Model for Forecasting Passenger of Airport

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Abstract

This research forecasts the growth of air traffic in one of int'l airport. It actually estimates the growth of air traffic with the trend model, and then the growth is forecasted by monthly air traffic and time series data. To estimate the coefficient of the model in general econometric methods use the time series data, it is suggested that the data should be stationary, otherwise false regression would be probable. Then before using, the data (variables), the data should be tested so as to be stationary. However, there are different methods to make data stationary such as Drawing Diagram and Augmented Dickey- Fuller Test (ADF), which were used in this dissertation. Finally, the estimation is base on the fifth month, namely (Mordad).

Keywords
forecasting , Augmented Dickey Fuller Test (ADF),time series, stationary.

1. Introduction

Civil Aviation, through a complicated interaction with other econometric sectors, benefits from and contributes to the economic development of all nations. As incomes and production level increase, the demand for aviation services expands. Therefore prospective tourism, trade and employment could be forecasted as well. Civil Aviation is an important instrument in economic development, and air transport also provides an intangible benefits by facilitating the international treaties and understanding. On the other, the role of air transport as a catalyst for general economic and social development is due to the expedition and flexibility, which has been provided by the global air transport system. It has widened the markets for numerous types of products, and also promoted the exchange and interaction of ideas, professional experience and skills among the nations. Since the role of air transport increasingly gains importance in the economic development of countries and regions, and aviation is the leading edge of industry, it is important to take due account of the economic and social benefits, which an efficient air transport system can offer, and to ensure that future air transport needs are properly assessed together with the associated financial and human resources that need to be provided. Forecasting of air traffic means to estimate the number of prospective passengers that use air transport. The main goal of this dissertation is to estimate the concerned model, then to forecast the air traffic with the model derived.

2. Forecasting Methods

Three main methods (models) of forecasting air traffic are: *trend projection, econometric relation ship, and market and industry surveys*. These methods vary in the amount of data and statistical analysis required and to the degree to which selective judgment plays a role.

2.1. Forecasting by trend projection

The first step in forecasting air traffic is usually to study the historical data (time series) and determine the trend in traffic development. In the context of medium or long-term forecasting, air traffic trend represents the regular or smooth development of air traffic over many years is isolated from short-term fluctuations in traffic levels. When deriving a medium or long-term forecast through extrapolating from the traffic trend, the historical development of air traffic may continue to operate in the future as in the past and their impact may change gradually.

2.2. Specification of trend surveys

The different types of trend surveys can be represented by various mathematical formulations. In each case, the dependent variable "*Y*" is air traffic, the independent variable "*T*" is the time which is normally measured in years and a, b, c all are constants that are called coefficients whose values can be estimated from the data.

- Liner $Y= a+bT$
- Exponential $Y= a\,(1+b)^T$

- Parabolic $Y= a+bT+cT^2$
- Gomperty $Y=ab^{-CT}$

2.3 Econometric Forecasting

The air traffic forecasting which is derived by the projection of post trends does not explicitly take into account the way in which various economic, social and operational conditions effect the development of air traffic. As these underlying casual factors change, it will be desirable to attempt to take these changes into account. Econometric forecasting involves determining the basis of historical data quantitatively. On the one hand, the relationship between traffic, on the other hand more important factors or variables, which influence the level of traffic are used to estimate the underlying variables to drive the traffic forecast.Users most often apply the econometric approach to the quantity of demand for air transport. It is convenient to identify five steps involved in an econometric forecast, although they are not performed independently of future components of an interwoven process.

- Selection of the relevant casual factors (independent variables)
- Collection of data
- Specification of the type of functiorial relationship that exists between the dependent and the independent variables.
- Statistical estimating and testing of the proposed relationship between the dependent and independent variables.
- Forecasting of the future development of variables from which the traffic forecast is subsequently derived.

3. Specification of Functional Relationship

The type of functional relationship to be used for an econometric traffic forecast must be developed through judgment and experimentation, and the adequacy of the relationship can only be established empirically through tests against actual historical data. Three alternative forms are suggested below in each case "y" is traffic, "x1" and "x2" are independent variables, and "a", "b" and "c" are constant coefficient.

