Department of Computer Science

Gujarat University

Certificate

Roll No: **30**   *Seat No:* ________

This is to certify that Mr./~~Ms.~~ ___***Rathod Ajinkya Sreekant***_________ *student of MCA Semester – III has duly completed his/~~her~~ term work for the semester ending in December 2020, in the subject of* _______________ ***Computer Oriented Statistical Methods (COSM)*** *towards partial fulfillment of his/~~her~~ Degree of Masters in Computer Applications.*

Date of Submission
11 - December - 2020

Internal Faculty

Head of Department

Department Of Computer Science
Rollwala Computer Centre
Gujarat University

MCA –III

Subject: - COMPUTER ORIENTED NUMERICAL METHODS

Name :- Ajinkya Rathod

Roll No.: - 30 **Exam Seat No.: -**______

Sr. No.	Contents	Date	Signature
1.	Central Tendency	11/12/2020	
2	Variation	11/12/2020	
3	Probability	11/12/2020	
4	Discrete / Continuous Random Variable	11/12/2020	
5	Binomial Probability Distribution	11/12/2020	
6	Poission Probability Distribution	11/12/2020	
7	Hyper Geometry Probability Distribution	11/12/2020	
8	Normal Probability Distribution	11/12/2020	
9	Exponential Probability Distribution	11/12/2020	
10	Uniform Probability Distribution	11/12/2020	

Computer Oriented Statistical Methods

Name: Ajinkya Rathod

MCA-3

Roll no- 30

Assignment-1

1. Consider number
2, 3, 4, 5, 5

(a.) Find mean, median and mode.

1. Mean

$$\bar{x} = \frac{\Sigma x_i}{n}$$

$$= \frac{2+3+4+5+5}{5}$$

$$= \frac{19}{5} = \boxed{3.8}$$

2. Median
(odd)

$$\frac{n+1}{2} = \frac{6}{2} = 3^{rd} \text{ Term}$$

$$\boxed{4}$$

3. Mode = 5

(b) Catalogue for colors of Shirt

Mode.

(c) One-way mileages

Mean
Median
Mode.

(d) Survey Respones from 1 to 5.

Mode
Median

Q2 Consider data set of 15 distinct measurements with mean A and median B.

a. If highest no. were increased, then

Ans The value of Σx_i will also increase
Median would remain same.

b. If highest no. were decreased, then

Ans Σx_i will also decrease
Median would be same.

c. Highest no. were decreased to value smaller than B, then

Ans Both mean and median would decrease.

Q3 Data set = 2, 2, 3, 6, 10

(i) Mean

$$\bar{x} = \frac{\Sigma x_i}{n}$$

$$= \frac{2+2+3+6+10}{\cancel{5}} = \frac{23}{5}$$

$$= \boxed{4.6}$$

(ii) Median

$$\left(\frac{n+1}{2}\right)^{th} \quad \left(\frac{\cancel{6}\ 3}{\cancel{2}}\right)^{th}$$

$$= 3$$

(iii) Mode = 2

$\rightarrow (\times 5)$ [Multiplied by 5]

(b) 10, 10, 15, 30, 50

$$Mean = \frac{\Sigma x_i}{n}$$

$$= \frac{115}{5}$$

$$= \boxed{23}$$

$$Median = \left(\frac{n+1}{2}\right)^{th}$$

$$= \boxed{15}$$

$$Mode = \boxed{10}$$

(c) Comparing & Results,

(i) The result of $\bar{x}, M, Z = 4.6, 3, 2$

(ii) The result of $\bar{x}, M, Z = 23, 15, 10$

The answer of $\bar{x}$, M and Z are multiplied by same number (i.e $= 5$).

(d) Mode = 70 inches
Medim = 68 inches
Mean = 71 inches

Find $\bar{x}$, M and Z in cms.

Mode = 70 × 2.54 = 177.8 cms
Medim = 68 × 2.54 = 172.72 cms
Mean = 71 × 2.54 = 180.34 cms

[Added by 5]

Q4 New set = 7, 7, 8, 11, 15

$\bar{x} = \frac{\Sigma x_i}{n} = \boxed{9.6}$

$M = \left(\frac{n+1}{2}\right)^{th}$ term

$= \left(\frac{6}{2}\right)^{th}$

$= \boxed{8}$

$Z = 7$

Comparing Results ----

The result of $\bar{x}$, M and Z are also added by 5.

