西交扎物浦大学

PAPER CODE	EXAMINER	DEPARTMENT	TEL
ECO111	Tiago Freire	IBSS	0450

#### 1<sup>st</sup> SEMESTER 2013/14 Final Examination

#### BA ACCOUNTANCY – Year 2

#### **BA BUSINESS ADMINISTRATION – Year 2**

#### **QUANTITATIVE METHODS**

#### TIME ALLOWED: 2 hours

#### **INSTRUCTIONS TO CANDIDATES**

- 1. This is a closed-book examination, which is to be written without books, tapes, or notes.
- 2. Total marks available are 100, divided in Section A (40 marks) and B (60 marks). Answer all questions.
- 3. In section A, 4 marks will be awarded for each correct answer and 0 marks for each wrong answer provided. There is NO penalty for providing a wrong answer.
- 4. In section B, a total of 60 marks are available. The number of marks awarded for each question is given in [] after each question.
- 5. Statistical distribution tables are provided on pages 10 to 14 of this question paper.
- 6. Answer should be written in the answer sheet(s) and/or booklet(s) provided.Only English solutions are accepted.
- 7. The university approved calculator Casio FS82ES/83ES can be used.
- 8. All materials must be returned to the exam supervisor upon completion of the exam. Failure to do so will be deemed academic misconduct and will be dealt with accordingly.

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#### **SECTION A (Multiple Choice Questions)**

Choose the one alternative that best completes the statement or answers the question. (4 marks per question, Total marks 40)

A1. A monopolist has the following demand function:

$$p = 20 - 0.5q$$

And her cost function is:

$$C = 0.04q^3 - 1.94q^2 + 32.96q - 1.44$$

Where C is total cost, q is quantity and p is price. What is the monopolist's profit?

[4 marks]

- a. 1.44
- b. 6
- c. 18
- d. 17

- A2. How much must I invest at a rate of 6% payable annually to obtain £5,000 after 4 years? [4 marks]
  - a. £2,855.34
  - b. £3,960.47
  - c. £4,706.67
  - d. £5,000

- A3. A property investment company has the opportunity to buy an office building now for £300,000. It will cost £100,000 to refurbish it, which will be payable at the end of year 1. The company expects to be able to sell it for £500,000 in 3 years' time. What is the net present value of the project, assuming a discount rate of 6%?
  - a. £35,210.60
  - b. £19,890.50
  - c. £25,470.02
  - d. £50,000

A4. The number of passengers on a bus route was recorded over a period of time, to give the following data:

Number of	Frequency
Passengers	
$0 \le n < 10$	3
$10 \le n < 20$	7
$20 \le n < 30$	12
$30 \le n < 40$	13
$40 \le n < 50$	29
$50 \le n < 60$	27

Table 1 – Data to accompany question A4.

What is the inter-quartile range (to the nearest integer)?

#### [4 marks]

- a. 31
- b. 18
- c. 28
- d. 21

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A5. Data in the 30 largest bond funds provided one-year and five-year percentage returns for the period ending the 31<sup>st</sup> of March, 2000 (The Wall Street Journal, 10<sup>th</sup> of April, 2000). Suppose we consider a one-year return in excess of 2% to be high and a five-year return in excess of 44% to be high. One-half of the funds had a one-year return in excess of 2%, 12 of the funds had a five-year return in excess of 44%, and six of the funds had both a one-year return in excess of 2% and a five year return in excess of 44%.

What is the probability that a fund had neither a high one-year return nor a high fiveyear return? [4 marks]

- a. 0.3
- b. 0.7
- c. 0.1
- d. 0.9

- A6. There is a 90% probability that each of 10 jury members casts a vote of not guilty. What is the probability that 7 or less members vote not guilty? Assume that each jury member's vote is independent of the others. [4 marks]
  - a. 0.0001b. 0.0702c. 0.0815
  - d. 0.0043

A7. Annually the U.S. Census Bureau provides estimates of a variety of demographic characteristics of the U.S. population. In terms of categorizing people by race, the bureau divides the population into those of "Hispanic" origin and those not. Within these two categories, a person can be associated with one of several races. For 2007, the bureau gives the following estimates:

	Hispanic	Not Hispanic					
Asian	0.001	0.043					
Black	0.006	0.123					
White	0.139	0.660					
Other	0.005	0.023					

Table 2 – Data to accompany question A6.

What is the probability that a person is white, given that that you know that the person is of Hispanic origin? [4 marks]

a. 0.123b. 0.660c. 0.920d. 0.174

- A8. According to a survey, salaries of dentists have an average of £48,000 with a standard deviation of £3,500. If the salary of a dentist is normally distributed what salary is such that 20% of dentists have a higher salary? [4 marks]
  - a. £60,566
  - b. £52,552
  - c. £48,213
  - d. £50,946

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A9. Management claim that the bonuses paid to workers at a plant average £1,000. A random sample of 100 workers gives an average bonus of only £975 and a standard deviation of £100. Are workers on average being paid £1000 in bonuses? What is the value of the statistical test that can answer this question? Assume a 5% significance level.

