UNIVERSITY OF SWAZILAND
MAIN EXAMINATION PAPER 2010/2011

TITLE OF PAPER: BIOSTATISTICS

COURSE CODE: B305

TIME ALLOWED: THREE (3) HOURS

INSTRUCTIONS:

1. ANSWER ANY FOUR QUESTIONS.
2. EACH QUESTION CARRIES TWENTY FIVE (25) MARKS.
3. ILLUSTRATE YOUR ANSWERS WITH LARGE AND CLEARLY LABELED DIAGRAMS WHERE APPROPRIATE.
4. CLEARLY STATE YOUR NULL AND ALTERNATIVE HYPOTHESES AND YOUR CONCLUSIONS WHERE APPROPRIATE.

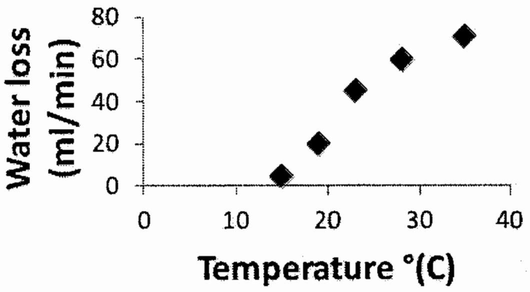
SPECIAL REQUIREMENTS:

1. CALCULATORS (CANDIDATES MUST BRING THEIR OWN).
2. GRAPH PAPER.
3. STATISTICAL TABLES (TO BE SUPPLIED BY THE LECTURER).
4. USEFUL EQUATIONS (TO BE SUPPLIED BY THE LECTURER).

ANSWER ANY FOUR (4) OUT OF SIX (6) QUESTIONS

QUESTION 1

The following data were collected by an ecophysiologist working on water loss in a cold-adapted rodent species:



a) Will the correlation coefficient *r* be closer to zero or closer to one (do NOT calculate it!)? Give reasons for your answer.

[3 marks]

b) Would you recommend doing a regression analysis on these data? Clearly explain your decision.

[7 marks]

c) What type of data are presented here? Give reasons for your answer. [4 marks]

d) Is it possible to predict water loss at 50°C from these data? Elaborate. [5 marks]

e) What are the assumptions of a parametric test?

[6 marks]

[TOTAL = 25 marks]

QUESTION 2

a) The data given in the table below are normally distributed. Can you use a parametric test to establish whether the two samples come from the same population? Support your answer with appropriatė evidence. [4 marks]

	Length (mm)	
	Lowlands	**Highlands**
	23	24
	27	29
	22	32
	18	31
	24	30
Mean	22.8	29.2
Variance	10.70	9.70

b) Using an appropriate statistical test, establish whether the lengths of organisms from the lowlands are different from those of the highlands.

[10 marks]

c) Draw a box plot showing the mean, SE and range of these two samples.

[11 marks]

[TOTAL = 25 marks]

QUESTION 3

The following table shows the results of vegetation transects in 3 habitats during which grass species were counted. The data do not meet the assumptions of parametric tests.

	Habitat	
Savanna	**Wetland**	**Grassland**
7	4	10
8	6	10
6	3	8
5	5	7
7	4	11

a) Using an appropriate statistical test, establish whether the three different habitats have significantly different grass species richness.

[15 marks]

b) Present these data in the form of a bar graph showing the mean ± SD

[10 marks]

[Total = 25 marks]

QUESTION 4

Consider the following data on male and female school children in a remote part of Swaziland

Sex	**Numbers**		
	Healthy	**Relatively unhealthy**	**Severely unhealthy**
Male	62	23	8
Female	65	26	24

a) Use an appropriate statistical test to test whether male and female school children differ in their health status. [12 marks]

b) What are the assumptions of the chi-square test? [3 marks]

c) Present these data in an appropriate graph that shows the relative abundance of males and females that are healthy, relatively unhealthy and severely unhealthy. [10 marks]

[TOTAL = 25 marks]

QUESTION 5

A biologist is hired to conduct a survey of a particular species of antelope in a national park in Swaziland. The park has a variety of different habitats, two of which are unsuitable for this antelope: 1) rocky outcrops and 2) open grasslands. Yet these two habitats cover over 75% of the national park. The biologist randomly selects 20 transects across the entire park and uses these to estimate the population of this antelope in the national park.

a) What is wrong with the design of this survey? [5 marks]

b) How would you design this survey, if you were given the task of estimating the population of this antelope in the national park? Clearly state your reasons. [10 marks]

c) What is the difference between accuracy and precision? [5 marks]

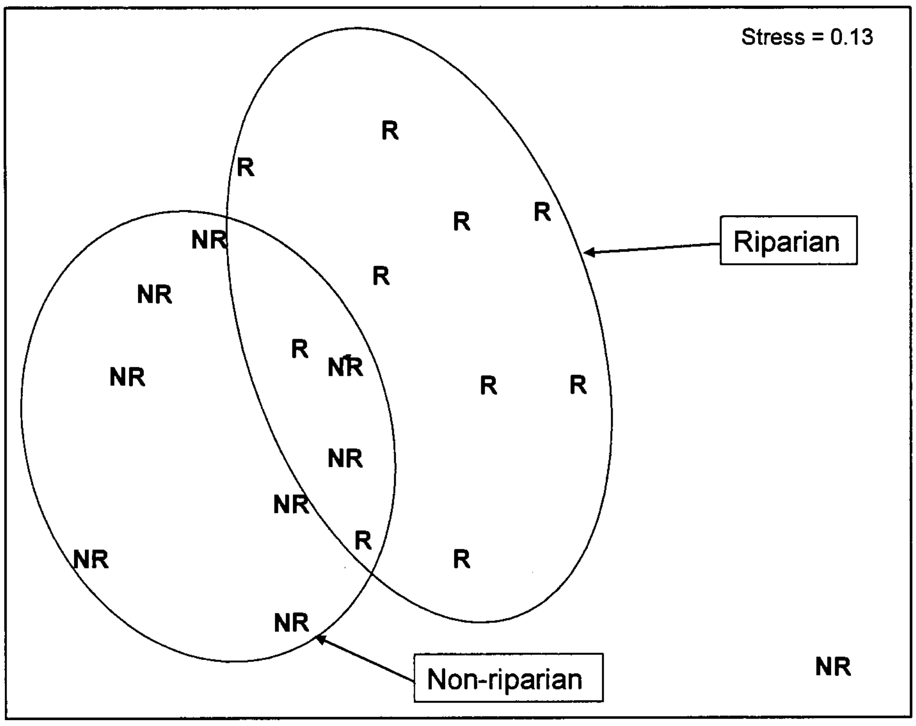
d) How could you increase precision in the example above? Elaborate. [5 marks]

QUESTION 6

a) Define multivariate statistics? [3 marks]

b) How does Principal Components Analysis (PCA) differ from Cluster Analysis? Explain the outputs of each analysis (you do not need to elaborate on how the analyses are performed), and describe the situations when you would use PCA and when you would use Cluster Analysis. [12 marks]

c) The figure below was produced from a non-metric Multi-Dimensional Scaling (MDS) analysis. The analysis was based on the survey of butterfly species at 19 different sites in two habitats: 10 sites in riparian (R) and 9 sites in non-riparian habitats (NR). What conclusions can you draw from this figure? [10 marks]



B305 (BIOSTATISTICS) EXAMINATION

USEFUL EQUATIONS

$S^2 = \sum (y_i - \tilde{y})^2/(n-1)$

$SE = S/\sqrt{n}$

$Z = (y_i - \mu)/\sigma$

$Z = (\tilde{y} - \mu)/SE$

C.I.: $\tilde{y} \pm [t_{(\alpha,df)}]SE$

$t = (\tilde{y} - \mu)/SE$

$t = (\tilde{y}_1 - \tilde{y}_2)/SE_{\text{pooled}}$

$SE_{\text{pooled}} = SD_{\text{pooled}}\sqrt{(1/n_1 + 1/n_2)}$

$SD_{\text{pooled}} = \sqrt{[(df_1 s_1{}^2 + df_2 s_2{}^2)/(df_1 + df_2)]}$

$\chi^2 = \Sigma (O - E)^2/E$

$\chi^2 = [n(|\text{cell1}*\text{cell4}-\text{cell2}*\text{cell3}|-n/2)^2]/[C_1*C_2*R_1*R_2]$

