**STA1510**

( 488417)

October/November 2012

**BASIC STATISTICS**

Duration 2 Hours

100 Marks

**EXAMINERS**

FIRST

SECOND

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MR TP MOHLALA

Use of a non-programmable pocket calculator is permissible

Closed book examination

This examination question paper remains the property of the University of South Africa and may not be removed from the examination venue

This paper consists of 21 pages, including 2 pages of formulae (pp 11–12) and 9 pages of tables (pp 13–21) as well as instructions for the completion of a mark reading sheet

**Please complete the attendance register on the back page, tear off and hand it to the invigilator.**

**Answer question paper on a mark-reading sheet.**

**INSTRUCTIONS**

Answer all 25 questions on one markreading sheet (4 marks each)

**[TURN OVER]**

**Question 1**

Fill in the missing words to the quote “statistical methods may be described as methods for drawing conclusions about \_\_\_\_\_ based on \_\_\_\_\_ computed from the \_\_\_\_\_”

- 1 statistics, samples, populations
- 2 populations, parameters, samples
- 3 statistics, parameters, samples
- 4 parameters, statistics, populations
- 5 populations, statistics, samples

**Question 2**

A random sample of 500 households in Acornhoek was selected and several variables were recorded Which of the following is NOT CORRECT?

- 1 Household total income is a ratio scaled variable
- 2 Household income which was rounded to the nearest R100 can be treated as a continuous variable even though it is “discrete”
- 3 The primary language used at home is a nominal scaled variable
- 4 Socio-economic status which was coded as 1 = low income, 2 = middle income, 3 = high income and is an interval scaled variable
- 5 The number of persons in the household is a discrete variable

**Question 3**

A single stem-and-leaf plot is a useful tool because

- 1 It includes the average and the standard deviation
- 2 It shows the percentage distribution of the data values
- 3 It enables us to examine the data values for the presence of trends, cycles, and seasonal variation
- 4 It enables us to compare this data set against others of a similar kind
- 5 It enables us to locate the centre of the data, see the overall shape of the distribution and look for marked deviations from the overall shape

**[TURN OVER]**

**Question 4**

In measuring the centre of the data from a positively skewed distribution, the median would be preferred over the mean for most purposes because

- 1 The median is the most frequent number while the mean is most likely
- 2 The mean may be too heavily influenced by the larger observations and this gives too high an indication of the centre
- 3 The median is less than the mean and smaller numbers are always appropriate for the centre
- 4 The mean measures the spread in the data
- 5 The median measures the arithmetic average of the data excluding outliers

**Question 5**

Listed below is a stem-and-leaf plot of the times it took 13 students to drink a beverage. Values for stems represents seconds and values for leaves represent tenths of a second.

3	2	4	1	3	5
4	0				
5	6				
6	1	1	3	7	9
7					
8	2				

Which of the following statements is incorrect?

- 1 The median time is 5.6 seconds
- 2  $Q_1$ , the lower quartile is equal to 3.13 seconds
- 3  $Q_3$ , the upper quartile is equal to 6.5 seconds
- 4 The standard deviation is equal to 1.747 seconds
- 5 Five students took less than four seconds to drink the beverage

[TURN OVER]

**Question 6**

Which one of the following events occur with a probability of zero?

- 1 An individual who runs quickly and swim's slowly
- 2 A single coin toss lands on heads or tails
- 3 Turning a doorknob neither clockwise nor counterclockwise
- 4 An animal that is a bird and cannot fly
- 5 A shape that is neither a circle nor a square

**Question 7**

Given an experiment such that

$$P(A) = 0.5, \quad P(B) = 0.4, \quad P(A|B) = 0.6$$

Calculate  $P(A \text{ and } B')$

- 1 0.5
- 2 0.24
- 3 1
- 4 0.26
- 5 0.34

**Question 8**

If  $P(A) = 0.2$ ,  $P(B) = 0.3$  and  $P(A/B) = 0.9$ , what is  $P(A \text{ and } B)$ ?

1. 0.18
- 2 0.42
- 3 0.27
- 4 0.06
- 5 0.15

[TURN OVER]

**Question 9**

A box of 7 gloves contains two left-handed gloves and five right-handed gloves. If two gloves are randomly selected from the box without replacement, what is the probability that there will be one right-handed glove and one left-handed glove selected?

- 1 0.4762
- 2 0.4082
- 3 0.0476
- 4 0.2381
- 5 0.8844

**Question 10**

Among applicants for life insurance, the probability that any one applicant will fail to meet the medical requirements is 10%. If there are ten applicants at a certain office in a given week, the probability that at least three of these applicants will fail to meet the medical requirement is?

- 1 0.0128
- 2 0.0702
- 3 0.4061
- 4 0.9298
- 5 0.9872

**Question 11**

A risky operation used for patients with no other hope of survival has a survival rate of 80%. What is the probability that more than 60% of the next 5 patients operated upon survive?

- 1 0.2048
- 2 0.3456
- 3 0.3370
- 4 0.7373
- 5 0.4096

**[TURN OVER]**

**Question 12**

In a particular country the average number of suicides reported each month is 2.50. Assume that the number of suicides follows a Poisson distribution. What is the probability that a minimum of two suicides will be reported in a particular month?

- 1 0.2565
- 2 0.7127
- 3 0.2873
- 4 0.8000
- 5 0.0821

**Question 13**

Suppose that the height of South African men has a mean of 1.77 m and a standard deviation of 4 cm. What is the proportion of South African men whose heights are less than or equal to 1.87 m?

- 1 0.9938
- 2 0.5120
- 3 0.0062
- 4 0.4880
- 5 0.5000

**Question 14**

Let  $z_1$  be a  $z$ -score that is unknown but identifiable by position and area. If the symmetrical area between a negative  $z_1$  and a positive  $z_1$  is 0.9544, then the value of  $z_1$  must be

- 1 0.06
- 2 2.50
- 3 0.11
- 4 2.20
- 5 2.00

**[TURN OVER]**

**Question 15**

Assume that  $z$  is from a standardized normal distribution with a mean of zero and the variance of one. What is the probability that  $z$  is less than  $-1.75$  or greater than  $2.18$ ?

