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MAIN EXAMINATION

JANUARY – APRIL 2018 TRIMESTER

FACULTY OF SCIENCE

DEPARTMENT OF MATHEMATICS AND ACTUARIAL SCIENCE

REGULAR PROGRAMME

MAT 261: QUALITY CONTROL AND ACCEPTANCE SAMPLING

Date: APRIL 2018	**Duration: 2 Hours**
INSTRUCTIONS: Answer Question ONE and any other TWO Questions	

Q1. a) i) Define chance causes of variation. **(2 marks)**

ii) Define assignable causes of variation. **(2 marks)**

iii) When is a process said to be in statistical control? **(2 marks)**

iv) When is a process said to be out of control? **(2 marks)**

b) Control charts are broadly classified into 2 general types. State them and describe the differences between these two categories of control charts. **(3 marks)**

c) Select an appropriate type of control chart in order to control the following control characteristics:

i) Weight of packed cookies **(1 mark)**
ii) The number of defectives in 1000 parts. **(1 mark)**
iii) The number of soldering defects in a radio set. **(1 mark)**
iv) Percent defective of a lot, the size of which might vary. **(1 mark)**
v) The strength of five test pieces sampled in a day. **(1 mark)**

d) To investigate the manner of variation in a machining process of certain parts, dimensions of the parts were measured 4 times a day, at 9:00,

11:00, 14:00 and 16:00 hours, as shown in the table. Construct an $\bar{x}$ and an R chart to analyze this process. If there are any assignable causes of variation in the process, state the sample number and date.**(14 marks)**

Sample number	Date	Time			
		9:00	11:00	14:00	16:00
1	Nov. 2	52.5	52.9	52.9	53.5
2	3	53.0	52.8	53.5	52.4
3	4	52.8	52.9	52.7	52.8
4	5	52.9	52.9	52.9	52.9
5	6	52.8	52.9	52.7	53.1
6	9	52.6	53.4	53.1	53.3
7	10	53.5	53.6	52.8	52.7
8	11	53.1	53.3	53.5	53.0
9	12	53.4	53.1	53.1	53.1
10	13	53.2	53.4	53.1	52.9
11	16	53.4	53.0	53.9	53.1
12	17	52.8	52.9	53.2	53.2
13	18	53.2	53.3	52.9	53.1
14	19	53.5	52.9	54.0	53.9
15	20	54.3	53.6	53.6	53.8
16	23	53.2	53.3	54.0	53.7
17	24	53.8	54.0	53.8	53.8
18	25	53.1	53.6	53.7	53.8
19	26	53.7	53.8	53.0	53.5
20	27	53.3	53.1	53.6	53.0
21	30	53.3	53.7	53.3	53.8
22	Dec. 1	53.1	53.1	53.2	53.1
23	2	53.6	53.4	53.2	53.0
24	3	53.4	53.7	53.0	53.2
25	4	53.3	53.2	53.5	53.4

Q2. a) i) Define the term fraction non-conforming and explain the use of the p-chart. **(4 marks)**

ii) The number of non-conforming switches in samples of size 150 is shown in the table. Construct a p-chart for these data. Does the process appear to be in control? If not assume that assignable causes can be found for all points outside the control limits and calculate the revised control limits. **(8 marks)**

Sample number	Number of non-conforming switches
1	8
2	1
3	3
4	0
5	2
6	4
7	0
8	1
9	10
10	6
11	6
12	0
13	4
14	0
15	3
16	1
17	15
18	2
19	3
20	0

b) i) Define what a non-conforming item is. **(2 marks)**

ii) Surface defects have been counted on 25 rectangular steel plates, and the data are shown in the table. Construct a c-chart using this data.

