Untitled

December 26, 2019

```python
[1]: import pandas as pd
     import numpy as np
     import time
     import seaborn as sns
     import matplotlib.pyplot as plt
     from sklearn import preprocessing
     from sklearn.metrics import mean_squared_error
     from statsmodels.tsa.holtwinters import ExponentialSmoothing
```

```python
[2]: df = pd.read_csv('challenge_data_20.csv',index_col='time',parse_dates=True)
     # df['time'] = pd.to_datetime(df['time'] )
     # df['time']
     # df = df.set_index('time')
     df.head()
```

```
[2]:            operating_hours  fuel_consumption(liter)   engine_id
     time
     2017-12-19            3726                    3404.8  8331744407
     2017-12-20            3746                    3865.6  8331744407
     2017-12-21            3748                    3891.2  8331744407
     2017-12-22            3768                    3840.0  8331744407
     2017-12-23            3776                    3891.2  8331744407
```

```python
[3]: def empty_col_reduct(df):
         col = df.columns.tolist()
         for c in col:
             v = (df[c].isnull().sum()*100)/len(df)
             print(v)


     empty_col_reduct(df)
```
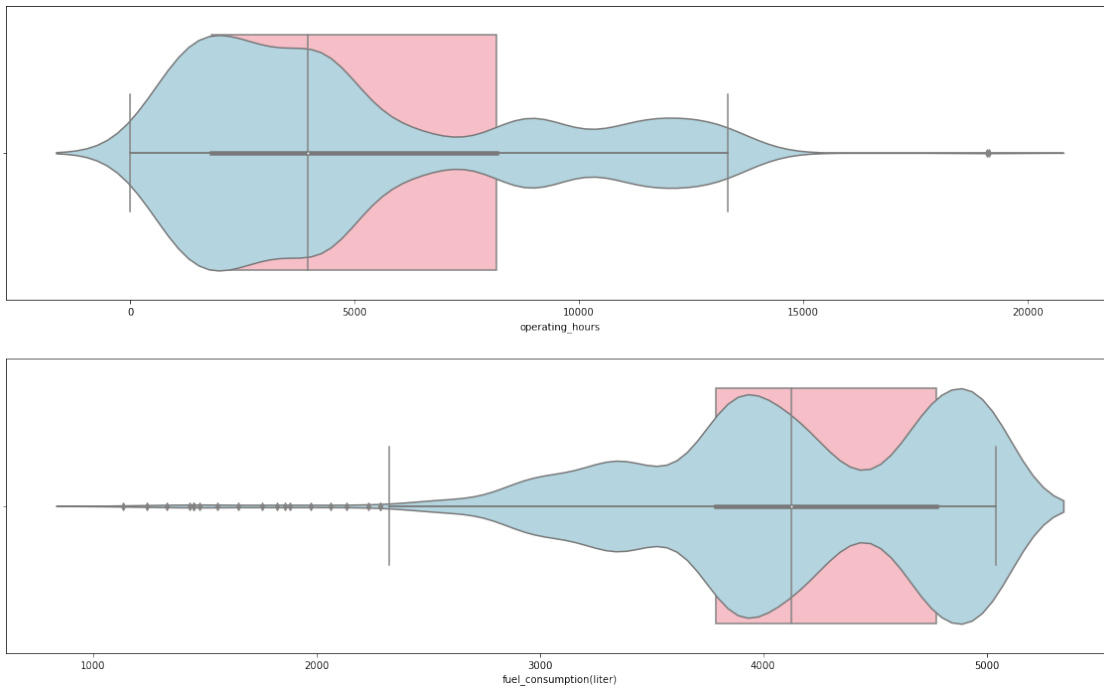
```
0.0
0.0
0.0
```

```
[4]: fig, ax = plt.subplots(2,figsize=(20, 12))

     sns.boxplot(df['operating_hours'],ax=ax[0],palette=["lightpink"])
     sns.violinplot(df['operating_hours'],ax=ax[0],palette=["lightblue"])
     sns.boxplot(df['fuel_consumption(liter)'],ax=ax[1],palette=["lightpink"])
     sns.violinplot(df['fuel_consumption(liter)'],ax=ax[1],palette=["lightblue"])
```
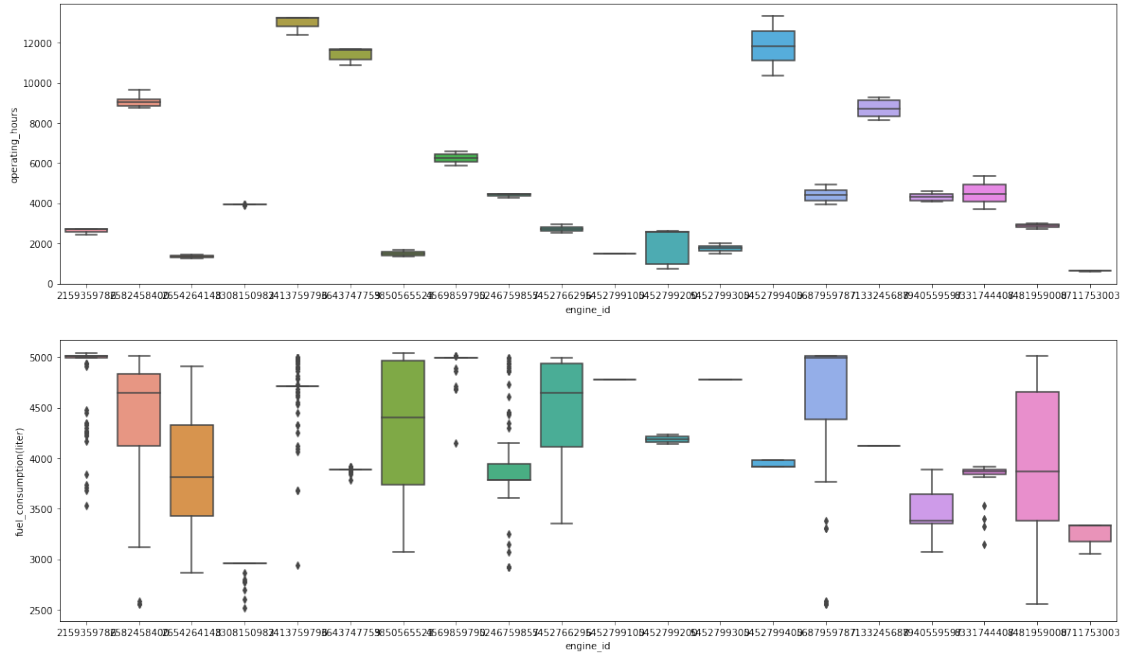
```
