UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2005/2006

April/Mei 2006

BOI 109E/4 – Biostatistics
[Biostatistik]

Duration : 3 hours
[Masa: 3 jam]

Please ensure that this examination paper contains TEN printed pages and TEN pages of Attachment before you begin the examination.

Answer FIVE out of SIX questions, in English or Bahasa Malaysia.

Each question carries 20 marks.

Sila pastikan bahawa kertas peperiksaan ini mengandungi SEPULUH muka surat yang bercetak dan SEPULUH muka surat Lampiran sebelum anda memulakan peperiksaan ini.

Jawab LIMA daripada ENAM soalan yang diberikan dalam Bahasa Inggeris atau Bahasa Malaysia.

Tiap-tiap soalan bernilai 20 markah.

...2/-

1. [a] Outline the similarities and differences between stratified and grouped random samplings.

(10 marks)

[b] A research was conducted to determine whether air pollution by exhaust fumes in Georgetown is serious/critical or not. An instrument to measure carbon monoxide (CO) levels (Type 1) was mounted at Penang Road. The hourly readings from 06:00 on a week day are as follows:

Time : 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00

Type 1 Readings : 68 96 270 149 88 92 112 154 175 78 91 253 180 118 134

According to the National Standard of Air Pollution Guidelines, a reading as high as 100 is said to be serious/critical for CO in the air. Run a statistical test whether the level of CO in Penang Road has reached a serious/critical level?

(10 marks)

1. [a] *Kemukakan persamaan dan perbezaan antara pensampelan rawak berkumpulan dan pensampelan rawak berstratum.*

(10 markah)

[b] *Satu penyelidikan telah dijalankan untuk menentukan sama ada pencemaran udara oleh asap ekzos di Georgetown sudah parah atau belum. Sejenis alat untuk mengukur aras karbon monoksida (CO) (Jenis 1) telah ditempatkan di Jalan Penang. Bacaan yang diambil setiap jam mulai 06:00 pada suatu hari kerja adalah seperti berikut:*

Masa : 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00

Bacaan Jenis 1 : 68 96 270 149 88 92 112 154 175 78 91 253 180 118 134

Berdasarkan kepada Piawaian Kebangsaan Mengenai Garispanduan Pencemaran Udara, bacaan CO di udara yang sudah mencapai 100 boleh dianggap parah. Lakukan ujian statistik untuk membuktikan sama ada aras CO di Jalan Penang sudah mencapai tahap yang parah?

(10 markah)

2. The level of CO in Penang Road detected by the Type 1 instrument during a week day and a week end are as follows:

Week day : 68 96 270 149 88 92 112 154 175 78 91 253 180 118 134

Week end : 62 82 95 56 85 85 101 167 107 70 89 118 184 130 145

[a] Conduct a suitable statistical analysis to prove that the air pollution on week day is higher then that on week end.

(14 marks)

[b] Give your reasons for choosing the statistical analysis.

(6 marks)

2. *Aras CO di Jalan Penang yang dikesan dengan menggunakan alat Jenis 1 semasa hari kerja dan hujung minggu adalah seperti berikut:*

Hari kerja : 68 96 270 149 88 92 112 154 175 78 91 253 180 118 134

Hujung minggu : 62 82 95 56 85 85 101 167 107 70 89 118 184 130 145

[a] Lakukan ujian statistik yang sesuai untuk membuktikan bahawa pencemaran udara pada hari kerja adalah lebih tinggi daripada hari di hujung minggu.

(14 markah)

[b] Kemukakan sebab-sebab mengapa anda memilih analisis statistik tersebut.

(6 markah)

3. [a] By using appropriate examples, why Biostatistics is so important to all students and researchers in life sciences?

(12 marks)

[b] Based on information from the importer, percentage of germination of corn seeds is 90%. If you try to germinate 11 seeds only, what is the probability of getting five corn seedlings?

(8 marks)

3. *[a] Dengan menggunakan contoh-contoh yang sesuai, mengapakah Biostatistik begitu penting bagi semua mahasiswa dan penyelidik dalam bidang sains hayat?*

(12 markah)

[b] Berdasarkan keterangan dari pengimport, peratusan percambahan biji jagung adalah 90%. Jika anda cuba mengecambahkan 11 biji sahaja, barapakah kebarangkalian untuk mendapatkan 5 anak benih jagung?

(8 markah)

4. An agricultural researcher is developing methods to reduce the use of chemical pesticides on the commercial strawberry crop. He applied ecological approach to agriculture known as the integrated pest management (IPM). He wished to compare a modified IPM program to traditional IPM and chemical control. In order to control for variables such as microclimates and soil conditions, he planted 3 plots of strawberries on each of 6 farms. The plots within each farm were matched as closely as possible in terms of soil type, etc. and the agricultural method is randomly assigned to the plots within each farm. Yields are in kg of strawberries per plot and the data collected are as follow:

Farm	Agricultural Method		
	Chemical Control	**IPM**	**Modified IPM**
I	71	73	77
II	90	90	92
III	59	70	80
IV	75	80	82
V	65	60	67
VI	82	86	85

From your data analysis, is IPM or modified IPM as good as the traditional chemical control in terms of marketable strawberry yield? Was blocking important to this analysis? Explain.