Plate number	Number of non-conformities	Plate number	Number of non-conformities
1	1	14	0
2	0	15	2
3	4	16	1
4	3	17	3
5	1	18	5
6	2	19	4
7	5	20	6
8	0	21	3
9	2	22	1
10	1	23	0
11	1	24	2
12	0	25	4
13	8		

Does the process producing these plates appear to be in statistical control? (**6 marks)**

Q3. a) Define the single sampling plans for attributes and how they are implemented. **(4 marks)**

b) Construct single-sampling plans to the following specifications given in proportion defective with producer's risk = 0.05 and consumer's risk = 0.10 using the binomial nomograph.

i) PQL = 0.04, CQL = 0.21. **(2 marks)**
ii) PQL = 0.03, CQL = 0.13. **(2 marks)**
iii) PQL = 0.02, CQL = 0.06. **(2 marks)**

c) i) Use the binomial nomograph to derive and compare the operating characteristic curves of the plans n = 5, c = 0 and n = 5, c = 1, at P_a = 0.95, 0.50, 0.10. **(5 marks)**

ii) Plot the AOQ curves for these plans for lots of size 200 and find their AOQL. **(5 marks)**

Q4. a) Describe the operation of a double-sampling plan. **(4 marks)**

b) Construct double-sampling plans to the following specifications given in proportion defective with producer's risk = 0.05 and consumer's risk = 0.10.

i) PQL = 0.04, CQL = 0.21. **(2 marks)**
ii) PQL = 0.03, CQL = 0.13. **(2 marks)**
iii) PQL = 0.02, CQL = 0.06. **(2 marks)**

c) i) Plot the type-B operating characteristic curve for the following double sampling plan using P_a = 0.95, 0.50, 0.10 at a minimum for plotting positions.
n: 8, 8
Ac: 0, 1
Re: 2, 2 **(3 marks)**

ii) If lots are received in quantities of 1000, obtain ASN, AOQ and ATI at the minimum plotting positions for the plan:
n: 8, 8
Ac: 0, 1
Re: 2, 2
And plot these curves. **(7 marks)**

Q5. a) Suppose a plan is desired having a producer's quality level of 1.78 per 100 units and a consumer's quality level of 19.5 defects per 100 units with risks $\alpha = 0.05$ and $\beta = 0.10$.

i) What are the appropriate set of matched single sampling, double sampling and multiple sampling matched plans. **(3 marks)**

ii) Plot the operating characteristic curves for these single sampling, double sampling and multiple sampling plans. **(6 marks)**

iii) At what point does the indifference quality level occur for each of the three matched sampling plans? **(3 marks)**

b) i) Calculate the producer's quality level for each of the three matched sampling plans. **(4 marks)**

ii) Calculate the consumer's quality level for each of the three matched sampling plans. **(4 marks)**

END

Q3. b) i)

