Box & whisher plot

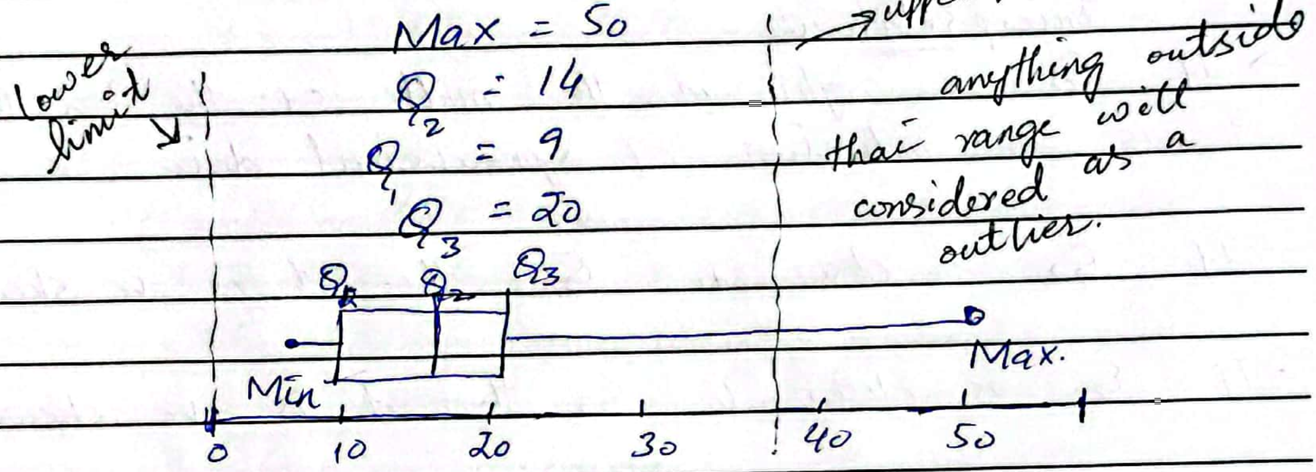
Date:

Following are the runs save by Rizwan
5, 6, 12, 13, 15, 18, 22, 50

(1) Construct Box & whisher plot?
(2) Interpret the results?

Solution:

Min = 5
Max = 50
Q_2 = 14
Q_1 = 9
Q_3 = 20



For the judgement of outliers:

$IQR = Q_3 - Q_1 \Rightarrow 20 - 9 = 11$

Lower Value: $Q_1 - 1.5 \times IQR$

$= 9 - 1.5(11) \Rightarrow -7.5$

Upper limit: $Q_3 + 1.5 \cdot IQR$
$= 20 + 1.5(11) \Rightarrow 36.5$

limit $(-7.5, 36.5)$
↓
0 as well because lowest value in dataset is 5.

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Date: Suspected Vs Confirmed outliers.

For surely checking an outlier, we could use

lower limit = $Q_1 - 3*IQR$

upper limit = $Q_3 + 3*IQR$

Interpretation:

The data is (-ve) negatively skewed.

Relative Measure of Dispersion

Dispersions

Absolute measure (units included)

→ ~~with~~ Range, S.D, Varience

Relative measure → no units

→ CV & CR

coefficient of variation = C.V. = $\frac{S}{\bar{x}} \times 100$

CR = Coefficient of Range = $\frac{X_m - X_o}{X_m + X_o} \times 100$

Notes: "Applications of CV"

to check the reliability of two or more data sets (Consistency of data sets)

Section 6A	Section 6B
$\bar{x} = 15$	$\bar{x} = 13$
S.D = 4	S.D = 2
$C.V = \frac{S.D}{\bar{x}} \times 100$	$C.V = \frac{S.D}{\bar{x}} \times 100 = \frac{2}{13} \times 100$
$= \frac{4}{15} \times 100 \Rightarrow 26.67\%$	C.V = 15.3% ✓
	→ more reliable

Date:

* The smaller the value of C.V the more consistant data will be.

→ for compairison of data don't use S.D

* We Should use CV to compair two or more data sets with same or different measurements units.

