UNIVERSITI SAINS MALAYSIA

Second Semester Examination
2012/2013 Academic Session

June 2013

EEE 233 – PROBABILITY AND ENGINEERING STATISTICS
[KEBARANGKALIAN DAN STATISTIK KEJURUTERAAN]

Duration : 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of **ELEVEN (11)** pages printed material and **TWO (2)** pages of Appendices before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **SEBELAS (11)** mukasurat bercetak beserta **DUA (2)** mukasurat lampiran bercetak sebelum anda memulakan peperiksaan ini.]*

Instructions: This question paper consists **FIVE (5)** questions. Answer **FIVE (5)** questions. All questions carry the same marks.

[***Arahan:*** *Kertas soalan ini mengandungi **LIMA (5)** soalan. Jawab **LIMA (5)** soalan. Semua soalan membawa jumlah markah yang sama.]*

Answer to any question must start on a new page.

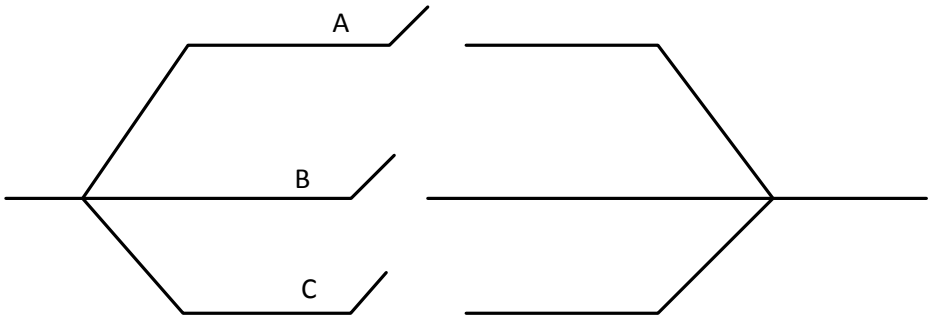
[Mulakan jawapan anda untuk setiap soalan pada muka surat yang baru]

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

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

1. (a) Suatu sistem mengandungi TIGA suis A, B dan C seperti yang ditunjukkan dalam Rajah 1. Arus elektrik hanya boleh mengalir jika sekurang-kurangnya salah satu daripada suiz tersebut ditutup. Kebarangkalian bahawa mana-mana suis yang diberikan adalah ditutup ialah 0.95. Hitungkan kebarangkalian bahawa arus boleh mengalir melalui sistem ini. Apakah andaian yang perlu dibuat?

A system contains THREE switches A, B and C as shown in Figure 1.Current can only flow if at least one of them is closed. The probability that any given switch is closed is 0.95. Calculate the probability that current can flow through the system. What assumption must be made?



Rajah 1 (a)

Figure 1(a)

(5 markah/*marks*)

(b) Sebuah syarikat penghantaran mempunyai 17 van penghantaran yang membuat perjalanan melalui laluan yang diberikan pada suatu hari tertentu. Kebarangkalian bahawa mana-mana van, akan rosak semasa perjalanan penghantaran adalah 0.05. Cari kebarangkalian bahawa

A courier company own 17 delivery vans which travel along a given route on a certain day. The probability that any van, will break down during a delivery journey is 0.05. Find the probability that

(i) Tepat sebuah van akan rosak

Exactly one van broke down

(ii) Sekurang-kurangnya tiga van akan rosak

At most three vans broke down

(iii) Dua atau lebih van akan rosak

Two or more vans broke down

(5 markah/*marks*)

(c) Seorang perunding elektrik diberi tugas memasang lampu di sebuah hotel yang baru dibina. Beliau mempunyai pilihan menggunakan mentol A atau B. Ujian yang telah dijalankan ke atas sampel yang dipilih secara rawak daripada dua mentol adalah seperti Jadual 1(c).

An electrical consultant is commission to install the lighting in a newly built hotel. He has a choice of using bulb A or B. Test that was carried out on randomly chosen samples of two bulbs are shown in Table 1(c).

