

KATHMANDU UNIVERSITY
End Semester Examination [C]
June, 2018

JUN 17 2018

Level : B. E./ B. Sc.
Year : II
Time : 2 hrs.30 mins.

Course : MATH 208
Semester : I
F.M. : 55

SECTION "C"

[3 Q. × 7 = 21 marks]

- The life time of a battery in a certain application is normally distributed with mean $\mu = 16$ hours and standard deviation $\sigma = 2$ hours. [2+3+2]
 - What is the probability that a battery will last more than 19 hours?
 - Find the 10 th percentile of the lifetimes.
 - What is the probability that the lifetime of a battery is between 14.5 and 17 hours?
- From the given data, a) find the regression line Y on X b) interpret this line of regression c) Test for the significance of regression of Y on X d) test $\rho=0$ [1+1+3+2]

Marks in Economics Y	25	28	35	32	31	36	29	38	34	32
Marks in Statistics X	43	46	49	41	36	32	31	30	33	39

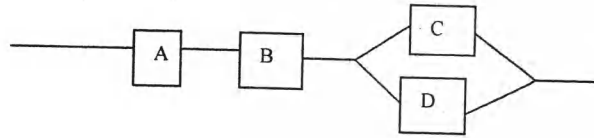
- Draw stem leaf plot and box plot for the following data. Does the box plot show any outliers? Interpret your result. [2+3+1+1]
14.1 14.4 14.7 14.8 15.3 15.6 16.1 16.6 17.3 14.2 14.4 14.7 14.9 15.3 15.7
16.2 17.2 17.3 14.3 14.4 14.8 15 15.4 15.7 16.4 17.2 17.8 14.3 14.4 14.8 15
15.4 15.9 16.4 17.2 21.9 14.3 14.6 14.8 15.2 15.5 15.9 16.5 17.2 22.4

SECTION "D"

[6Q. × 4 = 24 marks]

- In a sample of 100 steel wires the average breaking strength is 50kN, with a standard deviation of 2kN.
 - Find a 95% confidence interval for the mean breaking strength of this type of wire.
 - An engineer claims that the mean breaking strength is between 49.7 kN and 50.3kN. With what level of confidence can this statement be made? [2+2]
- A box contains 10 fuses. Eight of them are rated at 10 amperes (A) and other two are rated at 15A. Two fuses are selected at random.
 - What is the probability that the first fuse is rated at 15A?
 - What is the probability that the second fuse is rated 15A, given that the first fuse is rated at 10 A?
 - What is the probability that the second fuse is rated at 15A, given that the first fuse is rated at 15A? [2+1+1]

6. A system consists of four components, connected as shown in the diagram. Suppose that the components function independently, and that the probabilities of failure are 0.05 for A, 0.03 for B, 0.07 for C, and 0.14 for D. Find the probability that the system functions.



7. After manufacture, computer disks are tested for errors. Let X be the numbers of errors detected on the randomly chosen disk. The following table presents values of the cumulative distribution function $F(x)$ of X . [1+ 1+2]

x	$F(x)$
0	0.41
1	0.72
2	0.83
3	0.95
4	1.00

- What is the probability that two or fewer errors are detected?
 - What is the probability that more than three errors are detected?
 - What is the probability that exactly one error is detected?
8. The broth used to manufacture a pharmaceutical product has its sugar content, in mg/mL, measured several times on each of three successive days.
 Day 1: 5.0 4.8 5.1 5.1 4.8 5.1 4.8 4.8 5.0 5.2 4.9 4.9 5.0
 Day 2: 5.8 4.7 4.7 4.9 5.1 4.9 5.4 5.3 5.3 4.8 5.7 5.1 5.7
 Can you conclude that the variability of the process is greater on the second day than on the first day? What conclusion can be made about the average sugar content? [2+2]
9. Test whether the mean response differs between the two drugs and also construct the 95% confidence interval of the average difference between the mean response. [2+2]

	Subject						
	1	2	3	4	5	6	7
Drug A	6	3	4	5	7	1	4
Drug B	5	1	5	5	5	2	2

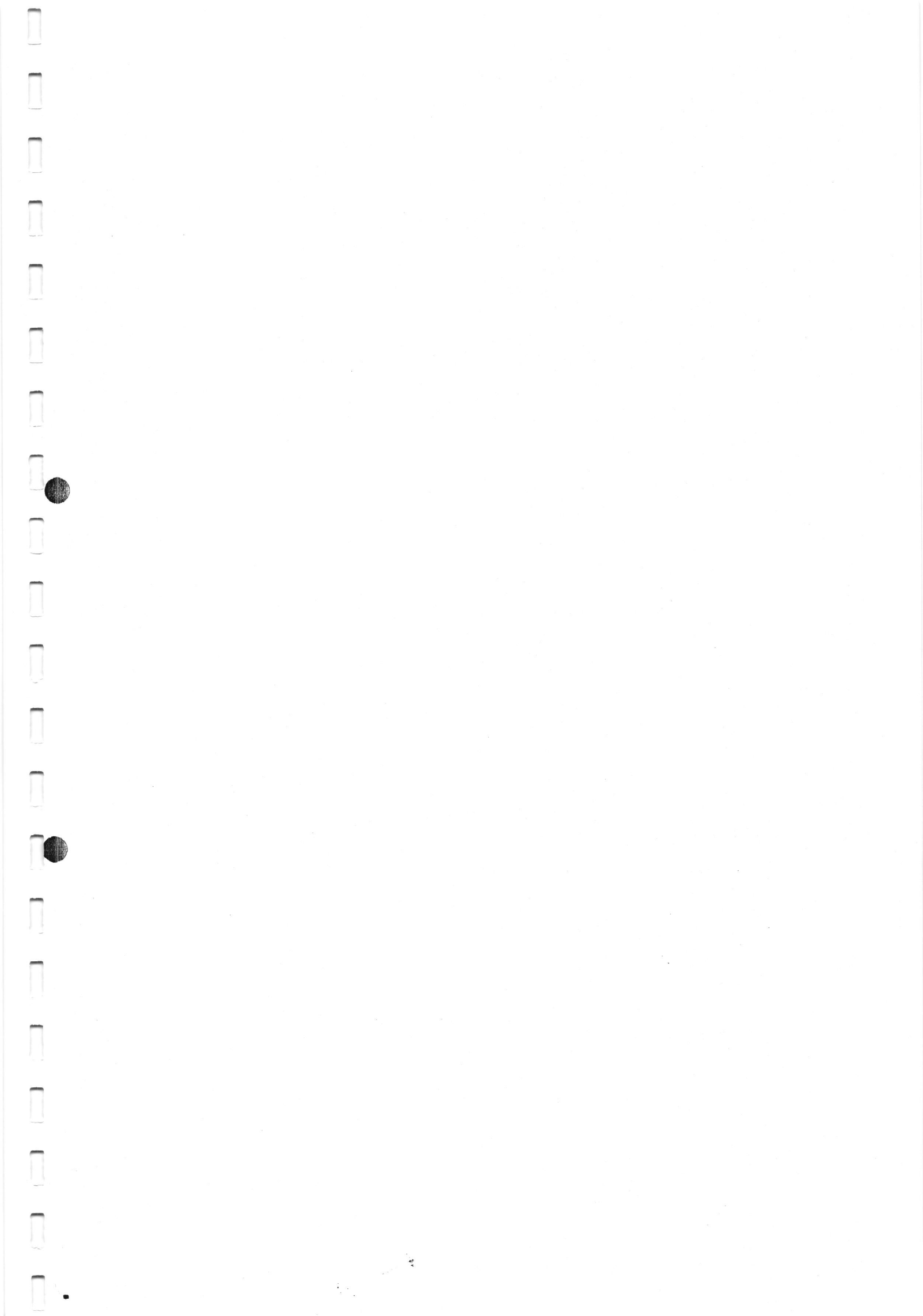
SECTION "E"
[5Q. \times 2 = 10 marks]

