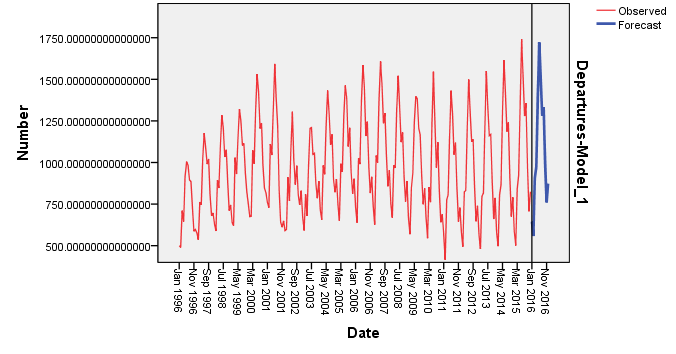
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COURSE: DSCI 5340  
MINI-CASE 3**

**Overview:**   
  
In this case study, we use 3 major statistical packages (SPSS, SAS and Minitab), as we analyze and forecast for 2016 using data from 1996 to 2015. This data was retrieved from the Office of Travel and Tourism Industries which is operated by the U.S Department of Commerce. This study predicts the number of air traveler’s departures from the Unites states having Europe as their destination for the year 2016. The ARIMA model was used.

1. Time series plot of the monthly air departures between January 1996 and December 2015. (**SPSS)**



1. Tentative ARIMA model Identification using **SAS**

| **Autocorrelation Check for White Noise** | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **To Lag** | **Chi-Square** | **DF** | **Pr > ChiSq** | **Autocorrelations** | | | | | |
| **6** | 116.50 | 6 | <.0001 | 0.087 | -0.005 | 0.268 | -0.365 | -0.509 | 0.054 |
| **12** | 422.11 | 12 | <.0001 | -0.472 | -0.358 | 0.265 | 0.022 | 0.081 | 0.886 |

| **Squared Canonical Correlation Estimates** | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| **Lags** | **MA 0** | **MA 1** | **MA 2** | **MA 3** | **MA 4** | **MA 5** |
| **AR 0** | 0.0076 | <.0001 | 0.0741 | 0.1385 | 0.2701 | 0.0030 |
| **AR 1** | 0.0002 | 0.0083 | 0.0179 | 0.2011 | 0.1919 | 0.1693 |
| **AR 2** | 0.0750 | 0.0166 | 0.0140 | 0.1073 | 0.3589 | 0.1900 |
| **AR 3** | 0.2101 | 0.2309 | 0.1540 | 0.1487 | 0.2326 | 0.0925 |
| **AR 4** | 0.2738 | 0.1923 | 0.3302 | 0.1129 | 0.0692 | 0.1362 |
| **AR 5** | 0.0094 | 0.1514 | 0.2837 | 0.0045 | 0.0808 | 0.1043 |

| **SCAN Chi-Square[1] Probability Values** | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| **Lags** | **MA 0** | **MA 1** | **MA 2** | **MA 3** | **MA 4** | **MA 5** |
| **AR 0** | 0.1766 | 0.9355 | <.0001 | <.0001 | <.0001 | 0.5461 |
| **AR 1** | 0.8376 | 0.1686 | 0.0879 | <.0001 | <.0001 | 0.0001 |
| **AR 2** | <.0001 | 0.0830 | 0.1544 | <.0001 | <.0001 | <.0001 |
| **AR 3** | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | 0.0018 |
| **AR 4** | <.0001 | <.0001 | <.0001 | 0.0008 | 0.0262 | 0.0049 |
| **AR 5** | 0.1362 | <.0001 | <.0001 | 0.4474 | 0.0022 | 0.0026 |

1. Final fitted ARIMA model equation using **Minitab;**  
     
   Final Estimates of Parameters

Type Coef SE Coef T P

AR 1 0.3992 0.1430 2.79 0.006

AR 2 -0.0910 0.0736 -1.24 0.218

AR 3 0.0227 0.0757 0.30 0.765

AR 4 -0.1025 0.0717 -1.43 0.154

AR 5 -0.2140 0.0776 -2.76 0.006

MA 1 0.6117 0.1381 4.43 0.000

SMA 12 0.6543 0.0543 12.06 0.000

Constant -0.1633 0.5274 -0.31 0.757

Differencing: 1 regular, 1 seasonal of order 12

Number of observations: Original series 240, after differencing 227

Residuals: SS = 745656 (backforecasts excluded)