[4]: <matplotlib.axes._subplots.AxesSubplot at 0x177fe70240>
```



```
[5]: mask1 = df['operating_hours']<14000
     mask3 = df['operating_hours']>0
     mask2 = df['fuel_consumption(liter)']>2450
     mask4 = df['fuel_consumption(liter)']<5200

     df = df[mask1 & mask2 & mask3 & mask4]
```
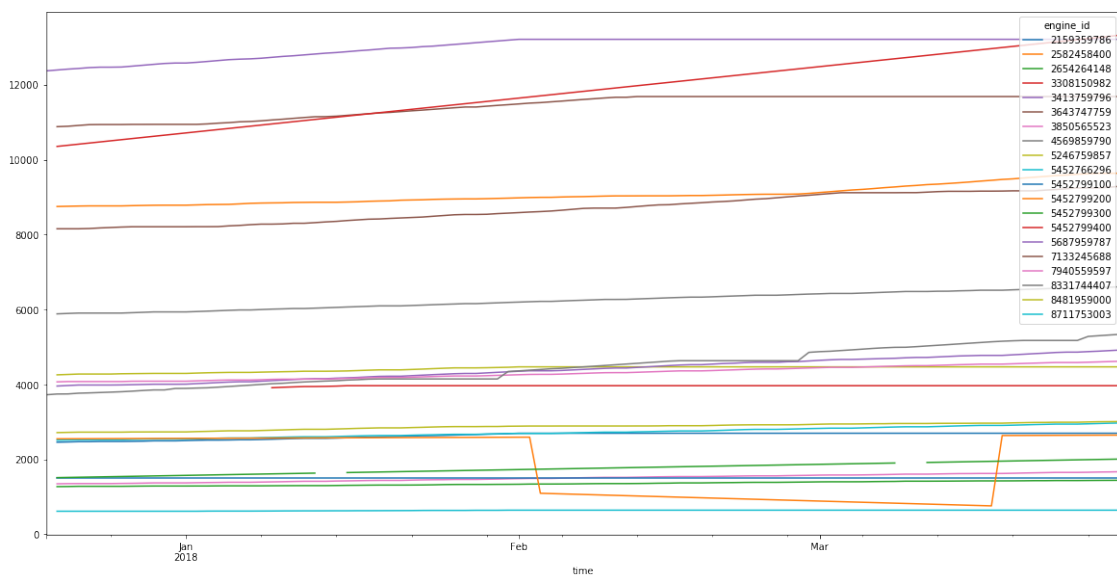
```
[6]: fig, ax = plt.subplots(2,figsize=(20, 12))
     sns.boxplot(data=df,x='engine_id',y='operating_hours',ax=ax[0]);
     sns.boxplot(data=df,x='engine_id',y='fuel_consumption(liter)',ax=ax[1]);
```
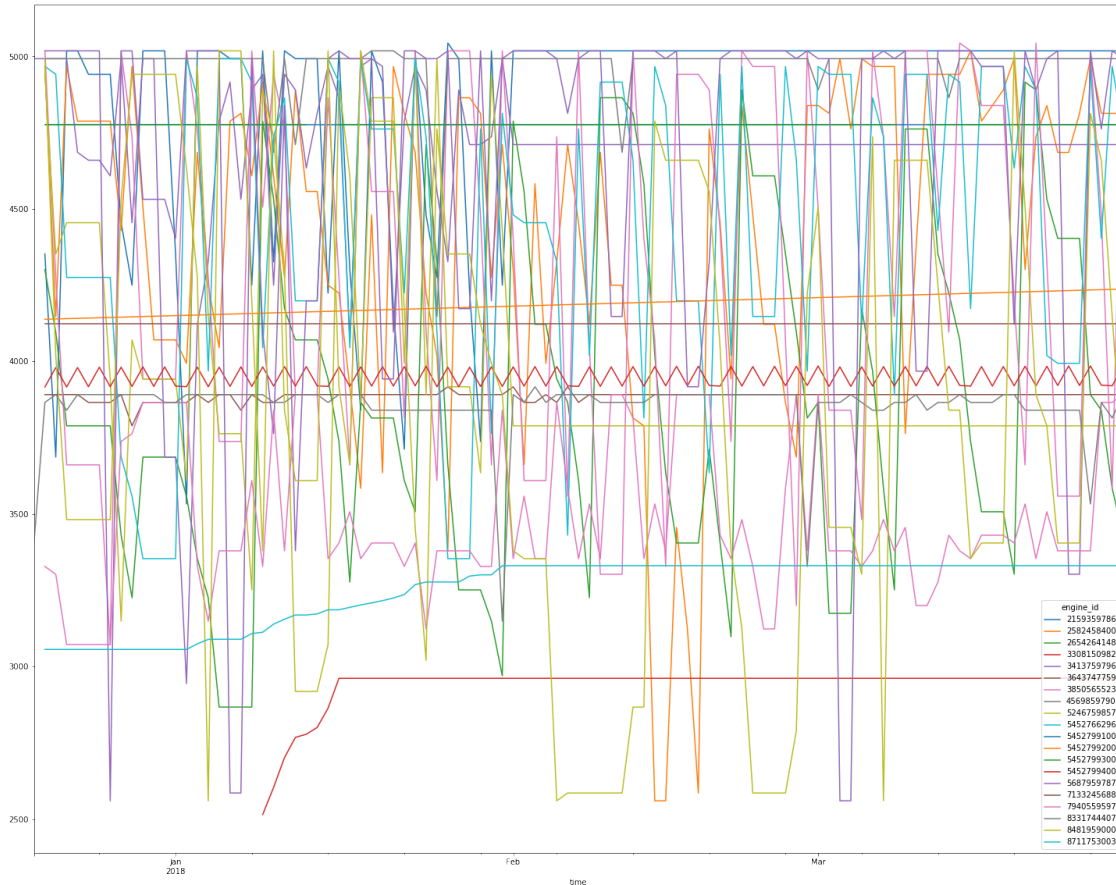
```
[7]:  # for x in user_id_list:
      #     df_here = df_id_wise.get_group(x)
      #     df_here['operating_hours'].plot(figsize=(12,5));
      #     print(df_here.head())
      df.pivot( columns="engine_id", values="operating_hours").plot(figsize=(20,10))
```

