UNIVERSITI SAINS MALAYSIA
Peperiksaan Semester Pertama
Sidang 1992/93

Oktober/November, 1992

AGW513- STATISTIK PENGURUSAN/*AGW513 - MANAGERIAL STATISTICS*

Masa: [3 jam]

<u>ARAHAN/*INSTRUCTIONS*</u>

Sila pastikan bahawa kertas peperiksaan ini mengandungi **DUA PULUH SEMBILAN** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.

Jawab **LAPAN** soalan. Soalan-soalan daripada Bahagian A adalah **WAJIB**. Pilih **DUA** soalan yang lain daripada Bahagian B.

Please make sure that this examination paper consist of TWENTY NINE printed pages before you begin.

Answer EIGHT questions. The questions from Section A are COMPULSORY. Answer TWO other questions from Section B.

<u>Bahagian A (WAJIB)/*Section A (COMPULSORY)*</u>

1. Suatu ujian IQ dijalankan bagi semua calon (bakal pekerja) di empat lokasi berlainan. Seratus calon mengambil ujian ini di setiap dari lokasi A dan B dan 50 di setiap dari lokasi C dan D. Tujuh puluh peratus dari mereka yang mengambil ujian di lokasi A lulus ujian itu. Peratusan dari lokasi B, C dan D yang lulus adalah 75%, 66% dan 72% masing-masing. Seorang calon dipilih secara rawak dari antara mereka yang menduduki ujian itu.

   (a) Apakah kebarangkalian calon yang terpilih lulus ujian itu.

   (b) Jika calon terpilih lulus peperiksaan itu, apakah kebarangkalian calon itu mengambil ujian di lokasi C.

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A standard IQ test was given to candidates (potential employees) at four different locations. One hundred candidates took the test at each of locations A and B and 50 at each of locations C and D. Seventy percent of those who took the test at location A passed the test. The percentages of students from locations B, C, and D who passed were 75%, 66% and 72% respectively. One candidate is selected at random from among those who took the test.

(a) What is the probability that the selected candidate passed the test?

(b) If the selected student passed the test, what is the probability that the candidate took it at location C?

[5/100 markah/*5/100 points*]

2. Pada permulaan setiap tahun, sebuah akhbar pelaburan meramalkan sama ada pasaran saham akan meningkat atau tidak sepanjang tahun berkenaan. Bukti-bukti sejarah menunjukkan bahawa peluang pasaran saham meningkat pada satu-satu tahun adalah 75%. Akhbar itu telah meramalkan pasaran saham meningkat bagi 80% daripada tahun-tahun pasaran itu sebenarnya meningkat dan telah meramalkan peningkatan bagi 40% daripada tahun-tahun di mana pasaran menurun. Cari kebarangkalian ramalan akhbar itu betul bagi tahun hadapan.

At the beginning of each year, an investment newsletter predicts whether or not the stock market will rise over the coming year. Historical evidence reveals that there is a 75% chance that the stock market will rise in any given year. The newsletter has predicted a rise for 80% of the years when the market actually rose, and has predicted a rise for 40% of the years when the market fell. Find the probability that the newsletter prediction for the next year will be correct.

[5/100 markah/*5/100 points*]

3. Seorang pegawai Suruhanjaya Sekuriti menganggarkan bahawa 80% daripada semua ahli bank perdagangan telah meraih untung dari penggunaan maklumat dalaman (insider information). Jika 20 ahli bank perdagangan dipilih secara rawak dari daftar suruhanjaya itu, cari kebarangkalian bahawa:

(a) tidak lebih daripada 15 telah meraih untung dari maklu mat dalaman

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(b) sekurang-kurangnya 11 telah meraih untung dari maklumat dalaman.

An official from the securities commission estimates that 80% of all merchant bankers have profited from the use of insider information. If 20 merchant bankers are selected at random from the commission's registry, find the probability that:

(a) at most 15 have profited from insider information.

(b) at least 11 have profited from insider information.

[5/100 markah/*5/100 points*]

4. Suatu jenama lampu banjir (flood lamp) mempunyai hayat yang bertaburan normal dengan min 3500 jam dan sisihan piawai 200 jam.

(a) Apakah peratusan lampu-lampu ini yang akan bertahan lebih daripada 3750 jam?

(b) Apakah panjang hayat lampu yang pengilang harus iklankan supaya hanya 3% daripada lampu-lampu ini akan terbakar sebelum hayat yang diiklankan?

(c) Cari kebarangkalian bahawa dua lampu yang dipilih secara rawak, kedua-duanya akan bertahan lebih daripada 3750 jam.

(d) Cari kebarangkalian bahawa purata hayat bagi dua lampu yang dipilih secara rawak dari populasi ini akan melebihi 3750 jam.

A certain brand of flood lamps has a length of life that is normally distributed with a mean of 3500 hours and a standard deviation of 200 hours.

(a) What proportion of these lamps will last for more than 3750 hours?

(b) What length of life should the manufacturer advertise for these lamps in order that only 3% of the lamps will burn out before the advertised length of life?

(c) Find the probability that average life time of two randomly selected flood lamps will both last for more than 3750 hours?

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(d) *Find the probability that mean life time of two random ly selected lamps from this population will be more than 3750 hours?*

[10/100 markah/*10/100 points*]

5. Seorang pemeriksa kawalan mutu menyimpan suatu rekod tali bagi bilangan keluaran yang boleh diterima dan tidak boleh diterima, yang dihasilkan oleh dua baris pengeluaran. Rekod yang lengkap dipaparkan di bawah:

Baris pengeluaran 1		Baris pengeluaran 2	
Boleh diterima	117	Boleh diterima	101
Tidak boleh diterima	23	Tidak boleh diterima	39

(a) Bolehkah pemeriksa itu membuat kesimpulan bahawa prestasi baris pengeluaran 1 lebih baik dari baris pengeluaran 2? Gunakan $\alpha = 0.1$.

(b) Andaikan pemeriksa itu memeriksa baris pengeluaran 3 dan 4 juga. Bilangan unit boleh diterima dan tidak boleh diterima bagi tempoh yang sama seperti di atas, adalah 135 dan 32 masing-masing untuk baris pengeluaran 3, dan 99 dan 36 untuk baris pengeluaran 4. Adakah sebarang perbezaan prestasi antara empat baris pengeluaran ini? Gunakan $\alpha = 0.5$.

A quality control inspector keeps a tally sheet of the number of acceptable and unacceptable products that comes off two different production lines. The completed sheet is shown below.

Production line 1		Production line 2	
Acceptable	117	Acceptable	101
Unacceptable	23	Unacceptable	39

(a) *Can the inspector conclude that production line 1 is doing a better job than production line 2? Use $\alpha = 0.1$.*

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(b) *Supposing the inspector is also inspecting production lines 3 and 4. Number of acceptable and unacceptable units for the same time period as above are 135 and 32 respectively for production line 3, and 99 and 36 for production line 4. Are there any differences in the performances of the four production lines? Use α = 0.05.*

[10/100 markah/*10/100 points*]

6. (a) Pengurus besar sebuah rangkaian kedai perabot percaya bahawa pengalamanlah faktor paling penting dalam menentukan kejayaan seseorang jurujual. Untuk mengkaji kepercayaan ini, beliau mencatatkan jualan bulanan 10 jurujual yang dipilih secara rawak. Datanya seperti berikut:

Jurujual	Tahun pengalaman (X)	Jualan ($1000) (Y)
1	0	7
2	2	9
3	10	20
4	3	15
5	8	18
6	5	14
7	12	20
8	7	17
9	20	30
10	15	25

$\Sigma x_i = 82$ $\Sigma y_i = 175$ $\Sigma x_i^2 = 1020$ $\Sigma y_i^2 = 3489$ $\Sigma x_i y_i = 1811$

(i) Adakah data ini bukti yang cukup pada aras keertian 10%, untuk membuat kesimpulan bahawa jurujual lebih berpengalaman mempunyai jualan yang lebih tinggi?