Jadual 1(c)

Table 1(c)

Jenis Bulb *Bulb Type*	Saiz sampel *Sample size*	Min jangka hayat seumur hidup (jam) *Mean lifetime (hrs)*	Sisihan piawai (jam) *Standard deviation (hrs)*
A	100	1800	100
B	200	1500	88

Dengan menggunakan ujian hipotesis yang sesuai, adakah min jangka hayat seumur hidup sebenar jenis mentol A lebih besar daripada min jangka hayat seumur hidup sebenar mentol B? Andaikan bahawa sampel telah dikumpulkan daripada taburan normal. Gunakan α = 0.05. Apakah keputusan perunding tersebut? Adakah keputusannya akan berbeza jika beliau menggunakan α = 0.1.

By using an appropriate hypothesis test, is the true mean lifetime of bulb type A greater than the true mean lifetime of bulb B? Assume that the samples were collected from the normal distribution. Use α=0.05. What would be the decision of the consultant? Will his decision be any different if he uses α=0.1.

(10 markah/*marks*)

2. (a) Berat (dalam gram) sebanyak 20 sampel blok konkrit adalah seperti yang diberikan dalam Jadual 2(a). Anggaplah bahawa data ini merupakan pemerhatian bebas daripada taburan normal dengan min μ dan varians tidak diketahui .

The weight (in grams) of 20 sample of concrete block is as given in Table 2(a). Assume that these data may be regarded independent observations from a normal distribution with unknown mean μ and unknown variance.

Jadual 2(a)

Table 2(a)

581	580	581	577	580	581	577	579	579	578
581	583	577	578	582	581	582	580	582	579

Dapatkan selang keyakinan 95% bagi varians σ^2 dan seterusnya cari selang keyakinan untuk sisihan piawai σ .

Find a 95% confidence interval for the variance σ^2 and hence find the confidence interval for the standard deviation σ.

(7 markah/*marks*)

(b) Kekuatan lerai sejenis blok plastik bertaburan normal dengan min 100 kg dan sisihan piawai 0.2 kg. Bagi memenuhi spesifikasi, kekuatan blok plastik mestilah dalam julat 100 ± 0.5kg.

The breaking strength of a certain type of plastic block is normally distributed with a mean of 100 kg and a standard deviation of 0.2 kg. To meet the specification, the strength of the plastic block must be within the range 100 ± 0.5kg.

(i) Apakah peratusan kekuatan yang tidak boleh diterima?
What is the percentage of strength being unacceptable?

(ii) Berapakah nilai sisihan piawai perlu dikurangkan jika bahagian blok plastik tidak boleh diterima adalah lebih daripada 0.2%?

To what value must the standard deviation be reduced if the proportion of unacceptable plastic block is to be more than 0.2%?

(7 markah/*marks*)

(c) *Masa pemprosesan purata (dalam mikrosaat) sebanyak 20 komputer yang dibeli bagi makmal elektronik didapati 38.713. Varian sampel adalah 20.284. Pembekal telah mendakwa bahawa masa pemprosesan min komputer adalah 35. Bolehkah anda mengesahkan dakwaan pembekal? Gunakan* $\alpha = 0.10$.

The average processing time (in microseconds) of 20 computers bought for the electronic laboratory is found to be 38.713. The sample variance is 20.284. The supplier has claimed that the mean processing time of the computers is 35. Can you confirm the supplier's claim? Use $\alpha = 0.10$.

(6 markah/*marks*)

3. (a) Satu sampel rawak 2 bateri dipilih dari satu kumpulan yang terdiri dari 2 rosak, 3 yang telah digunakan dan 3 bateri baru. Biarkan X, Y dan Z masing-masing mewakili yang rosak, telah digunakan dan bateri baru. Taburan kebarangkalian bercantum bagi X dan Y telah di bina dan diberikan seperti dalam Jadual 3(a).

A random sample of 2 batteries is chosen from a group of 2 defective, 3 used and 3 new batteries. Let $X, Y \; and \; Z$ *denote the defectives, used and new batteries respectively. The joint probability distribution for* $X \; and \; Y$ *is build and is as given in Table 3(a).*

Jadual 3(a)

Table 3(a)

	Y		
X	0	1	2
0	3/28	9/28	3/28
1	a	b	c
2	d	e	f

(i) Lengkapkan jadual dengan mencari nilai a, b, c, d, e, f
Complete the table by finding the values of a, b, c, d, e, f

(ii) Dapatkan taburan marginal bagi X dan Y dan seterusnya tentukan samaada X dan Y adalah bebas.

Find the marginal distribution of X *and* Y *and hence determine whether* X *and and* Y *are independent.*

(iii) Cari kovarians X dan Y dan seterusnya korelasi antara X dan Y. Apa yang anda boleh simpulkan daripada nilai yang telah diperolehi?

