KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE

SMA 366: QUALITY CONTROL METHODS

DATE: THURSDAY, 29TH NOVEMBER 2011 **TIME: 2.00 P.M. – 4.00 P.M.**

INSTRUCTIONS: Answer Question ONE and any other TWO questions.

QUESTION ONE (Compulsory – 30 marks)

(a) (i) Define the term "Statistical Quality Control."

(ii) List any five objectives of statistical quality control.

(9 marks)

(b) An $\bar{X}$- chart is to be established using standard values $\mu = 64$, $\sigma = 6$ and $n = 4$. Find the Shewharts (3- σ) control limits. (5 marks)

(c) The control limits are given by $E(C) \pm K$ where C is the number of defects and K is a positive constant to be determined.

(i) If the level of significance α is known and c has a poisson distribution with mean λ determine k, hence write down the control limits based on this value of K.

(ii) Using Shewharts $(3-\sigma)$ approach, what is the value of K?

(9 marks)

(d) A process is normally distributed with mean 2,000 and variance 4900. The process mean changes to 2080 but this change is undetected. How many samples should be taken to detect this change. (5 marks)

(e) Distinguish between a defect and a defective item. (2 marks)

QUESTION TWO

Construct a control chart for mean and the range for the following data on the basis of fuses, samples of size 5 taken every hour. Comment on whether the production is under control.

42	42	19	36	42	51	60	18	69	64	61	15
65	45	24	54	51	74	60	20	109	90	78	30
75	68	80	69	57	75	72	27	113	93	94	39
78	72	81	77	59	78	95	42	118	109	109	62
87	90	81	84	78	132	138	60	153	112	136	84

(20 marks)

QUESTION THREE

(a) If the average fraction defective of a large sample of product is 0.1537. Given that the size of the subgroup is 2000, calculate the control limits. What modification do you need if the subgroup size is not constant. (6 marks)

(b) A certain company produces rolls of paper. The number of defects found were as follows:

14, 8, 11, 14, 21, 21, 10, 12, 9, 13, 10, 12, 6, 18, 4, 5, 2, 4, 7, 12

Construct (i) Shewharts c-chart.

(ii) Modified Shewhort c-chart

Comment.

(c) Obtain the control limits for the np chart when the value of p is given. In case the sample size varies from one sample to another would you prefer to use np or p-chart.

QUESTION FOUR

(a) Distinguish between acceptance quality level (AQL) and average outgoing quality limit (AOQL). (4 marks)

(b) Explain briefly the following concepts.

(i) Consumer's risk

(ii) Producer's risk

(4 marks)

(c) If the process average fraction defective is 2% and the consumer's lot tolerance percent defective is 4% from a lot of size 400 whose samples size is 50 and the acceptance number c = 1. Calculate the consumer's and producer's risk. (Use binomial approximation distribution) (12 marks)

QUESTION FIVE

(a) Briefly outline the single sampling procedure. (8 marks)

(b) Compare the merits and demerits of the single and double sampling plans. (4 marks)

(c) Given the following data

$A.O.Q.L(\theta_1) = 5\%$

$L.T.P.D(\theta_2) = 20\%$

Consumer's risk $\beta = 0.10$

Producer's risk $\alpha = 0.10$

Construct a single sampling plan for attributes. (8 marks)

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Table 4 *Conversion of range to standard deviation*

n	a_n	n	a_n	n	a_n	n	a_n
2	0·8862	6	0·3946	10	0·3249	14	0·2935
3	0·5908	7	0·3698	11	0·3152	15	0·2880
4	0·4857	8	0·3512	12	0·3069	16	0·2831
5	0·4299	9	0·3367	13	0·2998	17	0·2787

An estimate of σ of a normal population can be obtained by multiplying the range of a sample of size n, or the average range of a set of samples of the same size n, by a_n.

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Table 5 *Percentage points of the distribution of the relative range* (range/σ)

Sample size	0·1	1·0	2·5	5·0	90	95·0	97·5	99·0	99·9
2	0·00	0·02	0·04	0·09	2·33	2·77	3·17	3·64	4·65
3	0·06	0·19	0·30	0·43	2·90	3·31	3·68	4·12	5·06
4	0·20	0·43	0·59	0·76	3·24	3·63	3·98	4·40	5·31
5	0·37	0·66	0·85	1·03	3·48	3·86	4·20	4·60	5·48
6	0·54	0·87	1·06	1·25	3·66	4·03	4·36	4·76	5·62
7	0·69	1·05	1·25	1·44	3·81	4·17	4·49	4·88	5·73
8	0·83	1·20	1·41	1·60	3·93	4·29	4·61	4·99	5·82
9	0·96	1·34	1·55	1·74	4·04	4·39	4·70	5·08	5·90
10	1·08	1·47	1·67	1·86	4·13	4·47	4·79	5·16	5·97
11	1·20	1·58	1·78	1·97	4·21	4·55	4·86	5·23	6·04
12	1·30	1·68	1·88	2·07	4·28	4·62	4·92	5·29	6·09

Table 6 *Values of* $r(c) = \chi^2_{1-\beta}/\chi^2_\alpha$ *with d.f.* $= 2(c+1)$

(a) $\alpha = 0{\cdot}100$, $1-\beta$					(b) $\alpha = 0{\cdot}050$, $1-\beta$				
c	0·900	0·950	0·975	0·990	c	0·900	0·950	0·975	0·990
0	21·85	28·43	35·01	43·71	0	44·89	58·40	71·92	89·78
1	7·31	8·92	10·48	12·48	1	10·95	13·35	15·68	18·68
2	4·83	5·71	6·56	7·63	2	6·51	7·70	8·84	10·28
3	3·83	4·44	5·02	5·76	3	4·89	5·67	6·42	7·35
4	3·29	3·76	4·21	4·77	4	4·06	4·65	5·20	5·89
5	2·94	3·34	3·70	4·16	5	3·55	4·02	4·47	5·02
6	2·70	3·04	3·35	3·74	6	3·21	3·60	3·98	4·44
7	2·53	2·82	3·10	3·44	7	2·96	3·30	3·62	4·02
8	2·39	2·66	2·90	3·20	8	2·77	3·07	3·36	3·71
9	2·28	2·52	2·75	3·02	9	2·62	2·89	3·15	3·46
10	2·19	2·42	2·62	2·87	10	2·50	2·75	2·98	3·27
11	2·12	2·33	2·51	2·74	11	2·40	2·63	2·84	3·10
12	2·06	2·25	2·42	2·64	12	2·31	2·53	2·73	2·97
13	2·00	2·18	2·35	2·55	13	2·24	2·44	2·63	2·85
14	1·95	2·12	2·28	2·47	14	2·18	2·37	2·54	2·75
15	1·91	2·07	2·22	2·40	15	2·12	2·30	2·47	2·66
16	1·87	2·03	2·17	2·34	16	2·07	2·24	2·40	2·59
17	1·84	1·99	2·12	2·29	17	2·03	2·19	2·34	2·52
18	1·81	1·95	2·08	2·24	18	1·99	2·15	2·29	2·46
19	1·78	1·92	2·04	2·19	19	1·95	2·10	2·24	2·40
20	1·76	1·89	2·01	2·15	20	1·92	2·07	2·20	2·35