UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2007/2008

October/November 2007

MAT 161 – Elementary Statistics
[Statistik Permulaan]

Duration : 3 hours
[Masa : 3 jam]

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

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

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

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

...2/-

1. (a) The distribution of marks obtained by 1200 students in a mathematics examination is shown below.

Marks	0-9	10-19	20-29	30-39	40-49
Number of candidates	6	20	80	158	384

Marks	50-59	60-69	70-79	80-89	90-99
Number of candidates	260	176	80	22	14

Calculate

(i) the mean and median scores

(ii) the interquartile range

(iii) the number of candidates who obtained Grade A, if the minimum mark for Grade A was fixed at 75.

(iv) the passing mark if 1000 candidates passed the examination

(b) Box A contains 4 defective and 16 nondefective light bulbs. Box B contains 1 defective and 1 nondefective light bulb. A fair die is rolled once. If number 1 or 2 is obtained, then a bulb is selected at random from box A. Otherwise a bulb is selected from box B. A light bulb was found to be defective. What is the probability that the selected bulb was chosen from box A?

(c) A misprint count was made for 100 pages of a recent novel with the number of misprints found as given below:

Number of misprints	0	1	2	3	Total
Number of pages	65	25	8	2	100

(i) What is a reasonable probability model for this type of data?

(ii) Test if this model adequately describes the data. Use $\alpha = 0.05$.

[25 marks]

...3/-

1 (a) *Taburan markah yang diperolehi 1200 orang pelajar di dalam suatu peperiksaan matematik ditunjukkan di dalam jadual berikut:*

Markah	*0-9*	*10-19*	*20-29*	*30-39*	*40-49*
Bilangan calon	*6*	*20*	*80*	*158*	*384*

Markah	*50-59*	*60-69*	*70-79*	*80-89*	*90-99*
Bilangan calon	*260*	*176*	*80*	*22*	*14*

Kirakan

(i) markah min dan markah median

(ii) julat antara pesuku

(iii) bilangan calon yang mendapat Gred A, jika markah minimum bagi Gred A ditetapkan pada 75.

(iv) markah lulus jika 1000 calon lulus peperiksaan tersebut

(b) *Kotak A mengandungi 4 lampu rosak dan 16 lampu yang tidak rosak. Kotak B mengandungi 1 lampu rosak dan 1 lampu yang tidak rosak. Sebiji dadu yang tak pincang dilempar sekali. Jika nombor 1 atau 2 diperolehi, sebiji lampu dipilih secara rawak daripada kotak A. Sebaliknya, sebiji lampu dipilih daripada kotak B . Sebiji lampu telah didapati rosak. Apakah kebarangkalian bahawa lampu yang dipilih diambil daripada kotak A?*

(c) *Suatu pengiraan silap cetak dilakukan untuk 100 muka surat sebuah novel yang terkini dengan bilangan silap cetak yang didapati diberikan dibawah:*

Bilangan silap cetak	*0*	*1*	*2*	*3*	*Jumlah*
Bilangan muka surat	*65*	*25*	*8*	*2*	*100*

(i) Apakah model kebarangkalian yang sesuai untuk jenis data tersebut?

(ii) Uji jika model tersebut secukupnya memberihal data. Guna $\alpha = 0.05$.

[25 markah]

...4/-

2 (a) An auto dealership records the number of cars sold during the past 12 months. Is there evidence to indicate that the number of cars sold increases? Use $\alpha = 0.01$.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cars sold	23	17	15	10	14	12	13	15	23	26	27	29

(b) Researchers feel that eating citrus fruits during the winter months reduces the rate of contracting colds. To test this theory, 200 subjects were randomly divided into a control group and an experimental group each of size 100. Each member of the experimental group ate three oranges a day during the month of November through March. The control group followed a normal diet. At the end of this period the following data were obtained.

	Control	Experimental
Total Sampled	100	100
Number contracting at least one cold	48	43

(i) State the appropriate assumptions.

(ii) Do these data provide enough evidence to support the claim? Use $\alpha = 0.10$.

(c) In a garden, plants are inspected for the presence of the deadly red angus leaf bug. The number of bugs per leaf is known to be one.

(i) What is the probability that any one leaf on a given plant will have been attacked (at least one bug is found on it)?

(ii) A random sample of twelve plants is taken. For each plant ten leaves are selected at random and inspected for these bugs. If more than eight leaves on any particular plant have been attacked then the plant is destroyed. What is the probability that exactly two of these 12 plants are destroyed?

[25 marks]

...5/-

2 (a) *Sebuah syarikat penjual kereta mencatat bilangan kereta yang dijual sepanjang 12 bulan yang lepas. Adakah terdapat bukti untuk menunjukkan bahawa bilangan kereta yang dijual meningkat? Guna* $\alpha = 0.01$.

