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CONFIDENTIAL

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UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JANUARY 2014 SESSION

SUBJECT CODE	:	FKB 20302
SUBJECT TITLE	:	STATISTICAL DATA ANALYSIS FOR ENGINEERING TECHNOLOGY STUDENTS
LEVEL	:	BACHELOR
TIME / DURATION	:	(2 HOURS) 9.00 am - 11.00 am
DATE	:	31 MAY 2014

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. Please write your answers on the answer booklet provided.
4. Answer should be written in blue or black ink except for sketching, graphic and illustration.
5. This question paper consists of FIVE (5) questions. You are required to answer FOUR (4) questions only.
6. Answer all questions in English.
7. Fomula is appended.

THERE ARE 9 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

Answer 4 (FOUR) questions only. Please use the answer booklet provided.

Question 1

a) Ali has a farm in Southland. She records the weights of 32 lambs born on her farm. The results are shown on the histogram of **Figure 1** below.

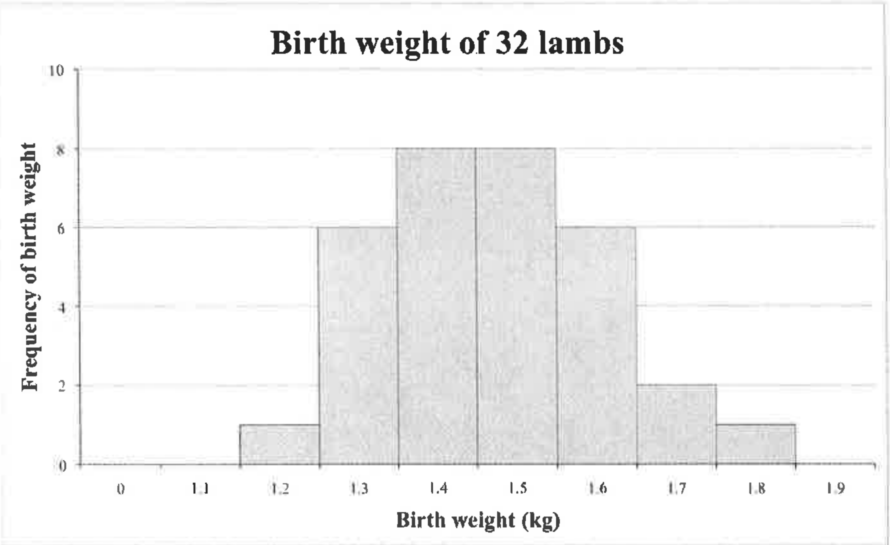


Figure 1

i) Determine the percentage of the lambs weighing less than 1.45 kg. (2 marks)

ii) Determine the mean, median and mode of the lamb weight. (5 marks)

iii) Based on Figure 1, describe the shape of the data distribution. (3 marks)

b) An electronics engineer is interested in the effect on tube conductivity of five different types of coating for cathode ray tubes in a telecommunications system display device. The following **Table 1** is the Minitab output for ANOVA of the data.

One-way ANOVA: Type 1, Type 2, Type 3, Type 4, Type 5

Source	DF	SS	MS	F	P
Factor	4	?	?	?	0.004
Error	15	437.5	?		
Total	19	1154.8			

Table 1

i) Fill in the missing values of the ANOVA output below in the **ANSWER BOOKLET**. (4 marks)

ii) Test the hypothesis whether that there are differences among the mean of conductivity. (1 mark)

Question 2

a) The probability density function of a discrete random variable , X is given by

$$p(X = x) = \frac{x^2}{k} \qquad \text{for } x = 0, 1, 2, 3 \text{ and } 4$$

i) Construct probability distribution table.

(2 marks)

ii) Determine the value of k

(2 marks)

iii) E(x)

(2 marks)

iv) Var (X)

(4 marks)

b) The lifetime of a battery in a certain application is normally distributed with mean $\mu = 16$ hours and standard deviation $\sigma = 2$ hours. Determine the probability that a battery will last between 17 hours and 19 hours?

(5 marks)

Question 3

a) A botanist is studying the distribution of daisies in a field. The field is divided into number of equal sized squares. The mean number of daisies per square is assumed to be 3. The daisies follow a Poisson distribution throughout the field.

i) Determine the probability that in a randomly chosen square there will be at most 2 daisies.

(3 marks)

ii) Determine the probability that in a randomly chosen square there will be more than 3 daisies.

(7 marks)

b) In a sample of 150 boards of a certain grade, the average modulus of elasticity was 1.57 psi and the standard deviation was 0.23 psi. Determine the confidence level of the interval (1.54, 1.60)?