(20 marks)

4. *Seorang penyelidik dalam bidang pertanian sedang mereka kaedah untuk menggurangkan kegunaan pestisid kimia dalam pengeluaran buah strawberi secara komersial. Beliau telah menggunakan kaedah ekologi dalam pertanian yang dinamakan pengurusan perosak bersepadu (IPM) dalam kajiannya. Beliau ingin membandingkan program IPM yang telah diubahsuai dengan kaedah IPM tradisional dan kawalan kimia. Untuk mengawal variabel seperti mikrocuaca dan keadaan tanah, beliau menanam 3 plot strawberi pada setiap 6 ladang yang dikaji. Plot-plot kajian di setiap ladang dibandingkan supaya mereka adalah sama dari segi jenis tanah, dan lain-lain dan kaedah yang dikaji diagihkan secara rawak kepada plot-plot kajian dalam setiap ladang. Hasil ditentukan dalam bentuk kg strawberi setiap plot dan data kajian yang dikumpulkan adalah seperti berikut:*

Ladang	***Kaedah Pertanian***		
	Kawalan Kimia	***IPM***	***IPM yang diubahsuai***
I	*71*	*73*	*77*
II	*90*	*90*	*92*
III	*59*	*70*	*80*
IV	*75*	*80*	*82*
V	*65*	*60*	*67*
VI	*82*	*86*	*85*

Daripada analisis data anda, adakah IPM atau IPM yang telah diubahsuai sama baiknya dengan kaedah kawalan kimia dari segi keluaran hasil strawberi? Adakah pemblokan penting dalam analisis kajian? Jelaskan.

(20 markah)

5. A dog breeder has kept records on the litter size for several years. He suspects that the litter size at delivery is depended on the age of the breeding bitch at conception. From the following data :-

Age of bitch (year)	Litter size (cm)
2.0	11
2.5	10
4.0	9
3.3	12
6.0	5
5.0	9
4.5	9
4.1	8
8.2	7
2.4	10
2.9	12
3.7	10
4.0	9

[a] From the above data, construct a scatterplot of these data. Based on the constructed diagram, is there a linear relationship between the litter size and the age of the breeding bitch?

(5 marks)

[b] Compute the linear regression equation from these data.

(8 marks)

[c] What is the size of the litter when the age of the breeding bitch at conception is 7 years old?

(3 marks)

[d] Explain the trends of the relationship between these two variables.

(4 marks)

5. *Seorang penternak anjing telah menyimpan rekod saiz anak anjing selama beberapa tahun. Beliau mensyaki bahawa saiz anak anjing semasa dilahirkan adalah bergantung kepada umur ibu anjing semasa hamil. Daripada data barikut:*

Umur ibu anjing (tahun)	***Saiz anak anjing (cm)***
2.0	11
2.5	10
4.0	9
3.3	12
6.0	5
5.0	9
4.5	9
4.1	8
8.2	7
2.4	10
2.9	12
3.7	10
4.0	9

[a] *Lakarkan satu plot serakan bagi data tersebut. Sebutkan sama ada terdapat pertalian linear antara saiz anak anjing dengan umur ibunya.*

(5 markah)

[b] *Dapatkan persamaan regresi linear daripada data tersebut.*

(8 markah)

[c] *Apakah saiz anak anjing apabila umur ibu semasa hamil ialah 7 tahun?*

(3 markah)

[d] *Jelaskan tren pertalian antara dua variabel yang dikaji.*

(4 markah)

6. [a] The Poisson distribution is useful for describing rare, random events such as severe storm. Based on data collected from studies carried out in the United States from 1900 to 1997, a total of 159 hurricanes were recorded. Does the number of hurricanes/year as shown in the table below follow a Poisson distribution?

Hurricanes/year (x_i)	0	1	2	3	4	5	6
Frequency (f_i)	18	34	24	16	3	1	2

(10 marks)

[b] During a bird singing competition, results obtained from the judges showed that 7 out of the 15 birds had undergone special training (Group A), while the remaining birds were not given any training (Group B). Data obtained are shown below:

Rank*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Bird Group	A	B	A	B	B	A	A	B	A	B	A	A	B	B	B

*Rank 1 = best singing ability

Determine whether the training of birds has improved the singing ability?

(10 marks)

6. [a] *Taburan Poisson adalah berguna untuk menghuraikan kejadian luarbiasa dan rawak seperti taufan yang kuat. Berdasarkan kepada data yang telah dikumpulkan daripada kajian yang telah dijalankan dalam tempoh 1900 ke 1997, terdapat 159 angin ribut di America Syarikat dalam tempoh masa itu. Adakah bilangan angin ribut/tahun seperti yang ditunjukkan dalan jadual berikut mengikuti suatu Taburan Poisson?*

Hurricanes/year (x_i)	0	1	2	3	4	5	6
Frequency (f_i)	18	34	24	16	3	1	2

(10 markah)

[b] *Di suatu pertandingan nyanyian burung, keputusan daripada pengadil menunjukkan 7 daripada 15 ekor burung yang bertanding telah diberikan latihan istimewa (Kumpulan A) manakala yang baki tidak diberi latihan (Kumpulan B). Data yang diperolehi adalah seperti berikut:*

Rank*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Bird Group	A	B	A	B	B	A	A	B	A	B	A	A	B	B	B

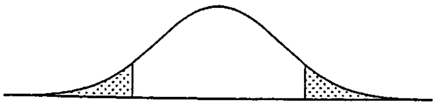
**Pangkat 1 = nyanyian yang paling merdu*

Ujikan sama ada latihan istimewa itu mangakibatkan keupayaan menyanyi.

(10 markah)

