Augmented Dickey-Fuller Test

|  |  |  |
| --- | --- | --- |
| **Dataset** | **Score** | **Is stationary?** |
| **Delhi** | 0.0 | yes |
| **Mumbai** | 0.011 | yes |
| **Chennai** | 0.0001 | yes |
| **Hyderabad** | 0.0022 | yes |
| **Kolkata** | 0.0113 | yes |

Triple Exponential Forecast results

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Dataset** | **Delhi** | **Mumbai** | **Chennai** | **Hyderabad** | **Kolkata** |
| **MAE** | 14.45 | 13.09 | 35.32 | 19.58 | 34.57 |

Observe the mean and variance of original and forecasted time series of last 30 days

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Dataset** | **Mean** | | **Variance** | |
| **Original** | **Forecasted** | **Original** | **Forecasted** |
| **Delhi** | 160.23 | 169.36 | 124.98 | 58.99 |
| **Mumbai** | 109.17 | 108.78 | 547.54 | 313.40 |
| **Chennai** | 127.87 | 84.82 | 1375.78 | 181.81 |
| **Hyderabad** | 157.60 | 134.25 | 434.84 | 61.04 |
| **Kolkata** | 204.00 | 188.36 | 3044.62 | 25.51 |

By observing the deviation from the mean of values, it is clear that there is lot of irregularity present in the original datasets. However, it is NOT captured by Triple Exponential Smoothing.

* **Exponential smoothing doesn’t have any provisions for residual components or they simply ignore the irregularity. Because, time series need to be stationary when applying any exponential smoothing method.**

Looking back the dataset and its mean. It is observed that the mean is moving or fluctuating when calculated for different portions of the dataset

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Dataset** | **Mean** | | | |
| **25%** | **50%** | **75%** | **Original** |
| **Delhi** | 164.29 | 176.99 | 174.02 | 170.94 |
| **Mumbai** | 109.29 | 119.76 | 118.40 | 113.65 |
| **Chennai** | 87.59 | 90.90 | 86.34 | 84.26 |
| **Hyderabad** | 122.18 | 129.86 | 122.48 | 116.08 |
| **Kolkata** | 127.77 | 140.81 | 140.21 | 133.70 |

Mean is fluctuating around the portion which is undesirable in forecasting time series. However, **augmented dickey-fuller test identified that the series are stationary.**

Comparison of variance when fitting the line of TES

|  |  |  |
| --- | --- | --- |
| **Dataset** | **Variance** | |
| **Original series** | **Fitted series** |
| **Chennai** | 1195.90 | 1576.79 |
| **Mumbai** | 2726.58 | 4561.05 |

Best worked parameters on Triple Exponential Smoothing

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Dataset | Alpha | Beta | Gamma | MAE |
| Delhi | 0.8 | 0.1 | 0.1 | 28.12 |
| Mumbai | 0.8 | 0.1 | 0.1 | 14.39 |
| Chennai | 0.8 | 0.1 | 0.1 | 14.43 |
| Hyderabad | 0.8 | 0.1 | 0.1 | 12.60 |
| Kolkata | 0.8 | 0.1 | 0.1 | 19.23 |

**Variance and mean of original and forecasted series on triple exponential smoothing**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Dataset** | **Mean** | | **Variance** | |
| **Original** | **Forecasted** | **Original** | **Forecasted** |
| **Delhi** | 170.95 | 170.94 | 6660.92 | 6994.17 |
| **Mumbai** | 113.65 | 113.66 | 2726.58 | 2814.89 |
| **Chennai** | 84.26 | 84.26 | 1195.90 | 1286.93 |
| **Hyderabad** | 116.08 | 116.10 | 1776.28 | 1855.13 |
| **Kolkata** | 133.70 | 133.70 | 5068.83 | 5256.21 |

**Variance Vs MAE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Dataset | Original variance | Forecast variance | MAE | Variance diff |
| Delhi | 6660.92 | 6994.17 | 28.12 | 333.25 |
| Mumbai | 2726.58 | 2814.89 | 14.39 | 88.31 |
| Chennai | 1195.90 | 1286.93 | 14.43 | 91.03 |
| Hyderabad | 1776.28 | 1855.13 | 12.60 | 78.85 |
| Kolkata | 5068.83 | 5256.21 | 19.23 | 187.38 |