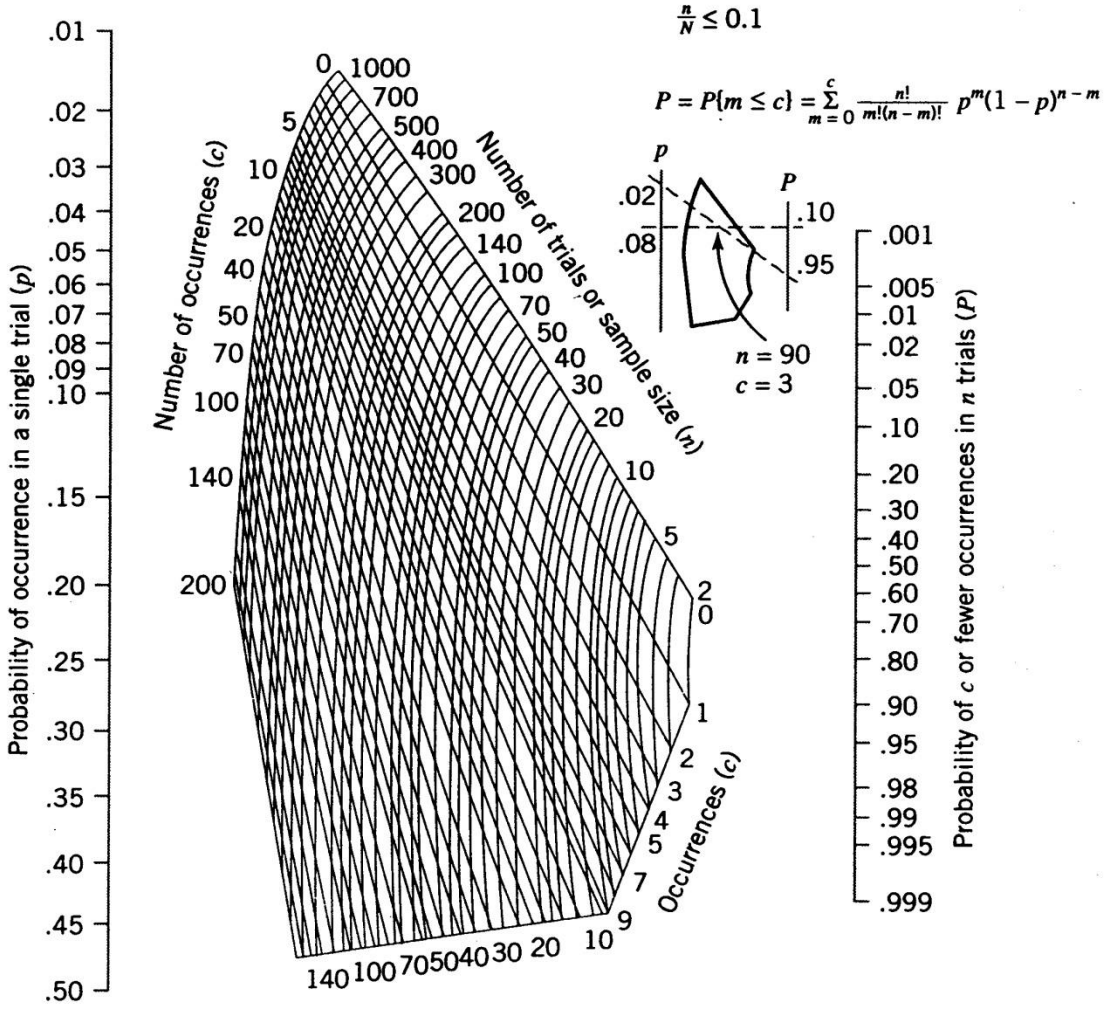

Figure 14-9 Binomial nomograph.

Q3. b) ii)