Appendix 1

Student's *t* distribution



1-tail 2-tail	0.25 0.50	0.10 0.20	0.05 0.10	0.025 0.05	0.01 0.02	0.005 0.010	0.0025 0.005	0.001 0.002	0.0005 0.001	1-tail 2-tail
df: 1	1.000	3.078	6.314	12.71	31.82	63.66	127.3	636.6	1273	df: 1
2	0.816	1.886	2.920	4.303	6.965	9.925	14.09	31.60	44.70	2
3	0.765	1.638	2.353	3.182	4.541	5.841	7.453	12.92	16.33	3
4	0.741	1.533	2.132	2.776	3.747	4.604	5.598	8.610	10.31	4
5	0.727	1.476	2.015	2.571	3.365	4.032	4.773	6.869	7.976	5
6	0.718	1.440	1.943	2.447	3.143	3.707	4.317	5.959	6.788	6
7	0.711	1.415	1.895	2.365	2.998	3.499	4.029	5.408	6.082	7
8	0.706	1.397	1.860	2.306	2.896	3.355	3.833	5.041	5.617	8
9	0.703	1.383	1.833	2.262	2.821	3.250	3.690	4.781	5.291	9
10	0.700	1.372	1.812	2.228	2.764	3.169	3.581	4.587	5.049	10
11	0.697	1.363	1.796	2.201	2.718	3.106	3.497	4.437	4.863	11
12	0.695	1.356	1.782	2.179	2.681	3.055	3.428	4.318	4.717	12
13	0.694	1.350	1.771	2.160	2.650	3.012	3.372	4.221	4.597	13
14	0.692	1.345	1.761	2.145	2.624	2.977	3.326	4.140	4.499	14
15	0.691	1.341	1.753	2.131	2.602	2.947	3.286	4.073	4.417	15
16	0.690	1.337	1.746	2.120	2.583	2.921	3.252	4.015	4.346	16
17	0.689	1.333	1.740	2.110	2.567	2.898	3.222	3.965	4.286	17
18	0.688	1.330	1.734	2.101	2.552	2.878	3.197	3.922	4.233	18
19	0.688	1.328	1.729	2.093	2.539	2.861	3.174	3.883	4.187	19
20	0.687	1.325	1.725	2.086	2.528	2.845	3.153	3.850	4.146	20
21	0.686	1.323	1.721	2.080	2.518	2.831	3.135	3.819	4.109	21
22	0.686	1.321	1.717	2.074	2.508	2.819	3.119	3.792	4.077	22
23	0.685	1.319	1.714	2.069	2.500	2.807	3.104	3.768	4.047	23
24	0.685	1.318	1.711	2.064	2.492	2.797	3.091	3.745	4.021	24
25	0.684	1.316	1.708	2.060	2.485	2.787	3.078	3.725	3.997	25
26	0.684	1.315	1.706	2.056	2.479	2.779	3.067	3.707	3.974	26
27	0.684	1.314	1.703	2.052	2.473	2.771	3.057	3.689	3.954	27
28	0.683	1.313	1.701	2.048	2.467	2.763	3.047	3.674	3.935	28
29	0.683	1.311	1.699	2.045	2.462	2.756	3.038	3.660	3.918	29
30	0.683	1.310	1.697	2.042	2.457	2.750	3.030	3.646	3.902	30
31	0.682	1.309	1.696	2.040	2.453	2.744	3.022	3.633	3.887	31
32	0.682	1.309	1.694	2.037	2.449	2.738	3.015	3.622	3.873	32
33	0.682	1.308	1.692	2.035	2.445	2.733	3.008	3.611	3.860	33
34	0.682	1.307	1.691	2.032	2.441	2.728	3.002	3.601	3.848	34
35	0.682	1.306	1.690	2.030	2.438	2.724	2.996	3.591	3.836	35
36	0.681	1.306	1.688	2.028	2.434	2.719	2.990	3.582	3.825	36
37	0.681	1.305	1.687	2.026	2.431	2.715	2.985	3.574	3.816	37
38	0.681	1.304	1.686	2.024	2.429	2.712	2.980	3.566	3.806	38
39	0.681	1.304	1.685	2.023	2.426	2.708	2.976	3.558	3.797	39
40	0.681	1.303	1.684	2.021	2.423	2.704	2.971	3.551	3.788	40
41	0.681	1.303	1.683	2.020	2.421	2.701	2.967	3.544	3.780	41
42	0.680	1.302	1.682	2.018	2.418	2.698	2.963	3.538	3.773	42
43	0.680	1.302	1.681	2.017	2.416	2.695	2.959	3.532	3.765	43
44	0.680	1.301	1.680	2.015	2.414	2.692	2.956	3.526	3.758	44
45	0.680	1.301	1.679	2.014	2.412	2.690	2.952	3.520	3.752	45