Find the covariance of X *and* Y *and hence the correlation between* X *and* Y*. What can you deduce from the values that were obtained?*

(10 markah/*marks*)

(b) Jadual 3(b) merupakan paparan keputusan MINITAB bagi analisis regresi berganda. Dapatkan nilai (A) hingga (H).

The following MINITAB in Table 3(b) is for a multiple regression. Find the values for (A) to (H).

Jadual 3(b)

Table 3(b)

Predictor	Coef	SE Coef	T	P
Constant	-0.58762	0.2873	(A)	0.086
X1	1.5102	(B)	4.30	0.005
X2	(C)	0.3944	-0.62	0.560
X3	1.8233	0.3867	(D)	0.003

S = 0.869 R-Sq = 90.2% R-Sq(adj) = 85.3%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	3	41.76	(E)	(F)	0.000
Residual Error	6	(G)	0.76		
Total	(H)	46.30			

(10 markah/*marks*)

4. Jadual 4 menunjukkan hubungan antara penggunaan petrol (batu per gelen) bagi kenderaan berdasarkan berat (dalam ton) dan suhu semasa pemanduan (^{0}C). Dapatkan model regresi linear berganda dalam bentuk $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2$

Table 4 shows the relationship between consumption of petrol (in miles per gallon) for automobiles based on their weights (in tons) and the temperature during driving (in ^0C). Fit a multiple linear regression model of the form $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2$

Jadual 4

Table 4

Car	Petrol consumption	Weight	Temperature
1	17.9	1.35	90
2	16.5	1.90	30
3	16.4	1.70	80
4	16.8	1.80	40
5	18.8	1.30	35
6	15.5	2.05	45
7	17.5	1.60	50
8	16.4	1.80	60
9	15.9	1.85	65
10	18.3	1.40	30

(20 markah/*marks*)

5. (a) Pelepasan florida (dalam ppm) daripada suatu bahan kimia telah direkodkan. Berikut adalah 15 pemerhatian berdasarkan sampel udara yang diambil secara rawak sepanjang sebulan : 7,3,4,2,5,6,9,8,7,3,4,4,3,2,6.

Florida emissions (in ppm) from a chemical plant are monitored. The following are 15 observations based on air samples taken during one month : 7,3,4,2,5,6,9,8,7,3,4,4,3,2,6.

(i) Bolehkah anda dakwakan bahawa median paras pencemaran florida adalah kurang dari 6 ppm? Gunakan ujian tanda dengan $\propto = 0.05$ untuk menguji hipotesis ini.

…10/-

Can you claim that the median fluorida impurity level is less than 6 ppm? Use sign test with $\propto = 0.05$ *to test this hipothesis.*

(7 markah/*marks*)

(ii) Seterusnya, dengan menggunakan penghampiran normal dengan $\propto = 0.05$, apakah kesimpulan yang boleh anda buat?

Next, using normal approximation with α = 0.05, what conclusions can be made?

(5 markah/*marks*)

(b) Diameter bagi rod keluli yang dikeluarkan oleh dua mesin yang berbeza adalah disiasat. 10 sampel rod dari setiap mesin adalah dipilih secara rawak. Bacaan diameter yang diambil adalah seperti dalam Jadual 5(b).

The diameter of steel rods manufactured by two different machines is investigated. 10 rod samples from each machine are selected randomly. The recorded diameter readings are as in Table 5(b).

Jadual 5(b)

Table 5(b)

Machine 1		Machine 2	
9.9	10.6	10.2	10.0
9.4	10.3	10.6	10.2
9.3	10.0	10.7	10.7
9.6	10.3	10.4	10.4
10.2	10.1	10.5	10.3

Gunakan ujian pangkat-tambah Wilcoxon bagi mengkaji dakwaan bahawa min diameter adalah sama untuk kedua-dua mesin.

Use the Wilcoxon rank-sum test to investigate the claim that the mean diameter is the same for both machines.

