

ภาคผนวก

TABLE A Factors for Computing Control Chart Line

Table of the Factors for Computing Control Chart Lines

Number of Observations in Sample, n	Chart for Averages			Chart for Standard Deviations						Chart for Ranges						
	Factors for Control Limits			Factors for Central Line			Factors for Control Limits			Factors for Central Line			Factors for Control Limits			
	A	A ₁	A ₂	c ₂	1/c ₂	B ₁	B ₂	B ₃	B ₄	d ₂	1/d ₂	d ₃	D ₁	D ₂	D ₃	D ₄
2	2.121	3.760	1.880	0.5642	1.7725	0	1.843	0	3.267	1.128	0.8865	0.853	0	3.686	0	3.267
3	1.732	2.394	1.023	0.7236	1.3820	0	1.858	0	2.568	1.693	0.5907	0.838	0	4.353	0	2.575
4	1.500	1.880	0.729	0.7979	1.2533	0	1.808	0	2.266	2.059	0.4857	0.880	0	4.698	0	2.282
5	1.342	1.596	0.577	0.8407	1.1894	0	1.756	0	2.059	2.328	0.4299	0.864	0	4.918	0	2.115
6	1.225	1.410	0.483	0.5686	1.1512	0.026	1.711	0.030	1.970	2.534	0.3945	0.848	0	5.078	0	2.004
7	1.134	1.277	0.419	0.8882	1.1259	0.105	1.672	0.118	1.882	2.704	0.3698	0.833	0.205	5.203	0.076	1.924
8	1.061	1.175	0.373	0.9027	1.1078	0.167	1.638	0.185	1.815	2.847	0.3512	0.829	0.387	5.307	0.136	1.864
9	1.000	1.094	0.337	0.9139	1.0942	0.219	1.609	0.239	1.761	2.970	0.3367	0.803	0.546	5.394	0.164	1.816
10	0.949	1.028	0.308	0.9227	1.0837	0.262	1.584	0.284	1.716	3.078	0.3249	0.797	0.687	5.469	0.223	1.777
11	0.905	0.973	0.285	0.9300	1.0753	0.299	1.561	0.321	1.679	3.173	0.3152	0.787	0.812	5.534	0.258	1.744
12	0.865	0.925	0.266	0.9359	1.0684	0.331	1.541	0.354	1.646	3.258	0.3069	0.778	0.924	5.592	0.284	1.716
13	0.832	0.884	0.249	0.9410	1.0627	0.359	1.523	0.382	1.618	3.336	0.2993	0.770	1.026	5.646	0.308	1.692
14	0.802	0.848	0.235	0.9453	1.0579	0.384	1.507	0.405	1.594	3.407	0.2935	0.762	1.121	5.693	0.329	1.671
15	0.775	0.816	0.223	0.9400	1.0537	0.406	1.492	0.428	1.572	3.472	0.2880	0.755	1.207	5.737	0.348	1.652
16	0.750	0.788	0.212	0.9523	1.0501	0.427	1.478	0.448	1.552	3.532	0.2831	0.749	1.285	5.779	0.364	1.635
17	0.728	0.762	0.203	0.9551	1.0170	0.445	1.465	0.466	1.534	3.588	0.2787	0.743	1.359	5.817	0.379	1.621
18	0.707	0.735	0.194	0.9576	1.0442	0.461	1.454	0.482	1.518	3.640	0.2747	0.739	1.426	5.854	0.392	1.608
19	0.688	0.717	0.187	0.9599	1.0413	0.477	1.443	0.497	1.503	3.689	0.2711	0.733	1.490	5.888	0.404	1.596
20	0.671	0.697	0.180	0.9619	1.0396	0.491	1.433	0.510	1.490	3.735	0.2677	0.723	1.548	5.922	0.414	1.586
21	0.655	0.679	0.173	0.9638	1.0376	0.504	1.424	0.523	1.477	3.778	0.2647	0.724	1.606	5.950	0.425	1.576
22	0.640	0.662	0.167	0.9655	1.0358	0.516	1.415	0.534	1.466	3.819	0.2618	0.720	1.659	5.979	0.434	1.566
23	0.626	0.647	0.162	0.9670	1.0342	0.527	1.407	0.545	1.455	3.858	0.2582	0.716	1.710	6.006	0.443	1.557
24	0.612	0.632	0.157	0.9684	1.0327	0.638	1.399	0.555	1.445	3.895	0.2567	0.712	1.759	6.031	0.452	1.548
25	0.600	0.619	0.153	0.9696	1.0313	0.548	1.392	0.565	1.436	3.931	0.2544	0.709	1.804	6.058	0.459	1.541
Over 25	3	3	3	†	†	†	†	†	†	†	†	†	†	†	†	†
	$\frac{3}{V_2n}$	$\frac{3}{V_n}$	$\frac{3}{V_n}$													