1-tail 2-tail	0.25 0.50	0.10 0.20	0.05 0.10	0.025 0.05	0.01 0.02	0.005 0.010	0.0025 0.005	0.001 0.002	0.0005 0.001	1-tail 2-tail
df: 46	0.680	1.300	1.679	2.013	2.410	2.687	2.949	3.515	3.746	df: 46
47	0.680	1.300	1.678	2.012	2.408	2.685	2.946	3.510	3.740	47
48	0.680	1.299	1.677	2.011	2.407	2.682	2.943	3.505	3.734	48
49	0.680	1.299	1.677	2.010	2.405	2.680	2.940	3.500	3.728	49
50	0.679	1.299	1.676	2.009	2.403	2.678	2.937	3.496	3.723	50
51	0.679	1.298	1.675	2.008	2.402	2.676	2.934	3.492	3.718	51
52	0.679	1.298	1.675	2.007	2.400	2.674	2.932	3.488	3.713	52
53	0.679	1.298	1.674	2.006	2.399	2.672	2.929	3.484	3.709	53
54	0.679	1.297	1.674	2.005	2.397	2.670	2.927	3.480	3.704	54
55	0.679	1.297	1.673	2.004	2.396	2.668	2.925	3.476	3.700	55
56	0.679	1.297	1.673	2.003	2.395	2.667	2.923	3.473	3.696	56
57	0.679	1.297	1.672	2.002	2.394	2.665	2.920	3.469	3.692	57
58	0.679	1.296	1.672	2.002	2.392	2.663	2.918	3.466	3.688	58
59	0.679	1.296	1.671	2.001	2.391	2.662	2.916	3.463	3.684	59
60	0.679	1.296	1.671	2.000	2.390	2.660	2.915	3.460	3.681	60
61	0.679	1.296	1.670	2.000	2.389	2.659	2.913	3.457	3.677	61
62	0.678	1.295	1.670	1.999	2.388	2.657	2.911	3.454	3.674	62
63	0.678	1.295	1.669	1.998	2.387	2.656	2.909	3.452	3.671	63
64	0.678	1.295	1.669	1.998	2.386	2.655	2.908	3.449	3.668	64
65	0.678	1.295	1.669	1.997	2.385	2.654	2.906	3.447	3.665	65
66	0.678	1.295	1.668	1.997	2.384	2.652	2.904	3.444	3.662	66
67	0.678	1.294	1.668	1.996	2.383	2.651	2.903	3.442	3.659	67
68	0.678	1.294	1.668	1.995	2.382	2.650	2.902	3.439	3.656	68
69	0.678	1.294	1.667	1.995	2.382	2.649	2.900	3.437	3.653	69
70	0.678	1.294	1.667	1.994	2.381	2.648	2.899	3.435	3.651	70
71	0.678	1.294	1.667	1.994	2.380	2.647	2.897	3.433	3.648	71
72	0.678	1.293	1.666	1.993	2.379	2.646	2.896	3.431	3.646	72
73	0.678	1.293	1.666	1.993	2.379	2.645	2.895	3.429	3.644	73
74	0.678	1.293	1.666	1.993	2.378	2.644	2.894	3.427	3.641	74
75	0.678	1.293	1.665	1.992	2.377	2.643	2.892	3.425	3.639	75
76	0.678	1.293	1.665	1.992	2.376	2.642	2.891	3.423	3.637	76
77	0.678	1.293	1.665	1.991	2.376	2.641	2.890	3.421	3.635	77
78	0.678	1.292	1.665	1.991	2.375	2.640	2.889	3.420	3.633	78
79	0.678	1.292	1.664	1.990	2.374	2.639	2.888	3.418	3.631	79
80	0.678	1.292	1.664	1.990	2.374	2.639	2.887	3.416	3.629	80
81	0.678	1.292	1.664	1.990	2.373	2.638	2.886	3.415	3.627	81
82	0.677	1.292	1.664	1.989	2.373	2.637	2.885	3.413	3.625	82
83	0.677	1.292	1.663	1.989	2.372	2.636	2.884	3.412	3.623	83
84	0.677	1.292	1.663	1.989	2.372	2.636	2.883	3.410	3.622	84
85	0.677	1.292	1.663	1.988	2.371	2.635	2.882	3.409	3.620	85
86	0.677	1.291	1.663	1.988	2.370	2.634	2.881	3.407	3.618	86
90	0.677	1.291	1.662	1.987	2.368	2.632	2.878	3.402	3.612	90
95	0.677	1.291	1.661	1.985	2.366	2.629	2.874	3.396	3.605	95
100	0.677	1.290	1.660	1.984	2.364	2.626	2.871	3.390	3.598	100
∞	0.674	1.282	1.645	1.960	2.326	2.576	2.807	3.090	3.290	∞

Appendix 3

Tables of Distributions and Critical Values

$P(F_{\nu_1,\nu_2}) \leq 0.95$

ν_2 \ ν_1	1	2	3	4	5	6	7	8	9	10	12	15
1	161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5	241.9	243.9	245.9
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40	19.41	19.43
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.74	8.70
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.86
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.62
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.94
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.57	3.51
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28	3.22
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07	3.01
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91	2.85
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.79	2.72
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69	2.62
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.60	2.53
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53	2.46
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48	2.40
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42	2.35
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.38	2.31
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34	2.27
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.31	2.23
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28	2.20
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.25	2.18
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.23	2.15
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27	2.20	2.13
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.18	2.11
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24	2.16	2.09
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	2.22	2.15	2.07
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25	2.20	2.13	2.06
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24	2.19	2.12	2.04
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22	2.18	2.10	2.03
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.09	2.01
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08	2.00	1.92
50	4.03	3.18	2.79	2.56	2.40	2.29	2.20	2.13	2.07	2.03	1.95	1.87
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99	1.92	1.84
70	3.98	3.13	2.74	2.50	2.35	2.23	2.14	2.07	2.02	1.97	1.89	1.81
80	3.96	3.11	2.72	2.49	2.33	2.21	2.13	2.06	2.00	1.95	1.88	1.79
90	3.95	3.10	2.71	2.47	2.32	2.20	2.11	2.04	1.99	1.94	1.86	1.78
100	3.94	3.09	2.70	2.46	2.31	2.19	2.10	2.03	1.97	1.93	1.85	1.77
120	3.92	3.07	2.68	2.45	2.29	2.18	2.09	2.02	1.96	1.91	1.83	1.75
150	3.90	3.06	2.66	2.43	2.27	2.16	2.07	2.00	1.94	1.89	1.82	1.73
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88	1.83	1.75	1.67

