03-forecasting

January 16, 2026

IMPORT LIBRARIES

[1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt

from statsmodels.tsa.statespace.sarimax import SARIMAX
```

LOAD TIME-SERIES DATA

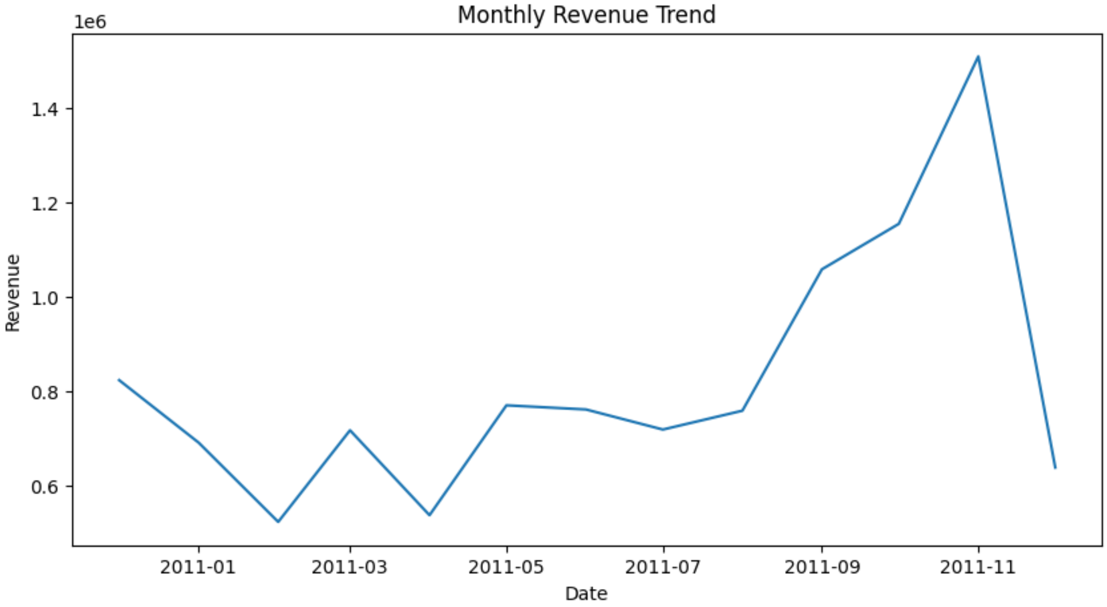
[21]:
```
time_df = pd.read_csv(
    r"D:\decision-intelligence-project\Data\Processed_Data\time_series_data.csv"
)

time_df["Date"] = pd.to_datetime(
    time_df["Year"].astype(str) + "-" + time_df["Month"].astype(str) + "-01"
)

time_df = time_df.set_index("Date")

time_df.head()
```

[21]:
```
            Year  Month  Monthly_Revenue  Monthly_Profit  Avg_Profit_Margin  \
Date
2010-12-01  2010     12       823746.140   223471.398977           0.274858
2011-01-01  2011      1       691364.560   180513.782370           0.274945
2011-02-01  2011      2       523631.890   143619.112084           0.275062
2011-03-01  2011      3       717639.360   197467.594117           0.274482
2011-04-01  2011      4       537808.621   149445.911037           0.274554

            Num_Transactions
Date
2010-12-01              1559
2011-01-01              1086
2011-02-01              1100
2011-03-01              1454
2011-04-01              1246
```

VISUALIZE REVENUE TREND

[22]:

```python
plt.figure(figsize=(10,5))
plt.plot(time_df.index, time_df["Monthly_Revenue"])
plt.title("Monthly Revenue Trend")
plt.xlabel("Date")
plt.ylabel("Revenue")
plt.show()
```



TRAIN–TEST SPLIT

[23]:

```python
train = time_df.iloc[:-6]
test = time_df.iloc[-6:]
```

BUILD FORECAST MODEL

[26]:

