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| Part 1 |
| 1.1 |
| In this case, I am taking value of m = 3 |
| 1.2 |
| The RMSE value obtained from the model at m = 3 is: **24.22457** |
| 1.3 |
| Now, we are varying values of m from 0 to 100 in order find the best value of m with lowest corresponding RMSE value.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **M** | **RMSE** | **M** | **RMSE** | **M** | **RMSE** | | 1 | 25.11553 | 35 | 42.6016 | 68 | 44.2591 | | **2** | **22.84046** | 36 | 42.79674 | 69 | 44.23476 | | 3 | 24.22457 | 37 | 42.98989 | 70 | 44.21765 | | 4 | 25.3994 | 38 | 43.17758 | 71 | 44.20381 | | 5 | 26.85595 | 39 | 43.36082 | 72 | 44.19329 | | 6 | 28.19926 | 40 | 43.52531 | 73 | 44.19143 | | 7 | 29.37931 | 41 | 43.68047 | 74 | 44.18922 | | 8 | 30.57135 | 42 | 43.81992 | 75 | 44.19454 | | 9 | 31.59843 | 43 | 43.9411 | 76 | 44.19456 | | 10 | 32.60263 | 44 | 44.0452 | 77 | 44.19897 | | 11 | 33.50408 | 45 | 44.14166 | 78 | 44.20361 | | 12 | 34.37462 | 46 | 44.22264 | 79 | 44.21284 | | 13 | 35.1638 | 47 | 44.28158 | 80 | 44.22079 | | 14 | 35.90575 | 48 | 44.32617 | 81 | 44.23261 | | 15 | 36.59692 | 49 | 44.36454 | 82 | 44.24693 | | 16 | 37.2196 | 50 | 44.39082 | 83 | 44.26517 | | 17 | 37.8057 | 51 | 44.4101 | 84 | 44.27935 | | 18 | 38.31359 | 52 | 44.43324 | 85 | 44.29175 | | 19 | 38.77306 | 53 | 44.45395 | 86 | 44.30091 | | 20 | 39.18695 | 54 | 44.47079 | 87 | 44.30724 | | 21 | 39.57755 | 55 | 44.4794 | 88 | 44.30791 | | 22 | 39.93894 | 56 | 44.47622 | 89 | 44.29615 | | 23 | 40.25317 | 57 | 44.4659 | 90 | 44.27684 | | 24 | 40.54327 | 58 | 44.45775 | 91 | 44.2556 | | 25 | 40.7892 | 59 | 44.44474 | 92 | 44.22862 | | 26 | 41.02156 | 60 | 44.42683 | 93 | 44.20254 | | 27 | 41.21622 | 61 | 44.41112 | 94 | 44.1791 | | 28 | 41.39044 | 62 | 44.39144 | 95 | 44.153 | | 29 | 41.56193 | 63 | 44.3707 | 96 | 44.13113 | | 30 | 41.72719 | 64 | 44.35083 | 97 | 44.10805 | | 31 | 41.88969 | 65 | 44.32853 | 98 | 44.09247 | | 32 | 42.05265 | 66 | 44.30871 | 99 | 44.07678 | | 33 | 42.22186 | 67 | 44.28258 | 100 | 44.06102 | | 34 | 42.41066 |  | |  | | |
| 1.4 |
| On observation of the m values in the table above, the **lowest RMSE value = 22.84046** at **M = 2**    Now as we have out M value, we will test the model against the training data: |
| Part 2 |
| 2.1 |
| I have taken value for alpha = 0.45 in order to show how the model works at the particular value.  RMSE value for Exponential Smoothing Model at **alpha= 0.45: 23.6637841321677** |