$P(F_{\nu_1,\nu_2}) \leq 0.95$

$\nu_2 \backslash \nu_1$	18	20	24	25	30	40	50	60	90	120	∞
1	247.3	248.0	249.1	249.3	250.1	251.1	251.8	252.2	252.9	253.3	254.3
2	19.44	19.45	19.45	19.46	19.46	19.47	19.48	19.48	19.48	19.49	19.50
3	8.67	8.66	8.64	8.63	8.62	8.59	8.58	8.57	8.56	8.55	8.53
4	5.82	5.80	5.77	5.77	5.75	5.72	5.70	5.69	5.67	5.66	5.63
5	4.58	4.56	4.53	4.52	4.50	4.46	4.44	4.43	4.41	4.40	4.37
6	3.90	3.87	3.84	3.83	3.81	3.77	3.75	3.74	3.72	3.70	3.67
7	3.47	3.44	3.41	3.40	3.38	3.34	3.32	3.30	3.28	3.27	3.23
8	3.17	3.15	3.12	3.11	3.08	3.04	3.02	3.01	2.98	2.97	2.93
9	2.96	2.94	2.90	2.89	2.86	2.83	2.80	2.79	2.76	2.75	2.71
10	2.80	2.77	2.74	2.73	2.70	2.66	2.64	2.62	2.59	2.58	2.54
11	2.67	2.65	2.61	2.60	2.57	2.53	2.51	2.49	2.46	2.45	2.40
12	2.57	2.54	2.51	2.50	2.47	2.43	2.40	2.38	2.36	2.34	2.30
13	2.48	2.46	2.42	2.41	2.38	2.34	2.31	2.30	2.27	2.25	2.21
14	2.41	2.39	2.35	2.34	2.31	2.27	2.24	2.22	2.19	2.18	2.13
15	2.35	2.33	2.29	2.28	2.25	2.20	2.18	2.16	2.13	2.11	2.07
16	2.30	2.28	2.24	2.23	2.19	2.15	2.12	2.11	2.07	2.06	2.01
17	2.26	2.23	2.19	2.18	2.15	2.10	2.08	2.06	2.03	2.01	1.96
18	2.22	2.19	2.15	2.14	2.11	2.06	2.04	2.02	1.98	1.97	1.92
19	2.18	2.16	2.11	2.11	2.07	2.03	2.00	1.98	1.95	1.93	1.88
20	2.15	2.12	2.08	2.07	2.04	1.99	1.97	1.95	1.91	1.90	1.84
21	2.12	2.10	2.05	2.05	2.01	1.96	1.94	1.92	1.88	1.87	1.81
22	2.10	2.07	2.03	2.02	1.98	1.94	1.91	1.89	1.86	1.84	1.78
23	2.08	2.05	2.01	2.00	1.96	1.91	1.88	1.86	1.83	1.81	1.76
24	2.05	2.03	1.98	1.97	1.94	1.89	1.86	1.84	1.81	1.79	1.73
25	2.04	2.01	1.96	1.96	1.92	1.87	1.84	1.82	1.79	1.77	1.71
26	2.02	1.99	1.95	1.94	1.90	1.85	1.82	1.80	1.77	1.75	1.69
27	2.00	1.97	1.93	1.92	1.88	1.84	1.81	1.79	1.75	1.73	1.67
28	1.99	1.96	1.91	1.91	1.87	1.82	1.79	1.77	1.73	1.71	1.65
29	1.97	1.94	1.90	1.89	1.85	1.81	1.77	1.75	1.72	1.70	1.64
30	1.96	1.93	1.89	1.88	1.84	1.79	1.76	1.74	1.70	1.68	1.62
40	1.87	1.84	1.79	1.78	1.74	1.69	1.66	1.64	1.60	1.58	1.51
50	1.81	1.78	1.74	1.73	1.69	1.63	1.60	1.58	1.53	1.51	1.44
60	1.78	1.75	1.70	1.69	1.65	1.59	1.56	1.53	1.49	1.47	1.39
70	1.75	1.72	1.67	1.66	1.62	1.57	1.53	1.50	1.46	1.44	1.35
80	1.73	1.70	1.65	1.64	1.60	1.54	1.51	1.48	1.44	1.41	1.32
90	1.72	1.69	1.64	1.63	1.59	1.53	1.49	1.46	1.42	1.39	1.30
100	1.71	1.68	1.63	1.62	1.57	1.52	1.48	1.45	1.40	1.38	1.28
120	1.69	1.66	1.61	1.60	1.55	1.50	1.46	1.43	1.38	1.35	1.25
150	1.67	1.64	1.59	1.58	1.54	1.48	1.44	1.41	1.36	1.33	1.22
∞	1.60	1.57	1.52	1.51	1.46	1.39	1.35	1.32	1.26	1.22	1.00

