Q.1.a) Ans

Arranging given data in ascending order:

30	35	35	36	37	40	42	45
47	48	48	50	55	55	55	60
63	65	67	70	70	71	75	79
80	80	85	90	94	95		

i) Presenting in stem and leaf display:

Stem	Leaf (unit 1)
3	0, 5, 5, 6, 7
4	0, 2, 5, 7, 8, 8
5	0, 5, 5, 5,
6	0, 3, 5, 7
7	0, 0, 1, 5, 9
8	0, 0, 5
9	0, 4, 5

ii) $n = 30$

$$Q_1 = \left(\frac{n+1}{4}\right)^{th} \text{ item}$$

$$= \left(\frac{31}{4}\right)^{th} \text{ item}$$

$$= (7.75)^{th} \text{ item}$$

$$= 42 + 0.75 * (45-42)$$

$$= 44.25$$

$$Q_3 = \left\{\frac{3(n+1)}{4}\right\}^{th} \text{ item}$$

$$= \left(\frac{3*31}{4}\right)^{th} \text{ item}$$

$$= (23.25)^{th} \text{ item}$$

$$= 75 + 0.25 * (79-75)$$

$$= 76$$

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

Ctd $\rightarrow$

$= \left(\frac{31}{2}\right)^{th}$ item

$= 15.5^{th}$ item

$= \frac{55+60}{2}$

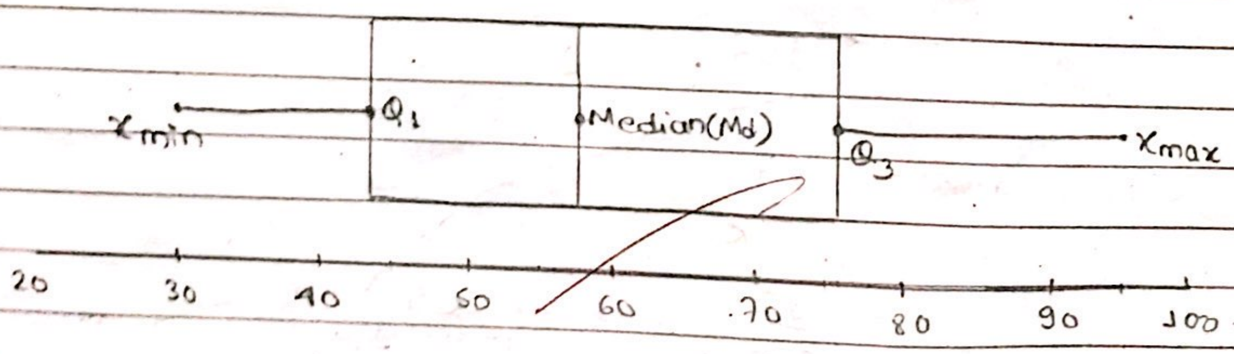
$= 57.5$

$x_{min} = 30$

$x_{max} = 95$

Box and whisker plot:

x_{min}	Q_1	Median	Q_3	x_{max}
(30)	(44.25)	(57.5)	(76)	95



Distance betⁿ $(Q_1 - X_{min}) = 44.25 - 30 = 14.25$

Distance betⁿ $(X_{max} - Q_3) = 95 - 76 = 19$

Distance betⁿ $(Md - X_{min}) = 57.5 - 30 = 27.5$

Distance betⁿ $(X_{max} - Md) = 95 - 57.5 = 37.5$.

∴ The distribution is $\boxed{\text{right-skewed}}$

iii) Using strnuge's formula;

$$\text{Range} = X_{max} - X_{min}$$
$$= 95 - 30$$
$$= 65$$

$$k = 1 + 3.322 \log n$$
$$= 1 + 3.322 \log(30)$$
$$= 5.906$$

$$\text{Class width} = \frac{\text{Range}}{k}$$
$$= \frac{65}{5.906} = 11.005$$

By using struge's formula, we got class width of 11.005.
Taking approximate value i.e, 10.

