

UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Pertama
Sidang 1995/96

Oktober/November 1995

ASP300 - STATISTIK PERNIAGAAN

Masa: [3 jam]

ARAHAN

Sila pastikan bahawa kertas peperiksaan ini mengandungi **TUJUH BELAS (17) muka surat** yang bercetak sebelum anda memulakan peperiksaan ini.

Jawab **ENAM** soalan. Soalan-soalan daripada Bahagian A adalah **WAJIB**. Pilih **TIGA** soalan daripada Bahagian B. Anda boleh memilih untuk menjawab **SEBAHAGIAN** daripada soalan di dalam Bahasa Inggeris atau menjawab keseluruhan soalan di dalam Bahasa Melayu.

BAHAGIAN A: (Jawab SEMUA soalan)

SECTION A: (Answer ALL the questions)

1. Pengurus sebuah kilang ingin mencari satu kaedah untuk meramal kecekapan setiap dari 400 orang pekerja dalam mengendalikan sebuah mesin yang sangat penting (kritikal) dalam operasi kilang tersebut. Selepas berfikir panjang, dia menyenaraikan lima faktor yang boleh membantu menentukan kecekapan mesin tersebut:

- (i) bilangan tahun pengalaman operator.
- (ii) "kekanan" dalam syarikat.
- (iii) "rating" kecekapan dalam kerja sekarang.
- (iv) umur.
- (v) skor dalam ujian kestabilan emosi.

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Dua puluh orang pekerja telah dipilih secara rawak dan diberikan ujian kestabilan emosi. Setiap seorang diberikan operasi kritikal itu untuk mengukur kecekapan mereka. Output komputer diberikan di bawah:

Variable	Regression coefficient	Std. error
1	0.653	0.178
2	0.011	0.220
3	0.040	0.131
4	-0.161	0.177
5	0.094	0.016

Pintasan 0.414

Koefisien penentuan 0.824

Ralat piaawai 5.091

Analisis varians

	DF	SS	MSS	F
SSR	5	1,704.1		
SSE	11	362.8		
SST	19	2,066.9		

- (a) Ungkapkan persamaan regresi yang menentukan kecekapan operator.
- (b) Apakah keertian setiap dari lima pembolehubah yang dikenalpasti?
- (c) Adakah model ini bererti secara keseluruhannya?
- (d) Anggarkan kecekapan pada mesin ini jika operator mempunyai pengalaman 5 tahun berumur 34 tahun, kekanan dalam syarikat 31, "rating" kecekapannya 75 dan skor dalam ujian kestabilan emosi adalah 65.
- (e) Tulis satu laporan ringkas mengenai kegunaan analisis ini.

A factory manager needed to find some way of predicting the effectiveness of each of the 400 employees on a machine that is critical to the operations of the factory. After some thought, he listed five factors that may help determine the effectiveness of the machine:

- (i) years of operator experience;
- (ii) seniority within the company;
- (iii) effectiveness rating on the current job;
- (iv) age;
- (v) score on emotional stability test.

Twenty employees were randomly selected and given the emotional stability test. Each was assigned the critical operation to measure the effectiveness. The computer output is given below:

Variable	Regression coefficient	Std. error
1	0.653	0.178
2	0.011	0.220
3	0.040	0.131
4	-0.161	0.177
5	0.094	0.016

Intercept 0.414

Coefficient of determination 0.824

Std error of estimate 5.091

Analysis of variance

	DF	SS	MSS	F
SSR	5	1,704.1		
SSE	11	362.8		
SST	19	2,066.9		

- (a) Express the regression equation which determines the operators' effectiveness.

