/\* Using ARIMA to forecast vechicle numbers \*/

**data** usecon;

set sashelp.usecon;

**run**;

/\*Creating difference and doube difference to verify stationarity \*/

**data** usecon2;

set usecon;

dvehicles = dif(VEHICLES);

sno = \_n\_;

**run**;

\* ARIMA identification \*/;

**proc** **arima** data=usecon2;

identify var=VEHICLES stationarity=(adf);

**run**;

**proc** **arima** data=usecon2;

identify var=dvehicles stationarity=(adf);

**run**;

**Output statistics of VEHCLES variable for stationary in SASHELP.USECON dataset**

|  |
| --- |
| **The ARIMA Procedure** |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | **Name of Variable = VEHICLES** | | | --- | --- | | **Mean of Working Series** | 11743.69 | | **Standard Deviation** | 5103.178 | | **Number of Observations** | 252 | |
| | **Autocorrelations** | | | | | | --- | --- | --- | --- | --- | | **Lag** | **Covariance** | **Correlation** | -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1 | **Std Error** | | **0** | 26042430 | 1.00000 | | |\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*| | 0 | | **1** | 23749049 | 0.91194 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* | | 0.062994 | | **2** | 21925072 | 0.84190 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* | | 0.102803 | | **3** | 21516554 | 0.82621 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* | | 0.127255 | | **4** | 21768320 | 0.83588 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* | | 0.147008 | | **5** | 21814074 | 0.83764 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* | | 0.164793 | | **6** | 21584817 | 0.82883 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* | | 0.180901 | | **7** | 21226504 | 0.81507 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* | | 0.195390 | | **8** | 20465725 | 0.78586 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* | | 0.208446 | | **9** | 19418084 | 0.74563 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* | | 0.219889 | | **10** | 19330427 | 0.74227 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* | | 0.229704 | | **11** | 20527605 | 0.78824 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* | | 0.239032 | | **12** | 21798116 | 0.83702 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* | | 0.249134 | | **13** | 20044251 | 0.76968 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* | | 0.260054 | | **14** | 18657877 | 0.71644 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\*\* | | 0.268941 | | **15** | 18150948 | 0.69698 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\*\* | | 0.276411 | | **16** | 18517171 | 0.71104 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\*\* | | 0.283299 | | **17** | 18783554 | 0.72127 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\*\* | | 0.290295 | | **18** | 18435281 | 0.70789 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\*\* | | 0.297321 | | **19** | 17926643 | 0.68836 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\*\* | | 0.303936 | | **20** | 17132555 | 0.65787 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\* | | 0.310061 | | **21** | 16038795 | 0.61587 | | . |\*\*\*\*\*\*\*\*\*\*\*\*. | | 0.315551 | | **22** | 15658504 | 0.60127 | | . |\*\*\*\*\*\*\*\*\*\*\*\*. | | 0.320285 | | **23** | 16678942 | 0.64045 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\* | | 0.324734 | | **24** | 17726528 | 0.68068 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\*\* | | 0.329708 |  | **Partial Autocorrelations** | | | | --- | --- | --- | | **Lag** | **Correlation** | -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1 | | **1** | 0.91194 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* | | | **2** | 0.06099 | | . |\* . | | | **3** | 0.29604 | | . |\*\*\*\*\*\* | | | **4** | 0.23133 | | . |\*\*\*\*\* | | | **5** | 0.13475 | | . |\*\*\* | | | **6** | 0.09971 | | . |\*\*. | | | **7** | 0.05102 | | . |\* . | | | **8** | -0.08830 | | .