[7]: <matplotlib.axes._subplots.AxesSubplot at 0x17041b4cc0>

3

```
[8]: df.pivot( columns="engine_id", values="fuel_consumption(liter)").
     ↪plot(figsize=(25,20))
```

```
[8]: <matplotlib.axes._subplots.AxesSubplot at 0x1703c5d0b8>
```



```
[9]: df_id_wise = df.groupby('engine_id')
     user_id_list = list(df_id_wise.groups.keys())
     user_id_list.remove(user_id_list[12])
     print(user_id_list)
```

```
[2159359786, 2582458400, 2654264148, 3308150982, 3413759796, 3643747759,
3850565523, 4569859790, 5246759857, 5452766296, 5452799100, 5452799200,
5452799400, 5687959787, 7133245688, 7940559597, 8331744407, 8481959000,
8711753003]
```

```
[10]: fig, ax = plt.subplots(len(user_id_list),figsize=(20, 20))
      i=0
      plt.subplots_adjust(bottom=0.1, right=0.8, top=10.9)
```

```
for x in user_id_list:

    df_id_wise.get_group(x).pivot( columns="engine_id",␣
 ↪values="fuel_consumption(liter)").plot(figsize=(25,20),ax=ax[i])
    i+=1
```
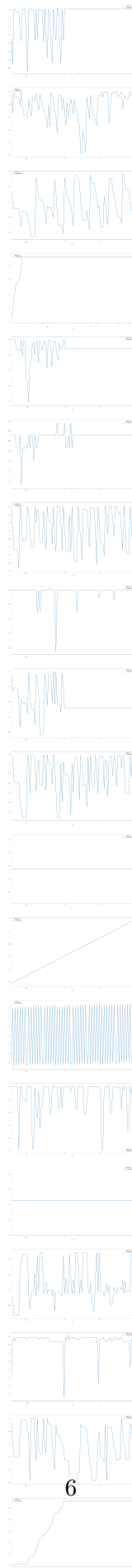
```
[11]: oh_log = np.log(df['operating_hours'])
```

```
[12]: fc_log = np.log(df['fuel_consumption(liter)'])
