

Confidence Bounds Info

Confidence Bounds on the mean (σ known):

$$P(\bar{X} - z_{\alpha/2} \frac{\sigma}{\sqrt{n}} < \mu < \bar{X} + z_{\alpha/2} \frac{\sigma}{\sqrt{n}}) = 1 - \alpha$$

Confidence Bounds on the mean (σ unknown, or a sample):

$$P(\bar{X} - t_{\alpha/2} \frac{S}{\sqrt{n}} < \mu < \bar{X} + t_{\alpha/2} \frac{S}{\sqrt{n}}) = 1 - \alpha$$

Confidence bounds on difference of two means:

$$P((\bar{X}_1 - \bar{X}_2) - t_{\alpha/2} \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}} < \mu_1 - \mu_2 < (\bar{X}_1 - \bar{X}_2) + t_{\alpha/2} \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}) = 1 - \alpha$$

where the degrees of freedom for t-table are

$$v = \frac{(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2})^2}{\frac{(\frac{s_1^2}{n_1})^2}{(n_1 - 1)} + \frac{(\frac{s_2^2}{n_2})^2}{(n_2 - 1)}}$$

Paired Comparisons:

If \bar{d} and s_d are the mean and standard deviation of the normally distributed differences of n random pairs of measurements, a $(1-\alpha)100\%$ confidence interval for $\mu_d = \mu_1 - \mu_2$ is

$$\bar{d} - t_{\alpha/2} \frac{s_d}{\sqrt{n}} < \mu_d < \bar{d} + t_{\alpha/2} \frac{s_d}{\sqrt{n}}$$

where $t_{\alpha/2}$ is the t-value with $v=n-1$ degrees of freedom.

Confidence bounds on σ^2 :

If s^2 is the variance of a random sample of size n from a normal population, a $(1-\alpha)100\%$ confidence interval for σ^2 is

$$\frac{(n-1)s^2}{\chi_{\alpha/2}^2} < \sigma^2 < \frac{(n-1)s^2}{\chi_{1-\alpha/2}^2} \text{ where } \chi_{\alpha/2}^2 \text{ and } \chi_{1-\alpha/2}^2 \text{ are } \chi^2\text{-values with } v=n-1 \text{ degrees of freedom.}$$

Confidence bounds on ratio of two variances:

Confidence interval for σ_1^2 / σ_2^2 :

If s_1^2 and s_2^2 are the variances of independent samples of size n_1 and n_2 , respectively, from normal populations, then a $(1-\alpha)100\%$ confidence interval for σ_1^2 / σ_2^2 is

$$\left(\frac{s_1^2}{s_2^2}\right) \left(\frac{1}{f_{\alpha/2}(v_1, v_2)}\right) < \frac{\sigma_1^2}{\sigma_2^2} < \left(\frac{s_1^2}{s_2^2}\right) f_{\alpha/2}(v_2, v_1)$$

where $f_{\alpha/2}(v_1, v_2)$ is an f-value with $v_1=n_1-1$ and $v_2=n_2-1$ degrees of freedom.

Confidence Bounds Info_continued

Confidence Interval on a Proportion

If \hat{p} is the proportion of successes in a random sample of size n , and $\hat{q} = 1 - \hat{p}$, an approximate $(1 - \alpha)100\%$ confidence interval for the binomial parameter p is given by

$$\hat{p} - z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{p}\hat{q}}{n}} < p < \hat{p} + z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{p}\hat{q}}{n}} \text{ where } z_{\frac{\alpha}{2}} \text{ is the z-value leaving an area of } \alpha/2 \text{ to the right.}$$

Sample size to assure a proportion:

If \hat{p} is used as an estimate of p , we can be at least $(1 - \alpha)100\%$ confident

that the error will not exceed a specified amount e when the sample size is $n = \frac{z_{\alpha/2}^2}{4e^2}$

Estimating the difference between two proportions:

If \hat{p}_1 and \hat{p}_2 are the proportion of successes in random samples of size

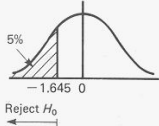
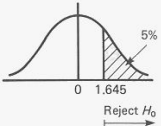
n_1 and n_2 , respectively, $\hat{q}_1 = 1 - \hat{p}_1$ and $\hat{q}_2 = 1 - \hat{p}_2$, an approximate $(1 - \alpha)100\%$ confidence interval for the difference of two binomial parameters $p_1 - p_2$ is given by

$$(\hat{p}_1 - \hat{p}_2) - z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{p}_1\hat{q}_1}{n_1} + \frac{\hat{p}_2\hat{q}_2}{n_2}} < p_1 - p_2 < (\hat{p}_1 - \hat{p}_2) + z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{p}_1\hat{q}_1}{n_1} + \frac{\hat{p}_2\hat{q}_2}{n_2}}$$

where $z_{\frac{\alpha}{2}}$ is the z-value leaving an area of $\alpha/2$ to the right.