(ii) Ramalkan dengan keyakinan 95%, jualan bulanan seorang jurujual yang mempunyai 10 tahun pengalaman

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The general manager of a chain of furniture stores believes that experience is the most important factor in determining the level of success of a salesperson. To examine this belief she records last month's sales and the years of experience of 10 randomly selected salespeople. The data are as follows:

Salesperson	*Years of experience (X)*	*Sales (in $1000) (Y)*
1	0	7
2	2	9
3	10	20
4	3	15
5	8	18
6	5	14
7	12	20
8	7	17
9	20	30
10	15	25

$\Sigma x_i = 82 \quad \Sigma y_i = 175 \quad \Sigma x_i^2 = 1020 \quad \Sigma y_i^2 = 3489 \quad \Sigma x_i y_i = 1811$

(i) *Do these data provide sufficient evidence at the 10% significance level to conclude that salespeople with more experience have higher sales?*

(ii) *Predict with 95% confidence the monthly sales of a salesperson with 10 years experience.*

[10/100 markah/*10/100 points*]

(b) Seorang pakar ekonomi ingin membangunkan sebuah model regresi berganda untuk membolehkan beliau meramal perbelanjaan keluarga setahun untuk pakaian. Selepas memikirkannya, beliau membangunkan model regresi berganda

$$y=\beta_0+\beta_1x_1+\beta_2x_2+\beta_3x_3+\epsilon$$

dengan

y = pelbelanjaan pakaian keluarga setahun ($1,000)
x_1 = pendapatan isi rumah setahun ($1,000)
x_2 = bilangan ahli keluarga
x_3 = bilangan anak di bawah 10 tahun

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Output komputer berdasarkan sampel 50 keluarga ditunjukkan di bawah:

PREDICTOR	COEFF	STDEV	T-RATIO
CONSTANT	1.74	0.63	
x1	0.091	0.025	
x2	0.93	0.92	
x3	0.26	0.18	

S = 2.06 R-SQUARE = 59.6%

ANALYSIS OF VARIANCE

SOURCE	DF	SS	MS
REGRESSION	3	288	96.0
ERROR	46	195	4.24
TOTAL	49	483	

(i) Ujikan utiliti model dengan α = .01.

(ii) Ujikan sama ada x_1 dan y berkaitan secara linear positif. Gunakan α = .05.

(iii) Tafsirkan pekali penentuan.

(iv) Terangkan bagaimana anda boleh mementukan sama ada masalah autokorelasi dalam sisa dan multikekolinearan wujud dalam masalah regresi berganda.

An economist wanted to develop a multiple regression model to enable him to predict the annual family expenditure on clothes. After some consideration he developed the multiple regression model

$$y=\beta_0+\beta_1 x_1+\beta_2 x_2+\beta_3 x_3+\epsilon$$

where

y = annual family clothes expenditure (in $1000)
x_1 =annual household income (in $1000)
x_2 =number of family members
x_3 =number of children under 10 years of age

The computer output based on a random sample of 50 families is shown below.

PREDICTOR	COEFF	STDEV	T-RATIO
CONSTANT	1.74	0.63	
X1	0.091	0.025	
X2	0.93	0.29	
X3	0.26	0.18	

S = 2.06 R-SQUARE = 59.6%

...8/-

ANALYSIS OF VARIANCE

SOURCE	*DF*	*SS*	*MS*
REGRESSION	*3*	*288*	*96.0*
ERROR	*46*	*195*	*4.24*
TOTAL	*49*	*483*	

(i) *Test the model's utility with* $\alpha = .01$.

(ii) *Test to determine if* x_1 *and* y *are positively linearly related. Use* $\alpha = .05$

(iii) *Interpret the coefficient of determination.*

(iv) *Explain how you would go about determining whether the problem of autocorrelation in residuals and multicollinearity exist in a multiple regression problem.*

[15/100 markah/*15/100 points*]

<u>Bahagian B/*Section B*</u>

Jawab **DUA** soalan sahaja. *Answer **TWO** questions only.*

7. (a) Pekerja-pekerja di sebuah loji yang besar dijangka menyiapkan suatu tugas tertentu dalam masa 60 saat atau kurang. Pengurus pengeluaran percaya bahawa pekerja biasa dapat memenuhi jangkaan ini. Untuk mengkaji isu ini beliau memerhati 8 orang pekerja menjalankan tugas ini dan menyukat masa yang diambil. Masa-masanya yang dianggap bertaburan normal, tertunjuk di bawah:

58, 53, 63, 62, 57, 55, 53, 55

(i) Adakah data ini memberi bukti yang cukup pada aras keertian 5% untuk menyokong kepercayaan pengurus itu?

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(ii) Setiap kali seorang pekerja mengambil masa lebih dari 60 saat untuk menjalankan tugas itu, bahan yang tiba didapati cacat. Telah didakwa bahawa peratusan cacatan dalam bahan yang tiba kurang dari 0.1%. Jika suatu sampel 10,000 unit bahan yang tiba dipilih dan 8 didapati cacat, uji dakwaan itu pada aras keertian $\alpha = .01$. Apakah nilai-p yang tercapai?

Workers in a large plant are expected to complete a particular task in 60 seconds or less. The production manager believes that the average worker is satisfying that expectation. To examine the issue she watches eight workers perform the task and measures their times. The times, which are assumed to be normally distributed are shown below.

58, 53, 63, 62, 57, 55, 53, 55

(i) Do these data provide sufficient evidence at the 5% significance level to support the manager's belief?

(ii) Every time a worker takes longer than 60 seconds to perform the task the incoming material is found to be defective. It was claimed that the percentage defects in incoming material is less than 0.1%. If a sample of 10,000 units of incoming materials were selected and 8 was found to be defective, test the claim at $\alpha = .01$ significance level. What was the achieved p-value?

[10/100 markah/*10/100 points*]

(b) Penilai insurans kereta memeriksa kereta-kereta yang terlibat dalam kemalangan untuk menilai kos pembaikan. Seorang eksekutif insurans prihatin tentang beza antara penilaian yang dibuat oleh beberapa orang penilai. Dalam suatu ujikaji, 10 kereta yang baru sahaja terlibat dalam kemalangan ditunjukkan kepada dua orang penilai. Setiap orang menilai anggaran kos pembaikan. Andaikan kos bertaburan normal. Kesudahannya ditunjukkan di bawah. Bolehkah kamu simpulkan pada aras keertian 5% bahawa penilai-penilai itu berbeza dari segi penilaian mereka.

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Kereta	Anggaran kos pembaikan Penilai 1	Penilai 2
1	1650	1400
2	360	380
3	640	600
4	1010	920
5	890	930
6	750	650
7	440	410
8	1210	1080
9	520	480
10	690	770

Automobile insurance appraisers examine cars that have been involved in accidents to assess the cost of repairs. An insurance executive is concerned about the differences in appraisal between appraisers. In an experiment, 10 cars that have recently been involved in accidents were shown to two appraisers. Each assessed the estimated repair costs. Assume that the costs are normally distributed. These results are shown below. Can you conclude at the 5% significance level that the appraisers differ in their assessments.

Car	*Estimated repair cost Appaiser 1*	*Appraiser 2*
1	*1650*	*1400*
2	*360*	*380*
3	*640*	*600*
4	*1010*	*920*
5	*890*	*930*
6	*750*	*650*
7	*440*	*410*
8	*1210*	*1080*
9	*520*	*480*
10	*690*	*770*

[10/100 markah/*10/100 points*]

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8. (a) Banyak bahagian kereta diuji dengan tangan untuk memastikan bahagian tidak rosak terlalu awal. Dalam suatu ujikaji untuk menentukan aloi yang menghasilkan engsel pintu yang lebih baik, 40 engsel dari setiap jenis aloi diuji sehingga rosak. Pembuat kereta menganggap bahawa sebarang engsel yang tidak boleh bertahan 1 juta pembukaan dan penutupan sebagai suatu kecacatan. Bilangan pembukaan dan penutupan dicerapi dan dicatatkan (hampir kepada 0.1 juta terdekat) dalam jadual yang berikut. Seorang pakar statistik telah menentukan bilangan pembukaan dan penutupan tertabur secara normal.

Bilangan pembukaan dan penutupan (jutaan)

Aloi 1				Aloi 2			
1.5	1.5	0.9	1.3	1.4	0.9	1.3	0.8
1.8	1.6	1.3	1.5	1.3	1.3	0.9	1.4
1.6	1.2	1.2	1.8	0.7	1.2	1.1	0.9
1.3	0.9	1.5	1.6	1.2	0.8	1.2	1.1
1.2	1.3	1.4	1.4	0.8	0.7	1.1	1.4
1.1	1.5	1.1	1.5	1.1	1.4	0.8	0.8
1.3	0.8	0.8	1.1	1.3	1.1	1.5	0.9
1.1	1.6	1.6	1.3	1.4	1.2	1.3	1.6
0.9	1.4	1.7	0.9	0.6	0.9	1.8	1.4
1.1	1.3	1.9	1.3	1.5	0.8	1.6	1.3

	Aloi 1	Aloi 2
$\bar{x}$	1.3275	1.1450
s	0.2810	0.2930

(i) Adakah keubahan bilangan pembukaan dan penutupan untuk kedua-dua aloi sama?

(ii) Cari selang keyakinan 99% untuk beza antara min bilangan pembukaan dan penutupan bagi pintu yang diperbuat dari aloi 1 dan pintu yang diperbuat dari aloi 2.

(iii) Bolehkah kita simpulkan pada aras keyakinan 1% bahawa engsel yang diperbuat dari aloi 1 bertahan lebih lama dari engsel yang didperbuat dari aloi 2? Apakah nilai-p yang tercapai?

