

**INDIAN STATISTICAL INSTITUTE  
SQC & OR Unit, Hyderabad**

**MS in Quality Management Science : 2014-16**

**III SEMESTER : MID-TERM EXAMINATION**

**Subject : Six Sigma – Business Excellence Strategies and Problem Solving Framework**

*Date : 25<sup>th</sup> August 2015*

*Max. Marks : 100 & Time : 120 minutes*

**Instructions**

This paper carries 120 marks. Answer as many questions as you can but maximum marks you can score is 100. Question - 4 is compulsory. You need to provide all the answers on the normal answer booklet (Hardcopy). You may provide graphs/charts/diagrams etc. (if any) on the soft answer booklet [word file : Mid-Term Answer Booklet (Student name).doc] by clearly writing your name on the answer sheet as well as file name.

1. State whether the following statements are correct or wrong with justification for your answer briefly.

(10×2 = 20)

  - a. In Kano Model the risk of providing a specific delighter is that the customer will start expecting for more and more of the delighter over time.
  - b. Process map (SIPOC) and Process Flow Diagram are one and the same and are drawn for the same purpose and deliver the same end result.
  - c. In Six Sigma methodology, MSA study is aimed at evaluating stability and capability of the measurement process.
  - d. A stable process having Sigma Level 4 will result in around 2700 DPMO (with 1.5 shift) and close to 33 DPMO without shift.
  - e. You make on an average 2 wrong calls per every 20 calls on your mobile, therefore your call connecting process is operating at 2.8 Sigma Level (with 1.5 Shift)
  - f. A group of 10 call center executives were subjected to training for performance improvement. Six Sigma Black Belt used a 2 sample t-test for statistically establishing whether there is any significant improvement in the average hold time.

- g. In a Six Sigma project an attempt was made to find the best among the three Temperatures for reducing the yield variation. A Black Belt performed a Chi Square test for testing the variances.
  - h. During Six Sigma implementation in a large organization, Master Black Belts play the crucial role in its effective and efficient deployment.
  - i. Stability analysis was planned to be performed for a financial process with respect to a CTQ, "number of failed transactions" in the accounts of a customer. The Six Sigma Green Belt used a c-chart to check the stability.
  - j. The need for application of Statistical thinking in Six Sigma is inevitable because only statistics has the ability to reduce product/process variation.
2. You are hired as a Six Sigma expert by a large corporate launching an affordable mobile service "AamMobile". The corporate is intending to provide a complete service (smartphone, data, voice, TV, helpline etc.) using the latest 4G technology. The corporate is looking for the semi-urban and rural market to start with considering the large volumes. It is facing competition from two more players (Hudaphone and Hawamobile)

A team was formed under you having specialization in different fields as applicable for design and development of the above concept. The team prepared a questionnaire and collected the requirements from the various stake holders including the end user (mobile user - customer). The requirement gathering exercise was limited to the four areas (i) Instrument, (ii) Data+Voice, (iii) apps and (iv) connectivity.

- a) Perform a Kano Analysis by listing down 12 VOCs in such a manner that you select 4 VOCs from each of the three Kano categories having representation from the above 4 areas.
- b) Identify Six (6) important and dominant technologies/processes and perform a QFD analysis.
- c) Provide 5 important findings which need to be discussed in the coming top management strategic meeting.

(30)

3. The smartphone which the above corporate is planning to provide need to be designed to make it affordable as well as robust to cater to the semi-urban and rural India requirements. The areas on which the R&D team have tried to work are
- a. Improving average Battery Life while reducing the cost
  - b. Strong Body (protection during fall/shock etc.) with low cost material

After a series of trials the design team claimed that they have significantly improved the above two parameters a) Average Battery Life and b) failure rate on drop test. It was possible to reduce overall cost by 20% with this improvement.

The company management asked you to verify the claims of the R&D team using appropriate statistical tests on 20 new mobile instruments. As a baseline input the management shared with you that before the design change the battery life (for single charging and normal usage) was on an average 500 minutes with standard deviation of 7.5 minutes. With respect to the mobile body, on an average 15% of the instruments were breaking or malfunctioning after the drop test (the instruments are dropped from a specific height for a fixed number of times). Your studies have given you 700 minutes of average battery life with 5.3 minutes of standard deviation and only 1 instrument failed in drop test.

