

TRDISF_Q A Seasonal Prediction Model Integrated In RDBMS Platform for Brihan Mumbai Electric Supply and Transport UNDERTKG (BEST) Mumbai

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Abstract- *The urbanization in India causes rapid rise in urban population in cities gives rise of increasing in vehicle and vehicle users. In spite of the increase in the number of travellers, the urban bus transport organizations still operate under heavy losses. This is mainly due to non-availability of right information at the right moment on various aspects of operation and functioning of public transport systems. The present work deals with the development of a seasonal prediction module for BEST public transportation. In this the specific databases for bus transport management is first designed, then developing a module for data retrieval and displaying by seasonal variation.*

This seasonal prediction model integrated in RDBMS platform for BRIHAN MUMBAI ELECTRIC SUPPLY AND TRANSPORT UNDERTKG (BEST) Mumbai is effectively used by transportation engineers to take right decision at right time to manage the public transportation in high profit.

Indexed Terms- BEST, DSS, Entity relationship, TRDISF_Q, Regression analysis, SPSS

I. INTRODUCTION

Public transport systems in the form of buses have played a major role in providing mobility to urban commuters in India over several decades. However, the non-availability of critical information at the right moment on various aspects of the functioning of bus transport undertakings severely reflects on their performance. The losses suffered in the operation of bus transport systems necessitate constant monitoring of activities in this sector. Efficient and well-managed

bus transport systems can provide solutions to the above problems to a large extent. Information Systems developed with Decision Support Capabilities within the framework of an Advanced Relational Data Base Management System (RDBMS) can play a major role in planning important aspects, and monitoring the performance of Urban Bus Transport Organizations.

• DECISION SUPPORT SYSTEM FOR TRANSPORTATION PLANNING

DSS is defined as a specific class of computerized information system that supports business and organizational decision-making activities. A properly designed DSS is an interactive software-based system intended to help decision makers compile useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems and make decisions.

Transportation planners are responsible for improving system performance, rationalizing upgrading and maintenance strategies based on often conflicting interests, and providing the public with increased transparency in the whole decision-making process.

• SPSS

Originally it is called as “Statistical Package for the Social Science” but now it stands for “Statistical Product and Service Solutions”. It provides a powerful statistical analysis and data management system in a graphical environment, using descriptive menus and simple dialog boxes to do most of the work for us. Most tasks can be accomplished simply by pointing and clicking the mouse.

One of the most popular statistical packages which can perform highly complex data manipulation and

analysis with simple instructions. SPSS is best used for minor data collection and especially data analysis.

- RDBMS

Data is one of the most important assets of a company. It is very important to make sure data is stored and maintained accurately and quickly. DBMS (Database Management System) is a system that is used to store and manage data.

A DBMS that is based on relational model is called as RDBMS. Relational model represents data in the form a table. A table is a two-dimensional array containing rows and columns. Each row contains data related to an entity such as a student. Each column contains the data related to a single attribute of the entity such as student name.

One of the reasons behind the success of relational model is its simplicity. It is easy to understand the data and easy to manipulate.

- OBJECTIVE OF THE WORK

- i. Collection of Quarterly data on financial and operational aspects of BEST for 5 years (2015-2019) which is published by *central institute of road transport*, Pune.
- ii. Identification of important financial and operational parameters for the evaluation of efficiency and effectiveness of BEST undertaking of Mumbai.
- iii. Selection and Identification of curves and important parameters respectively for seasonal prediction based on curve fitting techniques.
- iv. Development of TRDISF_Q module.
- v. Development of back end to store the data in MS-access.
- vi. Development of Visual studio Forms and interfaces to VP Expert System.