: Tables of Distributions and Critical Values

$P(F_{\nu_1,\nu_2}) \leq 0.99$

$\nu_2 \backslash \nu_1$	1	2	3	4	5	6	7	8	9	10	12	15
1	4052	4999	5404	5624	5764	5859	5928	5981	6022	6056	6107	6157
2	98.50	99.00	99.16	99.25	99.30	99.33	99.36	99.38	99.39	99.40	99.42	99.43
3	34.12	30.82	29.46	28.71	28.24	27.91	27.67	27.49	27.34	27.23	27.05	26.87
4	21.20	18.00	16.69	15.98	15.52	15.21	14.98	14.80	14.66	14.55	14.37	14.20
5	16.26	13.27	12.06	11.39	10.97	10.67	10.46	10.29	10.16	10.05	9.89	9.72
6	13.75	10.92	9.78	9.15	8.75	8.47	8.26	8.10	7.98	7.87	7.72	7.56
7	12.25	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.72	6.62	6.47	6.31
8	11.26	8.65	7.59	7.01	6.63	6.37	6.18	6.03	5.91	5.81	5.67	5.52
9	10.56	8.02	6.99	6.42	6.06	5.80	5.61	5.47	5.35	5.26	5.11	4.96
10	10.04	7.56	6.55	5.99	5.64	5.39	5.20	5.06	4.94	4.85	4.71	4.56
11	9.65	7.21	6.22	5.67	5.32	5.07	4.89	4.74	4.63	4.54	4.40	4.25
12	9.33	6.93	5.95	5.41	5.06	4.82	4.64	4.50	4.39	4.30	4.16	4.01
13	9.07	6.70	5.74	5.21	4.86	4.62	4.44	4.30	4.19	4.10	3.96	3.82
14	8.86	6.51	5.56	5.04	4.69	4.46	4.28	4.14	4.03	3.94	3.80	3.66
15	8.68	6.36	5.42	4.89	4.56	4.32	4.14	4.00	3.89	3.80	3.67	3.52
16	8.53	6.23	5.29	4.77	4.44	4.20	4.03	3.89	3.78	3.69	3.55	3.41
17	8.40	6.11	5.19	4.67	4.34	4.10	3.93	3.79	3.68	3.59	3.46	3.31
18	8.29	6.01	5.09	4.58	4.25	4.01	3.84	3.71	3.60	3.51	3.37	3.23
19	8.18	5.93	5.01	4.50	4.17	3.94	3.77	3.63	3.52	3.43	3.30	3.15
20	8.10	5.85	4.94	4.43	4.10	3.87	3.70	3.56	3.46	3.37	3.23	3.09
21	8.02	5.78	4.87	4.37	4.04	3.81	3.64	3.51	3.40	3.31	3.17	3.03
22	7.95	5.72	4.82	4.31	3.99	3.76	3.59	3.45	3.35	3.26	3.12	2.98
23	7.88	5.66	4.76	4.26	3.94	3.71	3.54	3.41	3.30	3.21	3.07	2.93
24	7.82	5.61	4.72	4.22	3.90	3.67	3.50	3.36	3.26	3.17	3.03	2.89
25	7.77	5.57	4.68	4.18	3.85	3.63	3.46	3.32	3.22	3.13	2.99	2.85
26	7.72	5.53	4.64	4.14	3.82	3.59	3.42	3.29	3.18	3.09	2.96	2.81
27	7.68	5.49	4.60	4.11	3.78	3.56	3.39	3.26	3.15	3.06	2.93	2.78
28	7.64	5.45	4.57	4.07	3.75	3.53	3.36	3.23	3.12	3.03	2.90	2.75
29	7.60	5.42	4.54	4.04	3.73	3.50	3.33	3.20	3.09	3.00	2.87	2.73
30	7.56	5.39	4.51	4.02	3.70	3.47	3.30	3.17	3.07	2.98	2.84	2.70
40	7.31	5.18	4.31	3.83	3.51	3.29	3.12	2.99	2.89	2.80	2.66	2.52
50	7.17	5.06	4.20	3.72	3.41	3.19	3.02	2.89	2.78	2.70	2.56	2.42
60	7.08	4.98	4.13	3.65	3.34	3.12	2.95	2.82	2.72	2.63	2.50	2.35
70	7.01	4.92	4.07	3.60	3.29	3.07	2.91	2.78	2.67	2.59	2.45	2.31
80	6.96	4.88	4.04	3.56	3.26	3.04	2.87	2.74	2.64	2.55	2.42	2.27
90	6.93	4.85	4.01	3.53	3.23	3.01	2.84	2.72	2.61	2.52	2.39	2.24
100	6.90	4.82	3.98	3.51	3.21	2.99	2.82	2.69	2.59	2.50	2.37	2.22
120	6.85	4.79	3.95	3.48	3.17	2.96	2.79	2.66	2.56	2.47	2.34	2.19
150	6.81	4.75	3.91	3.45	3.14	2.92	2.76	2.63	2.53	2.44	2.31	2.16
∞	6.64	4.61	3.78	3.32	3.02	2.80	2.64	2.51	2.41	2.32	2.18	2.04

Tables of Distributions and Critical Values

$P(F_{\nu_1,\nu_2}) \leq 0.99$

ν_2 \ ν_1	18	20	24	25	30	40	50	60	90	120	∞
1	6191	6209	6234	6240	6260	6286	6302	6313	6331	6340	6366
2	99.44	99.45	99.46	99.46	99.47	99.48	99.48	99.48	99.49	99.49	99.50
3	26.75	26.69	26.60	26.58	26.50	26.41	26.35	26.32	26.25	26.22	26.13
4	14.08	14.02	13.93	13.91	13.84	13.75	13.69	13.65	13.59	13.56	13.46
5	9.61	9.55	9.47	9.45	9.38	9.29	9.24	9.20	9.14	9.11	9.02
6	7.45	7.40	7.31	7.30	7.23	7.14	7.09	7.06	7.00	6.97	6.88
7	6.21	6.16	6.07	6.06	5.99	5.91	5.86	5.82	5.77	5.74	5.65
8	5.41	5.36	5.28	5.26	5.20	5.12	5.07	5.03	4.97	4.95	4.86
9	4.86	4.81	4.73	4.71	4.65	4.57	4.52	4.48	4.43	4.40	4.31
10	4.46	4.41	4.33	4.31	4.25	4.17	4.12	4.08	4.03	4.00	3.91
11	4.15	4.10	4.02	4.01	3.94	3.86	3.81	3.78	3.72	3.69	3.60
12	3.91	3.86	3.78	3.76	3.70	3.62	3.57	3.54	3.48	3.45	3.36
13	3.72	3.66	3.59	3.57	3.51	3.43	3.38	3.34	3.28	3.25	3.17
14	3.56	3.51	3.43	3.41	3.35	3.27	3.22	3.18	3.12	3.09	3.00
15	3.42	3.37	3.29	3.28	3.21	3.13	3.08	3.05	2.99	2.96	2.87
16	3.31	3.26	3.18	3.16	3.10	3.02	2.97	2.93	2.87	2.84	2.75
17	3.21	3.16	3.08	3.07	3.00	2.92	2.87	2.83	2.78	2.75	2.65
18	3.13	3.08	3.00	2.98	2.92	2.84	2.78	2.75	2.69	2.66	2.57
19	3.05	3.00	2.92	2.91	2.84	2.76	2.71	2.67	2.61	2.58	2.49
20	2.99	2.94	2.86	2.84	2.78	2.69	2.64	2.61	2.55	2.52	2.42
21	2.93	2.88	2.80	2.79	2.72	2.64	2.58	2.55	2.49	2.46	2.36
22	2.88	2.83	2.75	2.73	2.67	2.58	2.53	2.50	2.43	2.40	2.31
23	2.83	2.78	2.70	2.69	2.62	2.54	2.48	2.45	2.39	2.35	2.26
24	2.79	2.74	2.66	2.64	2.58	2.49	2.44	2.40	2.34	2.31	2.21
25	2.75	2.70	2.62	2.60	2.54	2.45	2.40	2.36	2.30	2.27	2.17
26	2.72	2.66	2.58	2.57	2.50	2.42	2.36	2.33	2.26	2.23	2.13
27	2.68	2.63	2.55	2.54	2.47	2.38	2.33	2.29	2.23	2.20	2.10
28	2.65	2.60	2.52	2.51	2.44	2.35	2.30	2.26	2.20	2.17	2.06
29	2.63	2.57	2.49	2.48	2.41	2.33	2.27	2.23	2.17	2.14	2.03
30	2.60	2.55	2.47	2.45	2.39	2.30	2.25	2.21	2.14	2.11	2.01
40	2.42	2.37	2.29	2.27	2.20	2.11	2.06	2.02	1.95	1.92	1.80
50	2.32	2.27	2.18	2.17	2.10	2.01	1.95	1.91	1.84	1.80	1.68
60	2.25	2.20	2.12	2.10	2.03	1.94	1.88	1.84	1.76	1.73	1.60
70	2.20	2.15	2.07	2.05	1.98	1.89	1.83	1.78	1.71	1.67	1.54
80	2.17	2.12	2.03	2.01	1.94	1.85	1.79	1.75	1.67	1.63	1.49
90	2.14	2.09	2.00	1.99	1.92	1.82	1.76	1.72	1.64	1.60	1.46
100	2.12	2.07	1.98	1.97	1.89	1.80	1.74	1.69	1.61	1.57	1.43
120	2.09	2.03	1.95	1.93	1.86	1.76	1.70	1.66	1.58	1.53	1.38
150	2.06	2.00	1.92	1.90	1.83	1.73	1.66	1.62	1.54	1.49	1.33
∞	1.93	1.88	1.79	1.77	1.70	1.59	1.52	1.47	1.38	1.32	1.00

