In [13]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from statsmodels.graphics.tsaplots import plot_acf
from statsmodels.tsa.stattools import adfuller
import warnings
```

In [14]:
```
df = pd.read_csv("Sample_Superstore_2.csv", encoding='latin1')
df.head()
```

Out[14]:

	Row ID	Order ID	Order_Date	Ship_Date	Ship Mode	Customer ID	Customer Name	Segment	Country	City
0	1	CA-2016-152156	11-08-2016	11-11-2016	Second Class	CG-12520	Claire Gute	Consumer	United States	Henderson
1	2	CA-2016-152156	11-08-2016	11-11-2016	Second Class	CG-12520	Claire Gute	Consumer	United States	Henderson
2	3	CA-2016-138688	06-12-2016	6/16/2016	Second Class	DV-13045	Darrin Van Huff	Corporate	United States	Los Angeles
3	4	US-2015-108966	10-11-2015	10/18/2015	Standard Class	SO-20335	Sean O'Donnell	Consumer	United States	Fort Lauderdale
4	5	US-2015-108966	10-11-2015	10/18/2015	Standard Class	SO-20335	Sean O'Donnell	Consumer	United States	Fort Lauderdale

5 rows × 21 columns

Creating Dataframe

In [15]:
```
new_df = df[['Order_Date','Sales']]
new_df.head()
new_df.dropna()
```

Out[15]:

	Order_Date	Sales
0	11-08-2016	261.9600
1	11-08-2016	731.9400
2	06-12-2016	14.6200
