UNIVERSITI SAINS MALAYSIA

Peperiksaan Kursus Semasa Cuti Panjang
Sidang Akademik 2007/2008

Jun 2008

MAA 161 – Statistics for Science Students
[Statistik untuk Pelajar Sains]

Duration : 3 hours
[Masa : 3 jam]

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

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

Instructions : Answer **all ten** [10] questions.

[Arahan : *Jawab **semua sepuluh** [10] soalan.]*

1. The following distribution of commuting distances was obtained for a sample of UKM employees:

Distance (in miles)	Frequency
1.0-3.0	2
3.0-5.0	7
5.0-7.0	14
7.0-9.0	60
9.0-11.0	40
11.0-13.0	18
13.0-15.0	6
15.0-17.0	3

$\sum fx = 1344$ $\sum fx^2 = 13000$

(i) Compute the average and standard deviation for the commuting distance.
(ii) Estimate the mode and the median.
(iii) Based on the value of the average, mode and median, comment on the shape of the distribution of the data.

[9 marks]

2. A light fixture can hold two light bulbs. Bulb A is of the type whose lifetime is normally distributed with mean 900 hours and variance 22500 hours. Bulb B has a lifetime that is normally distributed with mean 800 hours and variance 10000 hours. Assume that the lifetimes of the bulbs are independent.
(i) What is the probability that bulb A lasts more than 300 hours longer than bulb B?
(ii) Another light fixture can hold only one bulb. A bulb of type A is installed, and when it burns out, a bulb of type B is installed. What is the probability that the total lifetime of the two bulbs is more than 2000 hours?

[9 marks]

3. Gears produced by a grinding process are categorized as either by conforming (suitable for their intended purpose), degraded (unsuitable for the intended purpose but usable for another purpose), or scrap (not usable). Suppose that 80% of the gears produced are conforming, 15% are degraded and 5% are scrap. Ten gears are selected at random.
(i) What is the probability that one or more is scrap?
(ii) What is the probability that eight or more are not scrap?
(iii) What is the probability that more than two are either degraded or scrap?
(iv) What is the probability that exactly nine are either conforming or degraded?

[12 marks]

1. *Berikut adalah data taburan jarak perjalanan komuter bagi pekerja di UKM.*

Jarak (dalam batu)	Kekerapan
1.0-3.0	2
3.0-5.0	7
5.0-7.0	14
7.0-9.0	60
9.0-11.0	40
11.0-13.0	18
13.0-15.0	6
15.0-17.0	3

$\sum fx = 1344 \qquad \sum fx^2 = 13000$

(i) Hitungkan nilai purata dan sisihan piawai bagi jarak perjalanan komuter.
(ii) Anggarkan nilai mod dan median.
(iii) Berdasarkan nilai purata, mod dan median yang didapati, komen tentang taburan data.

[9 markah]

2. *Suatu soket lampu dapat dimuatkan dengan dua mentol. Mentol A adalah jenis yang mempunyai jangka hayat bertaburan secara normal dengan min 900 jam dan varians 22500 jam. Manakala, mentol B mempunyai jangka hayat bertaburan secara normal dengan min 800 jam dan varians 10000 jam. Andaikan bahawa jangka hayat kedua-dua mentol adalah tak bersandar.*
(i) Apakah kebarangkalian mentol A bertahan 300 jam lebih lama daripada mentol B?
(ii) Suatu soket yang lain hanya dapat memuatkan satu mentol sahaja. Mentol jenis A telah dipasang pada soket tersebut dan apabila mentol itu terbakar, mentol jenis B akan dipasang pula. Apakah kebarangkalian jumlah jangka hayat bagi kedua-dua mentol adalah lebih daripada 2000 jam?

[9 markah]

3. *Peralatan dihasilkan melalui suatu proses mengisar dikategorikan sama ada menurut piawaian (sesuai untuk tujuan yang ditetapkan), kurang baik (tidak sesuai untuk tujuan asal tetapi dapat digunakan untuk tujuan lain), atau buangan (tidak dapat digunakan). Andaikan bahawa 80% daripada peralatan dihasilkan adalah menurut piawai, 15% kurang baik dan 5% adalah buangan. Sepuluh peralatan telah dipilih secara rawak*
(i) Apakah kebarangkalian satu atau lebih adalah buangan?
(ii) Apakah kebarangkalian lapan atau lebih adalah bukan buangan?
(iii) Apakah kebarangkalian lebih daripada dua adalah sama ada kurang baik atau buangan?
(iv) Apakah kebarangkalian tepat sembilan adalah sama ada menurut piawaian atau kurang baik?

