

Bonferroniizing t and Other Tests

One of the simplest methods to protect against the so-called **multiple testing problem** is based on the *Bonferroni inequality*:

Let E_1, E_2, \dots, E_K be *any* "events", with probabilities $P(E_i)$, $i = 1, \dots, K$, and let F be the derived event $\{E_1 \text{ or } E_2 \text{ or } \dots \text{ or } E_K\}$ (sometimes notated $E_1 \cup E_2 \cup \dots \cup E_K$). That is, F occurs if and only if at least one of the events E_1, E_2, \dots, E_K occurs. Then

$$\max\{P(E_1), P(E_2), \dots, P(E_K)\} \leq P(F) \leq P(E_1) + P(E_2) + \dots + P(E_K)$$

There is *no* requirement that the events E_i be either independent or disjoint (mutually exclusive).

Note that the event $F = \{E_1 \text{ or } E_2 \text{ or } \dots \text{ or } E_K\}$ occurs if and only if *at least one* of the events E_1, E_2, \dots, E_K occurs, and its complement (negation) $\text{not}F = \text{not}\{E_1 \text{ or } E_2 \text{ or } \dots \text{ or } E_K\}$ occurs when and only when *none* of these events occurs.

Suppose you are testing K null hypotheses, $H_{01}, H_{02}, \dots, H_{0K}$, associated with a single experiment or data set, and each test separately has type I error probability α' , that is, $P(\text{reject } H_{0j} \mid H_{0j} \text{ is true}) = \alpha'$.

Define events E_1, E_2, \dots, E_K and F as follows:

$$E_1 = \{\text{you reject } H_{01}\}, E_2 = \{\text{you reject } H_{02}\}, \dots, E_K = \{\text{you reject } H_{0K}\}$$

$$F = \{\text{you reject at least one of } H_{01}, H_{02}, \dots, H_{0K}\}.$$

Then F is of the form given above, that is $F = \{E_1 \text{ or } E_2 \text{ or } \dots \text{ or } E_K\}$, since it occurs if and only if at least one of the events E_j occurs. Then, when *all* the null hypotheses are correct, the probability of erroneously rejecting at least one of them, that is, the probability of event F , is

$$P(F) \leq P(E_1) + P(E_2) + \dots + P(E_K) = \alpha' + \alpha' + \dots + \alpha' = K\alpha'.$$

Let H_0 be the *combined* null hypothesis $\{H_{01} \text{ and } H_{01} \text{ and } \dots \text{ and } H_{0K}\}$ (sometimes notated $H_{01} \cap H_{02} \cap \dots \cap H_{0K}$), that is, H_0 is true if *all* the H_{0j} are true and H_0 is false if *any* of the hypotheses $H_{01}, H_{02}, \dots, H_{0K}$ is false.

A plausible test of H_0 is

"reject if H_0 if *any* H_{0j} can be rejected at some significance level α' ". Then this test of the combined null hypothesis H_0 has significance level $= P(\text{reject } H_0 \mid H_0) = P(F) \leq K\alpha'$. (This *is* a test of H_0 since it specifies precisely under what conditions H_0 is to be rejected.)

Suppose now you want a particular value α to be the desired significance level, say $\alpha = 0.05$. If you let the significance level of each individual test be $\alpha' = \alpha/K$, then

Bonferroni t

(significance level of the combined test) $\leq K\alpha' = K(\alpha/K) = \alpha$. Thus, although you have made many (K) tests, you are protected against making a type I error relative to the overall null hypothesis H_0 . We sometimes say α is an upper bound on the *experimentwise* type I error rate. The price you pay is that, for testing any *particular* H_{0j} , the type I error rate is $\alpha' = \alpha/K$, which may be so stringent that you have low *power* – a high probability of a type II error (*not* rejecting H_{0j} when it is true).