Chapter #5

probability : BackBone of Statistics
Numerical measurement of uncertainity
probability helps us to draw inference about the unknown population.
→ Inferential statistics.
→ Educated Guess
Experiment:
procedure to generate data
Random Experiment:
An experiment which produces different results if it is repeated a large a number of times under similar condition.

Trial: Single performance of an experiment
properties of Experiment:
Unperidectable → repeated
Conditions must be Same. → diff. results

Sample Space: S

The set of all possible outcomes of an experiments.

$$S = \{HH, HT, TH, TT\}$$

Event: Subset of Sample space.

→ Simple Event: Exactly one outcome

↳ Single out come.

→ Toss the coin twice

→ Compound Event:

↳ More than one out comes.

عجیب : عجیب ہے دنیا — نزدیک : موت

عجیب تر : دنیادار

واجب : گناہ سے توبہ کرنا — نزدیک تر : قیامت

واجب تر : فوراً توبہ کرنا

مشکل : مشکل ہے قبر میں اترنا

مشکل تر : صالح اعمال کے بغیر قبر میں اترنا

Role of probability in Computer Science:

→ predictions

→ Generalization

→ Decision Making

Date:

Axioms of probability : Assumptions

(1) $P(A) \geq 0$

(2) $\sum_{i=1}^{k} p(A_i) = 1$

(3) $P(\Phi) = 0$ impossible event Φ

(4) $p(S) = 1$ Sure event

$P(A) = \frac{n(A)}{n(S)}$ → No. of favourable events / → Total no. of events

Examples: Two dies were rolled, find the probability of sum of 7 or 11 on the upper face.

$n(S) = \{(1,1), (1,2), (1,3), (1,4), (1,5), (1,6)$
$(2,1), (2,2), (2,3), (2,4), (2,5), (2,6)$
$(3,1), (3,2), (3,3), (3,4), (3,5), (3,6)$
$(4,1), (4,2), (4,3), (4,4), (4,5), (4,6)$
$(5,1), (5,2), (5,3), (5,4), (5,5), (5,6)$
$(6,1), (6,2), (6,3), (6,4), (6,5), (6,6)\}$.

$n(A) = 6$, $n(B) = 2$

$P(A) = \frac{6}{36} = \frac{1}{6} = 0.1667$

$\boxed{P(A) = 16.67\%}$

$P(B) = \frac{n(B)}{n(S)} = \frac{2}{36} = \frac{1}{18} = 0.055$

$\boxed{P(B) = 5\%}$

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Date:

or = $\cup$ = add +

and = $\cap$ = *

Addition law:

→ for 2 independent Events / not mutually exclusive

→ Events are said to be "not mutually exclusive" when the occurance of 1 event does not effect the occurance of other event.

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

→ Mutually exclusive event occurs same at some point.

→ for 2 mutually exclusive events.

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

$$= \frac{6}{36} + \frac{2}{36} = 0.22$$

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

$$\boxed{P(A \cup B) = 22\%}$$

Interpretation:

There are 22% chance that when we roll two die that we obtain sum of 7 & 11 on upper face.

→ Additional law with Not mutually exclusive

→ Additinal law with mutually exclusive

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

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Date:

probability :

Q: A die is rolled, what is the probability that a die showing a number 3 or number 5 ?

Solution:

Let P(A) be the probability of getting number 3.

Let P(B) be the probability of getting number 5.

Sample Space = { 1, 2, 3, 4, 5, 6 } $\Rightarrow n(S) = 6$

$$P(A) = \frac{n(A)}{n(S)} = \frac{1}{6}$$

$$P(B) = \frac{n(B)}{n(S)} = \frac{1}{6}$$

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

$$= \frac{1}{6} + \frac{1}{6} = \frac{2}{6} \Rightarrow \frac{1}{3} = 33.3\%$$

So, the probability of getting 3 or 5 is 33%

Not Mutually exclusive

Date:

Complement Law:

Probability of not occurance

$$P(A) + P(A') = 1$$

probability of event occurance

$$P(A) = 1 - P(A')$$

$$P(A') = 1 - P(A)$$

→ Reduce the computation ~~work~~ work Atleast, atmost

Conditional probability:

Let "A" & "B" be the two events than

(1) $P(A/B) = \frac{P(A \cap B)}{P(B)}$, $P(B) \neq 0$

(2) $P(B/A) = \frac{P(A \cap B)}{P(A)}$, $P(A) \neq 0$

probability of event "A" given that event "B" had already occured.

