Time Allowed: 2Hrs. & 30Mins.

SECTION-A   (Marks: 3X5)

Q.A1 What characteristics of a situation help to determine which the appropriate distribution to use is?

Q.A2 Reginald Dunfey, president of British World Airlines, is fiercely proud of his company's on time percentage; only 2 percent of all BWA flights arrive more than 10 minutes early or late. In his upcoming speech to the BWA board of directors, Mr. Dunfey wants to include the probability that none of the 200 flights scheduled for the following week will be more than 10 minutes early or late. What is the probability? What is the probability that exactly 10 flights will be more than 10 minutes early or late?

Q.A3 On the basis of past experience, automobile inspectors in Pennsylvania have noticed that 5 percent of all cars coming in for their annual inspection fail to pass. Using the normal approximation to the binomial, find the probability that between 7 and 18 of the next 200 cars to enter the Lancaster inspection station will fail the inspection.

Q.A4 A non-profit organisation is conducting a door-to-door opinion poll on municipal day-care centers. The organisation has devised a scheme for random sampling of houses, and plans to conduct the poll on weekdays from noon to 5 P.M.. Will this scheme produce a random sample?

Q.A5 By reviewing sales since opening 6 months ago, a restaurant owner found that the average bill for a couple was $26, and the standard deviation was $5.65. How large would a sample of customer have to be for the probability to be at least 95.44 percent that the mean cost per meal for the sample would fall between $25 and $27?

SECTION-B   (Marks: 2X10)

Q.B1 The department of transportation has mandated that the average speed of cars on interstate highways must be no more than 67 miles per hours in order for state highway departments to retain their federal funding. North Carolina troopers, in unmarked cars, clocked a sample of 186 cars and found that the average speed was 66.3 miles per hour and the standard deviation was 0.6 mph.
(a) Find the standard error of the mean.
(b) What is the interval around the sample mean that would contain the population mean 95.5 percent of the time?
(c) Can North Carolina truthfully report that the true mean speed on its highways is 67 mph or less with 95.5 percent confidence?

Q.B2 A research analyst dispute a trade group's prediction that back-to-school spending will average $506.40 per family this year. She believe that average back-to-school spending

will significantly differ from this amount. She decides to conduct a test on the basis of a random sample of 30 households with school-age children. She calculates the sample mean as $522.85. She also believes that back-to-school spending is normally distributed with a population standard deviation of $55.

(a) Specify the competing hypothesis in order to test the research analyst's claim.

(b) Calculate the value of the test statistics.

(c) Calculate the *p-value* and the state the decision rule.

(d) At the 5% significance level, does average back-to-school spending differ from $606.40?

Q.B3 The data processing department at a large life insurance company has installed new colour video display terminals to replace the monochrome units it previously used. The 95 operators trained to use the new machines averaged 7.2 hours before achieving a satisfactory level of performance. Their sample variance was 16.2 squared hours. Long experience with operators on the old monochrome terminals showed that they averaged 8.1 hours on the machines before their performances were satisfactory. At the 0.01 significance level, should the supervisor of the department conclude that the new terminals are easier to learn to operate?

SECTION-C   (15 Marks)

Case Study

William C. Andrews an organizational behavior consultant for Victory Motorcycles, has designed a test to show the company's supervisors the dangers of over supervising their workers. A worker from the assembly line is given a series of complicated tasks to perform. During the worker's performance, a supervisor constantly interrupts the worker to assist him or her in completing the tasks. The worker, upon completion of the tasks, is then given a psychological test designed to measure the worker's hostility toward authority (a high score equal low hostility). Eight different workers were assigned the tasks and then interrupted for the purpose of instructional assistance various numbers of times (line X). Their corresponding scores on the hostility test are revealed in line Y.

X(number of times worker interrupted)	5	10	10	15	15	20	20	25
Y(worker's score on hostility test)	58	41	45	27	26	12	16	3

(a) Plot these data.
(b) Develop the equation that best describes the relationship between the number of times interrupted and the test score.
(c) Predict the expected test score if the worker is interrupted 18 times.

