

Chapter 6: Statics

Statics :-

This chapter deals with the study of data, its organization and methods to find useful information from it. In our daily life, we often come across large sets of numbers, for example marks of students, prices of goods, or survey results. Statics provides us with tools to represent this data.

Main focus:-

Central tendency (mean, median, mode) dispersion (range, standard deviation) and graphical representation.

In exercise 6.1 we learned how to turn raw data into a frequency distribution table. Important points of a class interval.

- lower and upper limits
- class width
- frequency

Key formula = Upper limit - lower limit.

In exercise 6.2 we focus on finding center of data

$$\text{Mean} \Rightarrow \bar{x} = \frac{\sum x}{n} \quad \bar{x} = \frac{\sum f \cdot x}{\sum f}$$

b) Median:

for ungrouped: if n is odd \rightarrow middle value
if even \rightarrow average of two middle values

Grouped:
$$L + \frac{(n/2 - c \cdot f) \cdot h}{f}$$

Mode:

ungrouped: value that appears most often

Grouped:

$$L + \frac{(f_1 - f_0) \cdot h}{(2f_1 - f_0 - f_2)}$$

In 6.3 we don't just look at centre we also study how data is spread out.

Range = Maximum - Minimum

SD:

for ungrouped: $\sigma^2 = \frac{\sum (x - \bar{x})^2}{n}$, $\sigma = \sqrt{\sigma^2}$

$$\rightarrow \sigma = \sqrt{\frac{\sum f(x - \bar{x})^2}{\sum f}}$$

Then we learned how to visualize data.

Histogram: continuous bars for continuous data

Frequency Polygon: line graph by joining class

Ogive: useful for finding median and quartiles

Bar chart and best for qualitative data.
Pie chart

Then we applied all concepts to real problems.

Chp 7:

This chapter takes statistics a step further. Instead of finding averages, here we learn how to summarize large data in tables, compute measures of central tendency and dispersion and represent data graphically. The chapter also introduces bivariate data, correlation and regression.

In 7.1 we organize raw data into frequency tables.

↳ class limits ↳ class boundaries

↳ class width ↳ frequency and cumulative frequency

Graphical

↳ Histogram ↳ frequency polygon ↳ Ogive

Measures of Central Tendency.

Mean (average):

$$\bar{x} = \frac{\sum f \cdot x}{\sum f}$$

$$\left. \begin{array}{l} \text{Median: } L + \frac{(n/2 - c.f.) \times h}{f} \\ \text{Mode: } L + \frac{(f_1 - f_0) \times h}{2f_1 - f_0 - f_2} \end{array} \right\}$$

These measures give us one number that represents the whole data mean shows the balance point, median the middle and mode the most common.

Range:

In % range = $\frac{\text{Max} - \text{Min}}{\text{Max} + \text{Min}}$

Mean deviation

$$M.D = \frac{\sum f |x - \bar{x}|}{\sum f}$$

Variance and Standard deviation

$$\sigma^2 = \frac{\sum f(x - \bar{x})^2}{\sum f}, \quad \sigma = \sqrt{\sigma^2}$$

Then **Quartiles** divide data into the 4 parts than again.

Deciles divide data into 10 equal parts.

Percentiles divide data into 100 equal parts.

Than Correlation introduces bivariate data
(two variables together, like hours studied vs exam marks)

Scatter Plot → to visualize relation (Positive, negative, none)

Karl Pearson's correlation coefficient (γ):

$$\gamma = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sqrt{\sum (x - \bar{x})^2} \sqrt{\sum (y - \bar{y})^2}}$$

Regression.

means predicting one variable from another. The eq of regression line of

$$\left[\begin{array}{l} y - \bar{y} = b_{yx}(x - \bar{x}) \\ b_{yx} = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sum (x - \bar{x})^2} \end{array} \right]$$

CH 3: Book

discrete Random Variables.

This chapter introduces discrete random variables that take countable values. It focuses on their probability distributions, expectations and important discrete models

Probability Mass and function

A discrete RV assigns probabilities to specific values
PMF

$$P(X=x_i) = p_i, \sum p_i = 1$$

Cumulative distribution Function.

Shows probability that $X \leq x$

Non decreasing, jumps at each possible value.

expected value (mean)

$$E[X] = \sum x_i p_i$$

Variance

$$\text{Var}(X) = E[(X - E[X])^2] = E[X^2] - (E[X])^2$$

important discrete distributions.

Bernoulli trial with success (p) / failure ($1-p$)

Binomial.

number of successes in n trials.

$$\text{is binomial } P(X=k) = \binom{n}{k} p^k (1-p)^{n-k}$$

Poisson.

counts of events in fixed interval with mean λ . $P(X=k) = e^{-\lambda} \lambda^k / k!$

Moment Generating functions

Provide a shortcut to find mean or variance.

intro:-

variables.

CH 1: Probability

Introduction:-

This chapter lays the foundation of probability theory. It defines probability formally, explores the different approaches, and introduces the rules that govern random events.

Basic Concepts

Experiment: any process with uncertain outcome
(tossing a coin)

Sample Space: set of all possible outcomes

event:-

subset of S (like getting heads)

Classical probability.

if outcomes are equally likely.

$$P(A) = \frac{\text{favorable outcomes}}{\text{total outcomes}}$$

Axiomatic definition

- $0 \leq P(A) \leq 1$

- $P(S) = 1$

- $P(A \cup B) = P(A) + P(B)$

Conditional Probability and independence

Conditional

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

law of total Probability and Bayes theorem.

Total probability rule: break complex problems into partitions

Bayes theorem: update probabilities with new evidence.

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

CH#2:

introduction.

This chapter explains how to count outcomes systematically, which is essential for probability problems

1: Basic Counting Rules

multiplication principle: if one event has m choices and another has n then

$$\text{total} = m \times n$$

2. factorials

$$n! = n \times (n-1) \times \dots \times 1$$

3. Permutations

No. of ways to arrange n . objects : $n!$
choosing r objects from n ,

$$P(n, r) = \frac{n!}{(n-r)!}$$

Combinations

$$\binom{n}{r} = \text{binom}\{n\}{r} = \frac{n!}{(n-r)!r!}$$

Multinomial Coefficients.

for dividing n objects into groups of sizes n_1, n_2, \dots, n_k

$$\text{Applications in Probability: } \frac{n!}{n_1!n_2!\dots n_k!}$$

Using Combinations and permutations to calculate probabilities in card games, lotteries, seating arrangements etc.