q1.3

```
#The first step is to read the data in a .csv file and convert them to a time series object.

#Step 1 read the csv datasets files

data = read.csv("/Users/Bryan/Google Drive/Cours/DSBA/T1/1. Forecasting & Predictive Analysis/6. Projec
tsdata <- xts(data[,2:19], as.Date(data$date))
```

```
#We also read the data to set-up the SARIMAX method
Tempdata <- read.csv("/Users/Bryan/Downloads/California_temp_max_min.csv")
tstemp <- xts(Tempdata[,2:3],as.Date(data$date))
tstemp1 <- head(tstemp, 1378)
tstemp2 <- head(tstemp, 1575)
tstemp3 <- head(tstemp, 1772)
```

As for the previous questions, we split the time series in three different splits: - 70-30 - 80-20 - 90-10

split: 70-30

```
#Step 3 perform training and testing data split
train1 <- head(tsdata, 1378)
test1 <- tail(tsdata, 591)
```

split: 80-20

```
train2 <- head(tsdata, 1575)
test2 <- tail(tsdata, 394)
```

split: 90-10

```
train3 <- head(tsdata, 1772)
test3 <- tail(tsdata, 197)
```

For each product, we compute a series of key statistics to assess the accuracy of the forecast methods. The choice of the best method is based on the RMSSE statistics.

###Split1

Let's analyze the forecast for the Hobbies products [Store 1 - Train Split 1]

```
##              Naive       sNaive           MA           ES          ESX
## MAE     54.3571429 7.800000e+01   56.4196429   39.8161565   55.4586344
## MAPE     0.2100891 2.726595e-01    0.2405174    0.1757254    0.2285218
## MSE   4945.2857143 1.427064e+04 5468.6763393 3234.9517771 4970.7371640
## RMSE    70.3227254 1.194598e+02   73.9504992   56.8766365   70.5034550
## RMSSE   99.4513521 1.689417e+02  104.5817990   80.4357107   99.7069422
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE     53.1157180   55.0457955   55.5897899   57.0894035        55.3923781
## MAPE     0.2201403    0.2324053    0.2362762    0.2420746         0.2312666
## MSE   4709.3601882 5103.2523905 5274.9213464 5472.8616663      5090.4149363
## RMSE    68.6247782   71.4370519   72.6286538   73.9787920        71.3471439
## RMSSE   97.0500921  101.0272477  102.7124272  104.6218110       100.9000985
```

According to the results, the most accurate method is ES.

[Store 2 - Train Split 1]

```
##              Naive       sNaive          MA           ES          ESX
## MAE     49.0714286   29.2142857   42.625000   30.9214678   42.2142857
## MAPE     0.2817363    0.2072353    0.307797    0.2288556    0.2975545
## MSE   4080.9285714 1467.3571429 2919.569196 1730.6997188 2890.7420166
## RMSE    63.8821460   38.3060980   54.033038   41.6016793   53.7656211
## RMSSE   90.3429972   54.1730033   76.414255   58.8336591   76.0360706
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE     39.3439574   38.0892986   38.5258894 8.835999e+01        36.9464727
## MAPE     0.2832598    0.2804215    0.2856923 4.361813e-01         0.2692375
## MSE   2505.1931888 2404.5752100 2448.9304742 1.129221e+04      2309.2920512
## RMSE    50.0519049   49.0364682   49.4866697 1.062648e+02        48.0550939
## RMSSE   70.7840828   69.3480383   69.9847194 1.502811e+02        67.9601656
```

According to the results, the most accurate methods is ES.

[Store 3 - Train Split 1]

```
## Warning in HoltWinters(train1$Hobbies_CA_3, gamma = FALSE): optimization
## difficulties: ERROR: ABNORMAL_TERMINATION_IN_LNSRCH
```

```
##              Naive       sNaive          MA           ES          ESX
## MAE     79.9285714   65.2142857   78.4464286   69.1217235   78.6288097
## MAPE     0.2057572    0.1813453    0.2132702    0.1884453    0.2123457
## MSE   8839.1428571 7350.4285714 8066.2053571 7057.1937381 8114.8549118
## RMSE    94.0167158   85.7346404   89.8120557   84.0071053   90.0824895
## RMSSE  132.9597146  121.2470913  127.0134273  118.8039876  127.3958784
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE     76.7350859   77.6812518   77.800483   80.0494979        78.2054698
## MAPE     0.2071594    0.2116465    0.212461    0.1998975         0.2121814
## MSE   7820.4312702 7885.8738306 7894.517890 9374.8655385      8032.1547675
## RMSE    88.4332023   88.8024427   88.851100   96.8238893        89.6222895
## RMSSE  125.0634341  125.5856188  125.654430  136.9296574       126.7450572
```

According to the results, the most accurate method is ES.

Household_1 products [Store 1 - Train Split 1]

```
##             Naive       sNaive          MA           ES          ESX
## MAE     64.285714   53.2857143   51.8214286   33.1848687   49.8283049
## MAPE     0.276158    0.2549574    0.3003776    0.1923339    0.2851199
## MSE   6342.071429 4146.0000000 3875.3214286 1756.7947529 3628.2260970
## RMSE    79.637123   64.3894401   62.2520797   41.9141355   60.2347582
## RMSSE  112.623900   91.0604195   88.0377354   59.2755388   85.1848120
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE     33.7293893   41.1770980   40.8208258   49.3206435        41.5203418
## MAPE     0.1907465    0.2417248    0.2393842    0.2812415         0.2291935
## MSE   1889.6303045 2543.7414985 2498.1747233 3570.4225497      2480.2304798
## RMSE    43.4698781   50.4355182   49.9817439   59.7530129        49.8019124
## RMSSE   61.4756912   71.3265939   70.6848601   84.5035212        70.4305400
```

According to the results, the most accurate method is ES.

Household_1 products [Store 2 - Train Split 1]

```
##              Naive       sNaive          MA           ES          ESX
## MAE     46.5357143   28.8214286   46.0089286  20.8059164   47.9364649
```

```
## MAPE     0.2658023    0.1971052    0.3289976   0.1599573    0.3537291
## MSE   3807.3214286 1226.3928571 2948.9531250 614.7531196 3041.3028806
## RMSE    61.7034961   35.0198923   54.3042643  24.7942154   55.1480089
## RMSSE   87.2619210   49.5256067   76.7978271  35.0643158   77.9910621
##            ARIMA      SARIMA     SARIMAX Holt-Winters State-Space Model
## MAE    20.926090  26.4377810  26.0179000   43.4770355        24.0918386
## MAPE    0.161011   0.2052971   0.2008676    0.2753458         0.1865159
## MSE   621.080535 951.6187985 925.8434625 3004.4050075       819.4885877
## RMSE   24.921487  30.8483192  30.4276759   54.8124530        28.6267111
## RMSSE  35.244306  43.6261114  43.0312320   77.5165145        40.4842831
```

According to the results, the most accurate method is ES.

Household_1 products [Store 3 - Train Split 1]

```
##              Naive       sNaive           MA           ES          ESX
## MAE     65.8928571 8.725000e+01   78.1250000   53.9192837   74.3089797
## MAPE     0.1951851 2.599896e-01    0.2482089    0.1735873    0.2339215
## MSE   6614.2500000 1.014396e+04 8801.4709821 4768.0883886 8042.3753684
## RMSE    81.3280394 1.007172e+02   93.8161552   69.0513460   89.6792917
## RMSSE  115.0152164 1.424357e+02  132.6760791   97.6533501  126.8256707
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE     53.8266679   77.5230212   76.0527094   77.9005030         74.993876
## MAPE     0.1733205    0.2503464    0.2456656    0.2470695          0.242829
## MSE   4756.7389586 8640.9999556 8347.9017971 8825.5567602       8197.243956
## RMSE    68.9691160   92.9569791   91.3668528   93.9444344         90.538632
## RMSSE   97.5370592  131.4610205  129.2122424  132.8574933        128.040962
```

According to the results, the most accurate method is ARIMA.