3	10-11-2015	957.5775
4	10-11-2015	22.3680
...	...	...
9989	1/21/2014	25.2480
9990	2/26/2017	91.9600
9991	2/26/2017	258.5760
9992	2/26/2017	29.6000
9993	05-04-2017	243.1600

9994 rows × 2 columns

In [16]:
```
new_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9994 entries, 0 to 9993
Data columns (total 2 columns):
 #   Column      Non-Null Count  Dtype  
---  ------      --------------  -----  
 0   Order_Date  9994 non-null   object 
 1   Sales       9994 non-null   float64
dtypes: float64(1), object(1)
memory usage: 156.3+ KB
```

In [17]:
```
new_df = df[['Order_Date','Sales']]
new_df.head()
```

Out[17]:

	Order_Date	Sales
0	11-08-2016	261.9600
1	11-08-2016	731.9400
2	06-12-2016	14.6200
3	10-11-2015	957.5775
4	10-11-2015	22.3680

In [18]:
```
new_df.isnull()
```

Out[18]:

	Order_Date	Sales
0	False	False
1	False	False
2	False	False
3	False	False
4	False	False
...	...	...
9989	False	False
9990	False	False
9991	False	False
9992	False	False
9993	False	False

9994 rows × 2 columns

In [19]:
```
new_df.dropna(inplace=True)
new_df.drop_duplicates(inplace=True)
warnings.filterwarnings("ignore")
```

In [20]:
```
new_df.isnull()