10. Each hour, a $10m^2$ section of a fabric is inspected for flaws. The number of flaws observed for the last 20 hours are as follows:
 38 35 35 49 33 48 40 47 45 46 41 53
 36 41 51 63 35 58 55 57
- Compute the upper and lower 3σ limits for c chart
 - Is the process in control? If not, when is it first detected to be out of control?

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11. Consider the density function $f(x) = \begin{cases} k\sqrt{x}, & 0 < x < 1 \\ 0, & \text{elsewhere} \end{cases}$
Evaluate k
12. For Q11, find F(x) and use it to evaluate $P[.3 < X < .6]$
13. The length of a rivet manufactured by a certain process has mean $\mu_X = 50$ mm and standard deviation $\sigma_X = 0.45$ mm. What is the largest possible value for the probability that the length of the rivet outside the interval 49.1 – 50.9 mm?
14. Printed circuit boards are inspected for defective soldering. Five hundred circuits per day are tested for a 30-day period. The number defective per day is shown in the table below. Construct a upper and lower 3 σ limits for P- chart and locate any special causes.

Day	1	2	3	4	5	6	7	8	9	10
# Defectives	2	0	2	5	2	4	5	1	2	3
Day	11	12	13	14	15	16	17	18	19	20
# Defectives	3	2	0	4	3	8	10	4	4	5
Day	21	22	23	24	25	26	27	28	29	30
# Defectives	2	4	3	2	3	3	2	1	1	2



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Table II - Cumulative Standard Normal Distribution

$$\Phi(z) = \int_{-\infty}^z \frac{1}{\sqrt{2\pi}} e^{-u^2/2} du$$

z	0.00	0.01	0.02	0.03	0.04
0.0	0.50000	0.50399	0.50798	0.51197	0.51595
0.1	0.53983	0.54379	0.54776	0.55172	0.55567
0.2	0.57926	0.58317	0.58706	0.59095	0.59483
0.3	0.61791	0.62172	0.62551	0.62930	0.63307
0.4	0.65542	0.65910	0.66276	0.66640	0.67003
0.5	0.69146	0.69497	0.69847	0.70194	0.70540
0.6	0.72575	0.72907	0.73237	0.73565	0.73891
0.7	0.75803	0.76115	0.76424	0.76730	0.77035
0.8	0.78814	0.79103	0.79389	0.79673	0.79954
0.9	0.81594	0.81859	0.82121	0.82381	0.82639
1.0	0.84134	0.84375	0.84613	0.84849	0.85083
1.1	0.86433	0.86650	0.86864	0.87076	0.87285
1.2	0.88493	0.88686	0.88877	0.89065	0.89251
1.3	0.90320	0.90490	0.90658	0.90824	0.90988
1.4	0.91924	0.92073	0.92219	0.92364	0.92506
1.5	0.93319	0.93448	0.93574	0.93699	0.93822
1.6	0.94520	0.94630	0.94738	0.94845	0.94950
1.7	0.95543	0.95637	0.95728	0.95818	0.95907
1.8	0.96407	0.96485	0.96562	0.96637	0.96711
1.9	0.97128	0.97193	0.97257	0.97320	0.97381
2.0	0.97725	0.97778	0.97831	0.97882	0.97932
2.1	0.98214	0.98257	0.98300	0.98341	0.98382
2.2	0.98610	0.98645	0.98679	0.98713	0.98745
2.3	0.98928	0.98956	0.98983	0.99010	0.99036
2.4	0.99180	0.99202	0.99224	0.99245	0.99266
2.5	0.99379	0.99396	0.99413	0.99430	0.99446
2.6	0.99534	0.99547	0.99560	0.99573	0.99585
2.7	0.99653	0.99664	0.99674	0.99683	0.99693
2.8	0.99744	0.99752	0.99760	0.99767	0.99774
2.9	0.99813	0.99819	0.99825	0.99831	0.99836
3.0	0.99865	0.99869	0.99874	0.99878	0.99882
3.1	0.99903	0.99906	0.99910	0.99913	0.99916
3.2	0.99931	0.99934	0.99936	0.99938	0.99940
3.3	0.99952	0.99953	0.99955	0.99957	0.99958
3.4	0.99966	0.99968	0.99969	0.99970	0.99971
3.5	0.99977	0.99978	0.99978	0.99979	0.99980
3.6	0.99984	0.99985	0.99985	0.99986	0.99986
3.7	0.99989	0.99990	0.99990	0.99990	0.99991
3.8	0.99993	0.99993	0.99993	0.99994	0.99994
3.9	0.99995	0.99995	0.99995	0.99996	0.99996

(continues)

Table II Cumulative Standard Normal Distribution (continued)