Multiplication Law:

"Dependent Events"

(1) $P(A \cap B) = P(A) \cdot P\left(\frac{B}{A}\right)$

(2) $P(A \cap B) = P(B) \times P\left(\frac{A}{B}\right)$

Independent Events

$$P(A \cap B) = P(A) * P(B)$$

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Date: Complement Law

Example: If the probabilities that an automobile mechanic will service 3, 4, 5, 6, 7 or 8 or more cars on any given working day?

0.12, 0.19, 0.28, 0.24, 0.10 & 0.07

What is the probability that he will service at least 5 five cars on his next day at work?

Solution:

P(At least 5 cars service) = ?

Let A be the event that mechanic service at least 5 cars.

$P(A^c) = 1 - P(A')$ $P(A') = 0.12 + 0.19$

$P(A) = 1 - (0.12 + 0.19)$ ↓

$P(A) = 1 - 0.31$ Event that

$P(A^c) = 0.69$. won't occur.

There is 69% chance that he will service 5 or more than 5 cars on next working day

---

Conditional Law: Given that / prior

Suppose that in a population of adults in a small town who have completed the requirements of CD. we categorize them according to gender and Employement.

Date:

Gender	Employed	Unemployed	total
M	460	40	500
F	140	260	400
Total:	600	300	900

What is the probability that selected adult is a male, given that he is employed

Solution:

let "M" be the event that selected adult is a male.

let "E" be the event that selected adult is employed.

$P\left(\frac{M}{E}\right) = ?$ probability of Male given that hee is employed.

$$P\left(\frac{M}{E}\right) = \frac{P(M \cap E)}{P(E)} \quad \text{--- (i)}$$

$$P(E) = \frac{600}{900}$$

$P(M \cap E) = \frac{460}{600}$ put in eq (i)

$$\cancel{P\left(\frac{M}{E}\right) = \frac{460}{600} \times \frac{900}{600} = 0.128 = 12.8\%}$$

$$P(M/E) = \frac{460}{600} = 76.6\%$$

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Date:

A small town has 1 ambulance and 1 fire engine in case of emergency. The probability for fire Engine availability 0.98 The probability that ambulance is availability is 0.92

In a situation of injury find the probability that both fire Engine & ambulance are available?

$p(F) = 0.98$

$P(A) = 0.92$

Solution:

$= 0.98 \times 0.92 = 0.9016 \Rightarrow 90\%$

Laws of prob.

additional case1 (3), Case2 (2)

Multiplication Case 1 (3), Case 2 (2)

Conditional 5

Complement 2 — 3

Dependent Events → Mutually exclusive

Date:

permutation and Combination ~~tree diagram~~

These above are the counting techniques

permutations:

It is the ordered arrangement of objects

→Order

→Distinction

$$P_r^n = \frac{n!}{(n-r)!}$$

where, n = Total no. of objects

r = selected no. of objects

Combination:

It is the unordered arrangement of objects.

$$C_r^n \text{ OR } \binom{n}{r} = \frac{n!}{(n-r)!\,r!}$$

Q: A small community consist of 10 women each of whome have 3 children. If one women and 1 of her children to be choosen, How many different Choices are possible?

Sol:

: No order,

$$= \binom{10}{1}\binom{3}{1} = 10 \times 3 \Rightarrow 30$$

Q: A college planning commite consist of 3 freshman and 4 Sophomores, 5 juniors, & 2 Seniors. Sub comitte of 4, consisting of 1 person from each class?

