

GUJARAT TECHNOLOGICAL UNIVERSITY

3 SEMESTER – OLD PAPER – WINTER 2025 TO SUMMER 2026 – QUESTION BANK

Subject Name & Code: Statistical Techniques for Environmental Engineering - BE03013041

Chapter 1: Statistical Techniques for Environmental Engineering, Types of statistical data, Methods of presentation

Repeated Questions:

1. Significance of Statistics (Theory):

- Q. Discuss the significance of statistical techniques/statistics for Environmental Engineering. (WINTER 2025, 4 Marks; SUMMER 2026, 3 Marks)

2. Data Collection – Primary and Secondary Sources (Theory):

- Q. Enlist and explain primary and secondary sources for data collection. / Differentiate between Primary vs. secondary data, providing an Environmental Engineering example. (WINTER 2025, 4 Marks; SUMMER 2026, 4 Marks)

3. Pie Diagram (Theory):

- Q. For what type of data is a Pie diagram most suitable? Mention one important caution to be observed while using it. / Identify the type of data most suitable for a pie chart and mention the key point to be considered while preparing a pie chart. (WINTER 2025, 3 Marks; SUMMER 2026, 3 Marks)

Other Important Questions:

1. Statistical Terms and Types of Data (Theory):

- Q. Differentiate between the following pairs of statistical data types, providing an Environmental Engineering example for each: (a). Qualitative vs. Quantitative data (b). Discrete vs. Continuous data. (WINTER 2025, 4 Marks)
- Q. Define the following common statistical terms: i. Population, ii. Sample, iii. Variable, iv. Data. (SUMMER 2026, 4 Marks)

2. Data Collection Methods (Theory):

- Q. Mention one advantage of collecting data from field surveys in environmental studies. (WINTER 2025, 3 Marks)

3. Graphical Presentation of Data (Theory):

- Q. How can a scatter diagram help in studying the relationship between rainfall and river discharge? (WINTER 2025, 3 Marks OR)
- Q. Differentiate between histogram and frequency polygon. Discuss their applications in analysing air quality data. (SUMMER 2026, 3 Marks)
- Q. Enlist and explain two graphical methods for representing qualitative environmental data with example. (SUMMER 2026, 3 Marks OR)
- Q. Identify the type of data most suitable for a bar chart and mention the key points to be considered while preparing a bar chart. (SUMMER 2026, 3 Marks OR)

4. Numerical Problems:

- Q. The daily suspended particulate matter (SPM) concentration (in $\mu\text{g}/\text{m}^3$) was measured at a site over 20 days. The data is as follows: 110, 115, 120, 118, 122, 116, 125, 110, 119, 121, 124, 117, 123, 116, 119, 121, 120, 115, 124, 118. (a) Prepare a Frequency Distribution Table with histogram using a class interval width of $3 \mu\text{g}/\text{m}^3$ (starting the first class at 109.5). (b) State whether this data should be presented using a histogram or a bar diagram and why. (WINTER 2025, 7 Marks)

- **Q.** An environmental auditing firm collected data from a city's water infrastructure projects regarding two aspects: the primary Source of Funding for 100 projects (Qualitative Data) and the Daily Water Loss over 10 days at a single treatment plant (Quantitative Data). (a) Present the Funding Source data in a Pie Diagram showing percentage share. (b) Prepare a frequency distribution table for the daily water loss. (c) Identify the type of data for Funding Source and Water Loss and suggest which type of chart is appropriate for each. [Diagram required – refer to the original question paper] **(WINTER 2025, 7 Marks OR)**
- **Q.** An environmental engineer collected data on the primary type of air pollution control device (APCD) used at 50 local manufacturing facilities. (Data provided in paper). i. Prepare a table showing the Frequency and Relative Frequency (%) of each APCD type. ii. Calculate the Central Angle for all four APCD categories and describe how the calculated angles are used to construct the Pie Diagram. iii. Draw the bar diagram representing the frequency of the APCDs. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks OR)**

Chapter 2: Measures of Central Tendency and Measurement of Variability

Repeated Questions:

