Modeling Off-Street Parking Based on User's Behavior using Spss Software

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Abstract: Parking is mostly seen in a strategic point of view in terms of demand and supply. There is little knowledge about modeling the user's behavior and the time needed to park a car. The focus of this project is on modeling off-street parking at educational institutes based on user's behavior. In this study two types of multiple linear regression models using SPSS software were developed. Disaggregate model and aggregate model. Disaggregate model study determines the most suitable independent variables affecting the parking demand based on user's socio economic behavior. The demand for this model is expressed in terms of parking usage per person per day in hours at educational institutions in Srinagar city. The disaggregate model analysis revealed that the most influencing independent variables for this model are travel distance and income per month for employees and visitors with the coefficient of variation(R)=0.96 and coefficient of determination(R2) =0.92 and family income and travel distance for students with the coefficient of variation(R)=0.98 and coefficient of determination(R2) =0.96. Aggregate model study determines the most suitable independent variable for estimating the parking demand (vehicle hours) or parking supply (space hours) at educational institutions. The formula emulated can be used to establish the number of parking bays to be provided to accommodate the parking needs at educational institutions. The aggregate model analysis predicts that most fitting independent variable for determining the parking demand formula is the number of employees working at the institution with the coefficient of variation(R)=0.997 and coefficient of determination (R2) =0. 993.The most suitable model is that for which the coefficient of variation(R) and coefficient of determination (R2) is nearly equal to one. Goodness of fit test or significance test and validation test has been conducted on the developed equations and can be used with a high level of confidence.

I. INTRODUCTION

No specific studies have been carried out to project the parking demand of educational institutions. Most of the parking spaces allocated are based on free land available[1][2]. Hence, it is necessary to obtain a balance of parking supply and demand. Therefore, it is important to develop a parking demand model so that the parking demand is calculated based on various independent variables[3].

Parking demand is depend on trip generation, trip purpose and land use and socio-economic characteristics of users[4]. Parking demands are not generated by the building space itself but it is generating by the number of residents in the area and its mode of transportation[5]. Thus, there may be instances where an educational institution, because of its location (either at urban area, suburban area, or rural area etc.), would have higher or lower parking requirements than indicated by the recommended standard, where such conditions are not likely to change with time, modification of the standard is in order [6]. In such circumstances a specialized study needs to be undertaken to establish these parking requirements. Some of the socio economic factors which affect parking demand include a) Total population in catchments b) Average vehicle ownership c) Average income of parkers d) Average travel distance from each resident to destination e) Parking time f) The daily average passengers have high degree of association with parking supply.

The daily average passengers have high degree of association with the parking supply [7]. Parking influences the spatial distribution of transport use and viability of development. Parking should be considered as at metropolitan level than to consider for a particular region[8][9][10].Parking supply characteristics can play a significant role in reducing automobile dependency. Parking demand decreases with good and efficient transport facility. The majority of car drivers will not change their behavior when they do not have to pay for entering the area.The goodness of fit test is great and the model can reflect the actual situation of the relationship between speed and capacity under the road parking influence.

Research Objectives involve 1) To study the parking characteristics at higher educational institutions and to assess whether the demand is met with;2)To identify the problems of traffic and parking;3)To analyze the present parking scenario in Srinagar city 4)To determine the most suitable independent variables affecting parking demand and to develop a parking demand model.

METHODS

For developing the parking supply model, multiple linear regressions will be considered. The multiple linear regression equation will be solved using the software SPSS.

Steps followed in the Multiple Regression Analysis using SPSS Software Package are:

- Inclusion of the dependent variable;
- Inclusion of the entire set of independent variables (parameters) or predictors;
- Variables having least partial correlation with the dependent variable removed sequentially (step-wise) so that

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all the variables that contribute least to the model (statistically insignificant)

are eliminated; and

• Determining the final functional form containing only those parameters or predictors which have significant impact on the dependent variable (here parking demand).

Significance Level (Sig.) determines whether the particular parameter is a significant predictor of the dependent.

Site Selection

University of Kashmir was selected to develop disaggregate model predicting the parking usage based on the socio economical characteristics of users. Finally, an aggregate model was developed to predict the total parking demand based on number of users and other characteristics of institutions. NIT Srinagar, University of Kashmir, IUST Awantipora, GMC Srinagar, Zukara campus of KU, Womens college M.A road Srinagar were selected to develop aggregate model.

Site Survey and Data Collection

It includes employee survey, student survey, visitors survey and campus survey.

