text{Index}}(100) \quad [17\text{–}9]$$

- Purchasing power

$$\text{Purchasing power} = \frac{\$1}{\text{CPI}}(100) \quad [17\text{–}10]$$

CHAPTER 18

- Linear trend

$$\hat{y} = a + bt \quad [18\text{–}1]$$

- Log trend equation

$$\log \hat{y} = \log a + \log b(t) \quad [18\text{–}2]$$

- Correction factor for adjusting quarterly means

$$\text{Correction factor} = \frac{4.00}{\text{Total of four means}} \quad [18\text{–}3]$$

- Durbin-Watson statistic

$$d = \frac{\sum_{t=2}^{n}(e_t - e_{t-1})^2}{\sum_{t=1}^{n} e_t^2} \quad [18\text{–}4]$$

CHAPTER 19

- Grand mean

$$\bar{\bar{X}} = \frac{\Sigma \bar{X}}{k} \quad [19\text{–}1]$$

- Control limits, mean

$$\text{UCL} = \bar{\bar{X}} + A_2\bar{R} \qquad \text{LCL} = \bar{\bar{X}} - A_2\bar{R} \quad [19\text{–}4]$$

- Control limits, range

$$\text{UCL} = D_4\bar{R} \qquad \text{LCL} = D_3\bar{R} \quad [19\text{–}5]$$

- Mean proportion defective

$$p = \frac{\text{Total number defective}}{\text{Total number of items sampled}} \quad [19\text{–}6]$$

- Control limits, proportion

$$\text{UCL and LCL} = p \pm 3\sqrt{\frac{p(1-p)}{n}} \quad [19\text{–}8]$$

- Control limits, c-bar chart

$$\text{UCL and LCL} = \bar{c} \pm 3\sqrt{\bar{c}} \quad [19\text{–}9]$$

CHAPTER 20 (ON THE WEBSITE: www.mhhe.com/lind16e)

- Expected monetary value

$$\text{EMV}(A_i) = \Sigma[P(S_j) \cdot V(A_i, S_j)] \quad [20\text{–}1]$$

- Expected opportunity loss

$$\text{EOL}(A_i) = \Sigma[P(S_j) \cdot R(A_i, S_j)] \quad [20\text{–}2]$$

- Expected value of perfect information

EVPI = Expected value under conditions of certainty − Expected value of optimal decision under conditions of uncertainty [20–3]

Cumulative Poisson Probability Distribution Table

x	λt 0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0	0.9950	0.9900	0.9802	0.9704	0.9608	0.9512	0.9418	0.9324	0.9231	0.9139
1	1.0000	1.0000	0.9998	0.9996	0.9992	0.9988	0.9983	0.9977	0.9970	0.9962
2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9999	0.9999
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

x	λt 0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
0	0.9048	0.8187	0.7408	0.6703	0.6065	0.5488	0.4966	0.4493	0.4066	0.3679
1	0.9953	0.9825	0.9631	0.9384	0.9098	0.8781	0.8442	0.8088	0.7725	0.7358
2	0.9998	0.9989	0.9964	0.9921	0.9856	0.9769	0.9659	0.9526	0.9371	0.9197
3	1.0000	0.9999	0.9997	0.9992	0.9982	0.9966	0.9942	0.9909	0.9865	0.9810
4	1.0000	1.0000	1.0000	0.9999	0.9998	0.9996	0.9992	0.9986	0.9977	0.9963
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9998	0.9997	0.9994
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

x	λt 1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80	1.90	2.00
0	0.3329	0.3012	0.2725	0.2466	0.2231	0.2019	0.1827	0.1653	0.1496	0.1353
1	0.6990	0.6626	0.6268	0.5918	0.5578	0.5249	0.4932	0.4628	0.4337	0.4060
2	0.9004	0.8795	0.8571	0.8335	0.8088	0.7834	0.7572	0.7306	0.7037	0.6767
3	0.9743	0.9662	0.9569	0.9463	0.9344	0.9212	0.9068	0.8913	0.8747	0.8571
4	0.9946	0.9923	0.9893	0.9857	0.9814	0.9763	0.9704	0.9636	0.9559	0.9473
5	0.9990	0.9985	0.9978	0.9968	0.9955	0.9940	0.9920	0.9896	0.9868	0.9834
6	0.9999	0.9997	0.9996	0.9994	0.9991	0.9987	0.9981	0.9974	0.9966	0.9955
7	1.0000	1.0000	0.9999	0.9999	0.9998	0.9997	0.9996	0.9994	0.9992	0.9989
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9999	0.9998	0.9998
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