Q5 Environmental Studies

x_i

146	144
152	146
168	152
174	152
180	165
178	168
179	168
180	174
178	178
178	178
168	178
165	177
152	180
144	180
2342	

$\bar{x} = \frac{\sum x_i}{n}$

$= \frac{2342}{14}$

$= \boxed{167.28}$

$$\text{Median} = \frac{1}{2}\left(\frac{n}{2}^{th} \text{ term} + \left(\frac{n+1}{2}\right)^{th} \text{ term}\right)$$

$$= \frac{1}{2}\left(\frac{14}{2}^{7th} + \frac{14}{2}+1^{\,8th \text{ term}} \text{ term}\right)$$

$$= \frac{1}{2}\left(168 + 174\right)$$

$$= \boxed{171}$$

Mode = 178

06 x_i

13
10
7
5
7
7
2
4
3
2
3
15
4
4
2
8
7
8

111

$$\bar{x}_i = \frac{\sum x_i}{n}$$

$$= \frac{111}{18} = \boxed{6.16}$$

$$M = \frac{\left(\frac{n}{2}\right)^{th} + \left(\frac{n}{2}+1\right)^{th}}{2}$$

$$= \frac{5+7}{2}$$

$$= \boxed{6}$$

$$Z = \boxed{7}$$

Upper

Q7 x_i

1
1
1
2
3
3
3
3
4
6
9
10

36

$\bar{x} = \frac{\sum x_i}{n} = \frac{36}{11} = 3.27$

$M = \frac{n+1}{2} = \frac{12}{2} = 6^{th} = 13$

$Z = 3$

Lower

x_i

0
0
1
1
1
1
2
2
3
6
7
8
13
14

59

$\bar{x} = \frac{\sum x_i}{n}$

$= \frac{59}{14} = 4.2$

$M = \frac{2+2}{2} = 2$

$Z = 1$

Q8

40
40
45
50
50
55
60
60
60
65
67
71
89
125
130
235
250
350
375
500
2723

$$\bar{x} = \frac{\sum x_i}{n}$$

$$= \frac{2723}{20}$$

$$= \boxed{136.15}$$

$$M = \frac{\left(\frac{n}{2}\right)^{th} + \left(\frac{n}{2}+1\right)^{th}}{2}$$

$$= \frac{10^{th} + 11^{th}}{2}$$

$$= \frac{65+68}{2}$$

$$= \boxed{66.5}$$

$$Z = \boxed{60}$$

Assignment - 2

Variation

Q1 (a)

x	y	x^2	y^2
11	10	121	100
0	-2	0	4
36	29	1296	841
21	14	441	196
31	22	961	484
23	18	529	324
24	14	576	196
-11	-2	121	4
-11	-3	121	9
-21	10	441	100
103	90	4607	2258

Find mean, variance and std dev.

$\bar{x} = \Sigma$. Find Σx, Σx^2, Σy and Σy^2

(b) Find mean, variance and std dev of x and y.

x	$x_i - \bar{x}$	$(x_i - \bar{x})^2$
11	0.7	0.49
0	-10.3	106.09
36	25.7	660.49
21	10.7	114.49
31	20.7	428.49
23	12.7	161.29
24	13.7	187.69
-11	-21.3	453.69
-11	-21.3	453.69
21	-31.3	979.69
103	0	3546.1

$$\bar{x} = \frac{\sum x_i}{n} = \frac{103}{10}$$

$$\boxed{\bar{x} = 10.3}$$

Variance

$$s^2 = \frac{\sum (x_i - \bar{x})^2}{n-1} = \frac{3546.1}{9}$$

$$\boxed{= 394.01}$$

$$\text{std dev} = \sqrt{s^2} = \sqrt{394.01} = 19.85$$

(b)(i) $(y_i - \bar{y})$

(a)

y	$y - \bar{y}$	$(y_i - \bar{y})^2$
10	1	1
-2	-11	121
29	20	400
14	5	25
22	13	169
18	9	81
14	5	25
-2	-11	121
-3	-12	144
-10	-19	361
90	0	1448

$$\bar{x} = \frac{\sum x_i}{n} = \frac{90}{10} = 9$$

$$v^2 = \frac{\sum (y_i - \bar{y})^2}{n-1} = \frac{1448}{10-1} = \frac{1448}{9}$$

$$\boxed{v^2 = 160.89}$$

$$\text{std dev} = \sqrt{v^2} = \sqrt{160.89} = 12.68$$

(c) Compute 75% chebshv interval around mean for x and y.

Also use intervals to compare two funds.

Ans 75%

$\bar{x} \pm 2s = 10.3 - 2(19.85)$ | $10.3 + 2(19.85)$

$= -29.4$ | $= 50$

For x: Interval is between -29.4 to 50.