$\text{Total SS} = \Sigma\Sigma y^2 - (\Sigma\Sigma y)^2/N$

$\text{Groups SS} = \Sigma(\Sigma y)^2/n - (\Sigma\Sigma y)^2/N$

$\text{Error SS} = \text{Total SS} - \text{Groups SS}$

$F = \text{Groups MS}/\text{Error MS}$

$q = (\tilde{y}_a - \tilde{y}_b)/SE$

$y' = \log(y+1)$

$y' = \sqrt{(y+0.5)}$

$y' = \arcsin\sqrt{y}$

$\Phi = \sqrt{[(k-1)(\text{groups MS-error MS})]/(k)(\text{error MS})}$

$U = n_1 n_2 + n_1(n_1+1)/2 - R_1$

$H = 12/N(N+1)\Sigma[R^2/n] - 3(N+1)$

$r = \Sigma xy/\sqrt{(\Sigma x^2)(\Sigma y^2)}$

$b = \Sigma xy/\Sigma x^2$

$\Sigma xy = \Sigma XY - (\Sigma X)(\Sigma Y)/n$

$\Sigma x^2 = \Sigma X^2 - (\Sigma X)^2/n$

$\Sigma y^2 = \Sigma Y^2 - (\Sigma Y)^2/n$

$\text{Total SS} = \Sigma y^2$

$\text{Regression SS} = (\Sigma xy)^2/\Sigma x^2$

$\text{Residual SS} = \text{Total SS} - \text{Regression SS}$

$P(X) = n!/X!(n-X)![p^x(q^{n-x})]$

$p = [\Sigma(X)(Obs)/\Sigma(Obs)]/n$

$P(X) = \mu^x/e^{\mu}(X!)$

$\mu = [\Sigma(X*Obs)]/[\Sigma Obs]$

TABLE B.3 CRITICAL VALUES OF THE *t* DISTRIBUTION

ν	α(2): 0.50 α(1): 0.25	0.20 0.10	0.10 0.05	0.05 0.025	0.02 0.01	0.01 0.005	0.005 0.0025	0.002 0.001	
1	1.000	3.078	6.314	12.706	31.821	63.657	127.321	318.309	63
2	0.816	1.886	2.920	4.303	6.965	9.925	14.089	22.327	3
3	0.765	1.638	2.353	3.182	4.541	5.841	7.453	10.215	1
4	0.741	1.533	2.132	2.776	3.747	4.604	5.598	7.173	
5	0.727	1.476	2.015	2.571	3.365	4.032	4.773	5.893	
6	0.718	1.440	1.943	2.447	3.143	3.707	4.317	5.208	
7	0.711	1.415	1.895	2.365	2.998	3.499	4.029	4.785	
8	0.706	1.397	1.860	2.306	2.896	3.355	3.833	4.501	
9	0.703	1.383	1.833	2.262	2.821	3.250	3.690	4.297	
10	0.700	1.372	1.812	2.228	2.764	3.169	3.581	4.144	
11	0.697	1.363	1.796	2.201	2.718	3.106	3.497	4.025	
12	0.695	1.356	1.782	2.179	2.681	3.055	3.428	3.930	
13	0.694	1.350	1.771	2.160	2.650	3.012	3.372	3.852	
14	0.692	1.345	1.761	2.145	2.624	2.977	3.326	3.787	
15	0.691	1.341	1.753	2.131	2.602	2.947	3.286	3.733	
16	0.690	1.337	1.746	2.120	2.583	2.921	3.252	3.686	
17	0.689	1.333	1.740	2.110	2.567	2.898	3.222	3.646	
18	0.688	1.330	1.734	2.101	2.552	2.878	3.197	3.610	
19	0.688	1.328	1.729	2.093	2.539	2.861	3.174	3.579	
20	0.687	1.325	1.725	2.086	2.528	2.845	3.153	3.552	
21	0.686	1.323	1.721	2.080	2.518	2.831	3.135	3.527	3
22	0.686	1.321	1.717	2.074	2.508	2.819	3.119	3.505	3
23	0.685	1.319	1.714	2.069	2.500	2.807	3.104	3.485	3
24	0.685	1.318	1.711	2.064	2.492	2.797	3.091	3.467	3
25	0.684	1.316	1.708	2.060	2.485	2.787	3.078	3.450	3
26	0.684	1.315	1.706	2.056	2.479	2.779	3.067	3.435	3
27	0.684	1.314	1.703	2.052	2.473	2.771	3.057	3.421	3
28	0.683	1.313	1.701	2.048	2.467	2.763	3.047	3.408	3
29	0.683	1.311	1.699	2.045	2.462	2.756	3.038	3.396	3
30	0.683	1.310	1.697	2.042	2.457	2.750	3.030	3.385	3
31	0.682	1.309	1.696	2.040	2.453	2.744	3.022	3.375	3
32	0.682	1.309	1.694	2.037	2.449	2.738	3.015	3.365	3
33	0.682	1.308	1.692	2.035	2.445	2.733	3.008	3.356	3
34	0.682	1.307	1.691	2.032	2.441	2.728	3.002	3.348	3
35	0.682	1.306	1.690	2.030	2.438	2.724	2.996	3.340	3
36	0.681	1.306	1.688	2.028	2.434	2.719	2.990	3.333	3
37	0.681	1.305	1.687	2.026	2.431	2.715	2.985	3.326	3
38	0.681	1.304	1.686	2.024	2.429	2.712	2.980	3.319	3
39	0.681	1.304	1.685	2.023	2.426	2.708	2.976	3.313	3
40	0.681	1.303	1.684	2.021	2.423	2.704	2.971	3.307	3
41	0.681	1.303	1.683	2.020	2.421	2.701	2.967	3.301	3
42	0.680	1.302	1.682	2.018	2.418	2.698	2.963	3.296	3
43	0.680	1.302	1.681	2.017	2.416	2.695	2.959	3.291	3
44	0.680	1.301	1.680	2.015	2.414	2.692	2.956	3.286	3
45	0.680	1.301	1.679	2.014	2.412	2.690	2.952	3.281	3
46	0.680	1.300	1.679	2.013	2.410	2.687	2.949	3.277	3
47	0.680	1.300	1.678	2.012	2.408	2.685	2.946	3.273	3
48	0.680	1.299	1.677	2.011	2.407	2.682	2.943	3.269	3
49	0.680	1.299	1.677	2.010	2.405	2.680	2.940	3.265	3
50	0.679	1.299	1.676	2.009	2.403	2.678	2.937	3.261	3

TABLE B.16 CRITICAL VALUES OF THE CORRELATION COEFFICIENT, *r*

α(2):	0.50	0.20	0.10	0.05	0.02	0.01	0.005	0.002	0.001
α(1):	0.25	0.10	0.05	0.025	0.01	0.005	0.0025	0.001	0.0005
ν									
1	0.707	0.951	0.988	0.997	1.000	1.000	1.000	1.000	1.000
2	0.500	0.800	0.900	0.950	0.980	0.990	0.995	0.998	0.999
3	0.404	0.687	0.805	0.878	0.934	0.959	0.974	0.986	0.991
4	0.347	0.608	0.729	0.811	0.882	0.917	0.942	0.963	0.974
5	0.309	0.551	0.669	0.755	0.833	0.875	0.906	0.935	0.951
6	0.281	0.507	0.621	0.707	0.789	0.834	0.870	0.905	0.925
7	0.260	0.472	0.582	0.666	0.750	0.798	0.836	0.875	0.898
8	0.242	0.443	0.549	0.632	0.715	0.765	0.805	0.847	0.872
9	0.228	0.419	0.521	0.602	0.685	0.735	0.776	0.820	0.847
10	0.216	0.398	0.497	0.576	0.658	0.708	0.750	0.795	0.823
11	0.206	0.380	0.476	0.553	0.634	0.684	0.726	0.772	0.801
12	0.197	0.365	0.457	0.532	0.612	0.661	0.703	0.750	0.780
13	0.189	0.351	0.441	0.514	0.592	0.641	0.683	0.730	0.760
14	0.182	0.338	0.426	0.497	0.574	0.623	0.664	0.711	0.742
15	0.176	0.327	0.412	0.482	0.558	0.606	0.647	0.694	0.725
16	0.170	0.317	0.400	0.468	0.542	0.590	0.631	0.678	0.708
17	0.165	0.308	0.389	0.456	0.529	0.575	0.616	0.662	0.693
18	0.160	0.299	0.378	0.444	0.515	0.561	0.602	0.648	0.679
19	0.156	0.291	0.369	0.433	0.503	0.549	0.589	0.635	0.665
20	0.152	0.284	0.360	0.423	0.492	0.537	0.576	0.622	0.652
21	0.148	0.277	0.352	0.413	0.482	0.526	0.565	0.610	0.640
22	0.145	0.271	0.344	0.404	0.472	0.515	0.554	0.599	0.629
23	0.141	0.265	0.337	0.396	0.462	0.505	0.543	0.588	0.618
24	0.138	0.260	0.330	0.388	0.453	0.496	0.534	0.578	0.607
25	0.136	0.255	0.323	0.381	0.445	0.487	0.524	0.568	0.597
26	0.133	0.250	0.317	0.374	0.437	0.479	0.515	0.559	0.588
27	0.131	0.245	0.311	0.367	0.430	0.471	0.507	0.550	0.579
28	0.128	0.241	0.306	0.361	0.423	0.463	0.499	0.541	0.570
29	0.126	0.237	0.301	0.355	0.416	0.456	0.491	0.533	0.562
30	0.124	0.233	0.296	0.349	0.409	0.449	0.484	0.526	0.554
31	0.122	0.229	0.291	0.344	0.403	0.442	0.477	0.518	0.546
32	0.120	0.225	0.287	0.339	0.397	0.436	0.470	0.511	0.539
33	0.118	0.222	0.283	0.334	0.392	0.430	0.454	0.504	0.532
34	0.116	0.219	0.279	0.329	0.386	0.424	0.458	0.498	0.525
35	0.115	0.216	0.275	0.325	0.381	0.418	0.452	0.492	0.519
36	0.113	0.213	0.271	0.320	0.376	0.413	0.446	0.486	0.513
37	0.111	0.210	0.267	0.316	0.371	0.409	0.441	0.480	0.507
38	0.110	0.207	0.264	0.312	0.367	0.403	0.435	0.474	0.501
39	0.108	0.204	0.261	0.308	0.362	0.398	0.430	0.469	0.495
40	0.107	0.202	0.257	0.304	0.358	0.393	0.425	0.463	0.490
41	0.106	0.199	0.254	0.301	0.354	0.389	0.420	0.458	0.484
42	0.104	0.197	0.251	0.297	0.350	0.384	0.416	0.453	0.479
43	0.103	0.195	0.248	0.294	0.346	0.380	0.411	0.449	0.474
44	0.102	0.192	0.246	0.291	0.342	0.376	0.407	0.444	0.469
45	0.101	0.190	0.243	0.288	0.3.	0.372	0.403	0.439	0.465
46	0.100	0.188	0.240	0.285	0.335	0.368	0.399	0.435	0.460
47	0.099	0.186	0.238	0.282	0.331	0.365	0.395	0.431	0.456
48	0.098	0.184	0.235	0.279	0.328	0.361	0.391	0.427	0.451
49	0.097	0.182	0.233	0.276	0.325	0.358	0.387	0.423	0.447
50	0.096	0.181	0.231	0.273	0.322	0.354	0.384	0.419	0.443