Constructing continuous class ~~of~~ interval:

~~30-40~~

class interval	frequency.
30 - 40	5
40 - 50	6
50 - 60	4
60 - 70	4
70 - 80	5
80 - 90	3
90 - 100	3

iv) From given individual data:

Median speed is calculated as.

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

$$= \left(\frac{31}{2}\right)^{th} \text{ item}$$

$$= 57.5$$

Gd

* 25% speed can be calculated as-

$$P_{25} = \left\{ 25\left(\frac{n+1}{100}\right) \right\}^{th} \text{ item}$$

$$= \left(\frac{25 * 31}{100}\right)^{th} \text{ item}$$

$$= (7.75)^{th} \text{ item}$$

$$= 44.25$$

Now,

75% speed can be calculated as-

$$P_{75} = \left\{ 75\left(\frac{n+1}{100}\right) \right\}^{th} \text{ item}$$

$$= \left(\frac{75 * 31}{100}\right)^{th} \text{ item}$$

$$= (23.25)^{th} \text{ item}$$

$$= 76$$

Ans

8

Soln;

N

Q.1.b) Ans

Soln;

Calculation table for sample bulbs from A supplier:

length of life (hrs)	Sample from A f_A	x	x^2	$f_A \cdot x$	$f_A \cdot x^2$
700-900	10	800	640000	8000	6400000
900-1100	16	1000	1000000	16000	16000000
1100-1300	26	1200	1440000	31200	37440000
1300-1500	8	1400	1960000	11200	15680000
	$\Sigma f_A = 60$			$\Sigma f_A x = 66400$	$\Sigma f_A x^2 = 7552000$

~~Mean~~

Now,

Mean of A supplier is given by,

$$\bar{x}_A = \frac{\Sigma f_A x}{\Sigma f_A}$$

$$= \frac{66400}{60}$$

$$= 1106.66$$

~~Standard~~ Standard deviation of A supplier is given by

$$\sigma_A = \sqrt{\frac{\Sigma f_A x^2}{\Sigma f_A} - \left(\frac{\Sigma f_A x}{\Sigma f_A}\right)^2}$$

$$= \sqrt{\frac{75520000}{60} - \left(\frac{66400}{60}\right)^2}$$

$$= 184.27$$

Coeff of variance of A supplier is given by.

$$C.V_A = \frac{\sigma_A}{\bar{x}_A} \times 100\%$$

$$= \frac{184.27}{1106.66} \times 100\%$$

$$= 16.65\%$$

Now,

Calculation table for sample bulbs from B supplier

ad

$\rightarrow$

Length of life (hrs)	Sample from B (f_B)	x	x^2	$f_B \cdot x$	$f_B \cdot x^2$
700-900	3	800	640000	2400	1920000
900-1100	42	1000	1000000	42000	42000000
1100-1300	12	1200	1440000	14400	17280000
1300-1500	3	1400	1960000	4200	5880000
	$\Sigma f_B = 60$			$\Sigma f_B x = 63000$	$\Sigma f_B \cdot x^2 = 67080000$

Now,

Mean of B supplier is given by

$$\bar{x}_B = \frac{\Sigma f_B \cdot x}{\Sigma f_B}$$

$$= \frac{63000}{60}$$

$$= 1050$$

Standard deviation of B supplier is given by,

$$\sigma_B = \sqrt{\frac{\Sigma f_B x^2}{\Sigma f_B} - \left(\frac{\Sigma f_B x}{\Sigma f_B}\right)^2}$$

$$= \sqrt{\frac{67080000}{60} - \left(\frac{63000}{60}\right)^2}$$

$$= 124.49$$

Co-eff of variance of B supplier is given by

$$C.V_B = \frac{\sigma_B}{\bar{x}_B} * 100\%$$

$$= 11.85\%$$

a) A company's bulb gives a higher life as, $\bar{x}_A > \bar{x}_B$.

b) As,

$$C.V_B < C.V_A$$

So, the B company's bubls are more uniform because lower C.V leads to more uniformity.