II. RESEARCH METHODOLOGY

- Incorporation of Data to MS Excel
The collected data from CIRT journals from the year 2015 – 2019 are incorporated to MS excel.
- Statistical Product and Service Solutions
The data which are incorporated in excel sheets are verified and imported to SPSS software to perform regression analysis.
- Curve Fitting Technique: The best curve has been selected by analysing the R^2 value, F - test, T - test, and their Significance Level (less than 5%).
- Seasonal Index: Seasonal variation is measured in terms of an index called seasonal index. Since the present work is considering quarterly data, there are 4 separate indexes obtained per year.
- Development of relative database management system:
The MS-access software is used to create the Database by using the data's which is incorporated in the Excel sheets. These data's can be retrieved by using visual basic forms.
- VP-Expert system: The developed database is connected with VP-Expert system for the purpose of forecasting the relevant data.

III. EXECUTION OF THE SEASONAL INDEXES PREDICTION

The financial and operational data of BEST state transport undertakings MUMBAI such as traffic revenue, revenue total, fuel lubricant cost, interest, personnel cost, depreciation, total cost, operational cost, motor vehicle cost, average number of bus held on road, average age, fuel consumption, number of accident fatalities, total accidents, passenger carried, spares, average number of buses held on road, passenger kilometre and so on. Such parameter has been entered in MS Excel where parameters are entered in rows and corresponding values are entered in columns.

BEST_YR	TRAF_REV	TRRV_PSK	OTHR_REV	OT_RVPSK	REVE_TOT	REV_PSPK	PES_COST	PC_PSPKM	FUELB_C	F_L_PSPK	INTRTB	INTRTPSK	SPARES	SPARSPK	INTEREST	IN_PS
1999.00	100.00	1316142000	2074.2	145694000	229.6	1461836000	2303.8	1.095E+09	1726	270838000	426.8	36382000	57.3	91749000	144.6	77214000
1999.25	200.00	1413014000	2221.2	146258000	229.9	1559272000	2451.1	1.073E+09	1687.3	284095000	446.6	75032000	117.9	91749000	144.2	77214000
1999.50	300.00	1379307000	2178.2	122432000	193.3	1501739000	2371.6	1.101E+09	1738.7	361036000	570.1	41490000	65.5	70752000	111.7	69711000
1999.75	400.00	2.3519	2646.1	136099000	222.5	2488046000	2871.61	1.453E+09	1934.4	661294000	646	8160000	66	103746000	146.6	84075000
2000.00	500.00	1515081000	2.49E+03	137320000	201.3	1652401000	2713.3	1.145E+09	1880.2	355989000	653.3	25837000	48.7	69876000	105.6	77787000
2000.25	600.00	1619088000	2.67E+03	140865000	218.7	1759953000	2906.4	1.171E+09	1933	364923000	684.2	78482000	70	69876000	105.6	77787000
2000.50	700.00	1467207000	2.71E+03	135611000	220	1802818000	2925.8	1.186E+09	1925.5	420389000	703.7	34678000	56.3	109122000	177.1	76320000
2000.75	800.00	1801063000	2.39E+03	183536000	243.4	1984599000	3047.15	1.08E+09	1653.2	551126000	716.3	7769000	62.1	116126000	154.5	118198000