$$\Phi(z) = \int_{-\infty}^z \frac{1}{\sqrt{2\pi}} e^{-u^2/2} du$$

z	0.05	0.06	0.07	0.08	0.09	z
0.0	0.519 94	0.523 92	0.527 90	0.531 88	0.535 86	0.0
0.1	0.559 62	0.563 56	0.567 49	0.571 42	0.575 34	0.1
0.2	0.598 71	0.602 57	0.606 42	0.610 26	0.614 09	0.2
0.3	0.636 83	0.640 58	0.644 31	0.648 03	0.651 73	0.3
0.4	0.673 64	0.677 24	0.680 82	0.684 38	0.687 93	0.4
0.5	0.708 84	0.712 26	0.715 66	0.719 04	0.722 40	0.5
0.6	0.742 15	0.745 37	0.748 57	0.751 75	0.754 90	0.6
0.7	0.773 37	0.776 37	0.779 35	0.782 30	0.785 23	0.7
0.8	0.802 34	0.805 10	0.807 85	0.810 57	0.813 27	0.8
0.9	0.828 94	0.831 47	0.833 97	0.836 46	0.838 91	0.9
1.0	0.853 14	0.855 43	0.857 69	0.859 93	0.862 14	1.0
1.1	0.874 93	0.876 97	0.879 00	0.881 00	0.882 97	1.1
1.2	0.894 35	0.896 16	0.897 96	0.899 73	0.901 47	1.2
1.3	0.911 49	0.913 08	0.914 65	0.916 21	0.917 73	1.3
1.4	0.926 47	0.927 85	0.929 22	0.930 56	0.931 89	1.4
1.5	0.939 43	0.940 62	0.941 79	0.942 95	0.944 08	1.5
1.6	0.950 53	0.951 54	0.952 54	0.953 52	0.954 48	1.6
1.7	0.959 94	0.960 80	0.961 64	0.962 46	0.963 27	1.7
1.8	0.967 84	0.968 56	0.969 26	0.969 95	0.970 62	1.8
1.9	0.974 41	0.975 00	0.975 58	0.976 15	0.976 70	1.9
2.0	0.979 82	0.980 30	0.980 77	0.981 24	0.981 69	2.0
2.1	0.984 22	0.984 61	0.985 00	0.985 37	0.985 74	2.1
2.2	0.987 78	0.988 09	0.988 40	0.988 70	0.988 99	2.2
2.3	0.990 61	0.990 86	0.991 11	0.991 34	0.991 58	2.3
2.4	0.992 86	0.993 05	0.993 24	0.993 43	0.993 61	2.4
2.5	0.994 61	0.994 77	0.994 92	0.995 06	0.995 20	2.5
2.6	0.995 98	0.996 09	0.996 21	0.996 32	0.996 43	2.6
2.7	0.997 02	0.997 11	0.997 20	0.997 28	0.997 36	2.7
2.8	0.997 81	0.997 88	0.997 95	0.998 01	0.998 07	2.8
2.9	0.998 41	0.998 46	0.998 51	0.998 56	0.998 61	2.9
3.0	0.998 86	0.998 89	0.998 93	0.998 97	0.999 00	3.0
3.1	0.999 18	0.999 21	0.999 24	0.999 26	0.999 29	3.1
3.2	0.999 42	0.999 44	0.999 46	0.999 48	0.999 50	3.2
3.3	0.999 60	0.999 61	0.999 62	0.999 64	0.999 65	3.3
3.4	0.999 72	0.999 73	0.999 74	0.999 75	0.999 76	3.4
3.5	0.999 81	0.999 81	0.999 82	0.999 83	0.999 83	3.5
3.6	0.999 87	0.999 87	0.999 88	0.999 88	0.999 89	3.6
3.7	0.999 91	0.999 92	0.999 92	0.999 92	0.999 92	3.7
3.8	0.999 94	0.999 94	0.999 95	0.999 95	0.999 95	3.8
3.9	0.999 96	0.999 96	0.999 96	0.999 97	0.999 97	3.9

Table III Percentage Points of the χ^2 Distribution*

v	α	0.995	0.990	0.975	0.950	0.900	0.500	0.100	0.050	0.025	0.010	0.005
1		0.004	0.004	0.004	0.004	0.020	0.455	2.71	3.84	5.02	6.63	7.88
2		0.01	0.02	0.05	0.10	0.21	1.39	4.61	5.99	7.38	9.21	10.60
3		0.07	0.11	0.22	0.35	0.58	2.37	6.25	7.81	9.35	11.34	12.84
4		0.21	0.30	0.48	0.71	1.06	3.36	7.78	9.49	11.14	13.28	14.86
5		0.41	0.55	0.83	1.15	1.61	4.35	9.24	11.07	12.83	15.09	16.75
6		0.68	0.87	1.24	1.64	2.20	5.35	10.65	12.59	14.45	16.81	18.55
7		0.99	1.24	1.69	2.17	2.83	6.35	12.02	14.07	16.01	18.48	20.28
8		1.34	1.65	2.18	2.73	3.49	7.34	13.36	15.51	17.53	20.09	21.96
9		1.73	2.09	2.70	3.33	4.17	8.34	14.68	16.92	19.02	21.67	23.59
10		2.16	2.56	3.25	3.94	4.87	9.34	15.99	18.31	20.48	23.21	25.19
11		2.60	3.05	3.82	4.57	5.58	10.34	17.28	19.68	21.92	24.72	26.76
12		3.07	3.57	4.40	5.23	6.30	11.34	18.55	21.03	23.34	26.22	28.30
13		3.57	4.11	5.01	5.89	7.04	12.34	19.81	22.36	24.74	27.69	29.82
14		4.07	4.66	5.63	6.57	7.79	13.34	21.06	23.68	26.12	29.14	31.32
15		4.60	5.23	6.27	7.26	8.55	14.34	22.31	25.00	27.49	30.58	32.80
16		5.14	5.81	6.91	7.96	9.31	15.34	23.54	26.30	28.85	32.00	34.27
17		5.70	6.41	7.56	8.67	10.09	16.34	24.77	27.59	30.19	33.41	35.72
18		6.26	7.01	8.23	9.39	10.87	17.34	25.99	28.87	31.53	34.81	37.16
19		6.84	7.63	8.91	10.12	11.65	18.34	27.20	30.14	32.85	36.19	38.58
20		7.43	8.26	9.59	10.85	12.44	19.34	28.41	31.41	34.17	37.57	40.00
21		8.03	8.90	10.28	11.59	13.24	20.34	29.62	32.67	35.48	38.93	41.40
22		8.64	9.54	10.98	12.34	14.04	21.34	30.81	33.92	36.78	40.29	42.80
23		9.26	10.20	11.69	13.09	14.85	22.34	32.01	35.17	38.08	41.64	44.18
24		9.89	10.86	12.40	13.85	15.66	23.34	33.20	36.42	39.36	42.98	45.56
25		10.52	11.52	13.12	14.61	16.47	24.34	34.28	37.65	40.65	44.31	46.93
26		11.16	12.20	13.84	15.38	17.29	25.34	35.56	38.89	41.92	45.64	48.29
27		11.81	12.88	14.57	16.15	18.11	26.34	36.74	40.11	43.19	46.96	49.65
28		12.46	13.57	15.31	16.93	18.94	27.34	37.92	41.34	44.46	48.28	50.99
29		13.12	14.26	16.05	17.71	19.77	28.34	39.09	42.56	45.72	49.59	52.34
30		13.79	14.95	16.79	18.49	20.60	29.34	40.26	43.77	46.98	50.89	53.67
40		20.71	22.16	24.43	26.51	29.05	39.34	51.81	55.76	59.34	63.69	66.77
50		27.99	29.71	32.36	34.76	37.69	49.33	63.17	67.50	71.42	76.15	79.49
60		35.53	37.48	40.48	43.19	46.46	59.33	74.40	79.08	83.30	88.38	91.95
70		43.28	45.44	48.76	51.74	55.33	69.33	85.53	90.53	95.02	100.42	104.22
80		51.17	53.54	57.15	60.39	64.28	79.33	96.58	101.88	106.63	112.33	116.32
90		59.20	61.75	65.65	69.13	73.29	89.33	107.57	113.14	118.14	124.12	128.30
100		67.33	70.06	74.22	77.93	82.36	99.33	118.50	124.34	129.56	135.81	140.17

*v = degrees of freedom.