[12 markah]

...4/-

4. The probability that a married man watches a certain television show is 0.4 and the the probability that a married woman watches the show is 0.5. The probability that a man watches the show, given that his wife does is 0.7. Find the probability that

(i) a married couple watches the show;
(ii) a wife watches the show given that her husband does;
(iii) at least 1 person of a married couple will watch the show.

[9 marks]

5. The continuous random variable Y has probability density function f given by

$$f(y)=\begin{cases} k(3-y), & 0\le y\le 2, \\ k, & 2<y\le 6, \\ 0, & \textit{otherwise.} \end{cases}$$

(i) Find the value of k.
(ii) Find E(Y) and standard deviation of Y.
(iii) Calculate the median, m.

[14 marks]

6. A researcher wishes to estimate the proportion of adult males between 25 to 30 years old who are less than 1.75 meters tall. She wants to be 90% confident that her estimate is within 5% of the true proportion.

(i) How large a sample should be taken if in a sample of 300 males, 30 were less than 1.75 meters tall?
(ii) What is the most conservative estimate of the sample size?

[6 marks]

7. TESCO which has many departmental stores in Malaysia wanted to find the percentage of sales at two such stores in Penang and Ampang for which at least one of the item was returned. A sample of 800 sales randomly selected from TESCO Penang showed that for 240 of them at least one item was returned. Another sample of 900 sales randomly selected from TESCO Ampang showed that for 279 of them at least one item was returned.

(i) Construct a 98% confidence interval for the difference between the proportions of all sales at the two stores for which at least one item is returned.
(ii) Using the 1% significance level, can you conclude that the proportions of all sales at the two stores for which at least one item is returned are different? Use the p-value method.

[13 marks]

4. *Kebarangkalian lelaki berkahwin menonton suatu rancangan televisyen adalah 0.4 dan kebarangkalian wanita berkahwin menonton rancangan televisyen yang sama adalah 0.5. Manakala, kebarangkalian lelaki menonton rancangan televisyen tersebut diberi isterinya turut menonton adalah 0.7. Dapatkan kebarangkalian bahawa,*

(i) pasangan berkahwin menonton rancangan televisyen tersebut;

(ii) isteri menonton rancangan tersebut diberi suami turut menonton;

(iii) sekurang-kurangnya seorang daripada pasangan berkahwin akan menonton rancangan tersebut.

[9 markah]

5. *Pemboleh ubah rawak selanjar Y mempunyai fungsi ketumpatan kebarangkalian f di mana*

$$f(y)=\begin{cases} k(3-y), & 0\le y\le 2, \\ k, & 2<y\le 6, \\ 0, & lain-lain. \end{cases}$$

(i) Cari nilai k.

(ii) Cari E(Y) dan sisihan piawai untuk Y.

(iii) Hitungkan nilai median, m.

[14 markah]

6. *Seorang penyelidik berminat menganggar kadar lelaki dewasa berumur antara 25 hingga 30 tahun yang mempunyai ketinggian kurang daripada 1.75 meter. Dia hendak 90% yakin bahawa anggarannya adalah dalam lingkungan 5% daripada kadar sebenar.*

(i) Berapa besar sampel seharusnya diambil jika dalam satu sampel 300 orang lelaki, 30 adalah di bawah 1.75 meter?

(ii) Apakah anggaran saiz sampel yang paling konservatif?

[6 markah]

7. *TESCO yang mempunyai banyak gedung membeli-belah di Malaysia ingin mendapatkan peratusan di mana sekurang-kurangnya satu barangan telah dipulangkan selepas jualan di dua buah gedungnya di Pulau Pinang dan Ampang. Suatu sampel 800 jualan dipilih secara rawak daripada TESCO Penang dan didapati 240 jualan menunjukkan sekurang-kurangnya satu barangan telah dipulangkan. Manakala daripada suatu sampel 900 jualan dipilih secara rawak daripada TESCO Ampang didapati 279 jualan menunjukkan sekurang-kurangnya satu barangan telah dipulangkan.*

(i) Bina selang keyakinan 98% bagi perbezaan kadar sekurang-kurangnya satu barangan telah dipulangkan selepas jualan di antara kedua-dua buah gedung tersebut.