State clearly the different types of statistical tests you will perform to verify the claims made by the R&D along with the assumptions, hypotheses, errors etc. Perform the tests and give your inference for each of the tests.

(20)

4. AamMobile after starting its services for over two years was facing competition due to recent rise in the number of similar category of telecom service companies. The company sought your services as a Six Sigma consultant to advice the company. You are expected to study the two year data (100 sets) collected under the following heads

Parameter	Description
Region	Three regions were identified for study
Age	Age of the Customer
Marital Status	Unmarried and Married
Education	Lower, Middle and Higher levels
Gender	Male Female
Loyalty	Weeks as Customer (Specifications LSL = 10 weeks)
Billing	Weekly billing in hundreds (Specification LSL = Rs. 250)
Churn	Whether discontinued or not (Specification USL = 30%) (percentage of customers discontinued)

The data is provided in an excel sheet (AmmMobile.xls)

For introducing some marketing and business measures (corrective as well as improvement) you need to identify at least 5 very significant actions for presentation in the coming top management meeting.

The top management have given some indication of their business & improvement interest to you in the following manner

- To identify the existing performance of the services with respect to Loyalty, Billing & Churn.
- Does all the regions having the similar performance or any specific region need to be given more focus? Similarly for other parameters.
- Is there any association between region and education level so that product/service range can be changed?
- How age, Loyalty are related to the billing.
- Does education level has any association with the Churn ?
- Billing from unmarried female subscribers is comparatively more as compared to other groups.

Region	Customer Age	Marital Status	Education	Gender	Weeks as Customer	Billing (in Hundreds)	Discontinued (Churn)
Region 2	48	Married	lower	Female	31	6.6	No
Region 3	27	Unmarried	Higher	Female	28	4.1	No
Region 2	40	Unmarried	Higher	Female	39	7.2	No
Region 1	35	Unmarried	Middle	Female	50	8.8	No
Region 3	28	Married	Higher	Male	17	4.7	No
Region 2	53	Unmarried	Middle	Female	29	6.2	No
Region 2	40	Unmarried	Middle	Female	34	6.5	No
Region 3	36	Married	Higher	Female	23	5.4	Yes
Region 3	54	Unmarried	Higher	Male	24	5.9	No
Region 1	46	Unmarried	lower	Male	68	11	No
Region 3	34	Married	Middle	Female	25	6	Yes
Region 2	53	Married	lower	Male	37	6.2	No
Region 1	48	Unmarried	lower	Male	50	9	No
Region 1	68	Unmarried	lower	Female	98	12.5	No
Region 1	43	Unmarried	Middle	Female	41	7.8	No
Region 3	26	Married	Higher	Male	23	5.2	No
Region 3	71	Unmarried	Middle	Male	5	1.5	No
Region 2	27	Married	Middle	Male	34	6.9	No
Region 1	33	Unmarried	lower	Female	55	9.3	No
Region 2	51	Married	Middle	Female	39	6.5	No
Region 2	35	Married	lower	Male	32	6.9	Yes
Region 1	33	Unmarried	Middle	Female	42	7.8	No
Region 2	25	Unmarried	Higher	Female	38	7.3	No
Region 3	30	Married	Higher	Male	33	5.9	No
Region 3	46	Unmarried	Higher	Female	24	5.1	No
Region 3	42	Married	Higher	Female	27	5.5	No
Region 1	53	Unmarried	Higher	Male	55	10.4	No
Region 3	24	Unmarried	Middle	Male	19	5.4	Yes
Region 3	21	Married	Higher	Female	26	3.9	No
Region 2	31	Unmarried	Middle	Male	40	7.4	No
Region 1	50	Unmarried	lower	Female	62	10.2	No
Region 1	38	Married	lower	Male	52	8.9	Yes
Region 3	34	Unmarried	Higher	Female	16	4	No
Region 3	55	Married	Higher	Male	21	5.6	No
Region 2	34	Married	Middle	Female	35	7.2	No
Region 1	33	Unmarried	lower	Male	76	10	Yes
Region 2	54	Married	Middle	Male	33	7.1	Yes
Region 3	33	Unmarried	Higher	Male	23	4.7	Yes
Region 2	41	Married	Higher	Male	35	6.3	Yes
Region 1	52	Married	lower	Male	44	8.1	No
Region 3	34	Married	Higher	Male	29	5.3	Yes
Region 3	41	Married	Higher	Male	26	5.8	No
Region 1	39	Unmarried	lower	Female	48	8.2	No
Region 2	35	Married	Middle	Male	26	6.2	No
Region 3	48	Married	Middle	Male	30	4.9	Yes
Region 3	31	Unmarried	Higher	Male	15	5.4	Yes
Region 1	50	Married	lower	Female	53	8.7	No
Region 1	52	Unmarried	lower	Male	57	9.5	No