Table IV Percentage Points of the t Distribution

v	α	0.40	0.25	0.10	0.05	0.025	0.01	0.005	0.0025	0.001	0.0005
1	0.325	1.000	3.078	6.314	12.706	31.821	63.657	127.32	318.31	636.62	
2	0.289	0.816	1.886	2.920	4.303	6.965	9.925	14.089	23.326	31.598	
3	0.277	0.765	1.638	2.353	3.182	4.541	5.841	7.453	10.213	12.924	
4	0.271	0.741	1.533	2.132	2.776	3.747	4.604	5.598	7.173	8.610	
5	0.267	0.727	1.476	2.015	2.571	3.365	4.032	4.773	5.893	6.869	
6	0.265	0.718	1.440	1.943	2.447	3.143	3.707	4.317	5.208	5.959	
7	0.263	0.711	1.415	1.895	2.365	2.998	3.499	4.029	4.785		
8	0.262	0.706	1.397	1.860	2.306	2.896	3.355	3.833	4.501	5.041	
9	0.261	0.703	1.383	1.833	2.262	2.821	3.250	3.690	4.297	4.781	
10	0.260	0.700	1.372	1.812	2.228	2.764	3.169	3.581	4.144	4.587	
11	0.260	0.697	1.363	1.796	2.201	2.718	3.106	3.497	4.025	4.437	
12	0.259	0.695	1.356	1.782	2.179	2.681	3.055	3.428	3.930	4.318	
13	0.259	0.694	1.350	1.771	2.160	2.650	3.012	3.372	3.852	4.221	
14	0.258	0.692	1.345	1.761	2.145	2.624	2.977	3.326	3.787	4.140	
15	0.258	0.691	1.341	1.753	2.131	2.602	2.947	3.286	3.733	4.073	
16	0.258	0.690	1.337	1.746	2.120	2.583	2.921	3.252	3.686	4.015	
17	0.257	0.689	1.333	1.740	2.110	2.567	2.898	3.222	3.646	3.965	
18	0.257	0.688	1.330	1.734	2.101	2.552	2.878	3.197	3.610	3.922	
19	0.257	0.688	1.328	1.729	2.093	2.539	2.861	3.174	3.579	3.883	
20	0.257	0.687	1.325	1.725	2.086	2.528	2.845	3.153	3.552	3.850	
21	0.257	0.686	1.323	1.721	2.080	2.518	2.831	3.135	3.527	3.819	
22	0.256	0.686	1.321	1.717	2.074	2.508	2.819	3.119	3.505	3.792	
23	0.256	0.685	1.319	1.714	2.069	2.500	2.807	3.104	3.485	3.767	
24	0.256	0.685	1.318	1.711	2.064	2.492	2.797	3.091	3.467	3.745	
25	0.256	0.684	1.316	1.708	2.060	2.485	2.787	3.078	3.450	3.725	
26	0.256	0.684	1.315	1.706	2.056	2.479	2.779	3.067	3.435	3.7	
27	0.256	0.684	1.314	1.703	2.052	2.473	2.771	3.057	3.421	3.690	
28	0.256	0.683	1.313	1.701	2.048	2.467	2.763	3.047	3.408	3.674	
29	0.256	0.683	1.311	1.699	2.045	2.462	2.756	3.038	3.396	3.659	
30	0.256	0.683	1.310	1.697	2.042	2.457	2.750	3.030	3.385	3.646	
40	0.255	0.681	1.303	1.684	2.021	2.423	2.704	2.971	3.307	3.551	
60	0.254	0.679	1.296	1.671	2.000	2.390	2.660	2.915	3.232	3.460	
120	0.254	0.677	1.289	1.658	1.980	2.358	2.617	2.860	3.160	3.373	
∞	0.253	0.674	1.282	1.645	1.960	2.326	2.576	2.807	3.090	3.291	

Source: This table is adapted from *Biometrika Tables for Statisticians*, Vol. 1, 3rd edition, 1966, by permission of the Biometrika Trustees.

Table V Percentage Points of the F-Distribution

v ₁	Degrees of freedom for the numerator (v ₂)																		
	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1	5.83	7.50	8.20	8.58	8.82	8.98	9.10	9.19	9.26	9.32	9.41	9.49	9.58	9.63	9.67	9.71	9.76	9.80	9.85
2	2.57	3.00	3.15	3.23	3.28	3.31	3.34	3.35	3.37	3.38	3.39	3.41	3.43	3.43	3.44	3.45	3.46	3.47	3.48
3	2.02	2.28	2.36	2.39	2.41	2.42	2.43	2.44	2.44	2.44	2.45	2.46	2.46	2.46	2.47	2.47	2.47	2.47	2.47
4	1.81	2.00	2.05	2.06	2.07	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08
5	1.69	1.85	1.88	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.88	1.88	1.88	1.87	1.87	1.87
6	1.62	1.76	1.78	1.79	1.79	1.78	1.78	1.78	1.77	1.77	1.77	1.76	1.76	1.75	1.75	1.75	1.74	1.74	1.74
7	1.57	1.70	1.72	1.72	1.71	1.71	1.70	1.70	1.70	1.69	1.68	1.68	1.67	1.67	1.66	1.66	1.65	1.65	1.65
8	1.54	1.66	1.67	1.66	1.66	1.65	1.64	1.64	1.63	1.63	1.62	1.62	1.61	1.61	1.60	1.60	1.59	1.58	1.58
9	1.51	1.62	1.63	1.63	1.62	1.61	1.60	1.60	1.59	1.59	1.58	1.57	1.56	1.56	1.55	1.54	1.54	1.53	1.53
10	1.49	1.60	1.60	1.59	1.59	1.58	1.57	1.56	1.56	1.55	1.54	1.53	1.52	1.52	1.51	1.51	1.50	1.49	1.48
11	1.47	1.58	1.58	1.57	1.56	1.55	1.54	1.53	1.53	1.52	1.51	1.50	1.49	1.49	1.48	1.47	1.46	1.46	1.45
12	1.46	1.56	1.56	1.55	1.54	1.53	1.52	1.51	1.51	1.50	1.49	1.48	1.47	1.47	1.46	1.45	1.44	1.44	1.43
13	1.45	1.55	1.55	1.53	1.53	1.52	1.51	1.50	1.49	1.48	1.47	1.46	1.45	1.45	1.44	1.43	1.42	1.42	1.41
14	1.44	1.53	1.53	1.52	1.51	1.51	1.50	1.49	1.48	1.47	1.46	1.45	1.44	1.44	1.43	1.42	1.41	1.41	1.40
15	1.43	1.52	1.52	1.51	1.51	1.50	1.49	1.48	1.47	1.46	1.45	1.44	1.43	1.43	1.42	1.41	1.40	1.40	1.39
16	1.42	1.51	1.51	1.50	1.49	1.48	1.47	1.46	1.45	1.44	1.43	1.42	1.41	1.41	1.40	1.39	1.38	1.38	1.37
17	1.42	1.51	1.50	1.49	1.48	1.47	1.46	1.45	1.44	1.43	1.42	1.41	1.40	1.40	1.39	1.38	1.37	1.37	1.36
18	1.41	1.50	1.49	1.48	1.47	1.46	1.45	1.44	1.43	1.42	1.41	1.40	1.39	1.39	1.38	1.37	1.36	1.35	1.34
19	1.41	1.49	1.48	1.47	1.46	1.45	1.44	1.43	1.42	1.41	1.40	1.39	1.38	1.38	1.37	1.36	1.35	1.34	1.33
20	1.40	1.48	1.48	1.47	1.46	1.45	1.44	1.43	1.42	1.41	1.40	1.39	1.38	1.38	1.37	1.36	1.35	1.34	1.33
21	1.40	1.48	1.48	1.47	1.46	1.45	1.44	1.43	1.42	1.41	1.40	1.39	1.38	1.38	1.37	1.36	1.35	1.34	1.33
22	1.40	1.48	1.47	1.46	1.45	1.44	1.43	1.42	1.41	1.40	1.39	1.38	1.37	1.37	1.36	1.35	1.34	1.33	1.32
23	1.39	1.47	1.47	1.46	1.45	1.44	1.43	1.42	1.41	1.40	1.39	1.38	1.37	1.37	1.36	1.35	1.34	1.33	1.32
24	1.39	1.47	1.46	1.45	1.44	1.43	1.42	1.41	1.40	1.39	1.38	1.37	1.36	1.36	1.35	1.34	1.33	1.32	1.31
25	1.39	1.47	1.46	1.45	1.44	1.43	1.42	1.41	1.40	1.39	1.38	1.37	1.36	1.36	1.35	1.34	1.33	1.32	1.31
26	1.38	1.46	1.45	1.44	1.43	1.42	1.41	1.40	1.39	1.38	1.37	1.36	1.35	1.35	1.34	1.33	1.32	1.31	1.30
27	1.38	1.46	1.45	1.44	1.43	1.42	1.41	1.40	1.39	1.38	1.37	1.36	1.35	1.35	1.34	1.33	1.32	1.31	1.30
28	1.38	1.45	1.44	1.43	1.42	1.41	1.40	1.39	1.38	1.37	1.36	1.35	1.34	1.34	1.33	1.32	1.31	1.30	1.29
29	1.38	1.45	1.44	1.43	1.42	1.41	1.40	1.39	1.38	1.37	1.36	1.35	1.34	1.34	1.33	1.32	1.31	1.30	1.29
30	1.38	1.45	1.44	1.43	1.42	1.41	1.40	1.39	1.38	1.37	1.36	1.35	1.34	1.34	1.33	1.32	1.31	1.30	1.29
40	1.36	1.44	1.42	1.41	1.40	1.39	1.38	1.37	1.36	1.35	1.34	1.33	1.32	1.32	1.31	1.30	1.29	1.28	1.27
60	1.35	1.42	1.41	1.40	1.39	1.38	1.37	1.36	1.35	1.34	1.33	1.32	1.31	1.31	1.30	1.29	1.28	1.27	1.26
120	1.34	1.40	1.39	1.38	1.37	1.36	1.35	1.34	1.33	1.32	1.31	1.30	1.29	1.29	1.28	1.27	1.26	1.25	1.24
∞	1.32	1.39	1.37	1.35	1.33	1.31	1.29	1.28	1.27	1.25	1.24	1.22	1.22	1.21	1.19	1.18	1.16	1.13	1.10

