UNIVERSITI SAINS MALAYSIA

First Semester Examination
2014/2015 Academic Session

December 2014/January 2015

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.]*

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai].

1a. The marks awarded to 136 pupils in a statistics examination is summarized in a table.

Marks	10 -	30 - 39	40 - 49	50 - 59	60 - 64	65 – 69	- 84
Frequency	22	18	22	24	14	12	24

(i) Estimate the percentage of students who passed, if the passing mark was 45.
(ii) What would be the median mark obtained by all students except the top 10% and the bottom 20%?
(iii) If a student scored 67 in the exam, can the mark be considered good?

1b. Medical case histories indicate that different illnesses may produce identical symptoms. Suppose a particular set of symptoms occurs only when any one of three illnesses: A, B or C occurs. Studies showed that the percentages of getting either one of the three illnesses A, B and C are 10%, 0.05% and 2% respectively. It is also known that 90%, 95% and 75% of developing the symptoms by the specific illnesses respectively.

(i) Assuming that a person shows the symptoms, what is the probability that the person has illness A?
(ii) If a random sample of three persons were selected from a clinic, what is the probability at least two persons are with illness C?

1c. Bags of flour packed by a particular machine have masses which are normally distributed with mean 500 grams and standard deviation 20 grams. Two percent of the bags are rejected for being underweight and one percent of the bags are rejected for being overweight.

(i) What would be the mass of a bag of flour if it is to be accepted?
(ii) Suppose 5 bags of flour are selected at random, what is the probability that the total weight will be less than 2250 grams.
(iii) In one day, 1000 bags of flour are sold at a supermarket. Estimate how many weigh more than 565 grams.

[25 marks]

1a. *Markah yang diberikan kepada 136 murid dalam suatu peperiksaan statistik diringkaskan dalam suatu jadual.*

Markah	*10 -*	*30 - 39*	*40 - 49*	*50 - 59*	*60 - 64*	*65 – 69*	*- 84*
Kekerapan	*22*	*18*	*22*	*24*	*14*	*12*	*24*

(i) Anggarkan peratusan pelajar yang lulus, jika markah lulus adalah 45.
(ii) Apa markah median yang diperolehi oleh kesemua pelajar kecuali yang atas 10% dan bawah 20%?
(iii) Jika seorang pelajar mendapat markah 67 dalam peperiksaan tersebut, bolehkah markah itu dianggap bagus?

1b. *Sejarah kes perubatan menunjukkan bahawa penyakit yang berlainan boleh menghasilkan tanda serupa. Katakan suatu set tanda tertentu, berlaku hanya apabila salah satu daripada tiga penyakit: A, B atau C berlaku. Kajian menunjukkan bahawa peratusan untuk mendapat salah satu daripada tiga penyakit A, B dan C adalah 10%, 0.05% dan 2% masing-masing. Diketahui juga bahawa 90%, 95% dan 75% bagi memperolehi tanda daripada penyakit tertentu masing-masing.*

(i) Andaikan seseorang itu menunjukkan tanda-tanda, apakah kebarangkalian bahawa orang tersebut mempunyai penyakit A?
(ii) Jika suatu sampel rawak daripada tiga orang dipilih daripada sebuah klinik, apakah kebarangkalian sekurang-kurangnya dua orang berpenyakit C?

1c. *Paket tepung dibungkus oleh suatu mesin tertentu mempunyai jisim bertaburan secara normal dengan min 500 gram dan sisihan piawai 20 gram. Dua peratus daripada paket ditolak kerana kurang berat dan satu peratus daripada paket ditolak kerana berat berlebihan.*

(i) Apakah jisim suatu paket tepung jika ia diterima?
(ii) Katakan 5 paket tepung dipilih secara rawak, apakah kebarangkalian bahawa jumlah berat akan kurang daripada 2250 gram.
(iii) Dalam satu hari, 1000 paket tepung dijual di suatu pasar raya. Anggarkan berapa banyak mempunyai berat lebih dari 565 gram.

[25 markah]

2a. Nausea is a common symptom among postoperative patients. A group of physicians is interested in comparing two new drugs, A and B, for their effectiveness in preventing postoperative nausea. Patients scheduled for surgery at a large hospital were used in the study and each patient was assigned randomly to different drugs. A short time after the operation, patients were selected from each drug group and the degree of nausea felt were recorded.