new_df.reset_index(drop=True)
```

Out[20]:

	Order_Date	Sales
0	11-08-2016	261.9600
1	11-08-2016	731.9400
2	06-12-2016	14.6200
3	10-11-2015	957.5775
4	10-11-2015	22.3680
...	...	...
9976	1/21/2014	25.2480
9977	2/26/2017	91.9600
9978	2/26/2017	258.5760
9979	2/26/2017	29.6000
9980	05-04-2017	243.1600

9981 rows × 2 columns

In [21]:
```
new_df['Order_Date'] = pd.to_datetime(new_df['Order_Date'], format='%m-%d-%Y', errors='coerce')
new_df['Order_Date'].fillna(pd.to_datetime(new_df['Order_Date'], format='%m/%d/%Y', errors='coer
new_df.info()
warnings.filterwarnings("ignore")
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 9981 entries, 0 to 9993
Data columns (total 2 columns):
 #   Column      Non-Null Count  Dtype         
---  ------      --------------  -----         
 0   Order_Date  4032 non-null   datetime64[ns]
 1   Sales       9981 non-null   float64       
dtypes: datetime64[ns](1), float64(1)
memory usage: 233.9 KB
```

In [22]:
```
new_df.set_index('Order_Date',inplace=True)
```

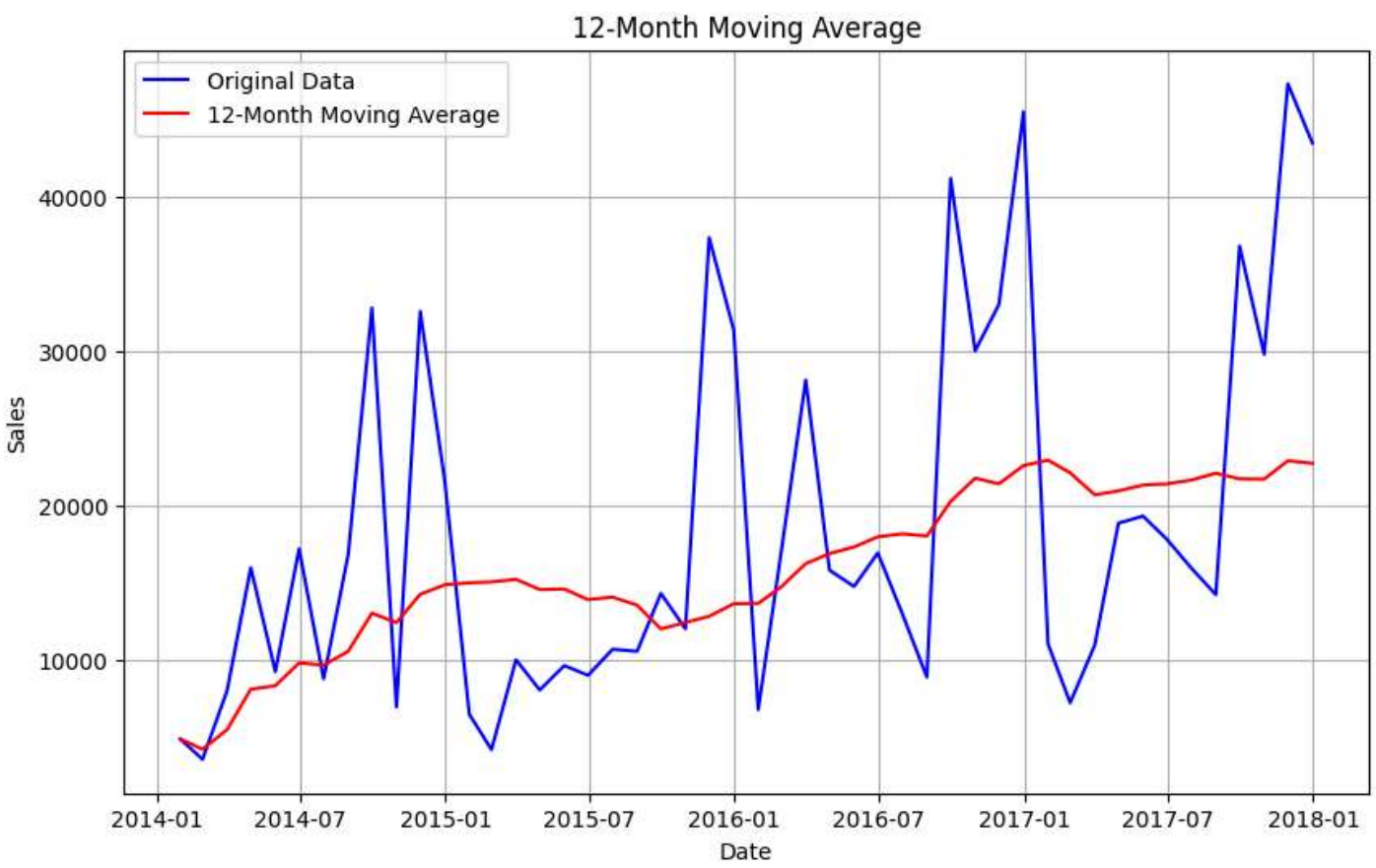
In [23]:
```
new_df = new_df.resample('M').sum()
new_df.head()
```

Out[23]:

Order_Date	Sales
2014-01-31	4923.616