(ii) Berdasarkan aras keertian 1%, dapatkah disimpulkan bahawa kadar sekurang-kurangnya satu barangan telah dipulangkan selepas jualan di antara kedua-dua buah gedung tersebut adalah berbeza? Guna kaedah nilai-p.

[13 markah]

...6/-

8. Each of the two supermarkets, Sunshine and Giant in Penang claims to offer lower-cost shopping. Fifty people who normally do the grocery shopping for their family are chosen at random. Each shopper makes up a list for a week's supply of groceries. Then these items are priced and the total cost is computed for each store. The paired differences are then calculated for each of the 50 shoppers, where a paired difference is defined as the cost of a cart of groceries at Sunshine minus the cost of the same cart of groceries at Giant. These paired differences were positive for 21 shoppers and negative for 29 shoppers. The sum of ranks of the positive paired differences was 527 and the sum of the absolute values of the ranks of the negative paired differences was 821. Using the 1% level of significance, can you conclude that either store is less expensive than the other?

[8 marks]

9. A new casino game involves rolling 3 dice. The number of wins are determined by the total number of one rolled. Suppose a gambler plays the game 100 times, with the following observed counts:

Number of One's Occur	Number of Rolls
0	48
1	35
2	14
3	3

The casino becomes suspicious of the gambler and wishes to determine whether the dice are fair. What do they conclude? Use $\alpha = 0.05$.

[10 marks]

10. A certain electronic component manufacturing process produces parts, 20% of which are defective. Parts are shipped in units of 400. Shipments containing more than 90 defective parts may be returned. You may assume that each shipment constitutes a simple random sample of parts.

(i) What is the probability that a given shipment will be returned?

(ii) On a particular day, 500 shipments are made. What is the probability that 60 or more of these shipments are returned?

[10 marks]

8. *Dua buah pasar raya di Pulau Pinang iaitu Sunshine dan Giant masing-masing mendakwa bahawa telah menawarkan kos membeli-belah yang rendah. Lima puluh orang yang kebiasaannya membeli-belah barangan runcit untuk keluarga mereka telah dipilih secara rawak. Setiap pembeli akan menyenaraikan barangan runcit yang hendak dibeli bagi kegunaan selama seminggu. Kemudian barang-barang ini akan dijumlahkan kosnya bagi setiap pasar raya. Perbezaan pasangan kemudiannya dihitung untuk setiap 50 pembeli tersebut, di mana perbezaan pasangan ditakrif sebagai kos membeli barangan runcit di Sunshine ditolak kos membeli barangan runcit serupa di Giant. Perbezaan pasangan adalah positif untuk 21 pembeli dan negatif untuk 29 pembeli. Jumlah pangkat positif untuk perbezaan pasangan adalah 527 dan jumlah nilai mutlak pangkat negatif perbezaan pasangan adalah 821. Menggunakan aras keertian 1%, dapatkah kita membuat kesimpulan bahawa kedua-dua pasar raya kurang mahal daripada yang lain?*

[8 markah]

9. *Suatu permainan baru di sebuah kasino melibatkan balingan 3 biji dadu. Kemenangan ditentukan oleh bilangan nombor satu yang didapati bagi setiap balingan. Seorang penjudi telah bermain permainan ini sebanyak 100 kali dan cerapan yang didapati adalah seperti berikut;*

Bilangan nombor satu yang didapati	*Bilangan Balingan*
0	*48*
1	*35*
2	*14*
3	*3*

Pemilik kasino mencurigai penjudi tersebut dan berhasrat menentukan sama ada dadu-dadu yang digunakan adalah adil. Apakah kesimpulannya? Guna $\alpha = 0.05$.

[10 markah]

10. *Suatu proses pengeluaran komponen elektronik menghasilkan bahagian tertentu di mana 20% kerosakan akan berlaku. Bahagian ini akan dihantar dalam bilangan 400 unit. Penghantaran yang mempunyai bilangan kerosakan melebihi 90 unit akan dikembalikan semula. Anggapkan bagi setiap penghantaran sampel bahagian yang diambil adalah secara rawak.*

(i) Apakah kebarangkalian suatu penghantaran akan dikembalikan semula?
(ii) Pada suatu hari tertentu, 500 penghantaran telah dibuat. Apakah kebarangkalian 60 atau lebih penghantaran akan dikembalikan semula?

