Appendix B

Probability Tables

This Appendix contains tables for selected common probability distributions, for which closed-form expressions for the cumulative distribution functions do not exist.

TABLE B.1 Left-Tail Cumulative Probabilities for the Standard Gaussian Distribution, $\Phi(z) = \Pr\{Z \leq z\}$

Z	.09	.08	.07	.06	.05	.04	.03	.02	.01	.00	Z
−4.0	.00002	.00002	.00002	.00002	.00003	.00003	.00003	.00003	.00003	.00003	−4.0
−3.9	.00003	.00003	.00004	.00004	.00004	.00004	.00004	.00004	.00005	.00005	−3.9
−3.8	.00005	.00005	.00005	.00006	.00006	.00006	.00006	.00007	.00007	.00007	−3.8
−3.7	.00008	.00008	.00008	.00008	.00009	.00009	.00010	.00010	.00010	.00011	−3.7
−3.6	.00011	.00012	.00012	.00013	.00013	.00014	.00014	.00015	.00015	.00016	−3.6
−3.5	.00017	.00017	.00018	.00019	.00019	.00020	.00021	.00022	.00022	.00023	−3.5
−3.4	.00024	.00025	.00026	.00027	.00028	.00029	.00030	.00031	.00032	.00034	−3.4
−3.3	.00035	.00036	.00038	.00039	.00040	.00042	.00043	.00045	.00047	.00048	−3.3
−3.2	.00050	.00052	.00054	.00056	.00058	.00060	.00062	.00064	.00066	.00069	−3.2
−3.1	.00071	.00074	.00076	.00079	.00082	.00084	.00087	.00090	.00094	.00097	−3.1
−3.0	.00100	.00104	.00107	.00111	.00114	.00118	.00122	.00126	.00131	.00135	−3.0
−2.9	.00139	.00144	.00149	.00154	.00159	.00164	.00169	.00175	.00181	.00187	−2.9
−2.8	.00193	.00199	.00205	.00212	.00219	.00226	.00233	.00240	.00248	.00256	−2.8
−2.7	.00264	.00272	.00280	.00289	.00298	.00307	.00317	.00326	.00336	.00347	−2.7
−2.6	.00357	.00368	.00379	.00391	.00402	.00415	.00427	.00440	.00453	.00466	−2.6
−2.5	.00480	.00494	.00508	.00523	.00539	.00554	.00570	.00587	.00604	.00621	−2.5
−2.4	.00639	.00657	.00676	.00695	.00714	.00734	.00755	.00776	.00798	.00820	−2.4
−2.3	.00842	.00866	.00889	.00914	.00939	.00964	.00990	.01017	.01044	.01072	−2.3
−2.2	.01101	.01130	.01160	.01191	.01222	.01255	.01287	.01321	.01355	.01390	−2.2
−2.1	.01426	.01463	.01500	.01539	.01578	.01618	.01659	.01700	.01743	.01786	−2.1
−2.0	.01831	.01876	.01923	.01970	.02018	.02068	.02118	.02169	.02222	.02275	−2.0
−1.9	.02330	.02385	.02442	.02500	.02559	.02619	.02680	.02743	.02807	.02872	−1.9
−1.8	.02938	.03005	.03074	.03144	.03216	.03288	.03362	.03438	.03515	.03593	−1.8
−1.7	.03673	.03754	.03836	.03920	.04006	.04093	.04182	.04272	.04363	.04457	−1.7
−1.6	.04551	.04648	.04746	.04846	.04947	.05050	.05155	.05262	.05370	.05480	−1.6
−1.5	.05592	.05705	.05821	.05938	.06057	.06178	.06301	.06426	.06552	.06681	−1.5
−1.4	.06811	.06944	.07078	.07215	.07353	.07493	.07636	.07780	.07927	.08076	−1.4
−1.3	.08226	.08379	.08534	.08692	.08851	.09012	.09176	.09342	.09510	.09680	−1.3
−1.2	.09853	.10027	.10204	.10383	.10565	.10749	.10935	.11123	.11314	.11507	−1.2
−1.1	.11702	.11900	.12100	.12302	.12507	.12714	.12924	.13136	.13350	.13567	−1.1
−1.0	.13786	.14007	.14231	.14457	.14686	.14917	.15151	.15386	.15625	.15866	−1.0
−0.9	.16109	.16354	.16602	.16853	.17106	.17361	.17619	.17879	.18141	.18406	−0.9
−0.8	.18673	.18943	.19215	.19489	.19766	.20045	.20327	.20611	.20897	.21186	−0.8
−0.7	.21476	.21770	.22065	.22363	.22663	.22965	.23270	.23576	.23885	.24196	−0.7
−0.6	.24510	.24825	.25143	.25463	.25785	.26109	.26435	.26763	.27093	.27425	−0.6
−0.5	.27760	.28096	.28434	.28774	.29116	.29460	.29806	.30153	.30503	.30854	−0.5
−0.4	.31207	.31561	.31918	.32276	.32636	.32997	.33360	.33724	.34090	.34458	−0.4
−0.3	.34827	.35197	.35569	.35942	.36317	.36693	.37070	.37448	.37828	.38209	−0.3
−0.2	.38591	.38974	.39358	.39743	.40129	.40517	.40905	.41294	.41683	.42074	−0.2
−0.1	.42465	.42858	.43251	.43644	.44038	.44433	.44828	.45224	.45620	.46017	−0.1
−0.0	.46414	.46812	.47210	.47608	.48006	.48405	.48803	.49202	.49601	.50000	0.0

