

B.7 Tables of the F distributionTable B.14: 90th percentiles of the F distribution

Den. df	Numerator degrees of freedom							
	1	2	3	4	5	6	7	8
1	39.862	49.500	53.593	55.833	57.240	58.204	58.906	59.439
2	8.5263	9.0000	9.1618	9.2434	9.2926	9.3255	9.3491	9.3668
3	5.5383	5.4625	5.3908	5.3427	5.3092	5.2847	5.2662	5.2517
4	4.5449	4.3246	4.1909	4.1072	4.0506	4.0098	3.9790	3.9549
5	4.0604	3.7797	3.6195	3.5202	3.4530	3.4045	3.3679	3.3393
6	3.7760	3.4633	3.2888	3.1808	3.1075	3.0546	3.0145	2.9830
7	3.5895	3.2574	3.0741	2.9605	2.8833	2.8274	2.7849	2.7516
8	3.4579	3.1131	2.9238	2.8065	2.7265	2.6683	2.6241	2.5894
9	3.3603	3.0065	2.8129	2.6927	2.6106	2.5509	2.5053	2.4694
10	3.2850	2.9245	2.7277	2.6054	2.5216	2.4606	2.4140	2.3772
11	3.2252	2.8595	2.6602	2.5362	2.4512	2.3891	2.3416	2.3040
12	3.1765	2.8068	2.6055	2.4801	2.3941	2.3310	2.2828	2.2446
13	3.1362	2.7632	2.5603	2.4337	2.3467	2.2830	2.2341	2.1954
14	3.1022	2.7265	2.5222	2.3947	2.3069	2.2426	2.1931	2.1539
15	3.0732	2.6952	2.4898	2.3614	2.2730	2.2081	2.1582	2.1185
16	3.0481	2.6682	2.4618	2.3328	2.2438	2.1783	2.1280	2.0880
17	3.0263	2.6446	2.4374	2.3078	2.2183	2.1524	2.1017	2.0613
18	3.0070	2.6240	2.4160	2.2858	2.1958	2.1296	2.0785	2.0379
19	2.9899	2.6056	2.3970	2.2663	2.1760	2.1094	2.0580	2.0171
20	2.9747	2.5893	2.3801	2.2489	2.1583	2.0913	2.0397	1.9985
21	2.9610	2.5746	2.3649	2.2334	2.1423	2.0751	2.0233	1.9819
22	2.9486	2.5613	2.3512	2.2193	2.1279	2.0605	2.0084	1.9668
23	2.9374	2.5493	2.3387	2.2065	2.1149	2.0472	1.9949	1.9531
24	2.9271	2.5384	2.3274	2.1949	2.1030	2.0351	1.9826	1.9407
25	2.9177	2.5283	2.3170	2.1842	2.0922	2.0241	1.9714	1.9293
26	2.9091	2.5191	2.3075	2.1745	2.0822	2.0139	1.9610	1.9188
28	2.8939	2.5028	2.2906	2.1571	2.0645	1.9959	1.9427	1.9002
30	2.8807	2.4887	2.2761	2.1422	2.0492	1.9803	1.9269	1.8841
32	2.8693	2.4765	2.2635	2.1293	2.0360	1.9669	1.9132	1.8702
34	2.8592	2.4658	2.2524	2.1179	2.0244	1.9550	1.9012	1.8580
36	2.8504	2.4563	2.2426	2.1079	2.0141	1.9446	1.8905	1.8471
38	2.8424	2.4479	2.2339	2.0990	2.0050	1.9352	1.8810	1.8375
40	2.8354	2.4404	2.2261	2.0909	1.9968	1.9269	1.8725	1.8289
60	2.7911	2.3932	2.1774	2.0410	1.9457	1.8747	1.8194	1.7748
80	2.7693	2.3702	2.1536	2.0165	1.9206	1.8491	1.7933	1.7483
100	2.7564	2.3564	2.1394	2.0019	1.9057	1.8339	1.7778	1.7324
150	2.7393	2.3383	2.1207	1.9827	1.8861	1.8138	1.7572	1.7115
200	2.7308	2.3293	2.1114	1.9732	1.8763	1.8038	1.7470	1.7011
300	2.7224	2.3203	2.1021	1.9637	1.8666	1.7939	1.7369	1.6908
400	2.7182	2.3159	2.0975	1.9590	1.8617	1.7889	1.7319	1.6856
∞	2.7055	2.3026	2.0838	1.9449	1.8473	1.7741	1.7167	1.6702