Degree of nausea	Drug A	Drug B	Placebo	Total
Severe	9	4	11	24
Moderate	11	4	13	28
Slight	10	22	16	48
Total	30	30	40	100

$\sum_i \sum_j Y_{ij}^2 = 1{,}364$

(i) State the assumptions.
(ii) Perform an appropriate statistical analysis to determine which drug is effective. Test at the 0.05 level of significance

2b. In recent years, lack of confidence in the postal service has led many companies to send all of their correspondences by private courier. A large company is in the process of selecting one of two possible couriers to act as its sole delivery method. To help in making the decision, an experiment was performed whereby letters were sent using each of the couriers at eight different times of the day to a delivery point across town. The number of minutes required for delivery was recorded.

	Time of day								
	a.m.			p.m.					
Courier	9.00	10.00	11.00	12.00	12.30	1.00	2.00	3.00	Total
A	75	74	60	71	63	59	71	75	548
B	62	60	51	62	77	63	70	61	506
Total	137	134	111	133	140	122	141	136	1,054

$\sum_i \sum_j Y_{ij}^2 = 70{,}266$

(i) State the assumptions.
(ii) Test for equal variances if it is needed at $\alpha = 0.01$.
(iii) Perform an appropriate statistical analysis.

2c. A marketing researcher of a company suspects that a call results in a sale is less than 50% of the time. To investigate his concern, each day a salesman calls on five prospective customers and records whether or not the call results in a sale for a period of 100 days.

Number sales	0	1	2	3	4	5	6
Number of days	15	21	40	14	6	4	0

What probability model adequately describes this type of data? Test at $\alpha = 0.01$.

[25 marks]

2a. *Rasa mual adalah suatu tanda biasa di kalangan pesakit selepas pembedahan. Sekumpulan pakar perubatan berminat dalam membandingkan dua ubat baru, A dan B, bagi keberkesanannya dalam mencegah loya selepas pembedahan. Pesakit yang dijadualkan untuk pembedahan di suatu hospital besar telah digunakan dalam kajian ini dan setiap pesakit diumpukkan secara rawak kepada ubat yang berlainan. Pada suatu jangka masa pendek selepas pembedahan, pesakit dipilih daripada setiap kumpulan ubat dan tahap mual yang dirasa dicatat.*

Tahap mual	*Ubat A*	*Ubat B*	*Plasebo*	*Jumlah*
Teruk	*9*	*4*	*11*	*24*
Sedang	*11*	*4*	*13*	*28*
Sedikit	*10*	*22*	*16*	*48*
Jumlah	*30*	*30*	*40*	*100*

$\sum_i \sum_j Y_{ij}^2 = 1{,}364$

(i) Nyatakan anggapan.
(ii) Lakukan suatu analisis statistik yang sesuai untuk menentukan ubat yang berkesan. Uji pada aras keertian 0.05.

2b. *Pada tahun kebelakangan ini, kurang keyakinan dalam perkhidmatan pos telah menyebabkan banyak syarikat menghantar semua surat-menyurat mereka melalui kurier swasta. Suatu syarikat besar sedang dalam proses memilih salah satu daripada dua kurier mungkin untuk bertindak sebagai kaedah penghantaran tunggal mereka. Untuk membantu dalam membuat keputusan, suatu ujikaji telah dilakukan iaitu surat telah dihantar menggunakan setiap satu daripada kurier tersebut di lapan waktu yang berlainan ke tempat penghantaran di seluruh bandar. Bilangan minit diperlukan untuk penghantaran dicatat.*

	Waktu								
	a.m.			*p.m.*					
Kurier	*9.00*	*10.00*	*11.00*	*12.00*	*12.30*	*1.00*	*2.00*	*3.00*	*Jumlah*
A	*75*	*74*	*60*	*71*	*63*	*59*	*71*	*75*	*548*
B	*62*	*60*	*51*	*62*	*77*	*63*	*70*	*61*	*506*
Jumlah	*137*	*134*	*111*	*133*	*140*	*122*	*141*	*136*	*1,054*

$\sum_i \sum_j Y_{ij}^2 = 70{,}266$

(i) Nyatakan anggapan.
(ii) Uji bagi kesamaan varians jika diperlukan pada $\alpha = 0.01$.
(iii) Lakukan suatu analisis statistik yang sesuai.