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Many parts of cars are mechanically tested to be certain that they do not fail prematurely. In an experiment to determine which one of two types of metal alloy produce superior door hinges, 40 of each type were tested until they failed. Car manufacturers consider any hinge that does not survive 1 million openings and closings to be a failure. The number of openings and closings was observed and recorded in the following table (to the nearest .1 million). A statistician has determined that the number of door openings and closings is normally distributed.

Number of Openings and Closings (in millions)

Alloy 1				Alloy 2			
1.5	1.5	0.9	1.3	1.4	0.9	1.3	0.8
1.8	1.6	1.3	1.5	1.3	1.3	0.9	1.4
1.6	1.2	1.2	1.8	0.7	1.2	1.1	0.9
1.3	0.9	1.5	1.6	1.2	0.8	1.2	1.1
1.2	1.3	1.4	1.4	0.8	0.7	1.1	1.4
1.1	1.5	1.1	1.5	1.1	1.4	0.8	0.8
1.3	0.8	0.8	1.1	1.3	1.1	1.5	0.9
1.1	1.6	1.6	1.3	1.4	1.2	1.3	1.6
0.9	1.4	1.7	0.9	0.6	0.9	1.8	1.4
1.1	1.3	1.9	1.3	1.5	0.8	1.6	1.3

	Alloy 1	Alloy 2
$\bar{x}$	1.3275	1.1450
s	0.2810	0.2930

(i) *Is the variability in the number of openings and closings for both alloys the same?*

(ii) *Find the 99% confidence interval for the difference in means of number of openings and closings for doors made with alloy 1 and doors made with alloy 2.*

(iii) *Can we conclude at the 1% significance level that hinges made with alloy 1 last longer than hinges made with alloy 2? What is the achieved p-value?*

[10/100 markah/*10/100 points*]

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(b) Sime Darby mengoperasi sebuah loji di Pasir Gudang dan sebuah lagi di Klang. Selama ini pekerja-pekerja di setiap loji terbahagi sama rata antara tiga isu (gaji, syarat kerja, dan faedah-faedah) dari segi apa yang dirasakan sebagai isu terpenting dalam perundingan kontrak/pekerjaan yang akan datang. Baru-baru ini Presiden Kesatuan Pekerja telah mengeluarkan suatu pekeliling kepada para pekerja, dalam usaha untuk menyakinkan mereka bahawa faedah-faedah sepatutnya menjadi isu terpenting. Suatu tinjauan selepas itu menunjukkan pecahan pekerja mengikut loji tempat kerja dan isu yang dirasakan patut disokong sebagai isu terpenting.

	Gaji	Syarat kerja	Faedah-faedah	Jumlah
Pasir Gudang	60	62	78	200
Klang	70	58	74	200
Jumlah	130	118	152	400

(i) Adakah sebarang alasan untuk mempercayai bahawa sokongan pekerja (di kedua-dua loji) kepada isu-isu itu telah berubah sejak pekeliling itu diedarkan?

(ii) Adakah sebarang alasan untuk mempercayai bahawa sokongan berkadaran oleh pekerja-pekerja di Pasir Gudang kepada isu-isu itu telah berubah sejak pekeliling itu diedarkan?

(iii) Adakah data ini menunjukkan bahawa wujud perbezaan antara dua loji ini dari segi isu yang seharusnya menjadi isu terpenting?

Gunakan $\alpha = .05$ untuk semua di atas

Sime-Darby operates a plant in Pasir Gudang and another in Klang. Employees at each plant have been evenly divided among three issues (wages, working conditions, and benefits) in terms of which one they feel should be the primary issue in the upcoming contract/employement negotiations. Workers association president has recently circulated pamphlets among the employees, attempting to convince them that benefits should be the primary issue. A subsequent survey revealed the following breakdown of employees according to the plant at which they worked and the issue that they felt should be supported as the primary one.

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	Wages	Working conditions	Benefits	Total
Pasir Gudang	60	62	78	200
Klang	70	58	74	200
Total	130	118	152	400

(i) *Is there a reason to believe that the proportional support by the employees (considering those at both plants) for the issues has changed since the pamphlet was circulated?*

(ii) *Is there reason to believe that the proportional support by the employees in Pasir Gudang for the three issues has changed since the pamphlet was circulated?*

(iii) *Do the data indicate that there are differences between the two plants regarding which issue should be the primary one?*

Use α = .05 in all the above.

[10/100 markah/*10/100 points*]

9. (a) Sebuah syarikat multinasional beribu pejabat di Jepun mempunyai pelbagai operasi di tiga buah negara, iaitu Malaysia, Indonesia dan Thailand. Dalam usaha memperkemaskan operasi antarabangsanya, ia melihat keberuntungan di ketiga-tiga buah negara ini. Tahun lepas, peratusan pulangan dari operasi-operasi ini dijadualkan di bawah:

		Peratusan pulangan	
	Malaysia	Indonesia	Thailand
	15	17	25
	23	21	27
	16	19	24
	29	25	31
		28	23
		19	
$\bar{x}$	20.75	21.50	26.00
s	6.55	4.18	3.16

...15/-

Sebahagian output SPSS (one-way ANOVA) adalah seperti berikut:

Analysis of Variance

Source	DF	Sum of square	Mean square	F ratio
Between groups	2	78.15	__?__	__?__
Within groups	__?__	__?__	__?__	
Total	14	334.40		

(i) Anggarkan dengan keyakinan 99% beza antara min peratusan pulangan operasi di Malaysia dan Indonesia; Malaysia dan Thailand; Thailand dan Indonesia. Apakah kesimpulan yang boleh anda buat?.

(ii) Lengkapkan jadual ANOVA di atas dengan mengisi tempat-tempat kosong bertanda "?".

(iii) Adakah sebarang perbezaan dalam peratusan pulangan bagi operasi di ketiga-tiga negara? Gunakan $\alpha = .05$.

A Japan-based multinational company has various operations in three different countries namely Malaysia, Indonesia and Thailand. In trying to streamline its international operations it looks at the profitability in these three countries. Last year, the percentage returns from these operations are as tabulated below.

Percentage returns

	Malaysia	*Indonesia*	*Thailand*
	15	*17*	*25*
	23	*21*	*27*
	16	*19*	*24*
	29	*25*	*31*
		28	*23*
		19	
$\bar{x}$	*20.75*	*21.50*	*26.00*
s	*6.55*	*4.18*	*3.16*

...16/-

A partial output of the SPSS (one-way ANOVA) command is as follows:

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Between groups	2	78.15	__?__	__?__
Within groups	__?__	__?__	__?__	
Total	14	334.40		

(i) *Estimate with 99% confidence the difference between mean percentage returns of operations in Malaysia and Indonesia; Malaysia and Thailand; Thailand and Indonesia. What conclusions can you draw from these pairwise comparisons?*

(ii) *Complete the above ANOVA table by filling in the blanks marked with the "?".*

(iii) *Is there difference in percentage returns of operations in the various countries? Use $\alpha = 0.05$*

[10/100 markah/*10/100 points*]

(b) Pengurus pasaran sebuah rangkaian pizza sedang dalam proses meneliti beberapa ciri demografi pelanggan-pelanggannya. Khususnya, beliau ingin mengkaji kepercayaan bahawa umur para pelanggan Pizza Hut, McDonald dan Kentucky Fried Chicken berbeza. Sebagai suatu ujikaji, umur lapan pelanggan, setiap rangkaian ini dicatatkan dan disenaraikan di bawah. Adakah data ini mengadakan bukti yang cukup pada aras keertian 10% untuk menyimpulkan bahawa terdapat perbezaan umur di kalangan pelanggan tiga rangkaian ini? Dari analisis sebelum ini umur didapati tidak bertaburan normal.

Pizza Hut	McDonald	Kentucky Fried Chicken
23	26	25
19	20	28
25	18	36
17	35	23
36	33	39
25	25	27
28	19	38
31	17	31

...17/-

The marketing manager of a pizza chain is in the process of examining some of the demographic characteristics of her customers. In particular, she would like to investigate the belief that the ages of the customers of Pizza Hut, McDonald, and Kentucky Fried Chicken are different. As an experiment, the ages of eight customers of each of these three chains are recorded and listed below. Do these data provide enough evidence at the 10% significance level to conclude that there are differences in ages among the customers of the three chains? From previous analyses we know that the ages are not normally distributed.

