(a)

(i) Population: Collection of all possible individual units (persons, objects, experimental outcome whose characteristics are to be studied)

Sample: A part of population tha is studid to learn more about the entire population.

(ii) Parameter: A quantitative measure that describes a characteristic of population.

Statistics: A quantitative measure that describes a characteristic of a sample.

(iii) Quantitative Data: Assume numerical values, which are normally as a result of measurements.

Quantitative Data: Also known as categorical data or attribute are data whose values fall into one or another of a set of mutually exclusive and exhaustive classes.

(b) (i) Sturges' Approximation:

$K = 1 + 3.322 \log_{10} n$

$n = 70$

$\therefore K = 1 + 3.322 \log 70$

$7.1294 = 7$

\- (ii) Range, R = Maximum observation – Minimum obersation

$= 80 - 11 = 69$

Class width, $C = \frac{R}{K} = \frac{69}{7} = 9.857 = 10$

Grouped Frequency Distribution of Shoes

Weight of Packet	Tally	Class width	Frequency	Cumulative Frequency	Fix
10.5 - 20.5	### //	15.5	7	7	108.5
20.5 - 30.5	### ### ### ### /	25.5	21	28	535.5
30.5 - 40.5	### ### /	35.5	11	39	390.5
40.5 - 50.5	### ### ### //	45.5	17	56	773.5
50.5 - 60.5	### //	55.5	7	63	388.5
60.5 - 70.5	###	65.5	5	68	327.5
70.5 - 80.5	//	75.5	2	70	151.0
			70		2675

$$\text{Mean} = \frac{\Sigma fx}{\Sigma f} = \frac{2675}{70} = 38.2143$$

$$\text{Median} = Lm + \left[\frac{\frac{n}{2} - fcm}{Fm} \right] Cm$$

Lm: Lower Class Boundary of the median class

fcm : Cumulative frequency just before median class

fm: Frequency of median class

Cm: Class width of median class

n: Total frequency

Lm = 30.5; fcm = 28; fm = 39; n = 70; Cm = 10

$$\therefore \text{Median} = 30.5 + \left[\frac{\frac{70}{2} - 28}{11} \right] 10$$

$$= 30.5 + 6.36$$
$$= 36.86$$

$$= 37$$

$$= Lo + \left(\frac{\Delta_1}{\Delta_1 + \Delta_2} C \right)$$

Lo: Lower class boundary of model class

Δ_1: Absolute difference between frequencies of pre-model and model classes

Δ_2: Absolute difference between frequencies of post-model and model classes

C: Class width of model class

Lo = 20.5; Δ_1 = 121 – 71 = 14;
Δ_2 = 121 – 11 \ = 10; C = 10

$$\text{Mode} = 20.5 + \frac{14}{24} + 10 = 26.33 = 26 \text{ (CAO)}$$

SOLUTION 2

(a)

Vehicle Number	Age (x)	Maintenance Cost (Y)	χY	X^2
1	2	60	120	4
2	8	132	1,056	64
3	6	100	600	36
4	8	120	960	64
5	10	150	1,500	100
6	4	84	336	16
7	4	90	360	16
8	2	68	136	4
9	6	104	624	36
10	10	140	1,400	100
	E x = 60	EY = 1,048	E xY = 7,092	E x^2 = 440

$\hat{Y} = a + 6x$, where

$$\hat{b} = \frac{\Sigma xY - \frac{\Sigma x \ \Sigma Y}{n}}{\Sigma x^2 - \frac{(\Sigma x^2)}{n}}$$

$$= \frac{7092 - \frac{(60 \times 1048)}{10}}{440 - \frac{(60)2}{10}}$$

$$= \frac{7092 - 6288}{440 - 360}$$

$$\hat{b} = \frac{7092 - 6288}{440 - 360}$$

$$= \frac{804}{80}$$

$$\hat{b} = \underline{10.05}$$

$$\hat{a} = Y - bx$$

$$\frac{\Sigma Y}{n} - b \frac{\Sigma x}{n}$$

$$= \frac{104.8}{10} - \hat{b}\frac{60}{10}$$

$\hat{a}$ = 104.8 – b, where b = 10.05

$\hat{a}$ = 104.8 – 10.05x

$\hat{a}$ = 104.8 – 60.3

$\hat{a}$ = 44.5

:. Y = 44.5 + 10.5x

(b) Maintenance Cost Table

Years (x)	Module $\bar{Y}$ = 44.5 + 10.05 x	Maintenance Cost GHS
1	44.5 + 10.05 (1)	54.55
2	44.5 + 10.05 (2)	64.60
3	44.5 + 10.05 (3)	74.65
4	44.5 + 10.05 (4)	84.70
5	44.5 + 10.05 (5)	94.75
6	44.5 + 10.05 (6)	104.80
7	44.5 + 10.05 (7)	114.85
8	44.5 + 10.05 (8)	124.90
9	44.5 + 10.05 (9)	134.95
10	44.5 + 10.05 (10)	145.00