Table B.15: 90th percentiles of the F distribution

Den. df	Numerator degrees of freedom							
	9	10	11	12	13	14	15	16
1	59.858	60.195	60.473	60.705	60.903	61.072	61.220	61.350
2	9.3805	9.3915	9.4005	9.4080	9.4144	9.4198	9.4245	9.4286
3	5.2401	5.2305	5.2226	5.2158	5.2098	5.2047	5.2003	5.1964
4	3.9357	3.9199	3.9067	3.8956	3.8859	3.8776	3.8704	3.8639
5	3.3163	3.2974	3.2816	3.2682	3.2568	3.2468	3.2380	3.2303
6	2.9577	2.9369	2.9195	2.9047	2.8920	2.8809	2.8712	2.8626
7	2.7247	2.7025	2.6839	2.6681	2.6545	2.6426	2.6322	2.6230
8	2.5613	2.5381	2.5186	2.5020	2.4876	2.4752	2.4642	2.4545
9	2.4404	2.4164	2.3961	2.3789	2.3640	2.3511	2.3396	2.3295
10	2.3473	2.3226	2.3018	2.2841	2.2687	2.2553	2.2435	2.2331
11	2.2735	2.2482	2.2269	2.2087	2.1930	2.1792	2.1671	2.1563
12	2.2135	2.1878	2.1660	2.1474	2.1313	2.1173	2.1049	2.0938
13	2.1638	2.1376	2.1155	2.0966	2.0802	2.0659	2.0532	2.0419
14	2.1220	2.0954	2.0730	2.0537	2.0370	2.0224	2.0095	1.9981
15	2.0862	2.0593	2.0366	2.0171	2.0001	1.9853	1.9722	1.9605
16	2.0553	2.0282	2.0051	1.9854	1.9682	1.9532	1.9399	1.9281
17	2.0284	2.0010	1.9777	1.9577	1.9404	1.9252	1.9117	1.8997
18	2.0047	1.9770	1.9535	1.9334	1.9158	1.9004	1.8868	1.8747
19	1.9836	1.9557	1.9321	1.9117	1.8940	1.8785	1.8647	1.8524
20	1.9649	1.9367	1.9129	1.8924	1.8745	1.8588	1.8450	1.8325
21	1.9480	1.9197	1.8957	1.8750	1.8570	1.8412	1.8271	1.8147
22	1.9328	1.9043	1.8801	1.8593	1.8411	1.8252	1.8111	1.7984
23	1.9189	1.8903	1.8659	1.8450	1.8267	1.8107	1.7964	1.7837
24	1.9063	1.8775	1.8530	1.8319	1.8136	1.7974	1.7831	1.7703
25	1.8947	1.8658	1.8412	1.8200	1.8015	1.7853	1.7708	1.7579
26	1.8841	1.8550	1.8303	1.8090	1.7904	1.7741	1.7596	1.7466
28	1.8652	1.8359	1.8110	1.7895	1.7708	1.7542	1.7395	1.7264
30	1.8490	1.8195	1.7944	1.7727	1.7538	1.7371	1.7223	1.7090
32	1.8348	1.8052	1.7799	1.7581	1.7390	1.7222	1.7072	1.6938
34	1.8224	1.7926	1.7672	1.7452	1.7260	1.7091	1.6940	1.6805
36	1.8115	1.7815	1.7559	1.7338	1.7145	1.6974	1.6823	1.6687
38	1.8017	1.7716	1.7459	1.7237	1.7042	1.6871	1.6718	1.6581
40	1.7929	1.7627	1.7369	1.7146	1.6950	1.6778	1.6624	1.6486
60	1.7380	1.7070	1.6805	1.6574	1.6372	1.6193	1.6034	1.5890
80	1.7110	1.6796	1.6526	1.6292	1.6087	1.5904	1.5741	1.5594
100	1.6949	1.6632	1.6360	1.6124	1.5916	1.5731	1.5566	1.5417
150	1.6736	1.6416	1.6140	1.5901	1.5690	1.5502	1.5334	1.5182
200	1.6630	1.6308	1.6031	1.5789	1.5577	1.5388	1.5218	1.5065
300	1.6525	1.6201	1.5922	1.5679	1.5464	1.5273	1.5102	1.4948
400	1.6472	1.6147	1.5868	1.5623	1.5408	1.5217	1.5045	1.4889
∞	1.6315	1.5987	1.5705	1.5458	1.5240	1.5046	1.4871	1.4714

Table B.16: 90th percentiles of the F distribution

Den. df	Numerator degrees of freedom							
	18	20	25	30	40	50	100	200
1	61.566	61.740	62.054	62.265	62.528	62.688	63.006	63.163
2	9.4354	9.4408	9.4513	9.4579	9.4662	9.4712	9.4812	9.4861
3	5.1900	5.1846	5.1747	5.1681	5.1597	5.1546	5.1442	5.1389
4	3.8531	3.8444	3.8283	3.8175	3.8037	3.7952	3.7781	3.7695
5	3.2172	3.2067	3.1873	3.1741	3.1573	3.1471	3.1263	3.1157
6	2.8481	2.8363	2.8147	2.8000	2.7812	2.7697	2.7463	2.7343
7	2.6074	2.5947	2.5714	2.5555	2.5351	2.5226	2.4971	2.4841
8	2.4381	2.4247	2.3999	2.3830	2.3614	2.3481	2.3208	2.3068
9	2.3123	2.2983	2.2725	2.2547	2.2320	2.2180	2.1892	2.1743
10	2.2153	2.2008	2.1739	2.1554	2.1317	2.1171	2.0869	2.0713
11	2.1380	2.1231	2.0953	2.0762	2.0516	2.0364	2.0050	1.9888
12	2.0750	2.0597	2.0312	2.0115	1.9861	1.9704	1.9379	1.9210
13	2.0227	2.0070	1.9778	1.9576	1.9315	1.9153	1.8817	1.8642
14	1.9785	1.9625	1.9326	1.9119	1.8852	1.8686	1.8340	1.8159
15	1.9407	1.9243	1.8939	1.8728	1.8454	1.8284	1.7928	1.7743
16	1.9079	1.8913	1.8603	1.8388	1.8108	1.7935	1.7570	1.7380
17	1.8792	1.8624	1.8309	1.8090	1.7805	1.7628	1.7255	1.7059
18	1.8539	1.8368	1.8049	1.7827	1.7537	1.7356	1.6976	1.6775
19	1.8314	1.8142	1.7818	1.7592	1.7298	1.7114	1.6726	1.6521
20	1.8113	1.7938	1.7611	1.7382	1.7083	1.6896	1.6501	1.6292
21	1.7932	1.7756	1.7424	1.7193	1.6890	1.6700	1.6298	1.6085
22	1.7768	1.7590	1.7255	1.7021	1.6714	1.6521	1.6113	1.5896
23	1.7619	1.7439	1.7101	1.6864	1.6554	1.6358	1.5944	1.5723
24	1.7483	1.7302	1.6960	1.6721	1.6407	1.6209	1.5788	1.5564
25	1.7358	1.7175	1.6831	1.6589	1.6272	1.6072	1.5645	1.5417
26	1.7243	1.7059	1.6712	1.6468	1.6147	1.5945	1.5513	1.5281
28	1.7039	1.6852	1.6500	1.6252	1.5925	1.5718	1.5276	1.5037
30	1.6862	1.6673	1.6316	1.6065	1.5732	1.5522	1.5069	1.4824
32	1.6708	1.6517	1.6156	1.5901	1.5564	1.5349	1.4888	1.4637
34	1.6573	1.6380	1.6015	1.5757	1.5415	1.5197	1.4727	1.4470
36	1.6453	1.6258	1.5890	1.5629	1.5282	1.5061	1.4583	1.4321
38	1.6345	1.6149	1.5778	1.5514	1.5163	1.4939	1.4453	1.4186
40	1.6249	1.6052	1.5677	1.5411	1.5056	1.4830	1.4336	1.4064
60	1.5642	1.5435	1.5039	1.4755	1.4373	1.4126	1.3576	1.3264
80	1.5340	1.5128	1.4720	1.4426	1.4027	1.3767	1.3180	1.2839
100	1.5160	1.4944	1.4527	1.4227	1.3817	1.3548	1.2934	1.2571
150	1.4919	1.4698	1.4271	1.3960	1.3534	1.3251	1.2595	1.2193
200	1.4799	1.4575	1.4142	1.3826	1.3390	1.3100	1.2418	1.1991
300	1.4679	1.4452	1.4013	1.3691	1.3246	1.2947	1.2236	1.1779
400	1.4619	1.4391	1.3948	1.3623	1.3173	1.2870	1.2143	1.1667
∞	1.4439	1.4206	1.3753	1.3419	1.2951	1.2633	1.1850	1.1301