$\bar{x} + 2s = 9 - 2(12.68)$ | $9 + 2(12.68)$

$= -16.36$ | $= 34.36$

For y: Interval is between -16.36 to 34.36

Vanguard Balanced Index has smaller spread than Vanguard stock index

C

Find range, mean, variance and std dev.

x_i	$(x_i-\bar{x})$	$(x_i-\bar{x})^2$	x_i	$x_i-\bar{x}$	$(x_i-\bar{x})^2$
0.54	.7	0.49	0.09	-1.15	1.32
1.80	.56	.31	0.19	-1.06	1.12
1.52	.28	.08	0.34	-0.9	0.81
2.05	.81	.66	1.51	0.27	0.07
1.03	-.21	.04	1.48	0.21	0.04
1.18	-.06	0.0036	1.52	0.28	0.09
0.80	-0.44	0.19	0.19	-1.05	1.10
1.33	.09	.0081	1.55	0.31	0.10
1.29	0.05	.0025	0.02	-1.22	1.49
1.11	-.13	0.02	0.07	-1.17	1.37
3.34	2.1	4.44	0.65	-0.59	0.35
1.54	.3	0.09	0.40	-0.84	0.71
0.08	-.16	1.31	0.04	-1	1
0.12	-1.12	1.25	1.51	0.27	0.07
0.60	-0.64	0.41	1.45	0.21	0.04
0.72	-0.52	0.27	1.60	0.36	0.13
0.92	-0.32	0.10	1.80	0.56	11.70
1.05	-0.19	0.04	4.69	3.45	1.35
1.43	0.19	0.04	0.08	-1.16	44.2
3.03	1.79	3.20	7.89	6.65	44.22
1.81	0.57	0.32	1.58	0.34	0.12
2.17	0.93	0.86	1.64	0.4	0.16
0.63	-0.61	0.37	0.03	-1.21	1.46
0.56	-0.68	0.46	0.23	-1.01	1.0
0.03	-1.21	1.46	0.72	-0.52	0.27
					89

$$s^2 = \frac{87}{50} = 1.75$$

$$s = \sqrt{1.75} = 1.33$$

(d) Calculate Co-eff of variation

$$\text{Co-eff of } s^2 = \frac{s}{\bar{x}} \times 100$$

$$= \frac{1.33}{1.27} \times 100$$

$$= \underline{\underline{1.07\ \%}}$$

(e) Smaller C.V indicates more consistent data coz. value of std. dev. in numerator is smaller.

Q3 Calculate C.V. (Co-eff of variation)

(i) $\bar{x} = 9.58\%$
$s = 14.05\%$

$C.V = \frac{14.05}{9.58} \times 100$

$= 146.7\%$

(ii) $\bar{x} = 9.02\%$
$s = 12.50\%$

$C.V = \frac{12.50}{9.02} \times 100$

$= 138.6\%$

Q4 Calculate ~~C.V~~ std. dev

$\bar{x} = 2.2$
$C.V = 1.5\%$

$C.V = \frac{s}{\bar{x}} \times 100$

$1.5 = \frac{s}{2.2} \times 100$

$= 0.033$

Probability

1. Steps Outcomes

Steps	Outcomes
1	3
2	2
3	4

Total Outcomes = $3 \times 2 \times 4$
= 24 outcomes

2. How many ways can 3 items be selected from a group of 6 items

$${}^{6}C_{3} = \frac{6!}{3!(6-3)!}$$

$$= \frac{\cancel{6} \times 5 \times \cancel{4}^{2} \times \cancel{3} \times 2 \times 1}{\cancel{3 \times 2} \times \cancel{3} \times \cancel{2}_{1}} = 20$$

[order is not important so used combination].

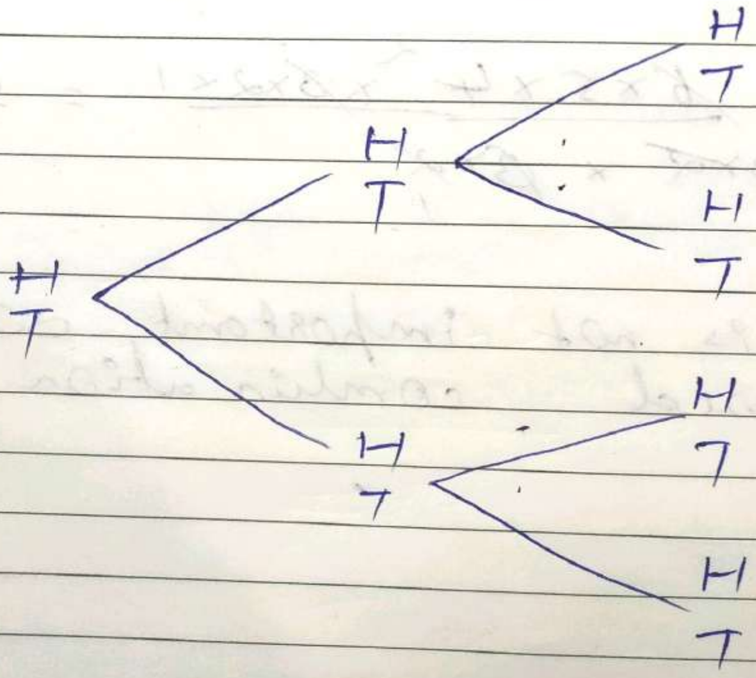
(3) Permutation of 3 items from 6 items

$$^6P_3 = \frac{6!}{(6-3)!}$$

$$= \frac{6 \times 5 \times 4 \times \cancel{3!}}{\cancel{3!}}$$

$$= 120 \text{ ways}$$

(4) Tree Diagram to toss One coin 3 times



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(b) $\{$ (HHH), (THH)
(HHT), (THT)
(HTH), (TTH)
(HTT), (TTT) $\}$

(c) $\frac{1}{8} = \underline{0.125}$

(5.) Outcoms = E_1, E_2, E_3, E_4, E_5.