Pizza Hut	*McDonald*	*Kentucky Fried Chicken*
23	26	25
19	20	28
25	18	36
17	35	23
36	33	39
25	25	27
28	19	38
31	17	31

[10/100 markah/*10/100 points*]

...18/-

APPENDIX 1. FORMULAE

$$s_x = \frac{\sum x_i^2 - n\bar{x}^2}{n-1}$$

$$s_{\bar{x}_1-\bar{x}_2} = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

$$s_{\bar{x}_1-\bar{x}_2} = s_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$$

$$s_p = \sqrt{\frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1+n_2-2}}$$

$$s_{\hat{p}_1-\hat{p}_2} = \sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}$$

$$s_{\hat{p}_1-\hat{p}_2} = \sqrt{\bar{p}(1-\bar{p})[\frac{1}{n_1} + \frac{1}{n_2}]}$$

$$s_{xy} = \sqrt{\frac{\sum x_i y_i - n\overline{xy}}{n-1}}$$

$$\hat{\beta}_1 = \frac{s_{xy}}{s_x}$$

$$\hat{\beta}_0 = \bar{y} - \hat{\beta}_1\bar{x}$$

$$\frac{SSE}{n-1} = s_y - \frac{s_{xy}^2}{s_x}$$

$$s_\varepsilon = \sqrt{\frac{SSE}{n-2}}$$

$$s_{\hat{\beta}_1} = \frac{s_\varepsilon}{s_x}$$

$$r = \frac{s_{xy}}{s_x s_y}$$

$$\hat{y} \pm t_{\alpha/2} s_\varepsilon \sqrt{1 + \frac{1}{n} + \frac{(x_g-\bar{x})^2}{(n-1)s_x}}$$

$$\hat{y} \pm t_{\alpha/2} s_\varepsilon \sqrt{\frac{1}{n} + \frac{(x_g-\bar{x})^2}{(n-1)s_x}}$$

APPENDIX 1A

$$U = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1$$

$$\hat{\sigma}_U = \sqrt{\frac{n_1 n_2 (n_1 + n_2 + 1)}{12}}$$

$$E(U) = \frac{n_1 n_2}{2}$$

$$K = \frac{12}{N(N+1)} \sum \frac{R_j^2}{n_j} - 3(N+1)$$

...20/-

Table 1

APPENDIX 2/LAMPIRAN 2

CUMULATIVE BINOMIAL PROBABILITIES

p = probability of success in a single trial; n = number of trials. The table gives the probability of obtaining r or more successes in n independent trials. i.e.

$$\sum_{x=r}^{n} \binom{n}{x} p^{x}(1-p)^{n-x}$$

When there is no entry for a particular pair of values of r and p, this indicates that the appropriate probability is less than 0.000 05. Similarly, except for the case r = 0, when the entry is exact, a tabulated value of 1.0000 represents a probability greater than 0.999 95.

	p=	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
n=2	r=0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	1	.0199	.0396	.0591	.0784	.0975	.1164	.1351	.1536	.1719
	2	.0001	.0004	.0009	.0016	.0025	.0036	.0049	.0064	.0081
n=5	r=0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	1	.0490	.0961	.1413	.1846	.2262	.2661	.3043	.3409	.3760
	2	.0010	.0038	.0085	.0148	.0226	.0319	.0425	.0544	.0674
	3		.0001	.0003	.0006	.0012	.0020	.0031	.0045	.0063
	4						.0001	.0001	.0002	.0003
n=10	r=0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	1	.0956	.1829	.2626	.3352	.4013	.4614	.5160	.5656	.6106
	2	.0043	.0162	.0345	.0582	.0861	.1176	.1517	.1879	.2254
	3	.0001	.0009	.0028	.0062	.0115	.0188	.0283	.0401	.0540
	4			.0001	.0004	.0010	.0020	.0036	.0058	.0088
	5					.0001	.0002	.0003	.0006	.0010
	6									.0001
n=20	r=0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	1	.1821	.3324	.4562	.5580	.6415	.7099	.7658	.8113	.8484
	2	.0169	.0599	.1198	.1897	.2642	.3395	.4131	.4831	.5484
	3	.0010	.0071	.0210	.0439	.0755	.1150	.1610	.2121	.2666
	4		.0006	.0027	.0074	.0159	.0290	.0471	.0706	.0993
	5			.0003	.0010	.0026	.0056	.0107	.0183	.0290
	6				.0001	.0003	.0009	.0019	.0038	.0068
	7						.0001	.0003	.0006	.0013
	8								.0001	.0002
n=50	r=0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	1	.3950	.6358	.7819	.8701	.9231	.9547	.9734	.9845	.9910
	2	.0894	.2642	.4447	.5995	.7206	.8100	.8735	.9173	.9468
	3	.0138	.0784	.1892	.3233	.4595	.5838	.6892	.7740	.8395
	4	.0016	.0178	.0628	.1391	.2396	.3527	.4673	.5747	.6697
	5	.0001	.0032	.0168	.0490	.1036	.1794	.2710	.3710	.4723
	6		.0005	.0037	.0144	.0378	.0776	.1350	.2081	.2928
	7		.0001	.0007	.0036	.0118	.0289	.0583	.1019	.1596
	8			.0001	.0008	.0032	.0094	.0220	.0438	.0768
	9				.0001	.0008	.0027	.0073	.0167	.0328
	10					.0002	.0007	.0022	.0056	.0125
	11						.0002	.0006	.0017	.0043
	12							.0001	.0005	.0013
	13								.0001	.0004
	14									.0001

APPENDIX 3/LAMPIRAN 3

	p=	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
n=100	r=0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	1	.6340	.8674	.9524	.9831	.9941	.9979	.9993	.9998	.9999
	2	.2642	.5967	.8054	.9128	.9629	.9848	.9940	.9977	.9991
	3	.0794	.3233	.5802	.7679	.8817	.9434	.9742	.9887	.9952
	4	.0184	.1410	.3528	.5705	.7422	.8570	.9256	.9633	.9827
	5	.0034	.0508	.1821	.3711	.5640	.7232	.8368	.9097	.9526
	6	.0005	.0155	.0808	.2116	.3840	.5593	.7086	.8201	.8955
	7	.0001	.0041	.0312	.1064	.2340	.3936	.5557	.6968	.8060
	8		.0009	.0106	.0475	.1280	.2517	.4012	.5529	.6872
	9		.0002	.0032	.0190	.0631	.1463	.2660	.4074	.5506
	10			.0009	.0068	.0282	.0775	.1620	.2780	.4125
	11			.0002	.0022	.0115	.0376	.0908	.1757	.2882
	12				.0007	.0043	.0168	.0469	.1028	.1876
	13				.0002	.0015	.0069	.0224	.0559	.1138
	14					.0005	.0026	.0099	.0282	.0645
	15					.0001	.0009	.0041	.0133	.0341
	16						.0003	.0016	.0058	.0169
	17						.0001	.0006	.0024	.0078
	18							.0002	.0009	.0034
	19							.0001	.0003	.0014
	20								.0001	.0005
	21									.0002
	22									.0001

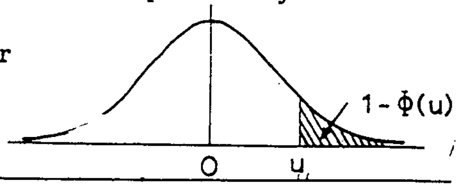
	p=	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50
n=2	r=0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	1	.1900	.2775	.3600	.4375	.5100	.5775	.6400	.6975	.7500
	2	.0100	.0225	.0400	.0625	.0900	.1225	.1600	.2025	.2500
n=5	r=0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	1	.4095	.5563	.6723	.7627	.8319	.8840	.9222	.9497	.9688
	2	.0815	.1648	.2627	.3672	.4718	.5716	.6630	.7438	.8125
	3	.0086	.0266	.0579	.1035	.1631	.2352	.3174	.4069	.5000
	4	.0005	.0022	.0067	.0156	.0308	.0540	.0870	.1312	.1875
	5		.0001	.0003	.0010	.0024	.0053	.0102	.0185	.0313
n=10	r=0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	1	.6513	.8031	.8926	.9437	.9718	.9865	.9940	.9975	.9990
	2	.2639	.4557	.6242	.7560	.8507	.9140	.9536	.9767	.9893
	3	.0702	.1798	.3222	.4744	.6172	.7384	.8327	.9004	.9453
	4	.0128	.0500	.1209	.2241	.3504	.4862	.6177	.7430	.8281
	5	.0016	.0099	.0328	.0781	.1503	.2485	.3669	.4956	.6230
	6	.0001	.0014	.0064	.0197	.0473	.0949	.1662	.2616	.3770
	7		.0001	.0009	.0035	.0106	.0260	.0548	.1020	.1719
	8			.0001	.0004	.0016	.0048	.0123	.0274	.0547
	9					.0001	.0005	.0017	.0045	.0107
	10							.0001	.0003	.0010
n=20	r=0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	1	.8784	.9612	.9885	.9968	.9992	.9998	1.0000	1.0000	1.0000
	2	.6083	.8244	.9308	.9757	.9924	.9979	.9995	.9999	1.0000
	3	.3231	.5951	.7939	.9087	.9645	.9879	.9964	.9991	.9998
	4	.1330	.3523	.5886	.7748	.8929	.9556	.9840	.9951	.9987
	5	.0432	.1702	.3704	.5852	.7625	.8818	.9490	.9811	.9941
	6	.0113	.0673	.1958	.3828	.5836	.7546	.8744	.9447	.9793
	7	.0024	.0219	.0867	.2142	.3920	.5834	.7500	.8701	.9423
	8	.0004	.0059	.0321	.1018	.2277	.3990	.5841	.7480	.8684
	9	.0001	.0013	.0100	.0409	.1133	.2376	.4044	.5857	.7483
	10		.0002	.0026	.0139	.0480	.1218	.2447	.4086	.5881
	11			.0006	.0039	.0171	.0532	.1275	.2493	.4119
	12			.0001	.0009	.0051	.0196	.0565	.1308	.2517
	13				.0002	.0013	.0060	.0210	.0580	.1316
	14					.0003	.0015	.0065	.0214	.0577
	15						.0003	.0016	.0064	.0207
	16							.0003	.0015	.0059
	17								.0003	.0013
	18									.0002

Table 3

APPENDIX 4/LAMPIRAN 4

AREAS IN TAIL OF THE NORMAL DISTRIBUTION

The function tabulated is $1 - \Phi(u)$ where $\Phi(u)$ is the cumulative distribution function of a standardised Normal variable u. Thus $1 - \Phi(u) = \frac{1}{\sqrt{2\pi}} \int_u^\infty e^{-x^2/2}\,dx$ is the probability that a standardised Normal variable selected at random will be greater than a value of $u \left(= \frac{x-\mu}{\sigma}\right)$.