Separate questionnaire has been developed for each category. At least 10 samples for each category will be collected which is as per the requirement of statistical tests. The questionnaire developed is given in the appendix. Campus data would be obtained from campus authorities.

Modeling of Parking Demands

Linear regression will be used to develop the parking demand model. Two types of models were developed. Disaggregate and Aggregate. Aggregate model has been developed based on the characteristics of the institutes. The demand is expressed in terms of peak parking demand based on accumulation curve. In aggregate model peak demand is expressed as a function of floor area, number of students, number of employees, availability of college bus facility and parking charges at these institutes. Disaggregate model was developed at KU based on socio-economic characteristics of users. Here users are student, employees and visitors. This model will give us the parking usage in hours per person at the educational institutes. The questions based on 'Revealed Preference Survey 'and 'stated preference survey' of over 50 respondents from student and employee and visitor group have been used to formulate the disaggregate demand functions. These demand functions help in identification of the factors influencing parking demand in the study areas, highlighting the fact that parking demand analysis should be done in a case specific manner. Parking demand has been expressed in terms of parking usage in hours per day. Disaggregate model has been developed for two groups. One group include only students and the other group includes employees and visitors. The structure of the disaggregate model

will be as: $Y(1,2,3) = a + b1 \times x1 + b2 \times x2 + b3 \times x3 \ldots\ldots$

Where Y is the demand function and x1, x2.x3 will be the characteristics of employees, students and visitors affecting parking. The parking supply is expected to have a positive linear relationship with daily number of users and a negative linear relationship with parking charges and bus service/public transport. The bus service/public transport is important in order to control the parking demand. The parking demand modeling will be carried out Using SPSS.

II. DATA COLLECTION

Separate questionnaire has been developed for employee, students, and visitors. Questionnaire of socio economic behavior of people affecting parking demand . Socio-economic behavior of employee and visitors at KU . Socio-economic behavior of students. At least 10 samples for each category will be collected which is as per the requirement of statistical tests. Campus data would be obtained from campus authorities. The general guidelines to be taken for the collection of parking data and analysis of the data collected at various sites under study. The data is collected to formulate two types of models. Disaggregate model based on the socio economic characteristics of the users affecting parking usage (demand) and aggregate model based on the general characteristic of the educational institutes. The guidelines prescribed by IRC were strictly followed in this study while collecting data in the campuses.

Since the campus has no defined parking area it becomes very difficult to use license plate method or fixed period patrolling method for studying parking characteristics, so IN OUT survey has been used to identify the various parking characteristics. The survey was carried out to determine the total number vehicles entering and leaving the campus at each ten minutes' interval, since the campus has three gates, three persons were employed to determine the total count. The survey was conducted from 8am to 5pm.The data for aggregate model is obtained from university records.

University of Kashmir (main campus at Hazratbal)

TABLE I:Parking demand at KU

***based on the parking space requirement and converting all the demand in terms of car parking space**

Vehicle	Peak parking demand (vehicle hours)	Conversion factor*	total car parking Demand (veh. hours)
Car	682	1	682
Bus	14	1.96	28
Bicycle	383	0.16	62

TABLE II: Characteristics of KU campus: source university record

Total area	Floor area m^2	Total number of Employees	Total number of students on roll	College bus Services	Parking Charges	Peak Parking Demand
74.56 hec.	94675	1974	7993	Available	None	772

Parking data analysis:

a) Case processing summary employee and visitor's data:

TABLE III: Correlation matrix at KU for employee and visitor group

Mode of travel	Public transport	24%
	Bicycle	16%
	Private car	60%
Liking efficient public transport	No	28%
	Yes	72%
Willing to choose public mode of travel if parking fee is introduced	No	63.2%
	Yes	36.8%

	parking usage per day	mode of travel	travelled distance	travel time (hour)	liking efficient public transport	age	income per month in lacs	Cars owned	preferred parking fee per hour	willing Choose parking fee is introduced
parking usage per day	1	.699	.640	.469	-.042	.09	.625	.406	.130	-.364
mode of travel	.699	1	.118	-.028	-.328	.631	.707	.891	.616	-.337
travelled distance	.640	.118	1	.861	.207	-.017	.109	-.023	.376	-.237
travel time (hour)	.469	-.028	.861	1	.213	-.108	-.083	-.132	.206	-.239
	-.042	-.328	.207	.213	1	-.265	-.298	-.260	-.170	.307
Age	.09	.631	-.017	-.108	-.265	1	.773	.722	.537	.566
income per month in lacs	.625	.707	.109	.083	-.298	.773	1	.751	.630	.564
cars owned	.406	.891	.023	.132	-.260	.722	.751	1	.568	-.272
	.130	.616	.376	.206	-.170	.537	.630	.568	1	-.496
willing to choose public mode of travel if parking fee is introduced	-.364	-.337	-.237	-.239	.307	.566	-.564	-.272	-.496	1

b) Case processing summary of students:

