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CONFIDENTIAL

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UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
SEPTEMBER 2014 SESSION

SUBJECT CODE	:	**FKB20302**
SUBJECT TITLE	:	**STATISTICAL DATA ANALYSIS FOR ENGINEERING TECHNOLOGY STUDENTS**
LEVEL	:	**BACHELOR**
TIME / DURATION	:	**9.00 AM – 11.00 AM (2 HOURS)**
DATE	:	**29 DECEMBER 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. Write your answer correct to THREE (3) decimal places.**

THERE ARE 8 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

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

Question 1

a) The accompanying box-and-whisker plots can be used to compare the annual incomes of three professions **Figure 1** below. Interpret the annual income based on the given comparative boxplots.

(5 marks)

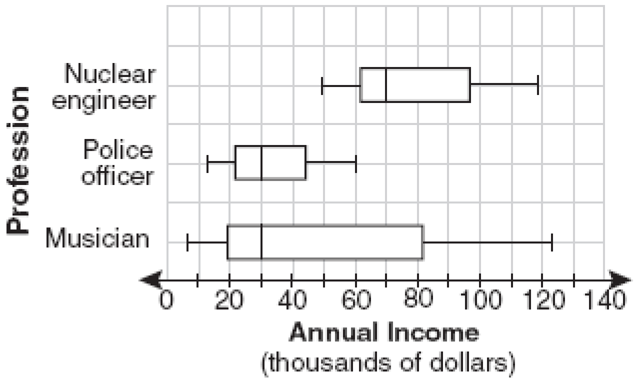


Figure 1

b) State either TRUE or FALSE for the following statements.

i) The smaller the standard deviation the smaller the spread.
ii) The median is a measure of center and the mean is a measure of spread.
iii) The standard deviation can never be 0.
iv) Pie Charts that display percentages of categorical data must always add up to 100
v) If the median is equal to the mean than the distribution must be skewed.

(5 marks)

c) Four different brands (A, B, C and D) of acrylic paint were being tested for their drying time. Table 1 shows data of the drying time in minutes for the different brands of acrylic paint.

Acrylic Brand			
A	B	C	D
17.5	16.4	20.3	14.6
16.9	19.2	15.7	16.7
15.8	17.7	17.8	20.8
18.6	15.4	18.9	18.9

Table 1

The following Table 2 is the Minitab output for ANOVA of the data.

One-way ANOVA: A, B C, D

```
Analysis of Variance

Source   DF   SS      MS   F-Value  P-Value
Factor    3   2.765   ?        ?     0.863
Error    12     ?     ?
Total    15   47.950
```

Table 2

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 drying time. (1 mark)

Question 2

a) The random variable X, representing the number of errors made by the typist per page, has the following distribution:

x	2	3	4	5	6
f(x)	0.01	0.25	0.4	0.3	0.04

If Z= 3x-2, determine E(Z) and Var(Z)

(5 marks)

b) When a robot welder is in adjustment, its mean time to perform its task is 1.3250 minutes. Past experience has found the standard deviation of the cycle time to be 0.0396 minutes. An incorrect mean operating time can disrupt the efficiency of other activities along the production line. For a recent random sample of 80 jobs, the mean cycle time for the welder was 1.3229 minutes. Test the hypothesis whether the machine appear to be in need of adjustment at 5 % significance level.

(5 marks)

c) A factory pays its employees and average wage of RM25.00 an hour with a standard deviation of RM1.50. If the wages are approximately normally distributed and paid to the nearest cent, determine the percentage of the workers receive wages between RM23.75 and RM 26.22 an hour inclusive?

(5 marks)

Question 3

a) A null hypothesis is rejected at the 5% level, determine True or False for the following statements;

   i) The p-value is greater than 5%
   ii) The p-value is less than or equal to 5%
   iii) The result is statistically significant at the 5%.

(3 marks)

b) At the site of an archaeological dig two large burial sites have been found. In trying to decide whether the skeletons from these two sites come from different tribes anthropologists have measured the height of 40 skeletons from each burial site. The following are the sample statistics:

Burial site 1	Mean = 163	Variance = 24
Burial site 2	Mean = 161	Variance = 12

   i) Test a hypothesis test at 5% significance level, that the mean height of skeletons from each burial site is the same

(5 marks)

   ii) Calculate the p-value for this test and state your conclusion clearly.

(2 marks)

c) A stamping machine produces ca tops whose diameters are normally distributed with a standard deviation of 0.02 inch. Determine the mean value so that that no more than 5 % of the can tops produced have diameters exceeding 3 inches.

(5 marks)

Question 4

a) A type of newly purchased advertising balloons is supposed to be filled with a pressure of at most 40 psi. A random sample of 38 such balloons was selected and it gives a sample mean of 40.8 psi and a standard deviation of 1.58 psi. Does this sample prove that such balloons fill with a pressure of at most 40psi? Test the hypothesis at 7 % significance level.

(5 marks)

b) A chemist made 8 independent measurements of the melting point of tungsten. She obtained a sample mean of 3410.14^{o}C and sample standard deviation of 1.018^{o}C. Determine the sample size needed for a 99% confidence interval to specify the proportion within ±1.705.

(4 marks)

c) The volume, X milliliters, of olive oil in one-litre bottles may be assumed to be normally distributed random variable with mean μ and standard deviation 3.

i) Assuming that μ = 1005, determine the probability that the volume of olive oil in a randomly selected bottle is less than 1010ml.