Household_2 products [Store 1 - Train Split 1]

```
##             Naive      sNaive          MA          ES         ESX       ARIMA
## MAE    17.5714286  14.5000000  17.7678571  12.1364442  18.5944470  13.4846519
## MAPE    0.1650825   0.1558081   0.1781828   0.1281334   0.1920563   0.1475105
## MSE   622.8571429 349.8571429 563.0691964 256.9473226 570.0509831 384.5973382
## RMSE   24.9571061  18.7044685  23.7290791  16.0295765  23.8757405  19.6111534
## RMSSE  35.2946779  26.4521131  33.5579855  22.6692445  33.7653960  27.7343591
##            SARIMA     SARIMAX Holt-Winters State-Space Model
## MAE    13.9094708  14.0272523   18.9367920        13.1622288
## MAPE    0.1450196   0.1466106    0.1737656         0.1384406
## MSE   346.5864475 349.8832482  683.8674251       294.5297843
## RMSE   18.6168324  18.7051663   26.1508590        17.1618701
## RMSSE  26.3281768  26.4530999   36.9828994        24.2705494
```

According to the results, the most accurate method is ES.

Household_2 products [Store 2 - Train Split 1]

```
##              Naive      sNaive           MA          ES          ESX
## MAE     43.9642857  22.5357143   44.6964286  22.4736936   43.6489950
## MAPE     0.2780959   0.1862682    0.3656127   0.1953433    0.3494118
## MSE   3662.0357143 932.9642857 2694.4732143 752.9280673 2685.5981889
## RMSE    60.5147562  30.5444641   51.9083155  27.4395348   51.8227574
## RMSSE   85.5807889  43.1963954   73.4094437  38.8053622   73.2884464
##              ARIMA       SARIMA     SARIMAX Holt-Winters State-Space Model
## MAE    21.3883903   29.3021411   29.268842   41.7610613        43.1046408
## MAPE    0.1865448    0.2525749    0.252159    0.3169561         0.3581528
```

```
## MSE   768.5134243 1171.2016222 1169.683081 2661.0882259      2505.2704497
## RMSE   27.7220747   34.2228231   34.200630   51.5857367        50.0526767
## RMSSE  39.2049340   48.3983806   48.366995   72.9532484        70.7851743
```

According to the results, the most accurate method is ES.

Household_2 products [Store 3 - Train Split 1]

```
##              Naive       sNaive           MA          ES          ESX
## MAE     44.8928571   36.6785714   29.7767857  22.8013464   31.8969574
## MAPE     0.2474772    0.2319728    0.2032827   0.1608913    0.2214753
## MSE   2849.3928571 1715.0357143 1349.6495536 805.2540184 1521.2183924
## RMSE    53.3797045   41.4129897   36.7375769  28.3769981   39.0027998
## RMSSE   75.4903021   58.5668117   51.9547794  40.1311355   55.1582885
##             ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE     31.305867   29.0529101   29.7158536   26.8612905        31.5796376
## MAPE     0.213725    0.2003901    0.2055259    0.1584429         0.2171663
## MSE   1384.234873 1172.5391003 1227.3753372 1324.6536409      1432.2603702
## RMSE    37.205307   34.2423583   35.0339170   36.3957915        37.8452159
## RMSSE   52.616250   48.4260075   49.5454405   51.4714220        53.5212177
```

According to the results, the most accurate method is ES.

Foods_1 products [Store 1 - Train Split 1]

```
##              Naive     sNaive           MA          ES          ESX
## MAE     38.8214286   55.53571   52.6785714   45.1285423   39.2335933
## MAPE     0.3076905    0.43735    0.4729787    0.4097299    0.3161866
## MSE   2467.8214286 4321.60714 3848.3281250 2934.9515498 2462.3380188
## RMSE    49.6771721   65.73893   62.0348944   54.1751931   49.6219510
## RMSSE   70.2541305   92.96889   87.7305890   76.6152929   70.1760361
##             ARIMA      SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE     44.7559906   36.304739   36.2570941   40.8553735      1.021316e+02
## MAPE     0.3708893    0.253595    0.2543765    0.3380722      8.583649e-01
## MSE   3160.1296752 2340.236293 2331.0170005 2621.9835521      1.299214e+04
## RMSE    56.2150307   48.375989   48.2806069   51.2053079      1.139831e+02
## RMSSE   79.5000588   68.413979   68.2790890   72.4152408      1.611964e+02
```

According to the results, the most accurate method is SARIMAX.

Foods_1 products [Store 2 - Train Split 1]

```
##            Naive      sNaive          MA          ES         ESX       ARIMA
## MAE     9.678571  12.1785714  10.7767857  11.2213148  12.4238597  11.5126022
## MAPE    0.314042   0.4055122   0.3110257   0.3211465   0.3375342   0.3194484
## MSE   154.250000 222.7500000 200.5424107 180.6739394 256.3182163 222.6057648
## RMSE   12.419742  14.9248116  14.1612998  13.4415006  16.0099412  14.9199787
## RMSSE  17.564168  21.1068709  20.0271022  19.0091525  22.6414759  21.1000362
##            SARIMA     SARIMAX Holt-Winters State-Space Model
## MAE    10.6987571  10.3462732   14.7625102        10.1110642
## MAPE    0.3084829   0.3053186    0.6011497         0.3023364
## MSE   201.0679648 190.1269179  355.3210397       176.6514301
## RMSE   14.1798436  13.7886518   18.8499613        13.2910282
## RMSSE  20.0533271  19.5000984   26.6578709        18.7963523
```

According to the results, the most accurate method is Naive.

Foods_1 products [Store 3 - Train Split 1]

```
##              Naive       sNaive           MA          ES         ESX
```

```
## MAE     48.4642857   56.6071429   50.5051020   53.8413899   50.632961
## MAPE     0.3283988    0.3487272    0.3417891    0.3607933    0.342628
## MSE   3835.3214286 4398.1071429 4064.6581633 4214.2931803 4079.875542
## RMSE    61.9299720   66.3182263   63.7546717   64.9175876   63.873903
## RMSSE   87.5822063   93.7881351   90.1627214   91.8073328   90.331341
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE     79.3865958   39.4124942   39.1200030   69.8634878        39.3043401
## MAPE     0.5185128    0.2317317    0.2344859    0.4582895         0.2325712
## MSE   8495.5760984 3032.8914741 2961.1446929 6805.0323385      3022.0542501
## RMSE    92.1714495   55.0716939   54.4164010   82.4926199        54.9732139
## RMSSE  130.3501139   77.8831365   76.9564122  116.6621819        77.7438647
```

According to the results, the most accurate method is SARIMAX.

Foods_2 products [Store 1 - Train Split 1]

```
##              Naive       sNaive           MA           ES          ESX
## MAE     71.1071429   65.7500000   76.4642857   57.3604600   74.3357154
## MAPE     0.2454797    0.2360355    0.2899452    0.2151065    0.2735194
## MSE   6639.3214286 6772.2500000 7821.8214286 5120.6378736 7122.6389282
## RMSE    81.4820313   82.2936814   88.4410619   71.5586324   84.3957281
## RMSSE  115.2329938  116.3808403  125.0745492  101.1991885  119.3535833
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE     53.9632651   69.8434893   70.8290802   69.9950806        66.4829839
## MAPE     0.1951979    0.2629011    0.2673829    0.2410301         0.2576901
## MSE   4797.7302902 7084.2636403 7188.2753095 6430.6366348      6524.3436144
## RMSE    69.2656501   84.1680678   84.7836972   80.1912504        80.7734091
## RMSSE   97.9564218  119.0316230  119.9022544  113.4075538       114.2308506
```

According to the results, the most accurate method is ARIMA.

