Chhatrapati Shahu Ji Maharaj
University, Kanpur

Answer Script Details
Barcode 11539567

Roll No. 24079000007
Total Mark 63/75.00

Exam M.SC-III_ODD_EXAM_NOV_2025
Subject B060904T - Industrial Statistics (Elective)

Question wise Mark Summary

Q.No	Mark	Q.No	Mark	Q.No	Mark	Q.No	Mark
1A	4/5	8	0/15				
1B	4/5	9	0/15				
1C	5/5						
1D	5/5						
1E	4/5						
1F	5/5						
1G	5/5						
1H	5/5						
1I	5/5						
2	0/15						
3	11/15						
4	0/15						
5A	0/5						
5B	0/5						
5C	0/5						
6	0/15						
7	10/15						

Chhatrapati Shahu Ji Maharaj University
Kanpur, Uttar Pradesh

PART-I

Date of Exam: 10/12/25 Shift: 3 Roll No: 24079000007

Name of Candidate: Divya Dwivedi Father's Name: NH

Course: Statistics Year/Semester: 3

Signature of Candidate: Divya

COE Facsimile

Signature of Invigilator

PART-II

MARKS OBTAINED

Q.	1	2	3	4	5	6	7	8	9	10
(a)										
(b)										
(c)										
(d)										
(e)										
(f)										
(g)										
(h)										
(i)										
(j)										
Total										

Total Marks in Figure: Max. Marks:

Total Marks in Words:

B060904T

Paper Code

Signature of Examiner

PART-III

Course: MSC

Session: 2025-26 Year/Semester: 3

Subject: Statistics (Industrial Statistics)

Paper Code: B060904T

Exam Date: 10 12 2025

Name of Candidate: DIVYA DWIVEDI

Father's Name: SANTRAM DWIVEDI

College Code: KND3

Exam Centre Code: KND3

Type of Exam: Regular ● Ex-Student ○ Private ○ Back paper Exam ○

ANSWER BOOKLET NO.: 11539567

B060904T

Paper Code

PART-IV

Enrollment Number: CSJMA24000003821

Candidate's Roll Number: 24079000007

Paper Code: B060904T

Signature of Candidate: Divya

Signature of Invigilator

C.S Facsimile

COE Facsimile

INSTRUCTIONS TO THE CANDIDATE FOR FILLING PART-I

1. Read the instructions carefully given on the answer script and admit card.
2. Write Date of Exam, Shift, Paper Code & Name of Subject Correctly.
3. Write Name & Roll No. Correctly.
4. Write Semester & Branch Correctly.

INSTRUCTIONS TO THE CANDIDATE FOR FILLING PART-III

1. Use blue or black ball point pen for writing alphabets & numerals in ☐ Boxes.
2. Carefully study the example before you start marking.
3. As shown in the example below blacken the circles completely.

Correct method	Incorrect method
① ● ③ ④	✓ ✗ ◉ ⊘

4. Make no Stray marks on this sheet.
5. **DO NOT WRITE OR MARK ON THE BAR CODE.**

परीक्षार्थी के लिए निर्देश

1. प्रवेश पत्र एवं उत्तर पुस्तिका पर दिये गये निर्देशों को ध्यान से पढ़ें।
2. कवर पृष्ठ के दूसरी तरफ कुछ न लिखें।
3. उत्तर पुस्तिका के पृष्ठों पर दोनों तरफ लिखें।
4. प्रश्न पत्र पर अपने अनुक्रमांक के अतिरिक्त कुछ न लिखें।
5. प्रश्न पत्र कोड एवं प्रश्न पत्र कोड सावधानी पूर्वक लिखें।
6. अपनी स्थिति स्पष्ट लिखें।
7. उत्तर पुस्तिका के पृष्ठों की संख्या देखें। अगर उत्तर पुस्तिका में पृष्ठ (1–24) से कम है या फटे हुए है, तो परीक्षा शुरू होने के पूर्व दूसरी उत्तर पुस्तिका ले लें।
8. प्रश्नपत्र को देख, यदि प्रश्नपत्र के विषय कोड, विषय का नाम तथा प्रश्न में कोई त्रुटि है तो उसके परीक्षा शुरू होने के 30 मिनट के अन्दर कक्ष निरीक्षक को तत्काल सूचित करें, उसके बाद विश्वविद्यालय द्वारा कोई कार्यवाही नहीं की जायेगी।
9. प्रश्नों के उत्तर लिखने के लिये पेंसिल का प्रयोग न करें।
10. B कोपी या अतिरिक्त ग्राफ नहीं दिया जायेगा।

IN ORDER TO AVOID UFM (UNFAIR MEANS) :

1. The Roll No. and Answer Book no. found elsewhere or any other symbol found in the answer book will be treated as unfair means.
2. Any tempering of Bar Code and Booklet no shall be treated as Unfair Means.
3. Do Not bring the materials like slip of paper/mobile/digital diaries/ study material/ revision notes in examination hall. Possession of the mobiles/ digital diaries/ electronic watch and any other electronic gadget except memory less scientific calculator shall be considered as UFM case.
4. Do not keep or paste currency note in answer script it shall be consider as UFM.