- 1 0.4854
- 2 0.0547
- 3 0.4599
- 4 0.0146
- 5 0.0401

**Question 16**

Given an infinite population with a mean of 75 and the variance of 144, the probability that the mean of a sample of 36 observations, taken at random from this population, exceeds 78 is.

- 1 0.4332
- 2 0.0987
- 3 0.4013
- 4 0.0668
- 5 0.9332

**Question 17**

A sample of size 200 will be taken at random from an infinite population. Given that the population proportion is 0.60, the probability that the sample proportion will be greater than 0.58 is

- 1 0.580
- 2 0.762
- 3 0.281
- 4 0.008
- 5 0.719

**[TURN OVER]**

**Question 18**

A 98% confidence interval estimate for a population mean  $\mu$  is determined to be [75.38; 86.52]. If the confidence level is reduced to 90% the confidence interval for  $\mu$

- 1 Becomes wider
- 2 Remains the same
- 3 Becomes narrower
- 4 Lower limit of 98% confidence interval will be equal to lower limit of the 90% confidence interval
- 5 None of the above answers is correct

**Question 19**

David Copperfield thinks that the prices of a certain type of “biased” coin are normally distributed with a variance of 4. He conducts a survey of 7 magic stores and finds the coins priced at the following: R52, R49, R54, R52, R50, R51 and R48.

A 90% confidence interval for the population mean of the price (to 2 decimal places) is

- 1 (49.61, 52.10)
- 2 (50.39, 51.33)
- 3 (47.57, 54.15)
- 4 (49.38, 52.34)
- 5 (50.10, 51.61)

**Question 20**

In testing the hypothesis  $H_0: \mu = 50$  against  $H_1: \mu < 50$  where population variance is known, it was found that the standardized test statistic is  $z_{STAT} = -1.59$ . The  $p$ -value is then equal to

- 1 0.1118
- 2 0.0559
- 3 0.9441
- 4 0.4441
- 5 0.8882

[TURN OVER]



**Question 21**

A professor of statistics refutes the claim that the average student spends 3 hours studying for the midterm exam. Which hypothesis is used to test the claim?

- 1  $H_0: \mu \neq 3, H_1: \mu > 3$
- 2  $H_0: \mu = 3, H_1: \mu < 3$
- 3  $H_0: \mu \neq 3, H_1: \mu = 3$
- 4  $H_0: \mu = 3, H_1: \mu \neq 3$
- 5  $H_0: \mu = 3, H_1: \mu > 3$

**Question 22**

Which of the following  $p$ -values will lead us to fail to reject the null hypothesis if the significance level is 10%?

- 1 0.05
- 2 0.025
- 3 0.03
- 4 0.15
- 5 All of the above will lead to the nonrejection of the null hypothesis

**Question 23**

To test if the absence of workers from their job occurs at a higher rate on cold days than on warm days, a company took a sample of 400 days and the results were as detailed below. At the 0.10 level of significance, is there evidence of a relationship between weather patterns and absence from work?

Weather Pattern	Absence from work	
	Yes	No
Cold	10	110
Warm	11	269

- 1 Since  $\chi^2_{STAT}$  is greater than the critical value do not reject the null hypothesis of independence
- 2 Since  $\chi^2_{STAT}$  is less than the critical value do not reject the null hypothesis of independence
- 3 Since  $\chi^2_{STAT}$  is greater than the critical value, reject the null hypothesis of independence
- 4 Since  $\chi^2_{STAT}$  is less than the critical value, reject the null hypothesis of independence.
- 5 More information is required to either reject the null hypothesis or not reject it

[TURN OVER]

**Question 24**

How do you interpret a coefficient of determination,  $r^2$ , equal to 0.82?

Choose the correct answer below

- 1 The interpretation is that 18% of the variation in the independent variable can be explained by the variation in the dependent variable
- 2 The interpretation is that 82% of the variation in the dependent variable can be explained by the variation in the independent variable
- 3 The interpretation is that 0.18% of the variation in the dependent variable can be explained by the variation in the independent variable
- 4 The interpretation is that 0.82% of the variation in the independent variable can be explained by the variation in the dependent variable
- 5 Only 0.82% of the variability in the dependent variable is due to factors other than what is accounted for by the linear regression

**Question 25**

Consider the following regression equation

$$\hat{Y}_i = -0.3517 + 1156X_i \text{ with}$$

$$\sum_{i=1}^{30} Y_i = 59.97, \quad \sum_{i=1}^{30} Y_i^2 = 155.3025 \quad \text{and}$$

$$\sum_{i=1}^{30} X_i Y_i = 1496.69$$

Determine the coefficient of correlation

- 1 0.9047
- 2 0.9512
- 3 -0.9512
- 4 -0.9047
- 5 0.0465

[TURN OVER]

**Formulae**

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

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

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

$$P(A|B) = \frac{P(A \text{ and } B)}{P(B)}$$

$$\mu = E(X) = \sum_{i=1}^N X_i P(X_i)$$

$$\sigma^2 = \sum_{i=1}^N [X_i - E(X)]^2 p(X_i)$$

$$P(X) = \frac{n!}{X!(n-X)!} \pi^X (1-\pi)^{n-X} \quad X = 0, 1, 2, \dots, n$$

$$P(X) = \frac{e^{-\lambda} \lambda^X}{X!} \quad X = 0, 1, 2, \dots, \infty$$

$$Z = \frac{X - \mu}{\sigma}$$

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$

$$\sigma_p = \sqrt{\frac{\pi(1-\pi)}{n}}$$

$$\bar{X} \pm Z \alpha \frac{\sigma}{\sqrt{n}}$$

**[TURN OVER]**

$$\bar{X} \pm t_{\alpha} \frac{S}{\sqrt{n}}$$

$$p \pm Z_{\alpha} \sqrt{\frac{p(1-p)}{n}}$$

$$z_{STAT} = \frac{\bar{X} - \mu}{\sigma_{\bar{X}}}$$

$$Z_{STAT} = \frac{p - \pi}{\sigma_p}$$

$$\chi^2_{STAT} = \sum_{\text{all cells}} \frac{(f_o - f_e)^2}{f_e}$$

$$SSE = \sum Y_i^2 - b_0 \sum Y_i - b_1 \sum X_i Y_i$$

$$SSR = b_0 \sum Y_i + b_1 \sum X_i Y_i - \frac{(\sum Y_i)^2}{n}$$

$$SST = \sum Y_i^2 - \frac{(\sum Y_i)^2}{n}$$

$$SSXY = \sum (X_i - \bar{X})(Y_i - \bar{Y})$$

$$SSX = \sum (X_i - \bar{X})^2$$

$$b_1 = \frac{SSXY}{SSX}$$

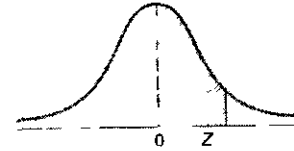
$$b_0 = \bar{Y} - b_1 \bar{X}$$

[TURN OVER]