$$\dagger 1 - \frac{3}{V_2n} \leq \frac{3}{V_n}$$

TABLE B1

Table for Testing Randomness of Grouping in a Sequence of Alternatives* (probability of an equal or smaller number of runs than that listed is $P = 0.005$)

s = cases on one side of average } r always taken as the smaller number of cases;
 r = cases on other side of average } s the larger

$r \backslash s$	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
6	2														
7	2	3													
8	3	3	3												
9	3	3	3	4											
10	3	3	4	4	5										
11	3	4	4	5	5	5									
12	3	4	4	5	5	6	6								
13	3	4	5	5	5	6	6	7							
14	4	4	5	5	6	6	7	7	7						
15	4	4	5	6	6	7	7	7	8	8					
16	4	5	5	6	6	7	7	8	8	9	9				
17	4	5	5	6	7	7	8	8	8	9	9	10			
18	4	5	6	6	7	7	8	8	9	9	10	10	11		
19	4	5	6	6	7	8	8	9	9	10	10	10	11	11	
20	4	5	6	7	7	8	8	9	9	10	10	11	11	12	12

* Freda S. Swed and C. Eisenhart, "Tables for Testing Randomness of Grouping in a Sequence of Alternatives," *Annals of Mathematical Statistics*, Vol. XIV (1943), pp. 66-87.

TABLE B2

Table for Testing Randomness of Grouping in a Sequence of Alternatives* (probability of an equal or smaller number of runs than that listed is $P = 0.05$)

s = cases on one side of average } r always taken as the smaller number of cases;
 r = cases on other side of average } s the larger

$r \backslash s$	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
6	3														
7	4	4													
8	4	4	5												
9	4	5	5	5											
10	5	5	6	6	6										
11	5	5	6	6	7	7									
12	5	6	6	7	7	8	8								
13	5	6	6	7	8	8	9	9							
14	5	6	7	7	8	8	9	9	10						
15	6	6	7	8	8	9	9	10	10	11					
16	6	6	7	8	8	9	10	10	11	11	11				
17	6	7	7	8	9	9	10	10	11	11	12	12			
18	6	7	8	8	9	10	10	11	11	12	12	13	13		
19	6	7	8	8	9	10	10	11	12	12	13	13	14	14	
20	6	7	8	9	9	10	11	11	12	12	13	13	14	14	15

* Source the same as that of Table B1.

TABLE C

Cumulative Probabilities of the Normal Probability Distribution* (areas under the normal curve from $-\infty$ to z)

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998
z	1.282	1.645	1.960	2.326	2.576	3.090	3.291	3.891	4.417	
$F(z)$	.90	.95	.975	.99	.995	.999	.9995	.99995	.999995	
$2[1 - F(z)]$	.20	.10	.05	.02	.01	.002	.001	.0001	.00001	

* Table A2 is reprinted with permission from A. M. Mood, *Introduction to the Theory of Statistics* (New York: McGraw-Hill Book Co., 1950), p. 423

TABLE D
Percentage Points of the Distribution of the Relative Range $w = R/\sigma'$, Normal Universe*