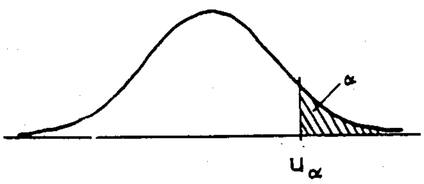


$\frac{(x-\mu)}{\sigma}$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641
0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
2.0	.02275	.02222	.02169	.02118	.02068	.02018	.01970	.01923	.01876	.01831
2.1	.01786	.01743	.01700	.01659	.01618	.01578	.01539	.01500	.01463	.01426
2.2	.01390	.01355	.01321	.01287	.01255	.01222	.01191	.01160	.01130	.01101
2.3	.01072	.01044	.01017	.00990	.00964	.00939	.00914	.00889	.00866	.00842
2.4	.00820	.00798	.00776	.00755	.00734	.00714	.00695	.00676	.00657	.00639
2.5	.00621	.00604	.00587	.00570	.00554	.00539	.00523	.00508	.00494	.00480
2.6	.00466	.00453	.00440	.00427	.00415	.00402	.00391	.00379	.00368	.00357
2.7	.00347	.00336	.00326	.00317	.00307	.00298	.00289	.00280	.00272	.00264
2.8	.00256	.00248	.00240	.00233	.00226	.00219	.00212	.00205	.00199	.00193
2.9	.00187	.00181	.00175	.00169	.00164	.00159	.00154	.00149	.00144	.00139
3.0	.00135									
3.1	.00097									
3.2	.00069									
3.3	.00048									
3.4	.00034									
3.5	.00023									
3.6	.00016									
3.7	.00011									
3,8	.00007									
3.9	.00005									
4.0	.00003									

Table 4

PERCENTAGE POINTS OF THE NORMAL DISTRIBUTION

The table gives the 100α percentage points, u_α, of a standardised Normal distribution where $\alpha = \frac{1}{\sqrt{2\pi}} \int_{u_\alpha}^{\infty} e^{-x^2/2}\,dx$. Thus u_α is the value of a standardised Normal variate which has probability α of being exceeded.



α	u_α	α	u_α	α	u_α	α	u_α	α	u_α	α	u_α
.50	0.0000	.050	1.6449	.030	1.8808	.020	2.0537	.010	2.3263	.050	1.6449
.45	0.1257	.048	1.6646	.029	1.8957	.019	2.0749	.009	2.3656	.010	2.3263
.40	0.2533	.046	1.6849	.028	1.9110	.018	2.0969	.008	2.4089	.001	3.0902
.35	0.3853	.044	1.7060	.027	1.9268	.017	2.1201	.007	2.4573	.0001	3.7190
.30	0.5244	.042	1.7279	.026	1.9431	.016	2.1444	.006	2.5121	.00001	4.2649
.25	0.6745	.040	1.7507	.025	1.9600	.015	2.1701	.005	2.5758	.025	1.9600
.20	0.8416	.038	1.7744	.024	1.9774	.014	2.1973	.004	2.6521	.005	2.5758
.15	1.0364	.036	1.7991	.023	1.9954	.013	2.2262	.003	2.7478	.0005	3.2905
.10	1.2816	.034	1.8250	.022	2.0141	.012	2.2571	.002	2.8782	.00005	3.8906
.05	1.6449	.032	1.8522	.021	2.0335	.011	2.2904	.001	3.0902	.000005	4.4172

APPENDIX 6/LAMPIRAN 6

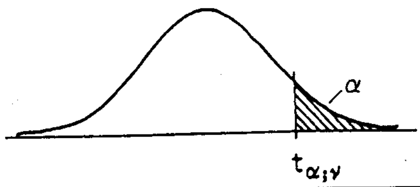
Table 7

PERCENTAGE POINTS OF THE t DISTRIBUTION

The table gives the value of $t_{\alpha;\nu}$ — the 100α percentage point of the t distribution for ν degrees of freedom.

The values of t are obtained by solution of the equation:-

$$\alpha = \Gamma\{\tfrac{1}{2}(\nu+1)\}\{\Gamma(\tfrac{1}{2}\nu)\}^{-1}(\nu\pi)^{-1/2}\int_t^{\infty}(1 + x^2/\nu)^{-(\nu+1)/2}dx$$



Note. The tabulation is for one tail only i.e. for positive values of t. For |t| the column headings for α must be doubled.

α =	0.10	0.05	0.025	0.01	0.005	0.001	0.0005
ν = 1	3.078	6.314	12.706	31.821	63.657	318.31	636.62
2	1.886	2.920	4.303	6.965	9.925	22.326	31.598
3	1.638	2.353	3.182	4.541	5.841	10.213	12.924
4	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	1.319	1.714	2.069	2.500	2.807	3.485	3.767
24	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	1.296	1.671	2.000	2.390	2.660	3.232	3.460
120	1.289	1.658	1.980	2.358	2.617	3.160	3.373
∞	1.282	1.645	1.960	2.326	2.576	3.090	3.291

Table 8

PERCENTAGE POINTS OF THE χ^2 DISTRIBUTION

Table of $\chi^2_{\alpha;\nu}$ — the 100 α percentage point of the χ^2 distribution for ν degrees of freedom