\*\*| . | | | **9** | -0.14719 | | \*\*\*| . | | | **10** | 0.09302 | | . |\*\*. | | | **11** | 0.30418 | | . |\*\*\*\*\*\* | | | **12** | 0.33145 | | . |\*\*\*\*\*\*\* | | | **13** | -0.47037 | | \*\*\*\*\*\*\*\*\*| . | | | **14** | -0.01797 | | . | . | | | **15** | -0.13943 | | \*\*\*| . | | | **16** | 0.14716 | | . |\*\*\* | | | **17** | 0.04677 | | . |\* . | | | **18** | -0.11266 | | .\*\*| . | | | **19** | -0.05777 | | . \*| . | | | **20** | 0.00269 | | . | . | | | **21** | 0.01228 | | . | . | | | **22** | -0.09051 | | .\*\*| . | | | **23** | 0.10913 | | . |\*\*. | | | **24** | 0.06893 | | . |\* . | |  | **Autocorrelation Check for White Noise** | | | | | | | | | | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **To Lag** | **Chi-Square** | **DF** | **Pr > ChiSq** | **Autocorrelations** | | | | | | | **6** | 1109.92 | 6 | <.0001 | 0.912 | 0.842 | 0.826 | 0.836 | 0.838 | 0.829 | | **12** | 2089.54 | 12 | <.0001 | 0.815 | 0.786 | 0.746 | 0.742 | 0.788 | 0.837 | | **18** | 2933.33 | 18 | <.0001 | 0.770 | 0.716 | 0.697 | 0.711 | 0.721 | 0.708 | | **24** | 3633.34 | 24 | <.0001 | 0.688 | 0.658 | 0.616 | 0.601 | 0.640 | 0.681 |  | **Augmented Dickey-Fuller Unit Root Tests** | | | | | | | | | --- | --- | --- | --- | --- | --- | --- | --- | | **Type** | **Lags** | **Rho** | **Pr < Rho** | **Tau** | **Pr < Tau** | **F** | **Pr > F** | | **Zero Mean** | 0 | -2.7719 | 0.2523 | -1.07 | 0.2560 |  |  | |  | 1 | -2.0460 | 0.3249 | -0.88 | 0.3337 |  |  | |  | 2 | -0.3945 | 0.5928 | -0.25 | 0.5957 |  |  | | **Single Mean** | 0 | -21.8639 | 0.0066 | -3.44 | 0.0106 | 5.98 | 0.0122 | |  | 1 | -18.5950 | 0.0150 | -3.09 | 0.0288 | 4.84 | 0.0435 | |  | 2 | -8.8658 | 0.1734 | -2.11 | 0.2416 | 2.41 | 0.4579 | | **Trend** | 0 | -112.988 | 0.0001 | -8.34 | <.0001 | 34.84 | 0.0010 | |  | 1 | -147.524 | 0.0001 | -8.38 | <.0001 | 35.17 | 0.0010 | |  | 2 | -93.1849 | 0.0006 | -6.15 | <.0001 | 18.93 | 0.0010 |   **Output statistics of DVEHCLES (single differencing of VEHICLES) variable for stationary in SASHELP.USECON dataset**   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | | **Name of Variable = dvehicles** | | | --- | --- | | **Mean of Working Series** | 39.749 | | **Standard Deviation** | 2087.995 | | **Number of Observations** | 251 | | | | **Autocorrelations** | | | | | | --- | --- | --- | --- | --- | | **Lag** | **Covariance** | **Correlation** | -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1 | **Std Error** | | **0** | 4359723 | 1.00000 | | |\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*| | 0 | | **1** | -511209 | -.11726 | | .