n	Mean w or d_2	σ'_w or d_4	Probability That w Is Less than or Equal to Tabular Entry†									
			0.001	0.005	0.010	0.025	0.050	0.950	0.975	0.990	0.995	0.999
2	1.128	0.8525	0.00	0.01	0.02	0.04	0.09	2.77	3.17	3.64	3.97	4.65
3	1.693	0.8884	0.06	0.13	0.19	0.30	0.43	3.31	3.68	4.12	4.42	5.06
4	2.059	0.8798	0.20	0.34	0.43	0.59	0.76	3.63	3.98	4.40	4.69	5.31
5	2.326	0.8641	0.37	0.55	0.66	0.85	1.03	3.86	4.20	4.60	4.89	5.48
6	2.534	0.8480	0.54	0.75	0.87	1.06	1.25	4.03	4.36	4.76	5.03	5.62
7	2.704	0.833	0.69	0.92	1.05	1.25	1.44	4.17	4.49	4.88	5.15	5.73
8	2.847	0.820	0.83	1.08	1.20	1.41	1.60	4.29	4.61	4.99	5.26	5.82
9	2.970	0.808	0.96	1.21	1.34	1.55	1.74	4.39	4.70	5.08	5.34	5.90
10	3.078	0.797	1.08	1.33	1.47	1.67	1.86	4.47	4.79	5.16	5.42	5.97
11	3.173	0.787	1.20	1.43	1.58	1.78	1.97	4.55	4.86	5.23	5.49	6.04
12	3.258	0.778	1.30	1.55	1.68	1.88	2.07	4.62	4.92	5.29	5.54	6.09

* Probabilities reproduced with permission from E. S. Pearson, "The Probability Integral of the Range in Samples of n Observations from a Normal Population," *Biometrika*, Vol. XXXII (1941-42), pp. 301-8. Mean and σ' reproduced with permission from E. S. Pearson, "The Percentage Limits for the Distribution of Range in Samples from a Normal Population," *Biometrika*, Vol. XXIV (1932), pp. 404-17.

† Note that, in contrast to Table C, these probabilities are cumulated from the lower end of the distribution.

TABLE E
Summation of Terms of the Poisson Distribution

Entries in body of table give the probability (decimal point omitted) of X or less defects (or defectives), when the expected number is that given in the left margin of the table.

X u or $p'u$	0	1	2	3	4	5	6	7	8	9
0.02	980	1,000								
0.04	961	999	1,000							
0.06	942	998	1,000							
0.08	923	997	1,000							
0.10	905	995	1,000							
0.15	861	990	999	1,000						
0.20	819	982	999	1,000						
0.25	779	974	998	1,000						
0.30	741	963	996	1,000						
0.35	705	951	994	1,000						
0.40	670	938	992	999	1,000					
0.45	638	925	989	999	1,000					
0.50	607	910	986	998	1,000					
0.55	577	894	982	998	1,000					
0.60	549	878	977	997	1,000					
0.65	522	861	972	996	999	1,000				
0.70	497	844	966	994	999	1,000				
0.75	472	827	959	993	999	1,000				
0.80	449	809	953	991	999	1,000				
0.85	427	791	945	989	998	1,000				
0.90	407	772	937	987	998	1,000				
0.95	387	754	929	984	997	1,000				
1.00	368	736	920	981	996	999	1,000			
1.1	333	699	900	974	995	999	1,000			
1.2	301	663	879	966	992	998	1,000			
1.3	273	627	857	957	989	998	1,000			
1.4	247	592	833	946	986	997	999	1,000		
1.5	223	558	809	934	981	996	999	1,000		
1.6	202	525	783	921	976	994	999	1,000		
1.7	183	493	757	907	970	992	998	1,000		
1.8	165	463	731	891	964	990	997	999	1,000	
1.9	150	434	704	875	956	987	997	999	1,000	
2.0	135	406	677	857	947	983	995	999	1,000	

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TABLE E - Continued
 Summation of Terms of the Poisson Distribution

X or pn	0	1	2	3	4	5	6	7	8	9
2.2	111	355	623	819	928	975	993	998	1,000	
2.4	091	308	570	779	904	964	988	997	999	1,000
2.6	074	267	518	736	877	951	983	995	999	1,000
2.8	061	231	469	692	848	935	976	992	998	999
3.0	050	199	423	647	815	916	966	988	996	999
3.2	041	171	380	603	781	895	955	983	994	998
3.4	033	147	340	558	744	871	942	977	992	997
3.6	027	126	303	515	706	844	927	969	988	996
3.8	022	107	269	473	668	816	909	960	984	994
4.0	018	092	238	433	629	785	889	949	979	992
4.2	015	078	210	395	590	753	867	936	972	989
4.4	012	066	185	359	551	720	844	921	964	985
4.6	010	056	163	326	513	686	818	905	955	980
4.8	008	048	143	294	476	651	791	887	944	975
5.0	007	040	125	265	440	616	762	867	932	968
5.2	006	034	109	238	406	581	732	845	918	960
5.4	005	029	095	213	373	546	702	822	903	951
5.6	004	024	082	191	342	512	670	797	886	941
5.8	003	021	072	170	313	478	638	771	867	929
6.0	002	017	062	151	285	446	606	744	847	916
	10	11	12	13	14	15	16			
2.8	1,000									
3.0	1,000									
3.2	1,000									
3.4	999	1,000								
3.6	999	1,000								
3.8	998	999	1,000							
4.0	997	999	1,000							
4.2	996	999	1,000							
4.4	994	998	999	1,000						
4.6	992	997	999	1,000						
4.8	990	996	999	1,000						
5.0	986	995	998	999	1,000					
5.2	982	993	997	999	1,000					
5.4	977	990	996	999	1,000					
5.6	972	988	995	998	999	1,000				
5.8	965	984	993	997	999	1,000				
6.0	957	980	991	996	999	999	1,000			