1. Measures of Variability (Numerical):

- **Q.** Calculate the Range, Mean Deviation, Standard Deviation, Coefficient of Variation. Also, based on these measures, comment on the consistency of the treatment unit's performance. / The BOD values (mg/L) of wastewater samples collected on 8 different days are: ... (a) Calculate the Range and Standard Deviation. (b) Find the Coefficient of Variation (C.V.) and comment on the consistency of the BOD values. / (a) Range of the removal efficiencies, (b) Mean Deviation, (c) Standard Deviation, and (d) Coefficient of Variation. [Diagram required – refer to the original question paper] [Data truncated in source – refer to the original question paper] **(WINTER 2025, 7 Marks; WINTER 2025, 7 Marks OR; SUMMER 2026, 7 Marks OR)**

2. Partition Values (Theory and Numerical):

- **Q.** Explain partition values (quartiles, deciles, percentiles) and their application in environmental data and justify why the inter-quartile range (IQR) is preferred over the range for assessing variability. / Calculate Q3 (Third Quartile), 3rd Decile (D3) and the 80th Percentile (P80). / Calculate (1) Q1 (2) 2nd Decile (D2) and (3) the 75th Percentile (P75). [Diagram required – refer to the original question paper] **(WINTER 2025, 7 Marks; WINTER 2025, 7 Marks OR; SUMMER 2026, 4 Marks)**

Other Important Questions:

1. Mean, Median and Mode (Theory):

- **Q.** Define and explain the following statistical terms with respect to Environmental Engineering data analysis (any three): (1) Mean (2) Median (3) Mode (4) Range **(WINTER 2025, 3 Marks)**
- **Q.** Differentiate between mean and median. Give one example with data where median is more suitable than mean. **(SUMMER 2026, 3 Marks)**

2. Variability (Theory):

- **Q.** Explain Experimental Variability. **(WINTER 2025, 4 Marks)**
- **Q.** Explain Real Variability. **(WINTER 2025, 4 Marks OR)**
- **Q.** Differentiate between mean deviation and standard deviation. **(WINTER 2025, 3 Marks)**
- **Q.** Distinguish between Range and Standard Deviation. **(WINTER 2025, 3 Marks OR)**

3. Numerical Problems:

- **Q.** An air pollution monitoring station recorded the daily average PM10 concentrations (in $\mu\text{g}/\text{m}^3$) for 30 days and grouped the data as follows... Estimate the mean PM10 concentration. [Diagram required – refer to the original question paper] [Data truncated in source – refer to the original question paper] **(WINTER 2025, 7 Marks)**
- **Q.** Calculating the average discharge quality of combined wastewater from different industrial sources. (Textile Factory, Food Processing, Chemical Plant data provided). The average BOD concentration of the combined wastewater. [Diagram required – refer to the original question paper] **(WINTER 2025, 4 Marks)**
- **Q.** An environmental consulting firm is assessing air quality in a region that includes urban, suburban, and rural areas. They want to find the overall average concentration of nitrogen oxides (NO_x). Calculate the population-weighted average NO_x concentration for the region. [Diagram required – refer to the original question paper] **(WINTER 2025, 4 Marks OR)**
- **Q.** The following are the daily Dissolved Oxygen (DO) levels (in mg/L) recorded in a river over 12 days: 6.5, 7.2, 6.8, 7.0, 6.9, 7.1, 7.0, 6.7, 7.3, 6.8, 7.0, 7.2. Calculate the mean, median, mode, range and mean deviation of the DO levels. **(SUMMER 2026, 7 Marks)**
- **Q.** A local environmental agency collected daily PM2.5 concentration data (in $\mu\text{g}/\text{m}^3$) in Ahmedabad for a month... Prepare a grouped and cumulative frequency distribution table for

PM2.5 concentrations, construct a histogram and cumulative frequency curve. Determine and interpret the 90th percentile value in terms of air quality for Ahmedabad. [Diagram required – refer to the original question paper] [Data truncated in source – refer to the original question paper] **(SUMMER 2026, 7 Marks)**

Chapter 3: Skewness, Kurtosis, Correlation and Regression

Repeated Questions:

