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Case Study 3 Analysis

Gestão de Operações e Logística

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Phrygian thread factory

Case Study 3)

Thread factory founded in 1980 by Ikos Matzakis.

Content

- **Context**
- **Analysis of the demand pattern for NC-216**
  - Overall look on demand
  - Temporal analysis of determinant events
- **Forecasting system proposal and evaluation**
  - Fred and Roy’s proposal
  - Simple Exponential
  - Holt Winters
  - Comparison between methods

Context

Why the need for a forecasting system?

Phrygian Thread Factory's **inability to meet a large rush order from Non-Specific Motors**.

- There was not enough raw material to produce Phrygian's most important product, NC-216, to fulfill the order.

Analyse the sales data from previous years to attempt **predicting the sales amount in the future**.

Context

Advantages of forecasting systems:

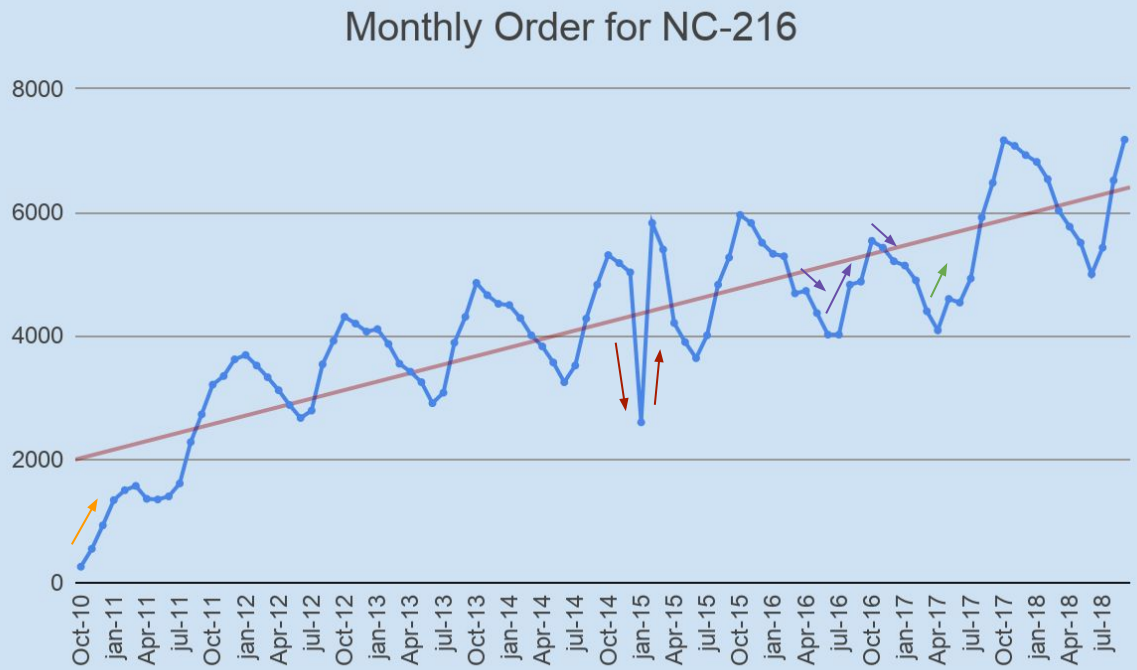
- Reduce uncertainty;
- Reduce inventory cost;
- Increase order fulfillment.

▼

The increase in forecasting accuracy increases profit margin.

Analysis of the demand pattern for NC-216

Overall look on demand:



Real demand

Trend

Oct-10: NC-216 introduction on the market.