2001.00	900.00	1609777000	2.74E+03	145564000	247.6	1755341000	2985.5	1.188E+09	2020.1	413248000	702.9	24944000	42.4	92874000	158	76932000
2001.25	1000.00	1670277000	2.80E+03	148160000	248.5	1818437000	3050.5	1.182E+09	1983.2	427007000	716.3	61633000	103.4	92874000	155.8	76932000
2001.50	1100.00	1680220000	2.83E+03	148452000	251.5	1828672000	3097.8	1.087E+09	1841.2	423031000	716.6	29573000	50.1	89265000	151.8	98115000
2001.75	1200.00	2019671000	3.36E+03	44558000	74.16	2064229000	3143.56	1.145E+09	1906	658287000	809	19335000	57	42487000	133.7	128694000
2002.00	1300.00	1666378000	2.84E+03	161075000	274.2	1827413000	3110.9	1.168E+09	1988.7	418498000	712.4	28831000	49.1	87750000	149.4	108887000
2002.25	1400.00	176476000	2.96E+03	100624000	168.9	1865391000	3125.2	1.12E+09	1876.8	484116000	811.1	62796000	105.2	87750000	147	10078000
2002.50	1500.00	1720000000	2.95E+03	112652000	183.1	1895043000	3119.6	1.127E+09	1830.7	464225000	821.6	22144000	38.9	43294000	138.5	100232000
2002.75	1600.00	2061246000	3.48E+03	105675000	175.2	2103425000	3193.35	1.395E+09	1910.1	597021000	815.4	23608000	57	7026000	120	100451000
2003.00	1700.00	1697883000	2.90E+03	122826000	209.5	1820509000	3110.3	1.225E+09	2093.6	480728000	821.3	4065000	69.5	83526000	142.7	110193000
2003.25	1800.00	1814180000	3.02E+03	123856000	206.2	1938036000	3225.9	1.179E+09	1963.3	47517000	790.9	67324000	112.1	83526000	139	110193000
2003.50	1900.00	1865080000	3.04E+03	119505000	195.1	1984585000	3239.5	1.178E+09	1922.7	483634000	789.5	18164000	29.6	60972000	99.5	86484000
2003.75	2000.00	2132674000	3.58E+03	375323000	364.2	2507997000	3445	1.408E+09	1912.1	73947000	926.5	125629000	52.5	160176000	174.6	235872000
2004.00	2100.00	1816863000	3.01E+03	141764000	235	1958637000	3246.1	1.261E+09	2090.1	40635000	822.6	26705000	44.3	75873000	125.7	64359000
2004.25	2200.00	1878959000	3.14E+03	148767000	249.2	2027726000	3383.3	1.224E+09	2041.6	550175000	918	56357000	94	75873000	126.6	64359000
2004.50	2300.00	1903712000	3.13E+03	231392000	380.8	2135104000	3513.4	1.238E+09	2036.7	579763000	954	28154000	46.3	133227000	219.2	53577000
2004.75	2400.00	2319953000	2.64E+03	57849000	101.2	2377802000	3536.6	2.11E+09	2477	891784000	1047.8	5145000	44.1	77025000	150.6	69875000
2005.00	2500.00	1934587000	3.23E+03	260219000	435.1	2194806000	3669.4	1.429E+09	2389.2	683691000	975.9	25444000	42.5	120276000	201.1	8235000
2005.25	2600.00	1943195000	3.29E+03	254178000	430.9	2197373000	3725.6	1.405E+09	2382.1	634730000	1059.2	39100000	66.3	120276000	203.9	8235000
2005.50	2700.00	2052401000	3.35E+03	29597000	48.3	2081998000	3397.3	1.498E+09	2444.3	674205000	1100.1	20417000	33.3	60723000	99.1	82343000
2005.75	2800.00	1961365000	3.43E+03	359895000	628.7	2321260000	3706.2	2.498E+09	4363.5	784076000	1127.9	21970000	45.1	295871000	124.7	82333000