(8 markah/*marks*)

oooOooo

LAMPIRAN 1 [EEE 233]

APPENDIX 1

Testing hypotheses for the difference between two populations mean based on the normal distribution

(i) Population variance is known

One Tail tests	Two tail tests
$H_0: \mu_1 - \mu_2 = d_0$ $H_1: \mu_1 - \mu_2 > d_0$ $(H_1: \mu_1 - \mu_2 < d_0)$	$H_0: \mu_1 - \mu_2 = d_0$ $H_1: \mu_1 - \mu_2 \neq d_0$
Test statistic $Z = \frac{(\bar{X}_1 - \bar{X}_2) - d_0}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$	
Rejection region Reject H_0 if	
$Z > z_\alpha$ or $Z < -z_\alpha$	$\|\boldsymbol{Z}\| > \boldsymbol{z_{\alpha/2}}$

Note:

(a) d_0 is a constant
(b) $\bar{X}_1$and $\bar{X}_2$ are the sample mean

Assumptions

(a) $X_{11}, X_{12}, \ldots, X_{1n}$ is a random sample of size n_1 from a population which has a normal distribution with mean μ_1 and variance σ_1^2
(b) $X_{21}, X_{22}, \ldots, X_{2n}$ is a random sample of size n_2 from a population which has a normal distribution with mean μ_2 and variance σ_2^2
(c) Both the samples are independent of each other
(d) The sample size n_1 and n_2 can either be small or large

(ii) Population variance is unknown

One Tail tests	Two tail tests
$H_0: \mu_1 - \mu_2 = d_0$ $H_1: \mu_1 - \mu_2 > d_0$ $(H_1: \mu_1 - \mu_2 < d_0)$	$H_0: \mu_1 - \mu_2 = d_0$ $H_1: \mu_1 - \mu_2 \neq d_0$
Test statistic $Z = \frac{(\bar{X}_1 - \bar{X}_2) - d_0}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$	
Rejection region Reject H_0 if	
$Z > z_\alpha$ or $Z < -z_\alpha$	$\|\boldsymbol{Z}\| > \boldsymbol{z_{\alpha/2}}$

Note:

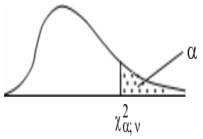
(a) d_0 is a constant
(b) $\bar{X}$ is the sample mean and S_1 and $S_2$are the sample standard deviation respectively

Assumptions

(a) $X_{11}, X_{12}, \ldots, X_{1n}$ is a random sample of size n_1 from a population which has a normal distribution with mean μ_1 and variance σ_1^2
(e) $X_{21}, X_{22}, \ldots, X_{2n}$ is a random sample of size n_2 from a population which has a normal distribution with mean μ_2 and variance σ_2^2
(b) Both the samples are independent of each other
(c) The sample size n_1 and n_2 is large