(c) Estinmate cost of maintaining a 12 year old vehicle

$\bar{Y}$ = 44.5 + 10.05x, where x = 12

$\bar{Y}$ = 44.5 + 10.05 (12)

Y = 165.10

When there is a change in $\bar{x}$, $\bar{Y}$ change by $\hat{b}$, where $\hat{a}$ is constant.

SOLUTION 3

(a)

(i) NPV ÷ is the present value of cash flows minus the present value of cash outflows

$$NPV = \sum_{t=o}^{n} \frac{\text{cash inflow at time t}}{(l+i)^t} \quad \sum_{t=o}^{n} \frac{\text{Cash outflow at time t}}{(l+i)^t}$$

(ii) IRR ÷ is the interest rate that causes the net present value to equal l zero:

$$NPV = \sum_{t=o}^{n} \frac{\text{Net cashflow at time t}}{(l + IRR)^t} = o$$

(b) (i) Let Cash Inflow = + , Cash outflow = -

Time	0	1	2	3	4	5
Cash Flow	-30,000	14,000	12,000 -4,000	10,000	18,000 -3,000	10,000

= 10% = 0.1

(ii) $$NPV = \sum_{t=o}^{n} \frac{\text{Cash Inflow at time t}}{(1+i)^t} - \sum_{t=o}^{n} \frac{\text{Cash Outflow at time t}}{(1+i)^t}$$

$$NPV = \frac{14,000}{(1.1)} + \frac{12,000}{(1.1)^2} + \frac{10,000}{(1.1)^3} + \frac{18,000}{(1.1)^4} + \frac{10,000}{(1.1)^5} - 30,000 - \frac{4,000}{(1.1)^2} - \frac{3,000}{(1.1)^4}$$

ALITER

NET INFLOW - NET

$$= 1000 \left(\frac{14}{1.1} + \frac{12}{1.1^2} + \frac{10}{1.1^3} + \frac{18}{1.1^4} + \frac{10}{1.1^5} - 30 - \frac{4}{1.1^2} - \frac{5}{1.1^4} \right)$$

$$NPV = 1000 \left(\frac{14}{1.1} + \frac{8}{1.1^2} + \frac{10}{1.1^3} + \frac{15}{1.1^4} + \frac{10}{1.1^5} - 30 \right) = GHS13,306.41$$

(iii) Yes, since the NPV > 0

(c)

(i) Net Cash Flow (GHS)