Prob. that E_1 will occur $= \frac{1}{5} = 0.2$

Prob. that E_2 will occur $= \frac{1}{5} = 0.2$

Prob. that E_3 will occur $= \frac{1}{5} = 0.2$

Prob. that E_4 will occur $= \frac{1}{5} = 0.2$

Prob that E_5 will occur $= \frac{1}{5} = 0.2$

★ FOR i = Outcoms

$0 \leq P(E_i) \leq 1$ for all i

Thus outcome is always between 0 to 1

* $P(E_1) + P(E_2) + P(E_3) + P(E_4) + P(E_5)$

$= 0.2 + 0.2 + 0.2 + 0.2 + 0.2$

$= 1$

Thus, Total outcoms is always 1

Q6

Exp.	Outcoms	Prob.
E_1	20	$20/50 = 0.40$
E_2	13	$13/50 = 0.26$
E_3	17	$17/50 = 0.34$
	50	

" Relative Frequency Method "

Q7

$P(E_1) = 0.10$
$P(E_2) = 0.15$
$P(E_3) = 0.40$
$P(E_4) = 0.20$

$\neq 1$

Total is not 1.

So, assigned prob. are not valid.

Discrete / Continous Random Variable

Q1. Random Variable

It provides a means for describing experimental outcomes using numerical values

It is a numerical description of outcome of an experiment.

It can be a
- Discrete Random Variable
  OR
- Continous Random Variable.

Q2 (a) Discrete Random Variable and Continous Random variable

(i) Discrete variate is a variable whose value is obtained by counting

Ex: no. of students in class
no. of marbles in jar

(ii) Continous Variable is variable whose value is obtained by measuring

Ex- height of students
distance travelled

Determine

Q3 (1) Discrete or Continous
(2) Range

(1.) Tossing coin with outcome head

-> Discrete

Range = 0, 1 0 : Not head
1 : Head

(2.) Tossing 2 coins with outcome tail

-> Discrete

Range : 0, 1, 2 0 : HH
1 : HT, TH
2 : TT

(3.) Time between 2 Flights arrival

Continous
Range : $x \geq 0$

(4.) Distance between

Continous
Range : $x \geq 0$

(5) Outcome of football match

Discrete

Range: 0, 1, 2

0 for lose

1 for win

2 for Tie

(6.) Person selected in interview

Discrete

Range: 0, 1, ---

Person 1

Person 2

(7.) weight

Continous

Range: $x > 0$

Poison Probability Distribution

- It is used to model random variables arrivals in waiting line situations

- A discrete random variable is often useful in estimating no. of occurances over a specified interval of time or space.

* Properties of Poisson Experiment

1. The probability of an occurance is same for any two intervals of equal length.

2. The occurances or unoccurance in any interval is independent of occurance or unoccurance in any other interval.

* Poisson Prob. Function

$$f(x) = \frac{\mu^{x} - e^{-\mu}}{x!}$$

$f(x)$ = prob. of occurance "x" in a interval

μ = expected value or mean no. of occurances

$e = 2.71828$

Q39 Given : $\mu = 2$

(a) $f(x) = \frac{\mu^x e^{-\mu}}{x!}$

$= \frac{2^x e^{-2}}{x!}$

(b) Expected no. of occurances in 3 time periods is $\underline{6}$.

(c) $f(x) = \frac{6^x e^{-6}}{x!}$

$\underline{\mu = 6}$

(d) Prob. of 2 occurans in one 3 time period

$\mu = 2$
$x = 2$

$f(2) = \frac{2^2 e^{-2}}{2!}$

$= \underline{0.2706}$

(e) Compute the probability of six occurances in 3 periods

→ Given: For three time periods $\mu = 6$

$x = 6$

$$f(6) = \frac{6^6 - e^{-6}}{6!}$$

$$= \frac{46,656(0.0025)}{720}$$

$$= 0.1606$$

(F) Compute prob. of five occurances in a given period.

