models

July 20, 2025

[2]:
```
import pandas as pd
import matplotlib.pyplot as plt
from statsmodels.tsa.arima.model import ARIMA
from statsmodels.tsa.holtwinters import ExponentialSmoothing
from prophet import Prophet
from sklearn.metrics import mean_absolute_error, mean_squared_error
```

```
Importing plotly failed. Interactive plots will not work.
```

1 Carga y preprocesamiento

[ ]:
```
df = pd.read_csv("utilizacionHDN.csv")
df['fecha'] = pd.to_datetime(df['fecha'])
df = df.sort_values('fecha')
df.set_index('fecha', inplace=True)
```

[5]:
```
# variable objetivo
series = df['total-por-genero']
```

[9]:
```
# train/test
train = series[:-6]
test = series[-6:]
```

2 Modelado

[10]:
```
# --- Model 1: ARIMA ---
arima_model = ARIMA(train, order=(1,1,1)).fit()
arima_forecast = arima_model.forecast(steps=6)

# --- Model 2: Holt-Winters (Exponential Smoothing) ---
hw_model = ExponentialSmoothing(train, trend='add', seasonal=None).fit()
hw_forecast = hw_model.forecast(6)

# --- Model 3: Prophet ---
prophet_df = df.reset_index()[['fecha', 'total-por-genero']].
 ↪rename(columns={'fecha': 'ds', 'total-por-genero': 'y'})
prophet_model = Prophet()
```

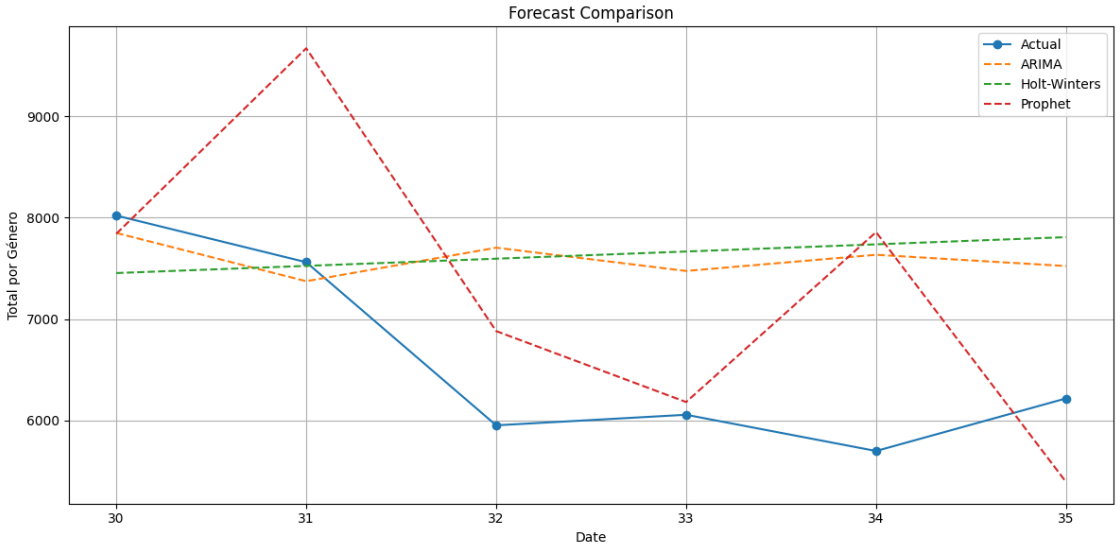
```
prophet_model.fit(prophet_df[:-6])  # use training part
future = prophet_model.make_future_dataframe(periods=6, freq='MS')
forecast_prophet = prophet_model.predict(future)
prophet_forecast = forecast_prophet[['ds', 'yhat']].set_index('ds').iloc[-6:]
```

```
10:17:13 - cmdstanpy - INFO - Chain [1] start processing
10:17:13 - cmdstanpy - INFO - Chain [1] done processing
```

3 Comparativa de Modelos

[11]:
```
# --- Combine results ---
results = pd.DataFrame(index=test.index)
results['Actual'] = test
results['ARIMA'] = arima_forecast.values
results['Holt-Winters'] = hw_forecast.values
results['Prophet'] = prophet_forecast['yhat'].values
```

[12]:
```
# --- Plot ---
plt.figure(figsize=(12, 6))
plt.plot(results.index, results['Actual'], label='Actual', marker='o')
plt.plot(results.index, results['ARIMA'], label='ARIMA', linestyle='--')
plt.plot(results.index, results['Holt-Winters'], label='Holt-Winters',␣
↪linestyle='--')
plt.plot(results.index, results['Prophet'], label='Prophet', linestyle='--')
plt.title('Forecast Comparison')
plt.xlabel('Date')
plt.ylabel('Total por Género')
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.show()
```



[14]:
```python
# --- Metrics table ---
def compute_metrics(actual, predicted):
    return {
        'MAE': mean_absolute_error(actual, predicted),
        'RMSE': mean_squared_error(actual, predicted)
    }

metrics = {
    'ARIMA': compute_metrics(results['Actual'], results['ARIMA']),
    'Holt-Winters': compute_metrics(results['Actual'], results['Holt-Winters']),
    'Prophet': compute_metrics(results['Actual'], results['Prophet']),
}

metrics_df = pd.DataFrame(metrics).T
print(metrics_df)
```

```
                     MAE          RMSE
ARIMA         1127.881593  1.764406e+06
Holt-Winters  1247.089812  2.048414e+06
Prophet       1054.032636  1.782169e+06
```