Bulan	*Jan*	*Feb*	*Mac*	*Apr*	*Mei*	*Jun*	*Jul*	*Ogo*	*Sep*	*Okt*	*Nov*	*Dis*
Kereta yang dijual	23	17	15	10	14	12	13	15	23	26	27	29

(b) *Penyelidik merasakan bahawa memakan buah-buahan citrus pada musim sejuk dapat mengurangkan kadar mendapat selsema. Untuk menguji teori ini, 200 subjek dibahagi secara rawak kepada kumpulan kawalan dan kumpulan ujikaji, setiapnya bersaiz 100. Setiap ahli kumpulan ujikaji memakan tiga buah limau setiap hari sepanjang bulan November hingga Mac. Kumpulan kawalan mengikuti diet biasa. Pada akhir tempoh ini data yang berikut diperolehi.*

	Kawalan	*Ujikaji*
Jumlah yang disampel	100	100
Bilangan yang mendapat sekurang-kurangnya satu selsema	48	43

(i) *Nyatakn anggapan yang sepadan.*

(ii) *Adakah data memberi cukup bukti untuk menyokong dakwaan tersebut? Guna* $\alpha = 0.10$.

(c) *Di dalam suatu taman, pokok-pokok diperiksa untuk kewujudan kumbang pemusnah daun angus merah. Bilangan kumbang bagi satu daun diketahui adalah satu.*

(i) *Apakah kebarangkalian bahawa sebarang satu daun bagi sesuatu pokok akan diserang (sekurang-kurangnya satu kumbang ditemui diatasnya)?*

(ii) *Suatu sampel rawak dua belas pokok diambil. Bagi setiap pokok sepuluh helai daun dipilih secara rawak dan diperiksa. Jika lebih daripada lapan daun bagi sesebarang pokok telah diserang, pokok tersebut dihapuskan. Apakah kebarangkalian bahawa tepat dua daripada 12 pokok tersebut dihapuskan?*

[25 markah]

...6/-

3 (a) An experiment is designed to study the side effects of two drugs used as treatments for a certain ailment. A group of 90 subjects are randomly assigned to two drug groups. After the specified drug is given, the side effects are recorded.

	Side Effects			
	Major	Minor	None	Total
Drug A	13	15	17	45
Drug B	8	21	16	45
Total	21	36	33	90

$\sum_i \sum_j Y_{ij}^2 = 1{,}444$

Is there evidence of a difference among the drugs? Test at the 0.10 level of significance.

(b) A study was conducted to determine whether the installation of a traffic light was effective in reducing the number of accidents at a busy intersection. Samples of 5 months prior to installation and 5 months after installation of the light yielded the number of accidents per month shown in the table.

Month	Before	After	Total
1	12	4	16
2	5	2	7
3	10	7	17
4	9	3	12
5	14	8	22
Total	50	24	74

$\sum_i \sum_j Y_{ij}^2 = 688$

(i) State the appropriate assumptions.
(ii) Test for equal variances if it is needed at $\alpha = 0.05$.
(iii) Perform an appropriate statistical analysis? Use $\alpha = 0.05$.

[25 marks]

...7/-

3 (a) *Suatu ujikaji dirangka untuk mengkaji kesan sampingan dua ubat yang diguankan sebagai rawatan untuk sejenis penyakit. Sekumpulan 90 subjek diumpukkan secara rawak kepada dua kumpulan. Setelah ubat tertentu diberikan, kesan-kesan sampingan dicatat.*

	Kesan Sampingan			
	Berat	*Ringan*	*Tiada*	*Jumlah*
Ubat A	*13*	*15*	*17*	*45*
Ubat B	*8*	*21*	*16*	*45*
Jumlah	*21*	*36*	*33*	*90*

$\sum_i \sum_j Y_{ij}^2 = 1{,}444$

Adakah terdapat bukti suatu perbezaan di anatara ubat-ubat tersebut? Uji pada 0.10 aras signifikan.

(b) *Suatu kajian dilakukan untuk menentukan sama ada pemasangan satu lampu trafik berkesan didalam mengurangkan bilangan kemalangan di suatu perimpangan yang sibuk. Sampel-sampel 5 bulan sebelum pemasangan dan 5 bulan selepas pemasangan lampu tersebut menghasilkan bilangan kemalangan sebulan yang ditunjukkan di dalam jadual.*

Bulan	*Sebelum*	*Selepas*	*Jumlah*
1	*12*	*4*	*16*
2	*5*	*2*	*7*
3	*10*	*7*	*17*
4	*9*	*3*	*12*
5	*14*	*8*	*22*
Jumlah	*50*	*24*	*74*

$\sum_i \sum_j Y_{ij}^2 = 688$

(i) Nyatakan anggapan-anggapan yang sepadan.

(ii) Uji kesamaan varians jika diperlukan pada $\alpha = 0.05$.

(iii) Lakukan suatu analisis statistik yang sepadan. Guna $\alpha = 0.05$.

[25 markah]

...8/-

4 (a) One important consideration in determining which location is best for new retail business is the amount of traffic that passes the location each business day. Counters are placed at each location on five weekdays, and the number of cars passing were recorded.