**Table 1: Standardized Normal Distribution**

The Standardized Normal Distribution

Entry represents area under the standardized normal distribution from the mean to Z

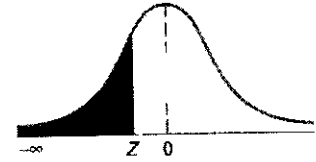


Z	00	01	02	03	04	05	06	07	08	09
0 0	0000	0040	0080	0120	0160	0199	0239	0279	0319	0359
0 1	0398	0438	0478	0517	0557	0596	0636	0675	0714	0753
0 2	0793	0832	0871	0910	0948	0987	1026	1064	1103	1141
0 3	1179	1217	1255	1293	1331	1368	1406	1443	1480	1517
0 4	1554	1591	1628	1664	1700	1736	1772	1808	1844	1879
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	4015
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	4982	4983	4984	4984	4985	4985	4986	4986
3 0	49865	49869	49874	49878	49882	49886	49889	49893	49897	49900
3 1	49903	49906	49910	49913	49916	49918	49921	49924	49926	49929
3 2	49931	49934	49936	49938	49940	49942	49944	49946	49948	49950
3 3	49952	49953	49955	49957	49958	49960	49961	49962	49964	49965
3 4	49966	49968	49969	49970	49971	49972	49973	49974	49975	49976
3 5	49977	49978	49978	49979	49980	49981	49981	49982	49983	49983
3 6	49984	49985	49985	49986	49986	49987	49987	49988	49988	49989
3 7	49989	49990	49990	49990	49991	49991	49992	49992	49992	49992
3 8	49993	49993	49993	49994	49994	49994	49994	49995	49995	49995
3 9	49995	49995	49996	49996	49996	49996	49996	49996	49997	49997

[TURN OVER]

**Table 2A: Cumulative Standardized Normal Distribution ( $Z < 0$ )**

The Cumulative Standardized Normal Distribution  
Entry represents area under the cumulative standardized  
normal distribution from  $-\infty$  to  $Z$



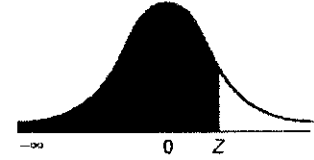
Cumulative Probabilities										
Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
-6.0	0.00000001									
-5.5	0.00000019									
-5.0	0.000000287									
-4.5	0.000003398									
-4.0	0.000031671									
-3.9	0.00005	0.00005	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00003	0.00003
-3.8	0.00007	0.00007	0.00007	0.00006	0.00006	0.00006	0.00006	0.00005	0.00005	0.00005
-3.7	0.00011	0.00010	0.00010	0.00010	0.00009	0.00009	0.00008	0.00008	0.00008	0.00008
-3.6	0.00016	0.00015	0.00015	0.00014	0.00014	0.00013	0.00013	0.00012	0.00012	0.00011
-3.5	0.00023	0.00022	0.00022	0.00021	0.00020	0.00019	0.00019	0.00018	0.00017	0.00017
-3.4	0.00034	0.00032	0.00031	0.00030	0.00029	0.00028	0.00027	0.00026	0.00025	0.00024
-3.3	0.00048	0.00047	0.00045	0.00043	0.00042	0.00040	0.00039	0.00038	0.00036	0.00035
-3.2	0.00069	0.00066	0.00064	0.00062	0.00060	0.00058	0.00056	0.00054	0.00052	0.00050
-3.1	0.00097	0.00094	0.00090	0.00087	0.00084	0.00082	0.00079	0.00076	0.00074	0.00071
-3.0	0.00135	0.00131	0.00126	0.00122	0.00118	0.00114	0.00111	0.00107	0.00103	0.00100
-2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
-2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
-2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
-2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
-2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
-2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
-2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
-2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
-2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
-2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
-1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
-1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
-1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
-1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
-1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
-1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
-1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
-1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
-1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
-1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
-0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
-0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
-0.7	0.2420	0.2388	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
-0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2482	0.2451
-0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
-0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
-0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
-0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
-0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
-0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641

[TURN OVER]

**Table 2B: Cumulative Standardized Normal Distribution ( $Z > 0$ )**

The Cumulative Standardized Normal Distribution (Continued)

Entry represents area under the cumulative standardized normal distribution from  $-\infty$  to  $Z$



**Cumulative Probabilities**

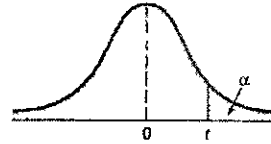
Z	0 00	0 01	0 02	0 03	0 04	0 05	0.06	0 07	0 08	0 09
0 0	0 5000	0 5040	0 5080	0 5120	0 5160	0 5199	0 5239	0 5279	0 5319	0 5359
0 1	0 5398	0 5438	0 5478	0 5517	0 5557	0 5596	0 5636	0 5675	0 5714	0 5753
0 2	0 5793	0 5832	0 5871	0 5910	0 5948	0 5987	0 6026	0 6064	0 6103	0 6141
0 3	0 6179	0 6217	0 6255	0 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 7518	0 7549
0 7	0 7580	0 7612	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 9978	0 9979	0 9979	0 9980
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 99865	0 99869	0 99874	0 99878	0 99882	0 99886	0 99889	0 99893	0 99897	0 99900
3 1	0 99903	0 99906	0 99910	0 99913	0 99916	0 99918	0 99921	0 99924	0 99926	0 99929
3 2	0 99931	0 99934	0 99936	0 99938	0 99940	0 99942	0 99944	0 99946	0 99948	0 99950
3 3	0 99952	0 99953	0 99955	0 99957	0 99958	0 99960	0 99961	0 99962	0 99964	0 99965
3 4	0 99966	0 99968	0 99969	0 99970	0 99971	0 99972	0 99973	0 99974	0 99975	0 99976
3 5	0 99977	0 99978	0 99978	0 99979	0 99980	0 99981	0 99981	0 99982	0 99983	0 99983
3 6	0 99984	0 99985	0 99985	0 99986	0 99986	0 99987	0 99987	0 99988	0 99988	0 99989
3 7	0 99989	0 99990	0 99990	0 99990	0 99991	0 99991	0 99992	0 99992	0 99992	0 99992
3 8	0 99993	0 99993	0 99993	0 99994	0 99994	0 99994	0 99994	0 99995	0 99995	0 99995
3 9	0 99995	0 99995	0 99996	0 99996	0 99996	0 99996	0 99996	0 99996	0 99997	0 99997
4 0	0 999968329									
4 5	0 999996602									
5 0	0 999999713									
5 5	0 999999981									
6 0	0 999999999									