Foods_2 products [Store 2 - Train Split 1]

```
##              Naive       sNaive           MA           ES          ESX
## MAE     44.1785714   33.8214286   37.9017857   28.7120495   39.2330619
## MAPE     0.2699035    0.2304352    0.2751379    0.1985679    0.2641655
## MSE   3135.7500000 1721.0357143 2366.4531250 1269.6643177 2509.7904514
## RMSE    55.9977678   41.4853675   48.6462036   35.6323493   50.0978088
## RMSSE   79.1928027   58.6691693   68.7961209   50.3917517   70.8490007
##              ARIMA      SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE     32.6475261   32.089457   32.0378712   46.3638332         33.388439
## MAPE     0.2032032    0.236937    0.2360775    0.2687007          0.230611
## MSE   1684.9420132 1764.430858 1762.2336189 3548.1327811       1872.998278
## RMSE    41.0480452   42.005129   41.9789664   59.5662050         43.278150
## RMSSE   58.0507022   59.404223   59.3672236   84.2393350         61.204547
```

According to the results, the most accurate method are ES.

Foods_2 products [Store 3 - Train Split 1]

```
##              Naive       sNaive           MA           ES         ESX
## MAE     78.2500000 9.289286e+01 8.748214e+01   78.6640257   74.381482
## MAPE     0.1690521 2.329219e-01 2.277452e-01    0.1968181    0.188853
## MSE   9242.9642857 1.207489e+04 1.131519e+04 8905.3223156 8432.081271
## RMSE    96.1403364 1.098858e+02 1.063729e+02   94.3680153   91.826365
## RMSSE  135.9629676 1.554020e+02 1.504340e+02  133.4565271  129.862090
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE     75.9032404   70.7501460   73.6118472   70.3262812        76.0911115
```

```
## MAPE     0.1975395    0.1829354    0.1907992    0.1708866         0.2012198
## MSE   9038.9599431 8430.3096287 8871.2663374 7188.8736959      9535.3278502
## RMSE    95.0734450   91.8167176   94.1874001   84.7872260        97.6490033
## RMSSE  134.4541553  129.8484473  133.2010986  119.9072450       138.0965449
```

According to the results, the most accurate method is Holt-Winters.

Foods_3 products [Store 1 - Train Split 1]

```
##              Naive       sNaive           MA           ES          ESX
## MAE   3.142143e+02 2.975714e+02 3.337143e+02 2.474804e+02 3.142160e+02
## MAPE  1.799394e-01 1.804373e-01 2.232305e-01 1.582699e-01 1.799391e-01
## MSE   1.536906e+05 1.218054e+05 1.575686e+05 8.514934e+04 1.536937e+05
## RMSE  3.920339e+02 3.490062e+02 3.969491e+02 2.918036e+02 3.920379e+02
## RMSSE 5.544196e+02 4.935694e+02 5.613708e+02 4.126726e+02 5.544253e+02
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE   2.398039e+02 2.763032e+02 2.825622e+02 3.153680e+02      3.782797e+02
## MAPE  1.508252e-01 1.906710e-01 1.954770e-01 2.048903e-01      2.465373e-01
## MSE   8.237133e+04 1.074349e+05 1.121610e+05 1.404304e+05      1.762072e+05
## RMSE  2.870041e+02 3.277726e+02 3.349044e+02 3.747404e+02      4.197705e+02
## RMSSE 4.058850e+02 4.635404e+02 4.736264e+02 5.299630e+02      5.936451e+02
```

According to the results, the most accurate method is ARIMA.

Foods_3 products [Store 2 - Train Split 1]

```
##              Naive       sNaive           MA           ES          ESX
## MAE   1.978571e+02 1.136429e+02 1.732143e+02 9.671074e+01   178.564918
## MAPE  2.112836e-01 1.383013e-01 2.052444e-01 1.145648e-01     0.222861
## MSE   6.572779e+04 2.393229e+04 4.699566e+04 1.431955e+04 45197.018259
## RMSE  2.563743e+02 1.547006e+02 2.167848e+02 1.196643e+02   212.595904
## RMSSE 3.625680e+02 2.187797e+02 3.065800e+02 1.692309e+02   300.656010
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE      96.330891 1.064705e+02 1.070005e+02 1.845256e+02      1.062356e+02
## MAPE      0.131458 1.289456e-01 1.292186e-01 2.023746e-01      1.282047e-01
## MSE   14777.921605 1.841073e+04 1.850431e+04 5.556429e+04      1.781346e+04
## RMSE    121.564475 1.356861e+02 1.360305e+02 2.357208e+02      1.334671e+02
## RMSSE   171.918129 1.918892e+02 1.923762e+02 3.333595e+02      1.887509e+02
```

According to the results, the most accurate method is ES.

Foods_3 products [Store 3 - Train Split 1]

```
## Warning in HoltWinters(train1$Foods_3_CA_3, gamma = FALSE): optimization
## difficulties: ERROR: ABNORMAL_TERMINATION_IN_LNSRCH
```

```
##              Naive       sNaive           MA           ES          ESX
## MAE   3.302857e+02 3.399286e+02 3.812411e+02 3.062927e+02 3.245826e+02
## MAPE  1.365744e-01 1.557649e-01 1.828465e-01 1.452850e-01 1.348762e-01
## MSE   1.891377e+05 1.630124e+05 1.939883e+05 1.261670e+05 1.832174e+05
## RMSE  4.348997e+02 4.037480e+02 4.404411e+02 3.551999e+02 4.280390e+02
## RMSSE 6.150410e+02 5.709859e+02 6.228777e+02 5.023285e+02 6.053385e+02
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE   4.226147e+02 2.815966e+02 2.925361e+02 3.574615e+02      3.255315e+02
## MAPE  2.013011e-01 1.360920e-01 1.416953e-01 1.678431e-01      1.567566e-01
## MSE   2.383890e+05 1.081242e+05 1.156583e+05 1.723777e+05      1.432119e+05
## RMSE  4.882509e+02 3.288225e+02 3.400857e+02 4.151839e+02      3.784334e+02
## RMSSE 6.904911e+02 4.650252e+02 4.809538e+02 5.871587e+02      5.351857e+02
```

According to the results, the most accurate method is SARIMA.

###SPLIT 2

Let's analyze the forecast for the Hobbies products [Store 1 - Train Split 2]

```
##              Naive       sNaive           MA           ES         ESX
## MAE     67.9642857   43.9642857   54.7857143   45.3289227   53.593153
## MAPE     0.2028392    0.1215436    0.1538551    0.1279859    0.149212
## MSE   6165.2500000 2808.2500000 4828.7500000 2783.8890245 4803.407693
## RMSE    78.5191060   52.9929241   69.4892078   52.7625722   69.306621
## RMSSE  111.0427845   74.9433119   98.2725801   74.6175452   98.014363
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE     50.7964852   52.7809764   54.3782489   54.4038244         53.120950
## MAPE     0.1414285    0.1476754    0.1534397    0.1522085          0.148629
## MSE   4429.5861121 4571.7589542 4629.7700731 4836.5869702       4633.646223
## RMSE    66.5551359   67.6147835   68.0424138   69.5455748         68.070891
## RMSSE   94.1231758   95.6217439   96.2265044   98.3522950         96.266777
```

According to the results, the most accurate method is ES.