The procedure of using $\alpha' = \alpha/K$ for the significance level of the tests of the individual hypotheses is often called *Bonferronizing* the individual tests. It is applicable, although often not optimal, in *all* situations in which an overall null hypothesis can be expressed as the combination of several individual null hypothesis for which tests are known.

Bonferronizing is often easier in terms of P-values. If you can compute P-values (observed significance levels) P_1, \dots, P_K for each individual test, then the *Bonferronized P-value* is $K \times \min_j \{P_j\}$. You now reject H_0 if and only if the Bonferronized P-value $\leq \alpha$.

Further, you can also reject any individual H_{0j} for which $KP_j \leq \alpha$. For example, if you are testing $K = 5$ hypotheses and have computed P-values .323, .007, .009, .123, and .567 whose minimum is .007, the Bonferronized P-value is $5 \times .007 = .035$. You can reject the *overall* null hypothesis if $\alpha = .05$ but not if $\alpha = .01$, even though you could reject H_2 and H_3 *individually* at level $\alpha = .01$. And you can reject H_2 and H_3 at significance level $\alpha = .05$.

It's easy to Bonferronize t-tests (or other tests) in MacAnova.

For example, if `tstats` is a vector of K t-statistics, each `fe` degrees of freedom, you can compute a Bonferronized two-tail P-value by

```
Cmd> pvalue <- length(tstats)*min(twotailt(tstats,fe))
```

The two-tail Bonferronized critical value(s) can be computed by

```
Cmd> critval <- invstu(1 - (alpha/length(tstats))/2, fe)
```

Similarly if `fstats` is a vector of F-statistics and `fh` and `fe` are scalars or vectors containing numerator and denominator degrees of freedom, respectively, then

```
Cmd> pvalue <- length(fstats)*min(1 - cumF(fstats,fh,fe))
```

and

```
Cmd> critval <- invF(1 - alpha/length(tstats), fh, fe)
```

compute Bonferronized P-values and critical values.

Without MacAnova, you need special tables. The next few pages contain tables of two-tail Bonferronized critical values for Student's t.

Bonferroni t

Suppose that all hypothesis tests are two tailed tests based on Student's t-statistics t_1, t_2, \dots, t_M , all with the *same* degrees of freedom f_e and you want an experimentwise type I error rate no greater than α . Then to use the Bonferroni method you need tables of $t_{f_e, \alpha/(2M)}$.

The tables below contain values of $t_{f_e, \alpha/(2M)}$ for $f_e = 4, 5, 6, \dots, 30, 32, \dots, 90, \alpha = .10, .05,$ and $.01$, and $K = 2, 3, \dots, 10, 15, 21, 28, 36$. You can also use the critical values from these tables for computing *simultaneous* confidence intervals for means based on Student's that have the property that you can have confidence $1 - \alpha$ that *all* the intervals contain their targeted means.

