
UNIVERSITI SAINS MALAYSIA

Peperiksaan Kursus Semasa Cuti Panjang
Sidang Akademik 2005/2006

Jun 2006

MAA 161E – Statistics For Science Students
[Statistik Untuk Pelajar Sains]

Duration : 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of TEN pages of printed material before you begin the examination.

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

Instructions : Answer **all four** [4] questions.

[Arahan : *Jawab **semua empat** [4] soalan.]*

1. (a) The closing prices in a particular day for 25 companies listed in the KLSE are as follows:

2.40	5.60	2.84	3.18	4.36	4.52	9.10	7.50	2.25	4.96
2.78	1.94	10.70	3.40	4.88	11.89	2.81	4.54	6.90	7.80
6.00	2.94	5.55	8.15	3.20					

- (i) Calculate the mean and standard deviation of the closing prices
(ii) Find the range of the closing prices
(iii) Tabulate the closing prices in a frequency table using the following class intervals :

1.90-3.89	3.90-5.89	5.90-7.89	7.90-9.89	9.90-11.89
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Calculate the estimate median of the frequency distribution

- (b) U is a set which has 6 blue balls, 3 red balls and a white ball. All balls are similar. A ball is picked randomly from the set. If a white ball is chosen, it is returned to the set. However, if other colours are chosen, it is not returned to the set. Subsequently, a second ball is picked. Find the probability of obtaining
- (i) Both red balls
(ii) A red ball and a blue ball
(iii) Both red balls given that both balls are of the same colour

- (c) A random variable X has the probability density function $f(x)$

$$f(x) = \begin{cases} \frac{1}{4}, & \text{if } -1 < x < 1 \text{ or } 3 < x < a \\ 0, & \text{otherwise} \end{cases}$$

Determine

- (i) the value of the constant a
(ii) the expected value for X
(iii) the standard deviation for X
(iv) $P(|X - \mu| < 2)$

[100 marks]

1. (a) *Harga tutup pada suatu hari tertentu bagi 25 syarikat tersenarai dalam bursa saham Kuala Lumpur adalah seperti berikut:*

2.40	5.60	2.84	3.18	4.36	4.52	9.10	7.50	2.25	4.96
2.78	1.94	10.70	3.40	4.88	11.89	2.81	4.54	6.90	7.80
6.00	2.94	5.55	8.15	3.20					

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- (i) Kira min dan sisihan piawai bagi harga-harga tutup tersebut .
 (ii) Cari julat bagi harga-harga tutup tersebut.
 (iii) Jadualkan harga-harga tutup dalam suatu jadual kekerapan dengan menggunakan selang-selang kelas berikut:

1.90-3.89 3.90-5.89 5.90-7.89 7.90-9.89 9.90-11.89

Kira median yang dianggarkan bagi taburan kekerapan.

- (b) U adalah suatu set yang mempunyai 6 biji bola biru, 3 biji bola merah dan sebiji bola putih. Semua bola adalah serupa. Satu biji bola dipilih secara rawak daripada set tersebut. Jika sebiji bola putih dipilih, ianya dikembalikan ke dalam set. Sebaliknya, jika bola warna lain dipilih, ianya tidak dikembalikan ke dalam set. Kemudian bola kedua dipilih. Cari kebarangkalian keputusan berikut diperolehi.
- (i) kedua-dua bola merah
 (ii) sebiji bola merah dan sebiji bola biru.
 (iii) kedua-dua bola merah sekiranya diketahui bahawa kedua-dua bola mempunyai warna yang sama.
- (c) Suatu pembolehubah rawak X mempunyai fungsi ketumpatan kebarangkalian $f(x)$

$$f(x) = \begin{cases} \frac{1}{4}, & \text{jika } -1 < x < 1 \text{ atau } 3 < x < a \\ 0, & \text{selainnya} \end{cases}$$

Tentukan

- (i) nilai pemalar a
 (ii) nilai dijangka bagi X
 (iii) sisihan piawai bagi X
 (iv) $P(|X - \mu| < 2)$

[100 markah]

2. (a) A bag has 10 balls. Two balls are numbered '1', three numbered '2' and the rest are numbered '3'. Four balls are taken one at a time with replacement.
- (i) Find the mean and variance of the population
 (ii) State the sample distribution for the sample mean
 (iii) What is the percentage of the mean sample which is more than 1.5?