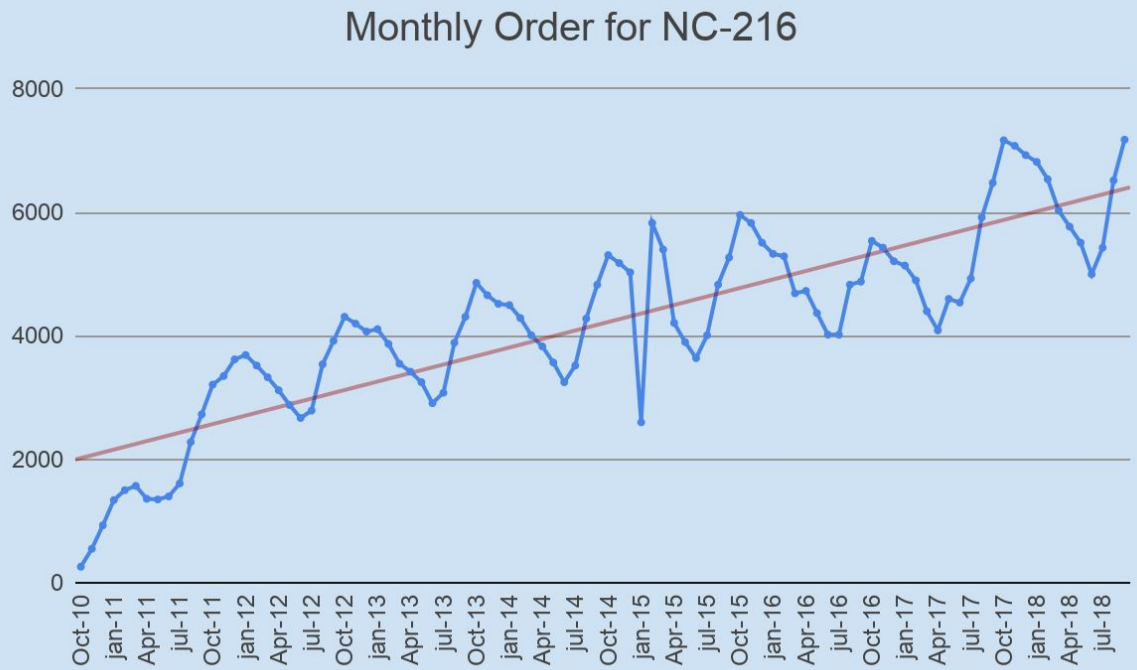
Jan-15: Workers' strike. Lead to unusual values breaking the growth pattern.

Jul-16: NC-366 dropped from the regular product line and retained at a premium price. Slowed the growth pattern.

Mar-17: NC-236 (similar to NC-216) introduction on the market. Possible cannibalization of sales but there is growth resumption in demand.

Analysis of the demand pattern for NC-216

Overall look on demand:



Growing trend in sales' volume over the years.

Annual sales patterns - **seasonality** - with sales peaking around October and then decreasing.