Ans

Q. 2.a) Ans

Baye's theorem states that, for events E_i, given the cond^n C.

$$P(C/E_i) = \frac{P(C) * P(E_i/c)}{\sum_{i=1}^{n} [P(C) * P(E_i/c)]}$$

Soln;

Total students (n) = 75.

Total intelligent students = 15

Total medium students = 45

Total below average students = 15.

Probability of intelligent students, $P(I) = \frac{15}{75} = 0.2$

Probability of medium students, $P(M) = \frac{45}{75} = 0.6$

Probability of below average students, $P(B) = \frac{15}{75} = 0.2$.

Probability that intelligent student fail in examination,

$P(F/I) = 0.005$

Probability that intelligent student pass in examination,

$P(Pa/I) = 1 - P(F/I)$

$= 0.995$

Probability that medium student fail in examination,

$P(F/M) = 0.05$

Probability that medium student pass in examination

$P(Pa/M) = 1 - P(F/M)$

$= 0.95$

Probability that below average student fail in examination,

$P(F/B) = 0.15$

Probability that below average student pass in examination,

$P(Pa/B) = 1 - 0.15$

$= 0.85$

P(I)

P(

P(B)

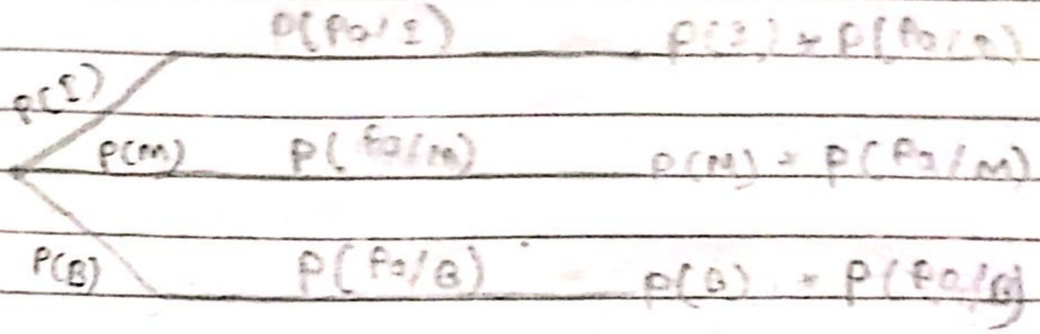
Now,

If a stude

tion, the

is given

P(B/



Now,

If a student is known to have passed the examination, the probability that he is below the average is given by,

$$P(B/Pa) = \frac{P(B) * P(Pa/B)}{P(B) * P(Pa/B) + P(I) * P(Pa/I) + P(M) * P(Pa/M)}$$

$$= \frac{0.2 * 0.85}{0.2 * 0.85 + 0.2 * 0.995 + 0.6 * 0.95}$$

$$= 0.18$$

8

Ans

Q.3.b) Ans

Given:

$$f(x,y) = 4xy \quad ; 0<x<1 \; , \; 0<y<1$$

$$ = 0 \quad ; \text{otherwise}$$

i)

~~we know that~~,

$$\int_0^1 \int_0^1 4xy \, dx \, dy$$

$$= \int_0^1 \left[\frac{\cancel{4}^{2} x^2 y}{\cancel{2}} \right]_0^1 dy$$

$$= \int_0^1 2y \, dy$$

$$= \left[\frac{\cancel{2} \cdot y^2}{\cancel{2}} \right]_0^1$$

$$= 1$$

verified

ii)