Mode of travel	Public transport	44.2%
	Bicycle	19.2%
	Private car	36.5%
Liking efficient public Transport	No	25%
	Yes	75%
Willing to choose public mode of travel if parking fee is introduced	No	44.8%
	Yes	55.2%

TABLE IV: Correlation matrix at KU for students group

	parking usage per day in hours	mode of travel	Travelled Distance	travel time	liking for efficient public transport	age	Scholarship availing per month	Vehicle owned	Family income per month	willing to choose public mode of travel if parking fee is introduced	Preferred Parking fee(rupees) per Day
parking usage per day in hours	1	.830	.569	.326	-.187	.573	.736	.830	.818	-.021	.511
mode of travel	.830	1	.287	.169	-.298	.583	.742	1.000	.895	.050	.442
travelled distance	.569	.287	1	.856	.072	.305	.413	.287	.330	-.026	.269
travel time liking for	.326	.169	.856	1	-.011	.192	.265	.169	.240	-.095	.138
efficient public Transport	-.187	-.298	.072	-.011	1	-.197	-.293	-.298	-.288	.089	-.139
Age	.573	.583	.305	.192	-.197	1	.531	.583	.485	-.009	.247
Scholarship availing per Month	.736	.742	.413	.265	-.293	.531	1	.742	.670	.096	.221
Vehicle owned	.830	1.000	.287	.169	-.298	.583	.742	1	.895	.050	.442
Family income per month	.818	.895	.330	.240	-.288	.485	.670	.895	1	.053	.433
willing to choose public mode of travel if parking fee is introduced	-.021	.050	-.026	-.095	.089	-.009	.096	.050	.053	1	-.115
Preferred parking fee(rupees) per Day	.511	.442	.269	.138	-.139	.247	.221	.442	.433	-.115	1

III. MODELING PARKING DEMAND

Derivation of disaggregate demand functions

The questions based on 'Revealed Preference Survey 'and 'stated preference survey' of over 50 respondents from the study area (KU) for educational trips have been used to formulate the disaggregate demand functions. Separate study was carried out at KU and two separate models-one for employees and visitors and other for students were formulated. These demand functions help in

identification of the factors influencing parking demand in the study areas, highlighting the fact that parking demand analysis should be done in a case specific manner. Parking demand has been expressed in terms of Duration of parking (parking space usage per visit) in hours. The Parameters (Independent Variables) considered for analysis include age monthly income in lacs for employee and visitors and family income of students (dummy variable with coding as :1=<0.25,2=0.25-0.5,3=0.5-0.75and so on)

- Parking usage per day
- Preferred parking fee

Their liking for efficient public transport (dummy variable:1=yes.0=no). Response to the introduction of parking fee i.e. if parking fee is introduced will parkers change their mode of travel (dummy variable:1=yes,0=no)

- Travel time and distance

The questionnaire is given in the Appendix A.

A) Demand function at KU for visitor and employee group

Using SPSS, parking modeling with simple linear regression analysis is done using "Stepwise" method. The following shows the summary of the models. Steps followed in the Multiple Regression Analysis using SPSS Software Package are:

Inclusion of the dependent variable;

Inclusion of the entire set of independent variables (parameters) or predictors; • Variables having least partial correlation with the dependent variable removed sequentially (step-wise) so that all the variables that contribute least to the model (statistically insignificant) are eliminated; and

• Determining the final functional form containing only those parameters or predictors which have significant impact on the dependent variable (here parking demand).