| 2.2 |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Alpha** | **RMSE** | **Alpha** | **RMSE** | **Alpha** | **RMSE** | | 0.01 | 42.99576 | 0.35 | 24.7051 | 0.68 | 23.14239 | | 0.02 | 41.51075 | 0.36 | 24.568 | 0.69 | 23.1614 | | 0.03 | 40.18578 | 0.37 | 24.4392 | 0.70 | 23.18332 | | 0.04 | 38.96413 | 0.38 | 24.31829 | 0.71 | 23.20813 | | 0.05 | 37.82915 | 0.39 | 24.20487 | 0.72 | 23.23578 | | 0.06 | 36.77735 | 0.40 | 24.09861 | 0.73 | 23.26625 | | 0.07 | 35.80594 | 0.41 | 23.99916 | 0.74 | 23.2995 | | 0.08 | 34.91052 | 0.42 | 23.90623 | 0.75 | 23.33552 | | 0.09 | 34.08553 | 0.43 | 23.81953 | 0.76 | 23.37428 | | 0.10 | 33.32494 | 0.44 | 23.73879 | 0.77 | 23.41575 | | 0.11 | 32.62283 | 0.45 | 23.66378 | 0.78 | 23.45994 | | 0.12 | 31.97362 | 0.46 | 23.59427 | 0.79 | 23.50682 | | 0.13 | 31.37223 | 0.47 | 23.53004 | 0.80 | 23.55637 | | 0.14 | 30.81413 | 0.48 | 23.47089 | 0.81 | 23.6086 | | 0.15 | 30.29529 | 0.49 | 23.41664 | 0.82 | 23.6635 | | 0.16 | 29.81214 | 0.50 | 23.36711 | 0.83 | 23.72106 | | 0.17 | 29.36154 | 0.51 | 23.32215 | 0.84 | 23.78128 | | 0.18 | 28.94071 | 0.52 | 23.28161 | 0.85 | 23.84416 | | 0.19 | 28.54721 | 0.53 | 23.24534 | 0.86 | 23.90972 | | 0.20 | 28.17883 | 0.54 | 23.21321 | 0.87 | 23.97795 | | 0.21 | 27.83364 | 0.55 | 23.18511 | 0.88 | 24.04886 | | 0.22 | 27.5099 | 0.56 | 23.16091 | 0.89 | 24.12246 | | 0.23 | 27.20603 | 0.57 | 23.14051 | 0.90 | 24.19878 | | 0.24 | 26.92062 | 0.58 | 23.1238 | 0.91 | 24.27781 | | 0.25 | 26.6524 | 0.59 | 23.1107 | 0.92 | 24.35959 | | 0.26 | 26.40021 | 0.60 | 23.10112 | 0.93 | 24.44413 | | 0.27 | 26.163 | 0.61 | 23.09498 | 0.94 | 24.53146 | | 0.28 | 25.93981 | **0.62** | **23.09219** | 0.95 | 24.6216 | | 0.29 | 25.72977 | 0.63 | 23.09269 | 0.96 | 24.71458 | | 0.30 | 25.53207 | 0.64 | 23.09642 | 0.97 | 24.81043 | | 0.31 | 25.34598 | 0.65 | 23.10331 | 0.98 | 24.90918 | | 0.32 | 25.17084 | 0.66 | 23.1133 | 0.99 | 25.01087 | | 0.33 | 25.00602 | 0.67 | 23.12634 | 1.0 | 25.11553 | | 34 | 24.85094 |  |  |  |  |   **Lowest value of RMSE is: 23.09219 at Alpha = 0.62.**  Given below is the graph to show the RMSE plot versus Alpha values as written in above table: |
| 2.3 |
| Alpha selected for the Exponential Smoothing Model **= 0.62** |
| Part 3 |
| 3.1 |
| Applying AR(p) model for p = 5.  **"RMSE value for AR(p) model at p = 5: 22.3326573420611"** |
| 3.2 |
| On observing PACF, there is sharp decline from P = 2 to P = 3. Hence, best value for P should be 2. |
| 3.3 |
| For P =2, we have got the following results:  **"RMSE value for AR(p) model at p = 2: 22.3611701949522"** |
| Part 4 |
| Comparison of the three models on Test Data is as follows:         |  |  | | --- | --- | | MODEL | RMSE | | "Simple Moving Average" | "23.8662613711004" | | "Exponential Smoothing" | "24.2961871095798" | | **"AR(p) Model"** | **"23.2375480361294"** |   **On observing the RMSE values, AR(p) Model is better than the rest of the models with RMSE =** 23.2. |