(3 marks)

ii) Determine to the nearest integer, the value of μ so that at most 1% of bottles contain less than 1 litre of olive oil.

(3 marks)

Question 5

1. The lengths of fish caught in the river are found to be normally distributed with a mean of 41 cm and a variance of 11 cm^2.

i) Determine the probability that a randomly selected fish is at least 50 cm.

(2 marks)

ii) In a sample of 200 fish, how many of them would you expect to be at most 45 cm?

(3 marks)

a) A vehicle manufacturing company wants to investigate how the price of one of the motorcycle models depreciates with its age. The research department of the company took a sample of ten motorcycles of this model and collected the following information on the ages (in years) and prices (in thousand RM) of these motorcycles.

Age	5	3	2	9	1	4	7	6	8	10
Price	2.2	2.5	3.5	1.0	4.0	2.4	1.5	1.8	1.2	0.7

i) Construct a scatter plot for these data. Does the scatter diagram show a linear relationship between ages and prices of motorcycles?

(3 marks)

ii) Determine the regression line with prices as a dependant variable and age as an independent variable.

(2 marks)

iii) Predict the price of a 75 – year old motorcycle of this model.

(2 marks)

iv) Determine the correlation value and explain the strength of the relationship between age of motorcycle and prices.

(3 marks)

END OF QUESTION

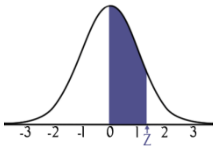
APPENDIX 1
FORMULA

Confidence Intervals for the Difference Between Two Means	Small-Sample Confidence Intervals for the Difference Between Two Means
$\overline{X}-\overline{Y}\pm z_{\alpha/2}\sqrt{\frac{s_X^2}{n_X}+\frac{s_Y^2}{n_Y}}$	$\overline{X}-\overline{Y}\pm t_{v,\alpha/2}\sqrt{\frac{s_X^2}{n_X}+\frac{s_Y^2}{n_Y}}$
The number of degrees of freedom (small-sample confidence intervals)	**Confidence Intervals for the Difference Between Two Proportions**
$v=\frac{\left(\frac{s_X^2}{n_X}+\frac{s_Y^2}{n_Y}\right)^2}{\frac{(s_X^2/n_X)^2}{n_X-1}+\frac{(s_Y^2/n_Y)^2}{n_Y-1}}$	$\tilde{p}_X-\tilde{p}_Y\pm z_{\alpha/2}\sqrt{\frac{\tilde{p}_X(1-\tilde{p}_X)}{\tilde{n}_X}+\frac{\tilde{p}_Y(1-\tilde{p}_Y)}{\tilde{n}_Y}}$
Large-Sample Confidence Intervals for a Population Mean	**Confidence Intervals for the Difference Between Two Means**
$\overline{X}\pm Z_{\frac{\alpha}{2}}\frac{\sigma}{\sqrt{n}}$	$\overline{X}-\overline{Y}\pm t_{n_X+n_Y-2,\alpha/2}\,.\,s_p\sqrt{\frac{1}{n_X}+\frac{1}{n_Y}}$
The Normal Distribution	**Small-Sample Confidence Intervals for a Population Mean**
$f(x)=\frac{1}{\sigma\sqrt{2\pi}}e^{-(x-\mu)^2/2\sigma^2}$	$\overline{X}\pm t_{n-1,\alpha/2}\frac{s}{\sqrt{n}}$
The Binomial Distribution	
$p(x)=P(X=x)={}^nC_k\,p^k(1-p)^{n-k}\quad k=0,1,...,n$	
The Poisson Distribution	
$P(X=x)=\begin{cases}\frac{e^{-\lambda}\lambda^x}{x!} & \text{if x is a non-negative integer}\\ 0 & \text{otherwise}\end{cases}$	
Test Statistic (Small-Sample)	**Sample Standard Deviation**
$t^*=\frac{\overline{X}-\mu}{s/\sqrt{n}}$	$s^2=\frac{1}{n-1}\sum_{i=1}^{n}\left(X_i-\overline{X}\right)^2$
Confidence Interval for Proportions	**Test Statistic (Small-Sample Tests)**
$\tilde{p}\pm z_{\alpha/2}\sqrt{\frac{\tilde{p}(1-\tilde{p})}{\tilde{n}}}$	$t^*=\frac{(\overline{X}-\overline{Y})-(\mu_X-\mu_Y)}{\sqrt{s_X^2/n_X+s_Y^2/n_Y}}$

Standard Unit	Test Statistic (Large-Sample)
$z = \dfrac{X - \mu}{\sigma}$	$z^* = \dfrac{\overline{X} - \mu_0}{\dfrac{\sigma}{\sqrt{n}}}$

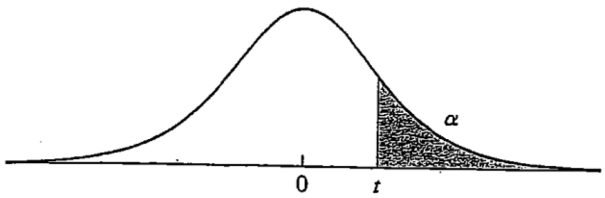
Test Statistic (Large-Sample Tests)
$Z^* = \dfrac{(\overline{X} - \overline{Y}) - (\mu_X - \mu_Y)}{\sqrt{\dfrac{\sigma_X^2}{n_X} + \dfrac{\sigma_y^2}{n_y}}}$

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