```

```
[13]: from statsmodels.tsa.seasonal import seasonal_decompose
      decomposition = seasonal_decompose(oh_log,model='additive',freq=10)

      trend = decomposition.trend
      seasonal = decomposition.seasonal
      residual = decomposition.resid

      fig, ax = plt.subplots(4,figsize=(40, 24))

      # sns.lineplot(data=df['operating_hours'],ax=ax[0],label='Original');
      # sns.lineplot(data=trend,ax=ax[1],label='Trend');
      # sns.lineplot(data=seasonal,ax=ax[2],label='Seasonality');
      # sns.lineplot(data=residual,ax=ax[3],label='Residuals');

      ax[0].plot(oh_log, label='Original')
      ax[0].legend(loc='best')
      ax[1].plot(trend, label='Trend')
      ax[1].legend(loc='best')
      ax[2].plot(seasonal,label='Seasonality')
      ax[2].legend(loc='best')
      ax[3].plot(residual, label='Residuals')
      ax[3].legend(loc='best')
      # oh_log.plot(figsize=(20,10))
```
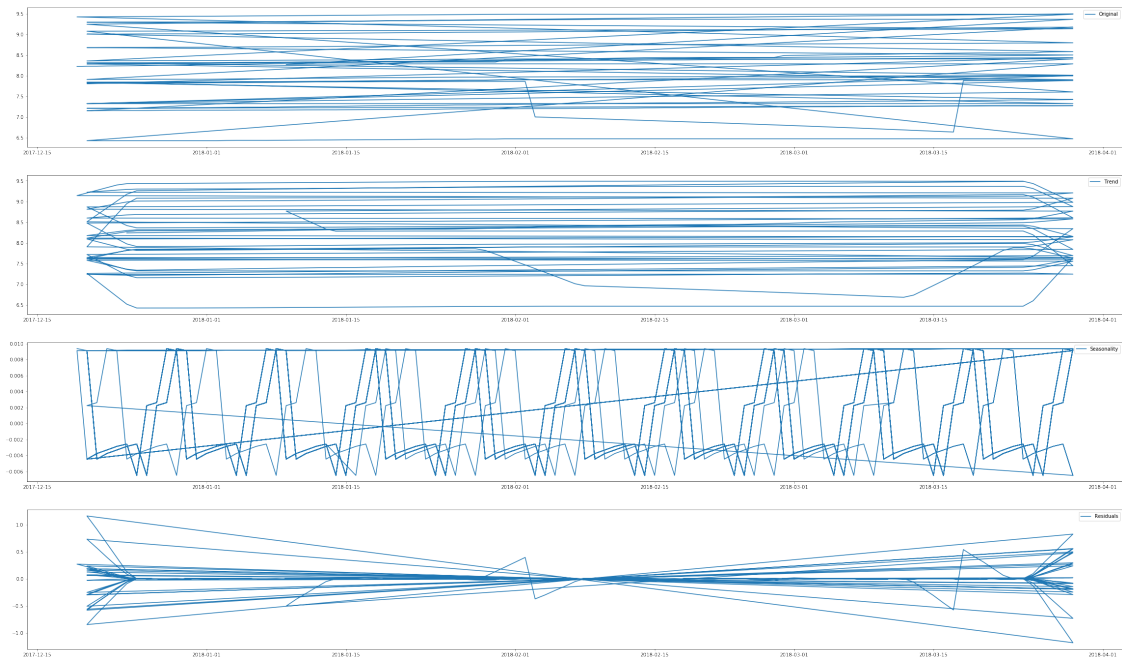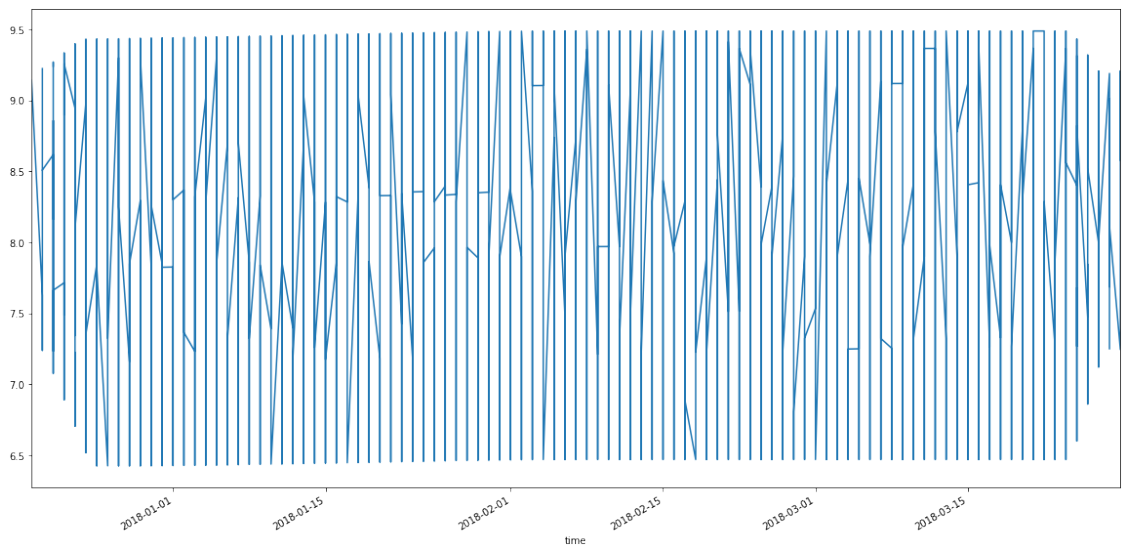
```
[13]: <matplotlib.legend.Legend at 0x17043109b0>
```

```
[14]: trend.plot(figsize=(20,10))
```