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- (b) *How useful are the five variables identified by the manager?*
- (c) *Is the model as a whole significant?*
- (d) *Estimate effectiveness on the critical machine for a 5 year experienced operator aged 34, seniority in the company being 31, the effectiveness rating being 75 and the score on the emotional stability being 65.*
- (e) *Write a short report on the usefulness of the analysis.*

[16 markah]

2. (a) Pengurus Personel Tonga National Berhad ingin menilai kecekapan program latihan ke atas pencapaian kerja para pekerjanya. Satu sampel penyelia/pegawai rendah telah didedahkan secara rawak kepada satu daripada 3 keadaan latihan: tiada latihan langsung, latihan dengan bantuan komputer, atau latihan dengan bantuan komputer ditambah dengan bengkel "Behaviour modelling". Selepas tempoh sebulan, pekerja-pekerja ini diberikan ujian pengurusan untuk mengukur pencapaian kerja mereka. Skor yang diperolehi adalah seperti berikut:

Tiada latihan	64, 72, 44, 56, 92
Latihan dengan bantuan komputer	76, 88, 52, 60, 80, 72, 84
Latihan dengan bantuan komputer ditambah dengan bengkel	48, 76, 72, 88, 64, 100

Dari keputusan di atas, bolehkah disimpulkan bahawa terdapat beza bererti bagi pencapaian ketiga-tiga kumpulan di atas? (Skor yang lebih tinggi menunjukkan prestasi yang lebih baik). Gunakan $\alpha = 0.05$.

The Personnel Manager of Tonga National Bhd. wanted to evaluate the effectiveness of training programmes on the job performance of the employees. A sample of supervisors/junior officers were randomly assigned to one of the three conditions: no training, computer assisted training, or computer-assisted training with a behavior modelling workshop. After a one-month period of the programme, these employees

were administered a managerial test to measure their performance on the job. The scores obtained by them are given below:

No training	64, 72, 44, 56, 92
Computer-based training	76, 88, 52, 60, 80, 72, 84
Computer training with a workshop	48, 76, 72, 88, 64, 100

From the above results, can we conclude that there is significant difference in the scores of three groups? (A higher score indicates better job performance). Use $\alpha = 0.05$.

- (b) Joanna seorang penyelidik, ingin menentukan kadar penggunaan minyak kelapa sawit oleh sebuah isirumah di Malaysia.

Beliau percaya bahawa penggunaan bagi bulanan bertaburan normal dengan min yang tidak diketahui dan sisihan piawai 1.25 kg .

- (i) Joanna mengambil satu sampel 36 isirumah dan merekod penggunaan bulanan minyak kepala sawit. Apakah kebarangkalian min sampel akan berada dalam lingkungan $\frac{1}{2} \text{ kg}$ dari min populasi?
- (ii) Berapa besarkah sampel yang harus diambil jika ia inginkan min sampel berada dalam lingkungan $\frac{1}{2} \text{ kg}$ dari min populasi dengan keyakinan 99%?

Joanna, a researcher for the Palm Oil Federation, is interested in determining the rate of palm oil usage per household in Malaysia. She believes that the monthly household consumption is normally distributed with an unknown mean and a standard deviation of 1.25 kg .

- (i) Joanna takes a sample of 36 households and records their monthly consumption of palm oil. What is the probability that the sample mean is within one-half kg. of the population mean?

(ii) How large a sample must she take in order to be 99 percent certain that the sample mean is within one-half kg. of the population mean?

[18 markah]

3. Seorang pengeluar jus oren membeli kesemua bekalan oreinya dari sebuah dusun oren yang besar. Jumlah jus yang dapat diperah dari setiap biji oren dianggarkan bertaburan normal dengan min 4.75 auns dan sisisian piawai sebanyak 0.16 auns.

- (a) Apakah kebarangkalian bahawa sebiji oren yang dipilih secara rawak akan mengandungi antara 4.70 dan 5.00 auns jus?
(b) 77% daripada semua biji oren akan mengandungi sekurang-kurangnya berapa auns jus?

Satu sampel 25 biji oren dipilih secara rawak:

- (c) Apakah kebarangkalian min sampel (jus) adalah sekurang-kurangnya 4.60 auns?
(d) 77% daripada min sampel melebihi nilai apa?

An orange juice producer buys all his oranges from a large orange orchard. The amount of juice squeezed from each of these oranges is approximately normally distributed with mean 4.75 ounces and a standard deviation of 0.16 ounces.