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- (b) Assume that the number of e-mails received in a day by an officer has a Poisson distribution with a standard deviation of 2.
- Determine the mean number of e-mails received on a given day.
 - Determine the probability that there are more than 3 e-mails received on a given day.
 - If 10 days were randomly chosen, find the probability that there are 5 days the officer receives more than 3 e-mails.
- (c) In a mathematics examination, the marks obtained are normally distributed with a mean of 75 and a standard deviation of 10.
- Find the probability that the marks of a student selected at random will lie between 45 and 65
 - If all students with marks of at least 60 will pass the examination, then what is the probability that a student selected at random will pass the examination?
 - Calculate the probability that from three candidates selected at random, only two of the candidates pass in the examination.
 - Find the interquartile range of the distribution of the marks.

[100 marks]

2. (a) *Sebuah beg mengandungi 10 biji bola. Dua biji bola dinomborkan '1', tiga biji bola dinomborkan '2' dan yang lain dinomborkan '3'. Empat biji bola diambil secara rawak daripada beg ini dengan pengembalian.*
- Cari min dan varians populasi*
 - Nyatakan taburan pensampelan bagi min sampel*
 - Apakah peratusan bahawa min sampel akan melebihi 1.5?*
- (b) *Anggapkan bilangan mel e yang diterima oleh seorang pegawai pada satu hari adalah bertaburan Poisson dengan sisihan piawai 2.*
- Tentukan bilangan min mel e yang diterima pada suatu hari.*
 - Tentukan kebarangkalian bahawa terdapat lebih 3 mel e diterima pada suatu hari.*
 - Sekiranya 10 hari dipilih secara rawak, cari kebarangkalian bahawa terdapat 5 hari dengan keadaan pegawai tersebut menerima lebih daripada 3 mel e.*
- (c) *Dalam suatu peperiksaan matematik, markah yang diperolehi adalah bertaburan normal dengan min 75 dan sisihan piawai 10.*
- Cari kebarangkalian bahawa markah seorang pelajar yang dipilih secara rawak berada di antara 45 dan 65.*

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- (ii) *Sekiranya semua pelajar dengan markah sekurang-kurangnya 60 akan lulus peperiksaan, apakah kebarangkalian seorang pelajar yang dipilih secara rawak akan lulus peperiksaan?*
- (iii) *Cari kebarangkalian bahawa daripada tiga calon yang dipilih secara rawak, hanya dua akan lulus dalam peperiksaan.*
- (iv) *Cari julat antara kuartil bagi taburan markah.*

[100 markah]

3. (a) A psychologist claims that one third of executive officers in the private and public sectors face extreme work pressure.
- (i) If 35 out of 120 executive officers in the private sector chosen randomly face extreme work pressure, test the claim of the psychologist at 5% level of significance.
 - (ii) If 40 out of 160 officers executive in the public sector chosen randomly face extreme work pressure, test whether there is any difference between the public and private sector in the ratio of the number of executives who face extreme work pressure at 1% level of significance
- (b) A market researcher for a consumer electronic company wishes to study the television viewing habits of residents of a particular small city. A random sample of 40 respondents is selected, and each respondent is instructed to keep a detail of all television viewing in a particular week. The results are as follows:
- Viewing time per week: $\bar{x} = 15.3$ hours, $s = 3.8$ hours
- (i) Construct a 90 % confidence interval for μ , the mean hours of television viewing per week.
 - (ii) Give the p -value when testing $H_0: \mu = 17$ vs $H_A: \mu < 17$.
 - (iii) What sample size is required if he wishes to be 95% confident of being within ± 2 hours of the true mean ?
- (c) In planning the human resource requirement, a company gathers the following data about the weekly output, y units, and the total labour hours, x hours for the production of an item in a year.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
x	600	250	260	650	504	480	360	242	400	360	350	470
y	60	6	12	68	54	40	32	26	38	26	18	30