INSTRUCTIONS TO THE CANDIDATE

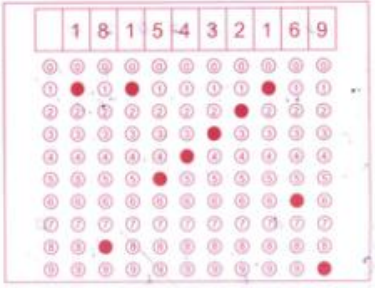
1. Read the instructions carefully given on the Question Paper, Admit Card & Answer Script.
2. Do not write anything on back side of the cover page.
3. Write on both sides of pages of answer book.
4. Do not write anything on question paper except Roll Number.
5. Write Paper Code & Question Paper Id carefully.
6. CHECK the number of pages (1-32) or any other kind of damage in your answer script, if found than change the answer script immediately before the commencement of examination.
7. CHECK the Question Paper for any kind of discrepancy e.g. Subject Code, Subject Name and Question of the Question Paper during first THIRTY MINUTES of the commencement of the exam, so that it can be corrected in TIME. After that no. corrections shall be entertained by the university.
8. Do not use pencil for answering the question.
9. Write status correctly e.g. those appearing in carry over papers should fill in status as Carry Over. Those appearing as Ex-Students should fill in status as ex.
10. No supplementary answer book & graph paper will be provided.

अनुचित साधन से बचने हेतु:

1. उत्तर पुस्तिका के निर्देशित स्थान को छोड़कर अनुक्रमांक एवं उत्तरपुस्तिका का क्रमांक कहीं और न लिखे तथा कोई भी चिन्ह न बनायें क्योंकि यह अनुचित साधन प्रयोग की परिधि में आता है।
2. उत्तर पुस्तिका के बारकोड अथवा उत्तर पुस्तिका संख्या पर छेड़ करने पर अनुचित साधन प्रयोग माना जायेगा।
3. परीक्षा कक्ष में निम्न वस्तुएं साथ न लायें, जैसे लिखे हुए कागज के टुकड़े, मोबाईल, डिजिटल डायरी, कोपी, पुस्तक यह सभी वस्तुएं जो अनुचित साधन के अन्तर्गत आती है। केवल सत्यापित प्रश्नपत्र में दी मेमोरी लेस साइंटफिक कैल्कुलेटर ले जाने की अनुमन्यता होगी।
4. उत्तर पुस्तिकाओं में रुपये न रखें न ही उत्तर पुस्तिका में चिपकायें। ऐसा करना अनुचित साधन प्रयोग की परिधि में आता है।

INSTRUCTIONS TO THE CANDIDATE FOR FILLING PART-IV

1. Use blue or black ball point pen for writing alphabets & numberals in ☐ Boxes.
2. Use blue or black ball point pen for filling the circles.



Note - If your Roll No. is of 10 digits. Please leave first three columns.

B 0 6 0 9 0 4 T 01

SHORT ANSWER TYPE QUESTIONS

1(A)

Statistical interpretation of quality — Quality of the product means the product has brand value or trust value. Quality of the product provide customer's satisfaction. Quality means the product has definite shape, definite colour. If products has not quality it does not maintain its name in the market.

for the Quality of the products different types of "Machine's and are alloted in the industries to maintain its quality. To measure or to maintain the quality of the Product the statistics introduces the statistics quality control.

(B) Process is being out of control if-
In the control chart
- the point of the curve lies out the upper central line and lower central line
- Process is out of control when in an OC curve chart there is continuous

- 7 points lies at one side of the curve
- When the curve shows jumps.

Process is out of control means there is error in manfacturing process or there is some fault in machines settings. While making the product the error occurs where called the process being out of control.

(C) Need of quality control —

Quality control is the statistical technique to maintain quality of the product —

- Competition — Quality control helps to maintain Brand and Trust value
- Standarization — Quality control helps to make product Uniform

of equal same size and colour.

Ex- In a factory, the making of biscuits should be in same size and colour.

- Continuous Production - Quality Control make production smooth. Ensure continuous production.

Helps to save money and Rework -
- Quality control helps to make proper monitoring in the making so if there is some defect it can detect early due to which it saves money and Rework.