1. Skewness and Kurtosis (Theory):

- **Q.** Explain the concepts of skewness and kurtosis in data distribution. Mention any one measure used for each. / Describe the significance of skewness and kurtosis in analyzing environmental datasets. / What is skewness? Describe Karl Pearson's coefficient of skewness and its interpretation. **(WINTER 2025, 7 Marks; SUMMER 2026, 3 Marks; SUMMER 2026, 4 Marks)**

2. Correlation and Regression (Theory):

- **Q.** Differentiate between correlation and regression with example. / Explain the concept of linear regression analysis in environmental engineering with example. / Define regression. Explain the concept of regression lines and regression coefficients. **(WINTER 2025, 7 Marks OR; SUMMER 2026, 3 Marks OR; SUMMER 2026, 4 Marks OR)**

Other Important Questions:

1. Numerical Problems:

- **Q.** An environmental engineer collected daily PM_{2.5} concentration data ($\mu\text{g}/\text{m}^3$) from an urban monitoring station for 15 days: 12, 15, 18, 20, 22, 24, 25, 26, 28, 30, 35, 38, 45, 50, 60. (i) Calculate and interpret the skewness of the data. (ii) Discuss the kurtosis and comment on whether the distribution is more peaked or flat compared to a normal distribution. (iii) Explain what these results indicate about air pollution variability in the area. **(SUMMER 2026, 7 Marks)**
- **Q.** An environmental engineer studied the relationship between rainfall (mm) and BOD levels (mg/L) in a river over six sampling events. Calculate and interpret the correlation coefficient with regression equation between rainfall and BOD. The data are as follows: Rainfall (mm): 10, 20, 30, 40, 50, 60; BOD (mg/L): 8, 7, 6, 5, 4, 3. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks OR)**

Chapter 4: Probability and Testing of Hypothesis (ANOVA)

Repeated Questions:

1. Analysis of Variance – ANOVA (Theory):

- **Q.** Explain the concept of Analysis of Variance (ANOVA). Compare one-way and two-way ANOVA used for pollutant levels across different locations and time periods. / Describe the steps involved in performing one-way ANOVA. / Define Analysis of Variance (ANOVA). What is its importance in statistics? **(WINTER 2025, 4 Marks; WINTER 2025, 4 Marks OR; SUMMER 2026, 4 Marks OR)**

Other Important Questions:

1. Probability and Sample Tests (Theory):

- **Q.** Differentiate between large and small sample tests with suitable examples. **(SUMMER 2026, 3 Marks)**
- **Q.** Explain probability and its use in estimating the risk of exceeding groundwater contamination limits. **(SUMMER 2026, 4 Marks)**
- **Q.** Explain the basic laws of probability with an example related to environmental risk assessment. **(SUMMER 2026, 3 Marks OR)**

2. Testing of Hypothesis (Numerical):

- **Q.** A sample of 150 river water samples shows a mean turbidity of 12 NTU. The population standard deviation is 3 NTU. Test at 5% significance level if the mean turbidity differs from the standard limit of 11 NTU. **(WINTER 2025, 7 Marks)**
- **Q.** A wastewater treatment plant claims that the average BOD of treated water is 20 mg/L. A sample of 100 water samples shows a mean BOD of 21 mg/L. Assume population standard deviation $\sigma = 5$ mg/L. Test at 5% significance level whether the plant's claim is valid. **(WINTER 2025, 7 Marks OR)**
- **Q.** An environmental engineer measured lead concentrations (mg/L) in water from two different industrial sites over five days... Determine if there is a significant difference in the variances of lead concentrations between Site A and Site B along with its interpretation. [Diagram required – refer to the original question paper] [Data truncated in source – refer to the original question paper] **(SUMMER 2026, 7 Marks)**
- **Q.** An environmental engineer surveyed presence of a particular aquatic species in three different rivers to see if distribution is independent of location... Check and interpret whether the presence of the species is independent of the river. Explain the ecological implications. [Diagram required – refer to the original question paper] [Data truncated in source – refer to the original question paper] **(SUMMER 2026, 7 Marks OR)**