2014-02-28	3610.402
2014-03-31	8048.773
2014-04-30	16017.851
2014-05-31	9288.864

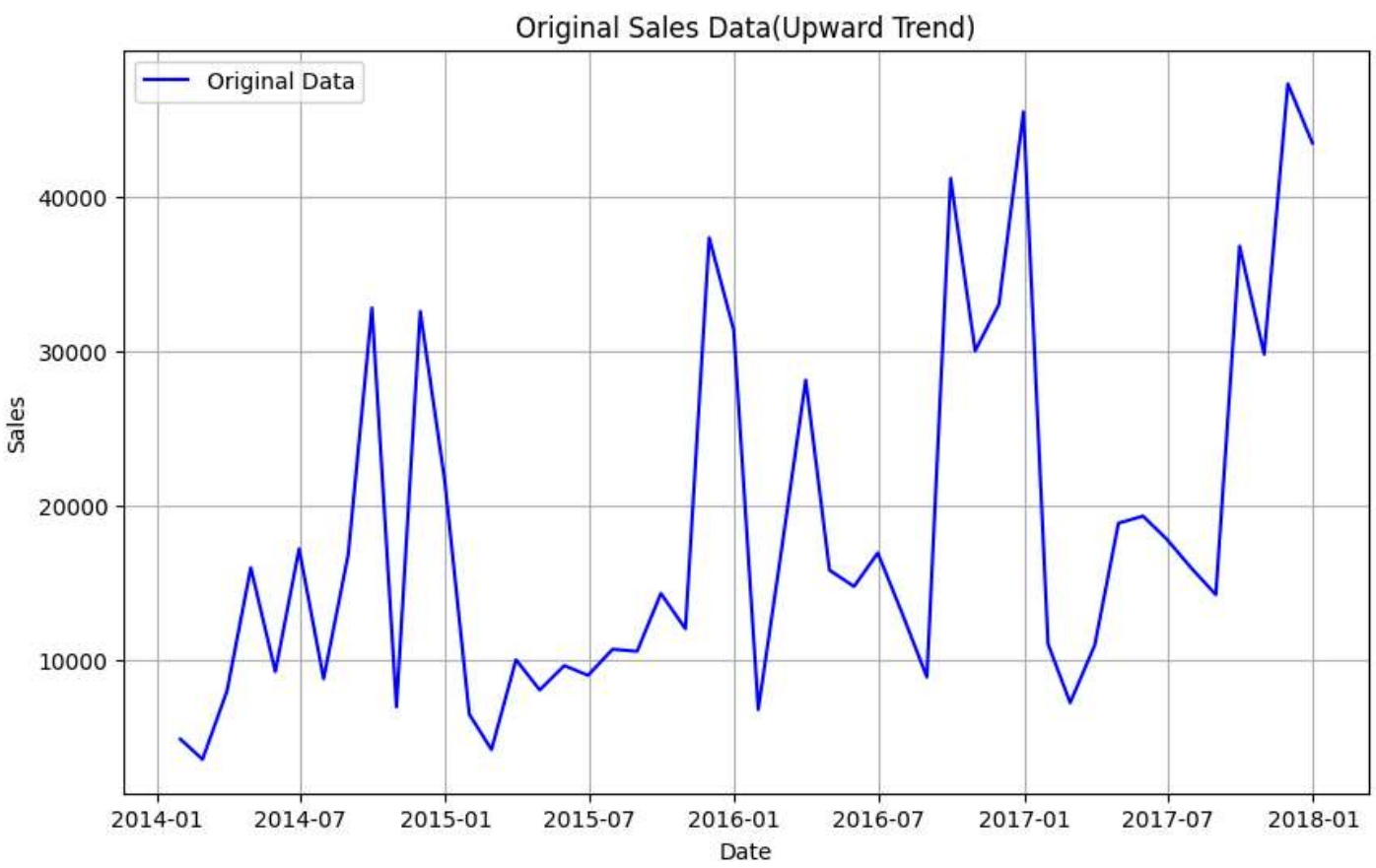
Moving Average

In [24]:
```
window_size = 12
moving_avg = new_df['Sales'].rolling(window=window_size, min_periods=1).mean()
plt.figure(figsize=(10, 6))
plt.plot(new_df.index, new_df['Sales'], label='Original Data', color='blue')
plt.plot(new_df.index, moving_avg, label=f'{window_size}-Month Moving Average', color='red')
plt.title(f'{window_size}-Month Moving Average')
plt.xlabel('Date')
plt.ylabel('Sales')
plt.legend()
plt.grid(True)
plt.show()
```



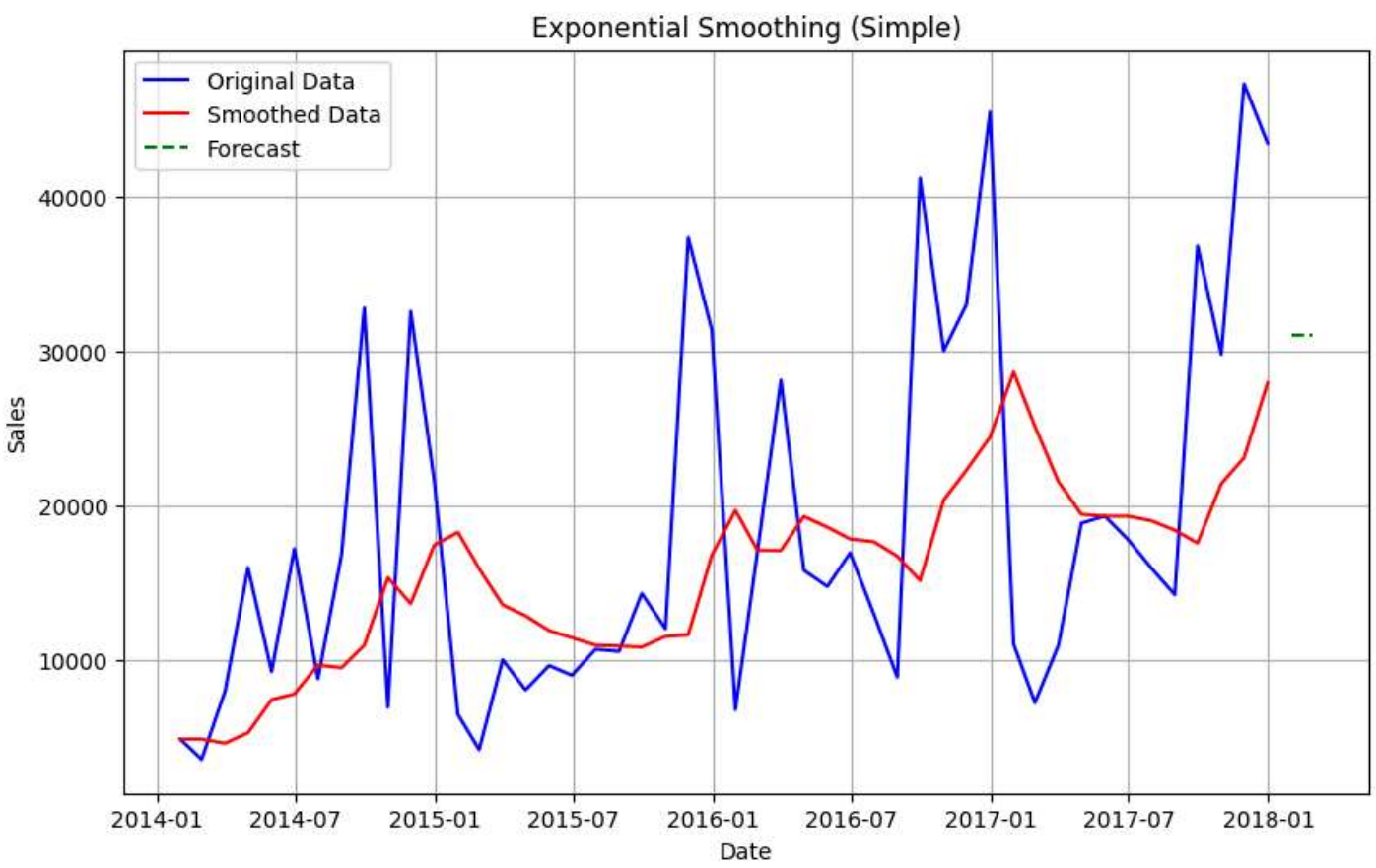
Trend Analysis

In [25]:
```
plt.figure(figsize=(10, 6))
plt.plot(new_df.index, new_df['Sales'], label='Original Data', color='blue')
plt.title('Original Sales Data(Upward Trend)')
plt.xlabel('Date')
plt.ylabel('Sales')
plt.legend()
plt.grid(True)
plt.show()
```



Exponential Smoothing

In [26]:
```
from statsmodels.tsa.holtwinters import SimpleExpSmoothing
warnings.filterwarnings("ignore")#remove warings
alpha = 0.2
model = SimpleExpSmoothing(new_df['Sales']).fit(smoothing_level=alpha)
smoothed_series = model.fittedvalues