Values of the standardized Gaussian variable, z, are listed to tenths in the rightmost and leftmost columns. Remaining column headings index the hundredth place of z. Right-tail probabilities are obtained using $\Pr\{Z > z\} = 1 - \Pr\{Z \leq z\}$. Probabilities for $Z > 0$ are obtained using the symmetry of the Gaussian distribution, $\Pr\{Z \leq z\} = 1 - \Pr\{Z \leq -z\}$.

TABLE B.2 Quantiles of the Standard ($\beta = 1$) Gamma Distribution

	Cumulative Probability														
α	.001	.01	.05	.10	.20	.30	.40	.50	.60	.70	.80	.90	.95	.99	.999
0.05	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.077	0.262	1.057	2.423
0.10	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000	0.001	0.004	0.018	0.070	0.264	0.575	1.554	3.035
0.15	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.001	0.006	0.021	0.062	0.164	0.442	0.820	1.894	3.439
0.20	0.0000	0.0000	0.0000	0.000	0.000	0.002	0.007	0.021	0.053	0.122	0.265	0.602	1.024	2.164	3.756
0.25	0.0000	0.0000	0.0000	0.000	0.001	0.006	0.018	0.044	0.095	0.188	0.364	0.747	1.203	2.395	4.024
0.30	0.0000	0.0000	0.0000	0.000	0.003	0.013	0.034	0.073	0.142	0.257	0.461	0.882	1.365	2.599	4.262
0.35	0.0000	0.0000	0.0001	0.001	0.007	0.024	0.055	0.108	0.192	0.328	0.556	1.007	1.515	2.785	4.477
0.40	0.0000	0.0000	0.0004	0.002	0.013	0.038	0.080	0.145	0.245	0.398	0.644	1.126	1.654	2.958	4.677
0.45	0.0000	0.0000	0.0010	0.005	0.022	0.055	0.107	0.186	0.300	0.468	0.733	1.240	1.786	3.121	4.863
0.50	0.0000	0.0001	0.0020	0.008	0.032	0.074	0.138	0.228	0.355	0.538	0.819	1.349	1.913	3.274	5.040
0.55	0.0000	0.0002	0.0035	0.012	0.045	0.096	0.170	0.272	0.411	0.607	0.904	1.454	2.034	3.421	5.208
0.60	0.0000	0.0004	0.0057	0.018	0.059	0.120	0.204	0.316	0.467	0.676	0.987	1.556	2.150	3.562	5.370
0.65	0.0000	0.0008	0.0086	0.025	0.075	0.146	0.240	0.362	0.523	0.744	1.068	1.656	2.264	3.698	5.526
0.70	0.0001	0.0013	0.0123	0.033	0.093	0.173	0.276	0.408	0.579	0.811	1.149	1.753	2.374	3.830	5.676
0.75	0.0001	0.0020	0.0168	0.043	0.112	0.201	0.314	0.455	0.636	0.878	1.227	1.848	2.481	3.958	5.822