Solution: No. Sub comitte = ?

$$\binom{3}{1}\binom{4}{1}\binom{5}{1}\binom{2}{1} = 120$$

Date:

How many different 7 place lisence plates are possible if the first 3 places are occupied by English letters and the final 4 are No.?

A-Z 0-9

| | | | | | | - | | | | | | | | | |

$$\binom{26}{1}\binom{26}{1}\binom{26}{1}\binom{10}{1} \Rightarrow 26\times26\times26\times10\times10\times10\times10$$

→ How many lisence plates whould be possible if repitition among letters or numbers where prohibited.

$$\binom{26}{1}\binom{25}{1}\binom{24}{1}\binom{10}{1}\binom{9}{1}\binom{8}{1}\binom{7}{1}$$

$$= 26\times25\times24\times10\times9\times8 * 7$$

→ How many different batting orders are possible for a cricket consisting of 5 batsman.

$$\binom{5}{1}\binom{4}{1}\binom{3}{1}\binom{2}{1} \Rightarrow 5\times4\times3\times2\times1 = 120$$

→ A class of probability consist of 6 men & 4 Girls. An Examination is given and the students are ranked according to their performance. No two std. have obtained the same scores. How many different rankings are possible?

Sol: $10!$

→ If the men are ranked just among the selves and the women just among them selves?

$= 6! \times 4!$

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Date:

Mr. abdur Rahman have 10 books. He is going to put the in his book shelf. 4 are math books, 3 are chemistry 2 history and 1 is for language. He wants to arrange his books so that all the books of the same subjects are together.

Ans: $4! \times 3! \times 2! \times 1$

A chess tournament have 10 competents of which 4 are for BS-2, 3 BS-4, 2 BS-6 and 1 BS-8. If the tournament result list just the semestors of the players in the order in which they placed. How many outcomes are possible?

Ans $= \dfrac{10!}{4! \times 3! \times 2! \times 1}$

How many differeni signals, each consisting of 9 flags hung in a line, can be made from of 4 white flags, 3 red & 2 blue flags if all flags of the sane color are ideticle?

$= \dfrac{9!}{4!3!2!}$

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Date:

Q: From a list of 12 players, 3 have to be selected as batsman, bowler and wicket keeper. Determine the possible No. of ways?

Ans $^{12}P_3 = \frac{12!}{(12-3)!} = \frac{12!}{9!} = 12 \times 11 \times 10 =$

From a list of 12 players (6 Bats, 6 bowl) 3 have to be selected. What is the probability that among selected players 2 are batsmen and 1 is bowler?

$P(A) = \frac{n(A)}{n(S)}$ $n(S) = \binom{12}{3}$

$n(A) = \underbrace{\binom{6}{2}}_{\text{Batsman}} \times \underbrace{\binom{6}{1}}_{\text{Bowler}}$

Data Entry

Histrogram

→ To add numerical Number to a Qualitative variable we use values Tab

Analyze → Descriptive Stats → Descriptive

Analyze → Descriptive → Frequencies.

Construct Charts.

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Date:

Bayer's Theorem:

In prob theory and Statistics, Bayer's theorem, named after thomas Bayers, describes the prob. of an event, based on the prior knowlege of conditions that might be related to the event.

Purpose:

It allows you to update the predicted probabilities of an event by incorporating new information.

Bayer Rules

It provides us with a way to update our beliefs based on the arrival of new, relevant pieces of evidence.

Real life Application:

If cancer corresponds to one's age then by using Bayer's theorem, we can determine the prob. of cancer. more accurately with the help of age.

Formula: let A, B be the two events, the.

$$P(A/B) = \frac{P(B/A) \cdot P(A)}{P(B)}$$

$P(B) \rightarrow$ Total probability

Date:

$$P(B) = P\left(\frac{B}{A}\right) \cdot P(A) + P\left(\frac{B}{A^c}\right) P(A^c)$$

Example:

Insaurance Company believes that people can be divided into two classes.