• Significance Level (Sig.) determines whether the particular parameter is a significant predictor of the dependent variable. Significance Level of the Full Model is a measure of the overall 'Goodness of Fit'

Linear regression by stepwise method with constant

TABLE V(a) linear regression by stepwise method with constant

Model	Variables entered	R	R square	Std. error of the estimate
1	travelled distance	.632	.400	3.68213
2	income per month in lacs	.752	.565	3.17938
3	cars owned	.799	.639	2.93923

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	325.303	1	325.303	23.993	.000
	Residual	488.092	36	13.558		
	Total	813.395	37			
2	Regression	459.599	2	229.799	22.733	.000
	Residual	353.796	35	10.108		
	Total	813.395	37			
3	Regression	519.665	3	173.222	20.051	.000
	Residual	293.729	34	8.639		
	Total	813.395	37			

TABLE V(b): linear regression by stepwise method with constant

model	Variables	Coefficient	T	Sig
	(Constant)	1.8	3.989	.000
	traveled distance	.248	4.898	.000
	(Constant)	0.37	.646	.523
	traveled distance	0.25	5.759	.000
	income per month in lacs	0.406	3.645	.001
	(Constant)	.98	1.792	.082

	traveled distance	0.22	5.091	.000
	income per month in lacs	.628	4.722	.000
	cars owned	0.363	-2.637	.013

regression by stepwise method without constant

Table VI(a) regression by stepwise method without constant

Variables Entered	R	R square	Std. error of The estimate		Sum of Squares	df	Mean Square	F	Sig.
Traveled distance	0.914	.836	4.3614	Regression	3577.171	1	3577.171	188.050	.000
				Residual	703.829	37	19.022		
				Total	4281.000	38			
Traveled distance, income per month in Lacs	0.957	.916	3.1535	Regression	3922.990	2	1961.495	197.240	.000
				Residual	358.010	36	9.945		
				Total	4281.00	38			

model	Variables	coefficient	t	Sig
1	traveled distance	0.38	13.713	0.000
2	Traveled distance	0.23	7.913	0.000
	Income per month in lacs	0.43	5.887	0.000

TABLE VI(b): Linear regression by stepwise method without constant

Model	Excluded variables	Beta In	t	Sig.	Partial Correlation
1	travel time (hour)	.367	1.529	.135	.247
	liking efficient public transport	.176	1.692	.099	.271
	age	.392	4.867	.006	.630
	income per month in lacs	.435	5.897	.000	.701
	cars owned	.253	3.067	.006	.455
	willing to choose public mode of travel if parking fee is introduced	-.006	-.073	.942	-.012
2	travel time (hour)	.036	.184	.855	.031
	liking efficient public transport	.100	1.284	.207	.212
	age	.019	.119	.906	.020
	cars owned	.228	1.995	.054	.319
	willing to choose public mode of travel if parking fee is introduced	-.025	.431	.669	.073

B) Demand function at KU for student group

Using SPSS, parking modeling with simple linear regression analysis is done using "Stepwise" method. The following shows the summary of the models

linear regression by stepwise method with constant

TABLE VII(a):linear regression by stepwise method with constant

Model	Variables entered	R	R square		Sum of Squares	df	Mean Square	F	Sig.
1	traveled distance	.72	.524	Regression	180.288	1	180.28	30.86	.00
				Residual	163.578	28	5.842		
				Total	343.867	29			
2	Family income per month	.79	.632	Regression	217.264	2	108.63	23.16	.00
				Residual	126.603	27	4.68		
				Total	343.867	29			
3	travel time	.84	.713	Regression	245.039	3	81.68	21.48	.00
				Residual	98.828	26	3.80		
				Total	343.867	29			

TABLE VII(b): Linear regression by stepwise method with constant

model	Variables	coefficient	T	Sig
1	(Constant)	2.064	5.072	.000
	traveled distance	0.28	5.555	.000
2	(Constant)	0.93	1.689	.103
	traveled distance	0.28	5.923	.000
	Family income per month	0.329	2.808	.009
3	(Constant)	1.522	2.820	.009
	traveled distance	0.43	6.061	.000
	Family income per month	0.415	3.764	.001
	travel time	-0.497	-2.703	.012

Model	Variables removed	Beta In	T	Sig.	Partial Correlation
1	travel time	-.298	-1.388	.177	-.258
	liking for efficient public transport	-.115	-.859	.398	-.163
	age	.105	.789	.437	.150
	Scholarship availing per month	.303	2.346	.027	.411
	Family income per month	.329	2.808	.009	.475