2c. *Seorang penyelidik pemasaran syarikat mengesyaki bahawa satu panggilan yang menghasilkan satu jualan adalah kurang daripada 50%. Untuk menyiasat kebimbangan beliau, setiap hari seorang jurujual membuat panggilan kepada lima bakal pelanggan dan mencatat sama ada atau tidak panggilan tersebut menghasilkan jualan dalam suatu tempoh 100 hari.*

Bilangan jualan	*0*	*1*	*2*	*3*	*4*	*5*	*6*
Bilangan hari	*15*	*21*	*40*	*14*	*6*	*4*	*0*

Apakah model kebarangkalian yang memerihal secukupnya jenis data tersebut? Uji pada $\alpha = 0.01$.

[25 markah]

…6/-

3a. An agricultural experiment station was studying the yields of two new varieties of corn. As there might be a great deal of variability in yield from one farm to another, each variety was randomly assigned to a one acre plot on each of seven farm. The plots were planted, the corn (in kilograms) was harvested at maturity.

	Farm							
Variety	1	2	3	4	5	6	7	Total
A	58.2	44.6	49.7	40.5	54.6	47.1	51.4	346.1
B	41.5	40.1	44.0	41.2	49.8	41.7	46.8	305.1
Total	99.7	84.7	93.7	81.7	104.4	88.8	98.2	651.2

$\sum_i \sum_j Y_{ij}^2 = 30{,}701.14$

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

3b. The produce manager of a large supermarket has two possible suppliers of fresh tomatoes. Both offer about the same financial deal. One of the biggest problems is that a large number of tomatoes are damaged in shipping. To decide which shipping to use, the following data are obtained over a period of several years.

	Supplier A	Supplier B
Total shipped	2000	1600
Good Tomatoes	1700	1300

(i) State the assumptions.
(ii) Is there substantial evidence to justify discontinuing business with one or the other supplier? Use $\alpha = 0.01$.

[25 marks]

3a. *Suatu stesen ujikaji pertanian mengkaji hasil dua varieti baru jagung. Oleh kerana mungkin terdapat banyak variasi dalam hasil daripada satu ladang yang lain, setiap varieti diumpukkan secara rawak kepada satu ekar plot pada setiap tujuh ladang. Plot tersebut ditanam, jagung (dalam kilogram) dituai pada tempoh matang.*

	Ladang							
Varieti	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*Jumlah*
A	*58.2*	*44.6*	*49.7*	*40.5*	*54.6*	*47.1*	*51.4*	*346.1*
B	*41.5*	*40.1*	*44.0*	*41.2*	*49.8*	*41.7*	*46.8*	*305.1*
Jumlah	*99.7*	*84.7*	*93.7*	*81.7*	*104.4*	*88.8*	*98.2*	*651.2*

$\sum_i \sum_j Y_{ij}^2 = 30{,}701.14$

(i) Nyatakan anggapan.
(ii) Uji bagi kesamaan varians jika diperlukan pada $\alpha = 0.05$.
(iii) Lakukan suatu analisis statistik yang sesuai.

3b. *Pengurus keluaran bagi suatu pasar raya yang besar mempunyai dua pembekal mungkin buah tomato segar. Keduanya menawarkan perjanjian kewangan yang agak sama. Salah satu masalah yang paling besar adalah bahawa sebilangan besar buah tomato rosak dalam pengiriman. Untuk menentukan pengirim yang digunakan, data berikut diperolehi bagi tempoh beberapa tahun.*

	Pembekal A	*Pembekal B*
Jumlah pengiriman	*2000*	*1600*
Buah tomato baik	*1700*	*1300*

(i) Nyatakan anggapan.
(ii) Adakah terdapat bukti yang cukup untuk menghentikan perniagaan dengan salah satu pembekal? Guna $\alpha = 0.01$.

[25 markah]

4a. A restaurant located in an office building decides to adopt a new strategy for attracting customers to the restaurant. Every week it advertises in the city newspaper. To measure how well the advertising is working, the restaurant owner recorded the weekly gross sales, in hundreds ringgit, for the seven weeks after the campaign began and seven weeks before the campaign.