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- (i) Calculate the correlation coefficient for the data and comment on your answer.
- (ii) Find the equation of the linear regression of x on y using the least square method.
- (iii) If the company intends to have an output of 50 units a week, estimate the total labour hours required

[100 marks]

3. (a) *Seorang pakar psikologi mendakwa bahawa satu per tiga pegawai eksekutif di dalam sektor swasta dan awam mengalami tekanan kerja yang ekstrim.*

- (i) *Jika 35 daripada 120 pegawai eksekutif dalam sector swasta mengalami tekanan kerja yang ekstrim, uji dakwaan pakar psikologi pada 5% aras keertian.*
- (ii) *Jika 40 daripada 160 pegawai eksekutif di sektor awam mengalami tekanan kerja ekstrim, uji samada terdapat perbezaan di antara sektor awam dan sektor swasta dalam nisbah bilangan eksekutif yang mengalami tekanan kerja ekstrim pada 1% aras keertian.*

(b) *Seorang penyelidik pasaran bagi sebuah syarikat elektronik ingin mengkaji tabiat menonton televisyen penghuni di sebuah bandar kecil. Suatu sampel 40 orang dipilih dan setiap orang diarah menyimpan perincian tontonan televisyen pada suatu minggu tertentu. Keputusan adalah seperti berikut:*

Masa menonton seminggu: $\bar{X} = 15.3$ jam, $s = 3.8$ jam.

- (i) *Bina suatu selang keyakinan 90% bagi μ , min jam menonton televisyen seminggu.*
- (ii) *Cari nilai-p apabila menguji $H_0: \mu = 17$ melawan $H_A: \mu < 17$.*
- (iii) *Apakah saiz sampel yang diperlukan jika seseorang ingin 95% bahawa anggaran akan berada dalam julat ± 2 jam dari min sebenar?*

(c) *Semasa merancang keperluan sumber manusia, suatu syarikat mengumpul data keluaran mingguan, y unit, dan jumlah jam buruh, x jam bagi pengeluaran sesuatu item dalam setahun.*

Bulan	Jan	Feb	Mar	Apr	May	Jun	Jul	Ogos	Sep	Okt	Nov	Dis
x	600	250	260	650	504	480	360	242	400	360	350	470
y	60	6	12	68	54	40	32	26	38	26	18	30

- (i) Cari pekali korelasi bagi data dan komen tentang jawapan anda
(ii) Cari persamaan garis regresi linear x lawan y dengan menggunakan kaedah kuasa dua terkecil.
(iii) Sekiranya syarikat itu ingin mengeluarkan 50 unit dalam seminggu, anggarkan jumlah jam buruh yang diperlukan

[100 markah]

4. (a) To determine the effectiveness of a new method of teaching reading to young children, a group of 22 nonreading children were randomly divided into two groups of 11 each. The first group was taught by a standard method and the second group by an experimental method. At the end of the school semester, a reading examination was given to each of the students, with the following summary statistics result:

Students using standard method (X) Students using experimental method (Y)

Mean score = 65.6

Mean score = 70.4

Standard deviation = 5.4

Standard deviation = 4.8

- (i) Are these data strong enough to prove, at the 5 percent level of significance, that the experimental method results in a higher mean test score? (Assume both population variances are equal)
(ii) Construct the 90% confidence interval on $\frac{\sigma_x^2}{\sigma_y^2}$.
- (b) The number of bacteria, X in each of fifty 0.1 litre samples is given in the following table:

X	0	1	2	3	4	5 or more
Frequency	23	14	9	3	1	0

- (i) Estimate the expected number of bacteria in a sample
(ii) Fit a Poisson distribution and test for its goodness of fit at 5% level of significance
- (c) A die of the shape of a regular tetrahedron with surfaces marked with number 1, 2, 3 and 4 is thrown 200 times. Find the probability of obtaining
(i) more than 60 times the number 4.
(ii) at most 50 times the number 4.