→ Given: $\mu = 4$

$x = 5$

$$f(5) = \frac{4^5 e^{-4}}{5!}$$

$$= \frac{1024(0.0183)}{100}$$

$$= 0.1563$$

Q40 $\mu = 4$ 3/hr

$$f(3) = \frac{4^3 e^{-4}}{3!}$$

$$= \frac{64(0.0183)}{6}$$

$$= 0.1952$$

b) $\mu = 12$
$x = 10$

$$f(10) = \frac{10^{10} e^{-12}}{10!}$$

$$= 0.1043$$

(c) $\mu = 4$

$$f(0) = \frac{4^0 e^{-4}}{0!}$$

$= 0.0183$

(d) $$f(0) = \frac{2.4^0 e^{-2.4}}{0!}$$

$= 0.0907$

Uniform Prob. Distribution

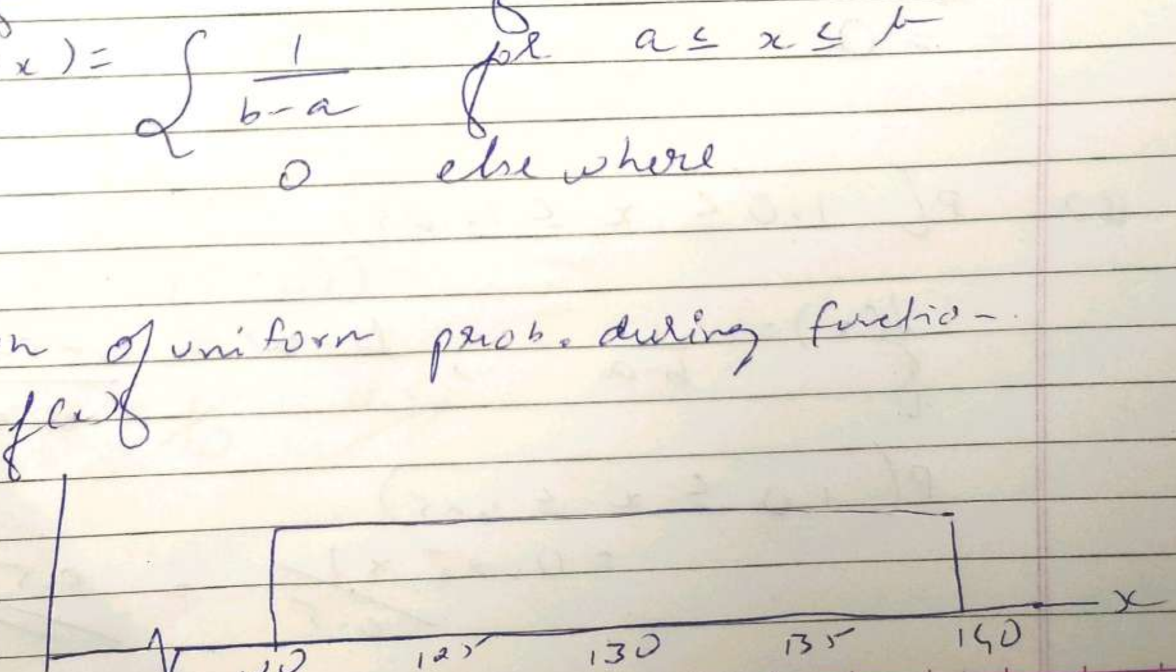
* Uniform Prob. Distribution

A continous prob. dist. for which prob. that the random variable will assure a value in any interval is same for each interval of equal length.

* Uniform Prob. Density Function

$$f(x) = \begin{cases} \frac{1}{b-a} & \text{for } a \le x \le b \\ 0 & \text{elsewhere} \end{cases}$$

* Graph of uniform prob. during functio-

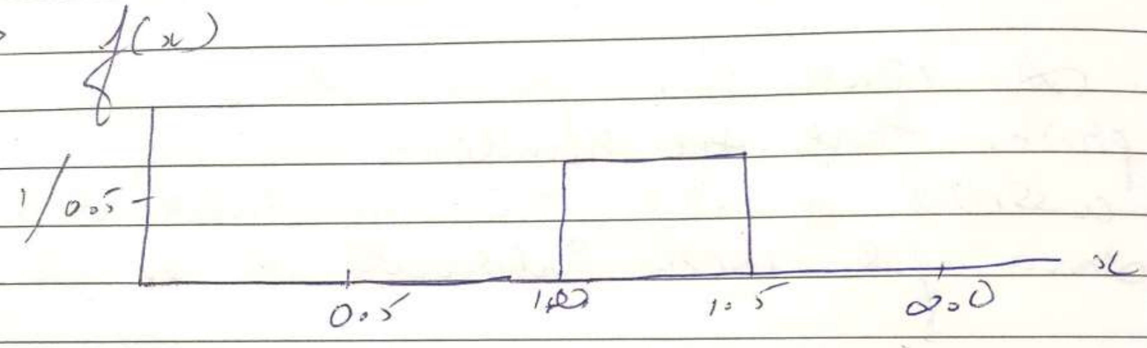


Exercises

(1) Random variable is known to be uniform distributed between 1.0 and 1.5.

(a) Show graph of probability density function.