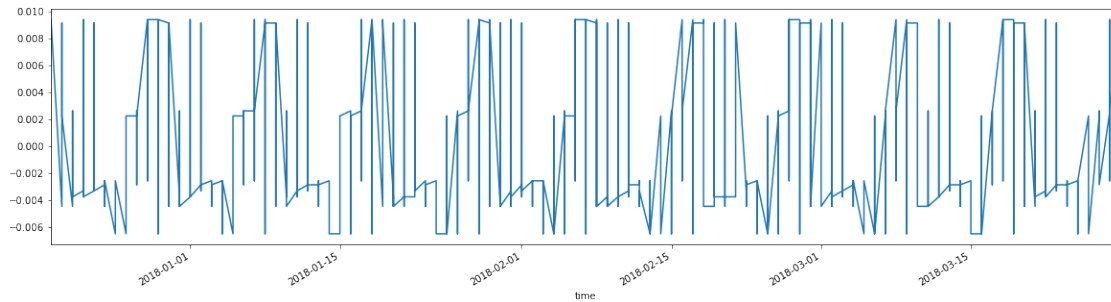```
[14]: <matplotlib.axes._subplots.AxesSubplot at 0x17043c2588>
```



```
[15]: seasonal.plot(figsize=(20,5))
```

```
[15]: <matplotlib.axes._subplots.AxesSubplot at 0x170443f400>
```
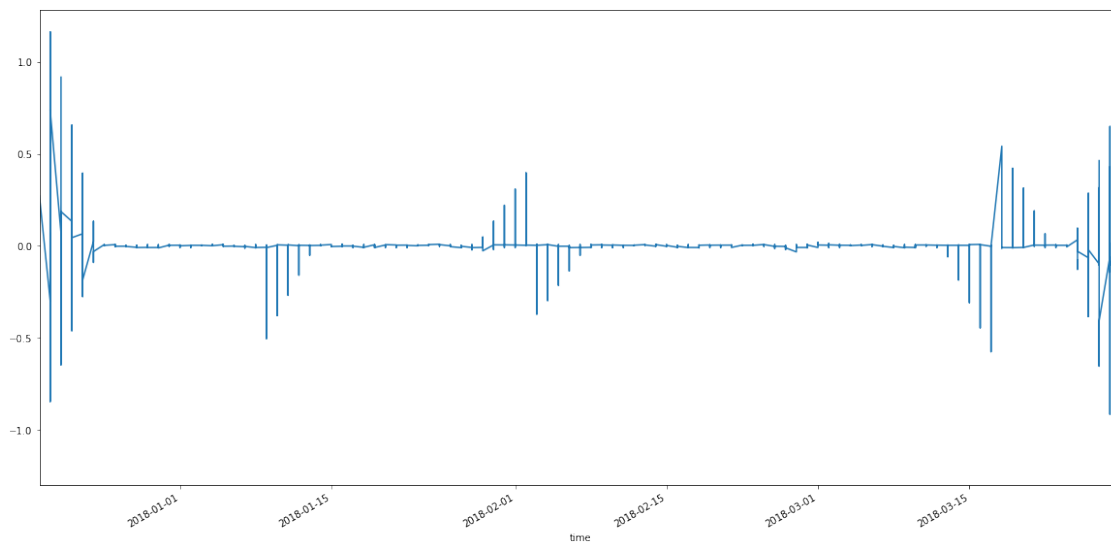
```
[16]: residual.plot(figsize=(20,10))
```

```
[16]: <matplotlib.axes._subplots.AxesSubplot at 0x17044c1f28>
```



```
[17]: def mode_plot(df_id_wise,x,ax,col):
          g = df_id_wise.get_group(x)
      #     g.info()
          train_data = g.iloc[:80]
          test_data = g.iloc[79:]
          fit_model = ExponentialSmoothing(train_data[col], trend='add',␣
      ↪seasonal='add',seasonal_periods=10).fit()
          test_pred = fit_model.forecast(len(test_data))
          error = np.sqrt(mean_squared_error(test_data[col],test_pred))
          print('RMSE of {} is '.format(x),str(error))
          try:
              train_data[col].plot(legend=True,label="Train",figsize=(20,5),ax=ax)
              test_data[col].plot(legend=True,label="Test",ax=ax)
```

```
        test_pred.plot(legend=True,label='Prediction',ax=ax)



    except:
        pass
```

[18]:
```
fig, ax = plt.subplots(len(user_id_list),figsize=(20, 20))
i=0
plt.subplots_adjust(bottom=0.1, right=0.8, top=10.9)

for x in user_id_list:
    mode_plot(df_id_wise,x,ax[i],'operating_hours')
    i+=1
```

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)

RMSE of 2159359786 is 9.599752726466487

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)

RMSE of 2582458400 is 19.802756005925346

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)

RMSE of 2654264148 is 13.209711546499985

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)

```
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)
```

RMSE of 3308150982 is 0.011181759384271572

```
C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)
```

RMSE of 3413759796 is 67.21854260968226

```
C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)
```

RMSE of 3643747759 is 12.175105841595814