• REGRESSION ANALYSIS OF DATA USING SPSS

Regression analysis is a statistical tool for the investigation of relationships between two or more variables. The curve fitting estimation is carried out using regression analysis, here dependent variable is considered as operational or financial parameter and independent variable is considered as time.

BEST_YR	TRRV_PSK	REVE_TOT	REV_PSPK	PES_COST	PC_PSPKM	FUELB_C	F_L_PSPK	INTEREST	IN_PS
1	2074.2	1461836000	2303.80	1095242000	1726.0	270838000	426.8	77214000	
2	2221.2	1559272000	2451.10	1073366000	1687.3	284095000	446.6	77214000	
3	2178.2	1501739000	2371.60	1100988000	1738.7	361036000	570.1	69711000	
4	2646.1	2488046000	2871.61	1453179000	1934.4	661294000	646	84075000	
5		1652401000	2713.30	1145028000		355989000	653.3	77787000	
6			2906.40	1170565000		364923000	684.2	77787000	
7			2925.80	1186453000		420389000	703.7	76320000	
8			3047.15	1079663000		551126000	716.3	118198000	
9			2985.50	1187732000		413248000	702.9	76932000	
10			3050.50	1182231000		427007000	716.3	76932000	
11			3097.80	1068893000		423031000	716.6	98115000	
12			3143.56	1145152000		658287000	809	12694000	
13			3110.90	1168208000		418498000	712.4	100887000	
14			3125.20	1120253000		484116000	811.1	10078000	
15			3119.60	1126740000		464225000	821.6	100232000	
16			3193.35	1394745000		597021000	815.4	100451000	
17			3110.30	1225391000		480728000	821.3	110193000	
18			3225.90	1179484000		475170000	790.9	110193000	
19			3239.50	1177911000		483634000	789.5	86484000	
20			3445.00	1405552000		779477000	926.5	235872000	
21	2100	1.8169E+009	1958627000	3246.10	1261138000	496359000	822.6	64359000	
22	2200	1.8790E+009	2027726000	3383.30	1223619000	550175000	918.0	64359000	
23	2300	1.9037E+009	2135104000	3513.40	1237751000	579763000	954.0	53577000	
24	2400	2.3200E+009	2377802000	3536.60	2109774000	891784000	1047.8	69875000	

- Curve estimation results

Model Summary and Parameter Estimates									
Dependent Variable: F_L_PSPK									
Equation	Model Summary					Parameter Estimates			
	R Square	F	df1	df2	Sig.	Constant	b1	b2	b3
Linear	.900	235.168	1	26	.000	501.713	.203		
Logarithmic	.833	129.904	1	26	.000	-540.661	190.132		
Inverse	.525	28.757	1	26	.000	886.201	-64362.674		
Quadratic	.901	113.553	2	25	.000	510.185	.186	5.843E-006	
Cubic	.952	160.137	3	24	.000	381.517	.676	.000	9.542E-008
Compound	.860	160.035	1	26	.000	527.603	1.000		
Power	.905	246.265	1	26	.000	119.850	.266		
S	.663	51.231	1	26	.000	6.790	-97.021		
Growth	.860	160.035	1	26	.000	6.268	.000		
Exponential	.860	160.035	1	26	.000	527.603	.000		
Logistic	.860	160.035	1	26	.000	.002	1.000		

The independent variable is V2.

• HOW TO PERFORM SEASONAL PREDICTION:

Example: The selected curve is linear then the equation is $y = b_0 + b_1x$

Where y stands for trend value, b_0 and b_1 values are obtained from the regression analysis results.

- Predictions made using the best fitting curves to obtain the trend
- Actual value/ trend value = ratio to trend, was found

- Average ratio to trend for each quarter (for 7 years) was determined
- Seasonal indices were thus obtained

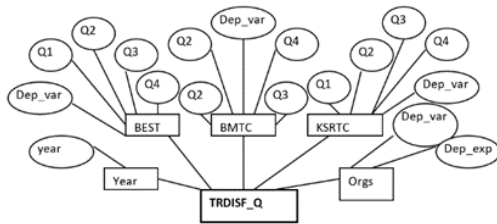
Hence, Seasonal prediction = predicted trend value x seasonal index

The obtained seasonal prediction for BEST undertakings is shown below:

The screenshot shows an Excel spreadsheet with the following columns: A (traf_rev), B (on/tv), C (indices), D (pred), E (error), F (trv_psk), G (on/tv), H (indices), I (pred), J (error), K (rev_tot), L (on/tv), M (indices), N (pred), O (error), P (rev_pspk), Q (on/tv). The data spans from row 32 to 62, showing various numerical values for each category.

IV. WORKING OF THE TRDISF_Q FORM

The transport manager is first required to login and activate TRDISF_Q. The form TRDISF_Q is then displayed. It is then required to select the transport undertaking for which the query has to be made, by clicking on the first combo box of the form. The combo box then links to the ORGS database that comprises the name of the BEST transport undertakings MUMBAI.