α =	.995	.99	.98	.975	.95	.90	.80	.75	.70	.50	.30	.25	.20	.10	.05	.025	.02	.01	.005	.001	= α
ν = 1	$.0^{4}393$	$.0^{3}157$	$.0^{3}628$	$.0^{3}982$	.00393	.0158	.0642	.102	.148	.455	1.074	1.323	1.642	2.706	3.841	5.024	5.412	6.635	7.879	10.827	ν = 1
2	.0100	.0201	.0404	.0506	.103	.211	.446	.575	.713	1.386	2.408	2.773	3.219	4.605	5.991	7.378	7.824	9.210	10.597	13.815	2
3	.0717	.115	.185	.216	.352	.584	1.005	1.213	1.424	2.366	3.665	4.108	4.642	6.251	7.815	9.348	9.837	11.345	12.838	16.268	3
4	.207	.297	.429	.484	.711	1.064	1.649	1.923	2.195	3.357	4.878	5.385	5.989	7.779	9.488	11.143	11.668	13.277	14.860	18.465	4
5	.412	.554	.752	.831	1.145	1.610	2.343	2.675	3.000	4.351	6.064	6.626	7.289	9.236	11.070	12.832	13.388	15.086	16.750	20.517	5
6	.676	.872	1.134	1.237	1.635	2.204	3.070	3.455	3.828	5.348	7.231	7.841	8.558	10.645	12.592	14.449	15.033	16.812	18.548	22.457	6
7	.989	1.239	1.564	1.690	2.167	2.833	3.822	4.255	4.671	6.346	8.383	9.037	9.803	12.017	14.067	16.013	16.622	18.475	20.278	24.322	7
8	1.344	1.646	2.032	2.180	2.733	3.490	4.594	5.071	5.527	7.344	9.524	10.219	11.030	13.362	15.507	17.535	18.168	20.090	21.955	26.125	8
9	1.735	2.088	2.532	2.700	3.325	4.168	5.380	5.899	6.393	8.343	10.656	11.389	12.242	14.684	16.919	19.023	19.679	21.666	23.589	27.877	9
10	2.156	2.558	3.059	3.247	3.940	4.865	6.179	6.737	7.267	9.342	11.781	12.549	13.442	15.987	18.307	20.483	21.161	23.209	25.188	29.588	10
11	2.603	3.053	3.609	3.816	4.575	5.578	6.989	7.584	8.148	10.341	12.899	13.701	14.631	17.275	19.675	21.920	22.618	24.725	26.757	31.264	11
12	3.074	3.571	4.178	4.404	5.226	6.304	7.807	8.438	9.034	11.340	14.011	14.845	15.812	18.549	21.026	23.337	24.054	26.217	28.300	32.909	12
13	3.565	4.107	4.765	5.009	5.892	7.042	8.634	9.299	9.926	12.340	15.119	15.984	16.985	19.812	22.362	24.736	25.472	27.688	29.819	34.528	13
14	4.075	4.660	5.368	5.629	6.571	7.790	9.467	10.165	10.821	13.339	16.222	17.117	18.151	21.064	23.685	26.119	26.873	29.141	31.319	36.123	14
15	4.601	5.229	5.985	6.262	7.261	8.547	10.307	11.036	11.721	14.339	17.322	18.245	19.311	22.307	24.996	27.488	28.259	30.578	32.801	37.697	15
16	5.142	5.812	6.614	6.908	7.962	9.312	11.152	11.912	12.624	15.338	18.418	19.369	20.465	23.542	26.296	28.845	29.633	32.000	34.267	39.252	16
17	5.697	6.408	7.255	7.564	8.672	10.085	12.002	12.792	13.531	16.338	19.511	20.489	21.615	24.769	27.587	30.191	30.995	33.409	35.718	40.790	17
18	6.265	7.015	7.906	8.231	9.390	10.865	12.857	13.675	14.440	17.338	20.601	21.605	22.760	25.989	28.869	31.526	32.346	34.805	37.156	42.312	18
19	6.844	7.633	8.567	8.907	10.117	11.651	13.716	14.562	15.352	18.338	21.689	22.718	23.900	27.204	30.144	32.852	33.687	36.191	38.582	43.820	19
20	7.434	8.260	9.237	9.591	10.851	12.443	14.578	15.452	16.266	19.337	22.775	23.828	25.038	28.412	31.410	34.170	35.020	37.566	39.997	45.315	20
21	8.034	8.897	9.915	10.283	11.591	13.240	15.445	16.344	17.182	20.337	23.858	24.935	26.171	29.615	32.671	35.479	36.343	38.932	41.401	46.797	21
22	8.643	9.542	10.600	10.982	12.338	14.041	16.314	17.240	18.101	21.337	24.939	26.039	27.301	30.813	33.924	36.781	37.659	40.289	42.796	48.268	22
23	9.260	10.196	11.293	11.688	13.091	14.848	17.187	18.137	19.021	22.337	26.018	27.141	28.429	32.007	35.172	38.076	38.968	41.638	44.181	49.728	23
24	9.886	10.856	11.992	12.401	13.848	15.659	18.062	19.037	19.943	23.337	27.096	28.241	29.553	33.196	36.415	39.364	40.270	42.980	45.558	51.179	24
25	10.520	11.524	12.697	13.120	14.611	16.473	18.940	19.939	20.867	24.337	28.172	29.339	30.675	34.382	37.652	40.646	41.566	44.314	46.928	52.620	25
26	11.160	12.198	13.409	13.844	15.379	17.292	19.820	20.843	21.792	25.336	29.246	30.434	31.795	35.563	38.885	41.923	42.856	45.642	48.290	54.052	26
27	11.808	12.879	14.125	14.573	16.151	18.114	20.703	21.749	22.719	26.336	30.319	31.528	32.912	36.741	40.113	43.194	44.140	46.963	49.645	55.476	27
28	12.461	13.565	14.847	15.308	16.928	18.939	21.588	22.657	23.647	27.336	31.391	32.620	34.027	37.916	41.337	44.461	45.419	48.278	50.993	56.893	28
29	13.121	14.256	15.574	16.047	17.708	19.768	22.475	23.567	24.577	28.336	32.461	33.711	35.139	39.087	42.557	45.722	46.693	49.588	52.336	58.302	29
30	13.787	14.953	16.306	16.791	18.493	20.599	23.364	24.478	25.508	29.336	33.530	34.800	36.250	40.256	43.773	46.979	47.962	50.892	53.672	59.703	30
40	20.706	22.164	23.838	24.433	26.509	29.051	32.345	33.660	34.872	39.335	44.165	45.616	47.269	51.805	55.759	59.342	60.436	63.691	66.766	73.402	40
50	27.991	29.707	31.664	32.357	34.764	37.689	41.449	42.942	44.313	49.335	54.723	56.334	58.164	63.167	67.505	71.420	72.613	76.154	79.490	86.661	50
60	35.535	37.485	39.699	40.482	43.188	46.459	50.641	52.294	53.809	59.335	65.227	66.981	68.972	74.397	79.082	83.298	84.580	88.379	91.952	99.607	60
70	43.275	45.442	47.893	48.758	51.739	55.329	59.898	61.698	63.346	69.334	75.689	77.577	79.715	85.527	90.531	95.023	96.388	100.425	104.215	112.317	70
80	51.171	53.539	56.213	57.153	60.391	64.278	69.207	71.145	72.915	79.334	86.120	88.130	90.405	96.578	101.880	106.629	108.069	112.329	116.321	124.839	80
90	59.196	61.754	64.634	65.646	69.126	73.291	78.558	80.625	82.511	89.334	96.524	98.650	101.054	107.565	113.145	118.136	119.648	124.116	128.299	137.208	90
100	67.327	70.065	73.142	74.222	77.929	82.358	87.945	90.133	92.129	99.334	106.906	109.141	111.667	118.498	124.342	129.561	131.142	135.807	140.170	149.449	100

For values of $\nu > 30$, approximate values for χ^2 may be obtained from the expression $\nu\left[1 - \frac{2}{9\nu} \pm \frac{x}{\sigma}\sqrt{\frac{2}{9\nu}}\right]^3$, where $\frac{x}{\sigma}$ is the normal deviate cutting off the corresponding tails of a normal distribution. If $\frac{x}{\sigma}$ is taken at the 0.02 level, so that 0.01 of the normal distribution is in each tail, the expression yields χ^2 at the 0.99 and 0.01 points. For very large values of ν, it is sufficiently accurate to compute $\sqrt{2\chi^2}$, the distribution of which is approximately normal around a mean of $\sqrt{2\nu - 1}$ and with a standard deviation of 1. This table is taken by consent from Statistical Tables for Biological, Agricultural, and Medical Research, by R. A. Fisher and F. Yates, published by Oliver and Boyd, Edinburgh, and from Table 8 of Biometrika Tables for Statisticians, Vol. 1, by permission of the Biometrika Trustees.

Table 9

PERCENTAGE POINTS OF THE F DISTRIBUTION

The table gives the values of $F_{\alpha;\,\nu_1,\,\nu_2}$ the 100α percentage point of the F distribution having ν_1 degrees of freedom in the numerator and ν_2 degrees of freedom in the denominator.

For each pair of values of ν_1 and ν_2, $F_{\alpha;\,\nu_1,\nu_2}$ is tabulated for $\alpha = 0.05, 0.025, 0.01, 0.001$, the 0.025 values being bracketed.

The lower percentage points of the distribution may be obtained from the relation:-