```python
time_df = pd.read_csv(
    r"D:\decision-intelligence-project\Data\Processed_Data\time_series_data.csv"
)

time_df["Date"] = pd.to_datetime(
    time_df["Year"].astype(str) + "-" + time_df["Month"].astype(str) + "-01"
)

time_df = time_df.set_index("Date")

# EXPLICITLY SET MONTHLY FREQUENCY
time_df = time_df.asfreq("MS")

train = time_df.iloc[:-6]
```

```
test = time_df.iloc[-6:]

from statsmodels.tsa.statespace.sarimax import SARIMAX

model = SARIMAX(
    train["Monthly_Revenue"],
    order=(1,1,1),
    enforce_stationarity=False,
    enforce_invertibility=False
)

model_fit = model.fit(disp=False)
```

BASE CASE FORECAST

Next 6 months

[27]:

```
forecast = model_fit.get_forecast(steps=6)
forecast_mean = forecast.predicted_mean
forecast_ci = forecast.conf_int()

forecast_df = pd.DataFrame({
    "Base_Forecast": forecast_mean,
    "Lower_CI": forecast_ci.iloc[:, 0],
    "Upper_CI": forecast_ci.iloc[:, 1]
})

forecast_df
```

[27]:

```
            Base_Forecast       Lower_CI      Upper_CI
2011-07-01  735969.970110  393240.409229  1.078700e+06
2011-08-01  738507.933895  179972.174243  1.297044e+06
2011-09-01  738257.981326   32877.666870  1.443638e+06
2011-10-01  738282.598024  -88775.027676  1.565340e+06
2011-11-01  738280.173636 -194673.231200  1.671234e+06
2011-12-01  738280.412403 -289721.622433  1.766282e+06
```

SCENARIO PLANNING

Best Case → +10% demand
Worst Case → -10% demand

[32]:

```
forecast_df["Best_Case"] = forecast_df["Base_Forecast"] * 1.10
forecast_df["Worst_Case"] = forecast_df["Base_Forecast"] * 0.90

forecast_df
```

[32]:

```
            Base_Forecast       Lower_CI      Upper_CI      Best_Case  \
2011-07-01  735969.970110  393240.409229  1.078700e+06  809566.967121
```

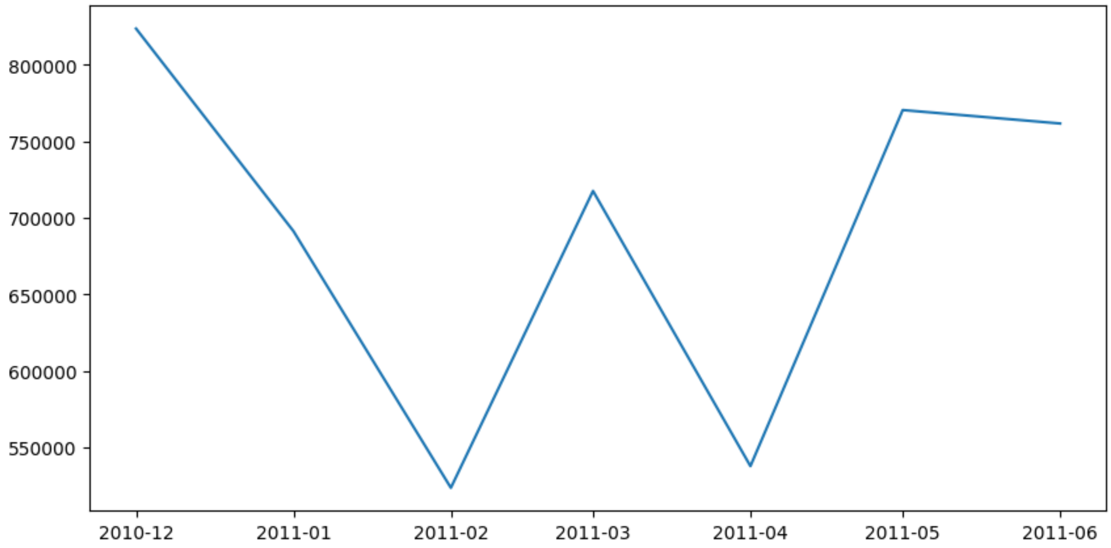
```
2011-08-01  738507.933895  179972.174243  1.297044e+06  812358.727284
2011-09-01  738257.981326   32877.666870  1.443638e+06  812083.779459
2011-10-01  738282.598024  -88775.027676  1.565340e+06  812110.857826
2011-11-01  738280.173636 -194673.231200  1.671234e+06  812108.191000
2011-12-01  738280.412403 -289721.622433  1.766282e+06  812108.453644