→



(b) $P(x = 1.125)$

$= 0$

(c) $P(1.0 \leq x \leq 1.25)$

$f(x) = \frac{1}{b-a}$; $b - a = \frac{1.25 - 1.0}{0.25}$

$P(1.0 \leq x \leq 1.25)$

$= 0.25 \times \frac{1}{0.5} = 0.5$

(d) $P(1.20 < x < 1.5)$

$(b-a) = (1.5 - 1.2) = 0.3$

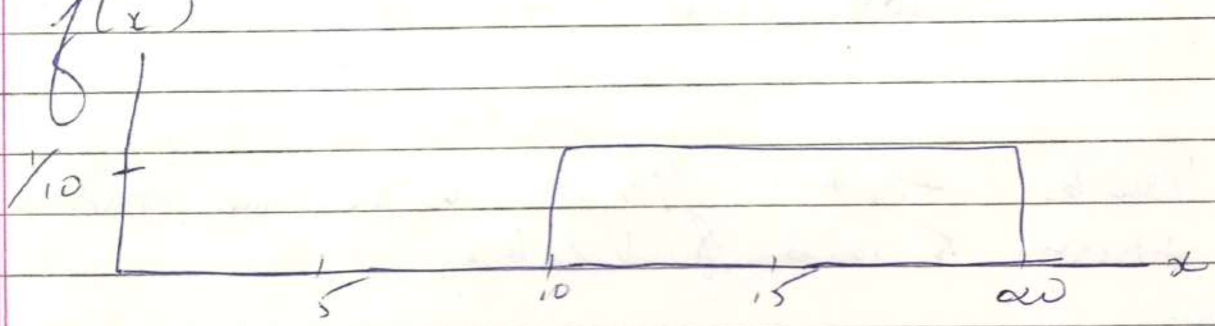
$P(1.2 < x < 1.5)$

$= 0.3 \times \frac{1}{0.5} = \underline{\underline{0.6}}$

Q2 Random variate x is known to be uniform distributed between 10 to 20.

(a) Show graph of prob. density function.

→



(b) $P(x < 15)$

$(b-a) = (15-10)$
$= 5$

$5 \times \frac{1}{10} = \underline{\underline{0.5}}$

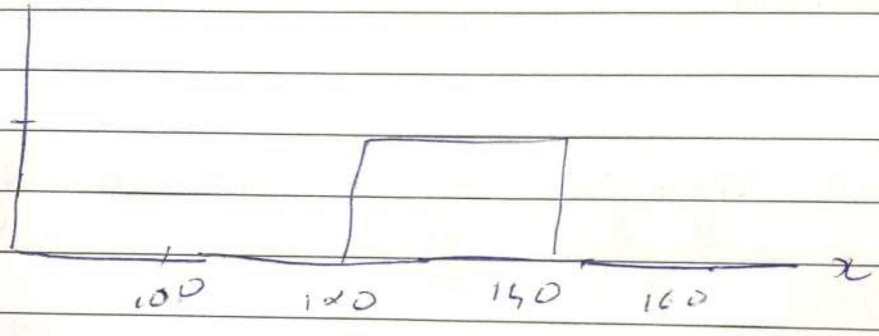
(c) $P(12 \leq x \leq 18)$

$(b-a) = (18-12)$
$= 6$

$6 \times \frac{1}{10} = 0.6$

Q3

(a) $\frac{1}{20}$



(b) Prob. that flight will no more than 5 mins of late.

-> $(b-a) = (130-120) = 10$

$10 \times \frac{1}{\cancel{20}_{2}} = 0.5$

(c) $(b-a) = 140 - 135 = 5$

$$5 \times \frac{1}{20} = \underline{\underline{0.25}}$$

Q6 $f(x) = \frac{1}{b-a}$

$$= \frac{1}{26-18} = \underline{\frac{1}{8}}$$

$(b-a) = (26-25) = 1$

$$1 \times \frac{1}{8} = \underline{\underline{0.125}}$$

(b) $(b-a) = 25 - 21 = 4$

$$= 4 \times \frac{1}{8} = \underline{\underline{0.5}}$$

(c) $30 - 22 = 8$ mins

$$(10-8) \times \frac{1}{8}$$

$$\frac{\cancel{2}\,1}{\cancel{8}\,4} = \underline{\underline{0.25}}$$

Hypergeometric Prob. Dist.

It is closely related to binomial distribution.

The two probability distributions differ in two keys ways

→ In hypergeometric distribution, the trials are not independent.

→ The prob. of success changes from trial to trial

* Hypergeometric Prob. Function

It is used to compute the prob. that in a random selection of n elements, selected without replacement, we obtain x elements labeled success and n-x elements labeled failure

$$f(x) = \frac{\binom{r}{x}\binom{N-r}{n-x}}{\binom{N}{n}}$$

Q46

$N = 10 \quad r = 3$

(a) $n = 4, \quad x = 1$

$$f(x) = \frac{\binom{r}{x}\binom{N-r}{n-x}}{\binom{N}{n}}$$

$$f(1) = \frac{\binom{3}{1}\binom{10-3}{4-1}}{\binom{10}{4}}$$

$$= \frac{\left(\frac{3!}{1!\,2!}\right)\left(\frac{7!}{3!\,4!}\right)}{\left(\frac{10!}{4!\,6!}\right)}$$