(5 marks)

Question 4

a) In a random sample of 150 customers of a high-speed Internet provider, 63 said that their service had been interrupted one or more times in the past month. Determine a 95% confidence interval for the proportion of customers whose service was interrupted one or more times in the past month.

(5 marks)

b) The following MINITAB output presents a confidence analysis for a population mean. Use the information in **Table 2**, to compute 99% confidence interval. Justify your answer based on these confidence intervals?

One-Sample T: X

Variable	N	Mean	StDev	95%CI
X	10	6.59635	0.11213	(6.51613, 6.6765)

Table 2

(5 marks)

c) In a process that manufactures tungsten-coated silicon wafers, the target resistance for a wafer is 85 mΩ. In a simple random sample of 50 wafers, the sample mean resistance was 84.8 mΩ and the standard deviation was 0.5 mΩ. Let μ represent the mean resistance of the wafers manufactured by this process. Perform a hypothesis testing if $H_0 : \mu = 85$ versus $H_1 : \mu \neq 85$ at 5% significance level.

(5 marks)

Question 5

a) Before a substance can be deemed safe for landfilling, its chemical properties must be characterized. A sample of six replicates of sludge from Bukit Beruntung wastewater treatment plant, the mean was 6.68 with a standard deviation of 0.20. Can we conclude that the mean pH is less than 7?

(5 marks)

b) The article from Journal of Engineering for Gas Turbines and Power, 1984:782-788 reports the accompanying data on x=% refuse-derived fuel (RDF) heat input and y=% efficiency for a certain boiler. The analysis result is shown by the Minitab output below.

Regression Analysis: y versus x

Predictor	Coef	SE Coef	T	P
Constant	80.904	2.455	32.96	0.000
x	-0.11813	0.08160	-1.45	0.198

S = 2.22280   R-Sq = 25.9%   R-Sq(adj) = 13.5%

i) Determine the regression equation.

(1 mark)

ii) Estimate the efficiency for a boiler when RDF equals 25.

(3 marks)

iii) Determine the coefficient of determination and interpret the percentage of variation of efficiency of boiler which can be explained by RDF.

(3 marks)

iv) Determine the correlation value and explain the strength of the relationship between percentage of variation of efficiency of boiler and RDF.

(3 marks)

END OF QUESTION

APPENDIX 1
FORMULA

Confidence Intervals for the Difference Between Two Means	Small-Sample Confidence Intervals for the Difference Between Two Means
$\overline{X}-\overline{Y}\pm z_{\alpha/2}\sqrt{\dfrac{\sigma_X^2}{n_X}+\dfrac{\sigma_Y^2}{n_Y}}$	$\overline{X}-\overline{Y}\pm t_{v,\alpha/2}\sqrt{\dfrac{s_X^2}{n_X}+\dfrac{s_Y^2}{n_Y}}$
Pooled standard deviation	**Confidence Intervals for the Difference Between Two Proportions**
$s_p=\sqrt{\dfrac{(n_X-1)s_X^2+(n_Y-1)s_Y^2}{n_X+n_Y-2}}$	$\widetilde{p}_X-\widetilde{p}_Y\pm z_{\alpha/2}\sqrt{\dfrac{\widetilde{p}_X(1-\widetilde{p}_X)}{\widetilde{n}_X}+\dfrac{\widetilde{p}_Y(1-\widetilde{p}_Y)}{\widetilde{n}_Y}}$
The number of degrees of freedom (small-sample confidence intervals)	**Confidence Intervals for the Difference Between Two Proportions (adjustments)**
$v=\dfrac{\left(\dfrac{s_X^2}{n_X}+\dfrac{s_Y^2}{n_Y}\right)^2}{\dfrac{(s_X^2/n_X)^2}{n_X-1}+\dfrac{(s_Y^2/n_Y)^2}{n_Y-1}}$	$\widetilde{n}_X=n_X+2$ $\quad$ $\widetilde{n}_Y=n_Y+2$ $\widetilde{p}_X=(X+1)/\widetilde{n}_X$ $\quad$ $\widetilde{p}_Y=(Y+1)/\widetilde{n}_Y$
Confidence Intervals for the Difference Between Two Means	**Confidence Intervals for Proportions (adjustments)**
$\overline{X}-\overline{Y}\pm t_{n_X+n_Y-2,\alpha/2}\cdot s_p\sqrt{\dfrac{1}{n_X}+\dfrac{1}{n_Y}}$	$\widetilde{n}=n+4$ $\quad$ $\widetilde{p}=\dfrac{X+2}{\widetilde{n}}$
Large-Sample Confidence Intervals for a Population Mean	**Small-Sample Confidence Intervals for a Population Mean**
$\overline{X}\pm z_{\alpha/2}\sigma_{\overline{X}}$	$\overline{X}\pm t_{n-1,\alpha/2}\dfrac{s}{\sqrt{n}}$