Time	0	1	2
Net Cash Flow (GHS)		1,000	-1,200

(ii) For IRR , NPV = 0

$$NPV = \sum_{t=u}^{n-2} \frac{\text{Net Cashflow at time t}}{(1 + IRR)^t} = 0$$

$$\frac{1000}{(1 + IRR)} - \frac{1200}{(1 + IRR)^2} = 0$$

$$1000\,(1 + IRR) - 1200 = 0$$

$$(1 + IRR) = \frac{1200}{1000} = 1.2$$

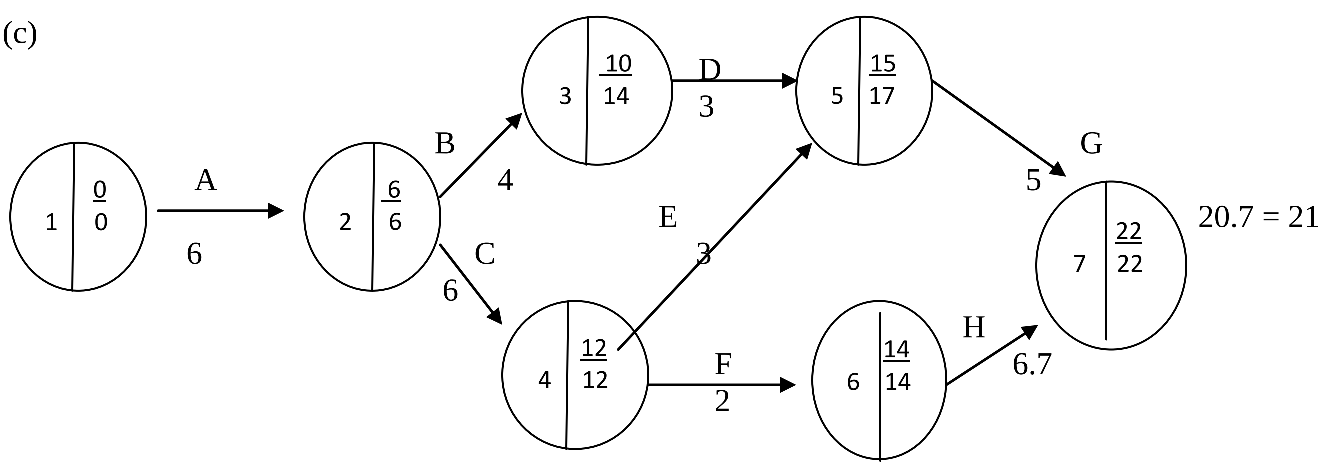
$$= IRR = 0.2 \text{ or } 20\%$$

SOLUTION 4

(a) (b)

Task	Preceeding Task	Exepected completion time		Standard deviation of completion time	
A	-	$\frac{(9 + 3 + (4 X 6))}{6}$	6	$\frac{(9 – 3)}{6}$	1
B	A	$\frac{(1 + 7 + (4 X 4)}{6}$	4	$\frac{(7 – 1)}{6}$	1
C	A		6	$\underline{(3 – 3)}$	0
D	B		3		1
E	C		3		1
F	C		2		1
G	D,E		5		1
H	F		8		2/3

(c)



(d) Critical path A, C F, H
Earliest completion time 20.7/21 weeks

(e) Variance of critical path $= (1^2 + 1^2 + 1^2 + 2/3^2)$
$= 3\ 4/9$
Standard deviation $= 1.857$

(f) Project completion time = 21 weeks
Standard deviation = 1.857 weeks
Prob (less then 20 weeks) : $Z = \frac{20 - 21}{1.857}$
$Z = 0.5385$

∪

From normal distribution tables $P(Z < -0.5385) = 0.5 - 0.2054$

$= \underline{\underline{0.2946}}$

SOLUTION 5

(a) Basic laws of Probability:
- Multiplicative Law states that:

If A and B are independent events then $P(A \cap B) = P(A)P(B)$
(i) If A and B are dependent events then $P(A \cap B) = P(A)P(B/A) = P(B)P(A/B)$
- Additive law states that:
(i) If A and B are events then:

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

If A and B are mutually exclusive events then $P(A \cup B) = P(A) + P(B)$

(b)

	Wuoyirie	Veverie	Zukyirie	Total
Outpatient treatment	40	45	35	120
Hospitalization	80	30	40	150
Physician's Bill	60	35	55	150
Total	180	110	130	420

(i) Prob (bill is from Veverie clan) $= \frac{110}{420}$
$= \underline{\underline{0.262}}$

(ii) Prob (Hospitalization or Zukyirie clan)

= Prob (Hospitalization) + P (Zukyirie clan) - (Hospitalization and Zukyirie clan)

$$= \frac{150}{420} + \frac{130}{420} - \frac{40}{420}$$

$$= \frac{4}{7}$$

$$= \underline{\underline{0.571}}$$

(iii) $$P(\text{Wuoyirie clan/Hospitalization}) = \frac{P(\text{Hospitalization and Wuoyirie clan})}{P(\text{Hospitalization})}$$

$$= \frac{80}{150}$$

$$\underline{\underline{= 0.533}}$$

(iv) Number of outpatient from Wuoyirie or Zuleyirie = 75

Total number of patients = 420

$$\therefore \Pr\{\text{Outpatient from either Wuoyirie or Zuleyirie}\} = \frac{75}{420}$$

(v) Number of outpatients or Physician visitor from Veverie = 80

Total number of patients = 420

$$\therefore \{\text{Outpatient or visits Physician from Veverie}\} = \frac{80}{420}$$

(vi) Number of hospitalized patient from <u>Veverie and Wuoyirie</u> = 0

$$\therefore \Pr\{\text{Hospitalized from Veverie and Wuoyirie}\} = \frac{0}{420} = 0$$

(vii) Number of patients of the description = 40 + 30 + 55 = 125

Total number of patients = 420

$$\therefore \{\Pr\ \text{Outpatient from wuoyirie or Hospitalized from Veverie or visit Physician and from Zukyirie}\} = \frac{125}{420}$$

SOLUTION 6

(a) We use the least square linea regression to find the trend. Let y = a + bx , a and b to be determined.