#### [4 marks]

- a. Yes, workers are on average being paid £1000 in bonuses. The statistical test has a value of -2.5
- b. No, workers are on average not being paid £1000 in bonuses. The statistical test has a value of -2.5
- c. Yes, workers are on average being paid £1000 in bonuses. The statistical test has a value of -0.25
- No, workers are on average not being paid £1000 in bonuses. The statistical test has a value of -0.25

- A10. In hypothesis testing, for a given level of significance, alpha, you can decrease the chance of Type II error by: [4 marks]
  - a. Increasing the sample size
  - b. Decreasing the sample size
  - c. Increasing the skewness
  - d. Decreasing the skewness

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#### **SECTION B (Short Answer Questions, total marks 60)**

- B11. Suppose ideally, a worker seeking a new job in a particular industry should acquire information about wage rates offered by all firms in the industry. However, this information search could be time consuming and costly. In particular, the longer an unemployed worker searches for a higher wage, the greater will be the loss in income. Therefore, workers may not find it worthwhile to search until they find the highest available wage rate. The result is that managers may not have to pay top dollar to attract workers. These factors help explain the existing disparity in wage rates among firms. Suppose the distribution of wage rates nationwide that would be offered to a particular skilled worker can be approximated by a normal distribution with  $\mu =$  \$10.50 per hour and  $\sigma =$  \$1.25 per hour. Suppose the worker were to undertake a nationwide job search.
  - a. What proportion of the wage rates that would be offered to the worker would be greater than \$12.00 per hour? [6 marks]
  - b. If the worker randomly selects one of the many jobs offers received, what is the probability that the wage rate will be between \$11.00 and \$12.00?

#### [4 marks]

c. If the worker randomly selects one of the many jobs offers received, what is the probability that the wage rate will be between \$9.5 and \$12.00?

#### [4 marks]

d. If the worker tries to avoid being in the 25% of the lowest paid category, what is the minimum wage rate that he will accept? [6 marks]

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B12. A home products firm has developed a new solar energy heater and now must decide whether to market it. The success of the product, as measured by its profit contribution, depends on the proportion of households in the target market that will purchase it. If the demand is high (that is if there is a favorable market for the heater), the firm could realize a profit of \$900,000. If the market is not favorable, the firm could lose \$500,000. Of course, the firm doesn't have to market the heater, in which case there is no cost. Based on experience, the marketing manager believes that the probability of a favorable market is 0.55 and the probability of an unfavorable market is 0.45.

The firm may hire Home Product Promotions Inc. (HPP), a marketing research firm, to conduct a study of the market, at a fee of \$5,000. Past studies by HPP show the following conditional probabilities:

Probability of favorable study given a favorable market = 0.80Probability of unfavorable study given an unfavorable market = 0.90

a. List the conditional probabilities and compute the joint probabilities. What are the probabilities of the different predictions by HPP (keep 3 decimal digits)?

[2 marks]

- b. Compute the posterior or revised probabilities using the information given above. [3 marks]
- c. Draw a decision tree. [3 marks]
- d. Should the firm hire HPP to conduct the market research or not? Explain your reasoning. [4 marks]
- e. How does the sampling method used in the market study affect your answer in the previous question? [8 marks]

#### Xi'an Jiaotong-Liverpool University

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B13. The number of staff working in a pub during an evening shift and the number of abusive customers encountered that evening for 5 consecutive Monday evenings are recorded in the table bellow.

Tuble 5 Dutu to dee	ompany question D15.
Number of	Abusive
staff	customers
3	10
4	11
2	13
6	15
2	10

Tuble 5 Data to accompany question D15	Table 3 –	Data to	accompany	question	B13.
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- a. Plot a scatter diagram of the data. What does it suggest? [5 marks]
- b. Calculate the linear regression equation that best fits the data. [5 marks]
- c. Comment on how useful the number of staff is in explaining the number of abusive customers. What can you say about causality? [10 marks]