- Liner $Y= a+bx_1+cx_2$
- Multiplicative $Y=ax_1^b x_2^c$
- Liner-log $Y= \log a+b\log x_1+c\log x_2$

4. Market and Industry Surveys

Traffic forecasting through market and industry surveys aim at analyzing the characteristics of the market for air transport in order to examine empirically how the use of air transport varies between different sectors of the population and different industries. Such a result, in combination with forecast of socio- economic changes, may indicate the likely future development in air transport.

5. Trend Projection Based Research

Stewart and Diluccio [10] forecast average daily number of passengers on transatlantic flights for each month from January. 1991 to December 1995.Time series shows a steady upward trend and a regular, recurring pattern associated with the months of the year. A number of factors may account for the upward trend, such as an increase in population, in income, in leisure time, or in popularity of travel. The monthly variation can be accounted for by the regularity of factors having to do with the weather and people's work and leisure holiday's .In order to describe the seasonal pattern, we may imagine a certain number (positive or negative) to be associated with each month. This number represents the "*effect*" of a particular month can be thoroughly generated by adding to the trend value for that month and pertinent monthly effect. For example, assuming a linear trend "b0+b1t" the estimated number of transatlantic passengers in February 1992 can be imagined as being the result of the following calculation:

$\hat{Y}=b_\circ+b_1\,(14) + \text{(February effect)}$

Similarly for march 1992

$\hat{Y}=b_\circ+b_1\,(15) + \text{(March effect)}$

The numbers 14 and 15 are the value of the variable "T", which measures time for estimating the coefficient. The model becomes:

$Y=952.2 + 17.6T - 265.2M2 + 267.1M3 + 559.9M4 + 1441.3M5 + 2835.8M6 + 3595.4M7 + 3573.4M8 + 2661.3M9 + 905.6M10 -180.1M11 + 109.4M12 - 4z$

The forecast for January 1996 is calculated by setting T=61 and all other variables equal to zero:

$\hat{Y} = 952.2 + (17.6)\,(61) = 2026$

The February 1996 forecast is found by setting T=62, M2=1, and all other variables equal to zero:

$\hat{Y} = 952.2 + (17.6)\,(62) – 265.2 =1778$

So, for other months the effect of the moving holding should be included in the April. Forecast if Easter occurred in April in 1996.

The estimation of Mehrabad airport passenger demand is estimated by the trend projection at first due to S.Stwart and Diluccio model then, by using Eviews as a statistical software and OLS[1] method. Then, the data of monthly time series is divided into domestic and international flights- From 1981-2000 equal to(1360-1379) for domestic flight (Table 1) and-From 1984-2000 equal to (1363-1379) or international flight (Table 2). Due to the probability of false regression econometric on the basis of study, if the process is non stationary, it will often be difficult to represent the time series over past and future interval of time by a simple algebraic model. Another one can model the process via an equation with fixed coefficients rather than being estimated from past data.

5.1 Stationary Test

Time series data is stationary when, mean, variance and coefficient correlation of them is constant during the time, and it is not important that in what time you compute them. If time series data that are used for estimating the coefficient of the model will be non-stationary, it could have the R- square near to "1". In other words, a regression of one variable against another can lead to a false result, and the OLS would yield a consistent estimator. There are different methods for stationary graph and ADF[2] unit roots test as elaborated before.

5.2 Drawing the Graph

The first step for the stationary test is drawing time series data graph. If the variables have ascending trend during the time, it is clear that at least the mean of the variable's are not constant, then it isn't stationary, but realizing the stationaryness of the variables on the basis of drawing the graph isn't enough because time series data may have ascending trend, but amount of this trend remain stationary. Fig. 1 and Fig. 2 show the graphs of domestic and international passenger of Mehrabad airport. Both of them have ascending trend, which is the reason for being stationary. However, as it was mentioned, it is not enough.