Forecasting system proposal

Fred and Roy's proposal

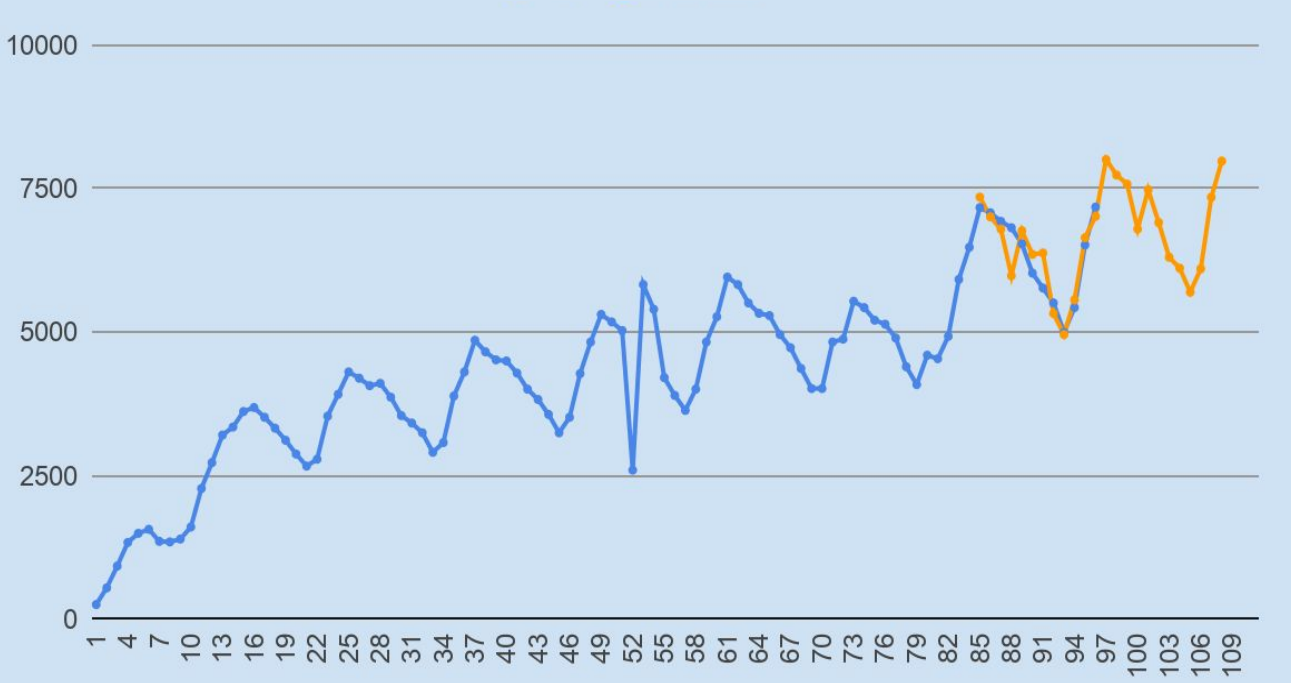
Approach

Monthly demand forecast = Average in the same month for past 5 years × (1 + Inflation factor)

Inflation factor = (Real demand of 3 months before the desired month − 5 preceding years' average of 3 months' demands before that month) / 5 preceding years' average of 3 months' demands before that month

Forecasting system proposal

Fred and Roy's proposal



Forecasting system proposal

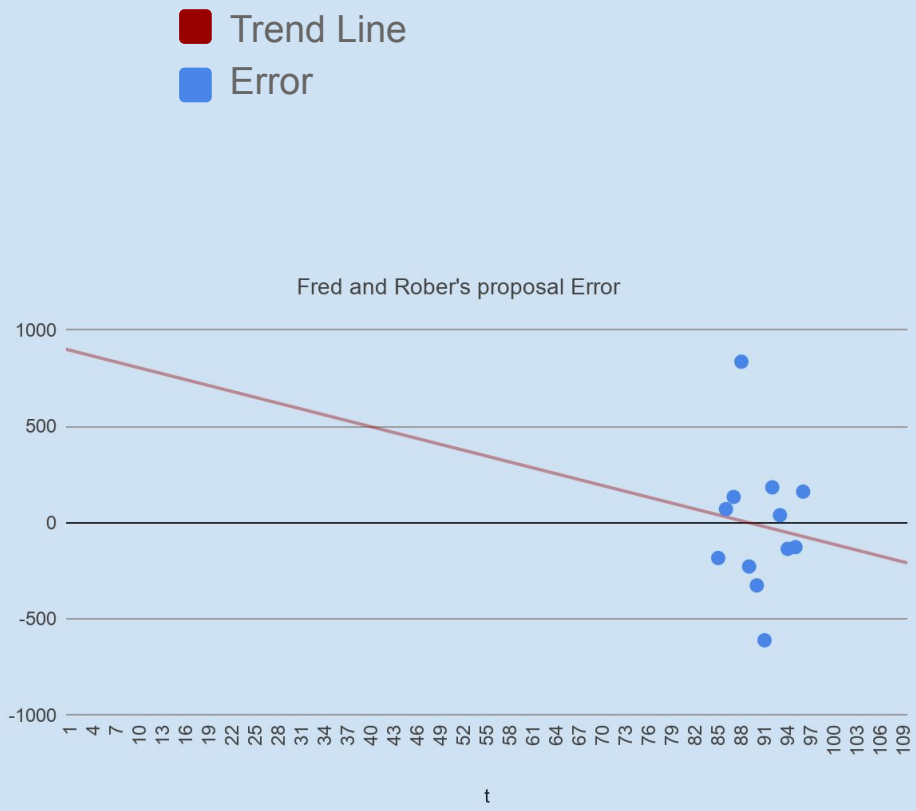
Fred and Roy's proposal - Evaluation

Advantages:

- The inflation factor should take into account years similar values and discard outliers;
- Allows for a full year forecasting.

Disadvantages:

- Values recorded at the time of the strike may induce errors in the forecasts in short or medium term.