Table B.17: 95th percentiles of the F distribution

Den. df	Numerator degrees of freedom							
	1	2	3	4	5	6	7	8
1	161.45	199.50	215.71	224.58	230.16	233.99	236.77	238.88
2	18.513	19.000	19.164	19.247	19.296	19.329	19.353	19.371
3	10.128	9.552	9.277	9.117	9.013	8.941	8.887	8.845
4	7.709	6.944	6.591	6.388	6.256	6.163	6.094	6.041
5	6.608	5.786	5.409	5.192	5.050	4.950	4.876	4.818
6	5.987	5.143	4.757	4.534	4.387	4.284	4.207	4.147
7	5.591	4.737	4.347	4.120	3.972	3.866	3.787	3.726
8	5.318	4.459	4.066	3.838	3.687	3.581	3.500	3.438
9	5.117	4.256	3.863	3.633	3.482	3.374	3.293	3.230
10	4.965	4.103	3.708	3.478	3.326	3.217	3.135	3.072
11	4.844	3.982	3.587	3.357	3.204	3.095	3.012	2.948
12	4.747	3.885	3.490	3.259	3.106	2.996	2.913	2.849
13	4.667	3.806	3.411	3.179	3.025	2.915	2.832	2.767
14	4.600	3.739	3.344	3.112	2.958	2.848	2.764	2.699
15	4.543	3.682	3.287	3.056	2.901	2.790	2.707	2.641
16	4.494	3.634	3.239	3.007	2.852	2.741	2.657	2.591
17	4.451	3.592	3.197	2.965	2.810	2.699	2.614	2.548
18	4.414	3.555	3.160	2.928	2.773	2.661	2.577	2.510
19	4.381	3.522	3.127	2.895	2.740	2.628	2.544	2.477
20	4.351	3.493	3.098	2.866	2.711	2.599	2.514	2.447
21	4.325	3.467	3.072	2.840	2.685	2.573	2.488	2.420
22	4.301	3.443	3.049	2.817	2.661	2.549	2.464	2.397
23	4.279	3.422	3.028	2.796	2.640	2.528	2.442	2.375
24	4.260	3.403	3.009	2.776	2.621	2.508	2.423	2.355
25	4.242	3.385	2.991	2.759	2.603	2.490	2.405	2.337
26	4.225	3.369	2.975	2.743	2.587	2.474	2.388	2.321
28	4.196	3.340	2.947	2.714	2.558	2.445	2.359	2.291
30	4.171	3.316	2.922	2.690	2.534	2.421	2.334	2.266
32	4.149	3.295	2.901	2.668	2.512	2.399	2.313	2.244
34	4.130	3.276	2.883	2.650	2.494	2.380	2.294	2.225
36	4.113	3.259	2.866	2.634	2.477	2.364	2.277	2.209
38	4.098	3.245	2.852	2.619	2.463	2.349	2.262	2.194
40	4.085	3.232	2.839	2.606	2.449	2.336	2.249	2.180
60	4.001	3.150	2.758	2.525	2.368	2.254	2.167	2.097
80	3.960	3.111	2.719	2.486	2.329	2.214	2.126	2.056
100	3.936	3.087	2.696	2.463	2.305	2.191	2.103	2.032
150	3.904	3.056	2.665	2.432	2.274	2.160	2.071	2.001
200	3.888	3.041	2.650	2.417	2.259	2.144	2.056	1.985
300	3.873	3.026	2.635	2.402	2.244	2.129	2.040	1.969
400	3.865	3.018	2.627	2.394	2.237	2.121	2.032	1.962
∞	3.841	2.996	2.605	2.372	2.214	2.099	2.010	1.938

