SUMMARY, CONCLUSIONS AND SCOPE FOR FURTHER WORK
CHAPTER 7
SUMMARY, CONCLUSIONS AND SCOPE FOR FURTHER WORK

7.1 To circumvent the estimation of travel demand by prohibitively costly primary surveys, efforts are being directed in transportation planning to obtain the above information by the use of inexpensive traffic counts which are collected as a matter of routine. However, this indirect approach for travel demand estimation is yet to gain adequate confidence among transportation planners, due largely to the lack of practical support from real life situations. This thesis is an attempt to simulate the spatial and temporal travel demands in an urban area, basically using link volume philosophy, through the application of some of the recently developed, and theoretically rigorous model formulations.

7.2 The review of literature carried out in this regard has suggested that, in spite of the sophistications that have been introduced in the estimation of travel demands through link volumes, the models have not been successful in generating keener interest. This is due to the lack of appropriate specifications that are reflective of the spatial and temporal characteristics of the urban structure.

7.3 Added to the above lacuna are some of the weaknesses in the link volume models themselves, such as

   i) lack of sufficient information in the traffic counts
   ii) wide variations in the travel patterns from hour to
hour, day to day etc. which are not appropriately accounted for in the model structure.

iii) The problems created by multiple counts and interdependent counts in the demand estimation.

Even though some of the recent developments like multi-objective formulation solutions have the potential to overcome some of the above mentioned shortcomings, it has been felt that additional information, including total trips, trip length frequency distributions etc., is needed to improve the model outputs.

7.4 Certain improvements in the demand estimation have also been reported with better urban structure specifications as seen in the works of Vaughan (1987), Mahmassani et al (1988) and others. However, it is felt that the changing activity sensitiveness during the different hours of the day is not reflected in their works.

7.5 The present thesis is an attempt to integrate the developments in the link volume modelling philosophy with that of better forms of urban structure specifications to simulate the spatial and temporal travel demand.

7.6 Trivandrum urban area, along with its interacting suburban zones, has been chosen as the study area for the conduct of experiments in this work. While many vital information for this study area is available through secondary sources, an O-D survey with one percent sample has been conducted in order to validate the model.
7.7 The object of the investigation in this work is whether the spatial and temporal travel demands that arise in an urban area through public transportation system could be simulated, using link volumes and urban structure specifications.

7.8 The pilot studies conducted, using the link count information provided by the statistical cell of the Kerala State Road Transport Corporation, have demonstrated that

   i) The gravity seeds are better than random or equiprobable seeds for updating the a priori knowledge in the entropy formulation.

   ii) A simple spatial structure specification in terms of distance from the CBD is able to improve the model compared to other specifications like urban/suburban and activity/nonactivity partitions.

7.9 A computer simulation model called EDETUSS has been drawn up for the Estimation of Demand through urban structure specifications. This model, while simulating the flows on the network through Entropy Maximisation, is able to estimate the demand simultaneously. Urban structure specifications are given to the model through the generation of appropriate seed matrices.

7.10 The urban structure has been specified in terms of 4 km band starting from the centre of activity in the city. The interactions from these structural groupings are specified in the form of trip length frequency distribution curves.
Further to this, the trip attractions to the zones concentrated in each of these rings are also monitored through a specification called an 'Operational range'. It is defined as the maximum distance from which the trips are attracted to them. The structure becomes more refined by its split between activity and nonactivity concentrations.

7.11 This specification has been found to replicate the trip productions, the trip attractions and the overall trip length frequencies much closer to the survey travel demand than many other pilot seeds tested, thus confirming the fact that the models with better urban structure specification are able to simulate the travel demand even within this link volume modelling approach.

7.12 Further experiment in the use of EDETUSS with an additional specification of supply accessibility has confirmed that the model with both these specifications (structure and accessibility) is able to simulate to household O-D matrix. In the above experimentation, the validations are based on link volumes not used for model calibration and the density of points in the various trip ranges.

7.13 The search for better forms of urban structure specification finally resulted in the identification of a 'Dynamic urban structure' in this work. This is defined as the pulsating demand ratios at different points of time and space; the demand ratios themselves being defined as the
actual travel demand at different times to the demand during a chosen base period.

7.14 A rhythmical pattern of demand ratios with respect to the distances from trip generators as obtained for Trivandrum city is shown in Fig 5.2. It is felt that similar curves for other cities, as and when developed, would give better temporal comparisons of different cities.

7.15 A model for estimation of travel demand using independent observation method of Bayesian statistics was specially developed to simulate temporal travel demands in the study. This model not only takes into account the mean traffic volumes on the links, but also their dispersions, in order to provide a travel demand matrix with their individual cell dispersions. These estimates are better than point values as given in Information minimisation/Entropy Maximisation approaches.

7.16 The demand ratios as simulated using EDETUSS, when combined with average Bayesian estimate, provided the temporal travel demands in the study. Once again, the validations were through link volume comparison and density of points in various trip ranges.

7.17 The study, in all, has demonstrated that better simulation of spatial and temporal travel demands is possible with better urban structure specification.
7.18 LIMITATIONS OF THE STUDY

In spite of many of the requirements introduced in this thesis, there are certain limitations to the study. One such limitation is ably demonstrated in Fig. 7.1. In this figure, the study focusses on the scatter of points plotted with variance/mean ratio of traffic volumes with the sequence of link numbers obtained using Maher's (1983) information measure.

It can be seen that there are three distinct clusters instead of a single curve demonstrating that the links form three distinct groups. A closer examination of the points has revealed that, while most of the points in the middle of the graph are concentrated on the activity routes, the points on the other clusters either fall on the corridor routes or residential routes. The corridor routes show minimum variance/mean ratio in view of the fact that the travel on corridors will be more uniform, throughout the day. Even though this graph has many interesting features in it, it has simultaneously pointed out the inherent weakness in the study. Better models could have been derived by grouping the links into the above three distinct groups and by estimating the demand separately for these three groups of links. However, because of lack of sufficient data, further experimentation could not be completed.
FIG. 7.1 VARIANCE/MEAN RATIOS AS A FUNCTION OF NUMBER OF LINK COUNTS
7.19 SCOPE FOR FURTHER STUDY

While the limitation pointed out in the study can itself be a scope for further work, there are other areas for further research also. Some of them are:

i) The use of some form of optimization technique to combine the a priori knowledge and the link volume information.

ii) Refinements in the use of better trip assignment techniques.

iii) Establishing confidence limits for forecasting provided by link volume models.

iv) Alternate specifications for urban structure description and their sensitivity in travel demand estimation.