	x (quarters)	Revenue (y)	xy	x^2
2007	1	37	37	1
	2	58	116	4
	3	67	201	9
	4	49	196	16
2008	5	38	190	25
	6	59	354	36
	7	68	476	49
	8	50	400	64
2009	9	40	360	81
	10	60	600	100
	11	70	770	121
	12	51	612	144
2010	13	42	546	169
	14	61	854	196
	15	72	1080	225
	$\Sigma x = 120$	822	6792	1240

(b) Least square equation):

$$\Sigma y = ax + b\,\Sigma x \quad : \quad 822 = 15a + 120b$$
$$\Sigma xy = a\,\Sigma x + b\,\Sigma x^2 \quad : \quad 6792 = 120a + 1240b$$

⇨ $216 = 280b$

or $b = \frac{216}{280} = 0.77$

Then $15a = 822 - (120)(0.77) = 729.6$

$a = 48.64$

∴ Trendline = $48.64 + 0.77x$

(c) The trendline $48.64 + 0.77x$ used to do estimates:

	x (quarters)	y (Revenue)	Estimated Revenue	Actual/Estimate x 100%
2007	1	37	49.41	74.88
	2	58	50.18	115.88
	3	67	50.95	131.50
	4	49	51.72	94.74
2008	5	38	52.49	72.39
	6	59	53.26	110.78
	7	68	54.03	125.86
	8	50	54.80	91.24
2009	9	40	55.57	71.98

	10	60	56.34	106.50
	11	70	57.11	122.57
	12	51	57.88	88.11
2010	13	42	58.65	71.61
	14	61	59.42	102.66
	15	72	60.19	119.62

2007: 1^{st} Quarter Estimate = 48.64 + 0.77 (1) = 49.41

2^{nd} Quarter Estimate = 48.64 + 0.77 (2) = 50.18 etc.

(d) Averaging the % variation for the quarters

	Q1	Q2	Q3	Q4
	75	116	132	95
	72	111	126	91
	72	107	123	88
	72	103	120	274
	291	437	501	
	$291/4^2$	$437/4^2$	$501/4^2$	$274/3^2$
Average Seasonal Variations	73%	109%	125%	91%

(e) Seasonally adjusted forecast = Trend Estimate x Seasonal Variations %

	x (quarters)	y (Revenue)	Seasonally adjusted forecast
2007	1	37	36.07
	2	58	54.50
	3	67	63.69
	4	49	47.07
2008	5	38	38.32
	6	59	58.05
	7	68	67.54
	8	50	49.87
2009	9	40	40.57
	10	60	61.41
	11	70	71.39
	12	51	52.67
2010	13	42	42.81
	14	61	64.77
	15	72	75.24

(f) P From the trendline, the 4th quarter of 2010 is obtained as follows:

Basic trnd = 48.64 + 0.77 (16)
= 60.96

Seasonal adjustment for 4th Quarter = 91%

∴ Adjusted Forecast = 60.96 x 91%
= 55.47

SOLUTION 7

(a) Reasons include:

1. Protection against delayed supply
2. Protection against fluactuating demand
3. Protection against price changes (inflation)
4. Savings or ordering cost
5. Benefits of large quantities discount

(b) Assumptions are:

1. The demand for the item is constant over time.
2. Within the range of quantities to be ordered, the per unit holding cost and ordering cost are independent of the quantity ordered.
3. The replenishment arrives exactly when the inventory level reaches zero.

(c) (i) Demand (D) = GHS500.00
Ordering cost (K) = GHS8.00
Holding cost (H) = 0.2 (20%)

$$EOQ = \sqrt{\frac{2DK}{H}} = \sqrt{\frac{2 \times 8 \times 500}{0.2}} = \sqrt{40,000} = \underline{\underline{GHS200}}$$

(ii) Annual demand GHS500.00
EOQ = GHS200.00
∴ Number of times orders are placed in a year = D/EOQ = $\frac{500}{200}$ = 2.5 times

Approximately 3 times

(ii) Total annual ordering cost = Number of orders in a year x ordering cost
= 2.5 x 8 = $\underline{\underline{\text{GHS20.00}}}$

(iii) Total annual holding cost $= \frac{HD}{2}$

$= \frac{0.2 \times 200}{2} = \underline{\underline{GHS20.00}}$

(iv) If D quadruples from 500 to 2,000

the EOQ $= \sqrt{\frac{2 \times 8 \times 2000}{0.2}} = \sqrt{160000}$

$=$ GHS400.00

EOQ douples from GHS200 to GHS400 ie GHS200