Two tail Bonferroni t probability points, $\alpha = 0.10$													
$f_e \backslash K$	2	3	4	5	6	7	8	9	10	15	21	28	36
4	2.776	3.186	3.495	3.747	3.961	4.148	4.315	4.466	4.604	5.167	5.673	6.138	6.570
5	2.571	2.912	3.163	3.365	3.534	3.681	3.810	3.926	4.032	4.456	4.829	5.164	5.471
6	2.447	2.749	2.969	3.143	3.287	3.412	3.521	3.619	3.707	4.058	4.362	4.632	4.876
7	2.365	2.642	2.841	2.998	3.128	3.238	3.335	3.422	3.499	3.806	4.068	4.299	4.506
8	2.306	2.566	2.752	2.896	3.016	3.117	3.206	3.285	3.355	3.632	3.867	4.072	4.256
9	2.262	2.510	2.685	2.821	2.933	3.028	3.111	3.184	3.250	3.505	3.721	3.909	4.075
10	2.228	2.466	2.634	2.764	2.870	2.960	3.038	3.107	3.169	3.409	3.611	3.785	3.939
11	2.201	2.431	2.593	2.718	2.820	2.906	2.981	3.047	3.106	3.334	3.524	3.689	3.833
12	2.179	2.403	2.560	2.681	2.779	2.863	2.934	2.998	3.055	3.273	3.455	3.611	3.749
13	2.160	2.380	2.533	2.650	2.746	2.827	2.896	2.957	3.012	3.223	3.398	3.548	3.679
14	2.145	2.360	2.510	2.624	2.718	2.796	2.864	2.924	2.977	3.181	3.350	3.495	3.621
15	2.131	2.343	2.490	2.602	2.694	2.770	2.837	2.895	2.947	3.146	3.310	3.450	3.573
16	2.120	2.328	2.473	2.583	2.673	2.748	2.813	2.870	2.921	3.115	3.275	3.412	3.531
17	2.110	2.316	2.458	2.567	2.655	2.729	2.793	2.848	2.898	3.089	3.245	3.378	3.494
18	2.101	2.304	2.445	2.552	2.639	2.712	2.775	2.829	2.878	3.065	3.219	3.349	3.463
19	2.093	2.294	2.433	2.539	2.625	2.697	2.759	2.813	2.861	3.045	3.196	3.323	3.435
20	2.086	2.285	2.423	2.528	2.613	2.683	2.744	2.798	2.845	3.026	3.175	3.301	3.410
21	2.080	2.278	2.414	2.518	2.601	2.671	2.732	2.784	2.831	3.010	3.156	3.280	3.388
22	2.074	2.270	2.405	2.508	2.591	2.661	2.720	2.772	2.819	2.995	3.140	3.262	3.368
23	2.069	2.264	2.398	2.500	2.582	2.651	2.710	2.761	2.807	2.982	3.125	3.245	3.350
24	2.064	2.258	2.391	2.492	2.574	2.642	2.700	2.751	2.797	2.970	3.111	3.230	3.333
25	2.060	2.252	2.385	2.485	2.566	2.634	2.692	2.742	2.787	2.959	3.098	3.216	3.318
26	2.056	2.247	2.379	2.479	2.559	2.626	2.684	2.734	2.779	2.949	3.087	3.204	3.304
27	2.052	2.243	2.373	2.473	2.552	2.619	2.676	2.726	2.771	2.939	3.076	3.192	3.292
28	2.048	2.238	2.368	2.467	2.546	2.613	2.669	2.719	2.763	2.930	3.067	3.181	3.280
29	2.045	2.234	2.364	2.462	2.541	2.607	2.663	2.713	2.756	2.922	3.057	3.171	3.269
30	2.042	2.231	2.360	2.457	2.536	2.601	2.657	2.706	2.750	2.915	3.049	3.162	3.259
32	2.037	2.224	2.352	2.449	2.526	2.591	2.647	2.695	2.738	2.902	3.034	3.145	3.241
34	2.032	2.218	2.345	2.441	2.518	2.583	2.638	2.686	2.728	2.890	3.021	3.131	3.226
36	2.028	2.213	2.339	2.434	2.511	2.575	2.629	2.677	2.719	2.879	3.009	3.118	3.212
38	2.024	2.208	2.334	2.429	2.505	2.568	2.622	2.670	2.712	2.870	2.999	3.107	3.199
40	2.021	2.204	2.329	2.423	2.499	2.562	2.616	2.663	2.704	2.862	2.989	3.096	3.188
42	2.018	2.200	2.325	2.418	2.494	2.556	2.610	2.657	2.698	2.855	2.981	3.087	3.179
44	2.015	2.197	2.321	2.414	2.489	2.551	2.605	2.651	2.692	2.848	2.974	3.079	3.170
46	2.013	2.194	2.317	2.410	2.485	2.547	2.600	2.646	2.687	2.842	2.967	3.071	3.161
48	2.011	2.191	2.314	2.407	2.481	2.543	2.595	2.641	2.682	2.836	2.960	3.065	3.154
50	2.009	2.188	2.311	2.403	2.477	2.539	2.591	2.637	2.678	2.831	2.955	3.058	3.147
52	2.007	2.186	2.308	2.400	2.474	2.535	2.588	2.633	2.674	2.826	2.949	3.052	3.141