Formulae:

$$t = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}}$$

$$\bar{x} \pm z_{\frac{\alpha}{2}} \frac{\sigma}{\sqrt{n}}$$

$$\bar{x} - z_{\frac{\alpha}{2}} \frac{\sigma}{\sqrt{n}} \leq \mu \leq \bar{x} + z_{\frac{\alpha}{2}} \frac{\sigma}{\sqrt{n}}$$

$$P\left[\bar{x} - z_{\frac{\alpha}{2}} \frac{\sigma}{\sqrt{n}} \leq \mu \leq \bar{x} + z_{\frac{\alpha}{2}} \frac{\sigma}{\sqrt{n}}\right] = (1 - \alpha)$$

$$\bar{x} - z_{\frac{\alpha}{2}} \frac{s}{\sqrt{n}} \leq \mu \leq \bar{x} + z_{\frac{\alpha}{2}} \frac{s}{\sqrt{n}}$$

$$\text{Probability of } x \text{ success in } n \text{ trials} = P(x) = \frac{!n}{!(n-x)!(x)} p^x q^{n-x}$$

Mean and variance of a binomial probability distribution

$$\text{Mean} = \mu = E(x) = np$$

$$\text{Var}(x) = \sigma^2 = np(1-p) = npq$$

$$\text{Standard deviation} = \sigma = \sqrt{npq}$$

Poisson formula

$$P(x) = \frac{\lambda^x \times e^{-\lambda}}{!x}$$

$$r = \frac{\sum(x - \bar{x})(y - \bar{y})}{\sqrt{[\sum(x - \bar{x})^2][\sum(y - \bar{y})^2]}}$$

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3

$$z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}}$$

$$z \equiv \frac{\bar{x} - \mu}{\sigma}$$

$$r = \frac{n\sum xy - \sum x \sum y}{\sqrt{[n(\sum x^2) - (\sum x)^2][n(\sum y^2) - (\sum y)^2]}}$$

$$b_1 = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sum (x - \bar{x})^2}$$

$$b_0 = \bar{y} - b_1\bar{x}$$

Binomial Probability Distribution

For a given combination of n and p, entry indicates the probability of a specified value of X. To locate entry: when $p < 0.50$, read p across the top heading and both n and X down the left margin; when $p > 0.50$, read p across the bottom heading and both n and X up the right margin.

										p												
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	X	n
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	2
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	0.0002	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	3
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	0.0005	0.0016	0.0039	0.0081	0.0150	0.0256	0.0410	0.0625	0	4
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	0.1323	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	0.0001	0.0003	0.0010	0.0024	0.0053	0.0102	0.0185	0.0312	0	5
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	0.3993	0.3932	0.3560	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	0.0001	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	0.0001	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	0.0001	0.0002	0.0007	0.0018	0.0041	0.0083	0.0156	0	6