	Week							
Campaign	1	2	3	4	5	6	7	Total
Before	45	49	48	44	76	52	54	368
After	54	60	57	58	78	59	54	420
Total	99	109	105	102	154	111	108	788

$$\sum_i \sum_j Y_{ij}^2 = 45{,}672$$

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

4b. Is eating oat bran an effective way to reduce cholesterol? Early studies indicated that eating oat bran daily reduces cholesterol levels by 5 to 10%. Reports of this study resulted in the introduction of many new breakfast cereals with various percentages of oat bran as an ingredient. However, an experiment performed by medical researchers in Boston, Massachusetts, cast doubt on the effectiveness of oat bran. In that study, the different grains of breakfast cereal were tested, each on eight randomly selected individuals. At the end of six weeks, the percentage of cholesterol reductions was computed.

	Volunteers								
Type of cereal	1	2	3	4	5	6	7	8	Total
Oat bran	14	18	4	9	4	0	12	2	63
Other cereal	3	3	8	11	9	7	12	13	66
Total	17	21	12	20	13	7	24	15	129

$$\sum_i \sum_j Y_{ij}^2 = 1{,}427$$

(i) State the assumptions.
(ii) Test for equal variances if it is needed at $\alpha = 0.01$.
(iii) Perform an appropriate statistical analysis.

[25 marks]

4a. *Sebuah restoran yang terletak di dalam bangunan pejabat mengambil keputusan menggunakan suatu strategi baru untuk menarik pelanggan ke restoran. Setiap minggu ia mengiklankan di akhbar bandar. Untuk mengukur sejauh mana iklan tersebut berfungsi, pemilik restoran mencatat jualan kasar mingguan, dalam beratus ringgit, selama tujuh minggu selepas kempen bermula dan tujuh minggu sebelum kempen.*

	Minggu							
Kempen	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*Jumlah*
Sebelum	*45*	*49*	*48*	*44*	*76*	*52*	*54*	*368*
Selepas	*54*	*60*	*57*	*58*	*78*	*59*	*54*	*420*
Jumlah	*99*	*109*	*105*	*102*	*154*	*111*	*108*	*788*

$\sum_i \sum_j Y_{ij}^2 = 45{,}672$

(i) Nyatakan anggapan.
(ii) Uji bagi kesamaan varians jika diperlukan pada $\alpha = 0.05$.
(iii) Lakukan suatu analisis statistik yang sesuai.

4b. *Adakah memakan dedak oat suatu cara yang berkesan untuk mengurangkan kolesterol? Kajian awal menunjukkan bahawa makan dedak oat setiap hari dapat mengurangkan tahap kolesterol sebanyak 5 hingga 10%. Laporan daripada kajian ini menghasilkan banyak bijirin sarapan baru diperkenalkan dengan pelbagai peratusan dedak oat sebagai suatu bahan. Walau bagaimana pun, satu eksperimen yang dilakukan oleh penyelidik perubatan di Boston, Massachusetts, menimbulkan keraguan mengenai keberkesanan dedak oat. Di dalam kajian tersebut, bijirin sarapan pagi yang berlainan diuji, setiap keatas lapan sukarelawan yang dipilih secara rawak. Pada akhir enam minggu, peratus pengurangan kolesterol telah dikira.*

	Sukarelawan								
Jenis bijirin	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*Jumlah*
Dedak oat	*14*	*18*	*4*	*9*	*4*	*0*	*12*	*2*	*63*
Bijirin lain	*3*	*3*	*8*	*11*	*9*	*7*	*12*	*13*	*66*
Jumlah	*17*	*21*	*12*	*20*	*13*	*7*	*24*	*15*	*129*

$\sum_i \sum_j Y_{ij}^2 = 1{,}427$

(i) Nyatakan anggapan.
(ii) Uji bagi kesamaan varians jika diperlukan pada $\alpha = 0.01$.
(iii) Lakukan suatu analisis statistik yang sesuai.

[25 markah]

APPENDIX: FORMULAS

1. Z Test

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

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

$$Z = \frac{\left(\bar{Y}_1 - \bar{Y}_2\right) - \left(\mu_1 - \mu_2\right)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

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

2. T Test

$$t = \frac{\bar{Y} - \mu}{s/\sqrt{n}}$$

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

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

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

3. χ^2 **Test**

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

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

4. F Test

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

5. Wicoxon Signed-Ranks Test

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

6. Mann-Whitney Test

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

-ooo000ooo-