Critical values for Duncan's multiple range test*

Least significant studentized ranges for testing p successive values out of a linearly ordered arrangement of k sample means from a normal population with ν degrees of freedom.

	$\alpha = 0.05$					$\alpha = 0.01$				
ν \ p	2	3	4	5	6	2	3	4	5	6
1	17.97	17.97	17.97	17.97	17.97	90.03	90.03	90.03	90.03	90.03
2	6.085	6.085	6.085	6.085	6.085	14.04	14.04	14.04	14.04	14.04
3	4.501	4.516	4.516	4.516	4.516	8.261	8.321	8.321	8.321	8.321
4	3.927	4.013	4.033	4.033	4.033	6.512	6.677	6.740	6.756	6.756
5	3.635	3.749	3.797	3.814	3.814	5.702	5.893	5.989	6.040	6.065
6	3.461	3.587	3.649	3.680	3.694	5.243	5.439	5.549	5.614	5.655
7	3.344	3.477	3.548	3.588	3.611	4.949	5.145	5.260	5.334	5.383
8	3.261	3.399	3.475	3.521	3.549	4.746	4.939	5.057	5.135	5.189
9	3.199	3.339	3.420	3.470	3.502	4.596	4.787	4.906	4.986	5.043
10	3.151	3.293	3.376	3.430	3.465	4.482	4.671	4.790	4.871	4.931
11	3.113	3.256	3.342	3.397	3.435	4.392	4.579	4.697	4.780	4.841
12	3.082	3.225	3.313	3.370	3.410	4.320	4.504	4.622	4.706	4.767
13	3.055	3.200	3.289	3.348	3.389	4.260	4.442	4.560	4.644	4.706
14	3.033	3.178	3.268	3.329	3.372	4.210	4.391	4.508	4.591	4.654
15	3.014	3.160	3.250	3.312	3.356	4.168	4.347	4.463	4.547	4.610
16	2.998	3.144	3.235	3.298	3.343	4.131	4.309	4.425	4.509	4.572
17	2.984	3.130	3.222	3.285	3.331	4.099	4.275	4.391	4.475	4.539
18	2.971	3.118	3.210	3.274	3.321	4.071	4.246	4.362	4.445	4.509
19	2.960	3.107	3.199	3.264	3.311	4.046	4.220	4.335	4.419	4.483
20	2.950	3.097	3.190	3.255	3.303	4.024	4.197	4.312	4.395	4.459
24	2.919	3.066	3.160	3.226	3.276	3.956	4.126	4.239	4.322	4.386
30	2.888	3.035	3.131	3.199	3.250	3.889	4.056	4.168	4.250	4.314
40	2.858	3.006	3.102	3.171	3.224	3.825	3.988	4.098	4.180	4.244
60	2.829	2.976	3.073	3.143	3.198	3.762	3.922	4.031	4.111	4.174
120	2.800	2.947	3.045	3.116	3.172	3.702	3.858	3.965	4.044	4.107
∞	2.772	2.918	3.017	3.089	3.146	3.643	3.796	3.900	3.978	4.040

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Tables of Distributions and Critical Values

Critical values for the Spearman rank correlation coefficient r_s*

2-tail / **1-tail**	**0.10** / **0.05**	**0.05** / **0.025**	**0.02** / **0.01**	**0.01** / **0.005**
n: **4**	1.000			
5	0.900	1.000	1.000	
6	0.829	0.886	0.943	1.000
7	0.714	0.786	0.893	0.929
8	0.643	0.738	0.833	0.881
9	0.600	0.700	0.783	0.833
10	0.564	0.648	0.745	0.794
11	0.536	0.618	0.709	0.755
12	0.503	0.587	0.678	0.727
13	0.484	0.560	0.648	0.703
14	0.464	0.538	0.626	0.679
15	0.446	0.521	0.604	0.654
16	0.429	0.503	0.582	0.635
17	0.414	0.485	0.566	0.615
18	0.401	0.472	0.550	0.600
19	0.391	0.460	0.535	0.584
20	0.380	0.447	0.520	0.570
21	0.370	0.435	0.508	0.556
22	0.361	0.425	0.496	0.544
23	0.353	0.415	0.486	0.532
24	0.344	0.406	0.476	0.521
25	0.337	0.398	0.466	0.511
26	0.331	0.390	0.457	0.501
27	0.324	0.382	0.448	0.491
28	0.317	0.375	0.440	0.483
29	0.312	0.368	0.433	0.475
30	0.306	0.362	0.425	0.467