Hypothesis tests:

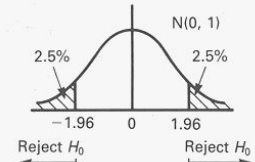
One-sided tests

Definite decrease $H_0: \mu = 25$ $H_1: \mu < 25$	Definite increase $H_0: \mu = 25$ $H_1: \mu > 25$
Critical region at 5% level:	
$P(Z < -1.645) = 0.05$ 	$P(Z > 1.645) = 0.05$ 

Two-sided tests

Critical region at 5% level:

$$P(|Z| > 1.96) = 0.05$$



A goodness-of-fit test between observed and expected frequencies is based on the quantity

$$\chi^2 = \sum_{i=1}^k \frac{(o_i - e_i)^2}{e_i} \text{ where each expected frequency must be } \geq 5$$

where χ^2 is a value of a random variable whose sampling distribution is approximated by the chi-squared distribution with $v = k - 1$ degrees of freedom. o_i and e_i represent the observed and expected frequencies, respectively, for the i th cell. Compare this calculated value to χ_{α}^2 , so that

if $\chi_{\text{calculated}}^2 > \chi_{\alpha}^2$, reject H_0 .

Standard Normal Table

	Normal(0,1)																				
	(2nd decimal place)					(2nd decimal place)															
	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	
-4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359	
-3.9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	
-3.8	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.2	0.5793	0.5832	0.5871	0.5911	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
-3.7	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
-3.6	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
-3.5	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
-3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	S	0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7519
-3.3	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003	t	0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823
-3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005	a	0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106
-3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007	n	0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365
-3.0	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0011	0.0010	0.0010	d	1	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8601
-2.9	0.0018	0.0018	0.0017	0.0017	0.0016	0.0015	0.0015	0.0015	0.0014	0.0014	a	1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810
-2.8	0.0026	0.0025	0.0024	0.0023	0.0022	0.0021	0.0021	0.0021	0.0020	0.0019	r	1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997
-2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026	d	1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162
-2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036	e	1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306
-2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048	D	1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429
-2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064	e	1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535
-2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084	v	1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625
-2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110	i	1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699
-2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143	a	1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761
-2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183	t	2	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812
-1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233	i	2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854
-1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294	o	2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887
-1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367	n	2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913
-1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455	s	2.4	0.9918	0.9920	0.9922	0.9924	0.9927	0.9929	0.9931	0.9932	0.9934
-1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559		2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9951	0.9952
-1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681		2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9962	0.9963	0.9964
-1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823		2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9974
-1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985		2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9980	0.9981
-1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170		2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9986	0.9986
-1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379		3	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9990	0.9990
-0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611		3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9993	0.9993
-0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867		3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
-0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148		3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9997	0.9997
-0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451		3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998
-0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776		3.5	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998
-0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121		3.6	0.9998	0.9998	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
-0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483		3.7	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
-0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859		3.8	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
-0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247		3.9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359		4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