E.R diagram for TRDISF_Q form

In the later part of the TRDISF_Q, the manager is required to specify the year for which the query has to be made by clicking on the combo box linked to the YEAR database that holds the list of years for which the data exists. The required component or variable

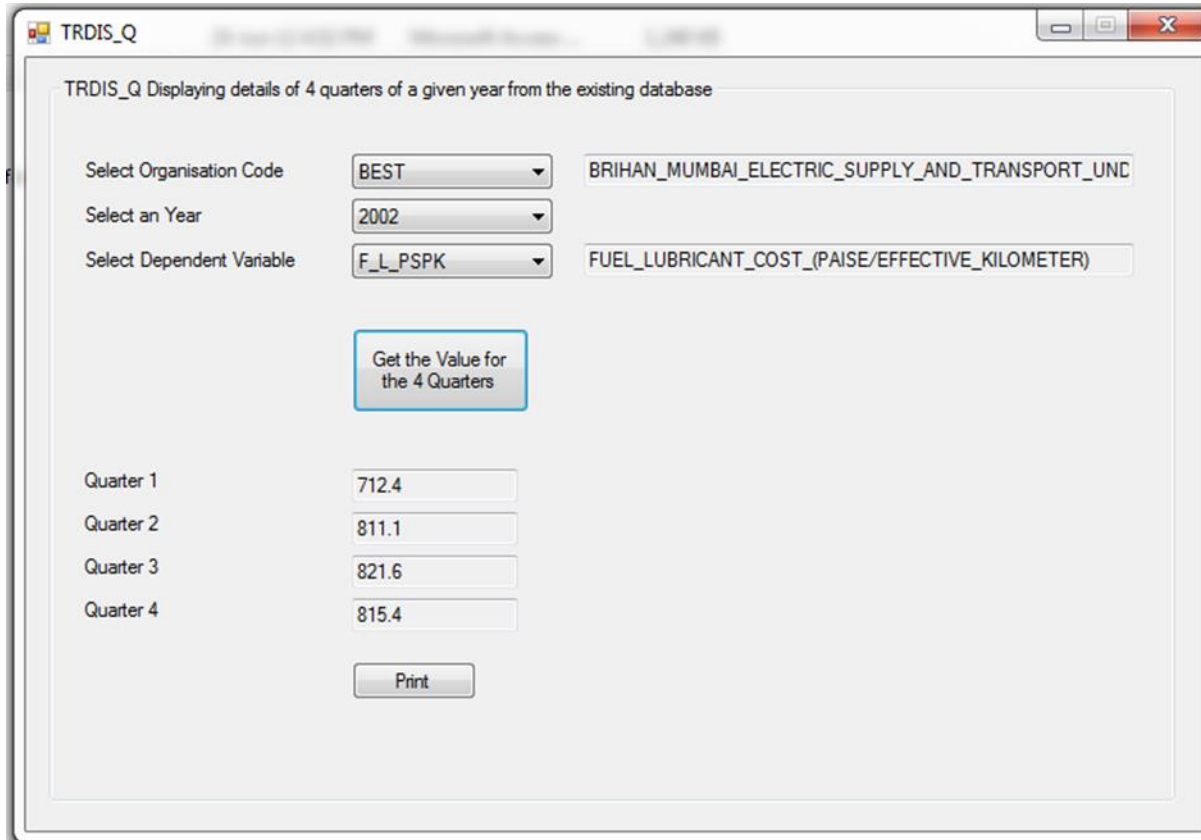
for which the quarterly data is required to be displayed is then selected from the combo box linked to the DEPEND database which comprises the list of dependent variables and the explanations.

The transport manager is then presented with the available quarterly data for a selected year and variable. On pressing the 'PRINT' button in the form, the TRDISF_Q stores all the relevant data regarding the selected variable into a formatted text file called TRDISF_Q.txt and prepares temporary ASCII output files for additional reference for the user.

The database for the seasonal prediction is developed using MS-Access which is described in the entity relationship diagram. Here number of tables is developed for all the selected state transport undertakings, such as BEST where details of the organization, dependent variable, curve, quarters, seasonal indexes, tren year. These details are entered in the MS-Access sheets in terms of rows and columns. The development of these kind of database in a table with two-dimensional array such as rows and columns called *relative database management system*. A table of database named as tren_best which belongs to BEST undertakings of Mumbai is shown below.