$$= 0.5$$

(b) $n = 2$
$x = 2$

$$f(2) = \frac{\binom{3}{2}\binom{7}{0}}{\binom{10}{2}}$$

$$f(2) = \underline{\underline{0.067}}$$

(c) $n = 2$
$x = 0$

$$f(0) = \frac{\binom{3}{0}\binom{7}{2}}{\binom{10}{2}}$$

$$= \underline{\underline{0.4667}}$$

(d) $n = 4$
$x = 2$

$$f(2) = \frac{\binom{3}{2}\binom{7}{2}}{\binom{10}{4}}$$

$$= \underline{\underline{0.3}}$$

2.) $n=4$ $x=4$

Given x is greater than r so,
$f(4)=0$

Q48

$N=10$
Football $=7$
Basketball $=3$

(a) What is prob. that exactly two prefer football?

→ $N=10$ $n=3$
$x=2$ $r=7$

$$f(x)=\frac{\binom{r}{x}\binom{N-r}{n-r}}{\binom{N}{n}}$$

$$=\frac{\binom{7}{2}\binom{3}{1}}{\binom{10}{3}}$$

$= 0.525$

(b) $f(2) = \dfrac{\binom{7}{2}\binom{3}{1}}{\binom{10}{3}}$

$= 0.525$

$f(3) = \dfrac{\binom{7}{3}\binom{3}{0}}{\binom{10}{3}} = 0.2917$

$= 0.8167$

(c) $f(x) = 1 - f(0) - f(1)$

$= 1 - 0.0112 - 0.0725$

$= 0.9163$

(d) $N = 60$ $\quad n = 10$

$x = 9$ $\quad r = 40$

$f(9) = \dfrac{\binom{40}{9}\binom{20}{1}}{\binom{60}{10}}$

$= 0.0725$

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Chapter-5

Binomial Prob. Distribution

* $f(x) = \binom{n}{x} p^x (1-p)^{n-x}$

$x = 2 \quad n = 6$

$f(2) = \binom{6}{2} p^2 (1-p)^4 = (2)^6 (.22)^2 (.78)^4$

$f(2) = .2789$

(b)

$f(2) = .2789$
$f(3) = .1111$
$f(4) = .0247$
$f(5) = .0030$
$f(6) = .0001$

$\Big\}\ 0.4178$

$$P(x \geq 3) = f(3) + f(4) + f(5) \cdots f(10)$$

$$\left.\begin{array}{ll}
f(3) & = .2668 \\
f(4) & = .2001 \\
f(5) & = .1029 \\
f(6) & = .0368 \\
f(7) & = .0090 \\
f(8) & = .0014 \\
f(9) & = .0001 \\
f(10 & = .0000
\end{array}\right\} 0.6171$$

Q30 Prob. that defective part being produced must be 0.03.

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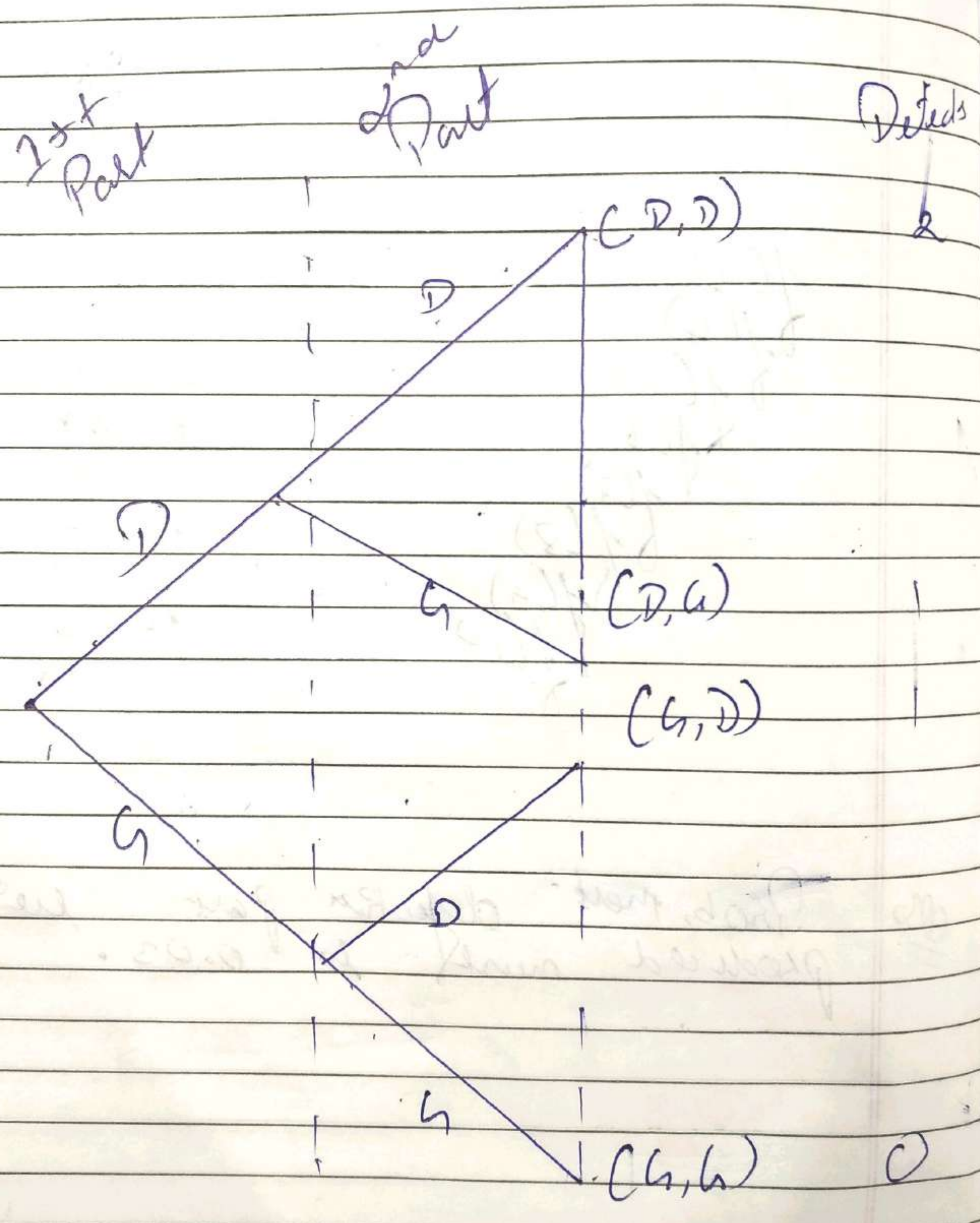