- (a) What is the probability that a randomly selected orange will contain juice between 4.70 and 5.00 ounces?
(b) 77% of the oranges will contain at least how many ounces of juice?

A sample of 25 oranges is selected at random:

- (c) What is the probability that the sample mean (of juice) will be at least 4.60 ounce?
(d) 77% of the sample means will be above what value?

[12 markah]

BAHAGIAN B: (Jawab TIGA soalan sahaja)

SECTION B: (Answer THREE questions)

4. (a) Seorang pelanggan telah membuat aduan bahawa timbang elektronik yang digunakan untuk menimbang makanan segar adalah tidak tepat. Dia telah menggunakan timbang biasa di jabatan makanan-hijau untuk menimbang pembeliannya dan percaya bahawa timbang elektronik telah terlebih nilai berat barang yang telah dipilih.

Pengurus bersetuju untuk menyemak ketepatan timbang elektronik, beliau menimbang beberapa jenis makanan segar dengan menggunakan kedua-dua penimbang. Hasilnya adalah seperti di bawah:

Hasil	Timbang biasa berat dlm Kg	Timbang elektronik berat dlm kg
Ubi-ubi	2.35	2.52
Tomatoes	2.21	2.23
Kacang	0.75	0.71
Mushrooms	0.24	0.27
Karot	0.78	0.84
Bawang	1.13	1.18
Epal	1.78	1.70
Pisang	2.12	2.43
Anggur	1.56	1.57
Plums	0.93	0.98
Pears	1.25	1.29
Peas	0.63	0.68

Adakah perbezaan yang bererti pada berat yang direkodkan pada dua jenis timbang yang berbeza ini? Adakah apa-apa asas dalam kecaman yang dibuat oleh pembeli berkenaan? Terangkan sebab-sebab anda.

A customer in a supermarket has complained that the electronic scales used to weigh fresh goods at the check-out are inaccurate. She had used the manual scales in the green-grocery department to weigh her purchases and believes that the scales at the check-out are over-estimating the weight of the goods that she had chosen.

The manager agrees to check the accuracy, and weighs a variety of fresh produce on each type of scales. The results are summarised below:

Produce	Manual scales Weight in Kg	Electronic scales Weight in kg
Potatoes	2.35	2.52
Tomatoes	2.21	2.23
Beans	0.75	0.71
Mushrooms	0.24	0.27
Carrots	0.78	0.84
Onions	1.13	1.18
Apples	1.78	1.70
Bananas	2.12	2.43
Grapes	1.56	1.57
Plums	0.93	0.98
Pears	1.25	1.29
Peas	0.63	0.68

Is there a significant difference in the weights recorded on the two types of scale? Is there any justification in the claim that the customer made? Explain your reasoning.

- (b) Data berikut menunjukkan bilangan hari cuti sakit (MC) yang diambil dalam setahun di kalangan pekerja wanita dan lelaki yang dipilih secara rawak di sebuah universiti di Malaysia. Sekiranya kita ingin menggunakan ujian tak berparameter, uji hipotesis bahawa tiada perbezaan yang bererti dalam bilangan hari cuti sakit yang diambil oleh kedua-dua kategori pekerja:

Lelaki: 11, 5, 18, 13, 12, 10, 14, 6, 13, 15
Perempuan: 14, 10, 4, 17, 17, 15, 12, 5, 7, 18

Following data gives the number of days of leave (MC) taken during a typical year by randomly selected male and female employees of a university in Malaysia. If you have to use a nonparametric test to test the hypothesis that there is no significant difference in the leave taken by two categories of employees, what conclusions will you draw?