To normalize for arbitrary Mean(μ) and Std Dev (σ) : $Z = (x - \mu) / \sigma$

t table

		Alpha Level																	
		0.1	0.05	0.025	0.02	0.015	0.01	0.0075	0.005	0.0025	0.0005	Area in one tail		Area in two tails					
		0.2	0.1	0.05	0.04	0.03	0.02	0.02	0.015	0.01	0.0075	0.005	0.0025	0.0005					
1		3.078	6.314	12.706	15.895	21.205	31.821	42.433	63.657	127.321	636.619								
2		1.886	2.920	4.303	4.849	5.643	6.965	8.073	9.925	14.089	31.599								
3		1.638	2.353	3.182	3.482	3.896	4.541	5.047	5.841	7.453	12.924								
4		1.533	2.132	2.776	2.999	3.298	3.747	4.088	4.604	5.598	8.610								
5		1.476	2.015	2.571	2.757	3.003	3.365	3.634	4.032	4.773	6.869								
6		1.440	1.943	2.447	2.612	2.829	3.143	3.372	3.707	4.317	5.959								
7		1.415	1.895	2.365	2.517	2.715	2.998	3.203	3.499	4.029	5.408								
8		1.397	1.860	2.306	2.449	2.634	2.896	3.085	3.355	3.833	5.041								
9		1.383	1.833	2.262	2.398	2.574	2.821	2.998	3.250	3.690	4.781								
10		1.372	1.812	2.228	2.359	2.527	2.764	2.932	3.169	3.581	4.587								
11		1.363	1.796	2.201	2.328	2.491	2.718	2.879	3.106	3.497	4.437								
12		1.356	1.782	2.179	2.303	2.461	2.681	2.836	3.055	3.428	4.318								
13		1.350	1.771	2.160	2.282	2.436	2.650	2.801	3.012	3.372	4.221								
14		1.345	1.761	2.145	2.264	2.415	2.624	2.771	2.977	3.326	4.140								
15		1.341	1.753	2.131	2.249	2.397	2.602	2.746	2.947	3.286	4.073								
16		1.337	1.746	2.120	2.235	2.382	2.583	2.724	2.921	3.252	4.015								
17		1.333	1.740	2.110	2.224	2.368	2.567	2.706	2.898	3.222	3.965								
18		1.330	1.734	2.101	2.214	2.356	2.552	2.689	2.878	3.197	3.922								
19		1.328	1.729	2.093	2.205	2.346	2.539	2.674	2.861	3.174	3.883								
20		1.325	1.725	2.086	2.197	2.336	2.528	2.661	2.845	3.153	3.850								
21		1.323	1.721	2.080	2.189	2.328	2.518	2.649	2.831	3.135	3.819								
22		1.321	1.717	2.074	2.183	2.320	2.508	2.639	2.819	3.119	3.792								
23		1.319	1.714	2.069	2.177	2.313	2.500	2.629	2.807	3.104	3.768								
24		1.318	1.711	2.064	2.172	2.307	2.492	2.620	2.797	3.091	3.745								
25		1.316	1.708	2.060	2.167	2.301	2.485	2.612	2.787	3.078	3.725								
26		1.315	1.706	2.056	2.162	2.296	2.479	2.605	2.779	3.067	3.707								
27		1.314	1.703	2.052	2.158	2.291	2.473	2.598	2.771	3.057	3.690								
28		1.313	1.701	2.048	2.154	2.286	2.467	2.592	2.763	3.047	3.674								
29		1.311	1.699	2.045	2.150	2.282	2.462	2.586	2.756	3.038	3.659								
30		1.310	1.697	2.042	2.147	2.278	2.457	2.581	2.750	3.030	3.646								
40		1.303	1.684	2.021	2.123	2.250	2.423	2.542	2.704	2.971	3.551								
50		1.299	1.676	2.009	2.109	2.234	2.403	2.519	2.678	2.937	3.496								
60		1.296	1.671	2.000	2.099	2.223	2.390	2.504	2.660	2.915	3.460								
70		1.294	1.667	1.994	2.093	2.215	2.381	2.494	2.648	2.899	3.435								
80		1.292	1.664	1.990	2.088	2.209	2.374	2.486	2.639	2.887	3.416								
90		1.291	1.662	1.987	2.084	2.205	2.368	2.475	2.632	2.878	3.402								
100		1.290	1.660	1.984	2.081	2.201	2.364	2.470	2.626	2.871	3.390								
110		1.289	1.659	1.982	2.078	2.199	2.361	2.471	2.621	2.865	3.381								
120		1.289	1.658	1.980	2.076	2.196	2.358	2.468	2.617	2.860	3.373								
∞		1.282	1.645	1.960	2.054	2.170	2.326	2.432	2.576	2.807	3.291								

