



UNIVERSITY OF GHANA
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SCHOOL OF ENGINEERING SCIENCES

FPEN 407 STATISTICAL QUALITY CONTROL IN FOOD PROCESSING

FIRST SEMESTER 2014-2015 EXAMINATIONS

TOTAL TIME ALLOWED THREE HOURS

ANSWER FIVE QUESTIONS

FURTHER INSTRUCTIONS: You have been given Statistical Tables, Please **DO NOT** take away, submit with your answer book. Graph sheets are available on request.

1.
 - a. Cost can be incurred in the process of producing quality food products. What are these and how do they relate to each other?
 - b. In general food manufacturing operations, how will you define quality? Comment on two distinct aspects of quality of interest to the Engineer.
2. You are the Leader of the Quality Control Team in a Food Plant. Management has tasked you to develop new grades and standards of quality for one of the product lines. Using a specific example, delineate the steps you will use and explain what happens at each step.
3. Cocoa is an important commodity in Ghana's economy. You are the Engineer in charge of a plant that sells cocoa to the Cocoa Processing Company (CPC) in Tema. Before the dried cocoa beans are bagged and sold they are sorted over a conveyor belt to remove defects before packing. Industry standards are such that the specification for top grade A quality cocoa provide a maximum tolerance of 2% defects; for grade B quality, it is 3-5% defects; grade C, may be as high as 10%. The value for Grade A passing over the belt in one hour is Gh¢ 2,000; value of grade B product is Gh¢1,900 and that of grade C is Gh¢1,750. Labour cost per inspector is Gh¢ 2.00 per hour. In the plant there is room for not more than 10 inspectors. Cocoa with % defects ranging from 3% to 18% were sorted by 10 Inspectors. The inspection was done by repeating several times for each sample and the average defects after inspection calculated.

The data obtained on the effects of number of inspectors on reduction of defects is shown below.

% Defects Before Inspection	Number of Inspectors				
	2	4	6	8	10
	Average % Defects after inspection				
3	1.5	2.0	1.0	0.5	1.0
4	2.6	2.0	1.7	1.4	1.2
5	2.9	2.4	2.1	2.2	2.2
6	3.5	2.5	2.0	2.0	1.5
7	4.0	3.5	2.5	2.2	1.5
8	5.0	4.0	2.5	2.0	1.5
9	5.5	4.5	2.7	2.5	1.7
10	7.5	5.0	4.0	2.5	2.0
11	8.5	6.5	5.0	3.0	2.7
12	8.0	6.5	6.0	4.0	3.0
13	9.0	7.0	6.5	6.0	5.0
14	10.0	9.0	8.5	6.0	4.0
15	11.0	10.0	8.5	7.0	4.0
16	12.0	10.5	10.0	8.0	4.0
17	14.0	12.0	11.0	8.5	4.5
18	15.0	13.0	11.5	9.0	5.0

Using the appropriate technique, determine

- the number of inspectors required to sort the cocoa into Grades A, B and C,
- the number of inspectors for maximum profit and the resulting Grade

4.

- Classification of food quality is important in understanding and relating to the consumer. Discuss this statement with specific examples.
- A well functioning QC Organization will contribute to the reduction of rejects, maintenance of uniform quality, increased customer satisfaction, employee morale and reduce costs. Discuss the critical responsibilities of a quality control Department in a modern food plant

5. In a fruit juice processing plant the vitamin C content of the juice was identified as an important quality attribute to the consumer. The Company therefore fortified its fruit juice with vitamin C and monitored the Vitamin C content of 20 batches of juice over a one-hour period. For each batch, four samples were taken at 3 minute intervals and their vitamin C content measured. The data below represent the outcome of the work.

- Calculate the indices required to set up the (\bar{X}) mean and (R) range charts based on the data.
- Plot the data using the indices from Question 2 (a) and

- c. Comment on the mean and range control charts

Sample Batch No.	Time a.m.	SAMPLE Vitamin C in mg/100mL				Mean \bar{X}	Range R
		1	2	3	4		
1	10.00	34.07	33.99	33.99	34.12	34.04	0.13
2	10.03	33.98	34.08	34.10	33.99	34.04	0.12
3	10.06	34.19	34.21	34.00	34.00	34.15	0.21
4	10.09	33.79	34.01	33.77	33.82	33.85	0.24
5	10.12	33.92	33.98	33.70	33.74	33.84	0.28
6	10.15	34.01	33.98	34.20	34.13	34.08	0.22
7	10.18	34.07	34.30	33.80	34.10	34.07	0.50
8	10.21	33.87	33.96	34.04	34.05	33.98	0.18
9	10.24	34.02	33.92	34.05	34.18	34.04	0.26
10	10.27	33.67	33.96	34.04	34.31	34.00	0.64
11	10.30	34.09	33.96	33.93	34.11	34.02	0.18
12	10.33	34.31	34.23	34.18	34.21	34.23	0.13
13	10.36	34.01	34.09	33.91	34.12	34.03	0.21
14	10.39	33.76	33.98	34.06	33.89	33.92	0.30
15	10.42	33.91	33.90	34.10	34.03	33.99	0.20
16	10.45	33.85	34.00	33.90	33.85	33.90	0.15
17	10.48	33.94	33.76	33.82	33.87	33.85	0.18
18	10.51	33.69	34.01	33.71	33.84	33.81	0.32
19	10.54	34.07	34.11	34.06	34.08	34.08	0.05
20	10.57	34.14	34.15	33.99	34.07	34.09	0.16
TOTAL						680.00	4.66

- a. Discuss the theory of evolutionary operations in Statistical Quality Control. How is it different from the use of control charts?

A food processor considers the solids content of the syrup surrounding the canned fruit as important quality index by the consumer. It is generally known that the solids content is influenced by the time and temperature of cooking (process variables). The current process time and temperature are 35 min at 105°C, (treatment 1). Other treatment values, (2) 30 mins at 100°C, (3) 40 mins. at 110°C (4) 40 mins at 100°C and (5) 30 mins at 110°C. These solid content values of 20% (current process), 22, 16, 24 and 28 for treatments 2,3, 4 and 5 respectively The EVOP committee went through three cycles of an EVOP Program and obtained the following as the outcome of the solids content.

	1	2	3	4	5
Cycle 1	20	22	16	24	28
Cycle 2	16	24	14	20	26
Cycle 3	22	22	8	22	26

Compute the appropriate indices for each cycle and comment on the results.
Assume a standard deviation of 1.8.