Region 3	29	Unmarried	Middle	Male	25	3.9	Yes
Region 3	57	Unmarried	Higher	Male	15	4.2	No
Region 2	27	Married	Middle	Male	34	6.4	No
Region 1	34	Married	Middle	Female	51	8.9	No
Region 1	42	Unmarried	lower	Female	46	8.3	No
Region 3	52	Married	Higher	Female	13	5.7	No
Region 2	47	Married	lower	Male	40	7.5	No
Region 3	33	Married	lower	Male	13	5.9	No
Region 2	43	Unmarried	Middle	Female	38	7.4	Yes
Region 3	28	Married	Middle	Female	10	5.5	No
Region 1	57	Unmarried	lower	Male	69	11.5	No
Region 1	52	Married	lower	Female	65	9.5	No
Region 2	43	Married	Middle	Male	30	6.4	No
Region 1	45	Unmarried	lower	Female	54	9.2	Yes
Region 3	62	Married	Higher	Male	37	5.2	No
Region 1	57	Unmarried	lower	Male	75	10.9	No
Region 2	27	Married	Middle	Male	35	6.7	No
Region 3	31	Unmarried	Higher	Male	13	4.1	Yes
Region 2	38	Married	Middle	Female	33	6.5	No
Region 1	60	Unmarried	lower	Male	71	11.9	No
Region 2	47	Married	lower	Male	37	6.9	No
Region 2	36	Married	Middle	Male	44	7.5	Yes
Region 1	35	Unmarried	Higher	Female	64	10.4	Yes
Region 2	41	Married	Middle	Male	37	6.4	No
Region 1	38	Unmarried	lower	Female	76	9.3	No
Region 3	24	Unmarried	Higher	Male	24	4.1	No
Region 3	33	Married	Higher	Female	16	5.4	Yes
Region 2	48	Unmarried	Middle	Female	35	7	No
Region 1	54	Married	Higher	Female	55	9.4	Yes
Region 2	67	Married	Middle	Male	36	7.3	No
Region 2	44	Unmarried	Middle	Male	47	7.5	Yes
Region 3	37	Unmarried	lower	Female	27	4.7	No
Region 1	35	Unmarried	Middle	Male	42	7.9	No
Region 2	46	Married	Middle	Male	40	6.9	No
Region 1	48	Unmarried	Middle	Male	41	7.6	No
Region 1	47	Unmarried	lower	Male	58	9.8	No
Region 3	22	Unmarried	Higher	Male	12	5	No
Region 2	21	Married	Middle	Female	16	6.1	No
Region 1	33	Unmarried	lower	Female	59	9.9	Yes
Region 1	39	Unmarried	lower	Male	45	8.3	Yes
Region 2	33	Married	Middle	Female	17	6.1	Yes
Region 1	29	Married	Higher	Male	46	8	Yes
Region 3	57	Unmarried	Higher	Female	5	4.4	No
Region 1	39	Unmarried	lower	Female	60	10.2	Yes
Region 2	48	Unmarried	Middle	Female	40	7.5	No
Region 1	59	Unmarried	lower	Male	78	11.1	No
Region 1	47	Married	lower	Male	72	11.9	No
Region 3	20	Married	Higher	Female	18	2.6	Yes
Region 2	41	Married	Middle	Female	26	6.5	Yes
Region 3	42	Unmarried	Higher	Male	10	3.8	No
Region 2	51	Married	Middle	Female	31	6.7	No
Region 2	61	Unmarried	Middle	Male	30	6.7	No