APPENDIX 2

Table of the Chi-square Distribution



α =	0.995	0.99	0.98	0.975	0.95	0.90	0.80	0.20	0.10	0.05	0.025	0.02	0.01	0.005	0.001	= α
ν = 1	0.0000393	0.000157	0.000628	0.000982	0.00393	0.0158	0.0642	1.642	2.706	3.841	5.024	5.412	6.635	7.879	10.827	ν = 1
2	0.0100	0.0201	0.0404	0.0506	0.103	0.211	0.446	3.219	4.605	5.991	7.378	7.824	9.210	10.597	13.815	2
3	0.0717	0.115	0.185	0.216	0.352	0.584	1.005	4.642	6.251	7.815	9.348	9.837	11.345	12.838	16.268	3
4	0.207	0.297	0.429	0.484	0.711	1.064	1.649	5.989	7.779	9.488	11.143	11.668	13.277	14.860	18.465	4
5	0.412	0.554	0.752	0.831	1.145	1.610	2.343	7.289	9.236	11.070	12.832	13.388	15.086	16.750	20.517	5
6	0.676	0.872	1.134	1.237	1.635	2.204	3.070	8.558	10.645	12.592	14.449	15.033	16.812	18.548	22.457	6
7	0.989	1.239	1.564	1.690	2.167	2.833	3.822	9.803	12.017	14.067	16.013	16.622	18.475	20.278	24.322	7
8	1.344	1.646	2.032	2.180	2.733	3.490	4.594	11.030	13.362	15.507	17.535	18.168	20.090	21.955	26.125	8
9	1.735	2.088	2.532	2.700	3.325	4.168	5.380	12.242	14.684	16.919	19.023	19.679	21.666	23.589	27.877	9
10	2.156	2.558	3.059	3.247	3.940	4.865	6.179	13.442	15.987	18.307	20.483	21.161	23.209	25.188	29.588	10
11	2.603	3.053	3.609	3.816	4.575	5.578	6.989	14.631	17.275	19.675	21.920	22.618	24.725	26.757	31.264	11
12	3.074	3.571	4.178	4.404	5.226	6.304	7.807	15.812	18.549	21.026	23.337	24.054	26.217	28.300	32.909	12
13	3.565	4.107	4.765	5.009	5.892	7.042	8.634	16.985	19.812	22.362	24.736	25.472	27.688	29.819	34.528	13
14	4.075	4.660	5.368	5.629	6.571	7.790	9.467	18.151	21.064	23.685	26.119	26.873	29.141	31.319	36.123	14
15	4.601	5.229	5.985	6.262	7.261	8.547	10.307	19.311	22.307	24.996	27.488	28.259	30.578	32.801	37.697	15
16	5.142	5.812	6.614	6.908	7.962	9.312	11.152	20.465	23.542	26.296	28.845	29.633	32.000	34.267	39.252	16
17	5.697	6.408	7.255	7.564	8.672	10.085	12.002	21.615	24.769	27.587	30.191	30.995	33.409	35.718	40.790	17
18	6.265	7.015	7.906	8.231	9.390	10.865	12.857	22.760	25.989	28.869	31.526	32.346	34.805	37.156	42.312	18
19	6.844	7.633	8.567	8.907	10.117	11.651	13.716	23.900	27.204	30.144	32.852	33.687	36.191	38.582	43.820	19
20	7.434	8.260	9.237	9.591	10.851	12.443	14.578	25.038	28.412	31.410	34.170	35.020	37.566	39.997	45.315	20
21	8.034	8.897	9.915	10.283	11.591	13.240	15.445	26.171	29.615	32.671	35.479	36.343	38.932	41.401	46.797	21
22	8.643	9.542	10.600	10.982	12.338	14.041	16.314	27.301	30.813	33.924	36.781	37.659	40.289	42.796	48.268	22
23	9.260	10.196	11.293	11.688	13.091	14.848	17.187	28.429	32.007	35.172	38.076	38.968	41.638	44.181	49.728	23
24	9.886	10.856	11.992	12.401	13.848	15.659	18.062	29.553	33.196	36.415	39.364	40.270	42.980	45.558	51.179	24
25	10.520	11.524	12.697	13.120	14.611	16.473	18.940	30.675	34.382	37.652	40.646	41.566	44.314	46.928	52.620	25
26	11.160	12.198	13.409	13.844	15.379	17.292	19.820	31.795	35.563	38.885	41.923	42.856	45.642	48.290	54.052	26
27	11.808	12.879	14.125	14.573	16.151	18.114	20.703	32.912	36.741	40.113	43.194	44.140	46.963	49.645	55.476	27
28	12.461	13.565	14.847	15.308	16.928	18.939	21.588	34.027	37.916	41.337	44.461	45.419	48.278	50.993	56.893	28
29	13.121	14.256	15.574	16.047	17.708	19.768	22.475	35.139	39.087	42.557	45.722	46.693	49.588	52.336	58.302	29
30	13.787	14.953	16.306	16.791	18.493	20.599	23.364	36.250	40.256	43.773	46.979	47.962	50.892	53.672	59.703	30
40	20.706	22.164	23.838	24.433	26.509	29.051	32.345	47.269	51.805	55.759	59.342	60.436	63.691	66.766	73.402	40
50	27.991	29.707	31.664	32.357	34.764	37.689	41.449	58.164	63.167	67.505	71.420	72.613	76.154	79.490	86.661	50
60	35.535	37.485	39.699	40.482	43.188	46.459	50.641	68.972	74.397	79.082	83.298	84.580	88.379	91.952	99.607	60
70	43.275	45.442	47.893	48.758	51.739	55.329	59.898	79.715	85.527	90.531	95.023	96.388	100.425	104.215	112.317	70
80	51.171	53.539	56.213	57.153	60.391	64.278	69.207	90.405	96.578	101.880	106.629	108.069	112.329	116.321	124.839	80
90	59.196	61.754	64.634	65.646	69.126	73.291	78.558	101.054	107.565	113.145	118.136	119.648	124.116	128.299	137.208	90
100	67.327	70.065	73.142	74.222	77.929	82.358	87.945	111.667	118.498	124.342	129.561	131.142	135.807	140.170	149.449	100