TABLE B.5 (cont.) CRITICAL VALUES OF THE q DISTRIBUTION

$\alpha = 0.05$

v	k(or p) = 2	3	4	5	6	7	8	9	10
1	17.97	26.98	32.82	37.08	40.41	43.12	45.40	47.36	49.07
2	6.085	8.331	9.798	10.88	11.74	12.44	13.03	13.54	13.99
3	4.501	5.910	6.825	7.502	8.037	8.478	8.853	9.177	9.462
4	3.927	5.040	5.757	6.287	6.707	7.053	7.347	7.602	7.826
5	3.635	4.602	5.218	5.673	6.033	6.330	6.582	6.802	6.995
6	3.461	4.339	4.896	5.305	5.628	5.895	6.122	6.319	6.493
7	3.344	4.165	4.681	5.060	5.359	5.606	5.815	5.998	6.158
8	3.261	4.041	4.529	4.886	5.167	5.399	5.597	5.767	5.918
9	3.199	3.949	4.415	4.756	5.024	5.244	5.432	5.595	5.739
10	3.151	3.877	4.327	4.654	4.912	5.124	5.305	5.461	5.599
11	3.113	3.820	4.256	4.574	4.823	5.028	5.202	5.353	5.487
12	3.082	3.773	4.199	4.508	4.751	4.950	5.119	5.265	5.395
13	3.055	3.735	4.151	4.453	4.690	4.885	5.049	5.192	5.318
14	3.033	3.702	4.111	4.407	4.639	4.829	4.990	5.131	5.254
15	3.014	3.674	4.076	4.367	4.595	4.782	4.940	5.077	5.198
16	2.998	3.649	4.046	4.333	4.557	4.741	4.897	5.031	5.150
17	2.984	3.628	4.020	4.303	4.524	4.705	4.858	4.991	5.108
18	2.971	3.609	3.997	4.277	4.495	4.673	4.824	4.956	5.071
19	2.960	3.593	3.977	4.253	4.469	4.645	4.794	4.924	5.038
20	2.950	3.578	3.958	4.232	4.445	4.620	4.768	4.896	5.008
24	2.919	3.532	3.901	4.166	4.373	4.541	4.684	4.807	4.915
30	2.888	3.486	3.845	4.102	4.302	4.464	4.602	4.720	4.824
40	2.858	3.442	3.791	4.039	4.232	4.389	4.521	4.635	4.735
60	2.829	3.399	3.737	3.977	4.163	4.314	4.441	4.550	4.646
120	2.800	3.356	3.685	3.917	4.096	4.241	4.363	4.468	4.560
∞	2.772	3.314	3.633	3.858	4.030	4.170	4.286	4.387	4.474

v	k(or p) = 11	12	13	14	15	16	17	18	19
1	50.59	51.96	53.20	54.33	55.36	56.32	57.22	58.04	58.83
2	14.39	14.75	15.08	15.38	15.65	15.91	16.14	16.37	16.57
3	9.717	9.946	10.15	10.35	10.53	10.69	10.84	10.98	11.11
4	8.027	8.208	8.373	8.525	8.664	8.794	8.914	9.028	9.134
5	7.168	7.324	7.466	7.596	7.717	7.828	7.932	8.030	8.122
6	6.649	6.789	6.917	7.034	7.143	7.244	7.338	7.426	7.508
7	6.302	6.431	6.550	6.658	6.759	6.852	6.939	7.020	7.097
8	6.054	6.175	6.287	6.389	6.483	6.571	6.653	6.729	6.802
9	5.867	5.983	6.089	6.186	6.276	6.359	6.437	6.510	6.579
10	5.722	5.833	5.935	6.028	6.114	6.194	6.269	6.339	6.405
11	5.605	5.713	5.811	5.901	5.984	6.062	6.134	6.202	6.265
12	5.511	5.615	5.710	5.798	5.878	5.953	6.023	6.089	6.151
13	5.431	5.533	5.625	5.711	5.789	5.862	5.931	5.995	6.055
14	5.364	5.463	5.554	5.637	5.714	5.786	5.852	5.915	5.974
15	5.306	5.404	5.493	5.574	5.649	5.720	5.785	5.846	5.904
16	5.256	5.352	5.439	5.520	5.593	5.662	5.727	5.786	5.843
17	5.212	5.307	5.392	5.471	5.544	5.612	5.675	5.734	5.790
18	5.174	5.267	5.352	5.429	5.501	5.568	5.630	5.688	5.743
19	5.140	5.231	5.315	5.391	5.462	5.528	5.589	5.647	5.701
20	5.108	5.199	5.282	5.357	5.427	5.493	5.553	5.610	5.663
24	5.012	5.099	5.179	5.251	5.319	5.381	5.439	5.494	5.545
30	4.917	5.001	5.077	5.147	5.211	5.271	5.327	5.379	5.429
40	4.824	4.904	4.977	5.044	5.106	5.163	5.216	5.266	5.313
60	4.732	4.808	4.878	4.942	5.001	5.056	5.107	5.154	5.199
120	4.641	4.714	4.781	4.842	4.898	4.950	4.998	5.044	5.086
∞	4.552	4.622	4.685	4.743	4.796	4.845	4.891	4.934	4.974

1	1	--	--	--	--	--	--	--	--
	2	--	--	--	--	--	--	--	--
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	4	--	--	--	--	--	--	--	--
	5	--	--	--	--	--	--	--	--
	6	--	--	--	--	--	--	--	--
	7	--	--	--	--	--	--	--	--
	8	--	--	--	--	--	--	--	--
	9	9	--	--	--	--	--	--	--
	10	10	--	--	--	--	--	--	--
	11	11	--	--	--	--	--	--	--
	12	12	--	--	--	--	--	--	--
	13	13	--	--	--	--	--	--	--
	14	14	--	--	--	--	--	--	--
	15	15	--	--	--	--	--	--	--
	16	16	--	--	--	--	--	--	--
	17	17	--	--	--	--	--	--	--
	18	18	--	--	--	--	--	--	--
	19	18	19	--	--	--	--	--	--
	20	19	20	--	--	--	--	--	--
	21	20	21	--	--	--	--	--	--
	22	21	22	--	--	--	--	--	--
	23	22	23	--	--	--	--	--	--
	24	23	24	--	--	--	--	--	--
	25	24	25	--	--	--	--	--	--
	26	25	26	--	--	--	--	--	--
	27	26	27	--	--	--	--	--	--
	28	27	28	--	--	--	--	--	--
	29	27	29	--	--	--	--	--	--
	30	28	30	--	--	--	--	--	--
	31	29	31	--	--	--	--	--	--
	32	30	32	--	--	--	--	--	--
	33	31	33	--	--	--	--	--	--
	34	32	34	--	--	--	--	--	--
	35	33	35	--	--	--	--	--	--
	36	34	36	--	--	--	--	--	--
	37	35	37	--	--	--	--	--	--
	38	36	38	--	--	--	--	--	--
	39	36	38	39	--	--	--	--	--
1	40	37	39	40	--	--	--	--	--
2	2	--	--	--	--	--	--	--	--
	3	6	--	--	--	--	--	--	--
	4	8	--	--	--	--	--	--	--
	5	9	10	--	--	--	--	--	--
	6	11	12	--	--	--	--	--	--
	7	13	14	--	--	--	--	--	--
	8	14	15	16	--	--	--	--	--
	9	16	17	18	--	--	--	--	--
2	10	17	19	20	--	--	--	--	--

2	11	19	21	22	--	--	--	--	--
	12	20	22	23	--	--	--	--	--
	13	22	24	25	26	--	--	--	--
	14	23	25	27	28	--	--	--	--
	15	25	27	29	30	--	--	--	--
	16	27	29	31	32	--	--	--	--
	17	28	31	32	34	--	--	--	--
	18	30	32	34	36	--	--	--	--
	19	31	34	36	37	38	--	--	--
	20	33	36	38	39	40	--	--	--
	21	34	37	39	41	42	--	--	--
	22	36	39	41	43	44	--	--	--
	23	37	41	43	45	46	--	--	--
	24	39	42	45	47	48	--	--	--
	25	41	44	47	49	50	--	--	--
	26	42	46	48	51	52	--	--	--
	27	44	47	50	52	53	54	--	--
	28	45	49	52	54	55	56	--	--
	29	47	51	54	56	57	58	--	--
	30	48	53	55	58	59	60	--	--
	31	50	54	57	60	61	62	--	--
	32	51	56	59	62	63	64	--	--
	33	53	58	61	64	65	66	--	--
	34	55	59	63	65	67	68	--	--
	35	56	61	64	67	69	70	--	--
	36	58	63	66	69	71	72	--	--
	37	59	64	68	71	73	74	--	--
	38	61	66	70	73	75	76	--	--
	39	62	68	71	75	76	77	--	--
2	40	64	69	73	77	78	79	--	--
3	3	8	9	--	--	--	--	--	--
	4	11	12	--	--	--	--	--	--
	5	13	14	15	--	--	--	--	--
	6	15	16	17	--	--	--	--	--
	7	17	19	20	21	--	--	--	--
	8	19	21	22	24	--	--	--	--
	9	22	23	25	26	27	--	--	--
	10	24	26	27	29	30	--	--	--
	11	26	28	30	32	33	--	--	--
	12	28	31	32	34	35	36	--	--
	13	30	33	35	37	38	39	--	--
	14	32	35	37	40	41	42	--	--
	15	35	38	40	42	43	44	--	--
	16	37	40	42	45	46	47	--	--
	17	39	42	45	47	49	50	51	--
	18	41	45	47	50	52	53	54	--
	19	43	47	50	53	54	56	57	--
3	20	45	49	52	55	57	58	60	--

3	21	48	52	55	58	60	61	63	63
	22	50	54	57	60	61	64	65	66
	23	52	56	60	63	65	67	68	69
	24	54	59	62	65	68	69	71	72
	25	56	61	65	68	70	72	74	75
	26	58	63	67	71	73	75	77	78
	27	60	66	70	74	76	78	80	80
	28	63	68	72	76	79	80	82	83
	29	65	70	74	79	81	83	85	86
	30	67	72	77	81	84	86	88	89
	31	69	75	79	84	87	89	91	92
	32	71	77	82	87	89	91	94	95
	33	73	80	84	89	92	94	96	98
	34	76	82	87	92	95	97	99	101
	35	78	84	89	94	97	100	102	103
	36	80	87	92	97	100	103	105	106
	37	82	89	94	100	103	105	108	109
	38	84	91	97	102	105	108	111	112
	39	86	94	99	105	108	111	113	115
3	40	88	96	102	107	111	114	116	118
4	4	13	15	16	--	--	--	--	--
	5	16	18	19	20	--	--	--	--
	6	19	21	22	23	24	--	--	--
	7	22	24	25	27	28	--	--	--
	8	25	27	28	30	31	32	--	--
	9	27	30	32	33	35	36	--	--
	10	30	33	35	37	38	39	40	--
	11	33	36	38	40	42	43	44	--
	12	36	39	41	43	45	46	48	--
	13	39	42	44	47	48	50	51	52
	14	41	45	47	50	52	53	55	56
	15	44	48	50	53	55	57	59	60
	16	47	50	53	57	59	60	62	63
	17	50	53	57	60	62	64	66	67
	18	52	56	60	63	66	67	69	71
	19	55	59	63	67	69	71	73	74
	20	58	62	66	70	72	75	77	78
	21	61	65	69	73	76	78	80	82
	22	63	68	72	77	79	82	84	85
	23	66	71	75	80	83	85	88	89
	24	69	74	79	83	86	89	91	93
	25	72	77	82	87	90	92	95	97
	26	74	80	85	90	93	96	99	100
	27	77	83	88	93	96	99	102	104
	28	80	86	91	96	100	103	106	108
	29	83	89	94	100	103	106	109	111
	30	85	92	97	103	107	110	113	115
4	31	88	95	100	106	110	113	117	119