n	X	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.91	0.92	0.93	0.94	0.95	0.96	0.97	0.98	0.99	X	n
7	0	0.0078	0.0152	0.0280	0.0490	0.0824	0.1335	0.2097	0.3206	0.4783	0.5168	0.5578	0.6017	0.6485	0.6983	0.7514	0.8080	0.8681	0.9321	7	
	1	0.0547	0.0872	0.1306	0.1848	0.2471	0.3115	0.3670	0.3960	0.3720	0.3578	0.3396	0.3170	0.2897	0.2573	0.2192	0.1749	0.1240	0.0659	6	
	2	0.1641	0.2140	0.2613	0.2985	0.3177	0.3115	0.2753	0.2097	0.1240	0.1061	0.0886	0.0716	0.0555	0.0406	0.0274	0.0162	0.0076	0.0020	5	
	3	0.2734	0.2918	0.2903	0.2679	0.2269	0.1730	0.1147	0.0617	0.0230	0.0175	0.0128	0.0090	0.0059	0.0036	0.0019	0.0008	0.0003	0.0000	4	
	4	0.2734	0.2388	0.1935	0.1442	0.0972	0.0577	0.0287	0.0109	0.0026	0.0017	0.0011	0.0007	0.0004	0.0002	0.0001	0.0000	—	—	3	
	5	0.1641	0.1172	0.0774	0.0466	0.0250	0.0115	0.0043	0.0012	0.0002	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	—	—	—	2	
	6	0.0547	0.0320	0.0172	0.0084	0.0036	0.0013	0.0004	0.0001	0.0000	0.0000	0.0000	—	—	—	—	—	—	—	1	
	7	0.0078	0.0037	0.0016	0.0006	0.0002	0.0001	0.0000	0.0000	—	—	—	—	—	—	—	—	—	—	0	7
8	0	0.0039	0.0084	0.0168	0.0319	0.0576	0.1001	0.1678	0.2725	0.4305	0.4703	0.5132	0.5596	0.6096	0.6634	0.7214	0.7837	0.8508	0.9227	8	
	1	0.0312	0.0548	0.0896	0.1373	0.1977	0.2670	0.3355	0.3847	0.3826	0.3721	0.3570	0.3370	0.3113	0.2793	0.2405	0.1939	0.1389	0.0746	7	
	2	0.1094	0.1569	0.2090	0.2587	0.2965	0.3115	0.2936	0.2376	0.1488	0.1288	0.1087	0.0888	0.0695	0.0515	0.0351	0.0210	0.0099	0.0026	6	
	3	0.2187	0.2568	0.2787	0.2786	0.2541	0.2076	0.1468	0.0839	0.0331	0.0255	0.0189	0.0134	0.0089	0.0054	0.0029	0.0013	0.0004	0.0001	5	
	4	0.2734	0.2627	0.2322	0.1875	0.1361	0.0865	0.0459	0.0185	0.0046	0.0031	0.0021	0.0013	0.0007	0.0004	0.0002	0.0001	0.0000	0.0000	4	
	5	0.2187	0.1719	0.1239	0.0808	0.0467	0.0231	0.0092	0.0026	0.0004	0.0002	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	—	—	3	
	6	0.1094	0.0703	0.0413	0.0217	0.0100	0.0038	0.0011	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	—	—	—	—	—	2	
	7	0.0312	0.0164	0.0079	0.0033	0.0012	0.0004	0.0001	0.0000	0.0000	0.0000	—	—	—	—	—	—	—	—	1	
	8	0.0039	0.0017	0.0007	0.0002	0.0001	0.0000	0.0000	—	—	—	—	—	—	—	—	—	—	—	0	8
9	0	0.0020	0.0046	0.0101	0.0207	0.0404	0.0751	0.1342	0.2316	0.3874	0.4279	0.4722	0.5204	0.5730	0.6302	0.6925	0.7602	0.8337	0.9135	9	
	1	0.0176	0.0339	0.0605	0.1004	0.1556	0.2253	0.3020	0.3679	0.3874	0.3809	0.3695	0.3525	0.3292	0.2985	0.2597	0.2116	0.1531	0.0830	8	
	2	0.0703	0.1110	0.1612	0.2162	0.2668	0.3003	0.3020	0.2597	0.1722	0.1507	0.1285	0.1061	0.0840	0.0629	0.0433	0.0262	0.0125	0.0034	7	
	3	0.1641	0.2119	0.2508	0.2716	0.2668	0.2336	0.1762	0.1069	0.0446	0.0348	0.0261	0.0186	0.0125	0.0077	0.0042	0.0019	0.0006	0.0001	6	
	4	0.2461	0.2600	0.2508	0.2194	0.1715	0.1168	0.0661	0.0283	0.0074	0.0052	0.0034	0.0021	0.0012	0.0006	0.0003	0.0001	0.0000	0.0000	5	
	5	0.2461	0.2128	0.1672	0.1181	0.0735	0.0390	0.0165	0.0050	0.0008	0.0005	0.0003	0.0002	0.0001	0.0000	0.0000	0.0000	—	—	4	
	6	0.1614	0.1160	0.0743	0.0424	0.0210	0.0087	0.0028	0.0006	0.0001	0.0000	0.0000	0.0000	0.0000	—	—	—	—	—	3	
	7	0.0703	0.0407	0.0212	0.0098	0.0039	0.0012	0.0003	0.0000	0.0000	0.0000	—	—	—	—	—	—	—	—	2	
	8	0.0176	0.0083	0.0035	0.0013	0.0004	0.0001	0.0000	0.0000	—	—	—	—	—	—	—	—	—	—	1	
	9	0.0020	0.0008	0.0003	0.0001	0.0000	0.0000	0.0000	—	—	—	—	—	—	—	—	—	—	—	0	9
10	0	0.0010	0.0025	0.0060	0.0135	0.0282	0.0563	0.1074	0.1969	0.3487	0.3894	0.4344	0.4840	0.5386	0.5987	0.6648	0.7374	0.8171	0.9044	10	
	1	0.0098	0.0207	0.0403	0.0725	0.1211	0.1877	0.2684	0.3474	0.3874	0.3851	0.3777	0.3643	0.3438	0.3151	0.2770	0.2281	0.1667	0.0914	9	
	2	0.0439	0.0763	0.1209	0.1757	0.2335	0.2816	0.3020	0.2759	0.1937	0.1714	0.1478	0.1234	0.0988	0.0746	0.0519	0.0317	0.0153	0.0042	8	
	3	0.1172	0.1665	0.2150	0.2522	0.2668	0.2503	0.2013	0.1298	0.0574	0.0452	0.0343	0.0248	0.0168	0.0105	0.0058	0.0026	0.0008	0.0001	7	
	4	0.2051	0.2384	0.2508	0.2377	0.2001	0.1460	0.0881	0.0401	0.0112	0.0078	0.0052	0.0033	0.0019	0.0010	0.0004	0.0001	0.0000	0.0000	6	
	5	0.2461	0.2340	0.2007	0.1536	0.1029	0.0584	0.0264	0.0085	0.0015	0.0009	0.0005	0.0003	0.0001	0.0001	0.0000	0.0000	—	—	5	
	6	0.2051	0.1596	0.1115	0.0689	0.0368	0.0162	0.0055	0.0012	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	—	—	—	—	4	
	7	0.1172	0.0746	0.0425	0.0212	0.0090	0.0031	0.0008	0.0001	0.0000	0.0000	0.0000	—	—	—	—	—	—	—	3	
	8	0.0439	0.0229	0.0106	0.0043	0.0014	0.0004	0.0001	0.0000	0.0000	—	—	—	—	—	—	—	—	—	2	
	9	0.0098	0.0042	0.0016	0.0005	0.0001	0.0000	0.0000	0.0000	—	—	—	—	—	—	—	—	—	—	1	
	10	0.0010	0.0003	0.0001	0.0000	0.0000	0.0000	0.0000	—	—	—	—	—	—	—	—	—	—	—	0	10
n	X	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

