Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2014/2015

COURSE NAME	:	STATISTICS FOR QUALITY IMPROVEMENT
COURSE CODE	:	BWB 31903
PROGRAMME	:	3 BWQ
EXAMINATION DATE	:	DECEMBER 2014 / JANUARY 2015
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 (a) In standard control chart usage, it involves two distinct phases. Interpret these phase and when to use it.

(4 marks)

(b) List all the magnificent seven tools. Draw a scatter plot and interpret the uses of this diagram in Quality Improvement problem.

(13 marks)

(c) Given that the probability of a point plots beyond the control limits is 0.0057. Calculate the average run length and give the conclusion.

(3 marks)

Q2 (a) Give the definition of process capability.

(1 marks)

(b) Sketch the curve that represent
(i) Process is capable.
(ii) Process is not capable.

(6 marks)

(c) Define Process Capability Index and Process Capability Ratio.

(4 marks)

(d) The intensive care unit lab process has a average turnaround time of 39.5 minutes and a standard deviation of 1.24 minutes. The nominal value for this service is 38 minutes with an upper specification limit of 40 minutes and a lower specification limit of 15 minutes. The administrator of the lab wants to have 3 sigma performance for her lab. Calculate the process capability ratio and process capability index.

(9 marks)

Q3 A manufacturer receives large batches of components daily and decides to institute an acceptance sampling schema. Three positive plans are considered, each of which requires a sample of 30 components to be tested.

Plan A: Accept the batch if no non-conforming component are found, otherwise reject.

Plan B: Accept the batch if not more than one non-conforming components are found, otherwise reject.

Plan C: Accept the batch if two or fewer non-conforming components are found, otherwise reject.

(a) For each plan, evaluate the probability of accepting a batch containing
(i) 2% non-conforming

(9 marks)

(ii) 8% non-conforming

(6 marks)

(b) Without further calculation draw on the same axes the operating characteristics of each plan.

(3 marks)

(c) Discuss which plan would be most appropriate in each of the circumstances listed below:

(i) There should be high probability of accepting batches containing 2% non-conforming.

(ii) There should be high probability of accepting batches containing 8% non-conforming.

(2 marks)

Q4 (a) Explain two purposes of statistical process control.

(2 marks)

(b) The copper content of bronze castings has a target value of 80%. The standard deviation is known to be 4%. During the production process, sample of size 6 are taken at regular intervals and their copper content measured.

(i) Evaluate upper and lower warning limits with 2σ and action limits for three-sigma control charts.

(8 marks)

(ii) Draw the warning limits and action limits control charts.

(4 marks)

(iii) **Table Q4(b)(iii)** is the results that obtained from samples on two separate processes.

Table Q4(b)(iii): Data from the copper processes

Process *A*	82.0	83.5	79.8	84.2	80.3	81.0
Process *B*	75.8	68.4	80.3	78.2	79.9	73.5

For each sample, compute the mean and standard deviation and recommends any necessary action based on answer in Q4(b)(ii).

(6 marks)

Q5 There are two variables, verbal and performance scores for $n=8$ elderly subjects aged 20-24 on the Malaysian University English Test (MUET) computed from 20 preliminary sample. Assume that the mean S is used to estimate $\sum$ and the vector $\bar{\bar{x}}$ replace the μ. Sample mean vector and covariance matrix are as below:

$$\bar{x}=\begin{pmatrix}115.25\\1.04\end{pmatrix} \quad \bar{\bar{x}}=\begin{pmatrix}115.59\\0.02\end{pmatrix} \quad S=\begin{pmatrix}1.23 & 0.83\\0.83 & 0.79\end{pmatrix}$$

(a) Evaluate the test statistics $T^2=n(\bar{x}-\bar{\bar{x}})'S^{-1}(\bar{x}-\bar{\bar{x}})$.

(9 marks)

(b) Find the UCL for the phase I and phase II if $\alpha=0.05$.

(6 marks)

(c) **Table Q5(c)** is the value of T^2 taken from five sample for MUET data. Construct the control chart by using Phase I and discuss whether the process is in control or not.

Table Q5(c): T^2 value from MUET data

Sample number k	T_k^2
1	2.16
2	6.17
3	7.54
4	2.41
5	3.01

(5 marks)

- END OF QUESTIONS –

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Formula

$$C_{pk} = \min \text{ of } \left[\frac{\bar{\bar{x}} - \text{lower specification}}{3\sigma}, \frac{\text{upper specification-}\bar{\bar{x}}}{3\sigma} \right]$$

$$C_p = \frac{\text{upper specification - lower specification}}{6\sigma}$$

$$\mu_{\bar{w}} \pm 2\sigma_{\bar{w}} \quad , \qquad \mu_{\bar{w}} \pm 3\sigma_{\bar{w}}$$

$$\text{UCL} = \frac{p(m-1)(n-1)}{mn-m-p+1} F_{\alpha,p,mn-m-p+1}$$

$$\text{UCL} = \frac{p(m+1)(n-1)}{mn-m-p+1} F_{\alpha,p,mn-m-p+1}$$