TABLE B.10 (cont.) CRITICAL VALUES OF THE MANN-WHITNEY *U* DISTRIBUTION

	α(2):	0.20	0.10	0.05	0.02	0.01	0.005	0.002	0.001
	α(1):	0.10	0.05	0.025	0.01	0.005	0.0025	0.001	0.0005
n_1	n_2								
4	32	91	98	104	110	114	117	120	122
	33	94	101	107	113	117	120	124	126
	34	96	104	110	116	120	124	127	130
	35	99	107	113	120	124	127	131	133
	36	102	110	116	123	127	131	135	137
	37	105	113	119	126	131	134	138	141
	38	107	116	122	130	134	138	142	144
	39	110	118	125	133	137	141	145	148
4	40	113	121	128	136	141	145	149	152
5	5	20	21	23	24	25	--	--	--
	6	23	25	27	28	29	30	--	--
	7	26	29	30	32	34	35	--	--
	8	30	32	34	36	38	39	40	--
	9	33	35	38	40	42	43	44	45
	10	37	39	42	44	46	47	49	50
	11	40	43	46	48	50	52	53	54
	12	43	47	49	52	54	56	58	59
	13	47	50	53	56	58	60	62	63
	14	50	54	57	60	63	64	67	68
	15	53	57	61	64	67	69	71	72
	16	57	61	65	68	71	73	75	77
	17	60	65	68	72	75	77	80	81
	18	63	68	72	76	79	81	84	86
	19	67	72	76	80	83	86	88	90
	20	70	75	80	84	87	90	93	95
	21	73	79	83	88	91	94	97	99
	22	77	82	87	92	96	98	102	104
	23	80	86	91	96	100	103	106	108
	24	84	90	95	100	104	107	110	113
	25	87	93	98	104	108	111	115	117
	26	90	97	102	108	112	115	119	121
	27	94	100	106	112	116	120	123	126
	28	97	104	110	116	120	124	128	130
	29	100	107	113	120	124	128	132	135
	30	104	111	117	124	128	132	136	139
	31	107	115	121	128	133	136	141	144
	32	110	118	125	132	137	141	145	148
	33	114	122	128	136	141	145	150	153
	34	117	125	132	140	145	149	154	157
	35	120	129	136	144	149	153	158	161
	36	124	132	140	148	153	158	163	166
	37	127	136	144	152	157	162	167	170
	38	130	140	147	156	161	166	171	175
	39	134	143	151	160	165	170	176	179
5	40	137	147	155	164	169	174	180	184
6	6	27	29	31	33	34	35	--	--
	7	31	34	36	38	39	40	42	--
6	8	35	38	40	42	44	45	47	48

TABLE B.10 (cont.) CRITICAL VALUES OF THE MANN-WHITNEY *U* DISTRIBUTION

	α(2):	0.20	0.10	0.05	0.02	0.01	0.005	0.002	0.001
	α(1):	0.10	0.05	0.025	0.01	0.005	0.0025	0.001	0.0005
n_1	n_2								
6	9	39	42	44	47	49	50	52	53
	10	43	46	49	52	54	55	57	58
	11	47	50	53	57	59	60	62	64
	12	51	55	58	61	63	65	68	69
	13	55	59	62	66	68	70	73	74
	14	59	63	67	71	73	75	78	79
	15	63	67	71	75	78	80	83	85
	16	67	71	75	80	83	85	88	90
	17	71	76	80	84	87	90	93	95
	18	74	80	84	89	92	95	98	100
	19	78	84	89	94	97	100	103	106
	20	82	88	93	98	102	105	108	111
	21	86	92	97	103	107	110	114	116
	22	90	96	102	108	111	115	119	121
	23	94	101	106	112	116	120	124	126
	24	98	105	111	117	121	125	129	132
	25	102	109	115	121	126	130	134	137
	26	106	113	119	126	131	134	139	142
	27	110	117	124	131	135	139	144	147
	28	114	122	128	135	140	144	149	152
	29	118	126	132	140	145	149	154	157
	30	122	130	137	145	150	154	159	163
	31	125	134	141	149	154	159	164	168
	32	129	138	145	154	159	164	169	173
	33	133	142	150	158	164	169	174	178
	34	137	147	154	163	169	174	179	183
	35	141	151	159	168	173	179	185	188
	36	145	155	163	172	178	184	190	194
	37	149	159	167	177	183	188	195	199
	38	153	163	172	181	188	193	200	204
	39	157	167	176	186	192	198	205	209
6	40	161	172	181	191	197	203	210	214
7	7	36	38	41	43	45	46	48	49
	8	40	43	46	49	50	52	54	55
	9	45	48	51	54	56	58	60	61
	10	49	53	56	59	61	63	65	67
	11	54	58	61	65	67	69	71	73
	12	58	63	66	70	72	74	77	79
	13	63	67	71	75	78	80	83	85
	14	67	72	76	81	83	86	89	91
	15	72	77	82	86	89	92	95	97
	16	76	82	86	91	94	97	101	103
	17	81	86	91	96	100	103	106	109
	18	85	91	96	102	105	108	112	115
	19	90	96	101	107	111	114	118	120
	20	94	101	106	112	116	120	124	126
	21	99	106	111	117	122	125	129	132
7	22	103	110	116	123	127	131	135	138

TABLE B.10 (cont.) CRITICAL VALUES OF THE MANN-WHITNEY *U* DISTR

	α(2):	0.20	0.10	0.05	0.02	0.01	0.005	0.002	0.00
	α(1):	0.10	0.05	0.025	0.01	0.005	0.0025	0.001	0.00
n_1	n_2								
7	23	108	115	121	128	132	136	141	144
	24	112	120	126	133	138	142	147	150
	25	117	125	131	139	143	148	153	156
	26	122	129	136	144	149	153	158	162
	27	126	134	141	149	154	159	164	168
	28	130	139	146	154	160	164	170	174
	29	135	144	151	160	165	170	176	179
	30	139	148	156	165	170	176	181	185
	31	144	153	161	170	176	181	187	191
	32	148	158	166	175	181	187	193	197
	33	153	163	171	181	187	192	199	203
	34	157	168	176	186	192	198	204	208
	35	162	172	181	191	198	203	210	215
	36	166	177	186	196	203	209	216	22
	37	171	182	191	202	208	215	222	22
	38	175	187	196	207	214	220	227	23
	39	180	191	201	212	219	226	233	23
7	40	184	196	206	217	225	231	239	24
8	8	45	49	51	55	57	58	60	6
	9	50	54	57	61	63	65	67	6
	10	56	60	63	67	69	71	74	7
	11	61	65	69	73	75	77	80	8
	12	66	70	74	79	81	84	87	8
	13	71	76	80	84	87	90	93	9
	14	76	81	86	90	94	96	100	10
	15	81	87	91	96	100	103	106	10
	16	86	92	97	102	106	109	113	11
	17	91	97	102	108	112	115	119	12
	18	96	103	108	114	118	122	126	12
	19	101	108	114	120	124	128	132	13
	20	106	113	119	126	130	134	139	14
	21	111	119	125	132	136	140	145	14
	22	116	124	131	138	142	147	152	15
	23	121	130	136	144	149	153	158	16
	24	126	135	142	150	155	159	165	16
	25	132	140	147	155	161	165	171	17
	26	137	146	153	161	167	171	177	18
	27	142	151	158	167	173	178	184	18
	28	147	156	164	173	179	184	190	19
	29	152	162	170	179	185	190	197	20
	30	157	167	175	185	191	197	203	20
	31	162	172	181	191	197	203	210	21
	32	167	178	187	197	203	209	216	22
	33	172	183	192	203	209	215	223	22
	34	177	188	198	208	215	222	229	23
	35	182	194	203	214	221	228	235	24
	36	188	199	209	220	227	234	242	24
8	37	193	205	214	226	234	240	248	25

196	210	220	232	240	247	255	260
201	215	226	238	246	253	261	267
208	221	231	244	252	259	268	273
54	60	64	67	70	72	74	76
63	66	70	74	77	78	82	85
68	71	75	81	85	88	89	91
75	78	82	85	90	95	96	98
79	84	88	94	97	100	103	106
85	90	95	100	104	107	111	111
90	96	101	107	111	114	118	120
96	102	107	111	113	122	125	128
102	108	114	118	124	128	131	135
107	114	120	126	132	136	139	142
113	120	126	133	138	142	146	150
118	126	132	140	144	149	154	157
124	132	139	146	151	155	161	164
130	138	145	153	158	162	169	172
135	144	151	159	164	169	176	178
141	150	157	166	171	176	182	186
147	156	163	172	178	183	188	191
152	162	170	179	185	190	196	203
158	168	176	185	191	197	203	208
164	174	183	192	198	204	211	215
169	179	188	198	205	212	218	223
175	185	194	206	212	218	225	230
180	191	201	211	219	226	232	237
186	197	207	218	225	231	239	244
192	203	213	224	232	238	246	251
197	209	219	231	238	245	251	259
203	215	226	237	245	252	260	266
209	221	232	244	252	259	267	273
214	227	238	250	258	266	275	280
220	233	244	257	265	273	282	288
225	238	250	263	272	280	289	295
231	245	256	270	279	286	296	303
64	73	77	81	84	87	90	93
74	79	84	88	92	96	99	100
81	86	91	96	99	102	106	108
87	93	97	103	106	110	113	116
93	99	104	110	114	117	121	124
99	106	111	117	121	125	129	132
106	112	118	124	128	133	137	140
112	119	125	131	136	140	145	148
118	125	132	138	143	148	153	156
124	132	138	146	151	155	161	164
130	138	145	153	158	163	168	172
137	145	152	160	166	170	176	180