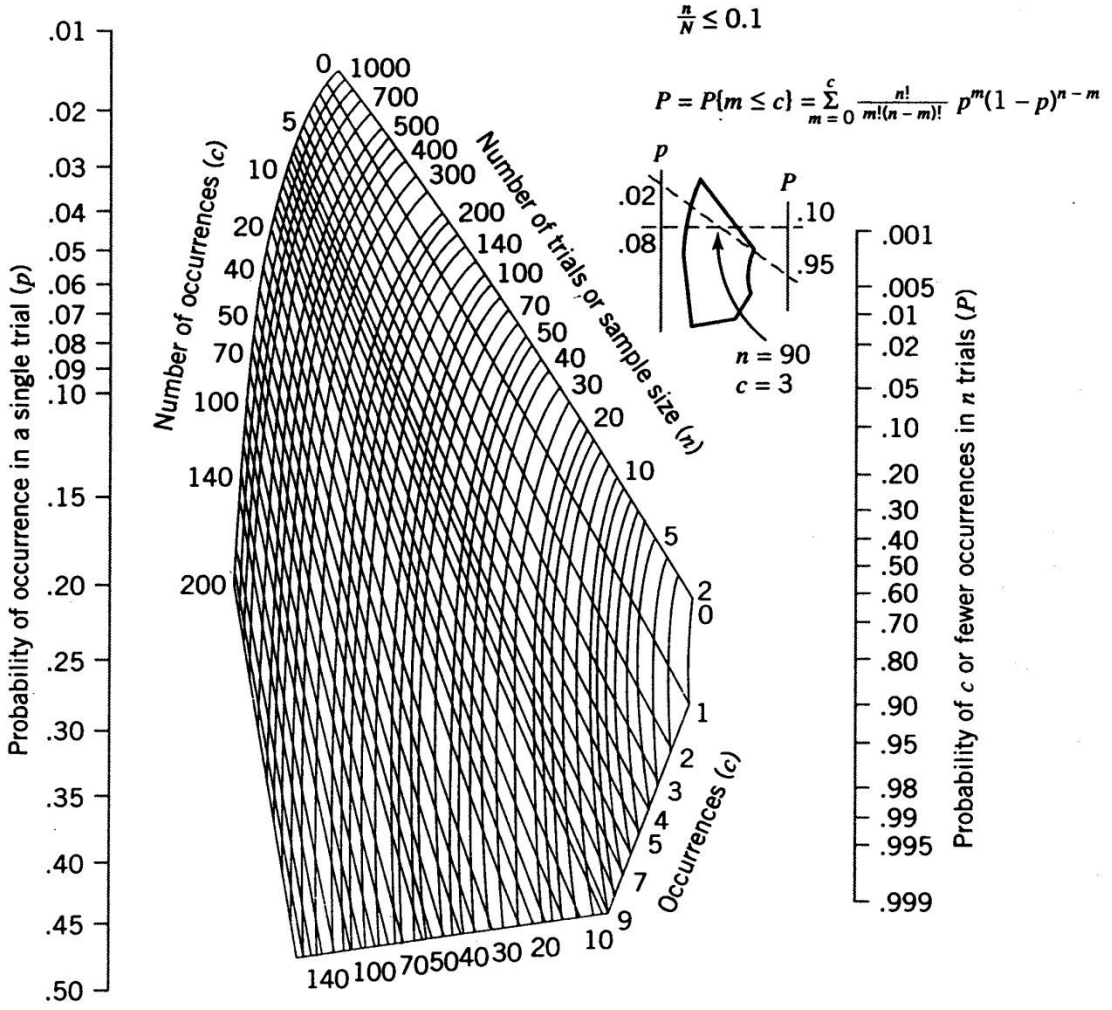

Figure 14-9 Binomial nomograph.

Q3. b) iii)