Table B.18: 95th percentiles of the F distribution

Den. df	Numerator degrees of freedom							
	9	10	11	12	13	14	15	16
1	240.54	241.88	242.98	243.91	244.69	245.36	245.95	246.46
2	19.385	19.396	19.405	19.412	19.419	19.424	19.429	19.433
3	8.812	8.786	8.763	8.745	8.729	8.715	8.703	8.692
4	5.999	5.964	5.936	5.912	5.891	5.873	5.858	5.844
5	4.772	4.735	4.704	4.678	4.655	4.636	4.619	4.604
6	4.099	4.060	4.027	4.000	3.976	3.956	3.938	3.922
7	3.677	3.637	3.603	3.575	3.550	3.529	3.511	3.494
8	3.388	3.347	3.313	3.284	3.259	3.237	3.218	3.202
9	3.179	3.137	3.102	3.073	3.048	3.025	3.006	2.989
10	3.020	2.978	2.943	2.913	2.887	2.865	2.845	2.828
11	2.896	2.854	2.818	2.788	2.761	2.739	2.719	2.701
12	2.796	2.753	2.717	2.687	2.660	2.637	2.617	2.599
13	2.714	2.671	2.635	2.604	2.577	2.554	2.533	2.515
14	2.646	2.602	2.566	2.534	2.507	2.484	2.463	2.445
15	2.588	2.544	2.507	2.475	2.448	2.424	2.403	2.385
16	2.538	2.494	2.456	2.425	2.397	2.373	2.352	2.333
17	2.494	2.450	2.413	2.381	2.353	2.329	2.308	2.289
18	2.456	2.412	2.374	2.342	2.314	2.290	2.269	2.250
19	2.423	2.378	2.340	2.308	2.280	2.256	2.234	2.215
20	2.393	2.348	2.310	2.278	2.250	2.225	2.203	2.184
21	2.366	2.321	2.283	2.250	2.222	2.197	2.176	2.156
22	2.342	2.297	2.259	2.226	2.198	2.173	2.151	2.131
23	2.320	2.275	2.236	2.204	2.175	2.150	2.128	2.109
24	2.300	2.255	2.216	2.183	2.155	2.130	2.108	2.088
25	2.282	2.236	2.198	2.165	2.136	2.111	2.089	2.069
26	2.265	2.220	2.181	2.148	2.119	2.094	2.072	2.052
28	2.236	2.190	2.151	2.118	2.089	2.064	2.041	2.021
30	2.211	2.165	2.126	2.092	2.063	2.037	2.015	1.995
32	2.189	2.142	2.103	2.070	2.040	2.015	1.992	1.972
34	2.170	2.123	2.084	2.050	2.021	1.995	1.972	1.952
36	2.153	2.106	2.067	2.033	2.003	1.977	1.954	1.934
38	2.138	2.091	2.051	2.017	1.988	1.962	1.939	1.918
40	2.124	2.077	2.038	2.003	1.974	1.948	1.924	1.904
60	2.040	1.993	1.952	1.917	1.887	1.860	1.836	1.815
80	1.999	1.951	1.910	1.875	1.845	1.817	1.793	1.772
100	1.975	1.927	1.886	1.850	1.819	1.792	1.768	1.746
150	1.943	1.894	1.853	1.817	1.786	1.758	1.734	1.711
200	1.927	1.878	1.837	1.801	1.769	1.742	1.717	1.694
300	1.911	1.862	1.821	1.785	1.753	1.725	1.700	1.677
400	1.903	1.854	1.813	1.776	1.745	1.717	1.691	1.669
∞	1.880	1.831	1.789	1.752	1.720	1.692	1.666	1.644

Table B.19: 95th percentiles of the F distribution

Den. df	Numerator degrees of freedom							
	18	20	25	30	40	50	100	200
1	247.32	248.01	249.26	250.09	251.14	251.77	253.04	253.68
2	19.440	19.446	19.456	19.462	19.470	19.475	19.486	19.491
3	8.675	8.660	8.634	8.617	8.594	8.581	8.554	8.540
4	5.821	5.803	5.769	5.746	5.717	5.699	5.664	5.646
5	4.579	4.558	4.521	4.496	4.464	4.444	4.405	4.385
6	3.896	3.874	3.835	3.808	3.774	3.754	3.712	3.690
7	3.467	3.445	3.404	3.376	3.340	3.319	3.275	3.252
8	3.173	3.150	3.108	3.079	3.043	3.020	2.975	2.951
9	2.960	2.936	2.893	2.864	2.826	2.803	2.756	2.731
10	2.798	2.774	2.730	2.700	2.661	2.637	2.588	2.563
11	2.671	2.646	2.601	2.570	2.531	2.507	2.457	2.431
12	2.568	2.544	2.498	2.466	2.426	2.401	2.350	2.323
13	2.484	2.459	2.412	2.380	2.339	2.314	2.261	2.234
14	2.413	2.388	2.341	2.308	2.266	2.241	2.187	2.159
15	2.353	2.328	2.280	2.247	2.204	2.178	2.123	2.095
16	2.302	2.276	2.227	2.194	2.151	2.124	2.068	2.039
17	2.257	2.230	2.181	2.148	2.104	2.077	2.020	1.991
18	2.217	2.191	2.141	2.107	2.063	2.035	1.978	1.948
19	2.182	2.156	2.106	2.071	2.026	1.999	1.940	1.910
20	2.151	2.124	2.074	2.039	1.994	1.966	1.907	1.875
21	2.123	2.096	2.045	2.010	1.965	1.936	1.876	1.845
22	2.098	2.071	2.020	1.984	1.938	1.909	1.849	1.817
23	2.075	2.048	1.996	1.961	1.914	1.885	1.823	1.791
24	2.054	2.027	1.975	1.939	1.892	1.863	1.800	1.768
25	2.035	2.007	1.955	1.919	1.872	1.842	1.779	1.746
26	2.018	1.990	1.938	1.901	1.853	1.823	1.760	1.726
28	1.987	1.959	1.906	1.869	1.820	1.790	1.725	1.691
30	1.960	1.932	1.878	1.841	1.792	1.761	1.695	1.660
32	1.937	1.908	1.854	1.817	1.767	1.736	1.669	1.633
34	1.917	1.888	1.833	1.795	1.745	1.713	1.645	1.609
36	1.899	1.870	1.815	1.776	1.726	1.694	1.625	1.587
38	1.883	1.853	1.798	1.760	1.708	1.676	1.606	1.568
40	1.868	1.839	1.783	1.744	1.693	1.660	1.589	1.551
60	1.778	1.748	1.690	1.649	1.594	1.559	1.481	1.438
80	1.734	1.703	1.644	1.602	1.545	1.508	1.426	1.379
100	1.708	1.676	1.616	1.573	1.515	1.477	1.392	1.342
150	1.673	1.641	1.580	1.535	1.475	1.436	1.345	1.290
200	1.656	1.623	1.561	1.516	1.455	1.415	1.321	1.263
300	1.638	1.606	1.543	1.497	1.435	1.393	1.296	1.234
400	1.630	1.597	1.534	1.488	1.425	1.383	1.283	1.219
∞	1.604	1.571	1.506	1.459	1.394	1.350	1.243	1.170