(D)

Control charts for Variables -

Control charts for Variables helps to determine the characteristic quality of through measurement. It is a Qualative Quantity like - weight, Thickness etc.

Control chart for sample Mean (X)

Control chart for sample mean is used to determine the Mean of the sample.

If follow the given steps—

- Select the samples at Equal intervals.
- Calculate the sample Mean ($\bar{X}$)
- Calculate the Grand Mean.
- Compute
  Central limit (CL)
  Upper Control limit (UCL)
  Lower Control limit (LCL)
- Plot the points
- Interpriete the result.

On interpretating the result if the point lies outside the UCL and LCL its means the process is out of control.

The process is out of control if all the point lies at one side of the curve.

Control chart for Range (R)

Control chart for Range is used to determine the range of the sample.

It follows the given steps –

Select the samples at equal interval

Compute the Range

$$R = Max - Min$$

Compute the limits,

Central limit, upper control limit and lower control limit.

Plot the points

and interprete the result.

If the process is out of control if the point lies outside the UCL and LCL

These

$\bar{X}$ charts is used to monitor sample Mean.

Range of the control chart is used to monitor the range.

Advantages -

Control charts for Variable gives more precesise information in comparison of attributes chart.

These required small samples.

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e Operating characteristic Curve-

Operating characteristic Curve show the relationship between the quality of lot and the probability of acceptance (Pa)

The two components of OC curve is—

X axis— fractional defective

Y axis— Probability of acceptance

Example—

In a factory there are two lot

lot A— It has 1% defective items

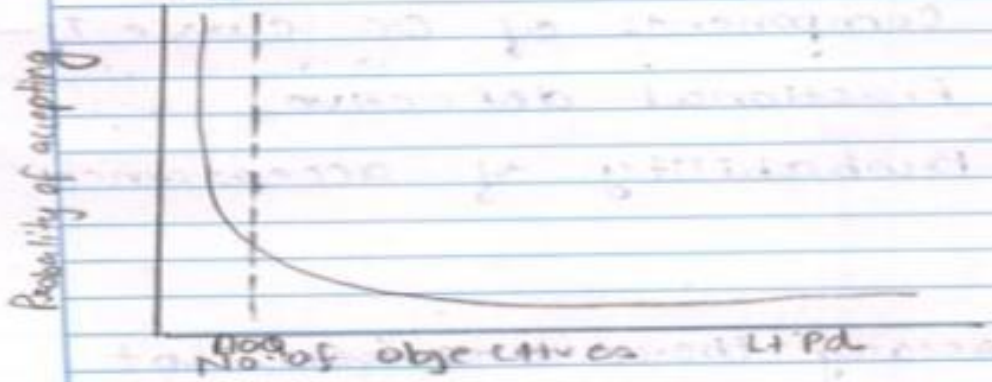
lot B— It has 15% defective items

lot A— If lot A is Good lot because the ~~propal~~ probability of acceptance is $P(a) = 0.9$

lot B— lot B is considered as a Bad lot with the $P(a) = 0.1$

OC curve shows the rejections and acceptance of the sampling.

Ideal shape of Operating curve—



(F) **Producer's Risk (α) = (α risk)**

Producer risk is the probability of rejecting a good lot.

~~In acceptance sampling,~~

~~On~~ making the Product ~~ther~~
Why it happens—

On making the Product there are some natural errors and due to acceptance sampling, the chance of choosing random sample, there are sample chosen which is bad even overall product is good.

So ..... defective is made so that defective item should reach ~~the~~ upto level of AQL to escape.

In producer risk—

there is loss of money and rework. so AQL is made. at this level first product has to satisfy.

Consumer Risk — (β risk)

Consumer risk is the probability of accepting a bad lot.

Why it happens—

On making the products there are samples even when the whole product is bad but at the sampling time there are some samples which is good even when they are bad.

Purpose

To escape from consumer like ltpd Introduce
lot tolerance Percent defective so that

the customer needs good quality products.

(G) ATI (Average total Inspection)

Average total Inspection is used to calculate all the items of the product. like

- Sample
- plus extra all the information like rejecting lot when it comes from 100% Inspection.

ATI for large samples - accept early

ATI for small sample - accept early

ATI for single sample = n

Where $\boxed{ATI = (1-\theta)(N-n)}$

Where —
P = probability of acceptance
N = lot size
n = sample size

ATI = n (Good lot)
ATI = N & 1

Graph of ATI

~~High quality —~~

~~Low~~

In ATI

Good lot — low ATI
(High quality)

Bad lot
(Bad quality) — low ATI

Medium quality — highest ATI

Advantages — Rectification is involved

Workload distributed
Man works distributed due to inspection of total items

(H) Lot tolerance Percent Defective

It is the worst level of quality that reaches to customer when sampling done.