[Store 2 - Train Split 2]

```
## Warning in HoltWinters(train2$Hobbies_CA_2, gamma = FALSE): optimization
## difficulties: ERROR: ABNORMAL_TERMINATION_IN_LNSRCH
```

```
##              Naive       sNaive           MA           ES          ESX
## MAE     38.9642857   39.1071429   34.1250000   32.1627791   37.6780242
## MAPE     0.1859346    0.1692023    0.1465324    0.1352393    0.1545661
## MSE   2202.0357143 2470.6785714 1956.1674107 1707.3463999 2357.1928189
## RMSE    46.9258534   49.7059209   44.2285814   41.3200484   48.5509302
## RMSSE   66.3631783   70.2947875   62.5486596   58.4353728   68.6613839
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE     36.4119437   35.9090165   34.9261302   42.3209351        35.5308594
## MAPE     0.1477808    0.1475944    0.1448727    0.2001765         0.1450859
## MSE   2283.8335340 2112.8382456 2005.8201690 2568.0945522      2108.4449080
## RMSE    47.7894710   45.9656203   44.7863837   50.6763707        45.9178060
## RMSSE   67.5845180   65.0052036   63.3375113   71.6672108        64.9375840
```

According to the results, the most accurate methods is ES.

[Store 3 - Train Split 2]

```
##              Naive       sNaive           MA           ES          ESX
## MAE     212.000000    92.500000   62.7040816   56.3106664   62.6725977
## MAPE      0.502308     0.197778    0.1409516    0.1260808    0.1410198
## MSE   50690.714286 14753.000000 5912.0204082 5045.9639624 5900.8804750
## RMSE    225.145984   121.461928   76.8896639   71.0349489   76.8171887
## RMSSE   318.404505   171.773106  108.7384054  100.4585881  108.6359100
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE     62.5034514   62.8795588   62.9052417   73.1760270        62.2167768
## MAPE     0.1401499    0.1420075    0.1422666    0.1811275         0.1404198
## MSE   5987.8564751 6240.2752347 6232.4094134 8416.3146767      6115.8788846
## RMSE    77.3812411   78.9954127   78.9456105   91.7404746        78.2040848
## RMSSE  109.4336006  111.7163841  111.6459530  129.7406234       110.5972774
```

According to the results, the most accurate method is ES.

Household_1 products [Store 1 - Train Split 2]

```
##              Naive       sNaive           MA           ES         ESX
## MAE     45.3571429   25.6428571   43.5714286  22.86762561   43.679725
## MAPE     0.1607711    0.1034197    0.1623978   0.09012642    0.167944
## MSE   4104.0000000 1052.2142857 3358.6071429 882.35433379 3115.159733
## RMSE    64.0624695   32.4378527   57.9534912  29.70444973   55.813616
## RMSSE   90.5980132   45.8740512   81.9586132  42.00843567   78.932373
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE    20.26208578   29.0514179   28.6572417   43.7855291        27.9534701
## MAPE    0.08067055    0.1053254    0.1038367    0.1665578         0.1059966
## MSE   647.18815019 1717.8721901 1692.1498892 3197.1924001      1408.4959914
## RMSE   25.43989289   41.4472217   41.1357495   56.5437211        37.5299346
## RMSSE  35.97744155   58.6152231   58.1747349   79.9648973        53.0753425
```

According to the results, the most accurate method is ES.

Household_1 products [Store 2 - Train Split 2]

```
##              Naive      sNaive           MA           ES          ESX
## MAE     47.7857143   33.857143   50.8214286   37.9103717   53.1609014
## MAPE     0.2261362    0.159944    0.2211329    0.1760816    0.2241918
## MSE   3676.0000000 1787.785714 4519.7834821 2072.4157676 5116.4275304
## RMSE    60.6300256   42.282215   67.2293350   45.5237934   71.5292075
## RMSSE   85.7438044   59.796082   95.0766373   64.3803661  101.1575754
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE     39.0815670   37.2945777   38.1963778   55.0117416        40.8495845
## MAPE     0.1808098    0.1545905    0.1589958    0.2283031         0.1722724
## MSE   2208.4347844 2718.9686164 2803.8029271 5571.7666942      3014.5116646
## RMSE    46.9939867   52.1437304   52.9509483   74.6442677        54.9045687
## RMSSE   66.4595333   73.7423707   74.8839492  105.5629357        77.6467857
```

According to the results, the most accurate method is ES.

Household_1 products [Store 3 - Train Split 2]

```
##              Naive      sNaive           MA           ES          ESX
## MAE     75.0714286   48.714286   70.0000000 3.987399e+01   70.7167422
## MAPE     0.1562104    0.105696    0.1656377 8.860516e-02    0.1592467
## MSE   8735.0000000 3544.000000 6575.0334821 2.578277e+03 6601.5162824
## RMSE    93.4612219   59.531504   81.0865802 5.077674e+01   81.2497156
## RMSSE  132.1741276   84.190261  114.6737414 7.180915e+01  114.9044497
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE   3.989467e+01   47.6764767   47.5054109    70.806654        54.8491315
## MAPE  8.875159e-02    0.1129098    0.1120038     0.154294         0.1310495
## MSE   2.584727e+03 3474.8166069 3437.1840056  6787.027795      4641.4334211
## RMSE  5.084021e+01   58.9475751   58.6275021    82.383419        68.1280663
## RMSSE 7.189892e+01   83.3644601   82.9118086   116.507749        96.3476354
```

According to the results, the most accurate method is ES.

Household_2 products [Store 1 - Train Split 2]

```
##             Naive       sNaive           MA           ES         ESX       ARIMA
## MAE    23.1428571   25.0000000  23.0446429  12.09601876  22.9970407  14.3517884
## MAPE    0.1647818    0.1754116   0.1657846   0.08562955   0.1662706   0.1005886
## MSE   808.7142857 1015.3571429 788.2120536 329.26432051 779.6355737 370.8727461
## RMSE   28.4379023   31.8646692  28.0751145  18.14564192  27.9219550  19.2580567
## RMSSE  40.2172671   45.0634473  39.7042077  25.66181289  39.4876075  27.2350049
##            SARIMA    SARIMAX Holt-Winters State-Space Model
```

```
## MAE    15.0156027  14.813002   23.5400784        13.7233731
## MAPE    0.1033185   0.102719    0.1655818         0.1010608
## MSE   431.0991571 413.892411  840.7834228       327.8291043
## RMSE   20.7629275  20.344346   28.9962657        18.1060516
## RMSSE  29.3632136  28.771250   41.0069122        25.6058237
```

According to the results, the most accurate method is State-Space Model.

Household_2 products [Store 2 - Train Split 2]

```
##             Naive      sNaive           MA          ES          ESX       ARIMA
## MAE     33.392857  24.8214286   36.2500000  18.5957010   33.7915110  19.6775469
## MAPE     0.244127   0.1772752    0.2758374   0.1402208    0.2491586   0.1455612
## MSE   1462.750000 944.1785714 1680.6785714 493.1388697 1490.4888649 552.5754329
## RMSE    38.245915  30.7274889   40.9960800  22.2067303   38.6068500  23.5069231
## RMSSE   54.087891  43.4552315   57.9772123  31.4050591   54.5983308  33.2438094
##            SARIMA     SARIMAX Holt-Winters State-Space Model
## MAE    24.1281095  24.1233374   32.7055572        31.8037510
## MAPE    0.1895659   0.1895251    0.2368596         0.2370598
## MSE   836.9068280 836.6140599 1425.5035870      1338.2428842
## RMSE   28.9293420  28.9242815   37.7558418        36.5820022
## RMSSE  40.9122678  40.9051112   53.3948235        51.7347636
```

According to the results, the most accurate method is ES.