Male: 11, 5, 18, 13, 12, 10, 14, 6, 13, 15
Female: 14, 10, 4, 17, 17, 15, 12, 5, 7, 18

[18 markah]

5. Seorang pengurus perakaunan pengurusan telah meringkaskan data bulanan mengenai kos pengeluaran (dalam RMs 000) dan bilangan unit pengeluaran bagi tahun sebelumnya. Data itu diberikan di bawah:

Kos pengeluaran (y dalam 000 RMs)	63	165	120	60	90	120	150	65
Pengeluaran unit (x)	3	34	21	12	13	16	30	6
y (dalam 000 RMs)	126	91	100	90				
x	27	15	20	10				

Pengiraan dalam "spread sheet" menghasilkan maklumat seperti berikut:

$$\begin{array}{lll}\Sigma x = 207 & \Sigma y = 1,240 & \Sigma x^2 = 4,565 \\ \Sigma y^2 = 140,676 & \Sigma xy = 24,686 & \Sigma(x - \bar{x})^2 = 994.25 \\ \Sigma(y - \bar{y})^2 = 12524.667 & \Sigma(x - \bar{x})(y - \bar{y}) = 3296.00 & \end{array}$$

- Lukiskan sebuah gambarajah serakan.
- Dapatkan persamaan regresi ganda dua terkecil bagi kos pengeluaran dan unit pengeluaran. Lakarkan garis regresi dalam gambarajah serakan.
- Sejauh manakah variasi dalam kos pengeluaran dapat dijelaskan oleh tahap pengeluaran? Apakah keertian unit pengeluaran dalam regresi ini?

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- (d) Apakah anggaran kos pengeluaran jika tahap pengeluaran bulan depan adalah 22 unit?

A management accountant has summarised the firms monthly production costs (in RM 000) and the units of output for the last year. These details are given below:

Production costs (y in 000 RM)	63	165	120	60	90	120	150	65
Units of output (x)	3	34	21	12	13	16	30	6
y (in 000 RM)	126	91	100	90				
x	27	15	20	10				

Calculations on the spreadsheet provided the following summary results

$$\Sigma x = 207$$

$$\Sigma y = 1,240$$

$$\Sigma x^2 = 4,565$$

$$\Sigma y^2 = 140,676$$

$$\Sigma xy = 24,686$$

$$\Sigma(x - \bar{x})^2 = 994.25$$

$$\Sigma(y - \hat{y})^2 = 12524.667$$

$$\Sigma(x - \bar{x})(y - \hat{y}) = 3296.00$$

- (a) Draw a scatter diagram.
- (b) Find a least squares regression equation for production costs on output. Plot the regression line on the scatter diagram.
- (c) To what extent the variation in production costs is explained by the level of output? What is the significance of units of output in this regression?
- (d) What are the likely production costs if the next month's production level is 22 units?

[18 markah]

6. (a) Terangkan ciri-ciri utama taburan normal dan jelaskan kepentingan taburan ini dalam analisis statistik.

Describe the main features of the normal distribution and explain the importance of this distribution in the statistical analysis of data.

- (b) Taburan markah dalam suatu peperiksaan dipercayai mengikut taburan normal dengan min 58 dan sisihan piawai 10. Terdapat 1,200 skrip peperiksaan yang telah disemak.
- (i) Berapa banyak skrip dijangka dalam kategori "A" di mana markah kelayakan adalah 70 dan ke atas?
 - (ii) Berapa banyak skrip dijangka dalam kategori "gagal" di mana markah adalah kurang daripada 40?
 - (iii) Berapakah markah minimum yang diperlukan untuk kategori cemerlang jika 10% pelajar patut diberikan pencapaian ini?

The distribution of marks in a certain examination is believed to be represented by a normal distribution with a mean of 58 and a standard deviation of 10. There are 1,200 marked scripts.

- (i) *How many scripts would be expected in the "A" category for which the qualifying mark is 70 or over?*
 - (ii) *How many scripts would be expected in the "failed" category with less than 40 marks?*
 - (iii) *What minimum mark should be required for the "distinction" category if 10% of the candidates are to be given that achievement level?*
- (c) Analisis tambahan telah dibuat pada markah yang diperolehi oleh 40 orang pelajar dari program luar kampus dan 50 orang dari program biasa bagi peperiksaan tahun 1994. Pelajar program luar kampus memperolehi purata markah 52 dengan sisihan piawai 12. Pelajar program biasa pula memperolehi purata markah 60 dengan sisihan piawai 9.
- (i) Adakah perbezaan yang bererti dalam purata markah yang diperolehi oleh pelajar dalam kedua-dua program di atas?
 - (ii) Adakah purata markah yang diperolehi oleh pelajar program luar kampus lebih rendah secara bererti daripada markah purata pelajar program biasa?