[100 marks]

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4. (a) Bagi menentukan keberkesanan suatu kaedah baru pengajaran membaca bagi kanak-kanak, suatu kumpulan 22 kanak-kanak yang tidak membaca diasingkan secara rawak kepada dua kumpulan setiap satunya terdiri daripada 11 kanak-kanak. Kumpulan pertama diajar kaedah standard dan kumpulan kedua diajar kaedah ujikaji. Pada akhir semester sekolah, suatu peperiksaan membaca diberi kepada setiap kanak-kanak dengan statistik ringkasan keputusan berikut:

Kanak-kanak mengguna
kaedah piawai (X)

Skor min = 65.6
Sisihan piawai = 5.4

Kanak-kanak mengguna
kaedah ujikaji (Y)

Skor min = 70.4
Sisihan piawai = 4.8

- (i) Adakah data tersebut cukup kukuh bagi membuktikan pada aras keertian 5% bahawa kaedah ujikaji menghasilkan skor min yang lebih tinggi? (Andaikan varians kedua-dua populasi adalah sama)
- (ii) Bina suatu selang keyakinan 90% untuk $\frac{\sigma_x^2}{\sigma_y^2}$.
- (b) Bilangan, bacteria, X dalam setiap lima puluh 0.1 liter sampel diberi dalam jadual berikut:

X	0	1	2	3	4	5 atau lebih
Kekerapan	23	14	9	3	1	0

- (i) Anggarkan bilangan bakteria yang dijangkakan dalam suatu sampel.
- (ii) Sesuaikan suatu taburan Poisson dan uji kebaikan penyuaiannya pada 5% aras keertian.
- (c) Sebuah dadu berbentuk tetrahedron seragam dengan permukaan-permukaan ditandakan dengan nombor 1, 2, 3 dan 4 dibaling 200 kali. Cari kebarangkalian bagi memperoleh
- (i) lebih daripada 60 kali nombor 4.
- (ii) selebih-lebihnya 50 kali nombor 4.

[100 markah]

