

Q NO (1)

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Trip distribution of 8-zone required in question by using Gravity model.

$i$	$A_i$	$F_{ij} = 1 / m_{ij} c$	$K_{ij}$	$A_i F_{ij} K_{ij}$	$P_{ij}$
1	45	0.0000210	1	0.00045	0.130
2	30	0.000037	1	0.0011	0.318
3	45	0.000010	1	0.00045	0.130
4	37	0.000019	1	0.00070	0.2030
5	60	0.0000046	1	0.000276	0.080
6	240	0.000000072	1	0.00001728	0.0050
7	45	0.000010	1	0.00045	0.130
8	480	0.0000000090	1	0.00000432	0.0012

$\sum_i = 0.00344$   $\sum_j = 0.9987$   
 $\approx 1$

using above table for calculation we find

Peshawar	Charsada	Mardan	Nowshera	Swabi	Abbottabad	Kohat	D.I Khan
$Q_{ij} = 67000$ $\times P_{ij}$	$Q_{ij} = 63300$ $\times P_{ij}$	$Q_{ij} = 59400$ $\times P_{ij}$	$Q_{ij} = 56200$ $\times P_{ij}$	$Q_{ij} = 53100$ $\times P_{ij}$	$Q_{ij} = 50300$ $\times P_{ij}$	$Q_{ij} = 47800$ $\times P_{ij}$	$Q_{ij} = 51500$ $\times P_{ij}$
8710	8229	7722	7306	6903	6539	6214	6695
21373	20192	18948	17927	16939	16045	15248	16428
8710	8229	7722	7306	6903	6539	6214	6695
13601	12849	12058	11408	10779	10210	9703	10454
5360	5064	4752	4496	4248	4042	3824	4120
335	316	297	281	265	251	239	257
8710	8229	7722	7306	6903	6539	6214	6695
80.4	76	71	68	63	60	57	62

$$A_1 = 8710 + 8229 + 7722 + 7306 + 6903 + 6539 + 6695 = \boxed{58318}$$

$$A_2 = 21373 + 20192 + 18948 + 17927 + 16939 + 16045 + 15248 + 16428 = \boxed{143100}$$

$$A_3 = 8710 + 8229 + 7722 + 7306 + 6903 + 6539 + 6214 + 6695 = \boxed{58318}$$

$$A_4 = 13601 + 12849 + 12058 + 11408 + 10779 + 10210 + 9703 + 10454 = \boxed{91062}$$

$$A_5 = 5360 + 5064 + 4752 + 4496 + 4248 + 4024 + 3824 + 4120 = \boxed{40888}$$

$$A_6 = 335 + 316 + 297 + 281 + 265 + 251 + 239 + 257 = \boxed{2241}$$

$$A_7 = 8710 + 8229 + 7722 + 7306 + 6903 + 6539 + 6214 + 6695 = \boxed{58318}$$

$$A_8 = 81 + 76 + 71 + 68 + 63 + 60 + 57 + 62 = \boxed{538}$$

Q NO 2) Given data:

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Finding Utilities for all Roads:

1) AUTOS :-

$$\begin{aligned}U_{\text{Autos}} &= 3.2 - 0.85C - 0.015A - 0.5W - 0.035R \\&= 3.2 - 0.85(300) - 0.015(4) - 0.035(25) \\&= 3.2 - 255 - 0.06 - 0.875\end{aligned}$$

$$U_{\text{Auto}} = -254.765$$

2) Light Circular Rail :-

$$\begin{aligned}U(\text{L.C.R}) &= 1.0 - 0.35C - 0.025A - 0.7W - 0.055R \\&= 1.0 - 0.35(70) - 0.025(7) - 0.7(10) - 0.055(30) \\&= 1.0 - 24.5 - 0.175 - 7 - 1.65\end{aligned}$$

$$U(\text{L.C.R}) = -32.325$$

3) Local Buses :-

$$U(\text{L.B}) = 1.7 - 0.15C - 0.75A - 0.9W - 0.075R$$

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$$\begin{aligned} &= 1.7 - 0.15(50) - 0.075(10) - 0.9(15) \\ &\quad - 0.075(40) \\ &= 1.7 - 7.5 - 0.75 - 13.5 - 3. \end{aligned}$$

$$U(L.B) = -23.05$$

(4) Riding Bikes:

$$\begin{aligned} U(R.B) &= 1.3 - 0.17C - 0.012A - 0.0W - 0.095R \\ &= 1.3 - 0.17(45) - 0.012(1) - 0.095(20) \\ &= 1.3 - 7.65 - 0.012 - 1.9. \end{aligned}$$

$$U(R.B) = -8.262$$

(5) Rapid Rail:

$$\begin{aligned} U(R.U) &= 1.5 - 0.25C - 0.095A - 0.6W - 0.025R \\ &= 1.5 - 0.25(90) - 0.095(5) - 0.6(20) - \\ &\quad 0.025(15) \\ &= 1.5 - 22.5 - 0.475 - 12 - 0.375 \end{aligned}$$

$$U(R.U) = -33.85$$

As we know that

$$P(x) = \frac{e^{U_n}}{\sum_n e^{U_n}}$$

$$Autos = P(Autos) = \frac{e^{U_n}}{\sum_n e^{U_n}}$$

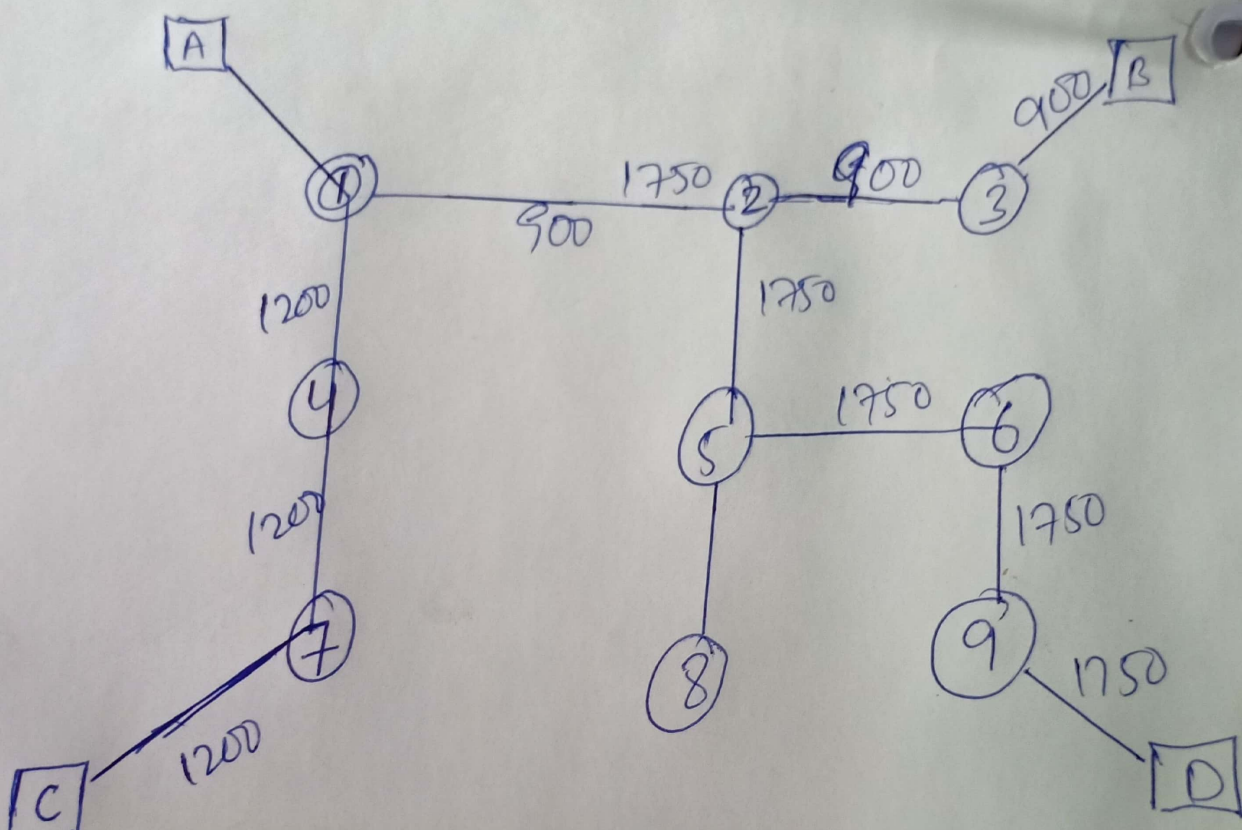
$$P(Auto) = \frac{e^{-254.765}}{e^{-254.765} + e^{-32.325} + e^{-23.05} + e^{-8.262} + e^{-33.85}}$$

$$e^{-254.7865} = 0$$

Stage <sub>N</sub>	Link		Compute new Path Impedance			Compare to tree table Stage <sub>N-A</sub>	Decision
	i	j	Path	Impedance			
	A	1	0	4	4	$4 < \text{Infinity}$	Accepted
	1	2	4	3	7	$7 < \text{Infinity}$	Accepted
	1	4	4	3	7	$7 < \text{Infinity}$	Accepted
	2	3	7	4	11	$11 < \text{Infinity}$	Accepted
	2	5	7	4	11	$11 < \text{Infinity}$	Accepted
	3	B	11	3	14	$14 < \text{Infinity}$	Accepted
	3	6	11	12	23	$23 > 18$	Rejected
	4	5	7	5	12	$12 > 11$	Rejected
	4	7	7	7	14	$14 < \text{Infinity}$	Accepted
	5	6	11	7	18	$18 < \text{Infinity}$	Accepted
	5	8	11	8	19	$19 < \text{Infinity}$	Accepted
	6	9	18	9	27	$27 < \text{Infinity}$	Accepted
	7	C	14	5	19	$19 < \text{Infinity}$	Accepted
	7	8	14	10	24	$24 > 19$	Rejected
	8	9	19	12	31	$31 > 27$	Rejected
	9	D	27	4	31	$31 < \text{Infinity}$	Accepted

Minimum Impedance from zone A to all other zone and nodes after removal of rejected link.

Stage	Line		Computed New Path Impedance			Compare to free table stage N-A	Decision
	i	j					
	A	1	0	4	4	4 < Infinity	Accepted
	1	2	4	3	7	7 < "	"
	1	4	4	3	7	7 < "	"
	2	3	7	4	11	11 < "	"
	2	5	7	4	11	11 < "	"
	3	B	11	3	14	14 < "	"
	4	7	7	7	14	14 < "	"
	5	6	11	7	18	18 < "	"
	5	8	11	8	19	19 < "	"
	6	9	18	9	27	27 < "	"
	7	C	14	5	19	19 < "	"
	9	D	27	4	31	31 < "	"





Travel time at practical capacity  
 = 1.5 mins.

Travel time =  $T_0 = 1.5 \times 0.87 = 1.31$  min.

Traffic flow =  $Q = 110000 / 24$  veh/hour

Practical capacity =  $Q_{max} = 75000 / 24$  veh/hour

$$T_Q = 1.31 \left[ 1 + 0.15 \left( \frac{4583.33}{3125} \right)^4 \right]$$

$$\boxed{T_Q = 2.2 \text{ minutes}}$$

link operating speed =  $36.24 / 2.2$   
 $= 16.47 / 60$   
 $= 0.27 \text{ mph.}$

Q NO 4 →

using net present value calculation  
are given below.

1) CNG bus:-

$$(25 \text{ uspwf}(7\%, 11) - 60 - (16.048 + 7.99) \text{ uspwf}(7\%, 11) + 7.04 \text{ sppwf}(7\%, 11) = 49.44$$

2) Bus Rapid Transit :-

$$27 \text{ uspwf}(7\%, 12) - 50 - (19.589 + 12.116) \text{ uspwf}(7\%, 12) + 11 \text{ sppwf}(7\%, 12) = -82.49$$

3) Light Rail :-

$$29 \text{ uspwf}(5\%, 12) - 66 - (19.554 + 16) \text{ uspwf}(5\%, 12) + 14 \text{ sppwf}(5\%, 12) = -116.294$$

4) Fast Train :-

$$45 \text{ uspwf}(8\%, 14) - 95 - (31.132 + 19.345) \text{ uspwf}(8\%, 14) = -134.367$$

5) Metro :-

$$35 \text{ uspwf}(6\%, 18) - 70 - (25 + 19.535) \text{ uspwf}(6\%, 18) + 16 \text{ sppwf}(6\%, 18) = 167.64$$

Conclusion:-

since value of CNG Bus is smaller than others alternatives, so I will recommend CNG Bus for the Govt

Transportation planning and  
Management.

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