[10 markah]

APPENDIX

Confidence Interval

$$\bar{X} \pm Z_{\frac{\alpha}{2}} \frac{\sigma}{\sqrt{n}} \qquad \bar{X} \pm t_{\frac{\alpha}{2}} \frac{s}{\sqrt{n}}$$

$$\bar{d} \pm t_{\frac{\alpha}{2}} \frac{s_d}{\sqrt{n_d}} \qquad b \pm t_{\frac{\alpha}{2}} s_b$$

$$\hat{p} \pm Z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

$$(\hat{p}_x - \hat{p}_y) \pm z_{\alpha/2} \cdot \sqrt{\frac{\hat{p}_x(1-\hat{p}_x)}{n_x} + \frac{\hat{p}_y(1-\hat{p}_y)}{n_y}}$$

$$(\bar{X} - \bar{Y}) \pm Z_{\alpha/2} \cdot \sqrt{\frac{\sigma_x^{\,2}}{n_x} + \frac{\sigma_y^{\,2}}{n_y}}$$

$$(\bar{X} - \bar{Y}) \pm t_{\alpha/2} \cdot \sqrt{\frac{s_x^{\,2}}{n_x} + \frac{s_y^{\,2}}{n_y}}$$

$$(\bar{X} - \bar{Y}) \pm t_{\alpha/2}\ \mathrm{S_p} \sqrt{\frac{1}{n_x} + \frac{1}{n_y}}$$

$$\left(\frac{(n-1)s^2}{\chi^2_{\frac{\alpha}{2},n-1}}, \frac{(n-1)s^2}{\chi^2_{1-\frac{\alpha}{2},n-1}} \right)$$

$$\left(\frac{s}{Z_{\frac{\alpha}{2}}}, \frac{s}{Z_{\frac{\alpha}{2}}} \right)$$
$$1+\frac{}{\sqrt{2n}} \qquad 1-\frac{}{\sqrt{2n}}$$

$$\left(\frac{s_1^2}{s_2^2} F_{1-\frac{\alpha}{2},(v_2,v_1)}, \frac{s_1^2}{s_2^2} F_{\frac{\alpha}{2},(v_2,v_1)} \right)$$

Test Statistic

$$Z = \frac{\bar{X} - \mu}{\sigma / \sqrt{n}}$$

$$T = \frac{\bar{X} - \mu}{s / \sqrt{n}}$$

$$T = \frac{\bar{d} - \mu_d}{s_d / \sqrt{n_d}}$$

$$T = \frac{b - \beta_1}{s_b}$$

$$T = r\sqrt{\frac{n-2}{1-r^2}}$$

$$\chi^2 = \frac{(n-1)s^2}{\sigma^2}$$

$$U_1 = n_1 n_2 + \frac{(n_2)(n_2+1)}{2} - R_2$$

$$U_2 = n_1 n_2 + \frac{(n_1)(n_1+1)}{2} - R_1$$

$$Z = \frac{s - \sigma}{\sigma / \sqrt{2n}}$$

$$Z = \frac{(\bar{X} - \bar{Y}) - (\mu_x - \mu_y)}{\sqrt{\frac{\sigma_x^{\,2}}{n_x} + \frac{\sigma_y^{\,2}}{n_y}}}$$

$$T = \frac{(\bar{X} - \bar{Y}) - (\mu_x - \mu_y)}{\sqrt{S_p^{\,2}\left(\frac{1}{n_x} + \frac{1}{n_y}\right)}}$$

$$S_p^{\,2} = \frac{(n_x - 1)s_x^{\,2} + (n_y - 1)s_y^{\,2}}{n_x + n_y - 2}$$

$$F = \frac{s_x^2}{s_y^2}$$

$$Z = \frac{(\hat{p}_x - \hat{p}_y) - (p_x - p_y)}{\sqrt{\hat{p}(1-\hat{p})\left(\frac{1}{n_x} + \frac{1}{n_y}\right)}}$$

$$T = \frac{(\bar{X} - \bar{Y}) - (\mu_x - \mu_y)}{\sqrt{\frac{s_x^2}{n_x} + \frac{s_y^2}{n_y}}}$$

$$dk = \frac{\left(\frac{s_x^2}{n_x} + \frac{s_y^2}{n_y}\right)^2}{\frac{\left(\frac{s_x^2}{n_x}\right)^2}{n_x - 1} + \frac{\left(\frac{s_y^2}{n_y}\right)^2}{n_y - 1}}$$

$$\chi^2 = \sum \frac{(O-E)^2}{E}, \quad E = np$$

-ooo000ooo-