

GUJARAT TECHNOLOGICAL UNIVERSITY

BE-3 SEMESTER –OLD PAPER– S22 TO S25- QUESTION BANK

Subject Name & Code:

Probability and Statistics- 3130006

Chapter 1: Basic Probability

Repeated Questions:

1. **Bayes' Theorem Application (Factory/Machine Defect Problem)**
 - **Q:** In a factory, machines A, B, C produce different percentages of output with different defect rates. A item is drawn at random and found defective. Find the probability it was produced by each machine.
 - **Appeared in:** S-2024 (07 Marks), W-2023 (07 Marks), S-2023 (07 Marks - Post Office Clerk variant).
 - This is arguably the most important question from this chapter. The numbers change, but the concept is identical.
2. **Definition of Random Variable**
 - **Q:** Define and give an example of a Random Variable.
 - **Appeared in:** S-2024 (03 Marks), W-2022 (03 Marks), S-2022 (03 Marks).
3. **Probability of Events (Card, Dice, Leap Year)**
 - **Q:** Basic probability calculations like probability of a king or a red card from a pack; probability of 53 Sundays in a leap year; probability that B or C wins a race.
 - **Appeared in:** S-2024 (04 Marks - Leap Year), W-2024 (04 Marks - King/Red Card), W-2024 (03 Marks - Race).

Other Important Questions:

4. **Conditional Probability**
 - **Q:** A study showed 65% managers have business education, 50% have engineering. 20% have business but no engineering. Find $P(\text{Business} | \text{Engineering})$. (S-2023, 03 Marks)
5. **Independent Events**
 - **Q:** If A and B are independent with $P(A)=1/4$, $P(B)=2/3$, find $P(A \cup B)$. (W-2022, 03 Marks)
6. **Probability of "at least one"**
 - **Q:** Two computers are sold independently. Given he sold at least one, find probability that computer A was sold. (S-2023, 04 Marks)

Chapter 2: Special Probability Distributions

Repeated Questions:

1. **Poisson Distribution under Condition $P(X=1) = P(X=2)$**
 - **Q:** If a random variable has a Poisson distribution such that $P(X=1) = P(X=2)$, find (i) mean (ii) $P(X=4)$ (iii) $P(X \geq 1)$ (iv) $P(1 < X < 4)$.
 - **Appeared in:** S-2024 (07 Marks), W-2024 (07 Marks - Q5b), S-2022 (04 Marks - Q3b). **Extremely Important.**
2. **Binomial Distribution Application**
 - **Q:** Find probability of exactly/at least/at most 'k' successes in 'n' Bernoulli trials (e.g., defective items, contract disease, fax messages).
 - **Appeared in:** W-2023 (04 Marks - Disease), S-2023 (04 Marks - Defectives), S-2022 (07 Marks - Fax messages).
3. **Normal Distribution - Probability Calculation**
 - **Q:** Given mean (μ) and standard deviation (σ), find percentage/probability of measurements within/beyond a certain range (e.g., battery life, resistor resistance, sales).
 - **Appeared in:** S-2024 (07 Marks - Batteries), W-2022 (04 Marks - Resistors), S-2022 (07 Marks - Batteries), S-2023 (07 Marks - Sales).
4. **Finding Mean & Variance of Binomial Distribution**
 - **Q:** The mean and variance of a binomial variate are 8 and 6. Find $P(X \geq 2)$. (S-2024, 03 Marks)
 - **Q:** The mean and variance of a binomial distribution are 4 and 2. Find $P(X \geq 2)$. (S-2022, 03 Marks - Q3a)

Other Important Questions:

5. **Fitting Poisson to Binomial (Approximation)**
 - **Q:** Blades are supplied in packets of 10, chance of defect is 0.002. Use Poisson to approximate number of packets with 0, 1, 2 defects in 10000 packets. (W-2022, 07 Marks)
6. **Exponential Distribution**
 - **Q:** Define Exponential distribution. Given average service time, find probability that service takes less than/more than/between a certain time. (W-2022, 07 Marks - OR part)
7. **Gamma Distribution**
 - **Q:** Define Gamma distribution. Given parameters r and λ , compute $E(X)$, $\text{Var}(X)$ and $P(X \leq 1.5)$. (W-2022, 07 Marks - Q5c)

Chapter 3: Basic Statistics

Repeated Questions:

1. **Calculation of Correlation Coefficient (Karl Pearson's)**
 - **Q:** Compute the correlation coefficient 'r' for the given bivariate data.
 - **Appeared in:** S-2024 (07 Marks), W-2024 (07 Marks), W-2022 (07 Marks - Q4c), S-2022 (07 Marks - Q5c). **Very Important.**
2. **Finding Mean from Regression Lines**
 - **Q:** The two lines of regression are given. Find the mean values of x and y.
 - **Appeared in:** S-2022 (04 Marks - Q5b), S-2023 (07 Marks - Q4c).
3. **Finding Correlation from Regression Lines**
 - **Q:** Find the coefficient of correlation between x and y if the regression lines are given (e.g., $x+6y=6$ and $3x+2y=10$).
 - **Appeared in:** S-2024 (03 Marks - Q3a), W-2022 (03 Marks - Q3a).