Forecasting system proposal

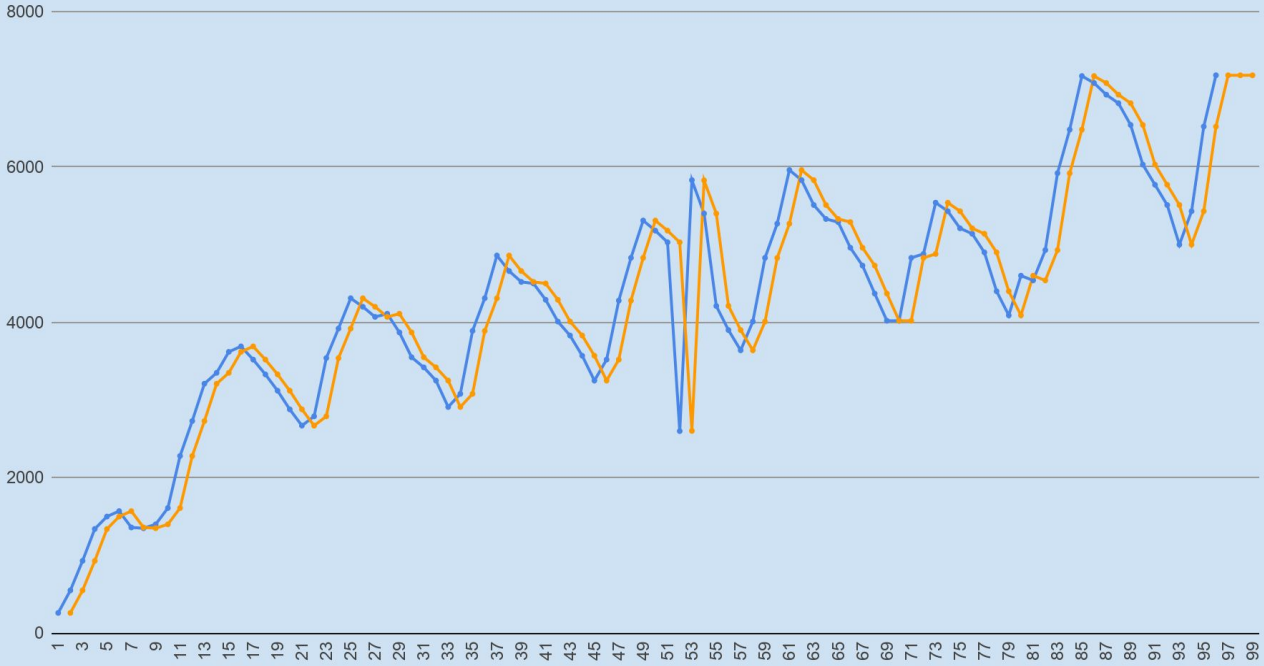
Simple Exponential

Approach

Monthly demand forecast = Alpha × Previous month's real demand + (1 − Alpha) × Calculated demand for previous month

Forecasting system proposal

Simple Exponential



Alpha: 0,999

Note: Alpha value obtained with Solver to provide best possible solution.

Forecasting system proposal

Simple Exponential - Evaluation

Advantages:

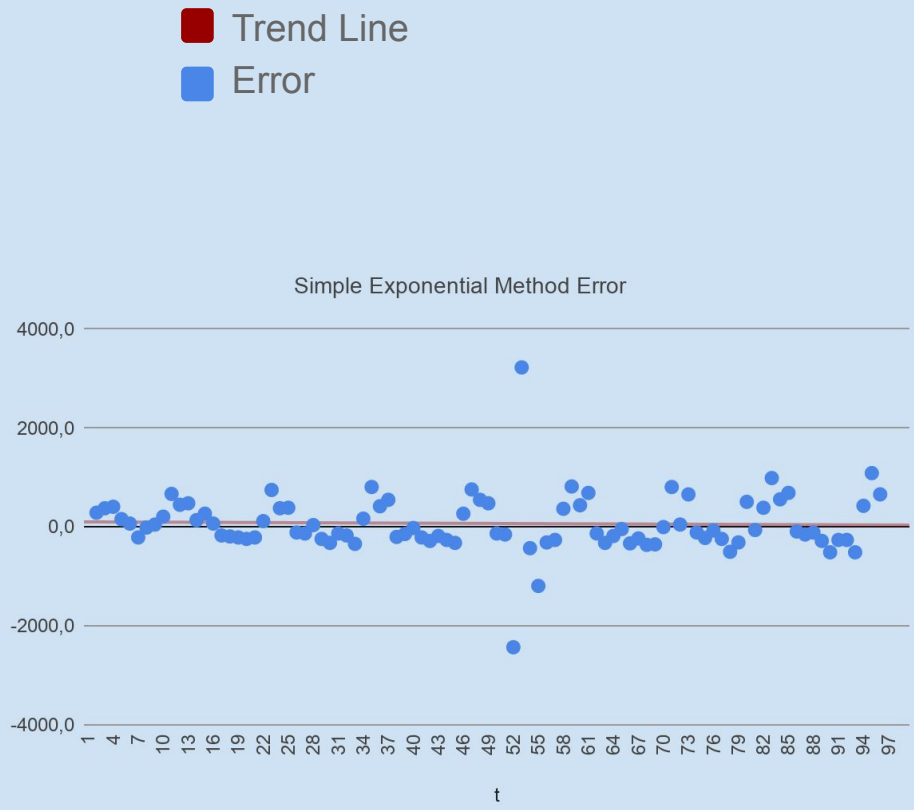
- Gives more significance to recent observations.

