

UNIVERSITI SAINS MALAYSIA
Peperiksaan Semester Pertama
Sidang 1992/93

Oktober/November, 1992

AGW513- STATISTIK PENGURUSAN/AGW513 - *MANAGERIAL STATISTICS*

Masa: [3 jam]

ARAHAN/ INSTRUCTIONS

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.

Bahagian A (WAJIB)/Section A (COMPULSORY)

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 maklumat 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 randomly 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 $\alpha = 0.05$.*

[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

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

- (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

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

- (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

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

dengan

- y = perbelanjaan pakaian keluarga setahun (\$1,000)
- x₁ = pendapatan isi rumah setahun (\$1,000)
- x₂ = bilangan ahli keluarga
- x₃ = 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 $\alpha = .01$.
- (ii) Ujikan sama ada x_1 dan y berkaitan secara linear positif. Gunakan $\alpha = .05$.
- (iii) Tafsirkan pekali penentuan.
- (iv) Terangkan bagaimana anda boleh menentukan sama ada masalah autokorelasi dalam sisa dan multi-kekolinearan 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%

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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]

Bahagian B/Section B

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	
	Appraiser 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 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
\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 diperbuat dari aloi 2? Apakah nilai-p yang tercapai?

- (b) Sime Darby mengoperasikan 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/employment 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 $\alpha = .05$ 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 memperkembangkan operasi antarabangnya, 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

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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

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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]

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APPENDIX 1. FORMULAE

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

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

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

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

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

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

$$s_{xy} = \sqrt{\frac{\sum x_i y_i - n\bar{x}\bar{y}}{n-1}}$$

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

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

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

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

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

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

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

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

APPENDIX 1A

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

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

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

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

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

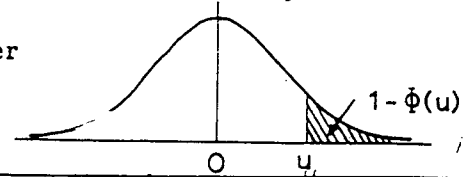
p=	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50
n=2 r=0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1	.1900	.2775	.3600	.4375	.5100	.5775	.6400	.6975	.7500
2	.0100	.0225	.0400	.0625	.0900	.1225	.1600	.2025	.2500
n=5 r=0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
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 ($= \frac{x-\mu}{\sigma}$).



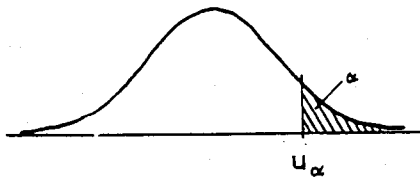
$\frac{(x - \mu)}{\sigma}$.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641
0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.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									

APPENDIX 5/LAMPIRAN 5

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

Table 7

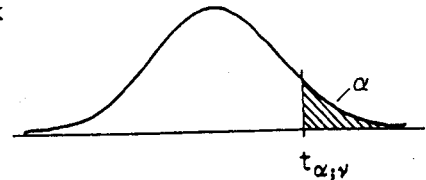
PERCENTAGE POINTS OF THE t DISTRIBUTION

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:-

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

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.



$\alpha =$	0.10	0.05	0.025	0.01	0.005	0.001	0.0005
$\nu = 1$	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