Accident prone =

not accident prone =

let A_1 and A be the two events, denote

A_1 = will have accident

A = Accident prone.

$$P\left(\frac{A_1}{A}\right) = 0.4$$

$$P\left(\frac{A_1}{A^c}\right) = 0.2$$

$$P(A) = 0.3$$

$$P(A_1) = ? \qquad P\left(\frac{A}{A_1}\right) = ?$$

$$P(A_1) = P\left(\frac{A_1}{A}\right) \cdot P(A) + P\left(\frac{A_1}{A^c}\right) \cdot P(A^c)$$

$$= 0.4 \times 0.3 + 0.2 \times 0.7$$

$$\boxed{P(A_1) = 0.26}$$

$$P\left(\frac{A}{A_1}\right) = \frac{P(A_1/A) \cdot P(A)}{P(A_1)} = \frac{0.4 \times 0.3}{0.26}$$

$$P\left(\frac{A}{A_1}\right) = 0.461$$

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Date:

Interpretation:

The probability of a new policy holder who is accident prone and has accident is 46%.

Q:2

Know answer = (P) let K, c be the 2 events

Guess $= (1-P)$ K = know answers

$P\left(\frac{c}{K^c}\right) = \frac{1}{m}$ C = Correct answer.

K^c = Guess

$P(K/c) = ?$

$$P\left(\frac{K}{C}\right) = \frac{P(K \cap C)}{P(C)}$$

$P(C) = P(C/K) \cdot P(K)$ and $P\left(\frac{c}{K^c}\right) \cdot P(K^c)$.

$= 1 \times p + \frac{1}{m}(1-P)$

$$P(C) = P + \frac{1-P}{m}$$

$$P(C) = \frac{mP + 1 - P}{m}$$

$$P(K \cap C) = \underbrace{P\left(\frac{C}{K}\right) \cdot P(K)}_{= 1 \times p}$$

$$\boxed{P(K \cap C) = P}$$

$$P\left(\frac{K}{C}\right) = \frac{P}{\frac{mP+1-P}{m}} \Rightarrow \frac{mP}{mP+1-P}$$

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Baye's Theorem

A laboratory blood test is 95% effective in detecting a certain disease when it is, in fact, present. However, the test also yields a "false positive" result of 1% of the healthy persons. If 0.5% of the population has the disease,

What is the prob. that a person has the disease given that the test result is ~~true~~ +ve??

Solution:

Let D be the event that person has the Disease

Let E be the event that result is +ve

$$P(D/E) = ?$$

$$P\left(\frac{D}{E}\right) = \frac{P(E/D) * P(D)}{P\left(\frac{E}{D}\right) * P(D) + P(E/D^c) * P(D^c)}$$

$P(D) = 0.005$ (Prior probability)

$P(D^c) = 1 - 0.005 \Rightarrow 0.995$

$P(E/D) = 0.95$

$P(E/D^c) = 0.01$

$$P(D/E) = \frac{0.95 * 0.005}{(0.95)(0.0.5) + (0.01)(0.995)}$$

$$\boxed{P(D/E) = 0.323 \Rightarrow \simeq 32\%}$$

Date:

Q: B_1 = 30% products | $P(D/B_1) = 2\%$

B_2 = 45% products | $P(D/B_2) = 3\%$

B_3 = 25% products. | $P(D/B_3) = 2\%$

Let "D" be the event that selected product is defective. $P(D) = ?$

Let "B_1" be the event that product is manufactured by machine B_1.

Let "B_2" --- --- --- --- by B_2 machine.

Let "B_3" --- --- --- --- by B_3 machine.

$$P(D) = P(D/B_1) \times P(B_1) + P(D/B_2) \times P(B_2) + P(D/B_3) \times P(B_3)$$

$$= (0.02)(0.3) + (0.03)(0.45) + (0.25)(0.02).$$

$$P(D) = 0.0245 \simeq 2.45\%$$

If selective product is defective what is the probability that it was made by B_3 = ?

$$P(B_3/D) = \frac{P(D/B_3) \times P(B_3)}{P(D)}$$

$$\boxed{P\left(\frac{B_3}{D}\right) = \frac{(0.02)(0.25)}{0.0245} = 20.41\%}$$