# Forecast future values
forecast = model.forecast(2)

plt.figure(figsize=(10, 6))
plt.plot(new_df['Sales'], label='Original Data', color='blue')
plt.plot(smoothed_series, label='Smoothed Data', color='red')
plt.plot(forecast, label='Forecast', color='green', linestyle='--')
plt.title('Exponential Smoothing (Simple)')
plt.xlabel('Date')
plt.ylabel('Sales')
plt.legend()
plt.grid(True)
plt.show()

print("Forecasted values for the next 2 periods:")
print(forecast)
```

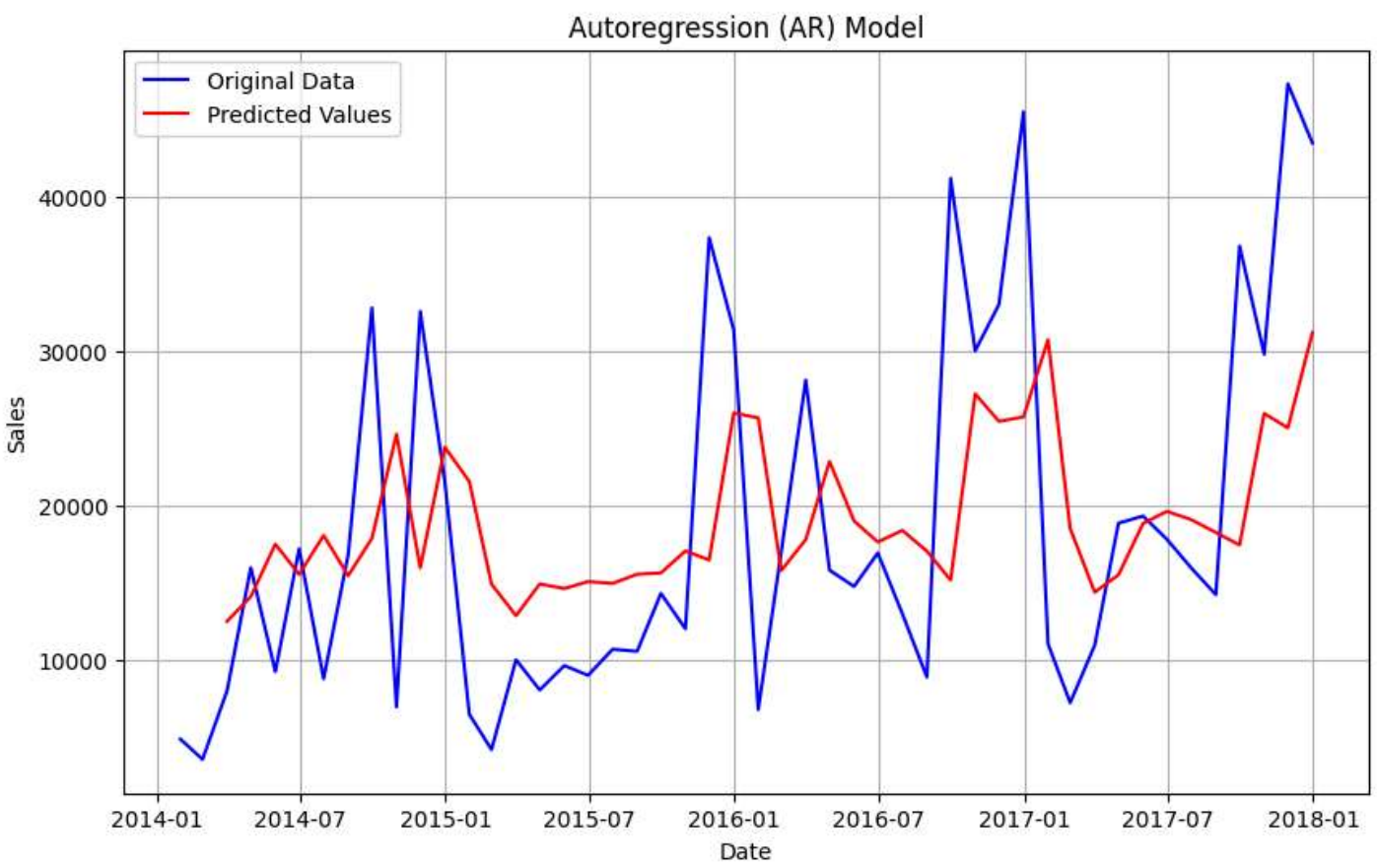