```
C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)
```

RMSE of 3850565523 is 6.563559372357323

```
C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)
```

RMSE of 4569859790 is 37.192782679675496

```
C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)
```

```
RMSE of 5246759857 is   3.7178961434844378

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)

RMSE of 5452766296 is   7.992281074371504

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:924:
RuntimeWarning: divide by zero encountered in log
  aic = self.nobs * np.log(sse / self.nobs) + k * 2
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:930:
RuntimeWarning: divide by zero encountered in log
  bic = self.nobs * np.log(sse / self.nobs) + k * np.log(self.nobs)

RMSE of 5452799100 is   0.0

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)

RMSE of 5452799200 is   1605.9537330014446

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)

RMSE of 5452799400 is   30.010033353799784

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)
```

```
RMSE of 5687959787 is  15.679227431337624

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)

RMSE of 7133245688 is  104.70463585502198

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)

RMSE of 7940559597 is  16.309480248593335

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)

RMSE of 8331744407 is  99.07661116107323

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)

RMSE of 8481959000 is  12.707418453688877

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)

RMSE of 8711753003 is  0.5319495879928924
```

14

```
[19]: fig, ax = plt.subplots(len(user_id_list),figsize=(20, 20))
      i=0
      plt.subplots_adjust(bottom=0.1, right=0.8, top=10.9)

      for x in user_id_list:
          mode_plot(df_id_wise,x,ax[i],'fuel_consumption(liter)')
          i+=1
```

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
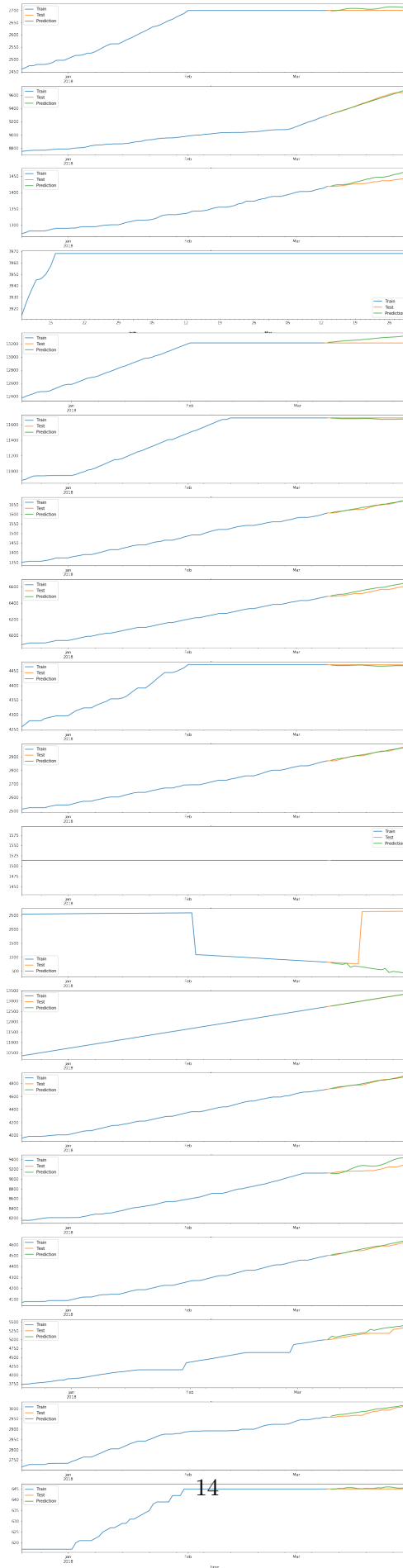ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)

RMSE of 2159359786 is 119.99466667433177

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)

RMSE of 2582458400 is 416.06731994123356

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)

RMSE of 2654264148 is 721.6148601759511

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)

RMSE of 3308150982 is 1.2134083915248084

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)

RMSE of 3413759796 is 109.44069089724209

```
C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)

RMSE of 3643747759 is  3.344297563124844

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)

RMSE of 3850565523 is  614.0181009838318

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)

RMSE of 4569859790 is  27.48832808641022

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)

RMSE of 5246759857 is  189.33163246683839

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)

RMSE of 5452766296 is  479.58430817100714

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:924:
RuntimeWarning: divide by zero encountered in log
```