Table A.2: *Continued*
Binomial Probability Distribution

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	X	n
20	0	0.8179	0.6676	0.5438	0.4420	0.3585	0.2901	0.2342	0.1887	0.1516	0.1216	0.0388	0.0115	0.0032	0.0008	0.0002	0.0000	0.0000	—	20	
	1	0.1652	0.2725	0.3364	0.3683	0.3774	0.3703	0.3526	0.3282	0.3000	0.2702	0.1368	0.0576	0.0211	0.0068	0.0020	0.0005	0.0001	0.0000	19	
	2	0.0159	0.0528	0.0988	0.1458	0.1887	0.2246	0.2521	0.2711	0.2818	0.2852	0.2293	0.1369	0.0699	0.0278	0.0100	0.0031	0.0008	0.0002	18	
	3	0.0010	0.0065	0.0183	0.0364	0.0596	0.0860	0.1139	0.1414	0.1672	0.1901	0.2428	0.2054	0.1339	0.0716	0.0323	0.0123	0.0040	0.0011	17	
	4	0.0000	0.0006	0.0024	0.0065	0.0133	0.0233	0.0364	0.0523	0.0703	0.0898	0.1821	0.2182	0.1897	0.1304	0.0738	0.0350	0.0139	0.0046	16	
	5	—	0.0000	0.0002	0.0009	0.0022	0.0048	0.0088	0.0145	0.0222	0.0319	0.1028	0.1746	0.2023	0.1789	0.1272	0.0746	0.0365	0.0148	15	
	6	—	—	0.0000	0.0001	0.0003	0.0008	0.0017	0.0032	0.0055	0.0089	0.0454	0.1091	0.1686	0.1916	0.1712	0.1244	0.0746	0.0370	14	
	7	—	—	—	0.0000	0.0000	0.0001	0.0002	0.0005	0.0011	0.0020	0.0160	0.0545	0.1124	0.1643	0.1844	0.1659	0.1221	0.0739	13	
	8	—	—	—	—	0.0000	0.0000	0.0000	0.0001	0.0002	0.0004	0.0046	0.0222	0.0609	0.1144	0.1614	0.1797	0.1623	0.1201	12	
	9	—	—	—	—	—	—	—	0.0000	0.0000	0.0001	0.0011	0.0074	0.0271	0.0654	0.1158	0.1597	0.1771	0.1602	11	
	10	—	—	—	—	—	—	—	0.0000	—	0.0000	0.0002	0.0020	0.0099	0.0308	0.0686	0.1171	0.1593	0.1762	10	
	11	—	—	—	—	—	—	—	—	—	—	0.0000	0.0005	0.0030	0.0120	0.0336	0.0710	0.1185	0.1602	9	
	12	—	—	—	—	—	—	—	—	—	—	—	0.0001	0.0008	0.0039	0.0136	0.0355	0.0727	0.1201	8	
	13	—	—	—	—	—	—	—	—	—	—	—	0.0000	0.0002	0.0010	0.0045	0.0146	0.0366	0.0739	7	
	14	—	—	—	—	—	—	—	—	—	—	—	—	0.0000	0.0002	0.0012	0.0049	0.0150	0.0370	6	
	15	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0000	0.0003	0.0013	0.0049	0.0148	5	
	16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0000	0.0003	0.0013	0.0046	4	
	17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0000	0.0002	0.0011	3	
	18	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0000	0.0002	2	
	19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0000	1	
	20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0	20
n	X	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