Marginal of X

$$f(x) = f_X(x) = \int_0^1 4xy \, dy$$

$$= \left[4x \cdot \frac{y^2}{2} \right]_0^1$$

$$= \left[2xy^2 \right]_0^1$$

$$= 2x$$

Marginal of Y

$$f(y) = f_Y(y) = \int_0^1 4xy \, dx$$

$$= \left[\frac{4x^2}{2} \cdot y \right]_0^1$$

$$= \left[2x^2 y \right]_0^1$$

$$= 2y$$

ctd

iii)

Conditional of X given Y is,

$$f(X/Y) = \frac{f(x,y)}{f(Y)}$$

$$= \frac{4xy}{2y}$$

$$= 2x$$

Conditional of Y given X is,

$$f(Y/X) = \frac{f(x,y)}{f(x)}$$

$$= \frac{4xy}{2x}$$

$$= 2y$$

2

iv)

$$f(x) * f(y) = 2x * 2y$$
$$= 4xy$$
$$= f(x,y)$$

As, $f(x) * f(y) = f(x,y)$, x and y are independent.

Q.4.b) Ans

sample (n) = 12.

sample mean ($\bar{x}$) = 31.9

sum of square of deviation from mean, $\Sigma(\bar{x}-x_i)^2 = 125$.

Now,

sample standard deviation is given by,

$$S = \sqrt{\frac{1}{n-1} * \Sigma(\bar{x}-x_i)^2}$$

$$= \sqrt{\frac{1}{11} * 125}$$

$$= 3.37.$$

for 95% confidence interval.

$$C.I = \left[\bar{x} \pm Z_{\frac{\alpha}{2}} \cdot \frac{S}{\sqrt{n}}\right]$$

$$= \left[31.9 \pm 1.96 * \frac{3.37}{\sqrt{12}}\right]$$

$$= [31.9 \pm 1.906]$$

ndent. B

$\therefore$ The 95% cofidence interval for population mean is,

$$[29.994,\ 33.806]$$

<u>for 99% confidence interval,</u>

$$C.I = \left[\bar{x} \pm Z_{\frac{\alpha}{2}} \cdot \frac{s}{\sqrt{n}} \right]$$

$$= \left[31.9 \pm 2.58 * \frac{3.37}{\sqrt{12}} \right]$$

$$= [31.9 \pm 2.509]$$

$\therefore$ The 99% confidence interval for population mean is.

$$[29.391,\ 34.409]$$

Ans 2

8

Q.5.a) <u>Ans</u>

Given;

$n = 10.$

Roll no.	Before training (x)	After training (y)	$d = y - x$	d^2
1	12	15	3	9
2	14	16	2	4
3	11	10	-1	1
4	8	7	-1	1
5	7	5	-2	4
6	10	12	2	4
7	3	10	7	49
8	0	2	2	4
9	5	3	-2	4
10	6	8	2	4
			$\Sigma d = 12$	$\Sigma d^2 = 84$

Now,

$$\bar{d} = \frac{\Sigma d}{n}$$

$$= \frac{12}{10}$$

$$= 1.2$$

Ctd →

$$S_d = \frac{1}{n-1}\sqrt{\Sigma d^2 - \frac{(\Sigma d)^2}{n}}$$

Again,

$$S_d = \sqrt{\frac{1}{n-1}\left(\Sigma d^2 - \frac{(\Sigma d)^2}{n}\right)}$$

$$= \sqrt{\frac{1}{9}\left(84 - \frac{12^2}{10}\right)}$$

$$= 2.78$$

Null Hypothesis:

$H_0: \mu_x = \mu_y$

[The training was not effective]

Alternative Hypothesis:

$H_1: \mu_x < \mu_y$ [left tail]

[The training was effective].