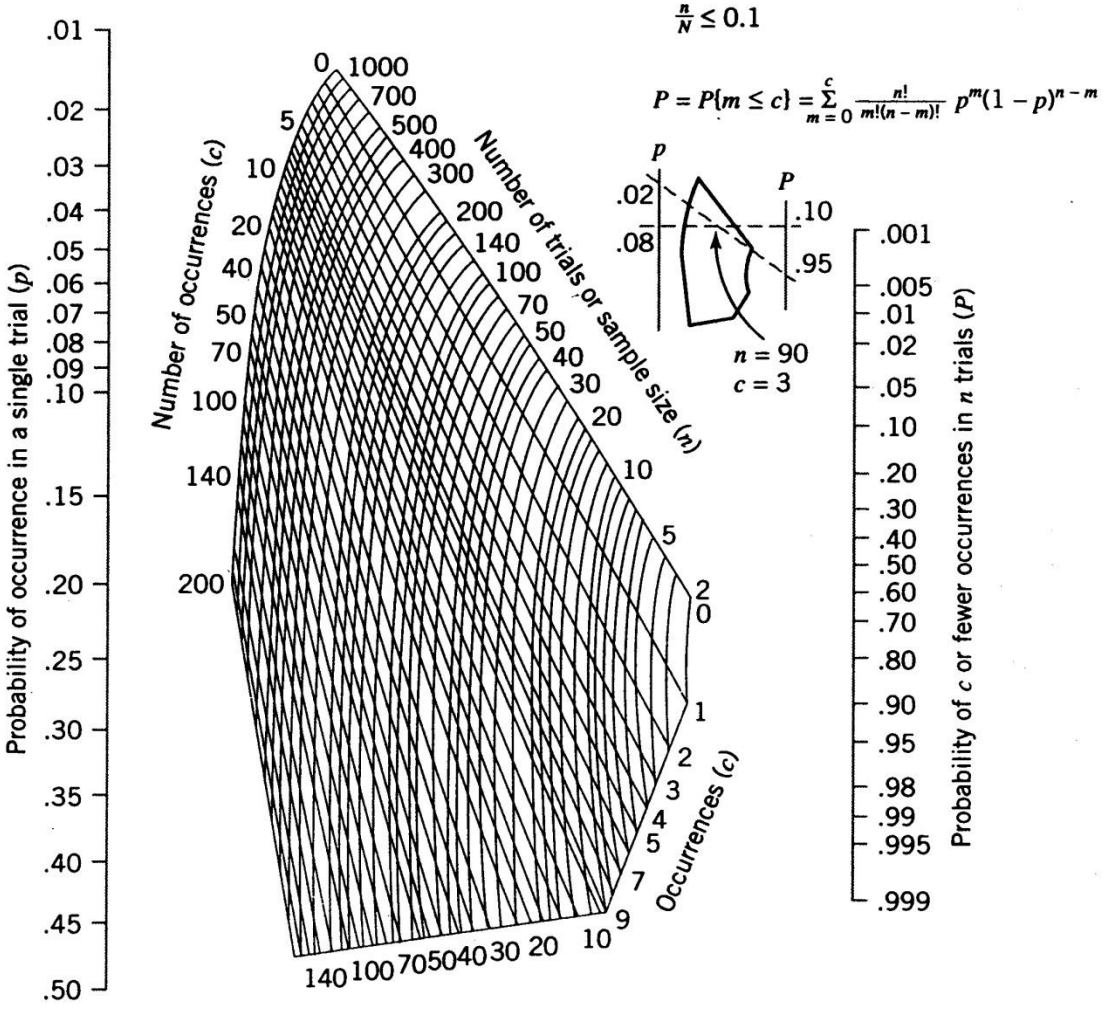

Figure 14-9 Binomial nomograph.

Q3. c) i)

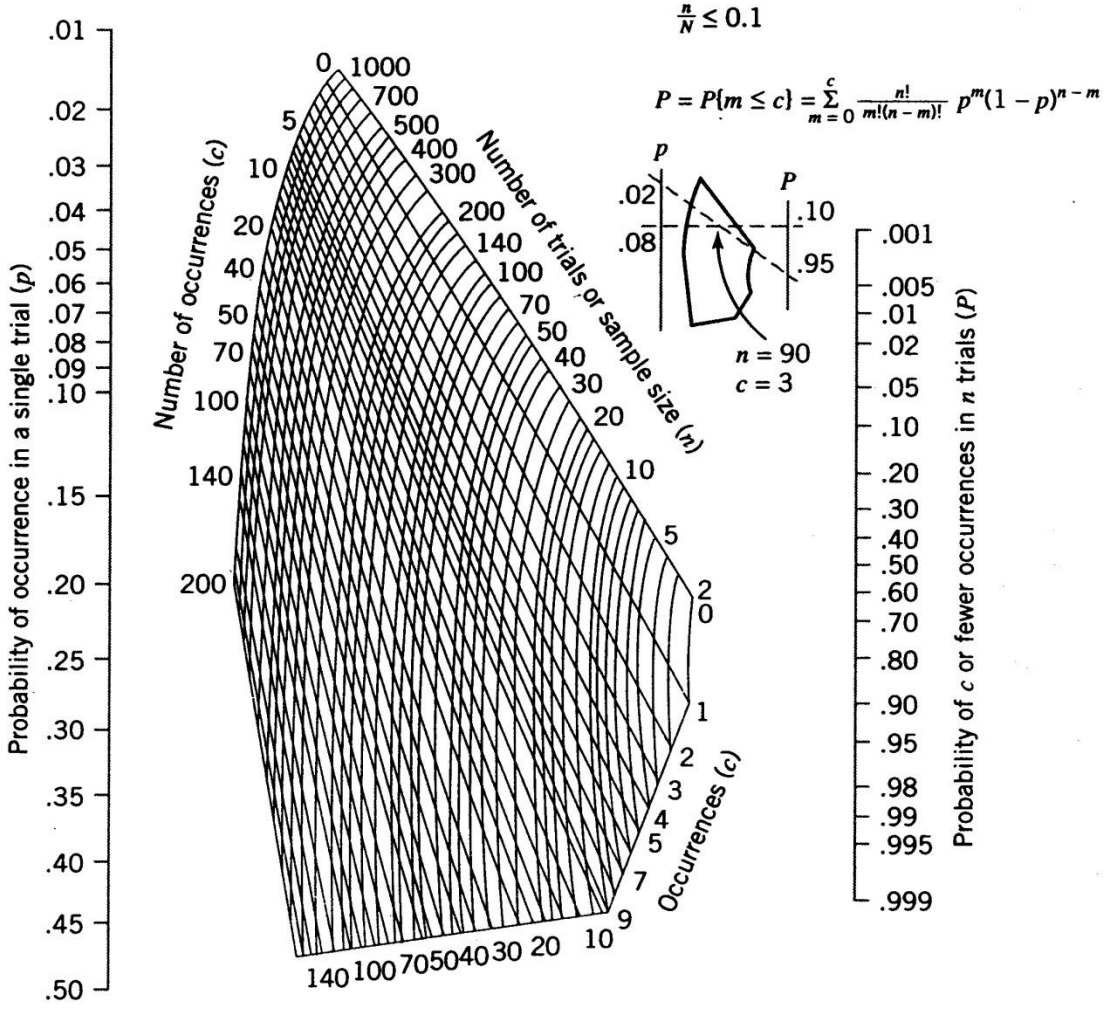

Figure 14-9 Binomial nomograph.