#### ---- END OF PAPER ----

# Probabilities for the Normal distribution



Z         0.00         0.01         0.02         0.03         0.04         0.05         0.06         0.07         0.08         0.09           Score											
0.0         0.5000         0.4960         0.4920         0.4880         0.4801         0.4761         0.4721         0.4681         0.4641           0.1         0.4602         0.4562         0.4522         0.4483         0.4404         0.4364         0.4325         0.4286         0.4247           0.2         0.4207         0.4168         0.4129         0.4090         0.4052         0.4013         0.3974         0.3366         0.3824         0.3386         0.3897         0.3356         0.3304         0.3357         0.3356         0.3307         0.3632         0.3354         0.3228         0.3192         0.3156         0.3121           0.5         0.3085         0.3015         0.2946         0.2912         0.2877         0.2843         0.2451         0.2483         0.2451         0.2483         0.2451         0.2483         0.2451         0.2483         0.2451         0.2484         0.2481         0.2484         0.2481         0.2484         0.2481         0.2484         0.2484         0.2481         0.2484         0.2481         0.2484         0.2481         0.2481         0.2481         0.2481         0.2481         0.2481         0.2481         0.2481         0.2481         0.2481         0.2481         0.2481 <th>Z Score</th> <th>0.00</th> <th>0.01</th> <th>0.02</th> <th>0.03</th> <th>0.04</th> <th>0.05</th> <th>0.06</th> <th>0.07</th> <th>0.08</th> <th>0.09</th>	Z Score	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.1         0.4662         0.4452         0.4052         0.4054         0.4364         0.4325         0.4031         0.4031           0.2         0.4207         0.4468         0.4422         0.4090         0.4052         0.4033         0.3374         0.3326         0.3387         0.33859           0.3         0.3821         0.3783         0.3745         0.3707         0.3669         0.3632         0.3174         0.3326         0.3387         0.33859           0.4         0.3446         0.3409         0.3372         0.3336         0.3300         0.3264         0.3228         0.3192         0.3156         0.3483           0.4         0.3446         0.3409         0.3372         0.3336         0.2301         0.2287         0.2286         0.2206         0.2177         0.2483         0.2410         0.2776         0.2464         0.4283         0.2411         0.2183         0.2206         0.2177         0.2148         0.2483         0.2411         0.1484         0.1655         0.1717         0.1949         0.1922         0.1841         0.1655         0.1611           1.0         0.1587         0.1562         0.1515         0.1422         0.1446         0.1423         0.1401         0.1379	0.0	0 5000	0 4960	n 4920	0.4880	0 4840	0 4801	0.4761	0 4721	0 4681	0 4641
0.1         0.14207         0.44128         0.14129         0.14090         0.1417         0.14017         0.13974         0.3936         0.3821         0.3821         0.3821         0.3763         0.3772         0.3336         0.3320         0.3824         0.3557         0.3520         0.3483           0.4         0.3446         0.3409         0.3372         0.3336         0.3300         0.3264         0.3228         0.3192         0.3156         0.3121           0.5         0.3085         0.3050         0.3015         0.2981         0.2946         0.2212         0.2877         0.2843         0.2483         0.2410         0.2483         0.2411         0.2483         0.2413         0.2411         0.2483         0.2411         0.2483         0.2417         0.2484         0.2481         0.2483         0.2481         0.1484         0.1660         0.1635         0.1611           0.7         0.2420         0.2386         0.2337         0.2266         0.2177         0.2148         0.2483         0.2483         0.2411         0.1483         0.1600         0.1635         0.1611           1.0         0.1587         0.1562         0.1539         0.1515         0.1977         0.1469         0.1446         0.1423	0.0	0.0000	0.4562	0.4520	0.4483	0 4443	0.4404	0.4364	0.4325	0.4286	0.4041
0.3         0.3821         0.3783         0.3745         0.3707         0.3669         0.3832         0.3594         0.3557         0.3520         0.3483           0.4         0.3446         0.3409         0.3372         0.3336         0.3300         0.3264         0.3228         0.3192         0.3156         0.3121           0.5         0.3085         0.3050         0.3015         0.2981         0.2946         0.2912         0.2877         0.2843         0.2420         0.2483         0.2451         0.2466         0.2264         0.2266         0.2200         0.1810         0.	0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
0.4         0.3446         0.3499         0.3372         0.3336         0.3300         0.3264         0.3228         0.3192         0.3156         0.3211           0.5         0.3085         0.3050         0.3015         0.2981         0.2946         0.2912         0.2877         0.2843         0.2810         0.2776           0.6         0.2743         0.2709         0.2676         0.2643         0.2611         0.2578         0.2266         0.2206         0.2117         0.2148         0.2481         0.2148         0.2481         0.2148         0.2481         0.1841         0.1841         0.1788         0.1762         0.1736         0.1711         0.1685         0.1660         0.1635         0.1611           1.0         0.1587         0.1562         0.1539         0.1515         0.1492         0.1469         0.1446         0.1423         0.1401         0.1379           1.1         0.1357         0.1539         0.1515         0.1492         0.1469         0.1446         0.1423         0.1401         0.1379           1.1         0.1357         0.1531         0.1120         0.1075         0.1056         0.0383         0.0823         0.0833         0.0833         0.0833         0.0833         0.	0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
0.5         0.3085         0.3050         0.3015         0.2981         0.2946         0.2912         0.2877         0.2843         0.2810         0.2743           0.6         0.2743         0.2709         0.2676         0.2643         0.2611         0.2578         0.2266         0.2266         0.2266         0.2266         0.2266         0.2266         0.2266         0.2266         0.2266         0.2266         0.2266         0.2266         0.2266         0.1449         0.1492         0.1844         0.1671         0.1446         0.1423         0.1660         0.1635         0.1611           1.0         0.1587         0.1562         0.1539         0.1515         0.1492         0.1466         0.1423         0.1401         0.1379           1.1         0.1357         0.1331         0.1112         0.1093         0.1075         0.1056         0.1038         0.1020         0.1003         0.0085           1.3         0.0968         0.0951         0.0934         0.0918         0.0901         0.0885         0.0869         0.0832         0.0631         0.0661           1.5         0.0668         0.0655         0.0643         0.0630         0.0618         0.0606         0.0594         0.0582         0.	0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
0.6         0.2743         0.2709         0.2676         0.2643         0.2611         0.2578         0.2546         0.2514         0.2483         0.2481           0.7         0.2420         0.2388         0.2385         0.2277         0.2266         0.2236         0.2206         0.2177         0.2148           0.8         0.2119         0.2090         0.2061         0.2033         0.2005         0.1977         0.1949         0.1922         0.1894         0.1867           0.9         0.1841         0.1782         0.1762         0.1736         0.1711         0.1685         0.1660         0.1635         0.1611           1.0         0.1587         0.1562         0.1539         0.1515         0.1492         0.1469         0.1446         0.1423         0.1401         0.1379           1.1         0.1357         0.1335         0.1314         0.1292         0.1210         0.1100         0.1073           1.3         0.0968         0.0951         0.0934         0.0918         0.0755         0.0721         0.0708         0.0694         0.0681           1.4         0.0808         0.0557         0.0562         0.0516         0.0505         0.0495         0.0485         0.0455	0.5	0.3085	0.3050	0.301.5	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