TABLE E-Continued
 Summation of Terms of the Poisson Distribution

X λ or μ	0	1	2	3	4	5	6	7	8	9
6.2	002	015	054	134	259	414	574	716	826	902
6.4	002	012	046	119	235	384	542	687	803	886
6.6	001	010	040	105	213	355	511	658	780	869
6.8	001	009	034	093	192	327	480	628	755	850
7.0	001	007	030	082	173	301	450	599	729	830
7.2	001	006	025	072	156	276	420	569	703	810
7.4	001	005	022	063	140	253	392	539	676	788
7.6	001	004	019	055	125	231	365	510	648	765
7.8	000	004	016	048	112	210	338	481	620	741
8.0	000	003	014	042	100	191	313	453	593	717
8.5	000	002	009	030	074	150	256	386	523	653
9.0	000	001	006	021	055	116	207	324	456	587
9.5	000	001	004	015	040	089	165	269	392	522
10.0	000	000	003	010	029	067	130	220	333	458
	10	11	12	13	14	15	16	17	18	19
6.2	949	975	989	995	998	999	1,000			
6.4	939	969	986	994	997	999	1,000			
6.6	927	963	982	992	997	999	999	1,000		
6.8	915	955	978	990	996	998	999	1,000		
7.0	901	947	973	987	994	998	999	1,000		
7.2	887	937	967	984	993	997	999	999	1,000	
7.4	871	926	961	980	991	996	998	999	1,000	
7.6	854	915	954	976	989	995	998	999	1,000	
7.8	835	902	945	971	986	993	997	999	1,000	
8.0	816	888	936	966	983	992	996	998	999	1,000
8.5	763	849	909	949	973	986	993	997	999	999
9.0	706	803	876	926	959	978	989	995	998	999
9.5	645	752	836	898	940	967	982	991	996	998
10.0	583	697	792	864	917	951	973	986	993	997
	20	21	22							
8.5	1,000									
9.0	1,000									
9.5	999	1,000								
10.0	998	999	1,000							

TABLE E-Continued
Summation of Terms of the Poisson Distribution

X or p/n	0	1	2	3	4	5	6	7	8	9
10.5	000	000	002	007	021	050	102	179	279	397
11.0	000	000	001	005	015	038	079	143	232	341
11.5	000	000	001	003	011	028	060	114	191	289
12.0	000	000	001	002	008	020	046	090	155	242
12.5	000	000	000	002	005	015	035	070	125	201
13.0	000	000	000	001	004	011	026	054	100	166
13.5	000	000	000	001	003	008	019	041	079	135
14.0	000	000	000	000	002	006	014	032	062	109
14.5	000	000	000	000	001	004	010	024	048	088
15.0	000	000	000	000	001	003	008	018	037	070
	10	11	12	13	14	15	16	17	18	19
10.5	521	639	742	825	888	932	960	978	988	994
11.0	460	579	689	781	854	907	944	968	982	991
11.5	402	520	633	733	815	878	924	954	974	986
12.0	347	462	576	682	772	844	899	937	963	979
12.5	297	406	519	628	725	806	869	916	948	969
13.0	252	353	463	573	675	764	835	890	930	957
13.5	211	304	409	518	623	718	798	861	908	942
14.0	176	260	358	464	570	669	756	827	883	923
14.5	145	220	311	413	518	619	711	790	853	901
15.0	118	185	268	363	466	568	664	749	814	875
	20	21	22	23	24	25	26	27	28	29
10.5	997	999	999	1.000						
11.0	995	998	999	1.000						
11.5	992	996	998	999	1.000					
12.0	988	994	997	999	999	1.000				
12.5	983	991	995	998	999	999	1.000			
13.0	975	986	992	996	998	999	1.000			
13.5	965	980	989	994	997	998	999	1.000		
14.0	952	971	983	991	995	997	999	999	1.000	
14.5	936	960	976	986	992	996	998	999	999	1.000
15.0	917	947	967	981	989	994	997	998	999	1.000