MS = 3405 DF = 219

Modified Box-Pierce (Ljung-Box) Chi-Square statistic

Lag 12 24 36 48

Chi-Square 9.0 20.0 24.6 31.6

DF 4 16 28 40

P-Value 0.060 0.222 0.649 0.824

1. Ljung-Box test for Autocorrelation in the residual using **SPSS**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Model Statistics** | | | | | | |
| Model | Number of Predictors | Model Fit statistics | **Ljung-Box Q(18)** | | | Number of Outliers |
| Stationary R-squared | Statistics | DF | Sig. |
| Departures-Model\_1 | 0 | .381 | 12.376 | 11 | .336 | 0 |

1. ACF and PACF plots of the residuals using **Minitab.**



1. Yes, the final model produces stationary residuals.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Forecast** | | | | | | | | | | | | | | |
| Model | | Jan 2016 | Feb 2016 | Mar 2016 | Apr 2016 | May 2016 | Jun 2016 | Jul 2016 | Aug 2016 | Sep 2016 | Oct 2016 | Nov 2016 | Dec 2016 |
| Departures-Model\_1 | Forecast | 644.94926660000000 | 557.85382970000000 | 907.02631630000000 | 976.41470429999990 | 1385.46246499999980 | 1721.69785000000000 | 1510.78951399999980 | 1282.51597300000000 | 1330.84103200000000 | 999.12244760000000 | 760.37919860000000 | 873.22002890000000 |
| UCL | 760.98444630000000 | 705.50374349999990 | 1070.91648999999980 | 1153.89455499999990 | 1571.81085199999980 | 1910.46086999999990 | 1701.56339900000000 | 1476.17554900000000 | 1527.98137000000000 | 1200.83824200000000 | 968.37204019999990 | 1087.96070300000000 |
| LCL | 528.91408700000000 | 410.20391589999997 | 743.13614230000000 | 798.93485340000000 | 1199.11407700000000 | 1532.93483000000000 | 1320.01562799999990 | 1088.85639700000000 | 1133.70069399999990 | 797.40665340000000 | 552.38635700000000 | 658.47935460000000 |
| For each model, forecasts start after the last non-missing in the range of the requested estimation period, and end at the last period for which non-missing values of all the predictors are available or at the end date of the requested forecast period, whichever is earlier. | | | | | | | | | | | | | | |

1. 95% CI for a 12 month forecast of Departures in 2016 (Jan-Dec) using **SPSS and SAS**

| **Forecasts for variable Departures** | | | | |
| --- | --- | --- | --- | --- |
| **Obs** | **Forecast** | **Std Error** | **95% Confidence Limits** | |
| **241** | 1013.5956 | 273.4629 | 477.6182 | 1549.5730 |
| **242** | 1014.0110 | 273.4629 | 478.0336 | 1549.9884 |
| **243** | 1014.4263 | 273.4629 | 478.4489 | 1550.4037 |
| **244** | 1014.8416 | 273.4629 | 478.8642 | 1550.8190 |
| **245** | 1015.2570 | 273.4629 | 479.2796 | 1551.2343 |
| **246** | 1015.6723 | 273.4629 | 479.6949 | 1551.6497 |
| **247** | 1016.0876 | 273.4629 | 480.1102 | 1552.0650 |
| **248** | 1016.5029 | 273.4629 | 480.5255 | 1552.4803 |
| **249** | 1016.9183 | 273.4629 | 480.9409 | 1552.8957 |
| **250** | 1017.3336 | 273.4629 | 481.3562 | 1553.3110 |
| **251** | 1017.7489 | 273.4629 | 481.7715 | 1553.7263 |
| **252** | 1018.1643 | 273.4629 | 482.1869 | 1554.1417 |

1. Upon visiting the NTTO website, obtaining all monthly data for 2016, Using the SPSS forecast to compare, all 12 observations are within the 95% forecasting confidence intervals as shown graphically below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Forecast | UCL 95% | LCL 95% | Actual |
| Jan | 644.9492666 | 760.9844463 | 528.914087 | 615.47 |
| Feb | 557.8538297 | 705.5037435 | 410.2039159 | 546.246 |
| Mar | 907.0263163 | 1070.91649 | 743.1361423 | 912.603 |
| Apr | 976.4147043 | 1153.894555 | 798.9348534 | 976.044 |
| May | 1385.462465 | 1571.810852 | 1199.114077 | 1441.559 |
| Jun | 1721.69785 | 1910.46087 | 1532.93483 | 1837 |
| Jul | 1510.789514 | 1701.563399 | 1320.015628 | 1654.182 |
| Aug | 1282.515973 | 1476.175549 | 1088.856397 | 1356.022 |
| Sep | 1330.841032 | 1527.98137 | 1133.700694 | 1437.634 |
| Oct | 999.1224476 | 1200.838242 | 797.4066534 | 1055.11 |
| Nov | 760.3791986 | 968.3720402 | 552.386357 | 807.099 |
| Dec | 873.2200289 | 1087.960703 | 658.4793546 | 975.396 |