[TURN OVER]

**Table 3A: Critical values of  $t$**

Critical Values of  $t$

For a particular number of degrees of freedom, entry represents the critical value of  $t$  corresponding to the cumulative probability  $(1 - \alpha)$  and a specified upper-tail area ( $\alpha$ )



Degrees of Freedom	Cumulative Probabilities					
	0.75	0.90	0.95	0.975	0.99	0.995
	Upper-Tail Areas					
	0.25	0.10	0.05	0.025	0.01	0.005
1	1.0000	3.0777	6.3138	12.7062	31.8207	63.6574
2	0.8165	1.8856	2.9200	4.3027	6.9646	9.9248
3	0.7649	1.6377	2.3534	3.1824	4.5407	5.8409
4	0.7407	1.5332	2.1318	2.7764	3.7469	4.6041
5	0.7267	1.4759	2.0150	2.5706	3.3649	4.0322
6	0.7176	1.4398	1.9432	2.4469	3.1427	3.7074
7	0.7111	1.4149	1.8946	2.3646	2.9980	3.4995
8	0.7064	1.3968	1.8595	2.3060	2.8965	3.3554
9	0.7027	1.3830	1.8331	2.2622	2.8214	3.2498
10	0.6998	1.3722	1.8125	2.2281	2.7638	3.1693
11	0.6974	1.3634	1.7959	2.2010	2.7181	3.1058
12	0.6955	1.3562	1.7823	2.1788	2.6810	3.0545
13	0.6938	1.3502	1.7709	2.1604	2.6503	3.0123
14	0.6924	1.3450	1.7613	2.1448	2.6245	2.9768
15	0.6912	1.3406	1.7531	2.1315	2.6025	2.9467
16	0.6901	1.3368	1.7459	2.1199	2.5835	2.9208
17	0.6892	1.3334	1.7396	2.1098	2.5669	2.8982
18	0.6884	1.3304	1.7341	2.1009	2.5524	2.8784
19	0.6876	1.3277	1.7291	2.0930	2.5395	2.8609
20	0.6870	1.3253	1.7247	2.0860	2.5280	2.8453
21	0.6864	1.3232	1.7207	2.0796	2.5177	2.8314
22	0.6858	1.3212	1.7171	2.0739	2.5083	2.8188
23	0.6853	1.3195	1.7139	2.0687	2.4999	2.8073
24	0.6848	1.3178	1.7109	2.0639	2.4922	2.7969
25	0.6844	1.3163	1.7081	2.0595	2.4851	2.7874
26	0.6840	1.3150	1.7056	2.0555	2.4786	2.7787
27	0.6837	1.3137	1.7033	2.0518	2.4727	2.7707
28	0.6834	1.3125	1.7011	2.0484	2.4671	2.7633
29	0.6830	1.3114	1.6991	2.0452	2.4620	2.7564
30	0.6828	1.3104	1.6973	2.0423	2.4573	2.7500
31	0.6825	1.3095	1.6955	2.0395	2.4528	2.7440
32	0.6822	1.3086	1.6939	2.0369	2.4487	2.7385
33	0.6820	1.3077	1.6924	2.0345	2.4448	2.7333
34	0.6818	1.3070	1.6909	2.0322	2.4411	2.7284
35	0.6816	1.3062	1.6896	2.0301	2.4377	2.7238
36	0.6814	1.3055	1.6883	2.0281	2.4345	2.7195
37	0.6812	1.3049	1.6871	2.0262	2.4314	2.7154
38	0.6810	1.3042	1.6860	2.0244	2.4286	2.7116
39	0.6808	1.3036	1.6849	2.0227	2.4258	2.7079
40	0.6807	1.3031	1.6839	2.0211	2.4233	2.7045
41	0.6805	1.3025	1.6829	2.0195	2.4208	2.7012
42	0.6804	1.3020	1.6820	2.0181	2.4185	2.6981
43	0.6802	1.3016	1.6811	2.0167	2.4163	2.6951
44	0.6801	1.3011	1.6802	2.0154	2.4141	2.6923
45	0.6800	1.3006	1.6794	2.0141	2.4121	2.6896
46	0.6799	1.3002	1.6787	2.0129	2.4102	2.6870
47	0.6797	1.2998	1.6779	2.0117	2.4083	2.6846
48	0.6796	1.2994	1.6772	2.0106	2.4066	2.6822