Household_2 products [Store 3 - Train Split 2]

```
##              Naive      sNaive           MA          ES          ESX
## MAE     34.3928571  25.5357143  21.7142857  16.0062305  19.85288874
## MAPE     0.1644735   0.1285459   0.1043316   0.0797327   0.09835148
## MSE   1854.8214286 932.4642857 934.3303571 421.9848422 785.57714292
## RMSE    43.0676378  30.5362782  30.5668179  20.5422696  28.02814912
## RMSSE   60.9068375  43.1848188  43.2280084  29.0511563  39.63778861
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE    15.81317089  19.82599282  17.95922127   53.3007854       19.30056664
## MAPE    0.07879284   0.09373511   0.08519777    0.2639188        0.09687277
## MSE   421.46760289 810.03855905 707.48075120 3820.3397195      773.39159778
## RMSE   20.52967615  28.46117635  26.59851032   61.8088968       27.80991905
## RMSSE  29.03334644  40.25018159  37.61597403   87.4109801       39.32916469
```

According to the results, the most accurate method is ARIMA.

Foods_1 products [Store 1 - Train Split 2]

```
##             Naive      sNaive           MA          ES         ESX       ARIMA
## MAE     25.1428571  23.4285714   24.5714286  17.5674056  24.8694886  19.9395991
## MAPE     0.1661107   0.1515272    0.1537264   0.1096945   0.1604289   0.1254299
## MSE   1007.0000000 839.9285714 1027.0357143 483.1020626 998.1374563 647.9378927
## RMSE    31.7332633  28.9815212   32.0473979  21.9795829  31.5933135  25.4546242
## RMSSE   44.8776113  40.9860603   45.3218648  31.0838242  44.6796924  35.9982748
##            SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE     23.3522290   23.0430583   25.1299725        19.2879506
## MAPE     0.1341943    0.1326369    0.1664686         0.1151087
## MSE   1032.1863638 1010.1948081 1006.8706481       686.5248084
## RMSE    32.1276573   31.7835619   31.7312251        26.2016184
## RMSSE   45.4353687   44.9487443   44.8747289        37.0546841
```

According to the results, the most accurate method is ES.

Foods_1 products [Store 2 - Train Split 2]

```
##              Naive       sNaive           MA           ES          ESX
## MAE     61.8214286   65.2500000   64.0803571   65.1998301   64.4124726
## MAPE     0.6265903    0.6701289    0.6404534    0.6801758    0.6430217
## MSE   4853.5357143 5297.1785714 5205.3638393 5123.8336522 5255.3572153
## RMSE    69.6673217   72.7817187   72.1482075   71.5809587   72.4938426
## RMSSE   98.5244712  102.9288936  102.0329735  101.2307626  102.5217754
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE     64.0131461   65.6750628   64.4253920   71.9904947        65.5420172
## MAPE     0.6422259    0.6636577    0.6543467    0.7139339         0.6624811
## MSE   5183.9895938 5403.3922844 5214.3362632 6473.1473131      5382.2196087
## RMSE    71.9999277   73.5077702   72.2103612   80.4558718        73.3636123
## RMSSE  101.8232743  103.9556856  102.1208721  113.7817851       103.7518155
```

According to the results, the most accurate method is Naive.

Foods_1 products [Store 3 - Train Split 2]

```
##              Naive       sNaive           MA           ES          ESX
## MAE     35.0714286   35.0714286   32.5714286  24.4596793   33.847148
## MAPE     0.1769381    0.1666142    0.1521452   0.1140372    0.148607
## MSE   1753.3571429 1940.7857143 1509.0714286 849.1191027 1771.936146
## RMSE    41.8731076   44.0543496   38.8467686  29.1396483   42.094372
## RMSSE   59.2175167   62.3022586   54.9376270  41.2096858   59.530432
##             ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE     33.057152   33.4614248   33.8337070    33.406543        32.9442979
## MAPE     0.144936    0.1492509    0.1530986     0.147484         0.1530522
## MSE   1675.718868 1681.9722754 1664.1370348  1738.846182      1427.9388977
## RMSE    40.935545   41.0118553   40.7938357    41.699475        37.7880788
## RMSSE   57.891603   57.9995220   57.6911958    58.971963        53.4404135
```

According to the results, the most accurate method is ES.

Foods_2 products [Store 1 - Train Split 2]

```
##              Naive       sNaive           MA           ES        ESX
## MAE     47.8571429   34.2857143   45.3392857   38.1172273   51.02110
## MAPE     0.1812348    0.1264493    0.1655038    0.1411611    0.19876
## MSE   3992.2142857 1829.7142857 4014.8482143 2147.9414624 4137.09919
## RMSE    63.1839717   42.7751597   63.3628299   46.3458894   64.32029
## RMSSE   89.3556298   60.4932110   89.6085734   65.5429853   90.96262
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE     46.2196319   33.0038336   34.3225179   64.0768473        40.1117959
## MAPE     0.1830031    0.1210169    0.1292172    0.2157774         0.1431803
## MSE   3208.4886905 2065.1609309 2092.5722241 7395.8631086      3326.2003120
## RMSE    56.6435229   45.4440418   45.7446415   85.9992041        57.6732201
## RMSSE   80.1060384   64.2675802   64.6926924  121.6212408        81.5622500
```

According to the results, the most accurate method is sNaive.

Foods_2 products [Store 2 - Train Split 2]

```
##              Naive       sNaive           MA           ES          ESX
## MAE     52.7500000   45.3928571   44.6696429   42.2208533   37.5279962
## MAPE     0.3081261    0.2643649    0.2600868    0.2608945    0.2244759
## MSE   4584.7500000 3583.7500000 3571.3816964 2887.5159503 2715.6886125
## RMSE    67.7107820   59.8644302   59.7610383   53.7356116   52.1122693
## RMSSE   95.7575062   84.6610891   84.5148708   75.9936307   73.6978780
```

```
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE     33.3622941   47.0663244   48.0196449 8.403736e+01        46.2744616
## MAPE     0.2107184    0.2738024    0.2793776 5.058261e-01         0.2711177
## MSE   1968.4319380 3841.8784882 3958.2788078 1.031427e+04      3601.0018360
## RMSE    44.3670141   61.9828887   62.9148536 1.015592e+02        60.0083481
## RMSSE   62.7444330   87.6570418   88.9750393 1.436264e+02        84.8646197
```

According to the results, the most accurate method are ARIMA.

Foods_2 products [Store 3 - Train Split 2]

```
##              Naive      sNaive           MA           ES         ESX
## MAE     52.9642857   66.821429   62.9642857   66.7857148   61.779063
## MAPE     0.1435291    0.171111    0.1569031    0.1717671    0.154357
## MSE   5486.1071429 6703.321429 7424.9352679 6559.5260401 7235.630612
## RMSE    74.0682600   81.873814   86.1680641   80.9909010   85.062510
## RMSSE  104.7483379  115.787058  121.8600449  114.5384306  120.296555
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE     50.0363170   48.8097543   52.4417742   75.2518795        47.1358925
## MAPE     0.1391643    0.1294914    0.1461334    0.1860401         0.1287856
## MSE   4843.9602527 4437.0366913 4725.9462882 9819.7756308      4509.4441050
## RMSE    69.5985650   66.6110853   68.7455183   99.0947810        67.1523946
## RMSSE   98.4272346   94.2023003   97.2208444  140.1411833        94.9678272
```

According to the results, the most accurate method is SARIMA.