```
Forecasted values for the next 2 periods:
2018-01-31    31076.561753
2018-02-28    31076.561753
Freq: ME, dtype: float64
```

Auto Regression

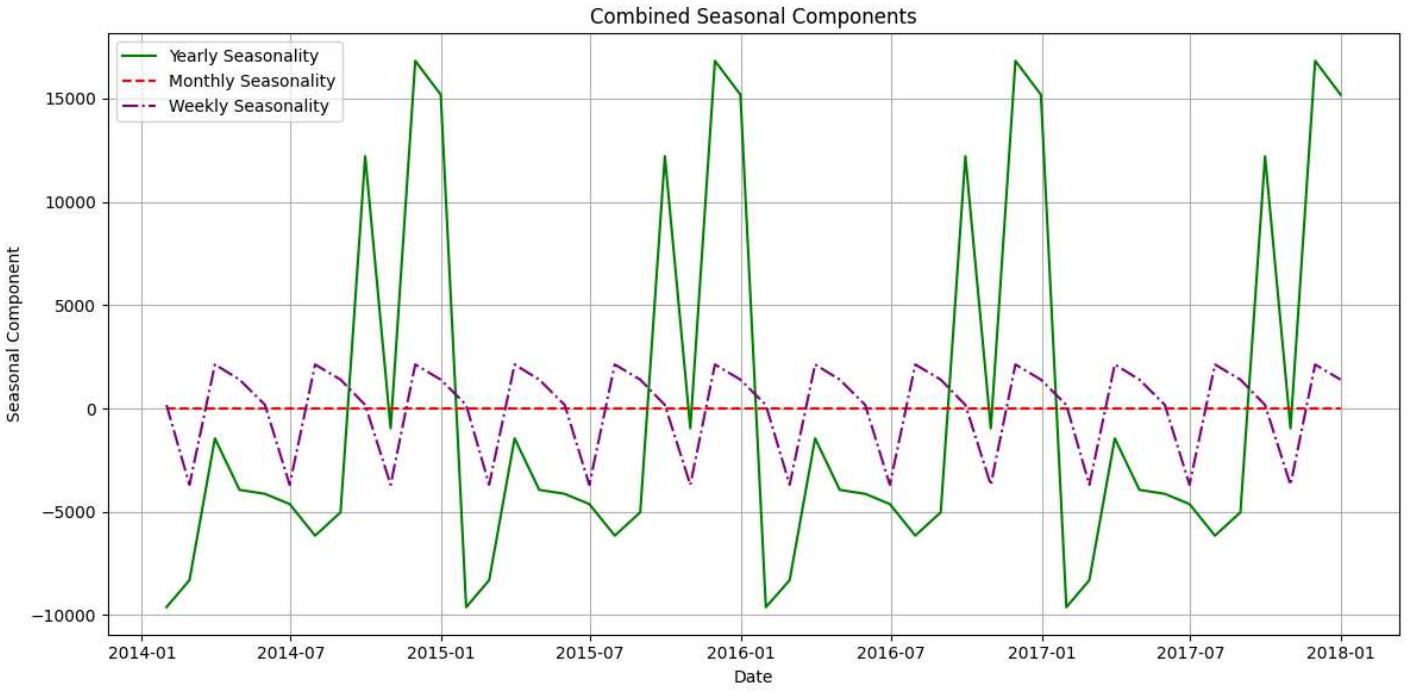
In [27]:

```python
from statsmodels.tsa.ar_model import AutoReg
from statsmodels.tools.eval_measures import rmse

model_order = 2
model = AutoReg(new_df, lags=model_order)
model_fit = model.fit()