Table 3B: Critical values of  $t$ 

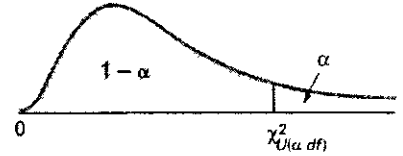
Degrees of Freedom	Cumulative Probabilities					
	0.75	0.90	0.95	0.975	0.99	0.995
	Upper-Tail Areas					
	0.25	0.10	0.05	0.025	0.01	0.005
49	0.6795	1.2991	1.6766	2.0096	2.4049	2.6800
50	0.6794	1.2987	1.6759	2.0086	2.4033	2.6778
51	0.6793	1.2984	1.6753	2.0076	2.4017	2.6757
52	0.6792	1.2980	1.6747	2.0066	2.4002	2.6737
53	0.6791	1.2977	1.6741	2.0057	2.3988	2.6718
54	0.6791	1.2974	1.6736	2.0049	2.3974	2.6700
55	0.6790	1.2971	1.6730	2.0040	2.3961	2.6682
56	0.6789	1.2969	1.6725	2.0032	2.3948	2.6665
57	0.6788	1.2966	1.6720	2.0025	2.3936	2.6649
58	0.6787	1.2963	1.6716	2.0017	2.3924	2.6633
59	0.6787	1.2961	1.6711	2.0010	2.3912	2.6618
60	0.6786	1.2958	1.6706	2.0003	2.3901	2.6603
61	0.6785	1.2956	1.6702	1.9996	2.3890	2.6589
62	0.6785	1.2954	1.6698	1.9990	2.3880	2.6575
63	0.6784	1.2951	1.6694	1.9983	2.3870	2.6561
64	0.6783	1.2949	1.6690	1.9977	2.3860	2.6549
65	0.6783	1.2947	1.6686	1.9971	2.3851	2.6536
66	0.6782	1.2945	1.6683	1.9966	2.3842	2.6524
67	0.6782	1.2943	1.6679	1.9960	2.3833	2.6512
68	0.6781	1.2941	1.6676	1.9955	2.3824	2.6501
69	0.6781	1.2939	1.6672	1.9949	2.3816	2.6490
70	0.6780	1.2938	1.6669	1.9944	2.3808	2.6479
71	0.6780	1.2936	1.6666	1.9939	2.3800	2.6469
72	0.6779	1.2934	1.6663	1.9935	2.3793	2.6459
73	0.6779	1.2933	1.6660	1.9930	2.3785	2.6449
74	0.6778	1.2931	1.6657	1.9925	2.3778	2.6439
75	0.6778	1.2929	1.6654	1.9921	2.3771	2.6430
76	0.6777	1.2928	1.6652	1.9917	2.3764	2.6421
77	0.6777	1.2926	1.6649	1.9913	2.3758	2.6412
78	0.6776	1.2925	1.6646	1.9908	2.3751	2.6403
79	0.6776	1.2924	1.6644	1.9905	2.3745	2.6395
80	0.6776	1.2922	1.6641	1.9901	2.3739	2.6387
81	0.6775	1.2921	1.6639	1.9897	2.3733	2.6379
82	0.6775	1.2920	1.6636	1.9893	2.3727	2.6371
83	0.6775	1.2918	1.6634	1.9890	2.3721	2.6364
84	0.6774	1.2917	1.6632	1.9886	2.3716	2.6356
85	0.6774	1.2916	1.6630	1.9883	2.3710	2.6349
86	0.6774	1.2915	1.6628	1.9879	2.3705	2.6342
87	0.6773	1.2914	1.6626	1.9876	2.3700	2.6335
88	0.6773	1.2912	1.6624	1.9873	2.3695	2.6329
89	0.6773	1.2911	1.6622	1.9870	2.3690	2.6322
90	0.6772	1.2910	1.6620	1.9867	2.3685	2.6316
91	0.6772	1.2909	1.6618	1.9864	2.3680	2.6309
92	0.6772	1.2908	1.6616	1.9861	2.3676	2.6303
93	0.6771	1.2907	1.6614	1.9858	2.3671	2.6297
94	0.6771	1.2906	1.6612	1.9855	2.3667	2.6291
95	0.6771	1.2905	1.6611	1.9853	2.3662	2.6286
96	0.6771	1.2904	1.6609	1.9850	2.3658	2.6280
97	0.6770	1.2903	1.6607	1.9847	2.3654	2.6275
98	0.6770	1.2902	1.6606	1.9845	2.3650	2.6269
99	0.6770	1.2902	1.6604	1.9842	2.3646	2.6264
100	0.6770	1.2901	1.6602	1.9840	2.3642	2.6259
110	0.6767	1.2893	1.6588	1.9818	2.3607	2.6213
120	0.6765	1.2886	1.6577	1.9799	2.3578	2.6174
$\infty$	0.6745	1.2816	1.6449	1.9600	2.3263	2.5758

[TURN OVER]

**Table 4: Critical values of  $\chi^2$**

Critical Values of  $\chi^2$

For a particular number of degrees of freedom, entry represents the critical value of  $\chi^2$  corresponding to the cumulative probability  $(1 - \alpha)$  and a specified upper-tail area  $(\alpha)$



Degrees of Freedom	Cumulative Probabilities											
	0.005	0.01	0.025	0.05	0.10	0.25	0.75	0.90	0.95	0.975	0.99	0.995
	Upper-Tail Areas ( $\alpha$ )											
	0.995	0.99	0.975	0.95	0.90	0.75	0.25	0.10	0.05	0.025	0.01	0.005
1			0.001	0.004	0.016	0.102	1.323	2.706	3.841	5.024	6.635	7.879
2	0.010	0.020	0.051	0.103	0.211	0.575	2.773	4.605	5.991	7.378	9.210	10.597
3	0.072	0.115	0.216	0.352	0.584	1.213	4.108	6.251	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	1.064	1.923	5.385	7.779	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	1.610	2.675	6.626	9.236	11.071	12.833	15.086	16.750
6	0.676	0.872	1.237	1.635	2.204	3.455	7.841	10.645	12.592	14.449	16.812	18.458
7	0.989	1.239	1.690	2.167	2.833	4.255	9.037	12.017	14.067	16.013	18.475	20.278
8	1.344	1.646	2.180	2.733	3.490	5.071	10.219	13.362	15.507	17.535	20.090	21.955
9	1.735	2.088	2.700	3.325	4.168	5.899	11.389	14.684	16.919	19.023	21.666	23.589
10	2.156	2.558	3.247	3.940	4.865	6.737	12.549	15.987	18.307	20.483	23.209	25.188
11	2.603	3.053	3.816	4.575	5.578	7.584	13.701	17.275	19.675	21.920	24.725	26.757
12	3.074	3.571	4.404	5.226	6.304	8.438	14.845	18.549	21.026	23.337	26.217	28.299
13	3.565	4.107	5.009	5.892	7.042	9.299	15.984	19.812	22.362	24.736	27.688	29.819
14	4.075	4.660	5.629	6.571	7.790	10.165	17.117	21.064	23.685	26.119	29.141	31.319
15	4.601	5.229	6.262	7.261	8.547	11.037	18.245	22.307	24.996	27.488	30.578	32.801
16	5.142	5.812	6.908	7.962	9.312	11.912	19.369	23.542	26.296	28.845	32.000	34.267
17	5.697	6.408	7.564	8.672	10.085	12.792	20.489	24.769	27.587	30.191	33.409	35.718
18	6.265	7.015	8.231	9.390	10.865	13.675	21.605	25.989	28.869	31.526	34.805	37.156
19	6.844	7.633	8.907	10.117	11.651	14.562	22.718	27.204	30.144	32.852	36.191	38.582
20	7.434	8.260	9.591	10.851	12.443	15.452	23.828	28.412	31.410	34.170	37.566	39.997
21	8.034	8.897	10.283	11.591	13.240	16.344	24.935	29.615	32.671	35.479	38.932	41.401
22	8.643	9.542	10.982	12.338	14.042	17.240	26.039	30.813	33.924	36.781	40.289	42.796
23	9.260	10.196	11.689	13.091	14.848	18.137	27.141	32.007	35.172	38.076	41.638	44.181
24	9.886	10.856	12.401	13.848	15.659	19.037	28.241	33.196	36.415	39.364	42.980	45.559
25	10.520	11.524	13.120	14.611	16.473	19.939	29.339	34.382	37.652	40.646	44.314	46.928
26	11.160	12.198	13.844	15.379	17.292	20.843	30.435	35.563	38.885	41.923	45.642	48.290
27	11.808	12.879	14.573	16.151	18.114	21.749	31.528	36.741	40.113	43.194	46.963	49.645
28	12.461	13.565	15.308	16.928	18.939	22.657	32.620	37.916	41.337	44.461	48.278	50.993
29	13.121	14.257	16.047	17.708	19.768	23.567	33.711	39.087	42.557	45.722	49.588	52.336
30	13.787	14.954	16.791	18.493	20.599	24.478	34.800	40.256	43.773	46.979	50.892	53.672