TABLE E Concluded
Summation of Terms of the Poisson Distribution

X n or p n	X									
	4	5	6	7	8	9	10	11	12	13
16	000	001	004	010	022	043	077	127	193	275
17	000	001	002	005	013	026	049	085	135	201
18	000	000	001	003	007	015	030	055	092	143
19	000	000	001	002	004	009	018	035	061	098
20	000	000	000	001	002	005	011	021	039	066
21	000	000	000	000	001	003	006	013	025	043
22	000	000	000	000	001	002	004	008	015	028
23	000	000	000	000	000	001	002	004	009	017
24	000	000	000	000	000	000	001	003	005	011
25	000	000	000	000	000	000	001	001	003	006
	14	15	16	17	18	19	20	21	22	23
16	368	467	566	659	742	812	868	911	942	963
17	281	371	468	564	655	736	805	861	905	937
18	208	287	375	469	562	651	731	799	855	899
19	150	215	292	378	469	561	647	725	793	849
20	105	157	221	297	381	470	559	644	721	787
21	072	111	163	227	302	384	471	558	640	716
22	048	077	117	169	232	306	387	472	556	637
23	031	052	082	123	175	238	310	389	472	555
24	020	034	056	087	128	180	243	314	392	473
25	012	022	038	060	092	134	185	247	318	394
	24	25	26	27	28	29	30	31	32	33
16	978	987	993	996	998	999	999	1.000		
17	959	975	985	991	995	997	999	999	1.000	
18	932	955	972	983	990	994	997	998	999	1.000
19	893	927	951	969	980	988	993	996	998	999
20	843	888	922	948	966	978	987	992	995	997
21	782	838	883	917	944	963	976	985	991	994
22	712	777	832	877	913	940	959	973	983	989
23	635	708	772	827	873	908	936	956	971	981
24	554	632	704	768	823	868	904	932	953	969
25	473	553	629	700	763	818	863	900	929	950
	34	35	36	37	38	39	40	41	42	43
19	999	1.000								
20	999	999	1.000							
21	997	998	999	999	1.000					
22	994	996	998	999	999	1.000				
23	988	993	996	997	999	999	1.000			
24	979	987	992	995	997	998	999	999	1.000	
25	966	978	985	991	994	997	998	999	999	1.000

TABLE F

Values Associated with the Distribution of the Average Range* $[\sqrt{v}R/(d_2^*)/\sigma]^2$ Is Distributed Approximately as χ^2 with v Degrees of Freedom: R is the average range of g subgroups, each of size (m)