χ^2 table

Area to the right of the critical value

ChiSq	alpha level	0.99	0.98	0.975	0.95	0.9	0.1	0.05	0.025	0.02	0.01	0.005
1	0.000	0.000	0.001	0.001	0.004	0.016	2.706	3.841	5.024	5.412	6.635	7.879
D	2	0.010	0.020	0.040	0.051	0.103	4.605	5.991	7.378	7.824	9.210	10.597
e	3	0.072	0.115	0.185	0.216	0.352	5.841	6.251	7.815	9.348	11.345	12.838
g	4	0.207	0.297	0.429	0.484	0.711	1.064	1.358	1.943	2.479	3.357	4.299
r	5	0.412	0.554	0.752	0.831	1.145	1.610	2.009	2.689	3.347	4.351	5.401
e	6	0.676	0.872	1.134	1.237	1.635	2.204	2.689	3.455	4.299	5.401	6.581
e	7	0.989	1.239	1.564	1.690	2.167	2.833	3.435	4.299	5.279	6.349	7.578
s	8	1.344	1.646	2.032	2.180	2.733	3.435	4.045	4.973	5.989	7.173	8.445
	9	1.735	2.088	2.522	2.700	3.325	4.168	4.838	5.989	7.173	8.445	9.843
of	10	2.156	2.558	3.059	3.247	3.940	4.865	5.639	6.938	8.328	9.843	11.534
	11	2.603	3.053	3.609	3.816	4.575	5.578	6.345	7.779	9.348	11.017	12.901
F	12	3.074	3.571	4.178	4.404	5.226	6.304	7.153	8.651	10.371	12.196	14.333
r	13	3.565	4.107	4.765	5.009	5.892	7.042	7.982	9.591	11.416	13.277	15.658
e	14	4.075	4.660	5.368	5.629	6.571	7.790	8.838	10.557	12.566	14.838	17.261
e	15	4.601	5.229	5.985	6.262	7.261	8.547	9.697	11.433	13.277	15.582	18.493
d	16	5.142	5.812	6.614	6.908	7.962	9.312	10.591	12.401	14.333	16.599	19.778
o	17	5.697	6.408	7.255	7.564	8.672	10.085	11.433	13.000	15.013	17.338	20.090
m	18	6.265	7.015	7.906	8.231	9.390	10.865	12.017	13.567	15.852	18.475	21.364
	19	6.844	7.633	8.567	8.907	10.117	11.651	12.901	15.085	17.338	20.090	22.758
	20	7.434	8.260	9.237	9.591	10.851	12.443	14.001	16.266	18.475	21.364	24.001
(v=n-1)	21	8.034	8.897	9.915	10.283	11.591	13.240	14.641	17.023	19.591	22.758	26.013
	22	8.643	9.542	10.600	10.982	12.338	14.041	15.013	17.923	20.791	23.581	27.204
	23	9.260	10.196	11.293	11.689	13.091	14.848	15.372	18.909	22.037	24.433	28.433
	24	9.886	10.856	11.992	12.401	13.848	15.659	16.013	19.909	23.179	25.179	29.664
	25	10.520	11.524	12.697	13.120	14.611	16.473	16.688	20.909	24.314	25.914	30.914
	26	11.160	12.198	13.409	13.844	15.379	17.292	17.357	21.909	25.449	26.649	32.185
	27	11.808	12.879	14.125	14.573	16.151	18.114	18.026	22.914	26.579	27.379	33.478
	28	12.461	13.565	14.847	15.308	16.928	18.939	18.916	23.914	27.701	28.101	34.788
	29	13.121	14.256	15.574	16.047	17.708	19.768	19.907	24.914	28.673	28.823	36.114
	30	13.787	14.953	16.306	16.791	18.493	20.599	20.907	25.914	29.433	29.543	37.464
	31	14.458	15.655	17.042	17.539	19.281	21.434	21.907	26.914	30.052	30.272	38.833
	32	15.134	16.362	17.783	18.291	20.072	22.271	22.914	27.914	30.591	30.914	40.223
	33	15.815	17.074	18.527	19.047	20.867	23.110	23.914	28.914	31.133	31.564	41.593
	34	16.501	17.789	19.275	19.806	21.684	23.952	24.907	29.914	31.701	32.223	42.983
	35	17.192	18.509	20.027	20.569	22.465	24.797	25.907	30.914	32.279	32.893	44.393
	36	17.887	19.233	20.783	21.336	23.269	25.643	26.914	31.914	32.857	33.564	45.823
	37	18.586	19.960	21.542	22.106	24.075	26.492	27.914	32.914	33.433	34.233	47.273
	38	19.289	20.691	22.304	22.878	24.884	27.343	28.914	33.914	33.991	34.904	48.743
	39	19.996	21.426	23.069	23.654	25.695	28.196	29.914	34.914	34.564	35.574	50.233
	40	20.707	22.164	23.838	24.433	26.509	29.051	30.914	35.914	35.133	36.243	51.743
	41	21.421	22.906	24.609	25.215	27.326	29.907	31.914	36.914	35.701	36.914	53.273
	42	22.138	23.650	25.383	25.999	28.144	30.765	32.914	37.914	36.279	37.584	54.823
	43	22.859	24.398	26.159	26.785	28.965	31.625	33.914	38.914	36.852	38.253	56.393
	44	23.584	25.148	26.939	27.575	29.787	32.487	34.914	39.914	37.423	38.923	57.983
	45	24.311	25.901	27.720	28.366	30.612	33.350	35.914	40.914	37.991	39.593	59.593
	46	25.041	26.657	28.505	29.160	31.439	34.215	36.914	41.914	38.564	40.264	61.223
	47	25.775	27.416	29.291	29.956	32.268	35.081	37.914	42.914	39.133	40.933	62.873
	48	26.511	28.177	30.080	30.755	33.098	35.949	38.914	43.914	39.701	41.604	64.543
	49	27.249	28.941	30.871	31.555	33.990	36.818	39.914	44.914	40.272	42.273	66.233
	50	27.991	29.707	31.664	32.357	34.764	37.689	40.914	45.914	40.843	42.943	67.943

can be used.