Q3. c) i)

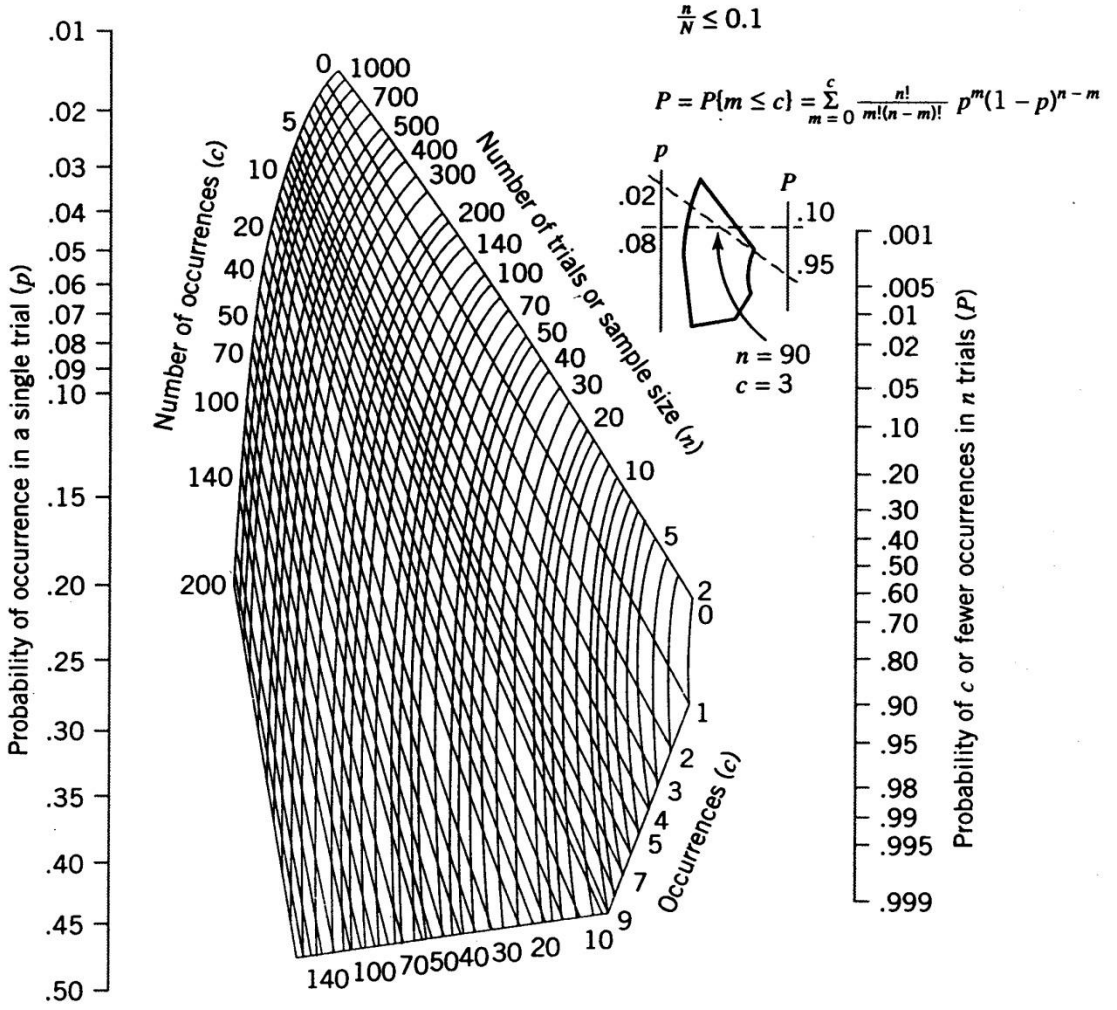

Figure 14-9 Binomial nomograph.

END