Foods_3 products [Store 1 - Train Split 2]

```
##              Naive       sNaive           MA           ES          ESX
## MAE   2.662857e+02 1.900000e+02 2.777589e+02 1.578784e+02 2.662884e+02
## MAPE  1.589348e-01 1.122724e-01 1.552550e-01 9.470050e-02 1.589329e-01
## MSE   9.823364e+04 4.763250e+04 1.172704e+05 3.377415e+04 9.823581e+04
## RMSE  3.134225e+02 2.182487e+02 3.424476e+02 1.837775e+02 3.134259e+02
## RMSSE 4.432463e+02 3.086503e+02 4.842941e+02 2.599006e+02 4.432512e+02
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE   1.279843e+02 2.155729e+02 2.062093e+02 2.692450e+02      1.530595e+02
## MAPE  7.749751e-02 1.159565e-01 1.138751e-01 1.567061e-01      8.759493e-02
## MSE   2.568688e+04 8.397637e+04 7.329671e+04 1.025619e+05      3.598003e+04
## RMSE  1.602713e+02 2.897868e+02 2.707337e+02 3.202529e+02      1.896840e+02
## RMSSE 2.266578e+02 4.098204e+02 3.828752e+02 4.529059e+02      2.682537e+02
```

According to the results, the most accurate method is ARIMA.

Foods_3 products [Store 2 - Train Split 2]

```
##              Naive       sNaive           MA           ES          ESX
## MAE   2.807500e+02 3.143214e+02 3.242589e+02 3.063748e+02 3.297814e+02
## MAPE  2.442668e-01 2.794303e-01 2.834086e-01 2.775457e-01 2.883768e-01
## MSE   1.356373e+05 1.456908e+05 1.663477e+05 1.310465e+05 1.706843e+05
## RMSE  3.682897e+02 3.816947e+02 4.078575e+02 3.620035e+02 4.131396e+02
## RMSSE 5.208403e+02 5.397978e+02 5.767975e+02 5.119502e+02 5.842676e+02
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE   3.094174e+02 3.175641e+02 3.231468e+02 3.864354e+02      3.171199e+02
## MAPE  2.805332e-01 2.757298e-01 2.808408e-01 3.408686e-01      2.756880e-01
## MSE   1.333109e+05 1.579633e+05 1.623191e+05 2.208469e+05      1.567144e+05
## RMSE  3.651177e+02 3.974460e+02 4.028884e+02 4.699435e+02      3.958717e+02
## RMSSE 5.163544e+02 5.620735e+02 5.697703e+02 6.646004e+02      5.598471e+02
```

According to the results, the most accurate method is ES.

Foods_3 products [Store 3 - Train Split 2]

```
##              Naive       sNaive           MA           ES          ESX
## MAE   4.402143e+02 4.416429e+02 4.409375e+02 4.045498e+02 4.473211e+02
## MAPE  1.673452e-01 1.714231e-01 1.676151e-01 1.599891e-01 1.699974e-01
## MSE   3.873889e+05 3.440818e+05 3.881767e+05 2.748383e+05 3.952402e+05
## RMSE  6.224058e+02 5.865848e+02 6.230383e+02 5.242502e+02 6.286813e+02
## RMSSE 8.802147e+02 8.295562e+02 8.811092e+02 7.414017e+02 8.890896e+02
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE   3.408927e+02 3.849162e+02 3.609328e+02 3.879008e+02      3.837679e+02
## MAPE  1.376016e-01 1.477447e-01 1.403943e-01 1.473667e-01      1.468221e-01
## MSE   2.185727e+05 2.861612e+05 2.546172e+05 3.265185e+05      2.941080e+05
## RMSE  4.675176e+02 5.349403e+02 5.045960e+02 5.714180e+02      5.423173e+02
## RMSSE 6.611697e+02 7.565199e+02 7.136066e+02 8.081071e+02      7.669524e+02
```

According to the results, the most accurate method is SARIMA.

###SPLIT 3

Let's analyze the forecast for the Hobbies products [Store 1 - Train Split 3]

```
##            Naive      sNaive          MA          ES         ESX        ARIMA
## MAE     111.1429    88.92857    81.0000    62.93851    72.26743    75.77718
## MAPE         Inf         Inf        Inf         Inf         Inf         Inf
## MSE   19801.5000 13878.35714 13469.4643 10743.21507 12716.27367 12937.23416
## RMSE    140.7178   117.80644   116.0580   103.64948   112.76646   113.74196
## RMSSE   199.0050   166.60346   164.1308   146.58250   159.47585   160.85543
##            SARIMA     SARIMAX Holt-Winters State-Space Model
## MAE      69.61017    69.55544     73.87442          70.60999
## MAPE          Inf         Inf          Inf               Inf
## MSE   12407.20708 12402.41062  12724.86410       12545.53058
## RMSE    111.38764   111.36611    112.80454         112.00683
## RMSSE   157.52592   157.49546    159.52971         158.40158
```

According to the results, the most accurate method is ES.

[Store 2 - Train Split 3]

```
##            Naive      sNaive         MA         ES        ESX      ARIMA
## MAE      89.03571    76.39286   70.19643   51.25388   69.18121   66.69265
## MAPE          Inf         Inf        Inf        Inf        Inf        Inf
## MSE   13334.96429 10776.96429 8839.06027 6368.25462 8973.91437 8404.38887
## RMSE    115.47712   103.81216   94.01628   79.80134   94.73075   91.67545
## RMSSE   163.30930   146.81256  132.95909  112.85614  133.96951  129.64867
##           SARIMA    SARIMAX Holt-Winters State-Space Model
## MAE     63.65393   63.82641     117.1502          74.28737
## MAPE         Inf        Inf          Inf               Inf
## MSE   8150.04179 8180.78377   20551.6281        9840.73445
## RMSE    90.27758   90.44769     143.3584          99.20048
## RMSSE  127.67178  127.91234     202.7394         140.29066
```

According to the results, the most accurate methods is ES.

[Store 3 - Train Split 3]

```
##            Naive     sNaive          MA          ES        ESX      ARIMA
## MAE     289.6071   122.1786    94.42347    73.58805    96.2344    91.0611
## MAPE         Inf        Inf         Inf         Inf        Inf        Inf
## MSE   99855.8214 23843.3214 16203.19898 12200.85622 16670.0173 16188.7071
```

```
## RMSE    315.9997   154.4128   127.29179   110.45749   129.1124   127.2349
## RMSSE   446.8911   218.3727   180.01777   156.21047   182.5925   179.9373
##           SARIMA     SARIMAX Holt-Winters State-Space Model
## MAE      89.1230    89.40892     151.1276          92.14837
## MAPE         Inf         Inf          Inf               Inf
## MSE   15673.9795 15701.67614   37814.3429       16146.43040
## RMSE    125.1958   125.30633     194.4591         127.06861
## RMSSE   177.0535   177.20991     275.0067         179.70214
```

According to the results, the most accurate method is ES.