Source: Adapted with permission from *Biometrika Tables for Statisticians*, Vol. 1, 3rd edition, by E. S. Pearson and H. O. Hartley, Cambridge University Press, Cambridge, 1966.

(continued)

Table XIII Factors for Quality-Control Charts

n ^a	\bar{X} Chart		R Chart		
	Factors for Control Limits		Factors for Central Line	Factors for Control Limits	
	A ₁	A ₂	d ₂	D ₃	D ₄
2	3.760	1.880	1.128		
3	2.394	1.023	1.693	0	3.267
4	1.880	0.729	2.059	0	2.575
5	1.596	0.577	2.326	0	2.282
6	1.410	0.483	2.534	0	2.115
7	1.277	0.419	2.704	0	2.004
8	1.175	0.373	2.847	0.076	1.924
9	1.094	0.337	2.970	0.136	1.864
10	1.028	0.308	3.078	0.184	1.816
11	0.973	0.285	3.173	0.223	1.777
12	0.925	0.266	3.258	0.256	1.744
13	0.884	0.249	3.336	0.284	1.716
14	0.848	0.235	3.407	0.308	1.692
15	0.816	0.223	3.472	0.329	1.671
16	0.788	0.212	3.532	0.348	1.652
17	0.762	0.203	3.588	0.364	1.636
18	0.738	0.194	3.640	0.379	1.621
19	0.717	0.187	3.689	0.392	1.608
20	0.697	0.180	3.735	0.404	1.596
21	0.679	0.173	3.778	0.414	1.586
22	0.662	0.167	3.819	0.425	1.575
23	0.647	0.162	3.858	0.434	1.566
24	0.632	0.157	3.895	0.443	1.557
25	0.619	0.153	3.931	0.452	1.548
				0.459	1.541

^an > 25; A₁ = 3/√n . n = number of observations in sample.

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Table V Percentage Points of the F Distribution (continued)

		$F_{0.05, v_1, v_2}$																		
		Degrees of freedom for the numerator (v_1)																		
$v_2 \backslash v_1$		1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1		161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5	241.9	243.9	245.9	248.0	249.1	250.1	251.1	252.2	253.3	254.3
2		18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40	19.41	19.43	19.45	19.45	19.46	19.47	19.48	19.49	19.50
3		10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.74	8.70	8.66	8.64	8.62	8.59	8.57	8.55	8.53
4		7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.69	5.66	5.63
5		6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.62	4.56	4.53	4.50	4.46	4.43	4.40	4.36
6		5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.94	3.87	3.84	3.81	3.77	3.74	3.70	3.67
7		5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.57	3.51	3.44	3.41	3.38	3.34	3.30	3.27	3.23
8		5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28	3.22	3.15	3.12	3.08	3.04	3.01	2.97	2.93
9		5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07	3.01	2.94	2.90	2.86	2.83	2.79	2.75	2.71
10		4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91	2.85	2.77	2.74	2.70	2.66	2.62	2.58	2.54
11		4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.79	2.72	2.65	2.61	2.57	2.53	2.49	2.45	2.40
12		4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69	2.62	2.54	2.51	2.47	2.43	2.38	2.34	2.30
13		4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.60	2.53	2.46	2.42	2.38	2.34	2.30	2.25	2.21
14		4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53	2.46	2.39	2.35	2.31	2.27	2.22	2.18	2.13
15		4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48	2.40	2.33	2.29	2.25	2.20	2.16	2.11	2.07
16		4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42	2.35	2.28	2.24	2.19	2.15	2.11	2.06	2.01
17		4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.38	2.31	2.23	2.19	2.15	2.10	2.06	2.01	1.96
18		4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34	2.27	2.19	2.15	2.11	2.06	2.02	1.97	1.92
19		4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.31	2.23	2.16	2.11	2.07	2.03	1.98	1.93	1.88
20		4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28	2.20	2.12	2.08	2.04	1.99	1.95	1.90	1.84
21		4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.92	1.87	1.81
22		4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.23	2.15	2.07	2.03	1.98	1.94	1.89	1.84	1.78
23		4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27	2.20	2.13	2.05	2.01	1.96	1.91	1.86	1.81	1.76
24		4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.18	2.11	2.03	1.98	1.94	1.89	1.84	1.79	1.73
25		4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.82	1.77	1.71
26		4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	2.22	2.15	2.07	1.99	1.95	1.90	1.85	1.80	1.75	1.69
27		4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25	2.20	2.13	2.06	1.97	1.93	1.88	1.84	1.79	1.73	1.67
28		4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24	2.19	2.12	2.04	1.96	1.91	1.87	1.82	1.77	1.71	1.65
29		4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22	2.18	2.10	2.03	1.94	1.90	1.85	1.81	1.75	1.70	1.64
30		4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.09	2.01	1.93	1.89	1.84	1.79	1.74	1.68	1.62
40		4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08	2.00	1.92	1.84	1.79	1.74	1.69	1.64	1.58	1.51
60		4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99	1.92	1.84	1.75	1.70	1.65	1.59	1.53	1.47	1.39
120		3.92	3.07	2.68	2.45	2.29	2.17	2.09	2.02	1.96	1.91	1.83	1.75	1.66	1.61	1.55	1.50	1.43	1.35	1.25
∞		3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88	1.83	1.75	1.67	1.57	1.52	1.46	1.39	1.32	1.22	1.00