Table B.20: 99th percentiles of the F distribution

Den. df	Numerator degrees of freedom							
	1	2	3	4	5	6	7	8
1	4052	5000	5403	5625	5764	5859	5928	5981
2	98.50	99.00	99.17	99.25	99.30	99.33	99.36	99.37
3	34.12	30.82	29.46	28.71	28.24	27.91	27.67	27.49
4	21.20	18.00	16.69	15.98	15.52	15.21	14.98	14.80
5	16.26	13.27	12.06	11.39	10.97	10.67	10.46	10.29
6	13.75	10.92	9.78	9.15	8.75	8.47	8.26	8.10
7	12.25	9.55	8.45	7.85	7.46	7.19	6.99	6.84
8	11.26	8.65	7.59	7.01	6.63	6.37	6.18	6.03
9	10.56	8.02	6.99	6.42	6.06	5.80	5.61	5.47
10	10.04	7.56	6.55	5.99	5.64	5.39	5.20	5.06
11	9.65	7.21	6.22	5.67	5.32	5.07	4.89	4.74
12	9.33	6.93	5.95	5.41	5.06	4.82	4.64	4.50
13	9.07	6.70	5.74	5.21	4.86	4.62	4.44	4.30
14	8.86	6.51	5.56	5.04	4.69	4.46	4.28	4.14
15	8.68	6.36	5.42	4.89	4.56	4.32	4.14	4.00
16	8.53	6.23	5.29	4.77	4.44	4.20	4.03	3.89
17	8.40	6.11	5.19	4.67	4.34	4.10	3.93	3.79
18	8.29	6.01	5.09	4.58	4.25	4.01	3.84	3.71
19	8.19	5.93	5.01	4.50	4.17	3.94	3.77	3.63
20	8.10	5.85	4.94	4.43	4.10	3.87	3.70	3.56
21	8.02	5.78	4.87	4.37	4.04	3.81	3.64	3.51
22	7.95	5.72	4.82	4.31	3.99	3.76	3.59	3.45
23	7.88	5.66	4.76	4.26	3.94	3.71	3.54	3.41
24	7.82	5.61	4.72	4.22	3.90	3.67	3.50	3.36
25	7.77	5.57	4.68	4.18	3.85	3.63	3.46	3.32
26	7.72	5.53	4.64	4.14	3.82	3.59	3.42	3.29
28	7.64	5.45	4.57	4.07	3.75	3.53	3.36	3.23
30	7.56	5.39	4.51	4.02	3.70	3.47	3.30	3.17
32	7.50	5.34	4.46	3.97	3.65	3.43	3.26	3.13
34	7.44	5.29	4.42	3.93	3.61	3.39	3.22	3.09
36	7.40	5.25	4.38	3.89	3.57	3.35	3.18	3.05
38	7.35	5.21	4.34	3.86	3.54	3.32	3.15	3.02
40	7.31	5.18	4.31	3.83	3.51	3.29	3.12	2.99
60	7.08	4.98	4.13	3.65	3.34	3.12	2.95	2.82
80	6.96	4.88	4.04	3.56	3.26	3.04	2.87	2.74
100	6.90	4.82	3.98	3.51	3.21	2.99	2.82	2.69
150	6.81	4.75	3.91	3.45	3.14	2.92	2.76	2.63
200	6.76	4.71	3.88	3.41	3.11	2.89	2.73	2.60
300	6.72	4.68	3.85	3.38	3.08	2.86	2.70	2.57
400	6.70	4.66	3.83	3.37	3.06	2.85	2.68	2.56
∞	6.63	4.61	3.78	3.32	3.02	2.80	2.64	2.51