0.7         0.2420         0.2389         0.2358         0.2327         0.2296         0.2266         0.2236         0.2206         0.2177         0.1844           0.8         0.2119         0.2090         0.2061         0.2033         0.2005         0.1977         0.1949         0.1922         0.1894         0.1867           0.9         0.1841         0.1841         0.1788         0.1762         0.1736         0.1711         0.1685         0.1600         0.1635         0.1611           1.0         0.1587         0.1562         0.1539         0.1515         0.1492         0.1469         0.1446         0.1423         0.1401         0.1379           1.1         0.1357         0.1335         0.1314         0.1292         0.1271         0.1251         0.1200         0.1003         0.9985           1.3         0.0968         0.0951         0.0934         0.0918         0.0749         0.0735         0.0708         0.0681         0.0681         0.0681         0.0681         0.0682         0.0571         0.0559           1.4         0.0808         0.0793         0.0778         0.0618         0.0666         0.0594         0.0582         0.0571         0.0559           1.4	0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
0.8         0.2119         0.2090         0.2061         0.2033         0.2005         0.1977         0.1949         0.1922         0.1894         0.1635         0.1611           0.9         0.1841         0.1814         0.1788         0.1762         0.1736         0.1711         0.1685         0.1660         0.1635         0.1611           1.0         0.1587         0.1562         0.1539         0.1515         0.1492         0.1469         0.1446         0.1423         0.1401         0.1379           1.1         0.1357         0.1335         0.1314         0.1292         0.1271         0.1230         0.1210         0.1100         0.1170           1.2         0.1151         0.1131         0.112         0.1093         0.1075         0.1056         0.1038         0.1020         0.1003         0.0985           1.3         0.0968         0.0951         0.0934         0.0918         0.0911         0.0885         0.0869         0.0853         0.0838         0.823           1.4         0.0808         0.0793         0.0778         0.0744         0.0735         0.0721         0.0708         0.0694         0.0651           1.5         0.0668         0.0537         0.0562	0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
0.9         0.1841         0.1814         0.1788         0.1762         0.1736         0.1711         0.1685         0.1660         0.1635         0.1611           1.0         0.1587         0.1562         0.1539         0.1515         0.1492         0.1469         0.1446         0.1423         0.1401         0.1379           1.1         0.1357         0.1335         0.1314         0.1292         0.1210         0.1210         0.1100         0.1170           1.2         0.1151         0.1131         0.1121         0.00934         0.0918         0.0901         0.0885         0.0269         0.0833         0.0838         0.0823           1.4         0.0808         0.0793         0.0778         0.0764         0.0749         0.0735         0.0721         0.0708         0.0694         0.0651           1.5         0.0668         0.0655         0.0643         0.0630         0.0618         0.0606         0.0594         0.0582         0.0571         0.0559           1.6         0.0548         0.0537         0.0562         0.0516         0.0505         0.0495         0.0485         0.0475         0.0465         0.0455           1.7         0.0446         0.0427         0.0418	0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
1.0         0.1587         0.1562         0.1539         0.1515         0.1492         0.1469         0.1446         0.1423         0.1401         0.1379           1.1         0.1357         0.1335         0.1314         0.1292         0.1271         0.1251         0.1230         0.1210         0.1190         0.1170           1.2         0.1151         0.1131         0.1112         0.1093         0.075         0.1056         0.1038         0.1020         0.1003         0.0985           1.3         0.0968         0.0951         0.0934         0.0918         0.0901         0.0885         0.0869         0.0853         0.0838         0.0231           1.4         0.0808         0.0773         0.0778         0.0744         0.0749         0.0735         0.0721         0.0708         0.0694         0.0651           1.5         0.0668         0.0655         0.0643         0.0630         0.0618         0.0606         0.0594         0.0582         0.0571         0.0559           1.6         0.0548         0.0557         0.0562         0.0516         0.0505         0.0445         0.0475         0.0465         0.0475         0.0465         0.0475         0.0465         0.0475         0.0464	0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
1.1       0.1357       0.1335       0.1314       0.1292       0.1271       0.1251       0.1230       0.1210       0.1190       0.1170         1.2       0.1151       0.1131       0.1112       0.1093       0.1075       0.1056       0.1038       0.1020       0.1003       0.0985         1.3       0.0968       0.0951       0.0934       0.0918       0.0901       0.0885       0.0869       0.0853       0.0838       0.0823         1.4       0.0808       0.0773       0.0778       0.0764       0.0749       0.0735       0.0721       0.0708       0.0694       0.0681         1.5       0.0668       0.0655       0.0643       0.0600       0.0618       0.0606       0.0594       0.0582       0.0571       0.0559         1.6       0.0548       0.0537       0.0562       0.0516       0.0505       0.0495       0.0485       0.0475       0.0465       0.0455         1.7       0.0446       0.0436       0.0274       0.0268       0.0262       0.0214       0.0307       0.0301       0.0294         1.9       0.0287       0.0281       0.0217       0.0212       0.0125       0.0125       0.0125       0.0124       0.0128       0.0146	1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
1.2       0.1151       0.1131       0.1112       0.1093       0.1075       0.1056       0.1038       0.1020       0.1003       0.0985         1.3       0.0968       0.0951       0.0934       0.0918       0.0901       0.0885       0.0869       0.0853       0.0838       0.0823         1.4       0.0808       0.0793       0.0778       0.0764       0.0749       0.0735       0.0721       0.0708       0.0694       0.0681         1.5       0.0668       0.0655       0.0643       0.0630       0.0618       0.0606       0.0594       0.0582       0.0571       0.0559         1.6       0.0548       0.0537       0.0562       0.0516       0.0505       0.0495       0.0485       0.0475       0.0465       0.0455         1.7       0.0446       0.0436       0.0274       0.0268       0.0222       0.0314       0.0307       0.0301       0.0294         1.9       0.0228       0.0221       0.0217       0.0212       0.0207       0.0202       0.0197       0.0192       0.0188       0.0143         2.1       0.0179       0.0174       0.0166       0.0122       0.0122       0.0197       0.0192       0.0188       0.0143	1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
1.3         0.0968         0.0951         0.0934         0.0918         0.0901         0.0885         0.0869         0.0853         0.0833         0.0833         0.0823           1.4         0.0808         0.0773         0.0778         0.0764         0.0749         0.0735         0.0721         0.0708         0.0694         0.0681           1.5         0.0668         0.0655         0.0643         0.0630         0.0618         0.0606         0.0594         0.0582         0.0571         0.0559           1.6         0.0548         0.0537         0.0562         0.0516         0.0505         0.0495         0.0485         0.0475         0.0465         0.0455           1.7         0.0446         0.0436         0.0277         0.0418         0.0409         0.0401         0.0392         0.0314         0.0375         0.0367           1.8         0.0359         0.0281         0.0274         0.0268         0.0262         0.0216         0.0250         0.0244         0.0239         0.0233           2.0         0.0228         0.0222         0.0174         0.0166         0.0162         0.0158         0.0154         0.0192         0.0188         0.0143           2.1         0.0179	1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