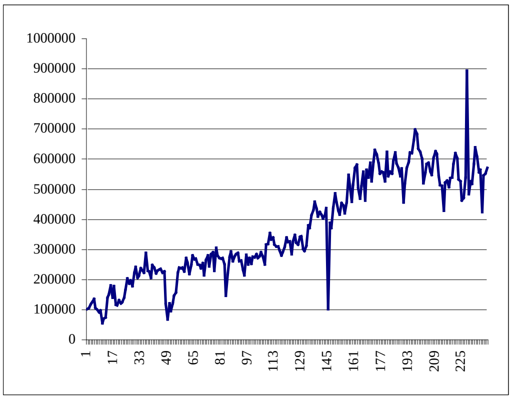

Figure 1: Graphs of domestic passenger of Mehrabad airport

5.3 ADF Unit Roots Test

The best method for realizing the stationary time series data is ADF unit roots test. For ADF test the following hypothesis should be examined. Here "H_0" is the existence of unit roots test in variables. This test has been done with Eviews that has calculated ADF compared with critical value for the Dickey fuller of a unit root test at the "1%" , "5%", and "10%" level of critical value of MacKinnon. Then the null hypothesis is rejected, which indicates the rejection of the presence of a unit root, and means the variables is stationary [I (0)]. In another test, it will be repeated with the correct value, which is first difference in degree, namely [I (1)]. If derived time series data is stationary as mentioned, then the time series data will be first degree [I (1)].

[1] -OLS: Ordinary Least Square

[2] ADF: Augmented Dickey and Fuller

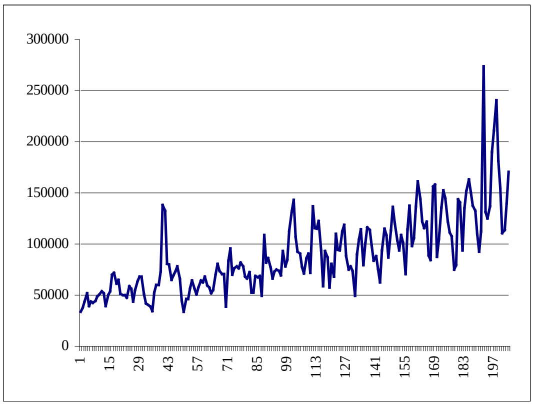

Figure 2: Graphs of international passenger of Mehrabad airport

However, if it is necessary to make stationary time series data, the difference in time means (n). With regard to above and Stewart and Diluccio Functional model formula will be as it follows:

$$Y=\alpha+\beta_{\circ}T+\beta_1M_1+\beta_2M_2+\ldots\beta_{12}M_{12}+U \qquad (1)$$

Where "Y" is number of domestic and international Mehrabad Airport passengers; "T" is the variable, which shows the month of the year. A digit is allocated for each month. For example, for first month of the year1360 (1981) , T=1 and for 12^{th} month, 12 is allocated accordingly and for the first month of 1361 , T=13 and for 12^{th} month of 1361 , T=24 and so on. M_i is dummy variables (i= 1 …12) such that;

M_1: =1 for farvardin observation . otherwise = 0

.

.

M_{12}: =1 for Esfand observation otherwise = 0

And $\alpha + \beta_{\circ}T$ is the trend component and $\beta_1 \ldots \beta_{12}$ are the effect of the months Farvardin, Ordibehesht … Esfand. When dummy variables are used one is dropped to avoid perfect collierity.

Table 3: ADF unit roots test for monthly domestic passenger

ADF Test Statistic	-7.8300	1% Critical value*	-3.999
		5% Critical Value	-3.429
		10%CriticalValue	-3.138
*Mac Kinnon critical values for rejection of hypothesis of a unit root.			

The result derived from the Eviews shown in Table 3 and Table 4 indicate that ADF test for domestic and international passenger (without need for difference) is greater than of critical Mac Kinnon value at level of 1%, 10%, 5% then null hypothesis is rejected. And then time series data are stationary.

Table 4: ADF unit roots test for monthly international passenger

ADF Test Statistic	-8.7294	1%Critical Value*	-4.006
		5% Critical Value	-3.432
		10% Critical Value	-3.140
*Mac Kinnon critical values for rejection of hypothesis of a unit root.			