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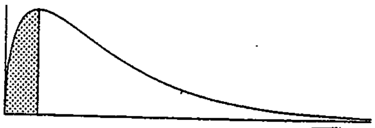
Tables of Distributions and Critical Values

Cumulative chi-square distribution

$$F(\chi^2) = P(\chi^2 \leq X^2)$$



df	0.005	0.01	0.025	0.05	0.10	0.90	0.95	0.975	0.99	0.995
1	0.0000393	0.000157	0.000982	0.00393	0.0158	2.71	3.84	5.02	6.63	7.88
2	0.0100	0.0201	0.0506	0.103	0.211	4.61	5.99	7.38	9.21	10.6
3	0.0717	0.115	0.216	0.352	0.584	6.25	7.81	9.35	11.3	12.8
4	0.207	0.297	0.484	0.711	1.06	7.78	9.49	11.1	13.3	14.9
5	0.412	0.554	0.831	1.15	1.61	9.24	11.1	12.8	15.1	16.7
6	0.676	0.872	1.24	1.64	2.20	10.6	12.6	14.4	16.8	18.5
7	0.989	1.24	1.69	2.17	2.83	12.0	14.1	16.0	18.5	20.3
8	1.34	1.65	2.18	2.73	3.49	13.4	15.5	17.5	20.1	22.0
9	1.73	2.09	2.70	3.33	4.17	14.7	16.9	19.0	21.7	23.6
10	2.16	2.56	3.25	3.94	4.87	16.0	18.3	20.5	23.2	25.2
11	2.60	3.05	3.82	4.57	5.58	17.3	19.7	21.9	24.7	26.8
12	3.07	3.57	4.40	5.23	6.30	18.5	21.0	23.3	26.2	28.3
13	3.57	4.11	5.01	5.89	7.04	19.8	22.4	24.7	27.7	29.8
14	4.07	4.66	5.63	6.57	7.79	21.1	23.7	26.1	29.1	31.3
15	4.60	5.23	6.26	7.26	8.55	22.3	25.0	27.5	30.6	32.8
16	5.14	5.81	6.91	7.96	9.31	23.5	26.3	28.8	32.0	34.3
17	5.70	6.41	7.56	8.67	10.1	24.8	27.6	30.2	33.4	35.7
18	6.26	7.01	8.23	9.39	10.9	26.0	28.9	31.5	34.8	37.2
19	6.84	7.63	8.91	10.1	11.7	27.2	30.1	32.9	36.2	38.6
20	7.43	8.26	9.59	10.9	12.4	28.4	31.4	34.2	37.6	40.0
21	8.03	8.90	10.3	11.6	13.2	29.6	32.7	35.5	38.9	41.4
22	8.64	9.54	11.0	12.3	14.0	30.8	33.9	36.8	40.3	42.8
23	9.26	10.2	11.7	13.1	14.8	32.0	35.2	38.1	41.6	44.2
24	9.89	10.9	12.4	13.8	15.7	33.2	36.4	39.4	43.0	45.6
25	10.5	11.5	13.1	14.6	16.5	34.4	37.7	40.6	44.3	46.9
26	11.2	12.2	13.8	15.4	17.3	35.6	38.9	41.9	45.6	48.3
27	11.8	12.9	14.6	16.2	18.1	36.7	40.1	43.2	47.0	49.6
28	12.5	13.6	15.3	16.9	18.9	37.9	41.3	44.5	48.3	51.0
29	13.1	14.3	16.0	17.7	19.8	39.1	42.6	45.7	49.6	52.3
30	13.8	15.0	16.8	18.5	20.6	40.3	43.8	47.0	50.9	53.7
31	14.5	15.7	17.5	19.3	21.4	41.4	45.0	48.2	52.2	55.0
32	15.1	16.4	18.3	20.1	22.3	42.6	46.2	49.5	53.5	56.3
33	15.8	17.1	19.0	20.9	23.1	43.7	47.4	50.7	54.8	57.6
34	16.5	17.8	19.8	21.7	24.0	44.9	48.6	52.0	56.1	59.0
35	17.2	18.5	20.6	22.5	24.8	46.1	49.8	53.2	57.3	60.3
36	17.9	19.2	21.3	23.3	25.6	47.2	51.0	54.4	58.6	61.6
37	18.6	20.0	22.1	24.1	26.5	48.4	52.2	55.7	59.9	62.9
38	19.3	20.7	22.9	24.9	27.3	49.5	53.4	56.9	61.2	64.2
39	20.0	21.4	23.7	25.7	28.2	50.7	54.6	58.1	62.4	65.5
40	20.7	22.2	24.4	26.5	29.1	51.8	55.8	59.3	63.7	66.8

Statistical Tables and Graphs

Critical Values of the Mann-Whitney *U* Distribution

n_1	n_2	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
6	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	146	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	182	188	193	200	204
	39	157	167	176	186	193	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	75	77	79
	13	63	67	71	75	78	80	83	85
	14	67	72	76	81	83	86	89	91
	15	72	77	81	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
	22	103	110	116	123	127	131	135	138
	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	121	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	149	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	209
	35	162	172	181	191	198	203	210	215
	36	166	177	186	196	203	209	216	221
	37	171	182	191	202	208	215	222	227
	38	175	187	196	207	214	220	227	232
	39	180	191	201	212	219	226	233	238
7	40	184	196	206	217	225	231	239	244
8	8	45	49	51	55	57	58	60	62
	9	50	54	57	61	63	65	67	68
8	10	56	60	63	67	69	71	74	75

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