               Worst_Case
2011-07-01  662372.973099
2011-08-01  664657.140505
2011-09-01  664432.183193
2011-10-01  664454.338221
2011-11-01  664452.156273
2011-12-01  664452.371163
```

[33]:

```
plt.figure(figsize=(10,5))
plt.plot(train.index, train["Monthly_Revenue"], label="Train")
```

[33]:

```
[<matplotlib.lines.Line2D at 0x13c7685e360>]
```



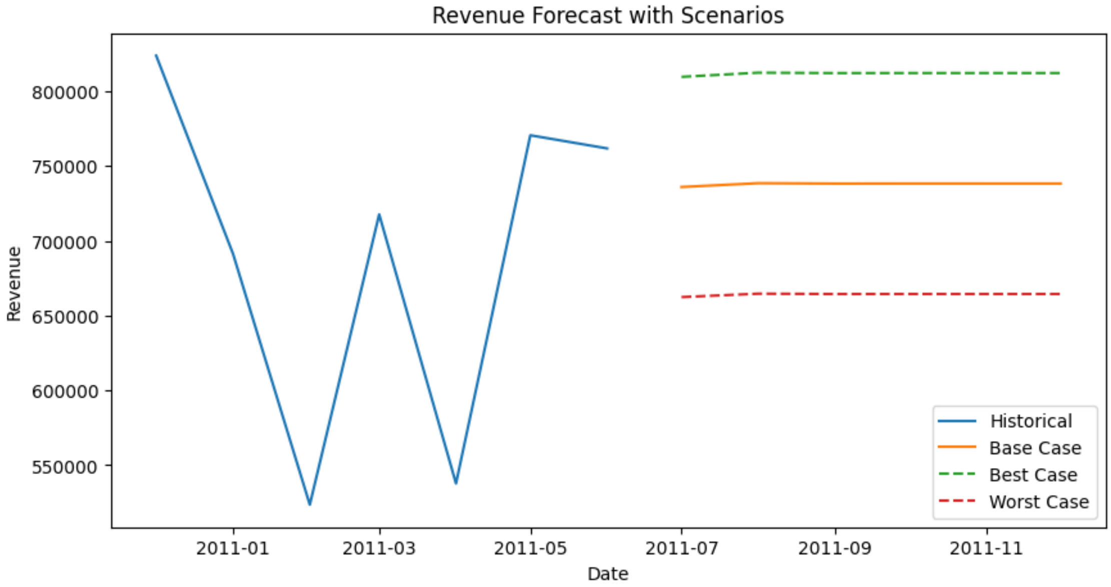
VISUALIZE SCENARIOS

CXO FRIENDLY

[41]:

```
plt.figure(figsize=(10,5))

plt.plot(train.index, train["Monthly_Revenue"], label="Historical")
plt.plot(forecast_df.index, forecast_df["Base_Forecast"], label="Base Case")
plt.plot(forecast_df.index, forecast_df["Best_Case"], linestyle="--",␣
  ↪label="Best Case")
```

```
plt.plot(forecast_df.index, forecast_df["Worst_Case"], linestyle="--",␣
 ↪label="Worst Case")

plt.title("Revenue Forecast with Scenarios")
plt.xlabel("Date")
plt.ylabel("Revenue")
plt.legend()
plt.show()
```



[42]:
```
forecast_df.to_csv(
    r"D:
 ↪\decision-intelligence-project\Data\processed\revenue_forecast_scenarios.csv"
)
```