An additional analysis was made of the marks in the 1994 examination for the 40 candidates sitting in off-campus programme and for the 50 candidates sitting in regular programme. The candidates in off-campus have an average marks of 52 with a standard deviation of 12. The regular programme candidates had an average of 60 marks with a standard deviation of 9.

- (i) Is there a significant difference in the average marks of those sitting in two different programmes?
- (ii) Is the average marks obtained by those sitting in off-campus Programme significantly lower than that for those sitting in regular programme?

[18 markah]

7. (a) Seorang pengurus cawangan suatu rangkaian pasaraya makanan binatang peliharaan ingin mengkaji ciri-ciri pelanggan cawangan beliau. Khususnya dia ingin menumpu pada 2 pembolehubah: jumlah wang yang dibelanjakan dan sama ada pelanggan memiliki anjing, kucing atau kedua-duanya. Hasil daripada 70 pelanggan adalah seperti berikut:

Jumlah wang dibelanjakan: $\bar{x} = \text{RM}53.35$, $s = 23.05$

Antara pelanggan yang dikaji, 37 memiliki anjing, 26 memiliki kucing dan yang selebihnya memiliki kedua-duanya sekali.

- (i) Bentuk anggaran selang keyakinan 95% bagi purata wang yang dibelanjakan bagi populasi.
- (ii) Bentuk anggaran selang keyakinan 90% bagi kadaran pelanggan yang hanya memiliki kucing.
- (iii) Bentuk anggaran selang keyakinan 95% bagi jumlah wang yang akan dibelanjakan oleh seorang bakal pelanggan di masa depan.
- (iv) Jika seorang pengurus cawangan lain ingin mengulang tinjauan di atas, berapa besarkah sampel yang perlu diambil untuk menganggar purata belanja bulanan populasi sebenar adalah dalam lingkungan $\pm \text{RM}4$ dengan andaian sisihan piawai RM25 pada aras keyakinan 95%?

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The branch manager of an outlet of a large chain of "pet" supply stores wanted to study characteristics of customers of her store. In particular, she decided to focus on two variables: the amount of money spent by customers and whether the customers owned a dog, a cat or both: a cat and a dog. The result of 70 customers is as follows:

Average amount of monthly money spent: $\bar{x} = RM53.35$, $s = RM23.05$

Among the customers studied, 37 owned only a dog, 26 owned only a cat and the remaining owned a dog and a cat.

- (i) *Develop a 95% confidence interval estimate of the population average amount of money spent in the pet.*
 - (ii) *Develop a 90% confidence interval estimate of the proportion of customers who own only a cat.*
 - (iii) *Develop a 95% confidence interval estimate of the amount of money spent by a future individual customer.*
 - (iv) *If another branch manager wishes to conduct a similar survey, how large should be the sample to have a 95% confidence of estimating true population monthly average amount spent by her customer is within $\pm RM4$, when the standard deviation is assumed to be RM25?*
- (b) Sebuah jurnal pengurusan kewangan melaporkan hasil kajian ke atas 582 orang eksekutif pengurusan kewangan korporat. Antara maklumat yang dikumpul adalah latar belakang pendidikan dan jantina. Maklumat berkenaan diberikan di bawah:

Latabelakang pendidikan

Jantina	SPM	STPM/Diploma	Ijazah	Profesional Sarjana
Lelaki	6	210	171	14
Perempuan	18	89	56	18

Adakah bukti yang menunjukkan bahawa peratusan eksekutif kewangan lelaki dan wanita berbeza dari segi latarbelakang pendidikan? (Gunakan $\alpha = 0.05$).