When it was confirmed that the data is stationary, the models are estimated. Therefore, the dummy variables (from 1 to 12) are respectively deleted to find the basic month. Then all models are compared with each other and the model, which had a good result, was adopted. Then, the model finally provided domestic passenger traffic by deleting 5^{th} month dummy variable (means 5^{th} month is basic month), the best result is derived. Then, the functional formula of the model will be as follow:

$$PASN = \alpha+\beta_{\circ}T+\sum_{i=1}^{12}\beta_iM_i + u \qquad (2)$$

where i =5. Here PASN stands for the monthly domestic passenger. The coefficient of determination (R^2) of this model is greater than 85 percent, which indicates more than 85% of variation of the dependent variable that is illustrate with independent variable. The result shows that dummy variables relate to (4^{th}, 6^{th}, 12^{th}), month is at a significant level of confidence, and the value of (F) is more than 120.15, which indicates that the estimating model is significant and D.W.= 0.80 indicates the possibility of self correlation. For the second model, variable for the domestic passenger is added to above formulated model. Then, the functional form of the model is as it follows:

$$PASN = \alpha+\beta_{\circ}T+\sum_{i=1}^{12} \beta_i M_i+u + PASN\,(-1) \tag{3}$$

The result shows that the growth of domestic passenger per each month is related to the very month year, because the result in this estimation is better. R^2 is greater than 91% and with regard to t-student, and dummy variables rotate to (2nd, 4^{th}, and 6^{th}), and 12th, is not significant at level of confidence 91%. It is because more passengers travel in this month due to holidays, or due to weather, which cause people, to choose this month for traveling. Value of F>179.30 indicates that estimating model is significant, and D.W>2.24 indicates that there is no possibility of correlation. Then, this model is a final model, which illustrates, for example in 3rd month, the number of passengers is 31739 which is less than 5^{th} month (as it was already said 5^{th} month is basic month) and in 9^{th} month, the number of passengers is 36176 that is less than 5^{th} month, and so on. However, the first model is for international passengers. The result of Estimation of final trend's model for domestic and international with the package of Eviews is provided in Table 5. Forecasting of domestic and international air traffic with trend model in 1380-85 (2001-2005) domestic and international with regard to trend method of forecasting the number of domestic and international passengers is provided in Table 6.

6. Conclusion

The model, which is estimated in accordance with the time series data, the result shows that the models, which are derived by removing (deleting) 5^{th} dummy variable namely, (5^{th} month is basic) has good R^2 (coefficient of determination). In this model except (4^{th} and 6^{th}) variables, which are related to (4^{th} and 6^{th}) month is not significant at level of confidence of 90% and this result is the one that was expected due to weather conditions in summer. In both of the models most of the air- passengers traffic is related to Mordad, and it hasn't more difference with Tir and Shahrivar (4^{th} and 6^{th} month). In regard to the coefficient of the months in Mehr air traffic passengers of Mehrabad Int'l Airport is less than others. It is probably because of starting the educational year and as well as decreasing of traveling. With regard to this conclusion it is better to do repairs and maintenance in these months that has low air traffic such as Tir, Mordad, and Shahrivar and will do at fall especial in Mehr. According to this finding, the forecasted and estimated air traffic and accordingly the rate of growth air passengers' domestic and international up to the end of 1385, with trend model will be 5.1% and 1.5%.

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Table 1: Number of passenger during 1981-2000 (1360-1379) for domestic flight