For larger values of degrees of freedom ( $df$ ) the expression  $Z = \sqrt{2\chi^2} - \sqrt{2(df) - 1}$  may be used and the resulting upper-tail area can be found from the cumulative standardized normal distribution (Table E.2)

**Table 5: Binomial Probabilities**

$\pi$

Table of Binomial Probabilities

For a given combination of  $n$  and  $\pi$  entry indicates the probability of obtaining a specified value of  $X$ . To locate entry, when  $\pi \approx 50$  read  $\pi$  across the bottom heading and both  $n$  and  $X$  up the right margin. When  $\pi < 50$  read  $\pi$  across the top heading and both  $n$  and  $X$  down the left margin, when  $\pi \approx 50$  read  $\pi$  across the bottom heading and both  $n$  and  $X$  up the right margin.

$n$	$X$	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	
2	0	0.9801	0.9604	0.9409	0.9216	0.9025	0.8836	0.8649	0.8464	0.8281	0.8100	0.7225	0.6400	0.5625	0.4900	0.4225	0.3600	0.3025	0.2500	2
	1	0.0198	0.0392	0.0582	0.0768	0.0950	0.1128	0.1302	0.1472	0.1638	0.1800	0.2550	0.3200	0.3750	0.4200	0.4550	0.4800	0.4950	0.5000	1
	2	0.0001	0.0004	0.0009	0.0016	0.0025	0.0036	0.0049	0.0064	0.0081	0.0100	0.0225	0.0400	0.0625	0.0900	0.1225	0.1600	0.2025	0.2500	0
3	0	0.9703	0.9412	0.9127	0.8847	0.8574	0.8306	0.8044	0.7787	0.7536	0.7290	0.6141	0.5120	0.4219	0.3430	0.2746	0.2160	0.1664	0.1250	3
	1	0.0294	0.0576	0.0847	0.1106	0.1354	0.1590	0.1816	0.2031	0.2236	0.2430	0.3251	0.3840	0.4219	0.4410	0.4436	0.4320	0.4084	0.3750	2
	2	0.0003	0.0012	0.0026	0.0046	0.0071	0.0102	0.0137	0.0177	0.0221	0.0270	0.0574	0.0960	0.1406	0.1890	0.2389	0.2880	0.3341	0.3750	1
	3	0.0000	0.0000	0.0000	0.0001	0.0001	0.0003	0.0003	0.0005	0.0007	0.0010	0.0034	0.0080	0.0156	0.0270	0.0429	0.0640	0.0911	0.1250	0
4	0	0.9606	0.9224	0.8853	0.8493	0.8145	0.7807	0.7481	0.7164	0.6857	0.6561	0.5220	0.4096	0.3164	0.2401	0.1785	0.1296	0.0915	0.0625	4
	1	0.0388	0.0753	0.1095	0.1416	0.1715	0.1993	0.2252	0.2492	0.2713	0.2916	0.3685	0.4096	0.4219	0.4116	0.3845	0.3456	0.2995	0.2500	3
	2	0.0006	0.0023	0.0051	0.0088	0.0135	0.0191	0.0254	0.0325	0.0402	0.0486	0.0975	0.1536	0.2109	0.2646	0.3105	0.3456	0.3675	0.3750	2
	3	0.0000	0.0000	0.0001	0.0002	0.0005	0.0008	0.0013	0.0019	0.0027	0.0036	0.0115	0.0256	0.0469	0.0756	0.1115	0.1536	0.2005	0.2500	1
	4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0005	0.0016	0.0039	0.0081	0.0150	0.0256	0.0410	0.0625	0
5	0	0.9510	0.9039	0.8587	0.8154	0.7738	0.7339	0.6957	0.6591	0.6240	0.5905	0.4437	0.3277	0.2373	0.1681	0.1160	0.0778	0.0503	0.0312	5
	1	0.0480	0.0922	0.1328	0.1699	0.2036	0.2342	0.2618	0.2866	0.3086	0.3280	0.3915	0.4096	0.3955	0.3601	0.3124	0.2592	0.2059	0.1562	4
	2	0.0010	0.0038	0.0082	0.0142	0.0214	0.0299	0.0394	0.0498	0.0610	0.0729	0.1382	0.2048	0.2637	0.3087	0.3364	0.3456	0.3369	0.3125	3
	3	0.0000	0.0001	0.0003	0.0006	0.0011	0.0019	0.0030	0.0043	0.0060	0.0081	0.0244	0.0512	0.0879	0.1321	0.1811	0.2304	0.2757	0.3125	2
	4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0002	0.0003	0.0004	0.0022	0.0064	0.0146	0.0283	0.0488	0.0768	0.1128	0.1562	1
	5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0003	0.0010	0.0024	0.0053	0.0102	0.0185	0.0312	0
6	0	0.9415	0.8858	0.8330	0.7828	0.7351	0.6899	0.6470	0.6064	0.5679	0.5314	0.3771	0.2621	0.1780	0.1176	0.0754	0.0467	0.0277	0.0156	6
	1	0.0571	0.1085	0.1546	0.1957	0.2321	0.2642	0.2922	0.3164	0.3370	0.3543	0.5993	0.7932	0.9350	0.3025	0.2437	0.1866	0.1359	0.0937	5
	2	0.0014	0.0055	0.0120	0.0204	0.0305	0.0422	0.0550	0.0688	0.0833	0.0984	0.1762	0.2458	0.2966	0.3241	0.3280	0.3110	0.2780	0.2344	4
	3	0.0000	0.0002	0.0005	0.0011	0.0021	0.0036	0.0055	0.0080	0.0110	0.0146	0.0415	0.0819	0.1318	0.1852	0.2355	0.2765	0.3032	0.3125	3
	4	0.0000	0.0000	0.0000	0.0000	0.0001	0.0002	0.0003	0.0005	0.0008	0.0012	0.0055	0.0154	0.0330	0.0595	0.0951	0.1372	0.1861	0.2344	2
	5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0004	0.0015	0.0044	0.0102	0.0205	0.0369	0.0609	0.0937	1
	6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0002	0.0007	0.0018	0.0041	0.0083	0.0156	0