For $\nu > 40$, the approximation

$$Q(p) \approx \nu \left(1 - \frac{2}{9\nu} + Q_z(p) \sqrt{\frac{2}{9\nu}} \right)$$

F distribution, .99 quantiles ($\alpha=.01$)

Prob	Numerator Degrees of Freedom																	
	1	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	60	120
D	1	4052.181	4999.500	5403.352	5624.583	5763.650	5858.986	5928.356	5981.070	6022.473	6055.847	6106.321	6157.285	6208.730	6260.649	6286.782	6313.030	6339.391
e	2	98.503	99.000	99.166	99.249	99.299	99.333	99.356	99.374	99.388	99.399	99.416	99.433	99.449	99.459	99.474	99.482	99.491
n	3	34.116	30.817	29.457	28.710	28.237	27.911	27.672	27.489	27.345	27.229	27.052	26.872	26.690	26.579	26.505	26.411	26.316
o	4	21.198	18.000	16.694	15.977	15.522	15.207	14.976	14.799	14.659	14.546	14.374	14.198	14.020	13.911	13.838	13.745	13.558
m	5	16.258	13.274	12.060	11.392	10.967	10.672	10.456	10.289	10.158	10.051	9.888	9.722	9.553	9.449	9.379	9.202	9.112
	6	13.745	10.925	9.780	9.148	8.746	8.466	8.260	8.102	7.976	7.874	7.718	7.559	7.396	7.296	7.143	7.057	6.969
	7	12.246	9.547	8.451	7.847	7.460	7.191	6.993	6.840	6.719	6.620	6.469	6.314	6.155	6.058	5.908	5.824	5.737
a	8	11.259	8.649	7.591	7.006	6.632	6.371	6.178	6.029	5.911	5.814	5.667	5.515	5.359	5.263	5.198	5.103	4.946
t	9	10.561	8.022	6.992	6.422	6.057	5.802	5.613	5.467	5.351	5.257	5.111	4.962	4.808	4.713	4.649	4.567	4.398
o	10	10.044	7.559	6.552	5.994	5.636	5.386	5.200	5.057	4.942	4.849	4.706	4.558	4.405	4.311	4.247	4.165	4.082
r	11	9.646	7.206	6.217	5.668	5.316	5.069	4.886	4.744	4.632	4.539	4.397	4.251	4.099	4.005	3.941	3.860	3.690
	12	9.330	6.927	5.953	5.412	5.064	4.821	4.640	4.499	4.388	4.296	4.155	4.010	3.858	3.765	3.701	3.619	3.449
	13	9.074	6.701	5.739	5.205	4.862	4.620	4.441	4.302	4.191	4.100	3.960	3.815	3.665	3.571	3.507	3.425	3.255
	14	8.862	6.515	5.564	5.035	4.695	4.456	4.278	4.140	4.030	3.939	3.800	3.656	3.505	3.412	3.348	3.266	3.094
	15	8.683	6.359	5.417	4.893	4.556	4.318	4.142	4.004	3.895	3.805	3.666	3.522	3.372	3.278	3.214	3.132	2.959
	16	8.531	6.226	5.292	4.773	4.437	4.202	4.026	3.890	3.780	3.691	3.553	3.409	3.259	3.165	3.101	3.018	2.845
	17	8.400	6.112	5.185	4.669	4.336	4.102	3.927	3.791	3.682	3.593	3.455	3.312	3.162	3.068	3.003	2.920	2.746
e	18	8.285	6.013	5.092	4.579	4.248	4.015	3.841	3.705	3.597	3.508	3.371	3.227	3.077	2.983	2.919	2.835	2.660
g	19	8.185	5.926	5.010	4.500	4.171	3.939	3.765	3.631	3.523	3.434	3.297	3.153	3.003	2.909	2.844	2.761	2.584
r	20	8.096	5.849	4.938	4.431	4.103	3.871	3.699	3.564	3.457	3.368	3.231	3.088	2.938	2.843	2.778	2.695	2.517
e	21	8.017	5.780	4.874	4.369	4.042	3.812	3.640	3.506	3.398	3.310	3.173	3.030	2.880	2.785	2.720	2.636	2.457
e	22	7.945	5.719	4.817	4.313	3.988	3.758	3.587	3.453	3.346	3.258	3.121	2.978	2.827	2.733	2.667	2.583	2.403
s	23	7.881	5.664	4.765	4.264	3.939	3.710	3.539	3.406	3.299	3.211	3.074	2.931	2.781	2.686	2.620	2.535	2.354
	24	7.823	5.614	4.718	4.218	3.895	3.667	3.496	3.363	3.256	3.168	3.032	2.889	2.738	2.643	2.577	2.492	2.310
o	25	7.770	5.568	4.675	4.177	3.855	3.627	3.457	3.324	3.217	3.129	2.993	2.850	2.699	2.604	2.538	2.453	2.270
f	26	7.721	5.526	4.637	4.140	3.818	3.591	3.421	3.288	3.182	3.094	2.958	2.815	2.664	2.569	2.503	2.417	2.233
f	27	7.677	5.488	4.601	4.106	3.785	3.558	3.388	3.256	3.149	3.062	2.926	2.783	2.632	2.536	2.470	2.384	2.198
r	28	7.636	5.453	4.568	4.074	3.754	3.528	3.358	3.226	3.120	3.032	2.896	2.753	2.602	2.506	2.440	2.354	2.167
e	29	7.598	5.420	4.538	4.045	3.725	3.499	3.330	3.198	3.092	3.005	2.868	2.726	2.574	2.478	2.412	2.325	2.138
e	30	7.562	5.390	4.510	4.018	3.699	3.473	3.304	3.173	3.067	2.979	2.843	2.700	2.549	2.453	2.386	2.299	2.111
e	40	7.314	5.179	4.313	3.828	3.514	3.291	3.124	2.993	2.888	2.801	2.665	2.522	2.369	2.271	2.203	2.114	1.917
d	50	7.171	5.057	4.199	3.720	3.408	3.186	3.020	2.890	2.785	2.698	2.562	2.419	2.265	2.167	2.098	2.007	1.803
o	60	7.077	4.977	4.126	3.649	3.339	3.119	2.953	2.823	2.718	2.632	2.496	2.352	2.198	2.098	2.028	1.936	1.726
m	120	6.851	4.787	3.949	3.480	3.174	2.956	2.792	2.663	2.559	2.472	2.336	2.192	2.035	1.932	1.860	1.763	1.533