year	Farvardin M1	Ordibehesht M2	Khorda M3	Tir M3	Mordad M5	Shahrivar M6	Mehr M7	Aban M8	Azar M9	Dey M10	Bahman M11	Esfand M12
1360	102146	106484	119515	124933	136819	106556	99230	92202	98123	54751	70350	74149
1361	139086	151281	180514	140108	177406	116314	115441	131675	121846	126126	139379	165702
1362	204414	185898	198343	178546	222819	242864	206202	211993	237824	229451	223899	288149
1363	228784	226643	206513	248526	239546	221350	229858	233303	235826	221971	227426	118909
1364	68687	120217	95723	121232	146453	157737	223954	240643	237026	240794	226522	270818
1365	256462	218100	249455	279765	268122	269412	250685	248722	237595	254504	213556	264853
1366	280933	243729	285209	291252	228248	306495	280698	271502	269833	270981	251279	146681
1367	218848	275380	293606	261978	277744	284596	289750	261346	263872	230418	214643	282247
1368	251547	272547	251952	276174	272860	284577	271337	277831	291697	276939	249787	315723
1369	319210	354317	333105	339871	317378	309515	309350	296899	281038	290974	306991	339991
1370	325053	326858	284280	327479	349112	322081	315815	341486	344217	302201	295778	311432
1371	380624	370939	413525	430873	458796	434346	409787	425287	414414	403500	414870	437613
1372	101680	388996	372124	439382	486491	457899	427854	416626	453690	445390	420542	457240
1373	547156	512491	459252	514941	571952	581160	503328	469588	509594	558581	462497	565457
1374	538375	587440	526167	592056	630473	616708	586920	551685	559214	556963	527410	624916
1375	543324	557599	551356	595262	623096	585281	571422	542582	568566	456325	518966	570697
1376	589907	621091	619826	662348	698287	683955	635297	623761	600693	520742	554890	584318
1377	588768	559435	547836	604934	626804	616827	544362	514229	512050	428992	521321	527901
1378	507891	538077	540301	583650	618904	602586	532551	525611	462526	471369	538761	892803
1379	484673	526577	518688	582821	638250	606221	556974	565096	425307	545487	552611	571147

Table 2: Number of passenger during 1984-2000 (1363-1379) for international flight

year	Farvardin M1	Ordibehesht M2	Khorda M3	Tir M3	Mordad M5	Shahrivar M6	Mehr M7	Aban M8	Azar M9	Dey M10	Bahman M11	Esfand M12
1363	34020	37539	43675	51693	43974	42498	44222	48782	50435	53612	51774	39598
1364	39598	49884	53838	70144	71934	61489	64738	51447	50131	50059	47226	58855
1365	56330	43566	54970	64028	67869	68161	50367	41587	40426	38590	34492	52574
1366	59762	60189	73345	138054	132492	80322	79760	64942	69327	72892	77850	65987
1367	44118	33451	46058	46290	57058	64252	56472	50891	57615	64239	62645	67834
1368	59590	57768	51910	55216	70657	80903	73627	70381	70408	38691	83464	95552
1369	69935	76252	77960	76532	82131	77977	68305	66100	72417	52599	52221	68604
1370	67680	68477	49328	108494	81655	86078	76644	66214	73160	75309	73461	69641
1371	93052	78024	84066	113257	131707	143226	106901	92510	90452	77718	70941	86310
1372	90591	71934	137086	115510	114820	122323	93397	58586	93132	86863	57616	80748
1373	68327	110146	94496	93504	112190	119034	88125	74926	77945	73825	49449	90167
1374	104503	114270	79289	100494	116094	113662	97872	83941	88067	75078	62693	93548
1375	115240	108860	86589	113289	136500	120639	103718	93989	108648	101448	70502	114236
1376	137614	98200	105738	136321	161480	144212	122083	115524	121670	88489	84415	156351
1377	157948	87322	104202	135799	152274	145133	121812	111398	107340	74716	79525	143974
1378	140314	93671	135228	151680	163236	150441	137241	132600	109260	92298	112246	273510
1379	131461	125186	136713	190054	210359	240365	181208	154916	110546	113902	140265	170359

Table 5: Final result of estimating of domestic and inter domestic passenger demand with trend model.