Table B.21: 99th percentiles of the F distribution

Den. df	Numerator degrees of freedom							
	9	10	11	12	13	14	15	16
1	6022	6056	6083	6106	6126	6143	6157	6170
2	99.39	99.40	99.41	99.42	99.42	99.43	99.43	99.44
3	27.35	27.23	27.13	27.05	26.98	26.92	26.87	26.83
4	14.66	14.55	14.45	14.37	14.31	14.25	14.20	14.15
5	10.16	10.05	9.96	9.89	9.82	9.77	9.72	9.68
6	7.98	7.87	7.79	7.72	7.66	7.60	7.56	7.52
7	6.72	6.62	6.54	6.47	6.41	6.36	6.31	6.28
8	5.91	5.81	5.73	5.67	5.61	5.56	5.52	5.48
9	5.35	5.26	5.18	5.11	5.05	5.01	4.96	4.92
10	4.94	4.85	4.77	4.71	4.65	4.60	4.56	4.52
11	4.63	4.54	4.46	4.40	4.34	4.29	4.25	4.21
12	4.39	4.30	4.22	4.16	4.10	4.05	4.01	3.97
13	4.19	4.10	4.02	3.96	3.91	3.86	3.82	3.78
14	4.03	3.94	3.86	3.80	3.75	3.70	3.66	3.62
15	3.89	3.80	3.73	3.67	3.61	3.56	3.52	3.49
16	3.78	3.69	3.62	3.55	3.50	3.45	3.41	3.37
17	3.68	3.59	3.52	3.46	3.40	3.35	3.31	3.27
18	3.60	3.51	3.43	3.37	3.32	3.27	3.23	3.19
19	3.52	3.43	3.36	3.30	3.24	3.19	3.15	3.12
20	3.46	3.37	3.29	3.23	3.18	3.13	3.09	3.05
21	3.40	3.31	3.24	3.17	3.12	3.07	3.03	2.99
22	3.35	3.26	3.18	3.12	3.07	3.02	2.98	2.94
23	3.30	3.21	3.14	3.07	3.02	2.97	2.93	2.89
24	3.26	3.17	3.09	3.03	2.98	2.93	2.89	2.85
25	3.22	3.13	3.06	2.99	2.94	2.89	2.85	2.81
26	3.18	3.09	3.02	2.96	2.90	2.86	2.81	2.78
28	3.12	3.03	2.96	2.90	2.84	2.79	2.75	2.72
30	3.07	2.98	2.91	2.84	2.79	2.74	2.70	2.66
32	3.02	2.93	2.86	2.80	2.74	2.70	2.65	2.62
34	2.98	2.89	2.82	2.76	2.70	2.66	2.61	2.58
36	2.95	2.86	2.79	2.72	2.67	2.62	2.58	2.54
38	2.92	2.83	2.75	2.69	2.64	2.59	2.55	2.51
40	2.89	2.80	2.73	2.66	2.61	2.56	2.52	2.48
60	2.72	2.63	2.56	2.50	2.44	2.39	2.35	2.31
80	2.64	2.55	2.48	2.42	2.36	2.31	2.27	2.23
100	2.59	2.50	2.43	2.37	2.31	2.27	2.22	2.19
150	2.53	2.44	2.37	2.31	2.25	2.20	2.16	2.12
200	2.50	2.41	2.34	2.27	2.22	2.17	2.13	2.09
300	2.47	2.38	2.31	2.24	2.19	2.14	2.10	2.06
400	2.45	2.37	2.29	2.23	2.17	2.13	2.08	2.05
∞	2.41	2.32	2.25	2.18	2.13	2.08	2.04	2.00

Table B.22: 99th percentiles of the F distribution

Den. df	Numerator degrees of freedom							
	18	20	25	30	40	50	100	200
1	6191	6209	6240	6261	6287	6302	6334	6350
2	99.44	99.45	99.46	99.46	99.47	99.48	99.49	99.49
3	26.75	26.69	26.58	26.50	26.41	26.35	26.24	26.18
4	14.08	14.02	13.91	13.84	13.75	13.69	13.58	13.52
5	9.61	9.55	9.45	9.38	9.29	9.24	9.13	9.08
6	7.45	7.40	7.30	7.23	7.14	7.09	6.99	6.93
7	6.21	6.16	6.06	5.99	5.91	5.86	5.75	5.70
8	5.41	5.36	5.26	5.20	5.12	5.07	4.96	4.91
9	4.86	4.81	4.71	4.65	4.57	4.52	4.41	4.36
10	4.46	4.41	4.31	4.25	4.17	4.12	4.01	3.96
11	4.15	4.10	4.01	3.94	3.86	3.81	3.71	3.66
12	3.91	3.86	3.76	3.70	3.62	3.57	3.47	3.41
13	3.72	3.66	3.57	3.51	3.43	3.38	3.27	3.22
14	3.56	3.51	3.41	3.35	3.27	3.22	3.11	3.06
15	3.42	3.37	3.28	3.21	3.13	3.08	2.98	2.92
16	3.31	3.26	3.16	3.10	3.02	2.97	2.86	2.81
17	3.21	3.16	3.07	3.00	2.92	2.87	2.76	2.71
18	3.13	3.08	2.98	2.92	2.84	2.78	2.68	2.62
19	3.05	3.00	2.91	2.84	2.76	2.71	2.60	2.55
20	2.99	2.94	2.84	2.78	2.69	2.64	2.54	2.48
21	2.93	2.88	2.79	2.72	2.64	2.58	2.48	2.42
22	2.88	2.83	2.73	2.67	2.58	2.53	2.42	2.36
23	2.83	2.78	2.69	2.62	2.54	2.48	2.37	2.32
24	2.79	2.74	2.64	2.58	2.49	2.44	2.33	2.27
25	2.75	2.70	2.60	2.54	2.45	2.40	2.29	2.23
26	2.72	2.66	2.57	2.50	2.42	2.36	2.25	2.19
28	2.65	2.60	2.51	2.44	2.35	2.30	2.19	2.13
30	2.60	2.55	2.45	2.39	2.30	2.25	2.13	2.07
32	2.55	2.50	2.41	2.34	2.25	2.20	2.08	2.02
34	2.51	2.46	2.37	2.30	2.21	2.16	2.04	1.98
36	2.48	2.43	2.33	2.26	2.18	2.12	2.00	1.94
38	2.45	2.40	2.30	2.23	2.14	2.09	1.97	1.90
40	2.42	2.37	2.27	2.20	2.11	2.06	1.94	1.87
60	2.25	2.20	2.10	2.03	1.94	1.88	1.75	1.68
80	2.17	2.12	2.01	1.94	1.85	1.79	1.65	1.58
100	2.12	2.07	1.97	1.89	1.80	1.74	1.60	1.52
150	2.06	2.00	1.90	1.83	1.73	1.66	1.52	1.43
200	2.03	1.97	1.87	1.79	1.69	1.63	1.48	1.39
300	1.99	1.94	1.84	1.76	1.66	1.59	1.44	1.35
400	1.98	1.92	1.82	1.75	1.64	1.58	1.42	1.32
∞	1.93	1.88	1.77	1.70	1.59	1.52	1.36	1.25