F distribution, .95 quantiles ($\alpha=.05$)

Prob	Numerator Degrees of Freedom																		
	1	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	60	120	
D	1	161.448	199.500	215.707	224.583	230.162	233.986	236.768	238.883	240.543	241.882	243.906	245.950	248.013	249.260	250.095	251.143	252.196	253.253
e	2	18.513	19.000	19.164	19.247	19.296	19.330	19.353	19.371	19.385	19.396	19.413	19.429	19.446	19.456	19.462	19.471	19.479	19.487
n	3	10.128	9.552	9.277	9.117	9.013	8.941	8.887	8.845	8.812	8.786	8.745	8.703	8.660	8.634	8.617	8.594	8.572	8.549
o	4	7.709	6.944	6.591	6.388	6.256	6.163	6.094	6.041	5.999	5.964	5.912	5.858	5.803	5.769	5.746	5.717	5.688	5.658
m	5	6.608	5.786	5.409	5.192	5.050	4.950	4.876	4.818	4.772	4.735	4.678	4.619	4.558	4.521	4.496	4.464	4.431	4.398
l	6	5.987	5.143	4.757	4.534	4.387	4.284	4.207	4.147	4.099	4.060	4.000	3.938	3.874	3.835	3.808	3.774	3.740	3.705
n	7	5.591	4.737	4.347	4.120	3.972	3.866	3.787	3.726	3.677	3.637	3.575	3.511	3.445	3.404	3.376	3.340	3.304	3.267
a	8	5.318	4.459	4.066	3.838	3.687	3.581	3.500	3.438	3.388	3.347	3.284	3.218	3.150	3.108	3.079	3.043	3.005	2.967
t	9	5.117	4.256	3.863	3.633	3.482	3.374	3.293	3.230	3.179	3.137	3.073	3.006	2.936	2.893	2.864	2.826	2.787	2.748
o	10	4.965	4.103	3.708	3.478	3.326	3.217	3.135	3.072	3.020	2.978	2.913	2.845	2.774	2.730	2.700	2.661	2.621	2.580
r	11	4.844	3.982	3.587	3.357	3.204	3.095	3.012	2.948	2.896	2.854	2.788	2.719	2.646	2.601	2.570	2.531	2.490	2.448
	12	4.747	3.885	3.490	3.259	3.106	2.996	2.913	2.849	2.796	2.753	2.687	2.617	2.544	2.498	2.466	2.426	2.384	2.341
	13	4.667	3.806	3.411	3.179	3.025	2.915	2.832	2.767	2.714	2.671	2.604	2.533	2.459	2.412	2.380	2.339	2.297	2.252
	14	4.600	3.739	3.344	3.112	2.958	2.848	2.764	2.699	2.646	2.602	2.534	2.463	2.388	2.341	2.308	2.266	2.223	2.178
	15	4.543	3.682	3.287	3.056	2.901	2.790	2.707	2.641	2.588	2.544	2.475	2.403	2.328	2.280	2.247	2.204	2.160	2.114
	16	4.494	3.634	3.239	3.007	2.852	2.741	2.657	2.591	2.538	2.494	2.425	2.352	2.276	2.227	2.194	2.151	2.106	2.059