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Table 5 (continued)

n	A	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.91	0.90	0.85	0.80	0.75	0.70	0.65	0.60	0.55	0.50	X	n
7	0	0.9321	0.8681	0.8080	0.7514	0.6983	0.6485	0.6017	0.5578	0.5168	0.4783	0.3206	0.2097	0.1335	0.0824	0.0490	0.0280	0.0152	0.0078	7	
	1	0.0659	0.1240	0.1749	0.2192	0.2573	0.2897	0.3170	0.3396	0.3578	0.3720	0.3960	0.3670	0.3115	0.2471	0.1848	0.1306	0.0872	0.0547	6	
	2	0.0020	0.0076	0.0162	0.0274	0.0406	0.0555	0.0716	0.0886	0.1061	0.1240	0.2097	0.2753	0.3173	0.2985	0.2613	0.2180	0.1749	0.1401	5	
	3	0.0000	0.0003	0.0008	0.0019	0.0036	0.0059	0.0090	0.0128	0.0175	0.0230	0.0617	0.1147	0.1730	0.2269	0.2903	0.2918	0.2734	0.2734	4	
	4	0.0000	0.0000	0.0000	0.0001	0.0002	0.0004	0.0007	0.0011	0.0017	0.0026	0.0109	0.0287	0.0577	0.0972	0.1442	0.1935	0.2388	0.2734	3	
	5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0002	0.0012	0.0043	0.0115	0.0250	0.0466	0.0774	0.1172	0.1641	2	
	6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1	
	7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0	
8	0	0.9227	0.8508	0.7837	0.7214	0.6634	0.6096	0.5596	0.5132	0.4703	0.4305	0.2725	0.1678	0.1001	0.0576	0.0319	0.0168	0.0084	0.0039	8	
	1	0.0746	0.1389	0.1939	0.2405	0.2793	0.3113	0.3370	0.3570	0.3721	0.3826	0.3847	0.3355	0.2670	0.1977	0.1373	0.0896	0.0548	0.0312	7	
	2	0.0026	0.0099	0.0210	0.0351	0.0515	0.0695	0.0888	0.1087	0.1288	0.1488	0.2376	0.2936	0.3115	0.2965	0.2587	0.2090	0.1569	0.1094	6	
	3	0.0001	0.0004	0.0013	0.0029	0.0054	0.0089	0.0134	0.0189	0.0255	0.0331	0.0839	0.1468	0.2076	0.2541	0.2786	0.2787	0.2568	0.2187	5	
	4	0.0000	0.0000	0.0001	0.0002	0.0004	0.0007	0.0013	0.0021	0.0031	0.0046	0.0185	0.0459	0.0865	0.1361	0.1875	0.2322	0.2627	0.2734	4	
	5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0002	0.0026	0.0092	0.0231	0.0467	0.0808	0.1239	0.1719	0.2187	3	
	6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2	
	7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1	
	8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0	
9	0	0.9135	0.8337	0.7602	0.6925	0.6302	0.5730	0.5204	0.4722	0.4279	0.3874	0.2316	0.1342	0.0751	0.0404	0.0207	0.0101	0.0046	0.0020	9	
	1	0.0830	0.1531	0.2116	0.2597	0.2985	0.3292	0.3525	0.3695	0.3809	0.3874	0.3679	0.3020	0.2253	0.1536	0.1004	0.0605	0.0339	0.0176	8	
	2	0.0034	0.0125	0.0262	0.0433	0.0629	0.0840	0.1061	0.1285	0.1507	0.1722	0.2597	0.3020	0.3003	0.2688	0.2162	0.1612	0.1110	0.0703	7	
	3	0.0001	0.0006	0.0019	0.0042	0.0077	0.0125	0.0186	0.0261	0.0348	0.0446	0.1069	0.1762	0.2336	0.2668	0.2716	0.2508	0.2119	0.1641	6	
	4	0.0000	0.0000	0.0001	0.0003	0.0006	0.0012	0.0021	0.0034	0.0052	0.0074	0.0283	0.0661	0.1168	0.1715	0.2194	0.2508	0.2600	0.2461	5	
	5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	4	
	6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3	
	7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2	
	8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1	
	9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0	
10	0	0.9044	0.8171	0.7374	0.6648	0.5987	0.5386	0.4840	0.4344	0.3894	0.3487	0.1969	0.1074	0.0563	0.0282	0.0135	0.0060	0.0025	0.0010	10	
	1	0.0914	0.1667	0.2381	0.2770	0.3151	0.3438	0.3643	0.3777	0.3851	0.3874	0.3474	0.2684	0.1877	0.1211	0.0725	0.0403	0.0207	0.0098	9	
	2	0.0042	0.0153	0.0317	0.0519	0.0746	0.0988	0.1234	0.1478	0.1714	0.1937	0.2759	0.3020	0.2816	0.2335	0.1757	0.1209	0.0763	0.0439	8	
	3	0.0001	0.0008	0.0026	0.0058	0.0105	0.0168	0.0248	0.0343	0.0452	0.0574	0.1298	0.2013	0.2503	0.2668	0.2522	0.2150	0.1665	0.1172	7	
	4	0.0000	0.0000	0.0001	0.0004	0.0010	0.0019	0.0033	0.0052	0.0078	0.0112	0.0401	0.0881	0.1460	0.2001	0.2377	0.2508	0.2384	0.2051	6	
	5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	5	
	6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	4	
	7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3	
	8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2	
	9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1	
	10	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0	

continued

[TURN OVER]