Disadvantages:

- Produced forecasts lag behind actual time trend;
- Only allows for 1 month forecasting;
- Does not consider seasonality or trends.

Note:

The highest error levels can be explained by the events mentioned before such as **Jan-15**'s.



Forecasting system proposal

Holt Winters (Triple Exponential Smoothing)

Approach

Monthly demand forecast =

$$nt + bt \times k + ft+k-s \quad \text{for } k=1,2,...,s$$

$$nt + bt \times k + ft+k-2s \quad \text{for } k=s+1, s+2,...,2s$$

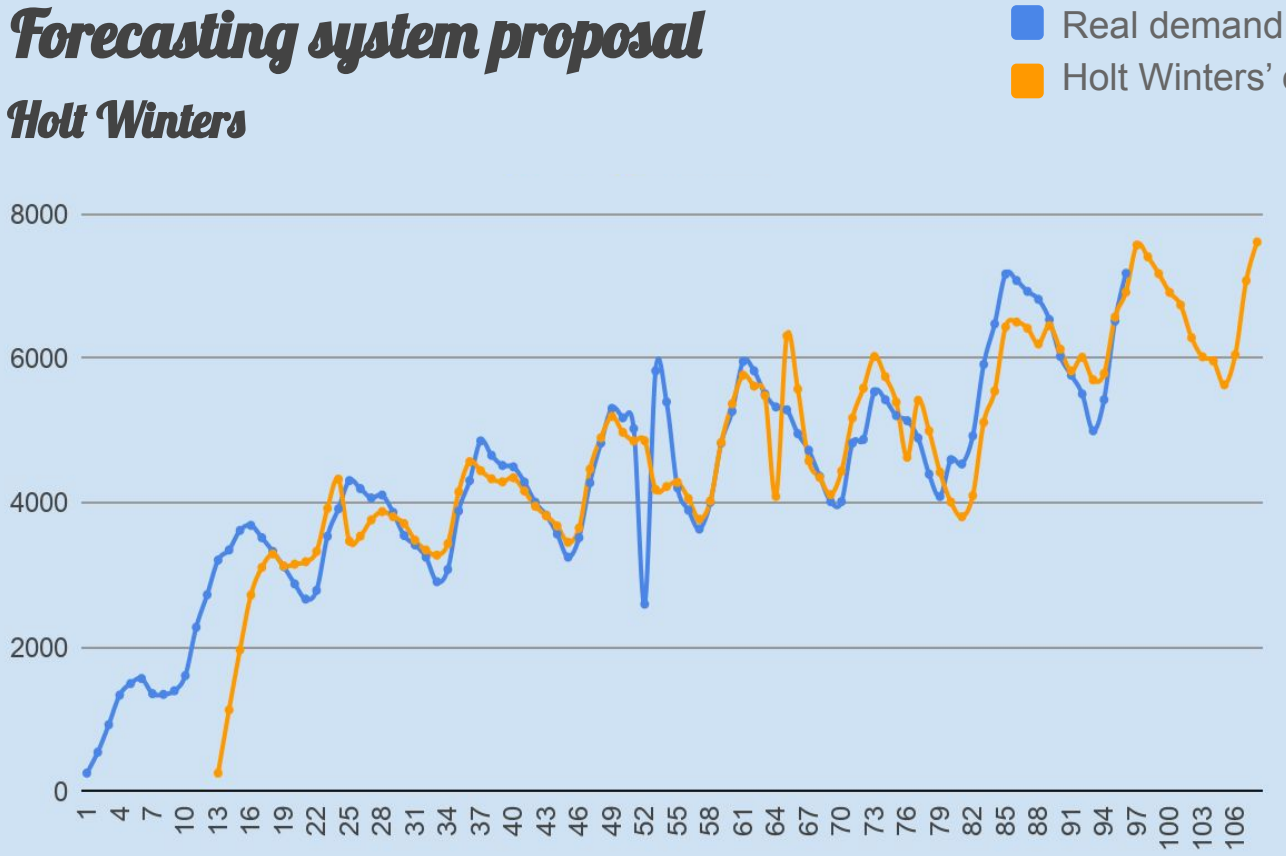
$$nt = Alpha \times (Zt - ft-s) + (1 - Alpha) \times nt-1 + bt-1$$