0.80	0.0003	0.0030	0.0221	0.053	0.132	0.231	0.352	0.502	0.692	0.945	1.305	1.941	2.586	4.083	5.964
0.85	0.0004	0.0044	0.0283	0.065	0.153	0.261	0.391	0.550	0.749	1.010	1.382	2.032	2.689	4.205	6.103
0.90	0.0007	0.0060	0.0353	0.078	0.176	0.292	0.431	0.598	0.805	1.076	1.458	2.122	2.790	4.325	6.239
0.95	0.0010	0.0080	0.0432	0.091	0.199	0.324	0.471	0.646	0.861	1.141	1.533	2.211	2.888	4.441	6.373
1.00	0.0014	0.0105	0.0517	0.106	0.224	0.357	0.512	0.694	0.918	1.206	1.607	2.298	2.986	4.556	6.503
1.05	0.0019	0.0133	0.0612	0.121	0.249	0.391	0.553	0.742	0.974	1.270	1.681	2.384	3.082	4.669	6.631
1.10	0.0022	0.0166	0.0713	0.138	0.275	0.425	0.594	0.791	1.030	1.334	1.759	2.469	3.177	4.781	6.757
1.15	0.0023	0.0202	0.0823	0.155	0.301	0.459	0.636	0.840	1.086	1.397	1.831	2.553	3.270	4.890	6.881
1.20	0.0024	0.0240	0.0938	0.173	0.329	0.494	0.678	0.889	1.141	1.460	1.903	2.636	3.362	4.998	7.003
1.25	0.0031	0.0271	0.1062	0.191	0.357	0.530	0.720	0.938	1.197	1.523	1.974	2.719	3.453	5.105	7.124
1.30	0.0037	0.0321	0.1192	0.210	0.385	0.566	0.763	0.987	1.253	1.586	2.045	2.800	3.544	5.211	7.242
1.35	0.0044	0.0371	0.1328	0.230	0.414	0.602	0.806	1.036	1.308	1.649	2.115	2.881	3.633	5.314	7.360
1.40	0.0054	0.0432	0.1451	0.250	0.443	0.639	0.849	1.085	1.364	1.711	2.185	2.961	3.722	5.418	7.476
1.45	0.0066	0.0493	0.1598	0.272	0.473	0.676	0.892	1.135	1.419	1.773	2.255	3.041	3.809	5.519	7.590
1.50	0.0083	0.0560	0.1747	0.293	0.504	0.713	0.935	1.184	1.474	1.834	2.324	3.120	3.897	5.620	7.704
1.55	0.0106	0.0632	0.1908	0.313	0.534	0.750	0.979	1.234	1.530	1.896	2.392	3.199	3.983	5.720	7.816
1.60	0.0136	0.0708	0.2070	0.336	0.565	0.788	1.023	1.283	1.585	1.957	2.461	3.276	4.068	5.818	7.928
1.65	0.0177	0.0780	0.2238	0.359	0.597	0.826	1.067	1.333	1.640	2.018	2.529	3.354	4.153	5.917	8.038
1.70	0.0232	0.0867	0.2411	0.382	0.628	0.865	1.111	1.382	1.695	2.079	2.597	3.431	4.237	6.014	8.147
1.75	0.0306	0.0958	0.2588	0.406	0.661	0.903	1.155	1.432	1.750	2.140	2.664	3.507	4.321	6.110	8.255

