

A Cross Country Analysis: Using and Assessing ARIMA as a Forecasting Technique On the Economic Impact of Terrorist Attacks

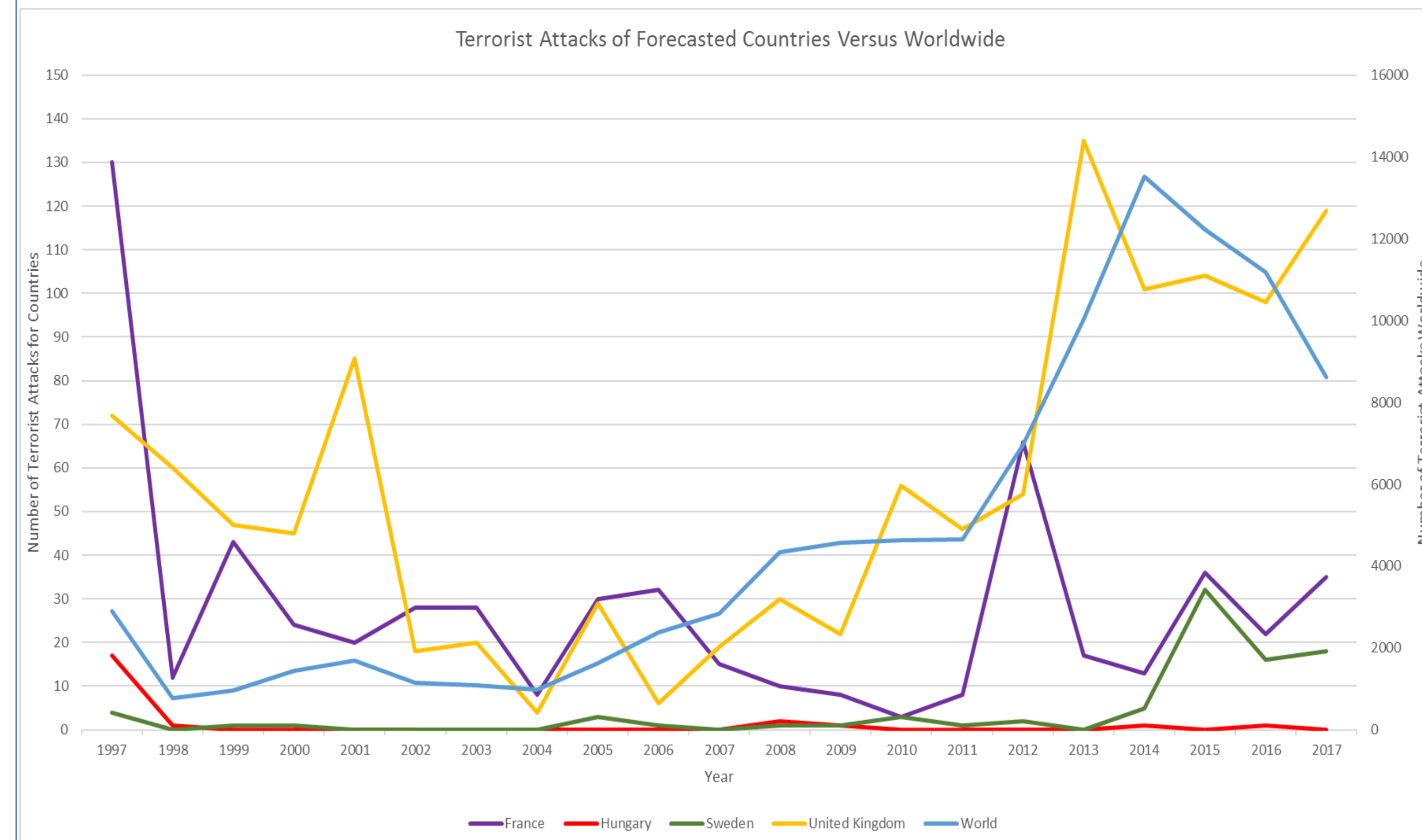
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Purpose of Study

- Examination ARIMA forecasting technique for purposes of evaluating the impact of terrorist attacks on a country's GDP.
- Period Examined: 1997 - 2017.
- Countries Examined: France; Hungary; Sweden; United Kingdom.

Introduction

- Between 1997 and 2014: continuous increase in terrorist attacks; more recently, slight decline. Economic impact: considered significant.



- 2017: estimated cost, both direct and indirect, US\$52 billion, with 25% of that reflected in GDP loss.