	Day					
Location	1	2	3	4	5	Total
A	453	500	392	441	427	2213
B	482	605	400	450	431	2368
Total	935	1105	792	891	858	4581

$\sum_i \sum_j Y_{ij}^2 = 2{,}132{,}293$

(i) State the appropriate assumptions.

(ii) Test for equal variances if it is needed at $\alpha = 0.05$.

(iii) Perform an appropriate statistical analysis. Use $\alpha = 0.05$.

(b) The health food business has boomed in recent years. Suppose two different health food diets, diet A and diet B are compared by placing seven overweight individuals on each diet for 6 weeks. The weight losses (in kilograms) are recorded. Use $\alpha = 0.10$

Individuals	Diet A	Diet B	Total
1	20	16	36
2	22	0	22
3	21	3	24
4	19	2	21
5	1	2	3
6	2	1	3
7	20	18	38
Total	105	42	147

$\sum_i \sum_j Y_{ij}^2 = 2689$

(i) State the appropriate assumptions.

(ii) Test for equal variances if it is needed at $\alpha = 0.10$.

(iii) Perform an appropriate statistical analysis. Use $\alpha = 0.10$.

[25 marks]

...9/-

4 (a) *Satu pertimbangan penting dalam menentukan lokasi yang terbaik untuk gedong perniagaan baru adalah amaun trafik yang melalui suatu lokasi setiap hari.Penghitung diletakkan pada setiap lokasi untuk lima hari bekerja, dan bilangan kereta yang melaluinya dicatat.*

	Hari					
Lokasi	*1*	*2*	*3*	*4*	*5*	*Jumlah*
A	*453*	*500*	*392*	*441*	*427*	*2213*
B	*482*	*605*	*400*	*450*	*431*	*2368*
Jumlah	*935*	*1105*	*792*	*891*	*858*	*4581*

$\sum_i \sum_j Y_{ij}^2 = 2,132,293$

(i) *Nyatakan anggapan-anggapan yang sepadan.*

(ii) *Uji kesamaan varians jika diperlukan pada* $\alpha = 0.05$.

(iii) *Lakukan suatu analisis statistik yang sepadan. Guna* $\alpha = 0.05$.

(b) Perniagaan makanan kesihatan telah meningkat pada tahun kebelakangan ini. Andaikan dua diet makanan kesihatan yang berlainan dibandingkan dengan meletakkan tujuh individu yang berlebihan berat badan pada setaip diet selama 6 minggu. Pengurangan berat (di dalam kilogram) dicatat.

Individu	*Diet A*	*Diet B*	*Jumlah*
1	20	16	36
2	22	0	22
3	21	3	24
4	19	2	21
5	1	2	3
6	2	1	3
7	20	18	38
Jumlah	105	42	147

$\sum_i \sum_j Y_{ij}^2 = 2689$

(i) *Nyatakan anggapan-anggapan yang sepadan.*

(ii) *Uji kesamaan varians jika diperlukan pada* $\alpha = 0.10$.

(iii) *Lakukan suatu analisis statistik yang sepadan. Guna* $\alpha = 0.10$.

[25 markah]

...10/-

APPENDIX

1. Z Test

i. $$Z = \frac{\overline{Y} - \mu}{\sigma/\sqrt{n}}$$

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

iii. $$Z = \frac{(\overline{Y}_1 - \overline{Y}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

iv. $$Z = \frac{(\hat{p}_1 - \hat{p}_2) - (p_1 - p_2)}{\sqrt{\hat{p}(1-\hat{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}, \qquad \hat{p} = \frac{Y_1 + Y_2}{n_1 + n_2}$$

2. T Test

i. $$t = \frac{\overline{Y} - \mu}{s/\sqrt{n}}$$

ii. $$t = \frac{\overline{d} - \mu_d}{s_d/n_d}$$

iii. $$t = \frac{(\overline{Y}_1 - \overline{Y}_2) - (\mu_1 - \mu_2)}{\sqrt{s_p^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}, \qquad s_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$$

iv. $$t = \frac{(\overline{Y}_1 - \overline{Y}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_1^2}{n_2}}}, \qquad df = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{\left(\frac{s_1^2}{n_1}\right)^2}{n_1 - 1} + \frac{\left(\frac{s_2^2}{n_2}\right)^2}{n_2 - 1}}$$

...11/-

3. χ^2 Test

i. $\chi^2 = \dfrac{(n-1)s^2}{\sigma^2}$

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

4. F Test

$$F = \frac{s_1^2}{s_2^2}$$

5. Wicoxon Signed-Ranks Test

$$T_+ = \frac{n(n+1)}{2} - T_- \quad \text{or} \quad T_- = \frac{n(n+1)}{2} - T_+$$

6. Mann-Whitney Test

$$T = \sum_i R(X_i) - \frac{n_1(n_1+1)}{2}$$

- ooo O ooo -