Number of Samples (g)	Size of Samples (m)																										
	2	3	4	5	6	7	8	9	10	11	12	13	14	15													
1	1.0	1.41	2.0	1.91	2.24	3.8	2.48	4.7	2.67	5.5	2.83	6.3	2.96	7.0	3.08	7.7	3.18	8.4	3.27	9.0	3.35	9.6	3.42	10.2	3.49	10.8	3.55
2	1.9	1.28	3.8	1.81	5.7	2.15	2.40	9.2	2.60	10.8	2.77	12.3	2.91	13.8	3.02	15.1	3.13	16.5	3.22	17.8	3.30	19.0	3.38	20.2	3.45	21.3	3.51
3	2.8	1.23	5.7	1.77	8.4	2.12	2.38	13.6	2.58	16.0	2.75	18.3	2.86	20.5	3.01	22.6	3.11	24.6	3.21	26.5	3.29	28.4	3.37	30.2	3.43	31.9	3.50
4	3.7	1.21	7.5	1.75	11.2	2.11	2.37	18.1	2.57	21.3	2.74	24.4	2.84	27.3	3.00	30.1	3.10	32.7	3.20	35.3	3.28	37.8	3.36	40.1	3.43	42.4	3.49
5	4.6	1.19	9.3	1.74	13.9	2.10	2.36	22.6	2.56	26.6	2.73	30.4	2.87	34.0	2.99	37.5	3.10	40.9	3.19	44.1	3.28	47.1	3.35	50.1	3.42	52.6	3.49
6	5.5	1.18	11.1	1.73	16.6	2.09	2.35	27.1	2.56	31.8	2.73	36.4	2.87	40.8	2.99	45.0	3.10	49.8	3.19	52.8	3.27	56.5	3.35	60.1	3.42	63.5	3.49
7	6.4	1.17	12.9	1.73	19.4	2.09	2.35	31.5	2.55	37.1	2.72	42.5	2.87	47.5	2.99	52.4	3.10	57.1	3.19	61.6	3.27	65.9	3.35	70.0	3.42	74.0	3.48
8	7.2	1.17	14.8	1.72	22.1	2.08	2.34	36.0	2.55	42.4	2.72	48.5	2.87	54.3	2.98	59.9	3.09	65.2	3.19	70.3	3.27	75.3	3.35	80.0	3.42	84.6	3.48
9	8.1	1.16	16.6	1.72	24.8	2.08	2.34	40.5	2.55	47.7	2.72	54.5	2.86	61.0	2.98	67.1	3.09	73.5	3.18	79.1	3.27	84.6	3.35	90.0	3.42	95.1	3.48
10	9.0	1.16	18.4	1.72	27.6	2.08	2.34	44.9	2.55	52.9	2.72	60.6	2.86	67.8	2.98	74.8	3.09	81.5	3.18	87.9	3.27	94.0	3.34	99.9	3.42	105.6	3.49
11	9.9	1.16	20.2	1.71	30.3	2.07	2.34	49.4	2.55	58.2	2.72	66.6	2.86	74.6	2.98	82.3	3.09	89.6	3.18	96.6	3.27	103.4	3.34	109.9	3.41	116.2	3.49
12	10.8	1.15	22.0	1.71	33.0	2.07	2.34	53.9	2.55	63.5	2.72	72.7	2.85	81.3	2.98	89.7	3.09	97.7	3.18	103.4	3.27	112.8	3.34	119.9	3.41	126.7	3.48
13	11.6	1.15	23.9	1.71	35.7	2.07	2.34	58.4	2.55	68.8	2.71	78.7	2.85	88.1	2.98	97.2	3.09	105.8	3.18	114.1	3.27	122.2	3.34	129.9	3.41	137.3	3.48
14	12.5	1.15	25.7	1.71	38.5	2.07	2.34	62.8	2.54	74.0	2.71	84.7	2.85	94.8	2.98	104.6	3.08	113.9	3.18	122.9	3.27	131.5	3.34	139.8	3.41	147.8	3.48
15	13.4	1.15	27.5	1.71	41.2	2.07	2.34	67.3	2.54	79.3	2.71	90.8	2.85	101.6	2.98	112.1	3.08	122.1	3.18	131.7	3.26	140.9	3.34	149.8	3.41	158.3	3.48
d_2^*	1.13	1.82	2.06	2.33	2.33	2.70	2.85	2.97	3.08	3.17	3.26	3.34	3.41	3.47	3.54	3.62	3.70	3.76	3.82	3.88	3.94	3.99	4.04	4.09	4.14	4.19	4.24
c.d.	0.88	1.82	2.74	3.62	4.47	5.27	6.03	6.76	7.45	8.12	8.76	9.38	9.97	10.54	11.11	11.68	12.24	12.79	13.33	13.86	14.38	14.89	15.39	15.88	16.36	16.83	17.29

* Table D3 is reproduced, with permission, in part from Table 30A of *Biometrika Tables for Statisticians*, Vol. 1, and in part from Acheson J. Duncan, "The Use of Ranges in Comparing Variabilities," *Industrial Quality Control*, Vol. XI, No. 5 (February 1955). Part of Table D3 has been computed by the author. d_2^* first appeared as a whole in the *Journal of the American Statistical Association*, Vol. LIII (1958), p. 548. In general, the degrees of freedom will be given approximately by the reciprocal of $(\frac{1}{2} + \frac{2}{2\sqrt{v}} + 2\sqrt{v})/g$ where c.v. is the coefficient of variation (d_2/d_2^*) of the range and g is the number of subgroups. Also, d_2^* is given approximately by d_2 (i.e., the infinity value of d_2) times $(1 + 1/4g)$. Values of v are also very readily built up from the constant differences. Table D 3 is a basic table that may be used whenever the average range is used in lieu of s .

Note: c.d. = constant difference.