Test statistics:

Under H_0,

$$t = \frac{\bar{d}}{S_d/\sqrt{n}}$$

$$= \frac{1.2}{2.78/\sqrt{10}}$$

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$= 1.36$

$\therefore |t_{cal}| = 1.36$

Confidence Interval:

$(1-\alpha)\%$

$= 95\%$

Level of significance:

$\alpha\% = 5\%$

Degree of freedom:

$n-1 = 9$

$t_{\alpha, n-1} = -1.833$

$\therefore |t_{tab}| = 1.833$

Decision:

$|t_{cal}| < |t_{tab}|$; Ho accepted.

Conclusion:

The training was effective.

Ans

8

Q.5.b) Ans

Given,

~~P=0.98~~

Total sample (n) = 250

No. of students not submitting assignment = 15.

No. of students submitting assignment = 235

~~probability~~ sample proportion of submitting assignment is,

$$p = \frac{235}{250} = 0.94 \quad , \quad q = 0.06.$$

$P = 0.98$

Null Hypothesis:

$$H_0 : P = 0.98$$

[The claim of coordinator is correct].

Alternative Hypothesis:

$$H_1 : P < 0.98 \text{ (left tail)}$$

[The claim of coordinator is incorrect].

Test statistics: under H_0

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$$Z = \frac{p - P}{\sqrt{\frac{PQ}{n}}}$$

$$= \frac{0.94 - 0.98}{\sqrt{\frac{0.94 \times 0.06}{250}}}$$

$$= -2.663$$

$\therefore |Z_{cal}| = 2.663$

Confidence Interval:

$(1-\alpha)\% = 90\%$

level of significance:

$\alpha\% = 10\%$

$Z_\alpha = -1.28$

$\therefore |Z_{tab}| = 1.28$

Decision:

$|Z_{cal}| > |Z_{tab}|$

so,

Ho is rejected.

Conclusion:

The claim of coordinator in a college that at least 98% of the students submit their assignment on time is incorrect.

Ans

Q.6.a) Ans

Type of feed	Nature of teeth		
	normal	Defective	Total
Breast	18	12	30
bottle	2	13	15
	20	25	45

less than 5

Null Hypothesis: Ho

[The type of feeding and nature of teeth are dependence].

CH

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Alternative hypothesis: H_1

[The type of feeding and nature of teeth are not dependence]

Test statistics: under Ho

$$\chi^2 = \frac{45 * (18*13 - 12*2)}{30 * 15 * 20 * 25}$$

$$\frac{N\left[(ad-bc) - \frac{N}{2}\right]^2}{(a+b)(b+c)(c+d)(a+d)}$$

corrected

$$= 0.042$$

$$|\chi^2_{cal}| = 0.042$$

Confidence Interval.

$(1-\alpha)\% = 95\%$

B

level of significance

$\alpha\% = 5\%$

Degree of freedom :

$(r-1)(c-1)$

$= (2-1)(2-1)$

$= 1*1$

$= 1$

$|\chi^2_{tab}| = 3.841$

Ct.

Decision:

$|\chi^2_{cal}| > |\chi^2_{tab}|$, Ho is rejected

Conclusion:

The type of feeding and nature of teeth are not dependence.

Ans

Q.6.b) Ans

Soln,

Given;

$n = 7$

i)

ctd →

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Marks A (x)	Marks B (y)	xy	x^2	y^2
46	40	1840	2116	1600
42	38	1596	1764	1444
44	36	1584	1936	1296
40	35	1400	1600	1225
43	39	1677	1849	1521
41	37	1517	1681	1369
45	41	1845	2025	1681
$\Sigma x = 301$	$\Sigma y = 266$	$\Sigma xy = 11459$	$\Sigma x^2 = 12971$	$\Sigma y^2 = 10136$

The simple regression eqn of y on x is given by.

$$y = a + bx$$

The value of constants a and b can be determined by fitting two normal equation by least square estimation.