A journal of financial management reported a survey results of 582 corporate financial executives. Among the several aspects of data gathered, it included information on educational background and the sex of the surveyed executives. These results are reproduced below:

Educational background

Sex	SPM	STPM/Diploma	Degree	Professional, Master's, etc.
Male	6	210	171	14
Female	18	89	56	18

Is there any evidence to indicate that the percentage of corporate financial executives, male and female, differ in their educational background? (Use $\alpha = 0.05$).

[18 markah]

8. (a) Bincangkan secara ringkas kepentingan analisis varians dalam penyelesaian masalah perniagaan.
Discuss briefly the importance of analysis of variance in solving business decision problems.
- (b) Output sejam 4 orang operator dengan menggunakan 5 jenis mesin berlainan diberikan di bawah:

Operator	Mesin				
	M1	M2	M3	M4	M5
01	72	67	55	62	65
02	66	53	64	68	60
03	57	72	58	70	64
04	57	62	59	74	66

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- (i) Adakah beza bererti dalam kecekapan operator berdasarkan output mereka?
- (ii) Adakah kecekapan mesin berbeza bagi mesin yang berlainan?
- (iii) Berikan cadangan untuk memperbaiki kecekapan.

The hourly output by four (4) operators with five (5) different makes of machines are given below:

Operator	Machine				
	M1	M2	M3	M4	M5
01	72	67	55	62	65
02	66	53	64	68	60
03	57	72	58	70	64
04	57	62	59	74	66

- (i) *Is there any significant difference in the operator efficiency as indicated in the outputs?*
- (ii) *Does the machine efficiency is different for different machines?*
- (iii) *Give suggestions for improving the over-all efficiency.*

[18 markah]

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$$r = \frac{1}{n} \frac{-\sum xy - \bar{x}\bar{y}}{\sigma_{xy}} \quad r_s = 1 - \frac{6\sum d^2}{n(n^2-1)}$$

$$\hat{b} = \frac{\sum xy - n\bar{x}\bar{y}}{\sum x^2 - n\bar{x}^2}$$

$$\hat{a} = \bar{y} - b\bar{x}$$

$$\hat{\sigma} = \sqrt{\frac{\sum (y - \hat{y})^2}{n-k-1}}$$

$$R^2 = 1 - \frac{\sum (y - \hat{y})^2}{\sum (y - \bar{y})^2}; \quad \bar{R}^2 = 1 - \frac{\sum (y - \hat{y})^2 / (n-k-1)}{\sum (y - \bar{y})^2 / (n-1)}$$

$$S_b^2 = \frac{\hat{\sigma}^2}{\sum x^2 - n\bar{x}^2}$$

$$P = \sum_{i=0}^x \binom{n}{i} p^i q^{n-i}$$

$$\chi^2 = \sum_{i=0}^k \frac{(O_i - E_i)^2}{E_i} \quad \text{or} \quad \chi^2 = \frac{(|B-C| - 1)^2}{B + C}$$

$$D = \max \{ |F_o(x) - S_o(X)| \}$$

$$D^* = \frac{1.36}{\sqrt{n}}$$

$$E(r) = \frac{2n_1 n_2}{n_1 + n_2} + 1$$

$$\text{Var}(r) = \frac{2n_1 n_2 (2n_1 n_2 - n_1 - n_2)}{(n_1 + n_2)^2 (n_1 + n_2 - 1)}$$

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

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

$$\text{Var}(U) = \frac{n_1 n_2 (n_1 + n_2 + 1)}{12}$$

$$H = \frac{12}{n(n+1)} \sum_{i=1}^k \frac{r_i^2}{n_i} - 3(n + 1)$$

$$Z = \frac{x - E(x)}{\text{SD}(x)}$$

$$t = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}$$

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sigma(\bar{x}_1 - \bar{x}_2)}$$

$$t = \frac{d - \mu_{dHO}}{s_d/\sqrt{n}}$$

$$\bar{x} \pm Z_{\alpha/2} \sigma_{\bar{x}} \text{ or } \bar{x} \pm t_{\alpha/2} \sigma_{\bar{x}}$$

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