Consumer risk(β) — Consumer risk is the probability of accepting bad lots. It measure on the level of LTPD.

Purpose —

- The purpose of LTPD is to provide Customer good quality
- Product.
- Provide Customer safety

Under the level of LTPD if the lot is equal to LTPD or over to LTPD the probability of accepting a good lot is become very low

LTPD provides the ~~max~~ level to which at this level a customer can provided the lots and after this level it is considered as Bad.

(I) CUSUM – cumulative sum mean method

In cumulative sum mean we do not add objects seperately, we add all the deviations together. It is a sequential sampling plan.

There are two types of CUSUM

One side CUSUM – Provide both upward and backward direction.

Two side CUSUM – Provide ~~only~~ in both direction.

Advantages of CUSUM.

- It provide continuous process
- Inspection cost is low
- Sample are small.
- Due to continuous process it required continuous monitoring
- It do not add items individually. It adds them all the deviations together. So time is minimum

LONG ANSWER TYPE QUESTION.

3. General theory on methodoly of control charts for Variables —

Control charts for Variables helps to determine the Characteristic quality through Measurement like —

Weight, thickness of pistols.

It is a qualative quantity

There are different types of Control chart —

Control chart for Sample Mean (X)

Control chart for sample Mean is used to determine the mean of the sample.

It follows the given steps—

- Select the sample interval at equal intervals.
- Calculate the sample Mean
- Calculate the Grand Mean
- Compute Central limit
- Upper control limit
- lower control limit
- Plot the points
- Interprete the results:

On interpretating, the process is out of control if the point lies outside of the UCL and LCL

Control chart for Range (R)

Control chart for Range is used to determine the range of the given sample

It follows the given step—

Select the sample at equal interval
Compute the range.

$R = Max - Min$

- Compute the limits —
- Upper control limit
- lower control limits
- Plot the Point
- Interprete the results.
- If the process is out of control its mean the point outside the UCL and LCL

Control chart for Standard deviation (S)

Control chart for standard deviation is used to measure ~~Variatta~~ deviation of the sample

The standard deviation charts is mainly used for variables

the following steps following —

- Select the sample at equal interval
- Compute the standard deviation
- Compute the limits
  - upper control limit
  - lower control limit
- Plot the points
- Interprete the results.

- If the process is out of control its mean the points lies outside the LCL and UCL

Uses

In chemical industries, food processing

In Machines parts.

Features

It contains both mean and variance

Detects small shifts quickly

Required small samples

Better than attributes charts.

Statistical testing of hypothesis is done by accepting or rejecting samples by statistics —
Null hypotheses
and
Alternative hypotheses.

$H_0 : \theta = \theta_0$
$H_1 : \theta = \theta_1$

In control charts we obtain sample mean, range by using variables and attributes.
Or by aceptance sampling like rejecting and accepting lots.

Section C

7.

Dodge - Roaming tables —

Dodge roaming tables are the classical tables mainly

used for AOQL and LTPD.

Definition —

Dodge Roaming tables is used to obtain the data by conceptualy and by not using Mathematical concepts. It uses its characteristics only.

Dodge Roaming for AOQL

- AOQL — Average outgoing Quality limit

It is used to obtain sample numbers or K value fraction value

Dodge Roaming for LTPD

- LTPD — (lot Tolerance Percentage distribution)

It is used to obtain sample Number

Probability of accepting lots.

Steps OF Dodge Roaming tables —

Firstly, select the Objective like AOQL and LTPD

Draw sample and compute sample at equal interval.

Compute Risk (α, β)

Draw and obtain Rowtable

Compute statistics tools (p, np, σ, USL, LSL)

Plot and interpret.

AQL

Average Quality level is

the average value of Product after inspection. assuming that the 100% inspection occured and no defects remained.

~~AQL~~ = $AOQ = \left(P - \frac{n}{N}\right)$ $N P C_N$ $\frac{N-NP}{C_{n-n}}$ | NC^n

100% acceptance means the process is not gone under inspection — sample goes out.

~~10~~ If sample goes into inspection there are rejection – sample does not goes out.

AQL is the level value θ' that at this value the quality of lot is good.

this level is measure on producer risk.

LTPD

It is the worst level quality that reaches to customer when sampling done.

Consumer risk (β) – Consumer risk is the probability of accepting bad lots is measure on the level of LTPD.

purpose —

The purpose of ltpd is to provide the Customer good quality.

ltpd provide the level to which at this level a Customer can prouided the lots and after this level it is Considered Bad.

The probability of acepting the good lot is very low in ltpd.

while the Probability of acepting the good lot is very high in AQL

Do Not Write anything in this Portion