Table B.23: 99.9th percentiles of the F distribution

Den. df	Numerator degrees of freedom							
	1	2	3	4	5	6	7	8
1	405292	500009	540389	562510	576416	585949	592885	598156
2	998.54	999.01	999.18	999.26	999.31	999.35	999.37	999.39
3	167.03	148.50	141.11	137.10	134.58	132.85	131.59	130.62
4	74.138	61.246	56.178	53.436	51.712	50.526	49.658	48.997
5	47.181	37.123	33.203	31.085	29.753	28.835	28.163	27.650
6	35.508	27.000	23.703	21.924	20.803	20.030	19.463	19.030
7	29.245	21.689	18.772	17.198	16.206	15.521	15.019	14.634
8	25.415	18.494	15.830	14.392	13.485	12.858	12.398	12.046
9	22.857	16.387	13.902	12.560	11.714	11.128	10.698	10.368
10	21.040	14.905	12.553	11.283	10.481	9.926	9.517	9.204
11	19.687	13.812	11.561	10.346	9.578	9.047	8.655	8.355
12	18.643	12.974	10.804	9.633	8.892	8.379	8.001	7.710
13	17.816	12.313	10.209	9.073	8.354	7.856	7.489	7.206
14	17.143	11.779	9.729	8.622	7.922	7.436	7.077	6.802
15	16.587	11.339	9.335	8.253	7.567	7.092	6.741	6.471
16	16.120	10.971	9.006	7.944	7.272	6.805	6.460	6.195
17	15.722	10.658	8.727	7.683	7.022	6.563	6.223	5.962
18	15.379	10.390	8.488	7.459	6.808	6.355	6.021	5.763
19	15.081	10.157	8.280	7.265	6.623	6.175	5.845	5.590
20	14.819	9.953	8.098	7.096	6.461	6.019	5.692	5.440
21	14.587	9.772	7.938	6.947	6.318	5.881	5.557	5.308
22	14.380	9.612	7.796	6.814	6.191	5.758	5.438	5.190
23	14.195	9.469	7.669	6.696	6.078	5.649	5.331	5.085
24	14.028	9.339	7.554	6.589	5.977	5.550	5.235	4.991
25	13.877	9.223	7.451	6.493	5.885	5.462	5.148	4.906
26	13.739	9.116	7.357	6.406	5.802	5.381	5.070	4.829
28	13.498	8.931	7.193	6.253	5.657	5.241	4.933	4.695
30	13.293	8.773	7.054	6.125	5.534	5.122	4.817	4.581
32	13.118	8.639	6.936	6.014	5.429	5.021	4.719	4.485
34	12.965	8.522	6.833	5.919	5.339	4.934	4.633	4.401
36	12.832	8.420	6.744	5.836	5.260	4.857	4.559	4.328
38	12.714	8.331	6.665	5.763	5.190	4.790	4.494	4.264
40	12.609	8.251	6.595	5.698	5.128	4.731	4.436	4.207
60	11.973	7.768	6.171	5.307	4.757	4.372	4.086	3.865
80	11.671	7.540	5.972	5.123	4.582	4.204	3.923	3.705
100	11.495	7.408	5.857	5.017	4.482	4.107	3.829	3.612
150	11.267	7.236	5.707	4.879	4.351	3.981	3.706	3.493
200	11.155	7.152	5.634	4.812	4.287	3.920	3.647	3.434
300	11.044	7.069	5.562	4.746	4.225	3.860	3.588	3.377
400	10.989	7.028	5.527	4.713	4.194	3.830	3.560	3.349
∞	10.828	6.908	5.422	4.617	4.103	3.743	3.475	3.266