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(c) Two outcomes with one defective found.

$$P(0) = \binom{2}{0}(0.03)^0(0.97)^2$$

$= .97 \times .97$

$= .9409$

$$P(1) = \binom{2}{1}(0.03)^1(0.97)^1$$

$= 0.0582$

$$P(2) = = \binom{2}{2}(0.03^2)(0.97)^0$$

$= 0.0009$

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Hypothesis Testing

Q.

$\mu \geq 20$
$\mu < 20$

$n = 50$ $\bar{x} = 19.4$ $\sigma = 2$

$$z = \frac{\bar{x} - \mu_0}{\sigma_{\bar{x}}}$$

$$= \frac{19.4 - 20}{0.2828}$$

$$= -2.12$$

$\sigma_{\bar{x}} = \sigma / \sqrt{n}$

$= 2 / 7.0711$

$= 0.2828$

(iv) $P(z \geq -2.12)$

$= 0.0170$

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d) $\mu \le 25$
$\mu > 25$

$n = 40$ $\bar{x} = 26$ $\sigma = 6$

(a) $z = \frac{x - \mu_0}{\sigma_{\bar{x}}}$

$= \frac{26.4 - 25}{0.9487}$

$z = \underline{\underline{1.4757}}$

Given $\alpha = 0.01$

p-value $< \alpha$ ✓ accept

p-value ≥ 0.01 ✗ reject

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(ii) $\mu = 15$
$\mu \neq 15$

$a = \frac{\bar{x} - \mu_0}{\sigma_{\bar{x}}}$

$= \frac{14.15 - 15}{0.4243}$

$\boxed{z = -2}$

(b) p-value $P(z \geq -2)$

$\mu = 15$ double p-value

$2(P(z \geq 2)) = 2(0.0228)$

$= 0.0456$

(c) $\alpha = 0.05$ p-value $\leq \alpha$, × rejt

α p-value $\leq \alpha$, × reject

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Q Given $H_0 : \mu = 22$
$H_a : \mu \neq 22$

$n = 75$ $\quad \sigma = 10$ $\quad \alpha = 0.01$
$\mu_0 = 22$

$\sigma_{\bar{x}} = \sigma / \sqrt{n}$

$= 10 / \sqrt{75}$

$= 1.1547$

(a) $\bar{x} = 23$

$z = \dfrac{\bar{x} - \mu_0}{\sigma_{\bar{x}}}$

$= \boxed{0.87}$

FOR $\mu_0 = 22$ p-value

$2[P(z \geq 0.87)$

$= 2(0.1922)$

$= 0.3844$

Not rejected

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(b) $\bar{x} = 25.1$

$$z = \frac{25.1 - 22}{1.1547}$$

$$= \underline{2.68}$$

p-value $= 2P(z > 6.8)$

$= 2(0.0037)$
$= 0.0074$

Not rejected

(c) $\bar{x} = 20$

$$z = \frac{20 - 22}{1.1547}$$
$$= \underline{-1.73}$$

P-value $= 2P(z \geq -1.73)$

$= 2(0.0418)$
$= 0.0836$

P-value ≥ 0.01. So, not rejected