$$\Sigma y = na + b\Sigma x$$

or, $266 = 7a + 301b$ ——— (1)

$$\Sigma xy = a\Sigma x + b\Sigma x^2$$

or, $11459 = 301a + 12971b$ ——— (2)

solving (1) and (2), we get;

$$a = 5.75$$

and,

$$b = 0.75$$

The estimated regression eqn of Y on x is

$$\hat{y} = 5.75 + 0.75x$$

ii)

when $x = 37$,

$$\hat{y} = 5.75 + 0.75 * 37$$

$$= 33.5$$

∴ The ~~e~~estimated value of y is 33.5 when x is 37.

iii)

$$\text{standard error of estimate} = \sqrt{\frac{\Sigma y^2 - a\Sigma y - b\Sigma xy}{n - k - 1}}$$

$$= \sqrt{\frac{10136 - 5.75 * 266 - 0.75 * 11459}{7 - 1 - 1}}$$

$$= 1.322$$

iv)

correlation co-eff $(r) = \dfrac{n\Sigma xy - \Sigma x \cdot \Sigma y}{\sqrt{n\Sigma x^2 - (\Sigma x)^2} \cdot \sqrt{n \cdot \Sigma y^2 - (\Sigma y)^2}}$

$= \dfrac{7 * 11459 - 301 * 266}{\sqrt{7 * 12971 - 301^2} \cdot \sqrt{7 * 10136 - 266^2}}$

$= 0.75$

$\therefore$ coefficient of determination $= r^2$

$= 0.75^2$

$= 0.5625$

5+3

Ans

Q.4.a) Ans

$P(X>63) = 0.15.$

$P(X<63) = 1-0.15$

$= 0.85$

when $x = 63$

$$z = \frac{x-\mu}{\sigma}$$

or, $$0.1368 = \frac{63-\mu}{\sigma}$$

or, $0.1368\sigma = 63-\mu$

or $0.1368\sigma + \mu = 63$ —— (1)

Also,

$P(X<32) = \cancel{10}\%\ 0.10$

when $x = 32$,

$$z = \frac{x-\mu}{\sigma}$$

or, $$-0.1554 = \frac{32-\mu}{\sigma}$$

or, $-0.15541\sigma = 32 - \mu$

or, $-0.15541\sigma + \mu = 32$ —— (2)

solving (1) and (2), we get,

$\sigma = 106.09$

$\mu = 48.48$

Now,

$P(20 < X < 80)$

~~when~~ when $x = 20$.

$z = \dfrac{x - \mu}{\sigma}$

$= \dfrac{20 - 48.48}{106.09}$

$= -0.26$

$\therefore P(X < 20) = P(0.5 - 0.26)$

$= P(0.24)$

$= 0.64$

$\therefore$ ~~P(X<20)~~ $P(X > 20) = 1 - 0.64 = 0.36$

when $x = 80$

$$z = \frac{x-\mu}{\sigma}$$

$$= \frac{80-48.48}{106.09}$$

$$= 0.29$$

$$P(X<80) = P(0.5+0.29)$$

$$= P\,(0.21)$$

$$= 0.55$$

$$\therefore P(20 < X < 80) = P(X<80) - P(X>20)$$

$$= 0.55 - 0.36$$

$$= 0.19$$

Ans

Q.3.a) Ans

Given;

$$\text{mean}(\lambda) = 3.$$

i) more than 3 accidents

$$P(X>3) = 1 - P(X \leq 3)$$

$$= 1 - [P(X=0) + P(X=1) + P(X=2) + P(X=3)]$$

$$= 1 - \left[\frac{e^{-3} * 3^0}{0!} + \frac{e^{-3} * 3^1}{1!} + \frac{e^{-3} * 3^2}{2!} + \frac{e^{-3} * 3^3}{3!} \right]$$

$$= 0.35$$

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ii) at least 1 accident:

$$P(X \geq 1) = 1 - P(X<1)$$

$$= 1 - [P(X=0)]$$

$$= 1 - \left[\frac{e^{-3} * 3^0}{0!} \right]$$

$$= 0.95$$

Ans

3