10	22	143	153	161	167	173	178	184	188
	23	149	158	168	175	180	186	192	196
	24	155	165	173	182	188	195	200	204
	25	161	171	179	189	195	201	207	212
	26	167	178	186	196	202	208	215	220
	27	174	184	193	203	210	216	223	228
	28	180	191	200	210	217	223	231	236
	29	186	197	207	217	224	231	238	244
	30	192	204	213	224	232	238	246	252
	31	199	210	220	231	239	246	254	259
	32	205	217	227	239	246	253	262	267
	33	211	223	234	246	254	261	269	275
	34	217	230	241	253	261	268	277	283
	35	223	236	247	260	268	276	285	291
	36	230	243	254	267	276	284	293	299
	37	236	249	261	274	283	291	300	307
	38	242	256	268	281	290	299	308	315
	39	248	262	275	288	298	306	316	323
10	40	254	268	281	296	305	314	324	331
11	11	83	87	91	96	100	103	106	109
	12	88	94	99	104	108	111	115	117
	13	95	101	106	112	116	119	123	126
	14	102	108	114	120	124	128	132	135
	15	108	115	121	128	132	136	141	144
	16	115	122	129	135	140	144	149	152
	17	122	130	136	143	148	152	158	161
	18	129	137	143	151	156	161	166	170
	19	136	144	151	159	164	168	175	178
	20	142	151	158	167	172	177	183	187
	21	149	158	166	174	180	185	191	196
	22	156	165	173	182	188	193	200	204
	23	163	172	180	190	196	202	208	213
	24	169	179	188	198	204	210	217	222
	25	176	186	195	205	211	218	225	230
	26	183	194	203	213	220	226	234	239
	27	190	201	210	221	228	234	242	247
	28	196	208	218	229	236	243	251	256
	29	203	215	225	238	244	251	259	265
	30	210	222	233	244	253	259	267	273
	31	217	229	240	252	260	267	276	282
	32	223	236	247	260	268	275	284	290
	33	230	243	255	267	276	283	293	299
	34	237	250	262	275	284	292	301	307
	35	244	257	269	283	293	300	309	316
	36	250	265	277	290	300	308	318	325
	37	257	272	284	298	308	316	326	333
	38	264	279	291	306	316	324	335	342
	39	271	286	299	314	325	332	343	350
11	40	277	293	306	321	333	341	351	359

12	12	95	102	107	113	117	120	124	127
	13	103	108	115	121	125	129	133	136
	14	110	117	123	130	134	138	143	146
	15	117	125	131	138	143	147	151	155
	16	125	132	139	146	151	155	161	165
	17	132	140	147	155	160	165	170	174
	18	139	148	155	163	169	173	179	183
	19	147	156	163	172	177	182	188	193
	20	154	163	171	180	186	191	198	202
	21	161	171	179	188	194	200	207	211
	22	169	179	187	197	203	209	216	220
	23	176	186	195	205	212	218	225	230
	24	183	194	203	213	220	227	234	239
	25	191	202	211	222	229	235	243	248
	26	198	209	219	230	238	244	252	258
	27	205	217	227	239	246	253	261	267
	28	213	225	235	247	255	262	270	276
	29	220	232	243	255	263	271	279	285
	30	227	240	251	264	272	279	288	295
	31	235	248	259	272	280	288	297	304
	32	242	255	267	280	289	297	307	313
	33	249	263	275	289	298	306	316	321
	34	257	271	283	297	306	315	325	332
	35	264	278	291	305	315	323	334	341
	36	271	286	299	314	323	332	343	350
	37	278	294	307	322	332	342	352	359
	38	286	302	315	330	340	350	361	368
	39	293	309	323	339	349	359	370	378
12	40	300	317	331	347	358	367	378	387
13	13	113	118	124	130	135	138	143	146
	14	119	126	132	139	144	149	153	157
	15	127	134	141	148	153	158	165	167
	16	134	143	149	157	163	167	173	177
	17	142	151	157	166	172	177	183	187
	18	150	158	167	175	181	186	193	197
	19	158	167	175	184	190	196	203	207
	20	166	176	184	193	200	205	212	217
	21	174	184	193	202	209	215	222	227
	22	182	192	201	211	218	224	232	237
	23	190	201	210	220	227	234	242	247
	24	198	209	218	228	237	243	251	256
	25	205	217	227	238	246	253	261	266
	26	213	225	236	247	255	262	270	276
	27	221	234	244	256	264	273	280	286
	28	229	242	253	265	273	281	290	296
	29	237	250	261	274	283	290	300	306
	30	245	258	270	283	292	300	309	316
13	31	253	267	278	292	301	309	319	326

1.10 (cont.) CRITICAL VALUES OF THE MANN-WHITNEY U DISTRIBUTIOI

α(2): 0.20 α(1): 0.10	0.10 0.05	0.05 0.025	0.02 0.01	0.01 0.005	0.005 0.0025	0.002 0.001	0.001 0.0005
260	275	287	301	310	319	328	338
268	283	296	310	320	328	338	346
276	291	304	319	328	337	348	355
284	299	313	328	338	347	358	364
292	308	321	337	347	358	367	375
300	316	330	346	356	366	377	385
308	324	339	355	365	375	387	393
315	332	347	363	374	386	397	403
323	342	355	372	384	396	406	413
127	135	141	149	154	161	166	167
136	144	151	159	164	168	174	178
144	153	160	168	174	179	185	188
153	161	169	178	184	189	195	199
161	170	178	187	194	199	208	210
169	179	188	197	203	209	216	221
178	188	197	207	213	219	226	232
186	197	206	216	223	229	237	242
195	206	215	226	233	240	247	252
203	215	224	235	243	250	258	263
212	223	234	245	253	260	268	274
220	232	243	255	263	270	278	284
228	241	252	264	272	280	289	293
237	250	261	274	282	290	299	306
245	259	270	283	292	300	309	316
254	268	279	293	302	310	320	327
262	276	288	302	312	320	330	337
271	285	295	312	321	330	340	348
279	294	307	321	331	340	351	358
287	303	316	331	341	350	361	368
296	312	325	341	351	360	371	378
304	320	334	350	361	370	382	390
313	329	343	360	370	380	392	400
321	338	353	369	380	390	402	411
329	347	362	379	390	400	413	421
338	356	371	388	400	410	423	432
346	364	380	398	410	420	433	442
145	153	161	168	174	178	185	189
154	163	170	178	185	190	197	201
163	172	180	189	195	201	208	212
172	182	190	200	206	212	219	224
181	191	200	210	216	223	230	235
190	200	210	220	227	233	241	246
198	210	219	230	237	244	252	257
207	219	229	240	248	255	263	269
216	228	239	251	258	265	274	280
225	238	249	261	269	276	285	291
233	247	258	271	279	287	296	302

TABLE B.10 (cont.) CRITICAL VALUES OF THE MANN-WHITNEY U DISTRIBUTIOI

	α(2):	0.20	0.10	0.05	0.02	0.01	0.005	0.002	0.001
	α(1):	0.10	0.05	0.025	0.01	0.005	0.0025	0.001	0.0005
n_1	n_2								
15	26	244	257	268	281	290	298	307	313
	27	253	266	279	291	300	308	318	325
	28	262	276	288	301	311	319	329	336
	29	271	285	298	311	321	330	340	347
	30	280	294	307	322	331	340	351	358
	31	288	304	317	332	342	351	362	369
	32	297	313	327	342	352	361	373	381
	33	306	323	336	352	363	372	384	392
	34	315	332	346	362	373	383	395	403
	35	324	341	356	372	383	394	406	414
	36	333	351	366	382	394	404	417	425
	37	342	360	375	393	404	415	428	436
	38	351	369	385	403	415	425	439	448
	39	360	379	395	413	425	436	449	459
15	40	369	388	404	423	435	447	460	470
16	16	163	173	181	190	196	202	208	215
	17	173	183	191	201	207	213	220	225
	18	182	193	202	212	218	224	231	237
	19	192	203	212	222	230	236	244	248
	20	201	213	222	233	241	247	255	261
	21	211	223	233	244	252	259	267	273
	22	221	233	243	255	263	270	278	285
	23	230	243	253	266	274	282	290	296
	24	240	252	264	276	285	293	302	308
	25	249	263	274	287	296	304	314	320
	26	259	273	284	298	307	315	325	332
	27	268	283	295	309	318	327	337	344
	28	278	293	305	320	330	338	348	356
	29	287	303	315	330	340	349	360	367
	30	297	312	326	341	352	360	372	379
	31	306	322	336	352	362	372	383	391
	32	316	332	346	362	373	383	395	403
	33	325	342	357	373	384	394	406	415
	34	335	352	367	384	395	406	418	427
	35	344	362	377	395	406	417	430	438
	36	354	372	388	405	417	428	442	450
	37	363	382	398	416	428	439	453	462
	38	373	392	408	427	439	451	464	474
	39	382	402	418	437	450	462	476	485
16	40	391	412	428	448	461	473	487	497
17	17	183	195	203	212	219	225	232	238
	18	193	204	214	224	231	237	245	250
	19	203	214	224	236	242	249	257	263
	20	213	225	236	247	254	261	270	275
	21	223	236	246	258	266	273	282	288
	22	233	246	257	269	278	285	294	300
	23	244	257	268	281	289	297	306	311
	24	254	267	279	292	301	309	319	325
17	25	264	278	290	303	313	321	331	337