```
  aic = self.nobs * np.log(sse / self.nobs) + k * 2
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:930:
RuntimeWarning: divide by zero encountered in log
  bic = self.nobs * np.log(sse / self.nobs) + k * np.log(self.nobs)
```

RMSE of 5452799100 is 0.0

```
C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)
```

RMSE of 5452799200 is 0.9116186122116875

```
C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)
```

RMSE of 5452799400 is 30.974360494149355

```
C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)
```

RMSE of 5687959787 is 803.1050795083854

```
C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:924:
RuntimeWarning: divide by zero encountered in log
  aic = self.nobs * np.log(sse / self.nobs) + k * 2
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:930:
RuntimeWarning: divide by zero encountered in log
  bic = self.nobs * np.log(sse / self.nobs) + k * np.log(self.nobs)
```

RMSE of 7133245688 is 0.0

```
C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
```

information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)

RMSE of 7940559597 is 184.82933013035856

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)

RMSE of 8331744407 is 85.73712057300361

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
  % freq, ValueWarning)

RMSE of 8481959000 is 622.7455249330264

C:\ProgramData\Anaconda3\lib\site-
packages\statsmodels\tsa\base\tsa_model.py:165: ValueWarning: No frequency
information was provided, so inferred frequency D will be used.
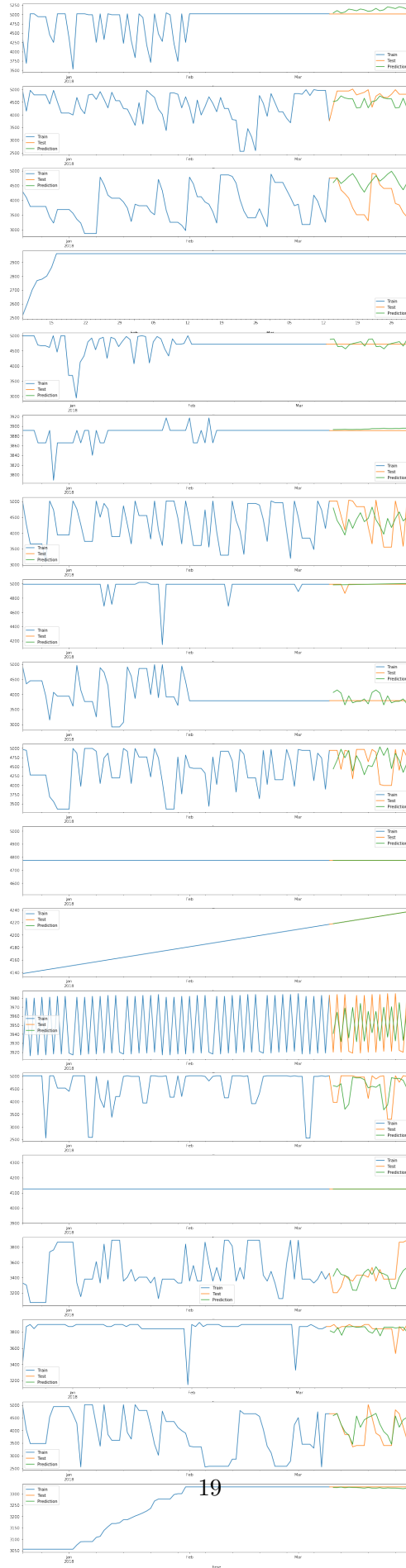 % freq, ValueWarning)
C:\ProgramData\Anaconda3\lib\site-packages\statsmodels\tsa\holtwinters.py:712:
ConvergenceWarning: Optimization failed to converge. Check mle_retvals.
  ConvergenceWarning)

RMSE of 8711753003 is 4.759180320910947

```
[20]: def forecast_15(df_id_wise,user_id_list,col):

          op_df = pd.DataFrame()
          for x in user_id_list:
              g = df_id_wise.get_group(x)
              train_data = g
              fit_model = ExponentialSmoothing(train_data[col], trend='add',␣
      ↪seasonal='add',seasonal_periods=10).fit()
              test_pred = fit_model.forecast(15)
              op_df[str(x)] = test_pred
          op_df.to_csv(r'output_{}.csv'.format(col))
```

```
[22]: forecast_15(df_id_wise,user_id_list,'operating_hours')
      forecast_15(df_id_wise,user_id_list,'fuel_consumption(liter)')
```

```
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[ ]: