Traffic Modelling and Simulation
CEE 598
Assignment 5

Question 1:
Vissim Travel Time Simulation
Part 1

In the following table information about link is being provided using Vissim.

Count: 39	No	Name	LinkBehavType	DisplayType	Level	NumLanes	Length2D	IsConn	FromLink	ToLink	HasOvtLn
1	1		1: Urban (motorized)	1: Road gray	1: Base	1	183.702	☐			☐
2	2		1: Urban (motorized)	1: Road gray	1: Base	2	272.597	☐			☐
3	3		1: Urban (motorized)	1: Road gray	1: Base	1	216.197	☐			☐
4	4		1: Urban (motorized)	1: Road gray	1: Base	2	355.162	☐			☐
5	5		1: Urban (motorized)	1: Road gray	1: Base	1	235.738	☐			☐
6	6		1: Urban (motorized)	1: Road gray	1: Base	1	196.614	☐			☐
7	7		1: Urban (motorized)	1: Road gray	1: Base	1	137.410	☐			☐
8	8		1: Urban (motorized)	1: Road gray	1: Base	2	160.107	☐			☐
9	9		1: Urban (motorized)	1: Road gray	1: Base	2	159.804	☐			☐
10	10		1: Urban (motorized)	1: Road gray	1: Base	2	67.732	☐			☐
11	11		1: Urban (motorized)	1: Road gray	1: Base	1	85.468	☐			☐
12	12		1: Urban (motorized)	1: Road gray	1: Base	1	227.695	☐			☐
13	13		1: Urban (motorized)	1: Road gray	1: Base	2	145.528	☐			☐
14	14		1: Urban (motorized)	1: Road gray	1: Base	1	179.486	☐			☐
15	15		1: Urban (motorized)	1: Road gray	1: Base	3	239.438	☐			☐
16	16		1: Urban (motorized)	1: Road gray	1: Base	2	280.253	☐			☐
17	17		1: Urban (motorized)	1: Road gray	1: Base	2	241.751	☐			☐

Snapshot showing Connector list

Count: 39	No	Name	LinkBehavType	DisplayType	Level	NumLanes	Length2D	IsConn	FromLink	ToLink	HasOvtLn
18	10000		1: Urban (motorized)	1: Road gray		1	63.155	☑	1	17	☐
19	10001		1: Urban (motorized)	1: Road gray		1	35.451	☑	12	1	☐
20	10002		1: Urban (motorized)	1: Road gray		1	91.384	☑	4	5	☐
21	10003		1: Urban (motorized)	1: Road gray		1	64.998	☑	4	6	☐
22	10004		1: Urban (motorized)	1: Road gray		2	51.519	☑	10	8	☐
23	10005		1: Urban (motorized)	1: Road gray		2	55.205	☑	10	9	☐
24	10006		1: Urban (motorized)	1: Road gray		1	37.581	☑	8	11	☐
25	10007		1: Urban (motorized)	1: Road gray		2	141.049	☑	2	17	☐
26	10008		1: Urban (motorized)	1: Road gray		1	59.707	☑	12	13	☐
27	10009		1: Urban (motorized)	1: Road gray		1	62.750	☑	12	13	☐
28	10010		1: Urban (motorized)	1: Road gray		2	125.689	☑	13	16	☐
29	10011		1: Urban (motorized)	1: Road gray		1	131.447	☑	12	7	☐
30	10012		1: Urban (motorized)	1: Road gray		1	27.166	☑	2	3	☐
31	10013		1: Urban (motorized)	1: Road gray		1	55.210	☑	5	7	☐
32	10014		1: Urban (motorized)	1: Road gray		2	132.320	☑	4	16	☐
33	10015		1: Urban (motorized)	1: Road gray		1	117.547	☑	6	15	☐
34	10016		1: Urban (motorized)	1: Road gray		1	72.036	☑	3	15	☐
35	10017		1: Urban (motorized)	1: Road gray		1	61.094	☑	2	14	☐
36	10018		1: Urban (motorized)	1: Road gray		2	132.022	☑	8	15	☐
37	10019		1: Urban (motorized)	1: Road gray		1	46.212	☑	11	16	☐
38	10020		1: Urban (motorized)	1: Road gray		2	108.967	☑	9	17	☐
39	10021		1: Urban (motorized)	1: Road gray		1	133.550	☑	14	7	☐

Figure Showing Vehicle Input Information:

Count: 4	No	Name	Link	Volume(0)	Volume(900)	Volume(1800)	Volume(2700)	VehComp(0)	VehComp(900)	VehComp(1800)	VehComp(2700)
1	2		10	282.0	282.0	282.0	282.0	1: Veh	1: Veh	1: Veh	1: Veh
2	3		4	164.0	164.0	164.0	164.0	1: Veh	1: Veh	1: Veh	1: Veh
3	4		12	682.0	682.0	682.0	682.0	1: Veh	1: Veh	1: Veh	1: Veh
4	5		2	135.0	135.0	135.0	135.0	1: Veh	1: Veh	1: Veh	1: Veh

Part 2:

Vehicle travel time evaluation results are shown in the following figures after successful running of the simulation.

Count: 3	SimRun	TimeInt	VehicleTravelTimeMeasurement	Vehs(All)	TravTm(All)	DistTrav(All)
1	1	0-600	1: North-South bound travel tim	37	16.02	384.54
2	1	0-600	2: North Bound through	21	6.12	133.30
3	1	0-600	3: West bound through	19	7.64	305.64

Question 2:
Deriving Greenberg's macroscopic model from GM-3 car-following model

GM-3 car-following model:

$$\mathbf{\ddot{x}_{n+1}(t+\Delta t) = \frac{\alpha_0}{x_n(t)-x_{n+1}(t)}[\dot{x}_n(t) - \dot{x}_{n+1}(t)]}$$

Integrating both sides of the equation we get,

$$\dot{x}_{n+1} = \alpha_0 \ln\left(x_n(t) - x_{n+1}(t)\right) + C_1$$

Now,

$x_n(t) - x_{n+1}(t)$ denotes the space between two vehicles, which we represent as $1/k$,

So, we re-write the equation as

$$u = \alpha_0 \ln(1/k) + C_1$$

Let constant C_1 be substituted for $\alpha_0 lnC_2$, then

$$u = \alpha_0 \ln(C_2/k)$$

Now, when $k = k_j$, $u = 0$ (at jam density flow is 0)
We get,

$$0 = \alpha_0 \ln\left(C_2/k_j\right)$$

Solving we get,

$$C_2 = k_j$$

Finally, the equation can be written as

$$\mathbf{u = \alpha_0 \ln\left(k_j/k\right)}$$

This is the Greenberg's macroscopic model logarithmic equation. (derived)

Question 3:
Deriving Q=KV from Little's law

We know Little's law is,

$$\bar{\mathbf{L}}(\mathbf{t}) = \frac{\mathbf{A(t)}}{\mathbf{t}} \times \bar{\mathbf{W}}(\mathbf{t})$$

To derive the relationship, we take $\bar{L}(t)$ as number of vehicles on the roads, and $\bar{W}(t)$ as average travel time.

Assuming the length of the road is L, we get

$$\bar{\mathrm{L}}(\mathrm{t})/\mathrm{L} = \left(\frac{\mathrm{A(t)}}{\mathrm{t}} \times \bar{\mathrm{W}}(\mathrm{t})\right)/\mathrm{L}$$

By dividing both sides of the equation for Little's Law by L
Now,

$$\bar{\mathrm{L}}(\mathrm{t})/\mathrm{L} = \mathrm{K},$$

where K denotes the density.
Again,

$$\frac{\mathrm{A(t)}}{\mathrm{t}} = \mathrm{Q}$$

, where Q denotes the arrival rate/flow of vehicles.
Again,

$$\bar{\mathrm{W}}(\mathrm{t})/\mathrm{L} = 1/\mathrm{V},$$

where V means the average speed of all vehicles.

So, combining we obtain,
$\mathrm{K} = \mathrm{Q}/\mathrm{V}$, or
$\mathbf{Q} = \mathbf{KV}$.