TABLE B.10 (cont.) CRITICAL VALUES OF THE MANN-WHITNEY U DISTRIBUT

	α(2):	0.20	0.10	0.05	0.02	0.01	0.005	0.002	0.001
	α(1):	0.10	0.05	0.025	0.01	0.005	0.0025	0.001	0.0005
n_1	n_2								
17	26	274	288	301	315	324	333	343	350
	27	284	299	312	326	336	345	355	363
	28	294	309	322	337	348	357	368	375
	29	304	320	333	349	359	368	380	388
	30	314	330	344	360	371	380	392	400
	31	324	341	355	371	382	392	404	413
	32	334	351	366	383	394	404	417	425
	33	344	362	377	394	406	416	429	438
	34	354	372	388	405	417	428	441	450
	35	365	383	399	417	429	440	453	462
	36	375	393	410	428	440	452	465	475
	37	385	404	420	439	452	464	478	487
	38	395	414	431	451	464	476	490	500
	39	405	425	442	462	475	487	502	512
17	40	415	435	453	473	487	498	514	525
18	18	204	213	225	236	243	250	258	263
	19	214	226	236	248	255	262	271	277
	20	225	237	248	260	268	275	284	290
	21	236	248	259	272	280	288	297	303
	22	246	260	271	284	292	300	310	316
	23	257	271	282	296	305	313	323	329
	24	268	282	294	308	317	325	336	343
	25	278	293	305	320	329	338	348	356
	26	289	304	317	332	341	350	361	369
	27	300	315	328	344	354	363	374	382
	28	310	326	340	355	366	376	387	395
	29	321	337	351	367	378	388	400	409
	30	331	348	363	379	390	401	413	421
	31	342	359	374	391	403	413	426	434
	32	353	370	386	403	415	426	439	447
	33	363	381	397	415	427	438	451	460
	34	374	393	409	427	439	451	464	473
	35	385	404	420	439	451	463	477	487
	36	395	415	432	451	464	475	490	500
	37	406	426	443	463	476	488	503	513
	38	416	437	454	475	488	500	515	526
	39	427	448	466	486	500	513	528	539
18	40	438	459	477	498	512	525	541	551
19	19	226	238	248	260	268	276	284	291
	20	237	250	261	273	281	289	298	304
	21	248	261	273	286	294	302	312	318
	22	259	273	285	298	307	315	325	331
	23	270	285	297	311	320	328	339	346
	24	282	296	309	323	333	342	352	360
	25	293	308	321	336	346	355	366	373
	26	304	320	333	348	358	368	379	387
	27	315	331	345	361	371	381	393	401
	28	326	343	357	373	384	394	406	415
19									

TABLE B.10 (cont.) CRITICAL VALUES OF THE MANN-WHITNEY U DISTRIBU

	α(2):	0.20	0.10	0.05	0.02	0.01	0.005	0.002	0.001
	α(1):	0.10	0.05	0.025	0.01	0.005	0.0025	0.001	0.0005
n_1	n_2								
19	29	338	354	369	386	397	407	420	428
	30	349	366	381	398	410	421	433	442
	31	360	378	393	411	423	434	447	456
	32	371	390	405	423	436	447	460	469
	33	382	401	417	436	448	460	474	483
	34	393	413	429	448	461	473	487	497
	35	403	424	441	461	474	486	500	511
	36	416	436	453	473	487	500	514	524
	37	427	448	465	486	500	513	528	538
	38	438	459	477	498	512	526	541	552
	39	449	471	489	511	525	538	554	565
19	40	--	482	502	523	538	551	566	578
20	20	249	262	273	286	295	303	312	318
	21	260	274	286	299	308	317	326	333
	22	272	286	299	313	322	330	341	348
	23	284	298	311	326	335	344	355	362
	24	296	311	324	339	349	358	369	377
	25	307	323	336	352	362	372	383	391
	26	319	335	348	365	376	386	397	405
	27	331	348	361	378	389	399	411	420
	28	343	360	374	391	403	413	425	434
	29	354	372	387	404	416	427	440	449
	30	366	384	400	417	430	440	454	463
	31	378	396	412	430	443	454	468	477
	32	389	409	425	443	456	468	482	491
	33	401	421	437	456	470	482	496	506
	34	413	433	450	470	483	495	510	520
	35	424	445	463	483	497	509	524	534
	36	436	452	475	496	510	523	539	549
	37	448	469	486	509	523	536	553	563
	38	--	482	501	522	537	550	566	577
	39	--	--	513	535	550	564	580	592
20	40	--	--	526	548	563	577	594	606

The preceding values were derived, with permission of the publisher, from the tal (1964, J. Amer. Statist. Assoc. 59: 925–934).

Examples:

$U_{0.05(2),9,8} = 34$ and $U_{0.05(1),10,8} = U_{0.05(1),8,10} = 60.$

For the Mann-Whitney test involving n_1 and/or n_2 larger than those in this tabl approximation (Section 9.9) may be used. This approximation is excellent for two-ta α 0.10 or 0.05 (or one-tailed testing at α = 0.05 or 0.025, respectively), especially are similar in magnitude. The approximation becomes progressively poorer as we c extreme significance levels.

TABLE B.4 CRITICAL VALUES OF THE *F* DISTRIBUTION

Numerator DF = 1

α(2):	0.50	0.20	0.10	0.05	0.02	0.01	0.005	0.002	0.001
α(1):	0.25	0.10	0.05	0.025	0.01	0.005	0.0025	0.001	0.0005
Denom. DF									
1	5.83	39.9	161.	648.	4050.	16200.	64800.	405000.	1620000.
2	2.57	8.53	18.5	38.5	98.5	199.	399.	999.	2000.
3	2.02	5.54	10.1	17.4	34.1	55.6	89.6	167.	267.
4	1.81	4.54	7.71	12.2	21.2	31.3	45.7	74.1	106.
5	1.69	4.06	6.61	10.0	16.3	22.8	31.4	47.2	63.6
6	1.62	3.78	5.99	8.81	13.7	18.6	24.8	35.5	46.1
7	1.57	3.59	5.59	8.07	12.2	16.2	21.1	29.2	37.0
8	1.54	3.46	5.32	7.57	11.3	14.7	18.8	25.4	31.6
9	1.51	3.36	5.12	7.21	10.6	13.6	17.2	22.9	28.0
10	1.49	3.29	4.96	6.94	10.0	12.8	16.0	21.0	25.5
11	1.47	3.23	4.84	6.72	9.65	12.2	15.2	19.7	23.7
12	1.46	3.18	4.75	6.55	9.33	11.8	14.5	18.6	22.2
13	1.45	3.14	4.67	6.41	9.07	11.4	13.9	17.8	21.1
14	1.44	3.10	4.60	6.30	8.86	11.1	13.5	17.1	20.2
15	1.43	3.07	4.54	6.20	8.68	10.8	13.1	16.6	19.5
16	1.42	3.05	4.49	6.12	8.53	10.6	12.8	16.1	18.9
17	1.42	3.03	4.45	6.04	8.40	10.4	12.6	15.7	18.4
18	1.41	3.01	4.41	5.98	8.29	10.2	12.3	15.4	17.9
19	1.41	2.99	4.38	5.92	8.18	10.1	12.1	15.1	17.5
20	1.40	2.97	4.35	5.87	8.10	9.94	11.9	14.8	17.2
21	1.40	2.96	4.32	5.83	8.02	9.83	11.8	14.6	16.9
22	1.40	2.95	4.30	5.79	7.95	9.73	11.6	14.4	16.6
23	1.39	2.94	4.28	5.75	7.88	9.63	11.5	14.2	16.4
24	1.39	2.93	4.26	5.72	7.82	9.55	11.4	14.0	16.2
25	1.39	2.92	4.24	5.69	7.77	9.48	11.3	13.9	16.0
26	1.38	2.91	4.23	5.66	7.72	9.41	11.2	13.7	15.8
27	1.38	2.90	4.21	5.63	7.68	9.34	11.1	13.6	15.6
28	1.38	2.89	4.20	5.61	7.64	9.28	11.0	13.5	15.5
29	1.38	2.89	4.18	5.59	7.60	9.23	11.0	13.4	15.3
30	1.38	2.88	4.17	5.57	7.56	9.18	10.9	13.3	15.2
35	1.37	2.85	4.12	5.48	7.42	8.98	10.6	12.9	14.7
40	1.36	2.84	4.08	5.42	7.31	8.83	10.4	12.6	14.4
45	1.36	2.82	4.06	5.38	7.23	8.71	10.3	12.4	14.1
50	1.35	2.81	4.03	5.34	7.17	8.63	10.1	12.2	13.9
60	1.35	2.79	4.00	5.29	7.08	8.49	9.96	12.0	13.5
70	1.35	2.78	3.98	5.25	7.01	8.40	9.84	11.8	13.3
80	1.34	2.77	3.96	5.22	6.96	8.33	9.75	11.7	13.2
90	1.34	2.76	3.95	5.20	6.93	8.28	9.68	11.6	13.0
100	1.34	2.76	3.94	5.18	6.90	8.24	9.62	11.5	12.9
120	1.34	2.75	3.92	5.15	6.85	8.18	9.54	11.4	12.8
140	1.33	2.74	3.91	5.13	6.82	8.14	9.48	11.3	12.7
160	1.33	2.74	3.90	5.12	6.80	8.10	9.44	11.2	12.6
180	1.33	2.73	3.89	5.11	6.78	8.08	9.40	11.2	12.6
200	1.33	2.73	3.89	5.10	6.76	8.06	9.38	11.2	12.5
300	1.33	2.72	3.87	5.07	6.72	8.00	9.30	11.0	12.4
500	1.33	2.72	3.86	5.05	6.69	7.95	9.23	11.0	12.3
∞	1.32	2.71	3.84	5.02	6.64	7.88	9.14	10.8	12.1