1.4         0.0808         0.0793         0.0778         0.0764         0.0749         0.0735         0.0721         0.0708         0.0694         0.0681           1.5         0.0668         0.0555         0.0643         0.0630         0.0618         0.0606         0.0594         0.0582         0.0571         0.0559           1.6         0.0548         0.0436         0.0427         0.0418         0.0495         0.0485         0.0475         0.0465         0.0455           1.7         0.0446         0.0436         0.0427         0.0418         0.0409         0.0322         0.0314         0.0307         0.0301         0.0294           1.9         0.0287         0.0281         0.0274         0.0268         0.0262         0.0250         0.0244         0.0239         0.0233           2.0         0.0228         0.0222         0.0217         0.0212         0.0207         0.0202         0.0197         0.0188         0.0183           2.1         0.0179         0.0174         0.0170         0.0166         0.0122         0.0125         0.0124         0.0150         0.0146         0.0143           2.2         0.0139         0.0136         0.0122         0.0125         0.0122	1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
1.5         0.0668         0.0655         0.0643         0.0630         0.0618         0.0606         0.0594         0.0582         0.0571         0.0559           1.6         0.0548         0.0537         0.0562         0.0516         0.0505         0.0495         0.0485         0.0475         0.0465         0.0455           1.7         0.0446         0.0436         0.0427         0.0418         0.0409         0.0322         0.0314         0.0307         0.0301         0.0294           1.9         0.0287         0.0281         0.0274         0.0268         0.0262         0.0226         0.0250         0.0244         0.0239         0.0233           2.0         0.0228         0.0222         0.0217         0.0212         0.0207         0.0202         0.0197         0.0192         0.0188         0.0183           2.1         0.0179         0.0174         0.0170         0.0166         0.0122         0.0122         0.0197         0.0192         0.0146         0.0143           2.2         0.0139         0.0132         0.0129         0.0125         0.0122         0.0111         0.0166         0.0144         0.0057         0.0073         0.0072         0.0069         0.0084         0.0066 <td>1.4</td> <td>0.0808</td> <td>0.0793</td> <td>0.0778</td> <td>0.0764</td> <td>0.0749</td> <td>0.0735</td> <td>0.0721,</td> <td>0.0708</td> <td>0.0694</td> <td>0.0681</td>	1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721,	0.0708	0.0694	0.0681
1.6         0.0548         0.0537         0.0562         0.0516         0.0505         0.0495         0.0485         0.0475         0.0465         0.0455           1.7         0.0446         0.0436         0.0427         0.0418         0.0409         0.0401         0.0392         0.0384         0.0375         0.0367           1.8         0.0359         0.0351         0.0344         0.0336         0.0329         0.0322         0.0314         0.0307         0.0301         0.0294           1.9         0.0287         0.0281         0.0274         0.0268         0.0262         0.0256         0.0250         0.0244         0.0239         0.0233           2.0         0.0228         0.0222         0.0217         0.0212         0.0207         0.0202         0.0197         0.0192         0.0188         0.0183           2.1         0.0179         0.0174         0.0170         0.0166         0.0162         0.0158         0.0154         0.0150         0.0146         0.0143           2.2         0.0139         0.0136         0.0122         0.0125         0.0122         0.0119         0.0116         0.0146         0.0144           2.3         0.0107         0.0104         0.0075	1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
1.7         0.0446         0.0436         0.0427         0.0418         0.0409         0.0401         0.0392         0.0384         0.0375         0.0367           1.8         0.0359         0.0351         0.0344         0.0336         0.0329         0.0322         0.0314         0.0307         0.0301         0.0294           1.9         0.0287         0.0281         0.0274         0.0268         0.0262         0.0256         0.0250         0.0244         0.0239         0.0233           2.0         0.0228         0.0222         0.0217         0.0212         0.0207         0.0202         0.0197         0.0192         0.0188         0.0183           2.1         0.0179         0.0174         0.0170         0.0166         0.0162         0.0158         0.0154         0.0150         0.0146         0.0143           2.2         0.0139         0.0136         0.0132         0.0129         0.0125         0.0122         0.0119         0.0116         0.0146         0.0143           2.3         0.0107         0.0104         0.0102         0.0099         0.0094         0.0091         0.0089         0.0087         0.0084           2.4         0.0082         0.0060         0.0059	1.6	0.0548	0.0537	0.0562	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
1.8         0.0359         0.0351         0.0344         0.0336         0.0329         0.0322         0.0314         0.0307         0.0301         0.0294           1.9         0.0287         0.0281         0.0274         0.0268         0.0262         0.0256         0.0250         0.0244         0.0239         0.0233           2.0         0.0228         0.0222         0.0217         0.0212         0.0207         0.0202         0.0197         0.0192         0.0188         0.0183           2.1         0.0179         0.0174         0.0170         0.0166         0.0162         0.0158         0.0154         0.0150         0.0146         0.0143           2.2         0.0139         0.0136         0.0132         0.0129         0.0125         0.0122         0.0119         0.0116         0.0113         0.0110           2.3         0.0107         0.0104         0.0102         0.0099         0.0096         0.0094         0.0091         0.0089         0.0087         0.0084           2.4         0.0082         0.0060         0.0059         0.0057         0.0055         0.0054         0.0052         0.0051         0.0049         0.0048           2.6         0.0047         0.0045	1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
1.9         0.0287         0.0281         0.0274         0.0268         0.0262         0.0256         0.0250         0.0244         0.0239         0.0233           2.0         0.0228         0.0222         0.0217         0.0212         0.0207         0.0202         0.0197         0.0192         0.0188         0.0183           2.1         0.0179         0.0174         0.0170         0.0166         0.0162         0.0158         0.0154         0.0150         0.0146         0.0143           2.2         0.0139         0.0136         0.0132         0.0129         0.0125         0.0122         0.0119         0.0116         0.0113         0.0110           2.3         0.0107         0.0104         0.0102         0.0099         0.0096         0.0094         0.0091         0.0089         0.0087         0.0084           2.4         0.0082         0.0060         0.0078         0.0075         0.0072         0.0069         0.0068         0.0066         0.0044           2.5         0.0062         0.0044         0.0043         0.0041         0.0040         0.0039         0.0038         0.0037         0.0036           2.7         0.0035         0.0024         0.0023         0.0023	1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