ORGANIZAT	MODEL_COC	CURVE_COD	CURVE_TYPE	DEPENDENT	DEPENDENT	DEGREE_OF	R_SQUARE	F_VALUE	b0	b1	b2
BEST	2	7	POWER_CURVI	TRRV_PSPK	TRAFFIC_REVEI	26	0.72	76.363	1026.749	0.146	
	8	5	CUBIC_CURVE	PC_PSPK	PERSONNEL_Ci	24	0.71	20.293	1393.103	1.837	-0.002
	10	5	CUBIC_CURVE	F_L_PSPK	FUEL_LUBRICAi	24	0.95	160.137	381.517	0.676	0
	21	7	POWER_CURVI	PA_TPSK	PASSENGER_Ti	25	0.82	113.563	32.949	0.16	
	25	7	POWER_CURVI	TO_TPSK	TOTAL_TAX_iP	26	0.769	86.773	64.258	0.151	
	29	5	CUBIC_CURVE	COST_PSPK	COST_iPAISE/E	24	0.92	97.478	2820.73	1.852	-0.001
	31	5	CUBIC_CURVE	AV_N_BUS_H	AVERAGE_NUA	24	0.919	90.294	3478.602	-0.095	2.157*10^-1
	40	5	CUBIC_CURVE	WS_STAFF	WORKSHOP_Ai	24	0.863	50.533	6797.95	0.776	-0.001
	42	5	CUBIC_CURVE	TOT_STAF	TOTAL_STAFF	24	0.939	122.843	40016.143	-4.254	0.002
	43	5	CUBIC_CURVE	FUEL_PERM_Ki	FUEL_CONSUM	24	0.775	27.524	3.091	0	2.514*10^-7

The front end is designed by using visual studio and the front end form is shown below



TRDISF_Q for Query and Display of Quarterly data

V. RESULTS, DISCUSSIONS, AND CONCLUSIONS

The present study includes the use of entity-relationship diagrams in the development of a RDBMS based information system with DSS capabilities. The previous chapters deal with the development an important module used in a DSS for State Transport Undertakings that operate public transport buses. TREN module provides middle level managers with the capability to make seasonal predictions for various financial and operational parameters of the STUs. The relevant data was compiled and verified in MS Excel and exported to SPSS 20 statistical package.

The variation of each cost component with respect to the time scale was studied and the relationships were established through simple curve-fitting techniques. The ratio of the actual value for each quarter to the trend value was then obtained. The average value of

the ratios for each season in the five year period provided the seasonal index that would assist in making seasonal predictions. The major results include the E-R diagrams, the process flow-charts, and the decision files. These provide important guide-lines for the development of the module. The important results of the software development activity include the finalized layouts of Visual Studio Forms for data manipulation and retrieval, interactive DSS module for decision making etc. This chapter presents the conclusions drawn from the 'software definition phase' and the 'software development phase' in the overall development of the DSS.

CONCLUSION

The overall development of the DSS involved the design of the data base structure for the information system, the development of basic data manipulation and retrieval forms, the design of basic expert system module for the DSS, and the interfaces between the

information system and the DSS module. The DSS module is developed which can forecast seasonal variations.

TRDIS_Q, is developed. TRDIS_Q was designed for query and display of quarterly values for the selected variables for a given year. This is an added advantage to the managers. → The RDBMS for public transportation is developed using decision support system which enhances the decision capabilities of transportation managers in various aspects. The future planning about operational and functional criteria in public transportation can be effectively done by using this RDBMS, this kind of system will avoid the losses, minimizes the traffic problems, accelerates the decision capability etc

Percentages of errors are encountered while comparing variables actual values with the predicted values of BEST public transportation organization. Whenever R2 value is in the range of 0.8-1.0 and higher the F-test value, the error in prediction is less hence, it is concluded that to select the best curves which having more R2 and F-test values.

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