	Vehicle owned	.298	2.465	.020	.429
	willing to choose public mode of travel if parking fee is Introduced	.091	.694	.494	.132
	Preferred parking fee(rupees) per day	.084	.638	.529	.122
2	travel time	-.497	-2.703	.012	-.468
	liking for efficient public transport	-.028	-.226	.823	-.044
	age	.073	.600	.554	.117
	Scholarship availing per month	.200	1.521	.140	.286
	Vehicle owned	.128	.763	.453	.148
	willing to choose public mode of travel if parking fee is Introduced	.037	.304	.764	.059
	Preferred parking fee(rupees) per day	.077	.650	.522	.126
3	liking for efficient public transport	-.050	-.439	.664	-.087
	age	.067	.614	.545	.122
	Scholarship availing per month	.148	1.217	.235	.237
	Vehicle owned	.072	.470	.642	.094
	willing to choose public mode of travel if parking fee is Introduced	-.026	-.237	.815	-.047
	Preferred parking fee(rupees) per day	.043	.395	.696	.079

Linear regression by stepwise method without constant

TABLE VIII: linear regression by stepwise method without

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Model	Variables entered	R	R Square		Sum of Squares	df	Mean Square	F	Sig.
1	traveled distance	.95	.710	Regression	3192.115	1	3192.115	294.921	.000
				Residual	313.885	29	10.824		
				Total	3506.000	30			
2	Family income per Month	.98	.960	Regression	3366.021	2	1683.010	336.652	.000
				Residual	139.979	28	4.999		
				Total	3506.000	30			

Model	Excluded variables	Beta In	t	Sig.	Partial Correlation
1	travel time	.395	1.957	.060	.347
	liking for efficient public transport	.083	.922	.365	.172
	Age	.427	4.419	.007	.641

	Scholarship availing per month	.273	3.117	.006	.508
	Family income per month	.437	5.898	.000	.744
	Vehicle owned	.402	5.855	.006	.742
	If parking fee is introduced	.150	2.149	.040	.376
	Preferred parking fee(rupees) per day	.196	2.602	.015	.441
2	travel time	-.282	-1.512	.142	-.279
	liking for efficient public transport	.033	.536	.596	.103
	Age	.175	1.605	.120	.295
	Scholarship availing per month	.105	1.374	.181	.256
	Vehicle owned	.208	1.478	.151	.274
	willing to choose public mode of Travel if parking fee is Introduced	.033	.582	.565	.111
	Preferred parking fee(rupees) per day	.074	1.209	.237	.227

Model		Coefficients	t	sig
1	traveled distance	0.58	17.471	.000
2	traveled distance	0.36	8.112	.000
	Family income per month	0.66	5.899	.000

Derivation of aggregate demand functions

The aggregate demand function is expressed in terms of peak parking demand and the characteristics of whole campus. The peak parking demand is the dependent variable and is expressed in terms of number of employees, number of tudent, floor area, bus feeder services and parking charges. The following data shows the summary of data collection at educational institutes from the authorities for parking demand modeling Before the analysis is carried out, it is important to find out whether the independent variables Selected for the parking demand modeling have high degree of association with the car parking demand at each site. The table below tabulates the correlation matrix between the chosen independent variables. the correlation between the independent variables seems to be more significant, therefore, parking demand modeling is carry out with SPSS.

TABLE IX: Correlation matrix

	peak parking demand	Floor area	students	employees	bus facilities
peak parking demand	1	.996	.920	.999	.574
Floor area	.996	1	.939	.994	.565
Students	.920	.939	1	.913	.404
Employees	.999	.994	.913	1	.596
bus facilities	.574	.565	.404	.596	1

Using SPSS, parking modeling with simple linear regression analysis is done using step wise method.The following shows the summary of the models

Linear regression by stepwise method with constant

TABLE X: linear regression by stepwise method with constant

model	Variables Entered	R	R Square		Sum of Squares	df	Mean Square	F	Sig.
3	Employees	.999	.998	Regression	302842.281	1	302842.281	1.686E3	.000
				Residual	718.552	4	179.638		
				Total	303560.833	5			

Model	**Variables Entered**	coefficient	t	Sig.	
3	(Constant)	40.348	5.019	.007	
	Employees	.368	41.059	.000	
	Variables Removed	Coefficient	t	Sig.	Partial Correlation
	Floor area	.244	1.097	.353	.535
	Students	.051	.816	.475	.426
	bus facilities	-.032	-1.101	.351	-.536

Linear regression by stepwise method without constant

TABLE XI: linear regression by stepwise method without constant

Model	Variables Entered	R	R Square		Sum of Squares	df	Mean Square	F	Sig.
4	Employees	.997	.993	Regression	776025.414	1	776025.414	739.97	.00
				Residual	5243.586	5	1048.717		
				Total	781269.000	6			