\*\*| . | | 0.063119 | | **2** | -1449216 | -.33241 | | \*\*\*\*\*\*\*| . | | 0.063981 | | **3** | -654236 | -.15006 | | \*\*\*| . | | 0.070527 | | **4** | 223332 | 0.05123 | | . |\* . | | 0.071788 | | **5** | 336882 | 0.07727 | | . |\*\*. | | 0.071933 | | **6** | 16524.937 | 0.00379 | | . | . | | 0.072263 | | **7** | 404983 | 0.09289 | | . |\*\*. | | 0.072264 | | **8** | 342646 | 0.07859 | | . |\*\*. | | 0.072738 | | **9** | -930403 | -.21341 | | \*\*\*\*| . | | 0.073076 | | **10** | -1303585 | -.29901 | | \*\*\*\*\*\*| . | | 0.075518 | | **11** | -87573.871 | -.02009 | | . | . | | 0.080096 | | **12** | 3091839 | 0.70918 | | . |\*\*\*\*\*\*\*\*\*\*\*\*\*\* | | 0.080116 | | **13** | -408429 | -.09368 | | . \*\*| . | | 0.102108 | | **14** | -935726 | -.21463 | | \*\*\*\*| . | | 0.102450 | | **15** | -851485 | -.19531 | | \*\*\*\*| . | | 0.104226 | | **16** | 95150.612 | 0.02182 | | . | . | | 0.105674 | | **17** | 678909 | 0.15572 | | . |\*\*\*. | | 0.105692 | | **18** | 145.066 | 0.00003 | | . | . | | 0.106602 | | **19** | 295090 | 0.06769 | | . |\* . | | 0.106602 | | **20** | 391088 | 0.08970 | | . |\*\* . | | 0.106773 | | **21** | -723321 | -.16591 | | .\*\*\*| . | | 0.107073 | | **22** | -1391848 | -.31925 | | \*\*\*\*\*\*| . | | 0.108092 | | **23** | 12300.630 | 0.00282 | | . | . | | 0.111786 | | **24** | 2705159 | 0.62049 | | . |\*\*\*\*\*\*\*\*\*\*\*\* | | 0.111786 | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | | **Partial Autocorrelations** | | | | --- | --- | --- | | **Lag** | **Correlation** | -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1 | | **1** | -0.11726 | | .\*\*| . | | | **2** | -0.35099 | | \*\*\*\*\*\*\*| . | | | **3** | -0.28202 | | \*\*\*\*\*\*| . | | | **4** | -0.19095 | | \*\*\*\*| . | | | **5** | -0.14339 | | \*\*\*| . | | | **6** | -0.13103 | | \*\*\*| . | | | **7** | 0.04942 | | . |\* . | | | **8** | 0.14304 | | . |\*\*\* | | | **9** | -0.09273 | | .\*\*| . | | | **10** | -0.34405 | | \*\*\*\*\*\*\*| . | | | **11** | -0.44486 | | \*\*\*\*\*\*\*\*\*| . | | | **12** | 0.44905 | | . |\*\*\*\*\*\*\*\*\* | | | **13** | 0.01576 | | . | . | | | **14** | 0.17984 | | . |\*\*\*\* | | | **15** | -0.14852 | | \*\*\*| . | | | **16** | -0.07731 | | .\*\*| . | | | **17** | 0.10148 | | . |\*\*. | | | **18** | 0.03329 | | . |\* . | | | **19** | -0.00755 | | . | . | | | **20** | -0.01996 | | . | . | | | **21** | 0.11842 | | . |\*\*. | | | **22** | -0.09429 | | .\*\*| . | | | **23** | -0.04708 | | . \*| . | | | **24** | 0.12968 | | . |\*\*\* | | | | | **Autocorrelation Check for White Noise** | | | | | | | | | | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **To Lag** | **Chi-Square** | **DF** | **Pr > ChiSq** | **Autocorrelations** | | | | | | | **6** | 39.66 | 6 | <.0001 | -0.117 | -0.332 | -0.150 | 0.051 | 0.077 | 0.004 | | **12** | 212.77 | 12 | <.0001 | 0.093 | 0.079 | -0.213 | -0.299 | -0.020 | 0.709 | | **18** | 244.43 | 18 | <.0001 | -0.094 | -0.215 | -0.195 | 0.022 | 0.156 | 0.000 | | **24** | 391.46 | 24 | <.0001 | 0.068 | 0.090 | -0.166 | -0.319 | 0.003 | 0.620 | |  |  |  |  |  |  |  |  |  |  | | | | **Augmented Dickey-Fuller Unit Root Tests** | | | | | | | | | --- | --- | --- | --- | --- | --- | --- | --- | | **Type** | **Lags** | **Rho** | **Pr < Rho** | **Tau** | **Pr < Tau** | **F** | **Pr > F** | | **Zero Mean** | 0 | -280.104 | 0.0001 | -17.53 | <.0001 |  |  | |  | 1 | -608.785 | 0.0001 | -16.86 | <.0001 |  |  | |  | 2 | 13271.93 | 0.9999 | -15.50 | <.0001 |  |  | | **Single Mean** | 0 | -280.269 | 0.0001 | -17.50 | <.0001 | 153.18 | 0.0010 | |  | 1 | -611.373 | 0.0001 | -16.85 | <.0001 | 141.95 | 0.0010 | |  | 2 | 10843.72 | 0.9999 | -15.52 | <.0001 | 120.44 | 0.0010 | | **Trend** | 0 | -280.257 | 0.0001 | -17.47 | <.0001 | 152.59 | 0.0010 | |  | 1 | -611.210 | 0.0001 | -16.81 | <.0001 | 141.36 | 0.0010 | |  | 2 | 10885.89 | 0.9999 | -15.48 | <.0001 | 119.93 | 0.0010 | | |