TABLE B.4 (cont.) CRITICAL VALUES OF THE *F* DISTRIBUTION

Numerator DF = 2

$\alpha(2)$:	0.50	0.20	0.10	0.05	0.02	0.01	0.005	0.002	0.001
$\alpha(1)$:	0.25	0.10	0.05	0.025	0.01	0.005	0.0025	0.001	0.0005
Denom. DF									
1	7.50	49.5	200.	800.	5000.	20000.	80000.	500000.	2000000.
2	3.00	9.00	19.0	39.0	99.0	199.	399.	999.	2000.
3	2.28	5.46	9.55	16.0	30.8	49.8	79.9	149.	237.
4	2.00	4.32	6.94	10.6	18.0	26.3	38.0	61.2	87.4
5	1.85	3.78	5.79	8.43	13.3	18.3	25.0	37.1	49.8
6	1.76	3.46	5.14	7.26	10.9	14.5	19.1	27.0	34.8
7	1.70	3.26	4.74	6.54	9.55	12.4	15.9	21.7	27.2
8	1.66	3.11	4.46	6.06	8.65	11.0	13.9	18.5	22.7
9	1.62	3.01	4.26	5.71	8.02	10.1	12.5	16.4	19.9
10	1.60	2.92	4.10	5.46	7.56	9.43	11.6	14.9	17.9
11	1.58	2.86	3.98	5.26	7.21	8.91	10.8	13.8	16.4
12	1.56	2.81	3.89	5.10	6.93	8.51	10.3	13.0	15.3
13	1.55	2.76	3.81	4.97	6.70	8.19	9.84	12.3	14.4
14	1.53	2.73	3.74	4.86	6.51	7.92	9.47	11.8	13.7
15	1.52	2.70	3.68	4.77	6.36	7.70	9.17	11.3	13.2
16	1.51	2.67	3.63	4.69	6.23	7.51	8.92	11.0	12.7
17	1.51	2.64	3.59	4.62	6.11	7.35	8.70	10.7	12.3
18	1.50	2.62	3.55	4.56	6.01	7.21	8.51	10.4	11.9
19	1.49	2.61	3.52	4.51	5.93	7.09	8.35	10.2	11.6
20	1.49	2.59	3.49	4.46	5.85	6.99	8.21	9.95	11.4
21	1.48	2.57	3.47	4.42	5.78	6.89	8.08	9.77	11.2
22	1.48	2.56	3.44	4.38	5.72	6.81	7.96	9.61	11.0
23	1.47	2.55	3.42	4.35	5.66	6.73	7.88	9.47	10.8
24	1.47	2.54	3.40	4.32	5.61	6.66	7.77	9.34	10.6
25	1.47	2.53	3.39	4.29	5.57	6.60	7.69	9.22	10.5
26	1.46	2.52	3.37	4.27	5.53	6.54	7.61	9.12	10.3
27	1.46	2.51	3.35	4.24	5.49	6.49	7.54	9.02	10.2
28	1.46	2.50	3.34	4.22	5.45	6.44	7.48	8.93	10.1
29	1.45	2.50	3.33	4.20	5.42	6.40	7.42	8.85	9.99
30	1.45	2.49	3.32	4.18	5.39	6.35	7.36	8.77	9.90
35	1.44	2.46	3.27	4.11	5.27	6.19	7.16	8.47	9.52
40	1.44	2.44	3.23	4.05	5.18	6.07	6.99	8.25	9.25
45	1.43	2.42	3.20	4.01	5.11	5.97	6.86	8.09	9.04
50	1.43	2.41	3.18	3.97	5.06	5.90	6.77	7.96	8.88
60	1.42	2.39	3.15	3.93	4.98	5.79	6.63	7.77	8.65
70	1.41	2.38	3.13	3.89	4.92	5.72	6.53	7.64	8.49
80	1.41	2.37	3.11	3.86	4.88	5.67	6.46	7.54	8.37
90	1.41	2.36	3.10	3.84	4.85	5.62	6.41	7.47	8.28
100	1.41	2.36	3.09	3.83	4.82	5.59	6.37	7.41	8.21
120	1.40	2.35	3.07	3.80	4.79	5.54	6.30	7.32	8.10
140	1.40	2.34	3.06	3.79	4.76	5.50	6.26	7.26	8.03
160	1.40	2.34	3.05	3.78	4.74	5.48	6.22	7.21	7.97
180	1.40	2.33	3.05	3.77	4.73	5.46	6.20	7.18	7.93
200	1.40	2.33	3.04	3.76	4.71	5.44	6.17	7.15	7.90
300	1.39	2.32	3.03	3.73	4.68	5.39	6.11	7.07	7.80
500	1.39	2.31	3.01	3.72	4.65	5.35	6.06	7.00	7.72
∞	1.39	2.30	3.00	3.69	4.61	5.30	5.99	6.91	7.60

TABLE B.4 (cont.) CRITICAL VALUES OF THE *F* DISTRIBUTION

Numerator DF = 3

$\alpha(2)$:	0.50	0.20	0.10	0.05	0.02	0.01	0.005	0.002	0.001
$\alpha(1)$:	0.25	0.10	0.05	0.025	0.01	0.005	0.0025	0.001	0.0005
Denom. DF									
1	8.20	53.6	216.	864.	5400.	21600.	86500.	540000.	2160000.
2	3.15	9.16	19.2	39.2	99.2	199.	399.	999.	2000.
3	2.36	5.39	9.28	15.4	29.5	47.5	76.1	141.	225.
4	2.05	4.19	6.59	9.98	16.7	24.3	35.0	56.2	80.1
5	1.88	3.62	5.41	7.76	12.1	16.5	22.4	33.2	44.4
6	1.78	3.29	4.76	6.60	9.78	12.9	16.9	23.7	30.5
7	1.72	3.07	4.35	5.89	8.45	10.9	13.8	18.8	23.5
8	1.67	2.92	4.07	5.42	7.59	9.60	12.0	15.8	19.4
9	1.63	2.81	3.86	5.08	6.99	8.72	10.7	13.9	16.8
10	1.60	2.73	3.71	4.83	6.55	8.08	9.83	12.6	15.0
11	1.58	2.66	3.59	4.63	6.22	7.60	9.17	11.6	13.7
12	1.56	2.61	3.49	4.47	5.95	7.25	8.65	10.8	12.7
13	1.55	2.56	3.41	4.35	5.74	6.93	8.24	10.2	11.9
14	1.53	2.52	3.34	4.24	5.56	6.68	7.91	9.73	11.3
15	1.52	2.49	3.29	4.15	5.42	6.48	7.63	9.34	10.8
16	1.51	2.46	3.24	4.08	5.29	6.30	7.40	9.01	10.3
17	1.50	2.44	3.20	4.01	5.19	6.16	7.21	8.73	9.99
18	1.49	2.42	3.16	3.95	5.09	6.03	7.04	8.49	9.69
19	1.49	2.40	3.13	3.90	5.01	5.92	6.89	8.28	9.42
20	1.48	2.38	3.10	3.86	4.94	5.82	6.76	8.10	9.20
21	1.48	2.36	3.07	3.82	4.87	5.73	6.64	7.94	8.99
22	1.47	2.35	3.05	3.78	4.82	5.63	6.54	7.80	8.82
23	1.47	2.34	3.03	3.75	4.76	5.58	6.45	7.67	8.66
24	1.46	2.33	3.01	3.72	4.72	5.52	6.36	7.53	8.51
25	1.46	2.32	2.99	3.69	4.68	5.46	6.29	7.45	8.39
26	1.45	2.31	2.98	3.67	4.64	5.41	6.22	7.36	8.27
27	1.45	2.30	2.96	3.65	4.60	5.36	6.16	7.27	8.16
28	1.45	2.29	2.95	3.63	4.57	5.32	6.10	7.19	8.07
29	1.45	2.28	2.93	3.61	4.54	5.28	6.05	7.12	7.98
30	1.44	2.28	2.92	3.59	4.51	5.24	6.00	7.05	7.89
35	1.43	2.25	2.87	3.52	4.40	5.09	5.80	6.79	7.56
40	1.42	2.23	2.84	3.46	4.31	4.98	5.66	6.59	7.33
45	1.42	2.21	2.81	3.42	4.25	4.89	5.55	6.45	7.15
50	1.41	2.20	2.79	3.39	4.20	4.83	5.47	6.34	7.01
60	1.41	2.18	2.76	3.34	4.13	4.73	5.34	6.17	6.81
70	1.40	2.16	2.74	3.31	4.07	4.66	5.26	6.06	6.67
80	1.40	2.15	2.72	3.28	4.04	4.61	5.19	5.97	6.57
90	1.39	2.15	2.71	3.26	4.01	4.57	5.14	5.91	6.49
100	1.39	2.14	2.70	3.25	3.98	4.54	5.11	5.86	6.43
120	1.39	2.13	2.68	3.23	3.95	4.50	5.05	5.78	6.34
140	1.38	2.12	2.67	3.21	3.92	4.47	5.01	5.73	6.28
160	1.38	2.12	2.66	3.20	3.91	4.44	4.98	5.69	6.23
180	1.38	2.11	2.65	3.19	3.89	4.42	4.95	5.66	6.19
200	1.38	2.11	2.65	3.18	3.88	4.41	4.94	5.63	6.16
300	1.38	2.10	2.63	3.16	3.85	4.38	4.88	5.56	6.08
500	1.37	2.09	2.62	3.14	3.82	4.33	4.84	5.51	6.01
∞	1.37	2.08	2.61	3.12	3.78	4.28	4.77	5.42	5.91