Terms

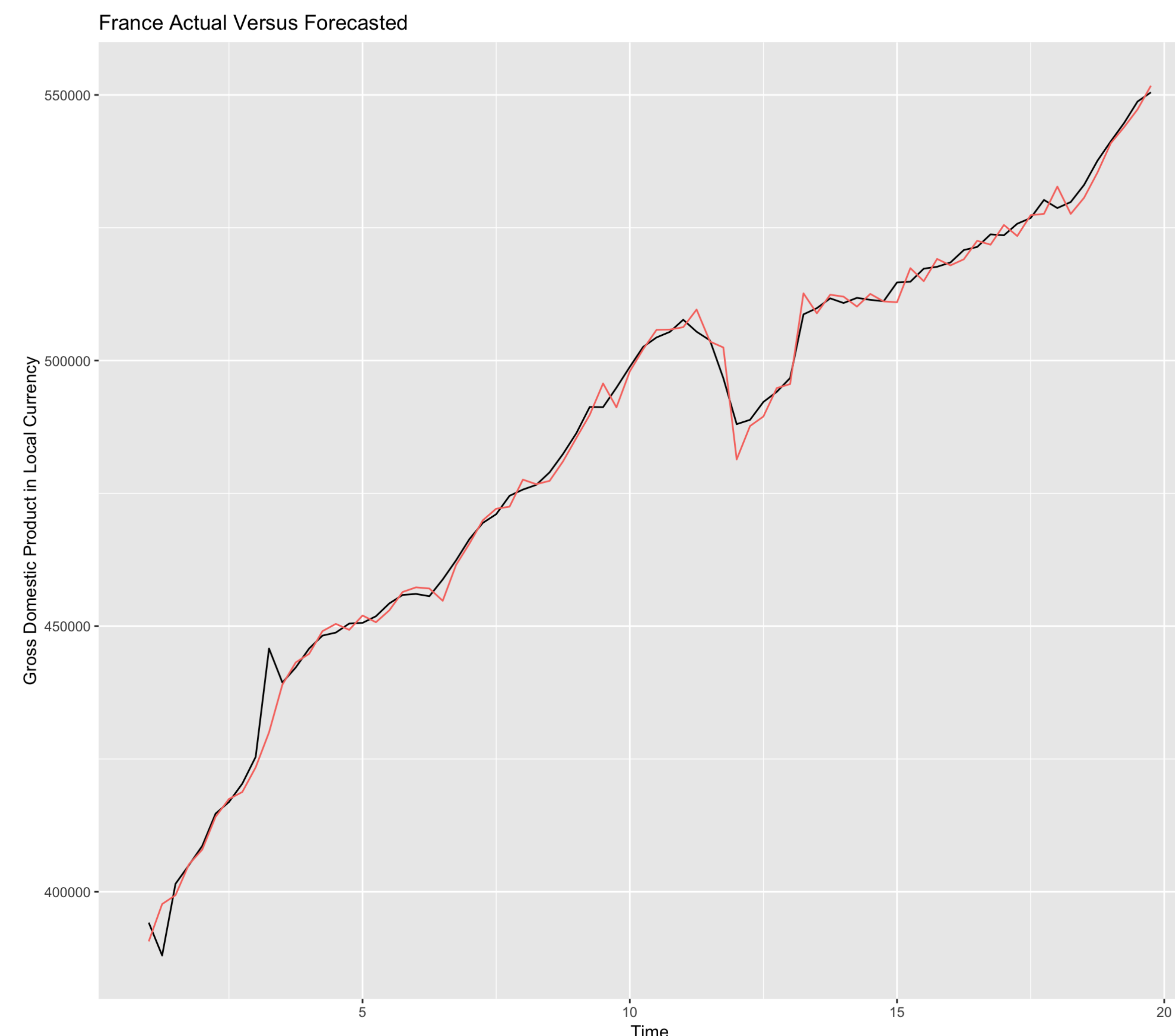
- GDP = Gross Domestic Product.
- ARIMA = Autoregressive integrated moving average.
- AICc = Second-Order Akaike Information Criterion.
- Box-Jenkins = forecasting methodology for using ARIMA.
- RSME = Root Square Mean Estimate.
- d is the degree of differencing in the integrated component, which is subtracting the current value from the previous value.
- q is the moving average component and represents a non-seasonal series by differencing autoregressive and moving average components.
- p represents the number of lags used in the model.

Hypothesis

- It is expected that a country's forecasted GDP, at least in the short-term, but for a terrorist attack, would be greater than reported GDP.

Conclusion

- Results inconclusive and inconsistent for post-terrorist attack period:
 - Actual GDP < Forecasted GDP; and
 - Actual GDP > Forecasted GDP.
 - Potential Rationale: Public becoming immune to terrorist attacks and/or anticipating such attacks and, therefore, investing to detect, prevent, and protect.



- ARIMA Model questionable forecasting technique.
- Consider alternative techniques to evaluate the impact of terrorist attacks, e.g., Event Study Methodology.

Method

- An auto.arima() model was generated for each country. Use of Box-Jenkins methodology to test for seasonality, tkey indicators for ARIMA model.
- After a country experienced a terrorist attack, there would be a forecast of the following quarter. The terrorist attacks were divided into two categories: (1) attack happened within the first two months of the quarter and (2) attack happened within the third month of the quarter.
- Look at level of error by examining the RSME and AICc for the auto.arima() model.
- Auto.arima() uses an optimized model for the criteria by searching through combinations of parameters (p,d,q) and generating a set.
- Visually examined a graph of each country's GDP for trend, seasonality, and cycle. Created a time-series linear regression model with trend and season as independent variables and GDP as the dependent variable.
- Perform an Augmented Dickey-Fuller Test to see if data is stationary.
- Test autocorrelation (ACF) and partial autocorrelation (PACF) by making plots to display correlation between a series and its lags.

Country	p,d,q	AICc	RSME
France	(1,1,0)	1703.57	1797.53
	$\hat{Y}_t = \mu + Y_{t-1} + \phi_1(Y_{t-1} - Y_{t-2})$		
Hungary	(1,1,0)	2341.75	52374.67
	$\hat{Y}_t = \mu + Y_{t-1} + \phi_1(Y_{t-1} - Y_{t-2})$		
Sweden	(1,1,1)	1960	6864.969
	$(1-\phi_1B)(1-B)Y_t = (1-\theta_1B)e_t$		
United Kingdom	(1,1,0)	1697.04	1758.904
	$\hat{Y}_t = \mu + Y_{t-1} + \phi_1(Y_{t-1} - Y_{t-2})$		

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