x	λt 2.10	2.20	2.30	2.40	2.50	2.60	2.70	2.80	2.90	3.00
0	0.1225	0.1108	0.1003	0.0907	0.0821	0.0743	0.0672	0.0608	0.0550	0.0498
1	0.3796	0.3546	0.3309	0.3084	0.2873	0.2674	0.2487	0.2311	0.2146	0.1991
2	0.6496	0.6227	0.5960	0.5697	0.5438	0.5184	0.4936	0.4695	0.4460	0.4232
3	0.8386	0.8194	0.7993	0.7787	0.7576	0.7360	0.7141	0.6919	0.6696	0.6472
4	0.9379	0.9275	0.9162	0.9041	0.8912	0.8774	0.8629	0.8477	0.8318	0.8153
5	0.9796	0.9751	0.9700	0.9643	0.9580	0.9510	0.9433	0.9349	0.9258	0.9161
6	0.9941	0.9925	0.9906	0.9884	0.9858	0.9828	0.9794	0.9756	0.9713	0.9665
7	0.9985	0.9980	0.9974	0.9967	0.9958	0.9947	0.9934	0.9919	0.9901	0.9881
8	0.9997	0.9995	0.9994	0.9991	0.9989	0.9985	0.9981	0.9976	0.9969	0.9962
9	0.9999	0.9999	0.9999	0.9998	0.9997	0.9996	0.9995	0.9993	0.9991	0.9989
10	1.0000	1.0000	1.0000	1.0000	0.9999	0.9999	0.9999	0.9998	0.9998	0.9997
11	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9999
12	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

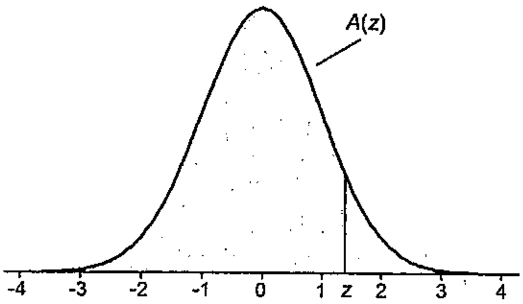
BINOMIAL PROBABILITY DISTRIBUTION.

Table 4 continued

n	r	.01	.05	.10	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60	.65	.70	.75	.80	.85	.90	.95
16	2	.010	.146	.275	.277	.211	.134	.073	.035	.015	.006	.002	.001	.000	.000	.000	.000	.000	.000	.000	.000
	3	.000	.036	.142	.229	.246	.208	.146	.089	.047	.022	.009	.003	.001	.000	.000	.000	.000	.000	.000	.000
	4	.000	.006	.051	.131	.200	.225	.204	.155	.101	.057	.028	.011	.004	.001	.000	.000	.000	.000	.000	.000
	5	.000	.001	.014	.056	.120	.180	.210	.201	.162	.112	.067	.034	.014	.005	.001	.000	.000	.000	.000	.000
	6	.000	.000	.003	.018	.055	.110	.165	.198	.198	.168	.122	.075	.039	.017	.006	.001	.000	.000	.000	.000
	7	.000	.000	.000	.005	.020	.052	.101	.152	.189	.197	.175	.132	.084	.044	.019	.006	.001	.000	.000	.000
	8	.000	.000	.000	.001	.006	.020	.049	.092	.142	.181	.196	.181	.142	.092	.049	.020	.006	.001	.000	.000
	9	.000	.000	.000	.000	.001	.006	.019	.044	.084	.132	.175	.197	.189	.152	.101	.052	.020	.005	.000	.000
	10	.000	.000	.000	.000	.000	.001	.006	.017	.039	.075	.122	.168	.198	.198	.165	.110	.055	.018	.003	.000
	11	.000	.000	.000	.000	.000	.000	.001	.005	.014	.034	.067	.112	.162	.201	.210	.180	.120	.056	.014	.001
	12	.000	.000	.000	.000	.000	.000	.000	.001	.004	.011	.028	.057	.101	.155	.204	.225	.200	.131	.051	.006
	13	.000	.000	.000	.000	.000	.000	.000	.000	.001	.003	.009	.022	.047	.089	.146	.208	.246	.229	.142	.036
	14	.000	.000	.000	.000	.000	.000	.000	.000	.000	.001	.002	.006	.015	.035	.073	.134	.211	.277	.275	.146
	15	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.001	.003	.009	.023	.053	.113	.210	.329	.371
	16	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.001	.003	.010	.028	.074	.185	.440
20	0	.818	.358	.122	.039	.012	.003	.001	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	1	.165	.377	.270	.137	.058	.021	.007	.002	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	2	.016	.189	.285	.229	.137	.067	.028	.010	.003	.001	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	3	.001	.060	.190	.243	.205	.134	.072	.032	.012	.004	.001	.000	.000	.000	.000	.000	.000	.000	.000	.000
	4	.000	.013	.090	.182	.218	.190	.130	.074	.035	.014	.005	.001	.000	.000	.000	.000	.000	.000	.000	.000
	5	.000	.002	.032	.103	.175	.202	.179	.127	.075	.036	.015	.005	.001	.000	.000	.000	.000	.000	.000	.000
	6	.000	.000	.009	.045	.109	.169	.192	.171	.124	.075	.037	.015	.005	.001	.000	.000	.000	.000	.000	.000
	7	.000	.000	.002	.016	.055	.112	.164	.184	.166	.122	.074	.037	.015	.005	.001	.000	.000	.000	.000	.000
	8	.000	.000	.000	.005	.022	.061	.114	.161	.180	.162	.120	.073	.035	.014	.004	.001	.000	.000	.000	.000
	9	.000	.000	.000	.001	.007	.027	.065	.116	.160	.177	.160	.119	.071	.034	.012	.003	.000	.000	.000	.000
	10	.000	.000	.000	.000	.002	.010	.031	.069	.117	.159	.176	.159	.117	.069	.031	.010	.002	.000	.000	.000
	11	.000	.000	.000	.000	.000	.003	.012	.034	.071	.119	.160	.177	.160	.116	.065	.027	.007	.001	.000	.000
	12	.000	.000	.000	.000	.000	.001	.004	.014	.035	.073	.120	.162	.180	.161	.114	.061	.022	.005	.000	.000
	13	.000	.000	.000	.000	.000	.000	.001	.005	.015	.037	.074	.122	.166	.184	.164	.112	.055	.016	.002	.000
	14	.000	.000	.000	.000	.000	.000	.000	.001	.005	.015	.037	.075	.124	.171	.192	.169	.109	.045	.009	.000
	15	.000	.000	.000	.000	.000	.000	.000	.000	.001	.005	.015	.036	.075	.127	.179	.202	.175	.103	.032	.002
	16	.000	.000	.000	.000	.000	.000	.000	.000	.000	.001	.005	.014	.035	.074	.130	.190	.218	.182	.090	.013
	17	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.001	.004	.012	.032	.072	.134	.205	.243	.190	.060
	18	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.001	.003	.010	.028	.067	.137	.229	.285	.189
	19	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.002	.007	.021	.058	.137	.270	.377
	20	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.001	.003	.012	.039	.122	.358