TABLE B.4 (cont.) CRITICAL VALUES OF THE *F* DISTRIBUTION

Numerator DF = 4

$\alpha(2)$:	0.50	0.20	0.10	0.05	0.02	0.01	0.005	0.002	0.001
$\alpha(1)$:	0.25	0.10	0.05	0.025	0.01	0.005	0.0025	0.001	0.0005
Denom. DF									
1	8.58	55.8	225.	900.	5620.	22500.	90000.	562000.	2250000.
2	3.23	9.24	19.2	39.2	99.2	199.	399.	999.	2000.
3	2.39	5.34	9.12	15.1	28.7	46.2	73.9	137.	218.
4	2.06	4.11	6.39	9.60	16.0	23.2	33.3	53.4	76.1
5	1.89	3.52	5.19	7.39	11.4	15.6	21.0	31.1	41.5
6	1.79	3.18	4.53	6.23	9.15	12.0	15.7	21.9	28.1
7	1.72	2.96	4.12	5.52	7.85	10.1	12.7	17.2	21.4
8	1.66	2.81	3.84	5.05	7.01	8.81	10.9	14.4	17.6
9	1.63	2.69	3.63	4.72	6.42	7.96	9.74	12.6	15.1
10	1.59	2.61	3.48	4.47	5.99	7.34	8.89	11.3	13.4
11	1.57	2.54	3.36	4.28	5.67	6.88	8.25	10.3	12.2
12	1.55	2.48	3.26	4.12	5.41	6.52	7.76	9.63	11.2
13	1.53	2.43	3.18	4.00	5.21	6.23	7.37	9.07	10.5
14	1.52	2.39	3.11	3.89	5.04	6.00	7.06	8.62	9.95
15	1.51	2.36	3.06	3.80	4.89	5.80	6.80	8.25	9.48
16	1.50	2.33	3.01	3.73	4.77	5.64	6.58	7.94	9.08
17	1.49	2.31	2.96	3.66	4.67	5.50	6.39	7.68	8.75
18	1.48	2.29	2.93	3.61	4.58	5.37	6.23	7.46	8.47
19	1.47	2.27	2.90	3.56	4.50	5.27	6.09	7.27	8.23
20	1.47	2.25	2.87	3.51	4.43	5.17	5.97	7.10	8.02
21	1.46	2.23	2.84	3.48	4.37	5.09	5.86	6.95	7.83
22	1.45	2.22	2.82	3.44	4.31	5.02	5.76	6.81	7.67
23	1.45	2.21	2.80	3.41	4.26	4.95	5.67	6.70	7.52
24	1.44	2.19	2.78	3.38	4.22	4.89	5.60	6.59	7.39
25	1.44	2.18	2.76	3.35	4.18	4.84	5.53	6.49	7.27
26	1.44	2.17	2.74	3.33	4.14	4.79	5.46	6.41	7.16
27	1.43	2.17	2.73	3.31	4.11	4.74	5.40	6.33	7.06
28	1.43	2.16	2.71	3.29	4.07	4.70	5.35	6.25	6.97
29	1.43	2.15	2.70	3.27	4.04	4.66	5.30	6.19	6.89
30	1.42	2.14	2.69	3.25	4.02	4.62	5.25	6.12	6.82
35	1.41	2.11	2.64	3.18	3.91	4.48	5.07	5.88	6.51
40	1.40	2.09	2.61	3.13	3.83	4.37	4.93	5.70	6.30
45	1.40	2.07	2.58	3.09	3.77	4.29	4.83	5.56	6.13
50	1.39	2.06	2.56	3.05	3.72	4.23	4.75	5.46	6.01
60	1.38	2.04	2.53	3.01	3.65	4.14	4.64	5.31	5.82
70	1.38	2.03	2.50	2.97	3.60	4.08	4.56	5.20	5.70
80	1.38	2.02	2.49	2.95	3.56	4.03	4.50	5.12	5.60
90	1.37	2.01	2.47	2.93	3.53	3.99	4.45	5.06	5.53
100	1.37	2.00	2.46	2.92	3.51	3.96	4.42	5.02	5.48
120	1.37	1.99	2.45	2.89	3.48	3.92	4.36	4.95	5.39
140	1.36	1.99	2.44	2.88	3.46	3.89	4.32	4.90	5.33
160	1.36	1.98	2.43	2.87	3.44	3.87	4.30	4.86	5.29
180	1.36	1.98	2.42	2.86	3.43	3.86	4.27	4.83	5.26
200	1.36	1.97	2.42	2.85	3.41	3.84	4.26	4.81	5.23
300	1.35	1.96	2.40	2.83	3.38	3.80	4.21	4.75	5.15
500	1.35	1.96	2.39	2.81	3.36	3.78	4.17	4.69	5.09
∞	1.35	1.94	2.37	2.79	3.32	3.72	4.11	4.62	5.00

TABLE B.1 CRITICAL VALUES OF THE CHI-SQUARE DISTRIBUTION

ν	α = 0.999	0.995	0.99	0.975	0.95	0.90	0.75	0.50	0.25	0.10	0.05	0.025	0.01	0.005	0.001
1	0.000	0.000	0.000	0.001	0.004	0.016	0.102	0.455	1.323	2.706	3.841	5.024	6.635	7.879	10.828
2	0.002	0.010	0.020	0.051	0.103	0.211	0.575	1.386	2.773	4.605	5.991	7.378	9.210	10.597	13.816
3	0.024	0.072	0.115	0.216	0.352	0.584	1.213	2.366	4.108	6.251	7.815	9.348	11.345	12.838	16.266
4	0.091	0.207	0.297	0.484	0.711	1.064	1.923	3.357	5.385	7.779	9.488	11.143	13.277	14.860	18.467
5	0.210	0.412	0.554	0.831	1.145	1.610	2.675	4.351	6.626	9.236	11.070	12.833	15.086	16.750	20.515
6	0.381	0.676	0.872	1.237	1.635	2.204	3.455	5.348	7.841	10.645	12.592	14.449	16.812	18.548	22.458
7	0.599	0.989	1.239	1.690	2.167	2.833	4.255	6.346	9.037	12.017	14.067	16.013	18.475	20.278	24.322
8	0.857	1.344	1.646	2.180	2.733	3.490	5.071	7.344	10.219	13.362	15.507	17.535	20.090	21.955	26.124
9	1.152	1.735	2.088	2.700	3.325	4.168	5.899	8.343	11.389	14.684	16.919	19.023	21.666	23.589	27.877
10	1.479	2.156	2.558	3.247	3.940	4.865	6.737	9.342	12.549	15.987	18.307	20.483	23.209	25.188	29.588
11	1.834	2.603	3.053	3.816	4.575	5.578	7.584	10.341	13.701	17.275	19.675	21.920	24.725	26.757	31.264
12	2.214	3.074	3.571	4.404	5.226	6.304	8.438	11.340	14.845	18.549	21.026	23.337	26.217	28.300	32.909
13	2.617	3.565	4.107	5.009	5.892	7.042	9.299	12.340	15.984	19.812	22.362	24.736	27.688	29.819	34.528
14	3.041	4.075	4.660	5.629	6.571	7.790	10.165	13.339	17.117	21.064	23.685	26.119	29.141	31.319	36.123
15	3.483	4.601	5.229	6.262	7.261	8.547	11.037	14.339	18.245	22.307	24.996	27.488	30.578	32.801	37.697
16	3.942	5.142	5.812	6.908	7.962	9.312	11.912	15.338	19.369	23.542	26.296	28.845	32.000	34.267	39.252
17	4.416	5.697	6.408	7.564	8.672	10.085	12.792	16.338	20.489	24.769	27.587	30.191	33.409	35.718	40.790
18	4.905	6.265	7.015	8.231	9.390	10.865	13.675	17.338	21.605	25.989	28.869	31.526	34.805	37.156	42.312
19	5.407	6.844	7.633	8.907	10.117	11.651	14.562	18.338	22.718	27.204	30.144	32.852	36.191	38.582	43.820
20	5.921	7.434	8.260	9.591	10.851	12.443	15.452	19.337	23.828	28.412	31.410	34.170	37.566	39.997	45.315
21	6.447	8.034	8.897	10.283	11.591	13.240	16.344	20.337	24.935	29.615	32.671	35.479	38.932	41.401	46.797
22	6.983	8.643	9.542	10.982	12.338	14.041	17.240	21.337	26.039	30.813	33.924	36.781	40.289	42.796	48.268
23	7.529	9.260	10.196	11.689	13.091	14.848	18.137	22.337	27.141	32.007	35.172	38.076	41.638	44.181	49.728
24	8.085	9.886	10.856	12.401	13.848	15.659	19.037	23.337	28.241	33.196	36.415	39.364	42.980	45.559	51.179
25	8.649	10.520	11.524	13.120	14.611	16.473	19.939	24.337	29.339	34.382	37.652	40.646	44.314	46.928	52.620
26	9.222	11.160	12.198	13.844	15.379	17.292	20.843	25.336	30.435	35.563	38.885	41.923	45.642	48.290	54.052
27	9.803	11.808	12.879	14.573	16.151	18.114	21.749	26.336	31.528	36.741	40.113	43.195	46.963	49.645	55.476
28	10.391	12.461	13.565	15.308	16.928	18.939	22.657	27.336	32.620	37.916	41.337	44.461	48.278	50.993	56.892
29	10.986	13.121	14.256	16.047	17.708	19.768	23.567	28.336	33.711	39.087	42.557	45.722	49.588	52.336	58.301
30	11.588	13.787	14.953	16.791	18.493	20.599	24.478	29.336	34.800	40.256	43.773	46.979	50.892	53.672	59.703
31	12.196	14.458	15.655	17.539	19.281	21.434	25.390	30.336	35.887	41.422	44.985	48.232	52.191	55.003	61.098
32	12.811	15.134	16.362	18.291	20.072	22.271	26.304	31.336	36.973	42.585	46.194	49.480	53.486	56.328	62.487
33	13.431	15.815	17.074	19.047	20.867	23.110	27.219	32.336	38.058	43.745	47.400	50.725	54.776	57.648	63.870
34	14.057	16.501	17.789	19.806	21.664	23.952	28.136	33.336	39.141	44.903	48.602	51.966	56.061	58.964	65.247
35	14.688	17.192	18.509	20.569	22.465	24.797	29.054	34.336	40.223	46.059	49.802	53.203	57.342	60.275	66.619
36	15.324	17.887	19.233	21.336	23.269	25.643	29.973	35.336	41.304	47.212	50.998	54.437	58.619	61.581	67.985
37	15.965	18.586	19.960	22.106	24.075	26.492	30.893	36.336	42.383	48.363	52.192	55.668	59.893	62.883	69.346
38	16.611	19.289	20.691	22.878	24.884	27.343	31.815	37.335	43.462	49.513	53.384	56.896	61.162	64.181	70.703
39	17.262	19.996	21.426	23.654	25.695	28.196	32.737	38.335	44.539	50.660	54.572	58.120	62.428	65.476	72.055
40	17.916	20.707	22.164	24.433	26.509	29.051	33.660	39.335	45.616	51.805	55.758	59.342	63.691	66.766	73.402
41	18.576	21.421	22.906	25.215	27.326	29.907	34.585	40.335	46.692	52.949	56.942	60.561	64.950	68.053	74.745
42	19.239	22.138	23.650	25.999	28.144	30.765	35.510	41.335	47.766	54.090	58.124	61.777	66.206	69.336	76.084
43	19.906	22.859	24.398	26.785	28.965	31.625	36.436	42.335	48.840	55.230	59.304	62.990	67.459	70.616	77.419
44	20.576	23.584	25.148	27.575	29.787	32.487	37.363	43.335	49.913	56.369	60.481	64.201	68.710	71.893	78.750
45	21.251	24.311	25.901	28.366	30.612	33.350	38.291	44.335	50.985	57.505	61.656	65.410	69.957	73.166	80.077
46	21.929	25.041	26.657	29.160	31.439	34.215	39.220	45.335	52.056	58.641	62.830	66.617	71.201	74.437	81.400
47	22.610	25.775	27.416	29.956	32.268	35.081	40.149	46.335	53.127	59.774	64.001	67.821	72.443	75.704	82.720
48	23.295	26.511	28.177	30.755	33.098	35.949	41.079	47.335	54.196	60.907	65.171	69.023	73.683	76.969	84.037
49	23.983	27.249	28.941	31.555	33.930	36.818	42.010	48.335	55.265	62.038	66.339	70.222	74.919	78.231	85.351
50	24.674	27.991	29.707	32.357	34.764	37.689	42.942	49.335	56.334	63.167	67.505	71.420	76.154	79.490	86.661