Household_1 products [Store 1 - Train Split 3]

```
##            Naive     sNaive         MA         ES        ESX      ARIMA
## MAE     181.0357   67.17857   70.12500   40.90691   61.74697   42.25830
## MAPE         Inf        Inf        Inf        Inf        Inf        Inf
## MSE   37987.4643 7370.10714 7908.25670 3557.32831 6013.01677 3593.82667
## RMSE    194.9037   85.84933   88.92838   59.64334   77.54364   59.94853
## RMSSE   275.6355  121.40928  125.76372   84.34842  109.66327   84.78003
##           SARIMA    SARIMAX Holt-Winters State-Space Model
## MAE     54.86457   55.04800     60.70670          87.86568
## MAPE         Inf        Inf          Inf               Inf
## MSE   6555.04631 6529.97266   5787.72851       10778.26140
## RMSE    80.96324   80.80825     76.07712         103.81841
## RMSSE  114.49931  114.28012    107.58930         146.82140
```

According to the results, the most accurate method is ES.

Household_1 products [Store 2 - Train Split 3]

```
##            Naive     sNaive         MA         ES        ESX      ARIMA
## MAE     152.9643   54.53571   71.91071   37.62059   63.76931   37.91407
## MAPE         Inf        Inf        Inf        Inf        Inf        Inf
## MSE   29232.5357 6088.39286 7421.63170 3813.60282 6196.16061 3829.76060
## RMSE    170.9752   78.02815   86.14889   61.75437   78.71569   61.88506
## RMSSE   241.7955  110.34847  121.83293   87.33387  111.32080   87.51869
##           SARIMA    SARIMAX Holt-Winters State-Space Model
## MAE     52.01599   51.83634     69.85047          52.33722
## MAPE         Inf        Inf          Inf               Inf
## MSE   6212.00776 6089.19929   7101.30881        6220.78674
## RMSE    78.81629   78.03332     84.26926          78.87196
## RMSSE  111.46307  110.35578    119.17474         111.54180
```

According to the results, the most accurate method is ES.

Household_1 products [Store 3 - Train Split 3]

```
##            Naive      sNaive          MA         ES         ESX       ARIMA
## MAE     157.2500    93.10714    99.60714   63.15883    83.91093    83.57424
## MAPE         Inf         Inf         Inf        Inf         Inf         Inf
## MSE   34938.3214 15541.46429 16898.10714 9689.46696 13530.25929 12972.39998
## RMSE    186.9180   124.66541   129.99272   98.43509   116.31964   113.89644
## RMSSE   264.3419   176.30351   183.83747  139.20824   164.50082   161.07390
##           SARIMA     SARIMAX Holt-Winters State-Space Model
## MAE      95.30046    95.44986     113.6313          108.5055
## MAPE          Inf         Inf          Inf               Inf
## MSE   16095.61870 16099.69374   21511.7724        18931.8895
## RMSE    126.86851   126.88457     146.6689          137.5932
```

```
## RMSSE   179.41917   179.44188     207.4212          194.5862
```

According to the results, the most accurate method is ES.

Household_2 products [Store 1 - Train Split 3]

```
##            Naive     sNaive        MA        ES       ESX     ARIMA    SARIMA
## MAE     41.35714   24.64286  21.72321  19.20813  21.52191  19.91402  19.62197
## MAPE         Inf        Inf       Inf       Inf       Inf       Inf       Inf
## MSE   2642.00000 1183.00000 959.21205 910.24922 937.49024 953.42514 886.39186
## RMSE    51.40039   34.39477  30.97115  30.17034  30.61846  30.87758  29.77233
## RMSSE   72.69113   48.64155  43.79982  42.66730  43.30104  43.66750  42.10444
##         SARIMAX Holt-Winters State-Space Model
## MAE    19.48756     22.96375          18.76992
## MAPE        Inf          Inf               Inf
## MSE   877.80578    990.39274         894.24169
## RMSE   29.62779     31.47051          29.90387
## RMSSE  41.90002     44.50602          42.29046
```

According to the results, the most accurate method is State-Space Model.

Household_2 products [Store 2 - Train Split 3]

```
##            Naive     sNaive         MA         ES        ESX       ARIMA
## MAE     66.46429   29.39286   43.64286   24.36748   42.41271   23.37228
## MAPE         Inf        Inf        Inf        Inf        Inf        Inf
## MSE   6457.60714 2306.53571 3129.91741 1557.78965 3084.65072 1635.89546
## RMSE    80.35924   48.02641   55.94566   39.46884   55.53963   40.44620
## RMSSE  113.64512   67.91960   79.11912   55.81737   78.54490   57.19957
##           SARIMA    SARIMAX Holt-Winters State-Space Model
## MAE     35.56762   35.37871     41.19858          38.50662
## MAPE         Inf        Inf          Inf               Inf
## MSE   2644.78675 2626.23006   3244.37852        2856.42786
## RMSE    51.42749   51.24676     56.95945          53.44556
## RMSSE   72.72945   72.47386     80.55282          75.58344
```

According to the results, the most accurate method is ES.

Household_2 products [Store 3 - Train Split 3]

```
##            Naive     sNaive         MA         ES        ESX       ARIMA
## MAE     55.46429   36.39286   27.42857   21.43721   27.06122   29.78660
## MAPE         Inf        Inf        Inf        Inf        Inf        Inf
## MSE   4618.89286 2476.53571 1677.48884 1270.84717 1647.45269 1946.13705
## RMSE    67.96244   49.76480   40.95716   35.64894   40.58882   44.11504
## RMSSE   96.11340   70.37806   57.92217   50.41522   57.40127   62.38809
##           SARIMA    SARIMAX Holt-Winters State-Space Model
## MAE     29.23116   29.66237     33.44576          25.39360
## MAPE         Inf        Inf          Inf               Inf
## MSE   1806.42949 1832.46809   2312.48364        1512.00397
## RMSE    42.50211   42.80734     48.08829          38.88450
## RMSSE   60.10706   60.53872     68.00711          54.99098
```

According to the results, the most accurate method is ES.

Foods_1 products [Store 1 - Train Split 3]

```
## Warning in HoltWinters(train3$Foods_1_CA_1, gamma = FALSE): optimization
## difficulties: ERROR: ABNORMAL_TERMINATION_IN_LNSRCH
```

```
##            Naive     sNaive         MA         ES        ESX      ARIMA
## MAE     45.85714   37.07143   32.17857   31.36343   46.28143   25.86119
## MAPE         Inf        Inf        Inf        Inf        Inf        Inf
## MSE   3391.21429 2879.78571 2171.52679 1959.57704 3434.75931 1497.09506
## RMSE    58.23413   53.66363   46.59964   44.26711   58.60682   38.69231
## RMSSE   82.35550   75.89184   65.90185   62.60315   82.88256   54.71919
##           SARIMA    SARIMAX Holt-Winters State-Space Model
## MAE     33.84936   33.92131     50.18690          31.32264
## MAPE         Inf        Inf          Inf               Inf
## MSE   2366.16097 2383.94575   3840.86822        1942.03546
## RMSE    48.64320   48.82567     61.97474          44.06853
## RMSSE   68.79187   69.04992     87.64552          62.32231
```

According to the results, the most accurate method is State-Space Model.

Foods_1 products [Store 2 - Train Split 3]

```
##            Naive     sNaive         MA         ES        ESX      ARIMA
## MAE     120.5714   37.00000   35.07143   32.02949   32.33146   29.66537
## MAPE         Inf        Inf        Inf        Inf        Inf        Inf
## MSE   16482.5000 3309.78571 2299.27679 2135.72726 2094.64144 1977.77296
## RMSE    128.3842   57.53074   47.95077   46.21393   45.76725   44.47216
## RMSSE   181.5627   81.36075   67.81264   65.35637   64.72467   62.89313
##           SARIMA    SARIMAX Holt-Winters State-Space Model
## MAE     46.94073   46.54992     53.20943          38.37670
## MAPE         Inf        Inf          Inf               Inf
## MSE   3571.65442 3516.70996   4126.69017        2557.07601
## RMSE    59.76332   59.30185     64.23932          50.56754
## RMSSE   84.51810   83.86549     90.84812          71.51330
```

According to the results, the most accurate method is ARIMA.