1.80	0.0360	0.1041	0.2771	0.430	0.693	0.942	1.199	1.481	1.805	2.200	2.731	3.584	4.405	6.207	8.362
1.85	0.0406	0.1145	0.2958	0.454	0.726	0.980	1.244	1.531	1.860	2.261	2.798	3.659	4.487	6.301	8.469
1.90	0.0447	0.1243	0.3142	0.479	0.759	1.020	1.288	1.580	1.915	2.321	2.865	3.735	4.569	6.396	8.575
1.95	0.0486	0.1361	0.3338	0.505	0.790	1.059	1.333	1.630	1.969	2.381	2.931	3.809	4.651	6.490	8.679
2.00	0.0525	0.1514	0.3537	0.530	0.823	1.099	1.378	1.680	2.024	2.442	2.997	3.883	4.732	6.582	8.783
2.05	0.0565	0.1637	0.3741	0.556	0.857	1.138	1.422	1.729	2.079	2.501	3.063	3.958	4.813	6.675	8.887
2.10	0.0657	0.1751	0.3949	0.583	0.891	1.178	1.467	1.779	2.133	2.561	3.129	4.032	4.894	6.767	8.989
2.15	0.0697	0.1864	0.4149	0.610	0.925	1.218	1.512	1.829	2.188	2.620	3.195	4.105	4.973	6.858	9.091
2.20	0.0740	0.2002	0.4365	0.637	0.959	1.258	1.557	1.879	2.242	2.680	3.260	4.179	5.053	6.949	9.193
2.25	0.0854	0.2116	0.4584	0.664	0.994	1.298	1.603	1.928	2.297	2.739	3.325	4.252	5.132	7.039	9.294
2.30	0.0898	0.2259	0.4807	0.691	1.029	1.338	1.648	1.978	2.351	2.799	3.390	4.324	5.211	7.129	9.394
2.35	0.0945	0.2378	0.5023	0.718	1.064	1.379	1.693	2.028	2.405	2.858	3.455	4.396	5.289	7.219	9.493
2.40	0.0996	0.2526	0.5244	0.747	1.099	1.420	1.738	2.078	2.459	2.917	3.519	4.468	5.367	7.308	9.592
2.45	0.1134	0.2680	0.5481	0.775	1.134	1.460	1.784	2.127	2.514	2.976	3.584	4.540	5.445	7.397	9.691
2.50	0.1184	0.2803	0.5754	0.804	1.170	1.500	1.829	2.178	2.568	3.035	3.648	4.612	5.522	7.484	9.789
2.55	0.1239	0.2962	0.5978	0.833	1.205	1.539	1.875	2.227	2.622	3.093	3.712	4.683	5.600	7.572	9.886
2.60	0.1297	0.3129	0.6211	0.862	1.241	1.581	1.920	2.277	2.676	3.152	3.776	4.754	5.677	7.660	9.983
2.65	0.1468	0.3255	0.6456	0.890	1.277	1.622	1.966	2.327	2.730	3.210	3.840	4.825	5.753	7.746	10.079
2.70	0.1523	0.3426	0.6705	0.920	1.314	1.663	2.011	2.376	2.784	3.269	3.903	4.896	5.830	7.833	10.176
2.75	0.1583	0.3561	0.6938	0.950	1.350	1.704	2.058	2.427	2.838	3.328	3.967	4.966	5.906	7.919	10.272
2.80	0.1647	0.3735	0.7188	0.980	1.386	1.746	2.103	2.476	2.892	3.386	4.030	5.040	5.982	8.004	10.367
2.85	0.1861	0.3919	0.7441	1.009	1.423	1.787	2.149	2.526	2.946	3.444	4.093	5.120	6.058	8.090	10.461
2.90	0.1919	0.4056	0.7697	1.040	1.460	1.829	2.195	2.576	2.999	3.502	4.156	5.190	6.133	8.175	10.556
2.95	0.1982	0.4242	0.7936	1.070	1.497	1.871	2.241	2.626	3.054	3.560	4.220	5.260	6.208	8.260	10.649
3.00	0.2050	0.4388	0.8193	1.101	1.534	1.913	2.287	2.676	3.108	3.618	4.283	5.329	6.283	8.345	10.743
3.05	0.2123	0.4577	0.8454	1.134	1.571	1.954	2.333	2.726	3.161	3.676	4.346	5.398	6.357	8.429	10.837
3.10	0.2385	0.4778	0.8717	1.165	1.607	1.996	2.378	2.776	3.215	3.734	4.408	5.468	6.432	8.513	10.930
3.15	0.2447	0.4922	0.8982	1.197	1.645	2.038	2.425	2.825	3.268	3.792	4.471	5.537	6.506	8.596	11.023
3.20	0.2514	0.5125	0.9251	1.227	1.682	2.080	2.471	2.875	3.322	3.850	4.533	5.605	6.580	8.680	11.113
3.25	0.2588	0.5278	0.9498	1.259	1.720	2.123	2.517	2.925	3.376	3.907	4.595	5.675	6.654	8.763	11.205
3.30	0.2667	0.5483	0.9767	1.291	1.758	2.165	2.563	2.975	3.430	3.965	4.658	5.743	6.727	8.845	11.298
3.35	0.2995	0.5704	1.0039	1.323	1.796	2.207	2.610	3.025	3.483	4.022	4.720	5.811	6.801	8.928	11.389
3.40	0.3057	0.5850	1.0313	1.354	1.834	2.250	2.656	3.075	3.537	4.079	4.782	5.879	6.874	9.010	11.480
3.45	0.3126	0.6072	1.0590	1.386	1.872	2.292	2.702	3.125	3.590	4.137	4.843	5.948	6.947	9.093	11.570
3.50	0.3201	0.6228	1.0870	1.418	1.910	2.334	2.748	3.175	3.644	4.194	4.905	6.015	7.020	9.174	11.660
3.55	0.3282	0.6450	1.1152	1.451	1.948	2.377	2.795	3.225	3.697	4.252	4.967	6.084	7.092	9.255	11.749
3.60	0.3370	0.6614	1.1405	1.483	1.985	2.420	2.841	3.274	3.750	4.309	5.028	6.152	7.165	9.337	11.840

Tabulated elements are values of the standardized random variable ξ corresponding to the cumulative probabilities $F(\xi)$ given in the column headings, for values of the shape parameter (α) given in the first column. To find quantiles for distributions with other scale parameters, enter the table at the appropriate row, read the standardized value in the appropriate column, and multiply the tabulated value by the scale parameter. To extract cumulative probabilities corresponding to a given value of the random variable, divide the value by the scale parameter, enter the table at the row appropriate to the shape parameter, and interpolate the result from the column headings.

TABLE B.2 Quantiles of the Standard ($\beta = 1$) Gamma Distribution—Cont'd

	Cumulative Probability														
α	.001	.01	.05	.10	.20	.30	.40	.50	.60	.70	.80	.90	.95	.99	.999
3.65	0.3767	0.6837	1.1687	1.516	2.024	2.462	2.887	3.324	3.804	4.366	5.091	6.219	7.237	9.418	11.929
3.70	0.3830	0.7084	1.1972	1.549	2.062	2.505	2.934	3.374	3.858	4.423	5.152	6.286	7.310	9.499	12.017
3.75	0.3900	0.7233	1.2259	1.582	2.101	2.547	2.980	3.425	3.911	4.480	5.214	6.354	7.381	9.579	12.107
3.80	0.3978	0.7480	1.2549	1.613	2.140	2.590	3.027	3.474	3.964	4.537	5.275	6.420	7.454	9.659	12.195
3.85	0.4064	0.7637	1.2843	1.646	2.179	2.633	3.073	3.524	4.018	4.594	5.336	6.488	7.525	9.740	12.284
3.90	0.4157	0.7883	1.3101	1.680	2.218	2.676	3.120	3.574	4.071	4.651	5.397	6.555	7.596	9.820	12.371
3.95	0.4259	0.8049	1.3393	1.713	2.257	2.719	3.163	3.624	4.124	4.708	5.458	6.622	7.668	9.900	12.459
4.00	0.4712	0.8294	1.3687	1.746	2.295	2.762	3.209	3.674	4.177	4.765	5.519	6.689	7.739	9.980	12.546
4.05	0.4779	0.8469	1.3984	1.780	2.334	2.805	3.256	3.724	4.231	4.822	5.580	6.755	7.811	10.059	12.634
4.10	0.4853	0.8714	1.4285	1.814	2.373	2.848	3.302	3.774	4.284	4.879	5.641	6.821	7.882	10.137	12.721
4.15	0.4937	0.8999	1.4551	1.848	2.413	2.891	3.350	3.823	4.337	4.936	5.701	6.888	7.952	10.216	12.807
4.20	0.5030	0.9141	1.4850	1.882	2.451	2.935	3.396	3.874	4.390	4.992	5.762	6.954	8.023	10.295	12.894
4.25	0.5133	0.9424	1.5150	1.916	2.491	2.978	3.443	3.924	4.444	5.049	5.823	7.020	8.093	10.374	12.981
4.30	0.5244	0.9575	1.5454	1.950	2.531	3.021	3.489	3.974	4.497	5.105	5.883	7.086	8.170	10.453	13.066
4.35	0.5779	0.9856	1.5762	1.985	2.572	3.065	3.537	4.024	4.550	5.162	5.944	7.153	8.264	10.531	13.152
4.40	0.5842	1.0016	1.6034	2.017	2.612	3.108	3.584	4.074	4.603	5.218	6.005	7.219	8.334	10.609	13.238
4.45	0.5916	1.0294	1.6339	2.051	2.653	3.152	3.630	4.123	4.656	5.274	6.065	7.284	8.405	10.687	13.324
4.50	0.6001	1.0463	1.6646	2.085	2.691	3.195	3.677	4.173	4.709	5.331	6.126	7.350	8.475	10.765	13.410
4.55	0.6096	1.0739	1.6956	2.120	2.731	3.239	3.724	4.223	4.762	5.387	6.186	7.415	8.544	10.843	13.495
4.60	0.6202	1.0917	1.7271	2.155	2.771	3.283	3.771	4.273	4.815	5.443	6.246	7.480	8.615	10.920	13.578
4.65	0.6319	1.1191	1.7547	2.190	2.812	3.326	3.817	4.323	4.868	5.501	6.306	7.546	8.684	10.998	13.663
4.70	0.6978	1.1378	1.7857	2.225	2.852	3.369	3.864	4.373	4.921	5.557	6.366	7.611	8.754	11.075	13.748
4.75	0.7031	1.1649	1.8170	2.260	2.890	3.412	3.911	4.423	4.974	5.613	6.426	7.676	8.823	11.152	13.832
4.80	0.7095	1.1844	1.8487	2.295	2.930	3.456	3.958	4.474	5.027	5.669	6.486	7.742	8.892	11.229	13.916
4.85	0.7172	1.2113	1.8809	2.330	2.970	3.500	4.005	4.524	5.081	5.725	6.546	7.807	8.962	11.306	14.000
4.90	0.7262	1.2465	1.9088	2.366	3.011	3.544	4.052	4.573	5.134	5.781	6.606	7.872	9.031	11.382	14.084
4.95	0.7365	1.2582	1.9403	2.398	3.051	3.588	4.099	4.623	5.186	5.837	6.665	7.937	9.100	11.457	14.168
5.00	0.7482	1.2931	1.9722	2.434	3.091	3.632	4.146	4.673	5.239	5.893	6.725	8.002	9.169	11.534	14.251
5.5	0.917	1.527	2.287	2.789	3.494	4.074	4.619	5.170	5.765	6.449	7.316	8.638	9.838	12.362	15.632
6.0	1.107	1.785	2.613	3.152	3.904	4.517	5.091	5.670	6.292	7.006	7.906	9.275	10.513	13.108	16.455
6.5	1.309	2.053	2.946	3.521	4.317	4.963	5.565	6.170	6.818	7.559	8.492	9.906	11.181	13.844	17.264
7.0	1.520	2.330	3.285	3.895	4.734	5.411	6.039	6.670	7.343	8.111	9.075	10.532	11.842	14.571	18.062
7.5	1.741	2.615	3.630	4.273	5.153	5.861	6.515	7.169	7.867	8.661	9.655	11.154	12.498	15.289	18.849
8.0	1.971	2.906	3.981	4.656	5.576	6.312	6.991	7.669	8.390	9.209	10.233	11.771	13.148	16.000	19.626
8.5	2.208	3.204	4.336	5.043	6.001	6.765	7.469	8.169	8.912	9.756	10.807	12.385	13.794	16.704	20.395
9.0	2.452	3.507	4.695	5.432	6.428	7.220	7.947	8.669	9.434	10.301	11.380	12.995	14.435	17.403	21.156

9.5	2.703	3.816	5.059	5.825	6.858	7.676	8.425	9.169	9.955	10.845	11.950	13.602	15.072	18.095	21.910
10.0	2.961	4.130	5.425	6.221	7.289	8.133	8.904	9.669	10.476	11.387	12.519	14.206	15.705	18.783	22.657
10.5	3.223	4.449	5.796	6.620	7.722	8.591	9.384	10.169	10.996	11.929	13.086	14.808	16.335	19.466	23.399
11.0	3.491	4.771	6.169	7.021	8.157	9.050	9.864	10.669	11.515	12.470	13.651	15.407	16.962	20.145	24.134
11.5	3.765	5.098	6.545	7.424	8.593	9.511	10.345	11.168	12.034	13.009	14.214	16.003	17.586	20.819	24.864
12.0	4.042	5.428	6.924	7.829	9.031	9.972	10.826	11.668	12.553	13.548	14.777	16.598	18.208	21.490	25.589
12.5	4.325	5.762	7.306	8.237	9.470	10.434	11.308	12.168	13.072	14.086	15.338	17.191	18.826	22.157	26.310
13.0	4.611	6.099	7.690	8.646	9.910	10.896	11.790	12.668	13.589	14.623	15.897	17.782	19.443	22.821	27.026
13.5	4.901	6.439	8.076	9.057	10.351	11.360	12.272	13.168	14.107	15.160	16.456	18.371	20.057	23.481	27.738
14.0	5.195	6.782	8.464	9.470	10.794	11.824	12.755	13.668	14.624	15.695	17.013	18.958	20.669	24.139	28.446
14.5	5.493	7.128	8.854	9.884	11.238	12.288	13.238	14.168	15.141	16.231	17.570	19.544	21.278	24.794	29.151
15.0	5.794	7.477	9.246	10.300	11.682	12.754	13.721	14.668	15.658	16.765	18.125	20.128	21.886	25.446	29.852
15.5	6.098	7.828	9.640	10.717	12.128	13.220	14.204	15.168	16.174	17.299	18.680	20.711	22.493	26.096	30.549
16.0	6.405	8.181	10.036	11.135	12.574	13.686	14.688	15.668	16.690	17.832	19.233	21.292	23.097	26.743	31.244
16.5	6.715	8.537	10.433	11.555	13.021	14.153	15.172	16.168	17.206	18.365	19.786	21.873	23.700	27.388	31.935
17.0	7.028	8.895	10.832	11.976	13.469	14.621	15.657	16.668	17.722	18.898	20.338	22.452	24.301	28.030	32.624
17.5	7.344	9.254	11.233	12.398	13.918	15.089	16.141	17.168	18.237	19.430	20.889	23.029	24.901	28.671	33.309
18.0	7.662	9.616	11.634	12.822	14.367	15.558	16.626	17.668	18.752	19.961	21.439	23.606	25.499	29.310	33.993
18.5	7.983	9.980	12.037	13.246	14.818	16.027	17.111	18.168	19.267	20.492	21.989	24.182	26.096	29.946	34.673
19.0	8.306	10.346	12.442	13.671	15.269	16.496	17.596	18.668	19.782	21.023	22.538	24.756	26.692	30.581	35.351
19.5	8.631	10.713	12.848	14.098	15.720	16.966	18.081	19.168	20.297	21.553	23.087	25.330	27.286	31.214	36.027
20.0	8.958	11.082	13.255	14.525	16.172	17.436	18.567	19.668	20.811	22.082	23.634	25.903	27.879	31.845	36.701
25.0	12.337	14.853	17.382	18.844	20.725	22.157	23.432	24.667	25.946	27.361	29.082	31.584	33.752	38.077	43.330
30.0	15.869	18.742	21.594	23.229	25.320	26.905	28.310	29.667	31.067	32.613	34.486	37.198	39.541	44.190	49.804
35.0	19.518	22.721	25.870	27.664	29.949	31.673	33.198	34.667	36.179	37.845	39.857	42.764	45.266	50.213	56.159
40.0	23.260	26.770	30.196	32.139	34.603	36.458	38.094	39.667	41.283	43.060	45.203	48.289	50.940	56.164	62.420
45.0	27.078	30.877	34.563	36.646	39.279	41.256	42.996	44.667	46.381	48.262	50.527	53.782	56.573	62.058	68.604
50.0	30.959	35.032	38.965	41.179	43.973	46.064	47.904	49.667	51.473	53.453	55.833	59.249	62.171	67.903	74.725
55.0	34.895	39.229	43.396	45.736	48.681	50.883	52.816	54.667	56.561	58.634	61.125	64.693	67.740	73.707	80.790
60.0	38.878	43.462	47.852	50.312	53.403	55.709	57.732	59.667	61.645	63.808	66.403	70.116	73.284	79.475	86.809
65.0	42.902	47.725	52.331	54.905	58.136	60.543	62.652	64.667	66.725	68.974	71.670	75.523	78.805	85.212	92.786
70.0	46.963	52.017	56.830	59.515	62.879	65.383	67.575	69.667	71.802	74.134	76.927	80.913	84.306	90.920	98.725
80.0	55.180	60.673	65.878	68.773	72.392	75.079	77.428	79.667	81.949	84.438	87.414	91.655	95.258	102.26	110.51
90.0	63.506	69.410	74.984	78.076	81.934	84.794	87.290	89.667	92.087	94.723	97.872	102.35	106.15	113.53	122.19
100.0	71.921	78.216	84.139	87.418	91.501	94.524	97.160	99.669	102.22	104.99	108.30	113.01	117.00	124.72	133.77

Tabulated elements are values of the standardized random variable ξ corresponding to the cumulative probabilities $F(\xi)$ given in the column headings, for values of the shape parameter (α) given in the first column. To find quantiles for distributions with other scale parameters, enter the table at the appropriate row, read the standardized value in the appropriate column, and multiply the tabulated value by the scale parameter. To extract cumulative probabilities corresponding to a given value of the random variable, divide the value by the scale parameter, enter the table at the row appropriate to the shape parameter, and interpolate the result from the column headings.

TABLE B.3 Right-Tail Quantiles of the Chi-Square Distribution

	Cumulative Probability					
ν	0.50	0.90	0.95	0.99	0.999	0.9999
1	0.455	2.706	3.841	6.635	10.828	15.137
2	1.386	4.605	5.991	9.210	13.816	18.421
3	2.366	6.251	7.815	11.345	16.266	21.108
4	3.357	7.779	9.488	13.277	18.467	23.512
5	4.351	9.236	11.070	15.086	20.515	25.745
6	5.348	10.645	12.592	16.812	22.458	27.855
7	6.346	12.017	14.067	18.475	24.322	29.878
8	7.344	13.362	15.507	20.090	26.124	31.827
9	8.343	14.684	16.919	21.666	27.877	33.719
10	9.342	15.987	18.307	23.209	29.588	35.563
11	10.341	17.275	19.675	24.725	31.264	37.366
12	11.340	18.549	21.026	26.217	32.910	39.134
13	12.340	19.812	22.362	27.688	34.528	40.871
14	13.339	21.064	23.685	29.141	36.123	42.578
15	14.339	22.307	24.996	30.578	37.697	44.262
16	15.338	23.542	26.296	32.000	39.252	45.925
17	16.338	24.769	27.587	33.409	40.790	47.566
18	17.338	25.989	28.869	34.805	42.312	49.190
19	18.338	27.204	30.144	36.191	43.820	50.794
20	19.337	28.412	31.410	37.566	45.315	52.385
21	20.337	29.615	32.671	38.932	46.797	53.961
22	21.337	30.813	33.924	40.289	48.268	55.523
23	22.337	32.007	35.172	41.638	49.728	57.074
24	23.337	33.196	36.415	42.980	51.179	58.613
25	24.337	34.382	37.652	44.314	52.620	60.140
26	25.336	35.563	38.885	45.642	54.052	61.656
27	26.336	36.741	40.113	46.963	55.476	63.164
28	27.336	37.916	41.337	48.278	56.892	64.661
29	28.336	39.087	42.557	49.588	58.301	66.152
30	29.336	40.256	43.773	50.892	59.703	67.632
31	30.336	41.422	44.985	52.191	61.098	69.104
32	31.336	42.585	46.194	53.486	62.487	70.570
33	32.336	43.745	47.400	54.776	63.870	72.030
34	33.336	44.903	48.602	56.061	65.247	73.481
35	34.336	46.059	49.802	57.342	66.619	74.926
36	35.336	47.212	50.998	58.619	67.985	76.365
37	36.336	48.363	52.192	59.892	69.347	77.798
38	37.335	49.513	53.384	61.162	70.703	79.224
39	38.335	50.660	54.572	62.428	72.055	80.645
40	39.335	51.805	55.758	63.691	73.402	82.061
41	40.335	52.949	56.942	64.950	74.745	83.474
42	41.335	54.090	58.124	66.206	76.084	84.880
43	42.335	55.230	59.304	67.459	77.419	86.280
44	43.335	56.369	60.481	68.710	78.750	87.678
45	44.335	57.505	61.656	69.957	80.077	89.070
46	45.335	58.641	62.830	71.201	81.400	90.456
47	46.335	59.774	64.001	72.443	82.721	91.842
48	47.335	60.907	65.171	73.683	84.037	93.221
49	48.335	62.038	66.339	74.919	85.351	94.597
50	49.335	63.167	67.505	76.154	86.661	95.968

TABLE B.3 Right-Tail Quantiles of the Chi-Square Distribution—Cont'd

	Cumulative Probability					
ν	**0.50**	**0.90**	**0.95**	**0.99**	**0.999**	**0.9999**
55	54.335	68.796	73.311	82.292	93.168	102.776
60	59.335	74.397	79.082	88.379	99.607	109.501
65	64.335	79.973	84.821	94.422	105.988	116.160
70	69.334	85.527	90.531	100.425	112.317	122.754
75	74.334	91.061	96.217	106.393	118.599	129.294
80	79.334	96.578	101.879	112.329	124.839	135.783
85	84.334	102.079	107.522	118.236	131.041	142.226
90	89.334	107.565	113.145	124.116	137.208	148.626
95	94.334	113.038	118.752	129.973	143.344	154.989
100	99.334	118.498	124.342	135.807	149.449	161.318

For large v, the Chi-square distribution is approximately Gaussian, with mean v and variance $2v$.