Table B.24: 99.9th percentiles of the F distribution

Den. df	Numerator degrees of freedom							
	9	10	11	12	13	14	15	16
1	602296	605634	608381	610681	612636	614316	615778	617058
2	999.40	999.41	999.42	999.43	999.44	999.44	999.45	999.45
3	129.86	129.25	128.74	128.32	127.96	127.65	127.38	127.14
4	48.475	48.053	47.705	47.412	47.163	46.948	46.761	46.597
5	27.245	26.917	26.646	26.418	26.224	26.057	25.911	25.783
6	18.688	18.411	18.182	17.989	17.825	17.683	17.559	17.450
7	14.330	14.083	13.879	13.707	13.561	13.434	13.324	13.227
8	11.767	11.540	11.353	11.195	11.060	10.943	10.841	10.752
9	10.107	9.894	9.718	9.570	9.443	9.334	9.238	9.154
10	8.956	8.754	8.587	8.445	8.325	8.220	8.129	8.048
11	8.116	7.922	7.761	7.626	7.510	7.409	7.321	7.244
12	7.480	7.292	7.136	7.005	6.892	6.794	6.709	6.634
13	6.982	6.799	6.647	6.519	6.409	6.314	6.231	6.158
14	6.583	6.404	6.256	6.130	6.023	5.930	5.848	5.776
15	6.256	6.081	5.935	5.812	5.707	5.615	5.535	5.464
16	5.984	5.812	5.668	5.547	5.443	5.353	5.274	5.205
17	5.754	5.584	5.443	5.324	5.221	5.132	5.054	4.986
18	5.558	5.390	5.251	5.132	5.031	4.943	4.866	4.798
19	5.388	5.222	5.084	4.967	4.867	4.780	4.704	4.636
20	5.239	5.075	4.939	4.823	4.724	4.637	4.562	4.495
21	5.109	4.946	4.811	4.696	4.598	4.512	4.437	4.371
22	4.993	4.832	4.697	4.583	4.486	4.401	4.326	4.260
23	4.890	4.730	4.596	4.483	4.386	4.301	4.227	4.162
24	4.797	4.638	4.505	4.393	4.296	4.212	4.139	4.074
25	4.713	4.555	4.423	4.312	4.216	4.132	4.059	3.994
26	4.637	4.480	4.349	4.238	4.142	4.059	3.986	3.921
28	4.505	4.349	4.219	4.109	4.014	3.932	3.859	3.795
30	4.393	4.239	4.110	4.001	3.907	3.825	3.753	3.689
32	4.298	4.145	4.017	3.908	3.815	3.733	3.662	3.598
34	4.215	4.063	3.936	3.828	3.735	3.654	3.583	3.520
36	4.144	3.992	3.866	3.758	3.666	3.585	3.514	3.451
38	4.080	3.930	3.804	3.697	3.605	3.524	3.454	3.391
40	4.024	3.874	3.749	3.642	3.551	3.471	3.400	3.338
60	3.687	3.541	3.419	3.315	3.226	3.147	3.078	3.017
80	3.530	3.386	3.265	3.162	3.074	2.996	2.927	2.867
100	3.439	3.296	3.176	3.074	2.986	2.908	2.840	2.780
150	3.321	3.180	3.061	2.959	2.872	2.795	2.727	2.667
200	3.264	3.123	3.005	2.904	2.816	2.740	2.672	2.612
300	3.207	3.067	2.950	2.849	2.762	2.686	2.618	2.558
400	3.179	3.040	2.922	2.822	2.735	2.659	2.592	2.532
∞	3.097	2.959	2.842	2.742	2.656	2.580	2.513	2.453

Table B.25: 99.9th percentiles of the F distribution

Den. df	Numerator degrees of freedom							
	18	20	25	30	40	50	100	200
1	619201	620922	624031	626114	628725	630301	633455	635033
2	999.46	999.46	999.47	999.48	999.49	999.49	999.50	999.50
3	126.74	126.42	125.84	125.45	124.96	124.67	124.07	123.77
4	46.322	46.101	45.699	45.429	45.089	44.884	44.470	44.261
5	25.568	25.395	25.080	24.869	24.602	24.441	24.115	23.951
6	17.267	17.120	16.853	16.673	16.445	16.307	16.028	15.887
7	13.063	12.932	12.692	12.530	12.326	12.202	11.951	11.824
8	10.601	10.480	10.258	10.109	9.919	9.804	9.571	9.453
9	9.012	8.898	8.689	8.548	8.369	8.260	8.039	7.926
10	7.913	7.804	7.604	7.469	7.297	7.193	6.980	6.872
11	7.113	7.008	6.815	6.684	6.518	6.417	6.210	6.105
12	6.507	6.405	6.217	6.090	5.928	5.829	5.627	5.524
13	6.034	5.934	5.751	5.626	5.467	5.370	5.172	5.070
14	5.655	5.557	5.377	5.254	5.098	5.002	4.807	4.706
15	5.345	5.248	5.071	4.950	4.796	4.702	4.508	4.408
16	5.087	4.992	4.817	4.697	4.545	4.451	4.259	4.160
17	4.869	4.775	4.602	4.484	4.332	4.239	4.049	3.950
18	4.683	4.590	4.418	4.301	4.151	4.058	3.868	3.770
19	4.522	4.430	4.259	4.143	3.994	3.902	3.713	3.615
20	4.382	4.290	4.121	4.005	3.856	3.765	3.576	3.478
21	4.258	4.167	3.999	3.884	3.736	3.645	3.456	3.358
22	4.149	4.058	3.891	3.776	3.629	3.538	3.349	3.251
23	4.051	3.961	3.794	3.680	3.533	3.442	3.254	3.156
24	3.963	3.873	3.707	3.593	3.447	3.356	3.168	3.070
25	3.884	3.794	3.629	3.516	3.369	3.279	3.091	2.992
26	3.812	3.723	3.558	3.445	3.299	3.208	3.020	2.921
28	3.687	3.598	3.434	3.321	3.176	3.085	2.897	2.798
30	3.581	3.493	3.330	3.217	3.072	2.981	2.792	2.693
32	3.491	3.403	3.240	3.128	2.983	2.892	2.703	2.603
34	3.413	3.325	3.163	3.051	2.906	2.815	2.625	2.524
36	3.345	3.258	3.096	2.984	2.839	2.748	2.557	2.456
38	3.285	3.198	3.036	2.925	2.779	2.689	2.497	2.395
40	3.232	3.145	2.984	2.872	2.727	2.636	2.444	2.341
60	2.912	2.827	2.667	2.555	2.409	2.316	2.118	2.009
80	2.763	2.677	2.518	2.406	2.258	2.164	1.960	1.846
100	2.676	2.591	2.431	2.319	2.170	2.076	1.867	1.749
150	2.564	2.479	2.319	2.206	2.056	1.959	1.744	1.618
200	2.509	2.424	2.264	2.151	2.000	1.902	1.682	1.552
300	2.456	2.371	2.210	2.097	1.944	1.846	1.620	1.483
400	2.429	2.344	2.184	2.070	1.917	1.817	1.589	1.448
∞	2.351	2.266	2.105	1.990	1.835	1.733	1.495	1.338