Foods_1 products [Store 3 - Train Split 3]

```
##            Naive     sNaive         MA         ES        ESX      ARIMA
## MAE     81.67857   52.25000   52.36224   61.96329   65.06718   106.3816
## MAPE         Inf        Inf        Inf        Inf        Inf        Inf
## MSE   9620.03571 5360.25000 4829.25000 5841.73720 6894.47161 15248.3560
## RMSE    98.08178   73.21373   69.49281   76.43126   83.03295   123.4842
## RMSSE  138.70858  103.53985   98.27767  108.09012  117.42633   174.6331
##           SARIMA    SARIMAX Holt-Winters State-Space Model
## MAE     44.14068   44.53646      96.8125          54.43413
## MAPE         Inf        Inf          Inf               Inf
## MSE   3613.06267 3673.16008   13066.4385        5089.25778
## RMSE    60.10876   60.60660     114.3085          71.33903
## RMSSE   85.00662   85.71068     161.6567         100.88863
```

According to the results, the most accurate method is SARIMA.

Foods_2 products [Store 1 - Train Split 3]

```
##             Naive     sNaive         MA         ES        ESX      ARIMA
## MAE      83.42857   44.00000   45.11607   42.88572   49.09527   67.27364
## MAPE          Inf        Inf        Inf        Inf        Inf        Inf
## MSE   10313.50000 3574.21429 3986.06920 3956.69119 4693.82862 7288.29452
## RMSE    101.55540   59.78473   63.13532   62.90224   68.51152   85.37151
## RMSSE   143.62103   84.54838   89.28683   88.95719   96.88992  120.73355
##           SARIMA    SARIMAX Holt-Winters State-Space Model
```

```
## MAE     66.98894   68.29885     44.81850          51.69597
## MAPE         Inf        Inf          Inf               Inf
## MSE   7317.33579 7522.19735   3640.87810        5123.43973
## RMSE    85.54143   86.73060     60.33969          71.57821
## RMSSE  120.97385  122.65559     85.33321         101.22687
```

According to the results, the most accurate method is sNaive.

Foods_2 products [Store 2 - Train Split 3]

```
##             Naive      sNaive         MA          ES         ESX       ARIMA
## MAE     135.39286   38.392857   46.80357   36.111015   49.625399   38.677889
## MAPE     12.48408    6.902903    8.01502    8.019861    8.316042    8.092171
## MSE   21294.39286 3058.107143 3498.75893 3130.506367 3926.895419 3312.804792
## RMSE    145.92598   55.300155   59.15031   55.950928   62.664946   57.556970
## RMSSE   206.37051   78.206229   83.65117   79.126561   88.621616   81.397848
##            SARIMA     SARIMAX Holt-Winters State-Space Model
## MAE     37.400244   37.866543    53.321170          37.54589
## MAPE     8.116482    8.109598     8.763957           8.03772
## MSE   2993.742741 3030.560248  4591.252977        2961.22374
## RMSE    54.715105   55.050524    67.758785          54.41713
## RMSSE   77.378844   77.853198    95.825393          76.95744
```

According to the results, the most accurate method are State-Space Model.

Foods_2 products [Store 3 - Train Split 3]

```
##             Naive     sNaive         MA         ES        ESX       ARIMA
## MAE      76.10714   57.96429   61.99107   51.03591   64.16837    87.19561
## MAPE          Inf        Inf        Inf        Inf        Inf         Inf
## MSE   10292.96429 6826.60714 7475.07812 6616.23060 7844.42988 12558.83219
## RMSE    101.45425   82.62328   86.45853   81.34022   88.56879   112.06620
## RMSSE   143.47797  116.84697  122.27083  115.03244  125.25518   158.48553
##           SARIMA    SARIMAX Holt-Winters State-Space Model
## MAE     61.19295   62.83679     56.33164          53.86662
## MAPE         Inf        Inf          Inf               Inf
## MSE   7397.28128 7686.90641   6290.99329        6016.81328
## RMSE    86.00745   87.67500     79.31578          77.56812
## RMSSE  121.63290  123.99118    112.16945         109.69789
```

According to the results, the most accurate method is State-Sapce Model.

Foods_3 products [Store 1 - Train Split 3]

```
##             Naive     sNaive          MA          ES         ESX       ARIMA
## MAE      419.7857   179.8571    216.0179    209.3329    419.7477    240.9587
## MAPE          Inf        Inf         Inf         Inf         Inf         Inf
## MSE   279646.7857 91413.0000 108466.1942 111985.0978 279612.9058 133835.0751
## RMSE     528.8164   302.3458    329.3421    334.6417    528.7844    365.8348
## RMSSE    747.8593   427.5816    465.7600    473.2549    747.8140    517.3685
##           SARIMA     SARIMAX Holt-Winters State-Space Model
## MAE      247.3081    252.4713     220.4246          175.1018
## MAPE          Inf         Inf          Inf               Inf
## MSE   142314.0949 146456.1151  107719.1028        89934.2770
## RMSE     377.2454    382.6959     328.2059          299.8904
## RMSSE    533.5056    541.2137     464.1532          424.1091
```

According to the results, the most accurate method is State-Space Model.

Foods_3 products [Store 2 - Train Split 3]

```
##              Naive     sNaive           MA          ES          ESX
## MAE      502.67857   192.8929    256.53571   183.20590    259.30807
## MAPE      61.47173    40.4688     43.49416    44.63573     45.16762
## MSE   363603.46429 93418.1071 119326.65179 96973.47452 121270.19753
## RMSE     602.99541   305.6438    345.43690   311.40564    348.23871
## RMSSE    852.76429   432.2455    488.52155   440.39408    492.48390
##              ARIMA       SARIMA     SARIMAX Holt-Winters State-Space Model
## MAE      189.29169    205.75622   205.36019    258.61483         207.50787
## MAPE      44.17866     44.99362    44.79353     42.95269          44.52472
## MSE   100604.71449 100934.88326 99507.13567 119814.60700      100779.56830
## RMSE     317.18246    317.70251   315.44752    346.14247         317.45798
## RMSSE    448.56374    449.29919   446.11016    489.51937         448.95338
```

According to the results, the most accurate method is sNaive.

Foods_3 products [Store 3 - Train Split 3]

```
## Warning in HoltWinters(train3$Foods_3_CA_3, gamma = FALSE): optimization
## difficulties: ERROR: ABNORMAL_TERMINATION_IN_LNSRCH
```

```
##             Naive       sNaive           MA           ES          ESX
## MAE      337.1071    190.10714    233.39286    217.94192    326.95138
## MAPE      35.6914     30.69439     31.33143     29.87977     35.36787
## MSE   228952.5357 134659.25000 164120.60714 146086.33306 220203.11202
## RMSE     478.4898    366.95947    405.11802    382.21242    469.25804
## RMSSE    676.6868    518.95905    572.92339    540.52999    663.63109
##              ARIMA       SARIMA      SARIMAX Holt-Winters State-Space Model
## MAE      378.61645    308.11894    319.90325    236.56963         261.15173
## MAPE      35.99367     32.93542     33.21269     31.81493          27.12258
## MSE   281407.01510 200793.88149 210077.82846 165276.35788      156983.19729
## RMSE     530.47810    448.10030    458.34248    406.54195         396.21105
## RMSSE    750.20932    633.70953    648.19415    574.93714         560.32704
```

According to the results, the most accurate method is sNaive.

Save environnment variables