APPENDIX

$\bar{X} \pm Z_{\frac{\alpha}{2}} \frac{\sigma}{\sqrt{n}}$ $\bar{d} \pm t_{\frac{\alpha}{2}} \frac{s_d}{\sqrt{n_d}}$	$\bar{X} \pm t_{\frac{\alpha}{2}} \frac{s}{\sqrt{n}}$ $b \pm t_{\frac{\alpha}{2}} s_b$	$(\bar{X} - \bar{Y}) \pm t_{\alpha/2} S_p \sqrt{\frac{1}{n_x} + \frac{1}{n_y}}$
$\hat{p} \pm Z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$ $(\hat{p}_x - \hat{p}_y) \pm z_{\alpha/2} \sqrt{\frac{\hat{p}_x(1-\hat{p}_x)}{n_x} + \frac{\hat{p}_y(1-\hat{p}_y)}{n_y}}$ $(\bar{X} - \bar{Y}) \pm Z_{\alpha/2} \sqrt{\frac{\sigma_x^2}{n_x} + \frac{\sigma_y^2}{n_y}}$ $(\bar{X} - \bar{Y}) \pm t_{\alpha/2} \sqrt{\frac{s_x^2}{n_x} + \frac{s_y^2}{n_y}}$	$\left(\frac{(n-1)s^2}{\chi_{\frac{\alpha}{2}, n-1}^2}, \frac{(n-1)s^2}{\chi_{1-\frac{\alpha}{2}, n-1}^2} \right)$ $\left(\frac{s}{Z_{\frac{\alpha}{2}}}, \frac{s}{Z_{\frac{\alpha}{2}}} \right)$ $\left(\frac{s}{1 + \frac{Z_{\frac{\alpha}{2}}}{\sqrt{2n}}}, \frac{s}{1 - \frac{Z_{\frac{\alpha}{2}}}{\sqrt{2n}}} \right)$ $\left(\frac{s_1^2}{s_2^2} F_{1-\frac{\alpha}{2}, (v_2, v_1)}, \frac{s_1^2}{s_2^2} F_{\frac{\alpha}{2}, (v_2, v_1)} \right)$	$\left(\frac{(n-1)s^2}{\chi_{\frac{\alpha}{2}, n-1}^2}, \frac{(n-1)s^2}{\chi_{1-\frac{\alpha}{2}, n-1}^2} \right)$ $\left(\frac{s}{Z_{\frac{\alpha}{2}}}, \frac{s}{Z_{\frac{\alpha}{2}}} \right)$ $\left(\frac{s}{1 + \frac{Z_{\frac{\alpha}{2}}}{\sqrt{2n}}}, \frac{s}{1 - \frac{Z_{\frac{\alpha}{2}}}{\sqrt{2n}}} \right)$ $\left(\frac{s_1^2}{s_2^2} F_{1-\frac{\alpha}{2}, (v_2, v_1)}, \frac{s_1^2}{s_2^2} F_{\frac{\alpha}{2}, (v_2, v_1)} \right)$

Test Statistic:

$Z = \frac{\bar{X} - \mu}{\sigma / \sqrt{n}}$ $T = \frac{\bar{X} - \mu}{s / \sqrt{n}}$ $T = \frac{\bar{d} - \mu_d}{s_d / \sqrt{n_d}}$ $T = \frac{b - \beta_1}{s_b}$ $T = r \sqrt{\frac{n-2}{1-r^2}}$ $\chi^2 = \frac{(n-1)s^2}{\sigma^2}$	$Z = \frac{s - \sigma}{\sigma / \sqrt{2n}}$ $Z = \frac{(\bar{X} - \bar{Y}) - (\mu_x - \mu_y)}{\sqrt{\frac{\sigma_x^2}{n_x} + \frac{\sigma_y^2}{n_y}}}$ $T = \frac{(\bar{X} - \bar{Y}) - (\mu_x - \mu_y)}{\sqrt{S_p^2 \left(\frac{1}{n_x} + \frac{1}{n_y} \right)}}$ $S_p^2 = \frac{(n_x - 1)s_x^2 + (n_y - 1)s_y^2}{n_x + n_y - 2}$ $F = \frac{s_x^2}{s_y^2}$	$Z = \frac{(\hat{p}_x - \hat{p}_y) - (p_x - p_y)}{\sqrt{\hat{p}(1-\hat{p}) \left(\frac{1}{n_x} + \frac{1}{n_y} \right)}}$ $T = \frac{(\bar{X} - \bar{Y}) - (\mu_x - \mu_y)}{\sqrt{\frac{s_x^2}{n_x} + \frac{s_y^2}{n_y}}}$ $dk = \frac{\left(\frac{s_x^2}{n_x} + \frac{s_y^2}{n_y} \right)^2}{\frac{\left(\frac{s_x^2}{n_x} \right)^2}{n_x - 1} + \frac{\left(\frac{s_y^2}{n_y} \right)^2}{n_y - 1}}$ $\chi^2 = \sum \frac{(O-E)^2}{E}, \quad E = np$
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Regression / Correlation Analysis

$$s_e = \sqrt{\frac{S_{YY} - bS_{XY}}{n-2}} \quad ; \quad s_b = \frac{s_e}{\sqrt{S_{XX}}} \quad ; \quad r = \frac{S_{XY}}{\sqrt{S_{XX} \cdot S_{YY}}}$$

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