Bonferroni t

Two tail Bonferroni t probability points, $\alpha = 0.10$ (continued)

$f_e \backslash K$	2	3	4	5	6	7	8	9	10	15	21	28	36
54	2.005	2.184	2.306	2.397	2.471	2.532	2.584	2.630	2.670	2.822	2.945	3.047	3.135
56	2.003	2.182	2.303	2.395	2.468	2.529	2.581	2.626	2.667	2.818	2.940	3.042	3.130
58	2.002	2.180	2.301	2.392	2.465	2.526	2.578	2.623	2.663	2.814	2.936	3.038	3.125
60	2.000	2.178	2.299	2.390	2.463	2.524	2.575	2.620	2.660	2.811	2.932	3.033	3.120
62	1.999	2.177	2.297	2.388	2.461	2.521	2.573	2.618	2.657	2.807	2.928	3.029	3.116
64	1.998	2.175	2.295	2.386	2.459	2.519	2.570	2.615	2.655	2.804	2.925	3.026	3.112
66	1.997	2.174	2.294	2.384	2.457	2.517	2.568	2.613	2.652	2.802	2.922	3.022	3.108
68	1.995	2.172	2.292	2.382	2.455	2.515	2.566	2.611	2.650	2.799	2.919	3.019	3.104
70	1.994	2.171	2.291	2.381	2.453	2.513	2.564	2.608	2.648	2.796	2.916	3.016	3.101
72	1.993	2.170	2.289	2.379	2.451	2.511	2.562	2.606	2.646	2.794	2.913	3.013	3.098
74	1.993	2.169	2.288	2.378	2.450	2.509	2.560	2.605	2.644	2.792	2.911	3.010	3.095
76	1.992	2.167	2.287	2.376	2.448	2.508	2.559	2.603	2.642	2.790	2.908	3.007	3.092
78	1.991	2.166	2.285	2.375	2.447	2.506	2.557	2.601	2.640	2.788	2.906	3.005	3.090
80	1.990	2.165	2.284	2.374	2.445	2.505	2.555	2.600	2.639	2.786	2.904	3.003	3.087
82	1.989	2.165	2.283	2.373	2.444	2.503	2.554	2.598	2.637	2.784	2.902	3.000	3.085
84	1.989	2.164	2.282	2.372	2.443	2.502	2.553	2.597	2.636	2.782	2.900	2.998	3.082
86	1.988	2.163	2.281	2.370	2.442	2.501	2.551	2.595	2.634	2.781	2.898	2.996	3.080
88	1.987	2.162	2.280	2.369	2.441	2.500	2.550	2.594	2.633	2.779	2.896	2.994	3.078
90	1.987	2.161	2.280	2.368	2.440	2.499	2.549	2.593	2.632	2.777	2.895	2.992	3.076