**Table 6: Poisson Probabilities**

Table of Poisson Probabilities  
For a given value of  $\lambda$ , entry indicates the probability of a specified value of  $X$ .

X	$\lambda$									
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
0	0.9048	0.8187	0.7408	0.6703	0.6065	0.5488	0.4966	0.4493	0.4066	0.3679
1	0.0905	0.1637	0.2222	0.2681	0.3033	0.3293	0.3476	0.3595	0.3659	0.3679
2	0.0045	0.0164	0.0333	0.0536	0.0758	0.0986	0.1217	0.1438	0.1647	0.1839
3	0.0002	0.0011	0.0033	0.0072	0.0126	0.0198	0.0284	0.0383	0.0494	0.0613
4	0.0000	0.0001	0.0003	0.0007	0.0016	0.0030	0.0050	0.0077	0.0111	0.0153
5	0.0000	0.0000	0.0000	0.0001	0.0002	0.0004	0.0007	0.0012	0.0020	0.0031
6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0002	0.0003	0.0005
7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001

X	$\lambda$									
	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
0	0.3329	0.3012	0.2725	0.2466	0.2231	0.2019	0.1827	0.1653	0.1496	0.1353
1	0.3662	0.3614	0.3543	0.3452	0.3347	0.3230	0.3106	0.2975	0.2842	0.2707
2	0.2014	0.2169	0.2303	0.2417	0.2510	0.2584	0.2640	0.2678	0.2700	0.2707
3	0.0738	0.0867	0.0998	0.1128	0.1255	0.1378	0.1496	0.1607	0.1710	0.1804
4	0.0203	0.0260	0.0324	0.0395	0.0471	0.0551	0.0636	0.0723	0.0812	0.0902
5	0.0045	0.0062	0.0084	0.0111	0.0141	0.0176	0.0216	0.0260	0.0309	0.0361
6	0.0008	0.0012	0.0018	0.0026	0.0035	0.0047	0.0061	0.0078	0.0098	0.0120
7	0.0001	0.0002	0.0003	0.0005	0.0008	0.0011	0.0015	0.0020	0.0027	0.0034
8	0.0000	0.0000	0.0001	0.0001	0.0001	0.0002	0.0003	0.0005	0.0006	0.0009
9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0002

X	$\lambda$									
	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0
0	0.1225	0.1108	0.1003	0.0907	0.0821	0.0743	0.0672	0.0608	0.0550	0.0496
1	0.2572	0.2438	0.2306	0.2177	0.2052	0.1931	0.1815	0.1703	0.1596	0.1494
2	0.2700	0.2681	0.2652	0.2613	0.2565	0.2510	0.2450	0.2384	0.2314	0.2240
3	0.1890	0.1966	0.2033	0.2090	0.2138	0.2176	0.2205	0.2225	0.2237	0.2240
4	0.0992	0.1082	0.1169	0.1254	0.1336	0.1414	0.1488	0.1557	0.1622	0.1680
5	0.0417	0.0476	0.0538	0.0602	0.0668	0.0735	0.0804	0.0872	0.0940	0.1008
6	0.0146	0.0174	0.0206	0.0241	0.0278	0.0319	0.0362	0.0407	0.0455	0.0504
7	0.0044	0.0055	0.0068	0.0083	0.0099	0.0118	0.0139	0.0163	0.0188	0.0216
8	0.0011	0.0015	0.0019	0.0025	0.0031	0.0038	0.0047	0.0057	0.0068	0.0081
9	0.0003	0.0004	0.0005	0.0007	0.0009	0.0011	0.0014	0.0018	0.0022	0.0027
10	0.0001	0.0001	0.0001	0.0002	0.0002	0.0003	0.0004	0.0005	0.0006	0.0008
11	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0002	0.0002
12	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001

X	$\lambda$									
	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0
0	0.0450	0.0408	0.0369	0.0334	0.0302	0.0273	0.0247	0.0224	0.0202	0.0183
1	0.1397	0.1340	0.1217	0.1135	0.1057	0.0984	0.0915	0.0850	0.0789	0.0733
2	0.2165	0.2087	0.2008	0.1929	0.1850	0.1771	0.1692	0.1615	0.1539	0.1465
3	0.2237	0.2226	0.2209	0.2186	0.2158	0.2125	0.2087	0.2046	0.2001	0.1954
4	0.1734	0.1781	0.1823	0.1858	0.1888	0.1912	0.1931	0.1944	0.1951	0.1954
5	0.1075	0.1140	0.1203	0.1264	0.1322	0.1377	0.1429	0.1477	0.1522	0.1563
6	0.0555	0.0608	0.0662	0.0716	0.0771	0.0826	0.0881	0.0936	0.0989	0.1042
7	0.0246	0.0278	0.0312	0.0348	0.0385	0.0425	0.0466	0.0508	0.0551	0.0595
8	0.0095	0.0111	0.0129	0.0148	0.0169	0.0191	0.0215	0.0241	0.0269	0.0298
9	0.0033	0.0040	0.0047	0.0056	0.0066	0.0076	0.0089	0.0102	0.0116	0.0132
10	0.0010	0.0013	0.0016	0.0019	0.0023	0.0028	0.0033	0.0039	0.0045	0.0053
11	0.0003	0.0004	0.0005	0.0006	0.0007	0.0009	0.0011	0.0013	0.0016	0.0019
12	0.0001	0.0001	0.0001	0.0002	0.0002	0.0003	0.0003	0.0004	0.0005	0.0006
13	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002
14	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001

*continued*