$$F_{1-\alpha;\,\nu_1,\,\nu_2} = 1/F_{\alpha;\,\nu_2,\,\nu_1}$$

e.g. $F_{.95;12,8} = 1/F_{.05;\,8,12} = 1/_{2.85} = \underline{0.351}$

F_{α,ν_1,ν_2}

ν_2 \ ν_1	1	2	3	4	5	6	7	8	10	12	24	∞
1	161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	241.9	243.9	249.0	254.3
	(648)	(800)	(864)	(900)	(922)	(937)	(948)	(957)	(969)	(977)	(997)	(1018)
	4052	5000	5403	5625	5764	5859	5928	5981	6056	6106	6235	6366
	4053*	5000*	5404*	5625*	5764*	5859*	5929*	5981*	6056*	6107*	6235*	6366*
2	18.5	19.0	19.2	19.2	19.3	19.3	19.4	19.4	19.4	19.4	19.5	19.5
	(38.5)	(39.0)	(39.2)	(39.2)	(39.3)	(39.3)	(39.4)	(39.4)	(39.4)	(39.4)	(39.5)	(39.5)
	98.5	99.0	99.2	99.2	99.3	99.3	99.4	99.4	99.4	99.4	99.5	99.5
	998.5	999.0	999.2	999.2	999.3	999.3	999.4	999.4	999.4	999.4	999.5	999.5
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.79	8.74	8.64	8.53
	(17.4)	(16.0)	(15.4)	(15.1)	(14.9)	(14.7)	(14.6)	(14.5)	(14.4)	(14.3)	(14.1)	(13.9)
	34.1	30.8	29.5	28.7	28.2	27.9	27.7	27.5	27.2	27.1	26.6	26.1
	167.0	148.5	141.1	137.1	134.6	132.8	131.5	130.6	129.2	128.3	125.9	123.5
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	5.96	5.91	5.77	5.63
	(12.22)	(10.65)	(9.98)	(9.60)	(9.36)	(9.20)	(9.07)	(8.98)	(8.84)	(8.75)	(8.51)	(8.26)
	21.2	18.0	16.7	16.0	15.5	15.2	15.0	14.8	14.5	14.4	13.9	13.5
	74.14	61.25	56.18	53.44	51.71	50.53	49.66	49.00	48.05	47.41	45.77	44.05
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.74	4.68	4.53	4.36
	(10.01)	(8.43)	(7.76)	(7.39)	(7.15)	(6.98)	(6.85)	(6.76)	(6.62)	(6.52)	(6.28)	(6.02)
	16.26	13.27	12.06	11.39	10.97	10.67	10.46	10.29	10.05	9.89	9.47	9.02
	47.18	37.12	33.20	31.09	29.75	28.83	28.16	27.65	26.92	26.42	25.14	23.79
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.06	4.00	3.84	3.67
	(8.81)	(7.26)	(6.60)	(6.23)	(5.99)	(5.82)	(5.70)	(5.60)	(5.46)	(5.37)	(5.12)	(4.85)
	13.74	10.92	9.78	9.15	8.75	8.47	8.26	8.10	7.87	7.72	7.31	6.88
	35.51	27.00	23.70	21.92	20.80	20.03	19.46	19.03	18.41	17.99	16.90	15.75
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.64	3.57	3.41	3.23
	(8.07)	(6.54)	(5.89)	(5.52)	(5.29)	(5.12)	(4.99)	(4.90)	(4.76)	(4.67)	(4.42)	(4.14)
	12.25	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.62	6.47	6.07	5.65
	29.25	21.69	18.77	17.20	16.21	15.52	15.02	14.63	14.08	13.71	12.73	11.70
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.35	3.28	3.12	2.93
	(7.57)	(6.06)	(5.42)	(5.05)	(4.82)	(4.65)	(4.53)	(4.43)	(4.30)	(4.20)	(3.95)	(3.67)
	11.26	8.65	7.59	7.01	6.63	6.37	6.18	6.03	5.81	5.67	5.28	4.86
	25.42	18.49	15.83	14.39	13.48	12.86	12.40	12.05	11.54	11.19	10.30	9.34
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.14	3.07	2.90	2.71
	(7.21)	(5.71)	(5.08)	(4.72)	(4.48)	(4.32)	(4.20)	(4.10)	(3.96)	(3.87)	(3.61)	(3.33)
	10.56	8.02	6.99	6.42	6.06	5.80	5.61	5.47	5.26	5.11	4.73	4.31
	22.86	16.39	13.90	12.56	11.71	11.13	10.69	10.37	9.87	9.57	8.72	7.81
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	2.98	2.91	2.74	2.54
	(6.94)	(5.46)	(4.83)	(4.47)	(4.24)	(4.07)	(3.95)	(3.85)	(3.72)	(3.62)	(3.37)	(3.08)
	10.04	7.56	6.55	5.99	5.64	5.39	5.20	5.06	4.85	4.71	4.33	3.91
	21.04	14.91	12.55	11.28	10.48	9.93	9.52	9.20	8.74	8.44	7.64	6.76
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.85	2.79	2.61	2.40
	(6.72)	(5.26)	(4.63)	(4.28)	(4.04)	(3.88)	(3.76)	(3.66)	(3.53)	(3.43)	(3.17)	(2.88)
	9.65	7.21	6.22	5.67	5.32	5.07	4.89	4.74	4.54	4.40	4.02	3.60
	19.69	13.81	11.56	10.35	9.58	9.05	8.66	8.35	7.92	7.63	6.85	6.00
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.75	2.69	2.51	2.30
	(6.55)	(5.10)	(4.47)	(4.12)	(3.89)	(3.73)	(3.61)	(3.51)	(3.37)	(3.28)	(3.02)	(2.72)
	9.33	6.93	5.95	5.41	5.06	4.82	4.64	4.50	4.30	4.16	3.78	3.36
	18.64	12.97	10.80	9.63	8.89	8.38	8.00	7.71	7.29	7.00	6.25	5.42
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.67	2.60	2.42	2.21
	(6.41)	(4.97)	(4.35)	(4.00)	(3.77)	(3.60)	(3.48)	(3.39)	(3.25)	(3.15)	(2.89)	(2.60)
	9.07	6.70	5.74	5.21	4.86	4.62	4.44	4.30	4.10	3.96	3.59	3.17
	17.82	12.31	10.21	9.07	8.35	7.86	7.49	7.21	6.80	6.52	5.78	4.97

* Entries marked thus must be multiplied by 100

APPENDIX 9/LAMPIRAN 9

ν_2 \ ν_1	1	2	3	4	5	6	7	8	10	12	24	∞
14	4.60 (6.30) 8.86 17.14	3.74 (4.86) 6.51 11.78	3.34 (4.24) 5.56 9.73	3.11 (3.89) 5.04 8.62	2.96 (3.66) 4.70 7.92	2.85 (3.50) 4.46 7.44	2.76 (3.38) 4.28 7.08	2.70 (3.29) 4.14 6.80	2.60 (3.15) 3.94 6.40	2.53 (3.05) 3.80 6.13	2.35 (2.79) 3.43 5.41	2.13 (2.49) 3.00 4.60
16	4.49 (6.12) 8.53 16.12	3.63 (4.69) 6.23 10.97	3.24 (4.08) 5.29 9.01	3.01 (3.73) 4.77 7.94	2.85 (3.50) 4.44 7.27	2.74 (3.34) 4.20 6.80	2.66 (3.22) 4.03 6.46	2.59 (3.12) 3.89 6.19	2.49 (2.99) 3.69 5.81	2.42 (2.89) 3.55 5.55	2.24 (2.63) 3.18 4.85	2.01 (2.32) 2.75 4.06
18	4.41 (5.98) 8.29 15.38	3.55 (4.56) 6.01 10.39	3.16 (3.95) 5.09 8.49	2.93 (3.61) 4.58 7.46	2.77 (3.38) 4.25 6.81	2.66 (3.22) 4.01 6.35	2.58 (3.10) 3.84 6.02	2.51 (3.01) 3.71 5.76	2.41 (2.87) 3.51 5.39	2.34 (2.77) 3.37 5.13	2.15 (2.50) 3.00 4.45	1.92 (2.19) 2.57 3.67
20	4.35 (5.87) 8.10 14.82	3.49 (4.46) 5.85 9.95	3.10 (3.86) 4.94 8.10	2.87 (3.51) 4.43 7.10	2.71 (3.29) 4.10 6.46	2.60 (3.13) 3.87 6.02	2.51 (3.01) 3.70 5.69	2.45 (2.91) 3.56 5.44	2.35 (2.77) 3.37 5.08	2.28 (2.68) 3.23 4.82	2.08 (2.41) 2.86 4.15	1.84 (2.09) 2.42 3.38
22	4.30 (5.79) 7.95 14.38	3.44 (4.38) 5.72 9.61	3.05 (3.78) 4.82 7.80	2.82 (3.44) 4.31 6.81	2.66 (3.22) 3.99 6.19	2.55 (3.05) 3.76 5.76	2.46 (2.93) 3.59 5.44	2.40 (2.84) 3.45 5.19	2.30 (2.70) 3.26 4.83	2.23 (2.60) 3.12 4.58	2.03 (2.33) 2.75 3.92	1.78 (2.00) 2.31 3.15
24	4.26 (5.72) 7.82 14.03	3.40 (4.32) 5.61 9.34	3.01 (3.72) 4.72 7.55	2.78 (3.38) 4.22 6.59	2.62 (3.15) 3.90 5.98	2.51 (2.99) 3.67 5.55	2.42 (2.87) 3.50 5.23	2.36 (2.78) 3.36 4.99	2.25 (2.64) 3.17 4.64	2.18 (2.54) 3.03 4.39	1.98 (2.27) 2.66 3.74	1.73 (1.94) 2.21 2.97
26	4.23 (5.66) 7.72 13.74	3.37 (4.27) 5.53 9.12	2.98 (3.67) 4.64 7.36	2.74 (3.33) 4.14 6.41	2.59 (3.10) 3.82 5.80	2.47 (2.94) 3.59 5.38	2.39 (2.82) 3.42 5.07	2.32 (2.73) 3.29 4.83	2.22 (2.59) 3.09 4.48	2.15 (2.49) 2.96 4.24	1.95 (2.22) 2.58 3.59	1.69 (1.88) 2.13 2.82
28	4.20 (5.61) 7.64 13.50	3.34 (4.22) 5.45 8.93	2.95 (3.63) 4.57 7.19	2.71 (3.29) 4.07 6.25	2.56 (3.06) 3.75 5.66	2.45 (2.90) 3.53 5.24	2.36 (2.78) 3.36 4.93	2.29 (2.69) 3.23 4.69	2.19 (2.55) 3.03 4.35	2.12 (2.45) 2.90 4.11	1.91 (2.17) 2.52 3.46	1.65 (1.83) 2.06 2.69
30	4.17 (5.57) 7.56 13.29	3.32 (4.18) 5.39 8.77	2.92 (3.59) 4.51 7.05	2.69 (3.25) 4.02 6.12	2.53 (3.03) 3.70 5.53	2.42 (2.87) 3.47 5.12	2.33 (2.75) 3.30 4.82	2.27 (2.65) 3.17 4.58	2.16 (2.51) 2.98 4.24	2.09 (2.41) 2.84 4.00	1.89 (2.14) 2.47 3.36	1.62 (1.79) 2.01 2.59
40	4.08 (5.42) 7.31 12.61	3.23 (4.05) 5.18 8.25	2.84 (3.46) 4.31 6.59	2.61 (3.13) 3.83 5.70	2.45 (2.90) 3.51 5.13	2.34 (2.74) 3.29 4.73	2.25 (2.62) 3.12 4.44	2.18 (2.53) 2.99 4.21	2.08 (2.39) 2.80 3.87	2.00 (2.29) 2.66 3.64	1.79 (2.01) 2.29 3.01	1.51 (1.64) 1.80 2.23
60	4.00 (5.29) 7.08 11.97	3.15 (3.93) 4.98 7.77	2.76 (3.34) 4.13 6.17	2.53 (3.01) 3.65 5.31	2.37 (2.79) 3.34 4.76	2.25 (2.63) 3.12 4.37	2.17 (2.51) 2.95 4.09	2.10 (2.41) 2.82 3.86	1.99 (2.27) 2.63 3.54	1.92 (2.17) 2.50 3.32	1.70 (1.88) 2.12 2.69	1.39 (1.48) 1.60 1.89
120	3.92 (5.15) 6.85 11.38	3.07 (3.80) 4.79 7.32	2.68 (3.23) 3.95 5.78	2.45 (2.89) 3.48 4.95	2.29 (2.67) 3.17 4.42	2.18 (2.52) 2.96 4.04	2.09 (2.39) 2.79 3.77	2.02 (2.30) 2.66 3.55	1.91 (2.16) 2.47 3.24	1.83 (2.05) 2.34 3.02	1.61 (1.76) 1.95 2.40	1.25 (1.31) 1.38 1.54
∞	3.84 (5.02) 6.63 10.83	3.00 (3.69) 4.61 6.91	2.60 (3.12) 3.78 5.42	2.37 (2.79) 3.32 4.62	2.21 (2.57) 3.02 4.10	2.10 (2.41) 2.80 3.74	2.01 (2.29) 2.64 3.47	1.94 (2.19) 2.51 3.27	1.83 (2.05) 2.32 2.96	1.75 (1.94) 2.18 2.74	1.52 (1.64) 1.79 2.13	1.00 (1.00) 1.00 1.00