Interdomestic	Model	Domestic	Model	
Second	First	Second	First	Variable
40063.43 (6.30)	61141.90 (10.72)	64627 33 (4 56)	131666.1 (8.24)	C
-20552.13 (-3.03)	-23383.63 (-3.24)	-55931 18 (-3 39)	-56597.42 (-2.79)	M1
-26825.81 (-3.97)	-33023.75 (-4.57)	-11986 24 (-0/73)	-35521.41 (-1.75)	M2
-17623.96 (2.56)	-27658.23 (-3.83)	-31739 93 (-1 95)	-42612.41 (-2.10)	M3
82.92 (0.01)	-7815.29 (-1.08)	-2285 14 (-0 14)	-17420.90 (-0.86)	M4
-5940.743 (-0.89)	-2829.65 (-0.39)	-21870 84 (-1 34)	-11404.55 (-0.56)	M6
-22812.76 (-3.42)	-20827.36 (-2.88)	-39549 26 (-2 43)	-35938.34 (-1.77)	M7
-27363.70 (-4.07)	-32541.01 (-4.50)	-32992 28 (-2 02)	-44126.29 (-2.17)	M8
-22313.02 (-3.25)	-32151.96 (-4.45)	-36176 16 (-2 21)	-52232.63 (-2.57)	M9
-32510.35 (-4.74)	-42193.90 (-5.84)	-45427 88 (-2 78)	-66407.78 (-3.28)	M10
-29870.92 (-4.23)	-43550/73 (-6/02)	-36957 21 (-2 24)	-66407.37 (-3.28)	M11
1189.93 (0.17)	-13029.38 (-1.80)	4757 60 (0 28)	-24694.52 (-1.22)	M12
302.88 (7.43)	502.24 (20.01)	895 96 (6 88)	2250.45 (37.66)	T
		0 60 (11 22)		PASN(-1)
0.40 (5.95)				PASI(-1)
0.76	0.72	0 91	0.86	R - Square
1.99	1.21	2.24	0.80	D.W.
46.03	40.50	179	120.15	F
203	203	239	239	N

Table 6: Forecasting of air traffic monthly passenger during 1380-85

International	1380	1381	1382	1383	1384	1385
Farvardin	134186.1	138910.7	144435.1	150279.42	156251.70	162275.18
Ordibehesht	125705.3	129547.58	134719.05	140422.20	146338.02	152338.91
Khordad	139820.83	144698.52	150284.16	156152.97	162135.06	168162.45
Tir	179001.15	178214.57	181534.49	186497.03	192116.60	197998.99
Mordad	187508.95	182003.49	183435.87	187643.37	192960.94	198722.53
Shahrivar	575817.08	331688.87	237672.15	203700.02	193745.73	193398.57
Mehr	153641.55	146249.53	146927.28	150832.94	156029.77	161743.06
Aban	138876.7	136095.54	138617.64	143261.03	148752.95	154584.28
Azar	126482.25	136491.31	144129.49	150819.33	157129.82	163288.58
Dey	117930.2	123176.04	128908.94	134836.65	140842.30	146879.12
Bahman	131418.01	131513.77	135186.6	140290.34	145966.39	151871.36
Esfand	172439.18	176905.81	182327.02	188130.07	194085.88	200102.72
Sum	2182827/3	1955495/74	1908177/84	1932865/40	1986355/13	2051365/75
Domestic	1380	1381	1382	1383	1384	1385
Farvardin	515426..31	544629.82	572903.44	600619.13	628896.03	656613.69
Ordibehesht	585409.61	631460.70	669842.87	703623.69	735539.66	765440.77
Khordad	561818.48	598448.29	631177.69	661566.86	691447.83	720127.94
Tir	630649.03	670097.37	704517.89	735921.72	766411.50	795456.89
Mordad	667087.53	695141.57	722725.51	750027.40	778056.01	805624.69
Shahrivar	626895.25	650051.32	674696.48	700235.10	727205.75	754139.66
Mehr	580564.59	605470.46	631165.51	657334.06	684682.66	711843.35
Aban	592890.73	620319.09	647527.62	674604.26	702497.73	729985.33
Azar	506729.41	566334.38	612848.88	651509.10	686352.71	718010.39
Dey	570431.65	596149.96	622332.47	648793.49	676317.58	703583.56
Bahman	584122.68	613781.21	642327.84	670207.35	698582.53	726359.16
Esfand	628339.85	673407.08	711198.94	745521.53	776866.61	806425.17
Sum	705036.12	7465291.23	7843265.14	8199963.68	8552856.61	8893610.60