d	17	4.451	3.592	3.197	2.965	2.810	2.699	2.614	2.548	2.494	2.450	2.381	2.308	2.230	2.181	2.148	2.104	2.058	2.011
e	18	4.414	3.555	3.160	2.928	2.773	2.661	2.577	2.510	2.456	2.412	2.342	2.269	2.191	2.141	2.107	2.063	2.017	1.968
g	19	4.381	3.522	3.127	2.895	2.740	2.628	2.544	2.477	2.423	2.378	2.308	2.234	2.155	2.106	2.071	2.026	1.980	1.930
r	20	4.351	3.493	3.098	2.866	2.711	2.599	2.514	2.447	2.393	2.348	2.278	2.203	2.124	2.074	2.039	1.994	1.946	1.896
e	21	4.325	3.467	3.072	2.840	2.685	2.573	2.488	2.420	2.366	2.321	2.250	2.176	2.096	2.045	2.010	1.965	1.916	1.866
e	22	4.301	3.443	3.048	2.816	2.661	2.549	2.464	2.397	2.342	2.297	2.226	2.151	2.071	2.020	1.984	1.938	1.889	1.838
s	23	4.279	3.422	3.028	2.796	2.640	2.528	2.442	2.375	2.320	2.275	2.204	2.128	2.048	1.996	1.961	1.914	1.865	1.813
	24	4.260	3.403	3.009	2.776	2.621	2.508	2.423	2.355	2.300	2.255	2.183	2.108	2.027	1.975	1.939	1.892	1.842	1.790
o	25	4.242	3.385	2.991	2.759	2.603	2.490	2.405	2.337	2.282	2.236	2.165	2.089	2.007	1.955	1.919	1.872	1.822	1.768
f	26	4.225	3.369	2.975	2.743	2.587	2.474	2.388	2.321	2.265	2.220	2.148	2.072	1.990	1.938	1.901	1.853	1.803	1.749
	27	4.210	3.354	2.960	2.728	2.572	2.459	2.373	2.305	2.250	2.204	2.132	2.056	1.974	1.921	1.884	1.836	1.785	1.731
f	28	4.196	3.340	2.947	2.714	2.558	2.445	2.359	2.291	2.236	2.190	2.118	2.041	1.959	1.906	1.869	1.820	1.769	1.714
r	29	4.183	3.328	2.934	2.701	2.545	2.432	2.346	2.278	2.223	2.177	2.104	2.027	1.945	1.891	1.854	1.806	1.754	1.698
e	30	4.171	3.316	2.922	2.690	2.534	2.421	2.334	2.266	2.211	2.165	2.092	2.015	1.932	1.878	1.841	1.792	1.740	1.683
e	40	4.085	3.232	2.839	2.606	2.449	2.336	2.249	2.180	2.124	2.077	2.003	1.924	1.839	1.783	1.744	1.693	1.637	1.577
d	50	4.034	3.183	2.790	2.557	2.400	2.286	2.199	2.130	2.073	2.026	1.952	1.871	1.784	1.727	1.687	1.634	1.576	1.511
o	60	4.001	3.150	2.758	2.525	2.368	2.254	2.167	2.097	2.040	1.993	1.917	1.836	1.748	1.690	1.649	1.594	1.534	1.467
m	120	3.920	3.072	2.680	2.447	2.290	2.175	2.087	2.016	1.959	1.910	1.834	1.750	1.659	1.598	1.554	1.495	1.429	1.352

F distribution, .90 quantiles ($\alpha=.10$)