Other Important Questions:

4. **Spearman's Rank Correlation**
 - **Q:** Compute Spearman's rank correlation coefficient for the given data of ranks. (W-2022, 03 Marks - Q2a), (S-2022, 07 Marks - Q5c)
5. **Calculation of Central Tendency (Mean, Median, Mode)**
 - **Q:** Problems involving missing frequencies calculated using given median and mode. (S-2023, 07 Marks - Q3c)
 - **Q:** Find the modal sales/profits from grouped data. (S-2023, 04 Marks - Q3a, Q3b)
6. **Skewness and Kurtosis**
 - **Q:** Calculate Karl Pearson's coefficient of skewness for the given data. (W-2022, 03 Marks - Q5a), (S-2023, 04 Marks - Q3b)
 - **Q:** Given the first four central moments, compute Skewness and Kurtosis. (W-2022, 03 Marks - Q5a)

Chapter 4: Applied Statistics (Hypothesis Testing - Large Samples)

Repeated Questions:

1. **Test for Single Proportion (Coin/Dice Unbiasedness)**
 - **Q:** A coin is tossed n times and heads appear X times. Is the coin unbiased? (Use Z-test).
 - **Appeared in:** S-2024 (04 Marks - Dice), W-2024 (04 Marks - Coin), S-2022 (04 Marks - Q4b - Coin). **Very Common.**
2. **Test for Difference of Proportions**
 - **Q:** Compare proportions from two independent samples (e.g., tea drinkers in two villages, physical defect in two cities).
 - **Appeared in:** W-2024 (07 Marks - Q4c), S-2023 (04 Marks - Q5b).
3. **Z-test for Single Mean**
 - **Q:** Given sample mean, size, and population SD, test the hypothesis about the population mean (e.g., light tube lifetime).
 - **Appeared in:** S-2023 (03 Marks - Q5a), W-2022 (04 Marks - Q4b).

Other Important Questions:

4. **Z-test for Difference of Means**
 - **Q:** Test if there is a significant difference in the average sales of two salesmen. (S-2023, 04 Marks - Q5b)
5. **Z-test for Difference of Standard Deviations**
 - **Q:** Is the difference between the standard deviations of two large samples significant? (S-2024, 04 Marks - Q4b)

Chapter 5: Test of Significance for Small Samples

Repeated Questions:

1. **t-test for Single Mean**
 - **Q:** Given a small sample ($n < 30$), its mean and standard deviation, test the hypothesis about the population mean (e.g., mean breaking strength of ropes, mean price of shares).
 - **Appeared in:** W-2024 (04 Marks - Q4a), S-2023 (03 Marks - Q5a).
2. **F-test for Ratio of Variances**
 - **Q:** Given two small samples, test whether they have been drawn from populations with the same variance/SD.
 - **Appeared in:** S-2022 (07 Marks - Q4c), W-2022 (04 Marks - Q5b - OR part).

Other Important Questions:

3. **Paired t-test**
 - **Q:** Scores of participants before and after training are given. Test if the training was effective. (W-2023, 04 Marks - Q5b)
4. **Chi-square (χ^2) Test for Goodness of Fit**
 - **Q:** Test if the observed data follows a specific distribution (e.g., Binomial, Uniform).
 - **Appeared in:** S-2024 (07 Marks - Binomial), W-2023 (04 Marks - Uniform accidents), S-2022 (04 Marks - Dice bias).
5. **Chi-square (χ^2) Test for Independence**
 - **Q:** Test if two attributes (e.g., flower color and leaf flatness) are independent. (W-2022, 07 Marks - Q4c)

Chapter 6: Curve Fitting

Repeated Questions:

1. **Fitting a Second-Degree Parabola ($y = a + bx + cx^2$)**
 - **Q:** Fit a second-degree parabola to the given data. Also, estimate y for a given x .
 - **Appeared in:** W-2023 (07 Marks), S-2022 (07 Marks - OR part), W-2024 (07 Marks - Q5c), S-2023 (07 Marks - Q5c). **Extremely Important.**
2. **Fitting a Straight Line ($y = a + bx$)**
 - **Q:** Fit a straight line to the given data using the method of least squares.
 - **Appeared in:** S-2024 (04 Marks), W-2024 (04 Marks - Q5a), S-2022 (07 Marks), W-2022 (04 Marks - Q5a).
3. **Fitting an Exponential Curve ($y = ab^x$)**
 - **Q:** Fit a curve of the form $y = ab^x$ to the given data.
 - **Appeared in:** S-2024 (07 Marks), W-2023 (07 Marks - OR part), S-2023 (07 Marks - Q5c).

Other Important Questions:

4. **Fitting a Curve of form $y = ax^b$**
 - **Q:** Fit the curve $y = ax^b$ to the given data. (W-2022, 04 Marks - Q5b)