The Binomial Distribution

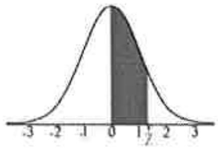
$$p(x)=P(X=x)=\begin{cases}\dfrac{n!}{x!(n-x)!}\,p^x(1-p)^{n-x} & x=0,1,\ldots,n\\ 0 & \text{otherwise}\end{cases}$$

The Poisson Distribution

$$P(X=x)=\begin{cases}\dfrac{e^{-\lambda}\lambda^x}{x!} & \text{if x is a non-negative integer}\\ 0 & \text{otherwise}\end{cases}$$

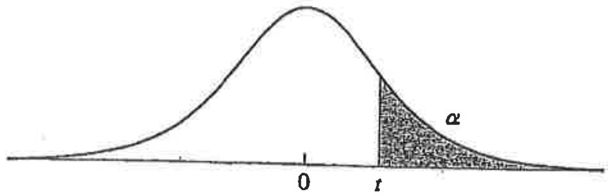
The Normal Distribution	Sample Standard Deviation
$f(x)=\frac{1}{\sigma\sqrt{2\pi}}e^{-(x-\mu)^2/2\sigma^2}$	$s^2=\frac{1}{n-1}\sum_{i=1}^{n}\left(X_i-\overline{X}\right)^2$
Test Statistic (Small-Sample)	**Test Statistic (Small-Sample Tests)**
$t=\frac{\overline{X}-\mu}{s/\sqrt{n}}$	$t=\frac{(\overline{X}-\overline{Y})-(\mu_X-\mu_Y)}{\sqrt{s_X^2/n_X+s_Y^2/n_Y}}$
Pooled Proportion (Test for the Difference Between Two Proportions)	**Test Statistic (Two Proportions)**
$\hat{p}=\frac{X+Y}{n_X+n_Y}$ $\quad \hat{p}_X=\frac{X}{n_X}$ $\quad \hat{p}_Y=\frac{Y}{n_Y}$	$z=\frac{\hat{p}_X-\hat{p}_Y}{\sqrt{\hat{p}(1-\hat{p})\left(\frac{1}{n_X}+\frac{1}{n_Y}\right)}}$
Standard Unit	**z-score (CLT)**
$z=\frac{X-\mu}{\sigma}$	$z=\frac{\overline{X}-\mu_0}{\sigma/\sqrt{n}}$
Test Statistic (Small-Sample with Equal Variances)	**Confidence Interval for Proportions**
$t=\frac{\left(\overline{X}-\overline{Y}\right)-\Delta_0}{s_p\sqrt{1/n_X+1/n_Y}}$	$\widetilde{p}\pm z_{\alpha/2}\sqrt{\frac{\widetilde{p}(1-\widetilde{p})}{\widetilde{n}}}$
Slope	**Intercept**
$\hat{\beta}_1=\frac{\sum xy-n\overline{XY}}{\sum x^2-n\overline{X}^2}$	$\hat{\beta}_0=\overline{Y}-\hat{\beta}_1\overline{X}$

STANDARD NORMAL DISTRIBUTION TABLE



	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990

TABLE Upper percentage points for the Student's t distribution



	α								
ν	0.40	0.25	0.10	0.05	0.025	0.01	0.005	0.001	0.0005
1	0.325	1.000	3.078	6.314	12.706	31.821	63.657	318.309	636.619
2	0.289	0.816	1.886	2.920	4.303	6.965	9.925	22.327	31.599
3	0.277	0.765	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	0.271	0.741	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.267	0.727	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	0.265	0.718	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	0.263	0.711	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	0.262	0.706	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	0.261	0.703	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	0.260	0.700	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	0.260	0.697	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	0.259	0.695	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	0.259	0.694	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	0.258	0.692	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	0.258	0.691	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	0.258	0.690	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	0.257	0.689	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	0.257	0.688	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	0.257	0.688	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	0.257	0.687	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	0.257	0.686	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	0.256	0.686	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	0.256	0.685	1.319	1.714	2.069	2.500	2.807	3.485	3.768
24	0.256	0.685	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	0.256	0.684	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	0.256	0.684	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	0.256	0.684	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	0.256	0.683	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	0.256	0.683	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	0.256	0.683	1.310	1.697	2.042	2.457	2.750	3.385	3.646
35	0.255	0.682	1.306	1.690	2.030	2.438	2.724	3.340	3.591
40	0.255	0.681	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	0.254	0.679	1.296	1.671	2.000	2.390	2.660	3.232	3.460
120	0.254	0.677	1.289	1.658	1.980	2.358	2.617	3.160	3.373
∞	0.253	0.674	1.282	1.645	1.960	2.326	2.576	3.090	3.291