Prob	Numerator Degrees of Freedom																	
	1	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	60	120
D	1	39.863	49.500	53.593	55.833	57.240	58.906	59.439	59.858	60.195	60.705	61.220	61.740	62.055	62.265	62.529	62.794	63.061
e	2	8.526	9.000	9.162	9.243	9.293	9.349	9.367	9.381	9.392	9.408	9.425	9.441	9.451	9.458	9.466	9.475	9.483
n	3	5.538	5.462	5.391	5.343	5.309	5.266	5.252	5.240	5.230	5.216	5.200	5.184	5.175	5.168	5.160	5.151	5.143
o	4	4.545	4.325	4.191	4.107	4.051	3.979	3.955	3.936	3.920	3.896	3.870	3.844	3.828	3.817	3.804	3.790	3.775
m	5	4.060	3.780	3.619	3.520	3.453	3.368	3.339	3.316	3.297	3.268	3.238	3.207	3.187	3.174	3.157	3.140	3.123
l	6	3.776	3.463	3.289	3.181	3.108	3.055	3.014	2.983	2.937	2.905	2.871	2.836	2.815	2.800	2.781	2.762	2.742
n	7	3.589	3.257	3.074	2.961	2.883	2.827	2.785	2.752	2.703	2.668	2.632	2.595	2.571	2.555	2.535	2.514	2.493
a	8	3.458	3.113	2.924	2.806	2.726	2.668	2.624	2.589	2.561	2.538	2.464	2.425	2.400	2.383	2.361	2.339	2.316
t	9	3.360	3.006	2.813	2.693	2.611	2.551	2.505	2.440	2.416	2.379	2.340	2.298	2.272	2.255	2.232	2.208	2.184
o	10	3.285	2.924	2.728	2.605	2.522	2.461	2.414	2.377	2.323	2.284	2.244	2.201	2.174	2.155	2.132	2.107	2.082
r	11	3.225	2.860	2.660	2.536	2.451	2.389	2.342	2.304	2.248	2.209	2.167	2.123	2.095	2.076	2.052	2.026	2.000
	12	3.177	2.807	2.606	2.480	2.394	2.331	2.283	2.245	2.188	2.147	2.105	2.060	2.031	2.011	1.986	1.960	1.932
	13	3.136	2.763	2.560	2.434	2.347	2.283	2.234	2.195	2.138	2.097	2.053	2.007	1.978	1.958	1.931	1.904	1.876
	14	3.102	2.726	2.522	2.395	2.307	2.243	2.193	2.154	2.122	2.054	2.010	1.962	1.933	1.912	1.885	1.857	1.828
	15	3.073	2.695	2.490	2.361	2.273	2.208	2.158	2.119	2.086	2.017	1.972	1.924	1.894	1.873	1.845	1.817	1.787
	16	3.048	2.668	2.462	2.333	2.244	2.178	2.128	2.088	2.055	1.985	1.940	1.891	1.860	1.839	1.811	1.782	1.751
d	17	3.026	2.645	2.437	2.308	2.218	2.152	2.102	2.061	2.028	1.958	1.912	1.862	1.831	1.809	1.781	1.751	1.719
e	18	3.007	2.624	2.416	2.286	2.196	2.130	2.079	2.038	2.005	1.933	1.887	1.837	1.805	1.783	1.754	1.723	1.691
g	19	2.990	2.606	2.397	2.266	2.176	2.109	2.058	2.017	1.984	1.912	1.865	1.814	1.782	1.759	1.730	1.699	1.666
r	20	2.975	2.589	2.380	2.249	2.158	2.091	2.040	1.999	1.965	1.892	1.845	1.794	1.761	1.738	1.708	1.677	1.643
e	21	2.961	2.575	2.365	2.233	2.142	2.075	2.023	1.982	1.948	1.875	1.827	1.776	1.742	1.719	1.689	1.657	1.623
e	22	2.949	2.561	2.351	2.219	2.128	2.060	2.008	1.967	1.933	1.859	1.811	1.759	1.726	1.702	1.671	1.639	1.604
s	23	2.937	2.549	2.339	2.207	2.115	2.047	1.995	1.953	1.919	1.845	1.796	1.744	1.710	1.686	1.655	1.622	1.587
	24	2.927	2.538	2.327	2.195	2.103	2.035	1.983	1.941	1.906	1.832	1.783	1.730	1.696	1.672	1.641	1.607	1.571
o	25	2.918	2.528	2.317	2.184	2.092	2.024	1.971	1.929	1.895	1.820	1.771	1.718	1.683	1.659	1.627	1.593	1.557
f	26	2.909	2.519	2.307	2.174	2.082	2.014	1.961	1.919	1.884	1.809	1.760	1.706	1.671	1.647	1.615	1.581	1.544
	27	2.901	2.511	2.299	2.165	2.073	2.005	1.952	1.909	1.874	1.799	1.749	1.695	1.660	1.636	1.603	1.569	1.531
f	28	2.894	2.503	2.291	2.157	2.064	1.996	1.943	1.900	1.865	1.790	1.740	1.685	1.650	1.625	1.592	1.558	1.520
r	29	2.887	2.495	2.283	2.149	2.057	1.988	1.935	1.892	1.857	1.781	1.731	1.676	1.640	1.616	1.583	1.547	1.509
e	30	2.881	2.489	2.276	2.142	2.049	1.980	1.927	1.884	1.849	1.773	1.722	1.667	1.632	1.606	1.573	1.538	1.499
e	40	2.835	2.440	2.226	2.091	1.997	1.927	1.873	1.829	1.793	1.715	1.662	1.605	1.568	1.541	1.506	1.467	1.425
d	50	2.809	2.412	2.197	2.061	1.966	1.895	1.840	1.796	1.760	1.680	1.627	1.568	1.529	1.502	1.465	1.424	1.379
o	60	2.791	2.393	2.177	2.041	1.946	1.875	1.819	1.775	1.738	1.657	1.603	1.543	1.504	1.476	1.437	1.395	1.348
m	120	2.748	2.347	2.130	1.992	1.896	1.824	1.767	1.722	1.684	1.601	1.545	1.482	1.440	1.409	1.368	1.320	1.265