Model	**Variables entered**	coefficient	t	Sig.	
4	employees	.401	27.202	.000	
	Variables				Partial

	removed	Coefficient	t	Sig.	Correlation
	Floor area	.087	.159	.882	.079
	students	.206	2.580	.061	.790
	bus facilities	.011	.161	.880	.080

IV. RESULT

Linear Regression Estimates for The Disaggregate Model Are:

I. For employees and visitors group

By stepwise method with constant

Parking usage=0.98+0.22(travelleddistance) +0.628(income per month in lac) +0.363(car owned)

With R= 0.799 and R2=0.639

Since the t-value for the constant and cars owned is not significant (i.e. more than 0.05), therefore, this model is rejected.

By stepwise method without constant

MODEL 1

Parking usage=0.38 (travelled distance); R= 0.914and R2=0.836

MODEL2

Parking usage=0.23(travelled distance) +0.43(income per month in lac)

R = 0.957and R2= 0.916

Over all t-value for both model 1 and model 2 is significant and also the individual coefficients have significant t -value (i.e. less than 0.05), therefore both models can be accepted. Further the model satisfies the validation test on the observed data.

II. For student group

By stepwise method with constant

Parking usage=1.522+0.43(travelled distance) +0.415(family income per month in lac)-0.497(travel time)

R= 0.84 and R2=0.713

the individual coefficient has significant t -value (i.e. less than 0.05), therefore the can be accepted and can be used to

Since the t-value for the constant and travel time are not significant (i.e. more than 0.05), therefore, this model is rejected.

By stepwise method without constant

MODEL1

Parking usage=0.58(travelled distance); R=0.95 and R2=0.91

MODEL2

Parking usage=0.36(travelled distance) +0.66(family income per month in lac) R=0.98 and R2=0.960

Over all t-value for both model 1 and model 2 is significant and also the individual coefficients have significant t -value (i.e. less than 0.05), therefore both models can be accepted. From the above equations it is predicted that travel distance and income are the only significant parameters affecting parking demand in terms of parking usage.

b) LINEAR REGRESSION ESTIMATES FOR THE AGGREGATE MODEL

By stepwise method with constant

Peak parking demand (vehicle hours) =40.348+0.368(total number of employees) R=0.99 and R2=0.998

Since the t-value for the constant is not significant (i.e. more than 0.05), therefore, this model is rejected.

By stepwise method without constant

Peak parking demand (vehicle hours) =0.401(total number of employees)

R=0.997 and R2=0.993

Over all t-value for the model is significant and also

determine the peak parking demand. Further the model satisfies the validation test on the observed data.

V. CONCLUSION

This study of parking demand analysis in Srinagar city is first time carried out in Srinagar city based on scientific methods using modern sophisticated software SPSS. This study was carried out in limited time and utilizing limited resources. This study concludes that: -

The disaggregate model developed determines the independent parameters influencing parking demand, where parking demand is expressed in terms of parking usage. It is concluded that for employees and visitors and students the travel distance and income are the influencing parameters effecting parking demand.

The aggregate model developed determines the independent variables influencing parking demand. The parking demand is expressed in the units of vehicle hours. The number of employees working in the institution has highest degree of association with the parking demand.

if a new educational institution will be located in the Srinagar and the parking facilities will be provided, the above calculated formula could be the guide to estimate the number of parking spaces to be provided.

The Srinagar city lacks in the efficient public transport system. The transportation system in the city faces frequent traffic jams and traffic congestions which is mainly due increased growth of private vehicles. The solution to the problem lies in introducing the best public transportation system.

Free parking in the city, mostly in the educational institutes and other offices encourages the use of private mode of travel, causing traffic jams and congestions at morning and evening peak hours, if parking fee is introduced the people will shift to public mode of travel and subsequently decrease traffic jams on the roads during morning and evening offices hours.

Almost all the study sites have inadequate parking area, the capacity of the parking lawn is less than demand, compelling the parkers to park their vehicles all-round the site at their own will. This vagueness may be removed by conducting detailed studies of parking demand and using scientific models as have been developed in this thesis. This

study is one of such efforts to study parking demand and the factors effecting parking demand at Srinagar city and finally formulate parking demand model. The parking demand models have been developed, but because of limited time and resource the study was carried out at small scale. For developing improved parking demand models in the Srinagar city, such studies should be conducted at comprehensive level

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