TABLE A.1

Cumulative Standardized Normal Distribution



$A(z)$ is the integral of the standardized normal distribution from $-\infty$ to z (in other words, the area under the curve to the left of z). It gives the probability of a normal random variable not being more than z standard deviations above its mean. Values of z of particular importance:

z	$A(z)$	
1.645	0.9500	Lower limit of right 5% tail
1.960	0.9750	Lower limit of right 2.5% tail
2.326	0.9900	Lower limit of right 1% tail
2.576	0.9950	Lower limit of right 0.5% tail
3.090	0.9990	Lower limit of right 0.1% tail
3.291	0.9995	Lower limit of right 0.05% tail

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998
3.5	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998
3.6	0.9998	0.9998	0.9999							

t Table

cum. prob	$t_{.50}$	$t_{.75}$	$t_{.80}$	$t_{.85}$	$t_{.90}$	$t_{.95}$	$t_{.975}$	$t_{.99}$	$t_{.995}$	$t_{.999}$	$t_{.9995}$
one-tail	**0.50**	**0.25**	**0.20**	**0.15**	**0.10**	**0.05**	**0.025**	**0.01**	**0.005**	**0.001**	**0.0005**
two-tails	**1.00**	**0.50**	**0.40**	**0.30**	**0.20**	**0.10**	**0.05**	**0.02**	**0.01**	**0.002**	**0.001**
df											
1	0.000	1.000	1.376	1.963	3.078	6.314	12.71	31.82	63.66	318.31	636.62
2	0.000	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	22.327	31.599
3	0.000	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	0.000	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.000	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	0.000	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	0.000	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	0.000	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	0.000	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	0.000	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	0.000	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	0.000	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	0.000	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	0.000	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	0.000	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	0.000	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	0.000	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	0.000	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	0.000	0.688	0.861	1.066	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	0.000	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	0.000	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	0.000	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	0.000	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.485	3.768
24	0.000	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	0.000	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	0.000	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	0.000	0.684	0.855	1.057	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	0.000	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	0.000	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	0.000	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	0.000	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	0.000	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660	3.232	3.460
80	0.000	0.678	0.846	1.043	1.292	1.664	1.990	2.374	2.639	3.195	3.416
100	0.000	0.677	0.845	1.042	1.290	1.660	1.984	2.364	2.626	3.174	3.390
1000	0.000	0.675	0.842	1.037	1.282	1.646	1.962	2.330	2.581	3.098	3.300
z	0.000	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	3.090	3.291
	0%	50%	60%	70%	80%	90%	95%	98%	99%	99.8%	99.9%
	Confidence Level										