2.0         0.0228         0.0222         0.0217         0.0212         0.0207         0.0202         0.0197         0.0192         0.0188         0.0183           2.1         0.0179         0.0174         0.0170         0.0166         0.0162         0.0158         0.0154         0.0150         0.0146         0.0143           2.2         0.0139         0.0136         0.0132         0.0129         0.0125         0.0122         0.0119         0.0116         0.0131         0.0110           2.3         0.0107         0.0104         0.0102         0.0099         0.0096         0.0094         0.0091         0.0089         0.0087         0.0084           2.4         0.0082         0.0080         0.0078         0.0075         0.0073         0.0072         0.0059         0.0088         0.0064         0.0044           2.5         0.0062         0.0040         0.0057         0.0055         0.0054         0.0052         0.0051         0.0049         0.0048           2.6         0.0047         0.0034         0.0033         0.0032         0.0031         0.0028         0.0027         0.0028         0.0037         0.0036           2.7         0.0035         0.0024         0.0023	1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
2.1         0.0179         0.0174         0.0170         0.0166         0.0162         0.0158         0.0154         0.0150         0.0146         0.0143           2.2         0.0139         0.0136         0.0132         0.0129         0.0125         0.0122         0.0119         0.0116         0.0113         0.0110           2.3         0.0107         0.0104         0.0102         0.0099         0.0096         0.0094         0.0091         0.0089         0.0087         0.0084           2.4         0.0082         0.0060         0.0078         0.0075         0.0073         0.0072         0.0069         0.0068         0.0066         0.0044           2.5         0.0062         0.0044         0.0043         0.0041         0.0040         0.0039         0.0038         0.0037         0.0048           2.6         0.0047         0.0045         0.0044         0.0043         0.0041         0.0049         0.0038         0.0037         0.0036           2.7         0.0035         0.0025         0.0024         0.0023         0.0023         0.0029         0.0028         0.0027         0.0026           2.8         0.0026         0.0018         0.0017         0.0016         0.0015	2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
2.2         0.0139         0.0136         0.0132         0.0129         0.0125         0.0122         0.0119         0.0116         0.0113         0.0110           2.3         0.0107         0.0104         0.0102         0.0099         0.0096         0.0094         0.0091         0.0089         0.0087         0.0084           2.4         0.0082         0.0080         0.0078         0.0075         0.0073         0.0072         0.0069         0.0068         0.0066         0.0044           2.5         0.0062         0.0060         0.0059         0.0057         0.0055         0.0054         0.0052         0.0051         0.0049         0.0048           2.6         0.0047         0.0045         0.0044         0.0043         0.0041         0.0040         0.0039         0.0038         0.0037         0.0036           2.7         0.0035         0.0034         0.0033         0.0032         0.0031         0.0029         0.0028         0.0027         0.0026           2.8         0.0026         0.0025         0.0018         0.0017         0.0016         0.0015         0.0015         0.0014         0.0014           3.0         0.0013         0.0013         0.0013         0.0012	2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.01.46	0.0143
2.3         0.0107         0.0104         0.0102         0.0099         0.0096         0.0094         0.0091         0.0089         0.0087         0.0084           2.4         0.0082         0.0080         0.0078         0.0075         0.0073         0.0072         0.0069         0.0089         0.0086         0.0066         0.0064           2.5         0.0062         0.0060         0.0059         0.0057         0.0055         0.0054         0.0052         0.0051         0.0049         0.0048           2.6         0.0047         0.0045         0.0044         0.0043         0.0041         0.0040         0.0039         0.0038         0.0037         0.0036           2.7         0.0035         0.0025         0.0023         0.0023         0.0022         0.0021         0.0028         0.0027         0.0026           2.8         0.0026         0.0025         0.0024         0.0023         0.0023         0.0022         0.0021         0.0021         0.0020         0.0019           2.9         0.0019         0.0018         0.0013         0.0013         0.0013         0.0012         0.0011         0.0011         0.0011         0.0010         0.0014	2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
2.4         0.0082         0.0080         0.0078         0.0075         0.0073         0.0072         0.0069         0.0068         0.0066         0.0064           2.5         0.0062         0.0060         0.0059         0.0057         0.0055         0.0054         0.0052         0.0051         0.0049         0.0048           2.6         0.0047         0.0045         0.0044         0.0043         0.0041         0.0040         0.0039         0.0038         0.0037         0.0036           2.7         0.0035         0.0034         0.0033         0.0032         0.0031         0.0030         0.0029         0.0028         0.0027         0.0026           2.8         0.0026         0.0025         0.0024         0.0023         0.0023         0.0022         0.0021         0.0020         0.0019           2.9         0.0019         0.0018         0.0017         0.0016         0.0015         0.0015         0.0014         0.0014           3.0         0.0013         0.0013         0.0013         0.0012         0.0012         0.0011         0.0011         0.0010         0.0010	2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
2.50.00620.00600.00590.00570.00550.00540.00520.00510.00490.00482.60.00470.00450.00440.00430.00410.00400.00390.00380.00370.00362.70.00350.00340.00330.00320.00310.00300.00290.00280.00270.00262.80.00260.00250.00240.00230.00230.00220.00210.00210.00200.00192.90.00190.00130.00130.00130.00120.00120.00110.00110.00110.00140.0014	2,4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0072	0.0069	0.0068	0.0066	0.0064
2.6         0.0047         0.0045         0.0044         0.0043         0.0041         0.0040         0.0039         0.0038         0.0037         0.0036           2.7         0.0035         0.0034         0.0033         0.0032         0.0031         0.0030         0.0029         0.0028         0.0027         0.0026           2.8         0.0026         0.0025         0.0024         0.0023         0.0023         0.0022         0.0021         0.0020         0.0019           2.9         0.0019         0.0018         0.0013         0.0013         0.0012         0.0016         0.0015         0.0015         0.0014         0.0014           3.0         0.0013         0.0013         0.0013         0.0012         0.0012         0.0011         0.0011         0.0010         0.0010	2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
2.7         0.0035         0.0034         0.0033         0.0032         0.0031         0.0030         0.0029         0.0028         0.0027         0.0026           2.8         0.0026         0.0025         0.0024         0.0023         0.0023         0.0022         0.0021         0.0021         0.0020         0.0019           2.9         0.0019         0.0018         0.0013         0.0017         0.0016         0.0016         0.0015         0.0015         0.0014         0.0014           3.0         0.0013         0.0013         0.0013         0.0012         0.0012         0.0011         0.0011         0.0010         0.0010	2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
2.8         0.0026         0.0025         0.0024         0.0023         0.0023         0.0022         0.0021         0.0021         0.0020         0.0019           2.9         0.0019         0.0018         0.0018         0.0017         0.0016         0.0016         0.0015         0.0015         0.0014         0.0014           3.0         0.0013         0.0013         0.0013         0.0012         0.0011         0.0011         0.0010         0.0010	2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
2.9         0.0019         0.0018         0.0018         0.0017         0.0016         0.0016         0.0015         0.0015         0.0014         0.0014           3.0         0.0013         0.0013         0.0013         0.0012         0.0012         0.0011         0.0011         0.0011         0.0010         0.0010	2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
3.0 0.0013 0.0013 0.0013 0.0012 0.0012 0.0011 0.0011 0.0011 0.0010 0.0010	2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
AND	3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010