(continues)

Table V Percentage Points of the F Distribution (continued)

v_2	v_1	$F_{0.10, v_1, v_2}$																		
		Degrees of freedom for the numerator (v_1)																		
		1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1	1	39.86	49.50	53.59	55.83	57.24	58.20	58.91	59.44	59.86	60.19	60.71	61.22	61.74	62.00	62.26	62.53	62.79	63.06	63.33
2	1	8.53	9.00	9.16	9.24	9.29	9.33	9.35	9.37	9.38	9.39	9.41	9.42	9.44	9.45	9.46	9.47	9.47	9.48	9.49
3	1	5.54	5.46	5.39	5.34	5.31	5.28	5.27	5.25	5.24	5.23	5.22	5.20	5.18	5.18	5.17	5.16	5.15	5.14	5.13
4	1	4.54	4.32	4.19	4.11	4.05	4.01	3.98	3.95	3.94	3.92	3.90	3.87	3.84	3.83	3.82	3.80	3.79	3.78	3.76
5	1	4.06	3.78	3.62	3.52	3.45	3.40	3.37	3.34	3.32	3.30	3.27	3.24	3.21	3.19	3.17	3.16	3.14	3.12	3.10
6	1	3.78	3.46	3.29	3.18	3.11	3.05	3.01	2.98	2.96	2.94	2.90	2.87	2.84	2.82	2.80	2.78	2.76	2.74	2.72
7	1	3.59	3.26	3.07	2.96	2.88	2.83	2.78	2.75	2.72	2.70	2.67	2.63	2.59	2.58	2.56	2.54	2.51	2.49	2.47
8	1	3.46	3.11	2.92	2.81	2.73	2.67	2.62	2.59	2.56	2.54	2.50	2.46	2.42	2.40	2.38	2.36	2.34	2.32	2.29
9	1	3.36	3.01	2.81	2.69	2.61	2.55	2.51	2.47	2.44	2.42	2.38	2.34	2.30	2.28	2.25	2.23	2.21	2.18	2.16
10	1	3.29	2.92	2.73	2.61	2.52	2.46	2.41	2.38	2.35	2.32	2.28	2.24	2.20	2.18	2.15	2.13	2.11	2.08	2.06
11	1	3.23	2.86	2.66	2.54	2.45	2.39	2.34	2.30	2.27	2.25	2.21	2.17	2.12	2.10	2.08	2.05	2.03	2.00	1.97
12	1	3.18	2.81	2.61	2.48	2.39	2.33	2.28	2.24	2.21	2.19	2.15	2.10	2.06	2.04	2.01	1.99	1.96	1.93	1.90
13	1	3.14	2.76	2.56	2.43	2.35	2.28	2.23	2.20	2.16	2.14	2.10	2.05	2.01	1.98	1.96	1.93	1.90	1.88	1.85
14	1	3.10	2.73	2.52	2.39	2.31	2.24	2.19	2.15	2.12	2.10	2.05	2.01	1.96	1.94	1.91	1.89	1.86	1.83	1.80
15	1	3.07	2.70	2.49	2.36	2.27	2.21	2.16	2.12	2.09	2.06	2.02	1.97	1.92	1.90	1.87	1.85	1.82	1.79	1.76
16	1	3.05	2.67	2.46	2.33	2.24	2.18	2.13	2.09	2.06	2.03	1.99	1.94	1.89	1.87	1.84	1.81	1.78	1.75	1.72
17	1	3.03	2.64	2.44	2.31	2.22	2.15	2.10	2.06	2.03	2.00	1.96	1.91	1.86	1.84	1.81	1.78	1.75	1.72	1.69
18	1	3.01	2.62	2.42	2.29	2.20	2.13	2.08	2.04	2.00	1.98	1.93	1.89	1.84	1.81	1.78	1.75	1.72	1.69	1.66
19	1	2.99	2.61	2.40	2.27	2.18	2.11	2.06	2.02	1.98	1.96	1.91	1.86	1.81	1.79	1.76	1.73	1.70	1.67	1.63
20	1	2.97	2.59	2.38	2.25	2.16	2.09	2.04	2.00	1.96	1.94	1.89	1.84	1.79	1.77	1.74	1.71	1.68	1.64	1.61
21	1	2.96	2.57	2.36	2.23	2.14	2.08	2.02	1.98	1.95	1.92	1.87	1.83	1.78	1.75	1.72	1.69	1.66	1.62	1.59
22	1	2.95	2.56	2.35	2.22	2.13	2.06	2.01	1.97	1.93	1.90	1.86	1.81	1.76	1.73	1.70	1.67	1.64	1.60	1.57
23	1	2.94	2.55	2.34	2.21	2.11	2.05	1.99	1.95	1.92	1.89	1.84	1.80	1.74	1.72	1.69	1.66	1.62	1.59	1.55
24	1	2.93	2.54	2.33	2.19	2.10	2.04	1.98	1.94	1.91	1.88	1.83	1.78	1.73	1.70	1.67	1.64	1.61	1.57	1.53
25	1	2.92	2.53	2.32	2.18	2.09	2.02	1.97	1.93	1.90	1.87	1.82	1.77	1.72	1.69	1.66	1.63	1.59	1.56	1.52
26	1	2.91	2.52	2.31	2.17	2.08	2.01	1.96	1.92	1.88	1.85	1.80	1.75	1.70	1.67	1.64	1.61	1.58	1.54	1.50
27	1	2.90	2.51	2.30	2.17	2.07	2.00	1.95	1.91	1.87	1.84	1.79	1.74	1.69	1.66	1.63	1.60	1.57	1.53	1.49
28	1	2.89	2.50	2.29	2.16	2.06	2.00	1.94	1.90	1.87	1.84	1.79	1.74	1.69	1.66	1.63	1.60	1.57	1.53	1.48
29	1	2.89	2.50	2.28	2.15	2.06	1.99	1.93	1.89	1.86	1.83	1.78	1.73	1.68	1.65	1.62	1.59	1.55	1.51	1.47
30	1	2.88	2.49	2.28	2.14	2.03	1.98	1.93	1.89	1.86	1.83	1.78	1.73	1.68	1.65	1.62	1.58	1.55	1.51	1.47
40	1	2.84	2.44	2.23	2.09	2.00	1.93	1.87	1.83	1.80	1.77	1.72	1.67	1.64	1.61	1.57	1.54	1.50	1.46	1.42
60	1	2.79	2.39	2.18	2.04	1.95	1.87	1.82	1.77	1.74	1.71	1.66	1.61	1.57	1.54	1.51	1.47	1.42	1.38	1.34
120	1	2.75	2.35	2.13	1.99	1.90	1.82	1.77	1.72	1.68	1.65	1.60	1.55	1.48	1.45	1.41	1.37	1.32	1.26	1.19
∞	1	2.71	2.30	2.08	1.94	1.85	1.77	1.72	1.67	1.63	1.60	1.55	1.49	1.42	1.38	1.34	1.30	1.24	1.17	1.00