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Table A.3:
Poisson Probabilities

					λ					
x	0.005	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0	0.9950	0.9900	0.9802	0.9704	0.9608	0.9512	0.9418	0.9324	0.9231	0.9139
1	0.0050	0.0099	0.0196	0.0291	0.0384	0.0476	0.0565	0.0653	0.0738	0.0823
2	0.0000	0.0000	0.0002	0.0004	0.0008	0.0012	0.0017	0.0023	0.0030	0.0037
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001

x	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	0.0988	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	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	0.1155	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	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	0.0498
1	0.2572	0.2438	0.2306	0.2177	0.2052	0.1931	0.1815	0.1703	0.1596	0.1496
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	0.8004	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

Continued

Table A.3: *Continued*
Poisson Probabilities

x	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	0.1304	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	0.1459
3	0.2237	0.2226	0.2209	0.2186	0.2158	0.2125	0.2987	0.2046	0.2001	0.1954
4	0.1733	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	0.1265	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	0.0225	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

| x	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0
0	0.0166	0.0150	0.0136	0.0123	0.0111	0.0101	0.0191	0.0082	0.0074	0.0067
1	0.0679	0.0630	0.0583	0.0540	0.0500	0.0462	0.0427	0.0395	0.0365	0.0337
2	0.1393	0.1323	0.1254	0.1188	0.1125	0.1063	0.1005	0.0948	0.0894	0.0842
3	0.1904	0.1852	0.1798	0.1743	0.1687	0.1631	0.1574	0.1517	0.1460	0.1404
4	0.1951	0.1944	0.1933	0.1917	0.1898	0.1875	0.1849	0.1820	0.1789	0.1755
5	0.1600	0.1633	0.1662	0.1687	0.1708	0.1725	0.1738	0.1747	0.1753	0.1755
6	0.1093	0.1143	0.1191	0.1237	0.1281	0.1323	0.1362	0.1398	0.1432	0.1462
7	0.0640	0.0686	0.0732	0.0778	0.0824	0.0869	0.0914	0.0959	0.1002	0.1044
8	0.0328	0.0360	0.0393	0.0428	0.0463	0.0500	0.0537	0.0575	0.0614	0.0653
9	0.0150	0.0168	0.0188	0.0209	0.0232	0.0255	0.0281	0.0307	0.0334	0.0363
10	0.0061	0.0071	0.0081	0.0092	0.0104	0.0118	0.0132	0.0147	0.0164	0.0181
11	0.0023	0.0027	0.0032	0.0037	0.0043	0.0049	0.0056	0.0064	0.0073	0.0082
12	0.0008	0.0009	0.0011	0.0013	0.0016	0.0019	0.0022	0.0026	0.0030	0.0034
13	0.0002	0.0003	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009	0.0011	0.0013
14	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0003	0.0003	0.0004	0.0005
15	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002

Table A.4:
Areas of the Standard Normal Distribution
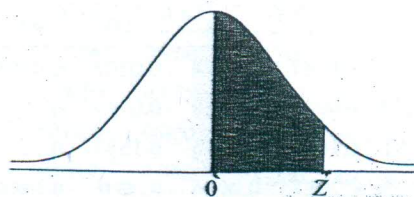
The entries in this table are the probabilities that a standard normal random variable is between 0 and Z (the shaded area).

Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998
3.5	0.4998									
4.0	0.49997									
4.5	0.499997									
5.0	0.4999997									
6.0	0.499999999									

Table A.5:
Critical Values from the t Distribution
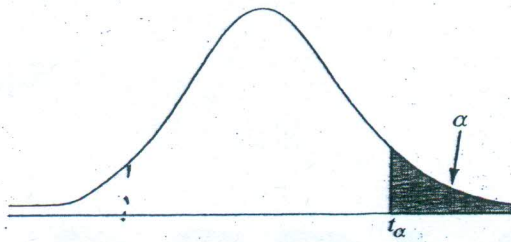
Values of α for one-tailed test and $\alpha/2$ for two-tailed test

df	$t_{0.100}$	$t_{0.050}$	$t_{0.025}$	$t_{0.010}$	$t_{0.005}$	$t_{0.001}$
1	3.078	6.314	12.706	31.821	63.656	318.289
2	1.886	2.920	4.303	6.965	9.925	22.328
3	1.638	2.353	3.182	4.541	5.841	10.214
4	1.533	2.132	2.776	3.747	4.604	7.173
5	1.476	2.015	2.571	3.365	4.032	5.894
6	1.440	1.943	2.447	3.143	3.707	5.208
7	1.415	1.895	2.365	2.998	3.499	4.785
8	1.397	1.860	2.306	2.896	3.355	4.501
9	1.383	1.833	2.262	2.821	3.250	4.297
10	1.372	1.812	2.228	2.764	3.169	4.144
11	1.363	1.796	2.201	2.718	3.106	4.025
12	1.356	1.782	2.179	2.681	3.055	3.930
13	1.350	1.771	2.160	2.650	3.012	3.852
14	1.345	1.761	2.145	2.624	2.977	3.787
15	1.341	1.753	2.131	2.602	2.947	3.733
16	1.337	1.746	2.120	2.583	2.921	3.686
17	1.333	1.740	2.110	2.567	2.898	3.646
18	1.330	1.734	2.101	2.552	2.878	3.610
19	1.328	1.729	2.093	2.539	2.861	3.579
20	1.325	1.725	2.086	2.528	2.845	3.552
21	1.323	1.721	2.080	2.518	2.831	3.527
22	1.321	1.717	2.074	2.508	2.819	3.505
23	1.319	1.714	2.069	2.500	2.807	3.485
24	1.318	1.711	2.064	2.492	2.797	3.467
25	1.316	1.708	2.060	2.485	2.787	3.450
26	1.315	1.706	2.056	2.479	2.779	3.435
27	1.314	1.703	2.052	2.473	2.771	3.421
28	1.313	1.701	2.048	2.467	2.763	3.408
29	1.311	1.699	2.045	2.462	2.756	3.396
30	1.310	1.697	2.042	2.457	2.750	3.385
40	1.303	1.684	2.021	2.423	2.704	3.307
50	1.299	1.676	2.009	2.403	2.678	3.261
60	1.296	1.671	2.000	2.390	2.660	3.232
70	1.294	1.667	1.994	2.381	2.648	3.211
80	1.292	1.664	1.990	2.374	2.639	3.195
90	1.291	1.662	1.987	2.368	2.632	3.183
100	1.290	1.660	1.984	2.364	2.626	3.174
150	1.287	1.655	1.976	2.351	2.609	3.145
200	1.286	1.653	1.972	2.345	2.601	3.131
∞	1.282	1.645	1.960	2.326	2.576	3.090

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