# Make predictions
predictions = model_fit.predict(start=model_order, end=len(new_df)-1)

# Plot original data and predicted values
plt.figure(figsize=(10, 6))
plt.plot(new_df, label='Original Data', color='blue')
plt.plot(predictions, label='Predicted Values', color='red')
plt.title('Autoregression (AR) Model')
plt.xlabel('Date')
plt.ylabel('Sales')
plt.legend()
plt.grid(True)
plt.show()
```



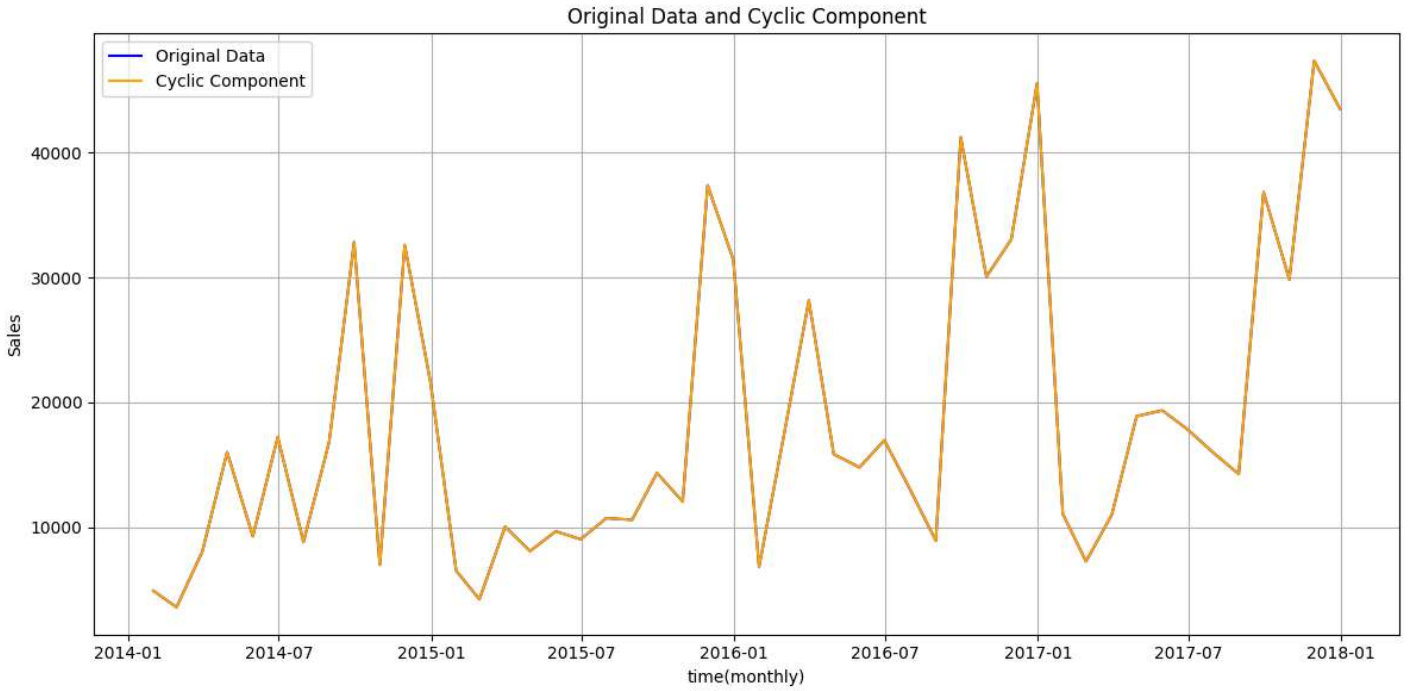
Seasonality

In [28]:
```
from statsmodels.tsa.seasonal import seasonal_decompose

# seasonal decomposition for Yearly seasonality
decomposition_yearly = seasonal_decompose(new_df, model='additive', period=12)

# seasonal decomposition for monthly seasonality
decomposition_monthly = seasonal_decompose(new_df, model='additive', period=1)

# seasonal decomposition for weekly seasonality
decomposition_weekly = seasonal_decompose(new_df, model='additive', period=4)

plt.figure(figsize=(12, 6))
plt.plot(decomposition_yearly.seasonal, label='Yearly Seasonality', color='green', linestyle='-'
plt.plot(decomposition_monthly.seasonal, label='Monthly Seasonality', color='red', linestyle='--
plt.plot(decomposition_weekly.seasonal, label='Weekly Seasonality', color='purple', linestyle='-