Table V Percentage Points of the *F* Distribution (continued)

		$F_{0.01, v_1, v_2}$																		
		Degrees of freedom for the numerator (v_1)																		
$v_2 \backslash v_1$		1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
	1	4052	4999.5	5403	5625	5764	5859	5928	5982	6022	6056	6106	6157	6209	6235	6261	6287	6313	6339	6366
	2	98.50	99.00	99.17	99.25	99.30	99.33	99.36	99.37	99.39	99.40	99.42	99.43	99.45	99.46	99.47	99.47	99.48	99.49	99.50
	3	34.12	30.82	29.46	28.71	28.24	27.91	27.67	27.49	27.35	27.23	27.05	26.87	26.69	26.00	26.50	26.41	26.32	26.22	26.13
	4	21.20	18.00	16.69	15.98	15.52	15.21	14.98	14.80	14.66	14.55	14.37	14.20	14.02	13.93	13.84	13.75	13.65	13.56	13.46
	5	16.26	13.27	12.06	11.39	10.97	10.67	10.46	10.29	10.16	10.05	9.89	9.72	9.55	9.47	9.38	9.29	9.20	9.11	9.02
	6	13.75	10.92	9.78	9.15	8.75	8.47	8.26	8.10	7.98	7.87	7.72	7.56	7.40	7.31	7.23	7.14	7.06	6.97	6.88
	7	12.25	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.72	6.62	6.47	6.31	6.16	6.07	5.99	5.91	5.82	5.74	5.65
	8	11.26	8.65	7.59	7.01	6.63	6.37	6.18	6.03	5.91	5.81	5.67	5.52	5.36	5.28	5.20	5.12	5.03	4.95	4.86
	9	10.56	8.02	6.99	6.42	6.06	5.80	5.61	5.47	5.35	5.26	5.11	4.96	4.81	4.73	4.65	4.57	4.48	4.40	4.31
	10	10.04	7.56	6.55	5.99	5.64	5.39	5.20	5.06	4.94	4.85	4.71	4.56	4.41	4.33	4.25	4.17	4.08	4.00	3.91
	11	9.65	7.21	6.22	5.67	5.32	5.07	4.89	4.74	4.63	4.54	4.40	4.25	4.10	4.02	3.94	3.86	3.78	3.69	3.60
	12	9.33	6.93	5.95	5.41	5.06	4.82	4.64	4.50	4.39	4.30	4.16	4.01	3.86	3.78	3.70	3.62	3.54	3.45	3.36
	13	9.07	6.70	5.74	5.21	4.86	4.62	4.44	4.30	4.19	4.10	3.96	3.82	3.66	3.59	3.51	3.43	3.34	3.25	3.17
	14	8.86	6.51	5.56	5.04	4.69	4.46	4.28	4.14	4.03	3.94	3.80	3.66	3.51	3.43	3.35	3.27	3.18	3.09	3.00
	15	8.68	6.36	5.42	4.89	4.56	4.32	4.14	4.00	3.89	3.80	3.67	3.52	3.37	3.29	3.21	3.13	3.05	2.96	2.87
	16	8.53	6.23	5.29	4.77	4.44	4.20	4.03	3.89	3.78	3.69	3.55	3.41	3.26	3.18	3.10	3.02	2.93	2.84	2.75
	17	8.40	6.11	5.18	4.67	4.34	4.10	3.93	3.79	3.68	3.59	3.46	3.31	3.16	3.08	3.00	2.92	2.83	2.75	2.65
	18	8.29	6.01	5.09	4.58	4.25	4.01	3.84	3.71	3.60	3.51	3.37	3.23	3.08	3.00	2.92	2.84	2.75	2.66	2.57
	19	8.18	5.93	5.01	4.50	4.17	3.94	3.77	3.63	3.52	3.43	3.30	3.15	3.00	2.92	2.84	2.76	2.67	2.58	2.50
	20	8.10	5.85	4.94	4.43	4.10	3.87	3.70	3.56	3.46	3.37	3.23	3.09	2.94	2.86	2.78	2.69	2.61	2.52	2.42
	21	8.02	5.78	4.87	4.37	4.04	3.81	3.64	3.51	3.40	3.31	3.17	3.03	2.88	2.80	2.72	2.64	2.55	2.46	2.36
	22	7.95	5.72	4.82	4.31	3.99	3.76	3.59	3.45	3.35	3.26	3.12	2.98	2.83	2.75	2.67	2.58	2.50	2.40	2.31
	23	7.88	5.66	4.76	4.26	3.94	3.71	3.54	3.41	3.30	3.21	3.07	2.93	2.78	2.70	2.62	2.54	2.45	2.35	2.26
	24	7.82	5.61	4.72	4.22	3.90	3.67	3.50	3.36	3.26	3.17	3.03	2.89	2.74	2.66	2.58	2.49	2.40	2.31	2.21
	25	7.77	5.57	4.68	4.18	3.85	3.63	3.46	3.32	3.22	3.13	2.99	2.85	2.70	2.62	2.54	2.45	2.36	2.27	2.17
	26	7.72	5.53	4.64	4.14	3.82	3.59	3.42	3.29	3.18	3.09	2.96	2.81	2.66	2.58	2.50	2.42	2.33	2.23	2.13
	27	7.68	5.49	4.60	4.11	3.78	3.56	3.39	3.26	3.15	3.06	2.93	2.78	2.63	2.55	2.47	2.38	2.29	2.20	2.10
	28	7.64	5.45	4.57	4.07	3.75	3.53	3.36	3.23	3.12	3.03	2.90	2.75	2.60	2.52	2.44	2.35	2.26	2.17	2.06
	29	7.60	5.42	4.54	4.04	3.73	3.50	3.33	3.20	3.09	3.00	2.87	2.73	2.57	2.49	2.41	2.33	2.23	2.14	2.03
	30	7.56	5.39	4.51	4.02	3.70	3.47	3.30	3.17	3.07	2.98	2.84	2.70	2.55	2.47	2.39	2.30	2.21	2.11	2.01
	40	7.31	5.18	4.31	3.83	3.51	3.29	3.12	2.99	2.89	2.80	2.66	2.52	2.37	2.29	2.20	2.11	2.02	1.92	1.80
	60	7.08	4.98	4.13	3.65	3.34	3.12	2.95	2.82	2.72	2.63	2.50	2.35	2.20	2.12	2.03	1.94	1.84	1.73	1.60
	120	6.85	4.79	3.95	3.48	3.17	2.96	2.79	2.66	2.56	2.47	2.34	2.19	2.03	1.95	1.86	1.76	1.66	1.53	1.38
	∞	6.63	4.61	3.78	3.32	3.02	2.80	2.64	2.51	2.41	2.32	2.18	2.04	1.88	1.79	1.70	1.59	1.47	1.32	1.00

Degrees of freedom for the denominator (v_2)

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Table V Percentage Points of the *F* Distribution (continued)

		$F_{0.025, v_1, v_2}$																		
		Degrees of freedom for the numerator (v_1)																		
$v_2 \backslash v_1$	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞	
1	647.8	799.5	864.2	899.6	921.8	937.1	948.2	956.7	963.3	968.6	976.7	984.9	993.1	997.2	1001	1006	1010	1014	1018	
2	38.51	39.00	39.17	39.25	39.30	39.33	39.36	39.37	39.39	39.40	39.41	39.43	39.45	39.46	39.46	39.47	39.48	39.49	39.50	
3	17.44	16.04	15.44	15.10	14.88	14.73	14.62	14.54	14.47	14.42	14.34	14.25	14.17	14.12	14.08	14.04	13.99	13.95	13.90	
4	12.22	10.65	9.98	9.60	9.36	9.20	9.07	8.98	8.90	8.84	8.75	8.66	8.56	8.51	8.46	8.41	8.36	8.31	8.26	
5	10.01	8.43	7.76	7.39	7.15	6.98	6.85	6.76	6.68	6.62	6.52	6.43	6.33	6.28	6.23	6.18	6.12	6.07	6.02	
6	8.81	7.26	6.60	6.23	5.99	5.82	5.70	5.60	5.52	5.46	5.37	5.27	5.17	5.12	5.07	5.01	4.96	4.90	4.85	
7	8.07	6.54	5.89	5.52	5.29	5.12	4.99	4.90	4.82	4.76	4.67	4.57	4.47	4.42	4.36	4.31	4.25	4.20	4.14	
8	7.57	6.06	5.42	5.05	4.82	4.65	4.53	4.43	4.36	4.30	4.20	4.10	4.00	3.95	3.89	3.84	3.78	3.73	3.67	
9	7.21	5.71	5.08	4.72	4.48	4.32	4.20	4.10	4.03	3.96	3.87	3.77	3.67	3.61	3.56	3.51	3.45	3.39	3.33	
10	6.94	5.46	4.83	4.47	4.24	4.07	3.95	3.85	3.78	3.72	3.62	3.52	3.42	3.37	3.31	3.26	3.20	3.14	3.08	
11	6.72	5.26	4.63	4.28	4.04	3.88	3.76	3.66	3.59	3.53	3.43	3.33	3.23	3.17	3.12	3.06	3.00	2.94	2.88	
12	6.55	5.10	4.47	4.12	3.89	3.73	3.61	3.51	3.44	3.37	3.28	3.18	3.07	3.02	2.96	2.91	2.85	2.79	2.72	
13	6.41	4.97	4.35	4.00	3.77	3.60	3.48	3.39	3.31	3.25	3.15	3.05	2.95	2.89	2.84	2.78	2.72	2.66	2.60	
14	6.30	4.86	4.24	3.89	3.66	3.50	3.38	3.29	3.21	3.15	3.05	2.95	2.84	2.79	2.73	2.67	2.61	2.55	2.49	
15	6.20	4.77	4.15	3.80	3.58	3.41	3.29	3.20	3.12	3.06	2.96	2.86	2.76	2.70	2.64	2.59	2.52	2.46	2.40	
16	6.12	4.69	4.08	3.73	3.50	3.34	3.22	3.12	3.05	2.99	2.89	2.79	2.68	2.63	2.57	2.51	2.45	2.38	2.32	
17	6.04	4.62	4.01	3.66	3.44	3.28	3.16	3.06	2.98	2.92	2.82	2.72	2.62	2.56	2.50	2.44	2.38	2.32	2.25	
18	5.98	4.56	3.95	3.61	3.38	3.22	3.10	3.01	2.93	2.87	2.77	2.67	2.56	2.50	2.44	2.38	2.32	2.26	2.19	
19	5.92	4.51	3.90	3.56	3.33	3.17	3.05	2.96	2.88	2.82	2.72	2.62	2.51	2.45	2.39	2.33	2.27	2.20	2.13	
20	5.87	4.46	3.86	3.51	3.29	3.13	3.01	2.91	2.84	2.77	2.68	2.57	2.46	2.41	2.35	2.29	2.22	2.16	2.09	
21	5.83	4.42	3.82	3.48	3.25	3.09	2.97	2.87	2.80	2.73	2.64	2.53	2.42	2.37	2.31	2.25	2.18	2.11	2.04	
22	5.79	4.38	3.78	3.44	3.22	3.05	2.93	2.84	2.76	2.70	2.60	2.50	2.39	2.33	2.27	2.21	2.14	2.08	2.00	
23	5.75	4.35	3.75	3.41	3.18	3.02	2.90	2.81	2.73	2.67	2.57	2.47	2.36	2.30	2.24	2.18	2.11	2.04	1.97	
24	5.72	4.32	3.72	3.38	3.15	2.99	2.87	2.78	2.70	2.64	2.54	2.44	2.33	2.27	2.21	2.15	2.08	2.01	1.94	
25	5.69	4.29	3.69	3.35	3.13	2.97	2.85	2.75	2.68	2.61	2.51	2.41	2.30	2.24	2.18	2.12	2.05	1.98	1.91	
26	5.66	4.27	3.67	3.33	3.10	2.94	2.82	2.73	2.65	2.59	2.49	2.39	2.28	2.22	2.16	2.09	2.03	1.95	1.88	
27	5.63	4.24	3.65	3.31	3.08	2.92	2.80	2.71	2.63	2.57	2.47	2.36	2.25	2.19	2.13	2.07	2.00	1.93	1.85	
28	5.61	4.22	3.63	3.29	3.06	2.90	2.78	2.69	2.61	2.55	2.45	2.34	2.23	2.17	2.11	2.05	1.98	1.91	1.83	
29	5.59	4.20	3.61	3.27	3.04	2.88	2.76	2.67	2.59	2.53	2.43	2.32	2.21	2.15	2.09	2.03	1.96	1.89	1.81	
30	5.57	4.18	3.59	3.25	3.03	2.87	2.75	2.65	2.57	2.51	2.41	2.31	2.20	2.14	2.07	2.01	1.94	1.87	1.79	
40	5.42	4.05	3.46	3.13	2.90	2.74	2.62	2.53	2.45	2.39	2.29	2.18	2.07	2.01	1.94	1.88	1.80	1.72	1.64	
60	5.29	3.93	3.34	3.01	2.79	2.63	2.51	2.41	2.33	2.27	2.17	2.06	1.94	1.88	1.82	1.74	1.67	1.58	1.48	
120	5.15	3.80	3.23	2.89	2.67	2.52	2.39	2.30	2.22	2.16	2.05	1.94	1.82	1.76	1.69	1.61	1.53	1.43	1.31	
∞	5.02	3.69	3.12	2.79	2.57	2.41	2.29	2.19	2.11	2.05	1.94	1.83	1.71	1.64	1.57	1.48	1.39	1.27	1.00	

Degrees of freedom for the denominator (v_2)