## **Cumulative Binomial probabilities**

			p = 0.01	0.05	0.10	0.20	0.30	0.40	0.45	0.50
n = 5	<i>r</i> =	0 1 2 3 4	1.0000 0.0490 0.0010	1.0000 0.2262 0.0226 0.0012	1.0000 0.4095 0.0815 0.0086 0.0005	1.0000 0.6723 0.2627 0.0579 0.0067	1.0000 0.8319 0.4718 0.1631 0.0308	1.0000 0.9222 0.6630 0.3174 0.0870	1.0000 0.9497 0.7438 0.4069 0.1312	1.0000 0.9688 0.8125 0.5000 0.1875
		5				0.0003	0.0024	0.0102	0.0185	0.0313
n = 10	r =	0 1 2 3 4	1.0000 0.0956 0.0043 0.0001	1.0000 0.4013 0.0861 0.0115 0.0010	1.0000 0.6513 0.2639 0.0702 0.0128	1.0000 0.8926 0.6242 0.3222 0.1209	1.0000 0.9718 0.8507 0.6172 0.3504	1.0000 0.9940 0.9536 0.8327 0.6177	1.0000 0.9975 0.9767 0.9004 0.7430	1.0000 0.9990 0.9893 0.9453 0.8281
		5 6 7 8 9		0.0001	0.00 <b>1</b> 6 0.0001	0.0328 0.0064 0.0009 0.0001	0.1503 0.0473 0.0106 0.0016 0.0001	0.3669 0.1662 0.0548 0.0123 0.0017	0.4956 0.2616 0.1020 0.0274 0.0045	0.6230 0.3770 0.1719 0.0547 0.0107
		10						0.0001	0.0003	0.001.0

where

p is the probability of a characteristic (e.g. a defective item),

n is the sample size and

r is the number with that characteristic.

Note: All probabilities are for 'r or more successes'. Only selected values for n and r are shown in this table.

## **Cumulative Poisson probabilities**

*****	μ = 1.0	2.0	3.0	4.0	5.0	6.0	7.0
<i>r</i> = 0	1.0000	1,0000	1.0000	1.0000	1.0000	1.0000	1 0000
1	0.6321	0.8647	0.9502	0.9817	0.9933	0.9975	0.9991
2	0.2642	0.5940	0.8009	0.9084	0.9596	0.9826	0.9927
3	0.0803	0.3233	0.5768	0.7619	0.8753	0.9380	0.9704
4	0.0190	0.1429	0.3528	0.5665	0.7350	0.8488	0.9182
5	0.0037	0.0527	0.1847	0.3712	0.5595	0.7149	0.8270
6	0.0006	0.0166	0.0839	0.2149	0.3840	0.5543	0.6993
7	0.0001	0.0011	0.0335	0.1107	0.2378	0.3937	0.5503
8		0.0002	0.0119	0.0511	0.1334	0.2560	0.4013
9			0.0038	0.0214	0.0681	0.1528	0.2709
10			0.0011	0.0081	0.0318	0.0839	0.1695
11			0.0003	0.0028	0.0137	0.0426	0.0985
12			0.0001	0.0009	0.0055	0.0201	0.0534
13				0.0003	0.0020	0.0088	0.0270
14				0.0001	0.0007	0.0036	0.0128
15					0.0002	0.0014	0.0057
16					0.0001	0.0005	0.0024
17						0.0002	0.0010
18			21			0.0001	0.0004
19							0.0001
				1000			

where

 $\mu(=np)_{_{\!\!A}}$  is the average number of times a characteristic occurs and

r is the number of occurrences.

Note: All probabilities are for 'r or more successes'.

## Student t Critical values



Probability	0.10	0.05	0.025	0.01	0.005
v = 1 $2$ $3$ $4$ $5$	3.078	6.314	12.706	31.821	63.657
	1.886	2.920	4.303	6.965	9.925
	1.638	2.353	3.182	4.541	5.841
	1.533	2.132	2.776	3.747	4.604
	1.476	2.015	2.571	3.365	4.032
6	1.440	1.943	2.447	3.143	3.707
7	1.415	1.895	2.365	2.998	3.499
8	1.397	1.860	2.306	2.896	3.355
9	1.383	1.833	2.262	2.821	3.250
10	1.372	1.812	2.228	2.764	3.169
11	1.363	1.796	2.201	2.718	3.106
12	1.356	1.782	2.179	2.681	3.055
13	1.350	1.771	2.160	2.650	3.012
14	1.345	1.761	2.145	2.624	2.977
15	1.341	1.753	2.131	2.602	2.947
16	1.337	1.746	2.120	2.583	2.921
17	1.333	1.740	2.110	2.567	2.898
18	1.330	1.734	2.101	2.552	2.878
19	1.328	1.729	2.093	2.539	2.861
20	1.325	1.725	2.086	2.528	2.845
21	1.323	1.721	2.080	2,518	2.831
22	1.321	1.717	2.074	2,508	2.819
23	1.319	1.714	2.069	2,500	2.807
24	1.318	1.711	2.064	2,492	2.797
25	1.316	1.708	2.060	2,485	2.787
26	1.315	1.706	2.056	2.479	2.779
27	1.314	1.703	2.052	2.473	2.771
28	1.313	1.701	2.048	2.467	2.763
29	1.311	1.699	2.045	2.462	2.756
30	1.310	1.697	2.042	2.457	2.750
40	1.303	1.684	2.021	2.423	2.704
60	1.296	1.671	2.000	2.390	2.660
120	1.289	1.658	1.980	2.358	2.617
∞	1.282	1.645	1.960	2.326	2.576

where v is the number of degrees of freedom.

# $\chi^2$ Critical values



v Probability v	0.250	0.100	0.050	0.025	0.010	0.005	0.001
1	1.32	2.71	3.84	5.02	6.63	7.88	10.8
2	2.77	4.61	5.99	7.38	9.21	10.6	13.8
3	4.11	6.25	7.81	9.35	11.3	12.8	16.3
4	5.39	7.78	9.49	11.1	13.3	14.9	18.5
5	6.63	9.24	11.1	12.8	15.1	16.7	20.5
6	7.84	10.6	12.6	14.4	16.8	18.5	22.5
7	9.04	12.0	14.1	16.0	18.5	20.3	24.3
8	10.2	13.4	15.5	17.5	20.3	22.0	26.1
9	11.4	14.7	16.9	19.0	21.7	23.6	27.9
10	12.5	16.0	18.3	20.5	23.2	25.2	29.6
11	13.7	17.3	19.7	21.9	24.7	26.8	31.3
12	14.8	18.5	21.0	23.3	26.2	28.3	32.9
13	16.0	19.8	22.4	24.7	27.7	29.8	34.5
14	17.1	21.1	23.7	26.1	29.1	31.3	36.1
15	18.2	22.3	25.0	27.5	30.6	32.8	37.7
16	19.4	23.5	26.3	28.8	32.0	34.3	39.3
17	20.5	24.8	27.6	30.2	33.4	35.7	40.8
18	21.6	26.0	28.9	31.5	34.8	37.2	42.3
19	22.7	27.2	30.1	32.9	36.2	38.6	43.8
20	23.8	28.4	31.4	34.2	37.6	40.0	45.3
21	24.9	29.6	32.7	35.5	38.9	41.4	46.8
22	26.0	30.8	33.9	36.8	40.3	42.8	48.3
23	27.1	32.0	35.2	38.1	41.6	44.2	49.7
24	28.2	33.2	36.4	39.4	43.0	45.6	51.2
25	29.3	34.4	37.7	40.6	44.3	46.9	52.6
26	30.4	35.6	38.9	41.9	45.6	48.3	54.1
27	31.5	36.7	40.1	43.2	47.0	49.6	55.5
28	32.6	37.9	41.3	44.5	48.3	51.0	56.9
29	33.7	39.1	42.6	45.7	49.6	52.3	58.3
30	34.8	40.3	43.8	47.0	50.9	53.7	59.7
40	45.6	51.8	55.8	59.3	63.7	66.8	73.4
50	56.3	63.2	67.5	71.4	76.2	79.5	86.7
60	67.0	74.4	79.1	83.3	88.4	92.0	99.6
70	77.6	85.5	90.5	95.0	100	104	112
80	88.1	96.6	102	107	112	116	125
90	98.6	108	113	118	124	128	137
100	109	118	124	130	136	140	149

where v is the number of degrees of freedom.