This table is taken from Table V of Fisher & Yates: Statistical Tables for Biological, Agricultural and Medical Research, published by Oliver & Boyd Ltd., Edinburgh, and by permission of the authors and publishers and also from Table 18 of Biometrika Tables for Statisticians, Volume 1, by permission of the Biometrika Trustees.

APPENDIX 10/LAMPIRAN 10

$n_2 = 8$

U \ n_1	1	2	3	4	5	6	7	8	t	Normal
0	.111	.022	.006	.002	.001	.000	.000	.000	3.308	.001
1	.222	.044	.012	.004	.002	.001	.000	.000	3.203	.001
2	.333	.089	.024	.008	.003	.001	.001	.000	3.098	.001
3	.444	.133	.042	.014	.005	.002	.001	.001	2.993	.001
4	.556	.200	.067	.024	.009	.004	.002	.001	2.888	.002
5		.267	.097	.036	.015	.006	.003	.001	2.783	.003
6		.356	.139	.055	.023	.010	.005	.002	2.678	.004
7		.444	.188	.077	.033	.015	.007	.003	2.573	.006
8		.556	.248	.107	.047	.021	.010	.005	2.468	.007
9			.315	.141	.064	.030	.014	.007	2.363	.009
10			.387	.184	.085	.041	.020	.010	2.258	.012
11			.461	.230	.111	.054	.027	.014	2.153	.016
12			.539	.285	.142	.071	.036	.019	2.048	.020
13				.341	.177	.091	.047	.025	1.943	.026
14				.404	.217	.114	.060	.032	1.838	.033
15				.467	.262	.141	.076	.041	1.733	.041
16				.533	.311	.172	.095	.052	1.628	.052
17					.362	.207	.116	.065	1.523	.064
18					.416	.245	.140	.080	1.418	.078
19					.472	.286	.168	.097	1.313	.094
20					.528	.331	.198	.117	1.208	.113
21						.377	.232	.139	1.102	.135
22						.426	.268	.164	.998	.159
23						.475	.306	.191	.893	.185
24						.525	.347	.221	.788	.215
25							.389	.253	.683	.247
26							.433	.287	.578	.282
27							.478	.323	.473	.318
28							.522	.360	.368	.356
29								.399	.263	.396
30								.439	.158	.437
31								.480	.052	.481
32								.520		

* Reproduced from Mann, H. B., and Whitney, D. R. 1947. On a test of whether one of two random variables is stochastically larger than the other. *Ann. Math. Statist.*, 18, 52–54, with the kind permission of the authors and the publisher.

APPENDIX 11/LAMPIRAN 11

Table K. Table of Critical Values of U in the Mann-Whitney Test*

Table K_I. Critical Values of U for a One-tailed Test at $\alpha = .001$ or for a Two-tailed Test at $\alpha = .002$

n_1 \ n_2	9	10	11	12	13	14	15	16	17	18	19	20
1												
2												
3									0	0	0	0
4		0	0	0	1	1	1	2	2	3	3	3
5	1	1	2	2	3	3	4	5	5	6	7	7
6	2	3	4	4	5	6	7	8	9	10	11	12
7	3	5	6	7	8	9	10	11	13	14	15	16
8	5	6	8	9	11	12	14	15	17	18	20	21
9	7	8	10	12	14	15	17	19	21	23	25	26
10	8	10	12	14	17	19	21	23	25	27	29	32
11	10	12	15	17	20	22	24	27	29	32	34	37
12	12	14	17	20	23	25	28	31	34	37	40	42
13	14	17	20	23	26	29	32	35	38	42	45	48
14	15	19	22	25	29	32	36	39	43	46	50	54
15	17	21	24	28	32	36	40	43	47	51	55	59
16	19	23	27	31	35	39	43	48	52	56	60	65
17	21	25	29	34	38	43	47	52	57	61	66	70
18	23	27	32	37	42	46	51	56	61	66	71	76
19	25	29	34	40	45	50	55	60	66	71	77	82
20	26	32	37	42	48	54	59	65	70	76	82	88

* Adapted and abridged from Tables 1, 3, 5, and 7 of Auble, D. 1953. Extended tables for the Mann-Whitney statistic. *Bulletin of the Institute of Educational Research at Indiana University*, 1, No. 2, with the kind permission of the author and the publisher.

Table K. Table of Critical Values of U in the Mann-Whitney Test* *(Continued)*

Table K_{II}. Critical Values of U for a One-tailed Test at $\alpha = .01$ or for a Two-tailed Test at $\alpha = .02$

n_1 \ n_2	9	10	11	12	13	14	15	16	17	18	19	20
1												
2					0	0	0	0	0	0	1	1
3	1	1	1	2	2	2	3	3	4	4	4	5
4	3	3	4	5	5	6	7	7	8	9	9	10
5	5	6	7	8	9	10	11	12	13	14	15	16
6	7	8	9	11	12	13	15	16	18	19	20	22
7	9	11	12	14	16	17	19	21	23	24	26	28
8	11	13	15	17	20	22	24	26	28	30	32	34
9	14	16	18	21	23	26	28	31	33	36	38	40
10	16	19	22	24	27	30	33	36	38	41	44	47
11	18	22	25	28	31	34	37	41	44	47	50	53
12	21	24	28	31	35	38	42	46	49	53	56	60
13	23	27	31	35	39	43	47	51	55	59	63	67
14	26	30	34	38	43	47	51	56	60	65	69	73
15	28	33	37	42	47	51	56	61	66	70	75	80
16	31	36	41	46	51	56	61	66	71	76	82	87
17	33	38	44	49	55	60	66	71	77	82	88	93
18	36	41	47	53	59	65	70	76	82	88	94	100
19	38	44	50	56	63	69	75	82	88	94	101	107
20	40	47	53	60	67	73	80	87	93	100	107	114

* Adapted and abridged from Tables 1, 3, 5, and 7 of Auble, D. 1953. Extended tables for the Mann-Whitney statistic. *Bulletin of the Institute of Educational Research at Indiana University*, 1, No. 2, with the kind permission of the author and the publisher.

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