plt.title('Combined Seasonal Components')
plt.xlabel('Date')
plt.ylabel('Seasonal Component')
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.show()
```



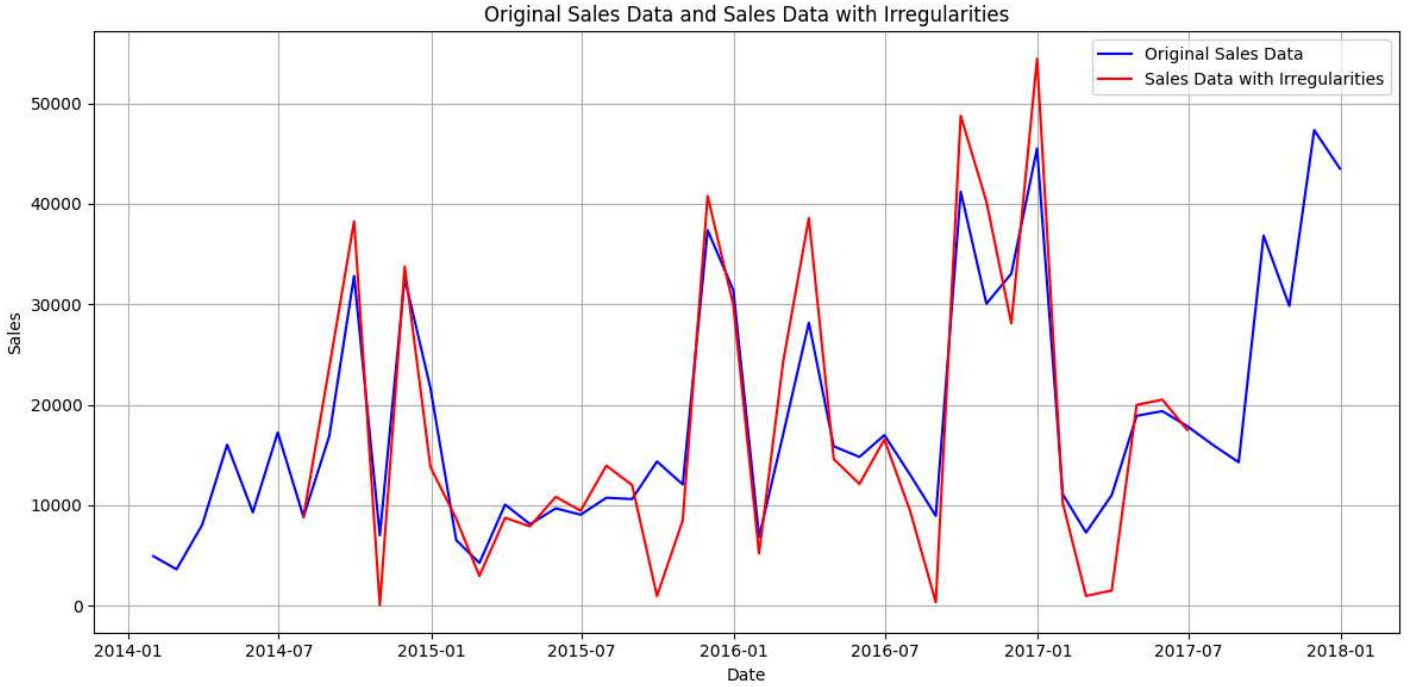
Cyclic Time Series Data

In [29]:
```
from statsmodels.tsa.seasonal import seasonal_decompose

decomposition_cyclic = seasonal_decompose(new_df, model='additive', period=1)

plt.figure(figsize=(12, 6))

plt.plot(new_df, label='Original Data', color='blue')
plt.plot(decomposition_cyclic.trend, label='Cyclic Component', color='orange')

plt.title('Original Data and Cyclic Component')
plt.xlabel('time(monthly)')
plt.ylabel('Sales')
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.show()
```



Irregularities

In [30]:
```
decomposition_sales = seasonal_decompose(new_df, model='additive', period=12)

residuals_aligned = decomposition_sales.resid.reindex(new_df.index)
sales_with_irregularities = new_df['Sales'] + residuals_aligned

plt.figure(figsize=(12, 6))

plt.plot(new_df.index, new_df['Sales'], label='Original Sales Data', color='blue')
plt.plot(new_df.index, sales_with_irregularities, label='Sales Data with Irregularities', color=

plt.title('Original Sales Data and Sales Data with Irregularities')
plt.xlabel('Date')
plt.ylabel('Sales')
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.show()
```


Original Sales Data and Sales Data with Irregularities
Original Sales Data
Sales Data with Irregularities
Sales
Date
0
10000
20000
30000
40000
50000
2014-01
2014-07
2015-01
2015-07
2016-01
2016-07
2017-01
2017-07
2018-01