Two tail Bonferroni t probability points, $\alpha = 0.05$

$f_e \backslash K$	2	3	4	5	6	7	8	9	10	15	21	28	36
4	3.495	3.961	4.315	4.604	4.851	5.068	5.261	5.437	5.598	6.254	6.847	7.392	7.900
5	3.163	3.534	3.810	4.032	4.219	4.382	4.526	4.655	4.773	5.247	5.666	6.045	6.391
6	2.969	3.287	3.521	3.707	3.863	3.997	4.115	4.221	4.317	4.698	5.030	5.326	5.594
7	2.841	3.128	3.335	3.499	3.636	3.753	3.855	3.947	4.029	4.355	4.636	4.884	5.107
8	2.752	3.016	3.206	3.355	3.479	3.584	3.677	3.759	3.833	4.122	4.370	4.587	4.781
9	2.685	2.933	3.111	3.250	3.364	3.462	3.547	3.622	3.690	3.954	4.179	4.374	4.549
10	2.634	2.870	3.038	3.169	3.277	3.368	3.448	3.518	3.581	3.827	4.035	4.215	4.375
11	2.593	2.820	2.981	3.106	3.208	3.295	3.370	3.437	3.497	3.728	3.923	4.091	4.240
12	2.560	2.779	2.934	3.055	3.153	3.236	3.308	3.371	3.428	3.649	3.833	3.992	4.133
13	2.533	2.746	2.896	3.012	3.107	3.187	3.256	3.318	3.372	3.584	3.760	3.912	4.045
14	2.510	2.718	2.864	2.977	3.069	3.146	3.214	3.273	3.326	3.530	3.699	3.845	3.973
15	2.490	2.694	2.837	2.947	3.036	3.112	3.177	3.235	3.286	3.484	3.648	3.788	3.911
16	2.473	2.673	2.813	2.921	3.008	3.082	3.146	3.202	3.252	3.444	3.604	3.740	3.859
17	2.458	2.655	2.793	2.898	2.984	3.056	3.119	3.173	3.222	3.410	3.565	3.698	3.814
18	2.445	2.639	2.775	2.878	2.963	3.034	3.095	3.149	3.197	3.380	3.532	3.661	3.774
19	2.433	2.625	2.759	2.861	2.944	3.014	3.074	3.127	3.174	3.354	3.503	3.629	3.739
20	2.423	2.613	2.744	2.845	2.927	2.996	3.055	3.107	3.153	3.331	3.477	3.601	3.709
21	2.414	2.601	2.732	2.831	2.912	2.980	3.038	3.090	3.135	3.310	3.453	3.575	3.681
22	2.405	2.591	2.720	2.819	2.899	2.965	3.023	3.074	3.119	3.291	3.432	3.552	3.656
23	2.398	2.582	2.710	2.807	2.886	2.952	3.009	3.059	3.104	3.274	3.413	3.531	3.634
24	2.391	2.574	2.700	2.797	2.875	2.941	2.997	3.046	3.091	3.258	3.396	3.513	3.614
25	2.385	2.566	2.692	2.787	2.865	2.930	2.986	3.035	3.078	3.244	3.380	3.495	3.595
26	2.379	2.559	2.684	2.779	2.856	2.920	2.975	3.024	3.067	3.231	3.366	3.480	3.578
27	2.373	2.552	2.676	2.771	2.847	2.911	2.966	3.014	3.057	3.219	3.353	3.465	3.563
28	2.368	2.546	2.669	2.763	2.839	2.902	2.957	3.004	3.047	3.208	3.340	3.452	3.549
29	2.364	2.541	2.663	2.756	2.832	2.894	2.949	2.996	3.038	3.198	3.329	3.440	3.535
30	2.360	2.536	2.657	2.750	2.825	2.887	2.941	2.988	3.030	3.189	3.319	3.428	3.523
32	2.352	2.526	2.647	2.738	2.812	2.874	2.927	2.974	3.015	3.172	3.300	3.408	3.501
34	2.345	2.518	2.638	2.728	2.802	2.863	2.915	2.961	3.002	3.157	3.283	3.390	3.482
36	2.339	2.511	2.629	2.719	2.792	2.853	2.905	2.950	2.990	3.144	3.269	3.374	3.465

Bonferroni t

Two tail Bonferroni t probability points, $\alpha = 0.05$ (continued)

$f_e \backslash K$	2	3	4	5	6	7	8	9	10	15	21	28	36
38	2.334	2.505	2.622	2.712	2.783	2.844	2.895	2.940	2.980	3.132	3.256	3.360	3.450
40	2.329	2.499	2.616	2.704	2.776	2.836	2.887	2.931	2.971	3.122	3.244	3.347	3.436
42	2.325	2.494	2.610	2.698	2.769	2.828	2.879	2.924	2.963	3.112	3.234	3.336	3.424
44	2.321	2.489	2.605	2.692	2.763	2.822	2.872	2.916	2.956	3.104	3.224	3.326	3.413
46	2.317	2.485	2.600	2.687	2.757	2.816	2.866	2.910	2.949	3.096	3.216	3.317	3.403
48	2.314	2.481	2.595	2.682	2.752	2.810	2.860	2.904	2.943	3.089	3.208	3.308	3.394
50	2.311	2.477	2.591	2.678	2.747	2.805	2.855	2.898	2.937	3.083	3.201	3.300	3.386
52	2.308	2.474	2.588	2.674	2.743	2.801	2.850	2.893	2.932	3.077	3.194	3.293	3.378
54	2.306	2.471	2.584	2.670	2.739	2.796	2.846	2.889	2.927	3.071	3.188	3.287	3.371
56	2.303	2.468	2.581	2.667	2.735	2.793	2.842	2.884	2.923	3.066	3.183	3.281	3.365
58	2.301	2.465	2.578	2.663	2.732	2.789	2.838	2.880	2.918	3.062	3.178	3.275	3.359
60	2.299	2.463	2.575	2.660	2.729	2.785	2.834	2.877	2.915	3.057	3.173	3.270	3.353
62	2.297	2.461	2.573	2.657	2.726	2.782	2.831	2.873	2.911	3.053	3.168	3.265	3.348
64	2.295	2.459	2.570	2.655	2.723	2.779	2.828	2.870	2.908	3.049	3.164	3.260	3.343
66	2.294	2.457	2.568	2.652	2.720	2.777	2.825	2.867	2.904	3.046	3.160	3.256	3.338
68	2.292	2.455	2.566	2.650	2.718	2.774	2.822	2.864	2.902	3.042	3.156	3.252	3.334
70	2.291	2.453	2.564	2.648	2.715	2.771	2.820	2.862	2.899	3.039	3.153	3.248	3.330
72	2.289	2.451	2.562	2.646	2.713	2.769	2.817	2.859	2.896	3.036	3.150	3.245	3.326
74	2.288	2.450	2.560	2.644	2.711	2.767	2.815	2.857	2.894	3.033	3.146	3.241	3.322
76	2.287	2.448	2.559	2.642	2.709	2.765	2.813	2.854	2.891	3.031	3.144	3.238	3.319
78	2.285	2.447	2.557	2.640	2.707	2.763	2.811	2.852	2.889	3.028	3.141	3.235	3.316
80	2.284	2.445	2.555	2.639	2.705	2.761	2.809	2.850	2.887	3.026	3.138	3.232	3.313
82	2.283	2.444	2.554	2.637	2.704	2.759	2.807	2.848	2.885	3.024	3.136	3.229	3.310
84	2.282	2.443	2.553	2.636	2.702	2.758	2.805	2.846	2.883	3.021	3.133	3.227	3.307
86	2.281	2.442	2.551	2.634	2.701	2.756	2.803	2.845	2.881	3.019	3.131	3.224	3.304
88	2.280	2.441	2.550	2.633	2.699	2.754	2.802	2.843	2.880	3.017	3.129	3.222	3.302
90	2.280	2.440	2.549	2.632	2.698	2.753	2.800	2.841	2.878	3.016	3.127	3.220	3.299

Two tail Bonferroni t probability points, $\alpha = 0.01$

$f_e \backslash K$	2	3	4	5	6	7	8	9	10	15	21	28	36
4	5.598	6.254	6.758	7.173	7.529	7.841	8.122	8.376	8.610	9.568	10.437	11.238	11.986
5	4.773	5.247	5.604	5.893	6.138	6.352	6.541	6.713	6.869	7.499	8.059	8.567	9.033
6	4.317	4.698	4.981	5.208	5.398	5.563	5.709	5.840	5.959	6.434	6.850	7.223	7.562
7	4.029	4.355	4.595	4.785	4.944	5.082	5.202	5.310	5.408	5.795	6.131	6.429	6.699
8	3.833	4.122	4.334	4.501	4.640	4.759	4.864	4.957	5.041	5.374	5.659	5.911	6.138
9	3.690	3.954	4.146	4.297	4.422	4.529	4.622	4.706	4.781	5.076	5.328	5.548	5.746
10	3.581	3.827	4.005	4.144	4.259	4.357	4.442	4.518	4.587	4.855	5.082	5.281	5.458
11	3.497	3.728	3.895	4.025	4.132	4.223	4.303	4.373	4.437	4.685	4.894	5.076	5.238
12	3.428	3.649	3.807	3.930	4.031	4.117	4.192	4.258	4.318	4.550	4.745	4.914	5.064
13	3.372	3.584	3.735	3.852	3.948	4.030	4.101	4.164	4.221	4.440	4.624	4.784	4.924
14	3.326	3.530	3.675	3.787	3.880	3.958	4.026	4.086	4.140	4.349	4.525	4.676	4.809
15	3.286	3.484	3.624	3.733	3.822	3.897	3.963	4.021	4.073	4.273	4.441	4.585	4.713
16	3.252	3.444	3.581	3.686	3.773	3.846	3.909	3.965	4.015	4.208	4.370	4.509	4.630
17	3.222	3.410	3.543	3.646	3.730	3.801	3.862	3.917	3.965	4.152	4.308	4.442	4.560
18	3.197	3.380	3.510	3.610	3.692	3.762	3.822	3.874	3.922	4.104	4.255	4.385	4.499
19	3.174	3.354	3.481	3.579	3.660	3.727	3.786	3.837	3.883	4.061	4.208	4.335	4.445
20	3.153	3.331	3.455	3.552	3.630	3.697	3.754	3.804	3.850	4.023	4.167	4.290	4.398
21	3.135	3.310	3.432	3.527	3.604	3.669	3.726	3.775	3.819	3.989	4.130	4.250	4.355
22	3.119	3.291	3.412	3.505	3.581	3.645	3.700	3.749	3.792	3.959	4.097	4.215	4.318
23	3.104	3.274	3.393	3.485	3.560	3.623	3.677	3.725	3.768	3.932	4.067	4.183	4.284
24	3.091	3.258	3.376	3.467	3.540	3.603	3.656	3.703	3.745	3.907	4.040	4.154	4.253
25	3.078	3.244	3.361	3.450	3.523	3.584	3.637	3.684	3.725	3.884	4.015	4.127	4.225

Bonferroni t

Two tail Bonferroni t probability points, $\alpha = 0.01$ (continued)

$f_{\alpha} \setminus K$	2	3	4	5	6	7	8	9	10	15	21	28	36
26	3.067	3.231	3.346	3.435	3.507	3.567	3.620	3.666	3.707	3.864	3.993	4.103	4.199
27	3.057	3.219	3.333	3.421	3.492	3.552	3.604	3.649	3.690	3.845	3.972	4.081	4.176
28	3.047	3.208	3.321	3.408	3.479	3.538	3.589	3.634	3.674	3.827	3.953	4.061	4.154
29	3.038	3.198	3.310	3.396	3.466	3.525	3.575	3.620	3.659	3.811	3.936	4.042	4.134
30	3.030	3.189	3.300	3.385	3.454	3.513	3.563	3.607	3.646	3.796	3.919	4.024	4.115
32	3.015	3.172	3.281	3.365	3.433	3.491	3.540	3.583	3.622	3.769	3.890	3.993	4.082
34	3.002	3.157	3.265	3.348	3.415	3.471	3.520	3.563	3.601	3.746	3.865	3.966	4.053
36	2.990	3.144	3.251	3.333	3.399	3.455	3.503	3.545	3.582	3.725	3.842	3.942	4.028
38	2.980	3.132	3.238	3.319	3.385	3.440	3.487	3.529	3.566	3.707	3.823	3.921	4.006
40	2.971	3.122	3.227	3.307	3.372	3.426	3.473	3.514	3.551	3.691	3.805	3.902	3.985
42	2.963	3.112	3.216	3.296	3.360	3.414	3.461	3.501	3.538	3.676	3.789	3.885	3.968
44	2.956	3.104	3.207	3.286	3.350	3.403	3.449	3.490	3.526	3.663	3.775	3.869	3.951
46	2.949	3.096	3.199	3.277	3.340	3.394	3.439	3.479	3.515	3.651	3.762	3.855	3.937
48	2.943	3.089	3.191	3.269	3.332	3.385	3.430	3.470	3.505	3.640	3.750	3.843	3.923
50	2.937	3.083	3.184	3.261	3.324	3.376	3.421	3.461	3.496	3.630	3.739	3.831	3.911
52	2.932	3.077	3.178	3.255	3.317	3.369	3.414	3.453	3.488	3.620	3.729	3.820	3.900
54	2.927	3.071	3.172	3.248	3.310	3.362	3.406	3.445	3.480	3.612	3.720	3.811	3.889
56	2.923	3.066	3.166	3.242	3.304	3.355	3.400	3.438	3.473	3.604	3.711	3.802	3.880
58	2.918	3.062	3.161	3.237	3.298	3.349	3.393	3.432	3.466	3.597	3.703	3.793	3.871
60	2.915	3.057	3.156	3.232	3.293	3.344	3.388	3.426	3.460	3.590	3.696	3.785	3.862
62	2.911	3.053	3.152	3.227	3.288	3.339	3.382	3.420	3.454	3.584	3.689	3.778	3.855
64	2.908	3.049	3.148	3.223	3.283	3.334	3.377	3.415	3.449	3.578	3.683	3.771	3.847
66	2.904	3.046	3.144	3.218	3.279	3.329	3.372	3.410	3.444	3.572	3.677	3.765	3.841
68	2.902	3.042	3.140	3.214	3.275	3.325	3.368	3.406	3.439	3.567	3.671	3.759	3.834
70	2.899	3.039	3.137	3.211	3.271	3.321	3.364	3.402	3.435	3.562	3.666	3.753	3.828
72	2.896	3.036	3.133	3.207	3.267	3.317	3.360	3.397	3.431	3.558	3.661	3.748	3.823
74	2.894	3.033	3.130	3.204	3.264	3.313	3.356	3.394	3.427	3.553	3.656	3.743	3.818
76	2.891	3.031	3.127	3.201	3.260	3.310	3.353	3.390	3.423	3.549	3.652	3.738	3.813
78	2.889	3.028	3.125	3.198	3.257	3.307	3.349	3.387	3.420	3.545	3.648	3.734	3.808
80	2.887	3.026	3.122	3.195	3.254	3.304	3.346	3.383	3.416	3.542	3.644	3.729	3.803
82	2.885	3.024	3.120	3.193	3.252	3.301	3.343	3.380	3.413	3.538	3.640	3.725	3.799
84	2.883	3.021	3.117	3.190	3.249	3.298	3.340	3.377	3.410	3.535	3.636	3.721	3.795
86	2.881	3.019	3.115	3.188	3.246	3.295	3.338	3.375	3.407	3.532	3.633	3.718	3.791
88	2.880	3.017	3.113	3.185	3.244	3.293	3.335	3.372	3.405	3.529	3.629	3.714	3.787
90	2.878	3.016	3.111	3.183	3.242	3.291	3.333	3.369	3.402	3.526	3.626	3.711	3.784