$$bt = Beta \times (nt - nt-1) + (1 - Beta) \times bt-1$$

$$ft = Gama \times (Zt - nt) + (1 - Gama) \times ft-s$$

Forecasting system proposal

Holt Winters



Alpha=0,194

Beta=0,023

Gama=0,699

Note: Alpha, beta and gama values obtained with Solver to provide best possible solution.

Forecasting system proposal

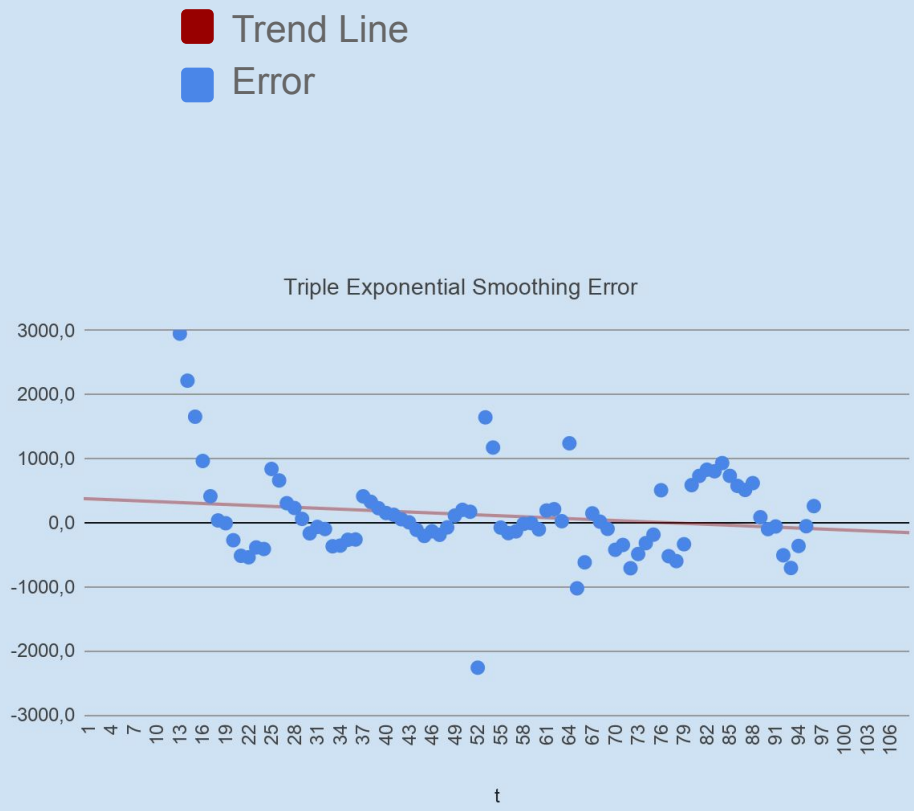
Holt Winters - Evaluation

Advantages:

- Gives more significance to recent observations;
- Allows for a full year forecasting;
- Considers both trend and seasonality.

Note:

The highest error levels can be explained by the events mentioned before such as **Jan-15**'s.



Forecasting system proposal

Comparison between methods

	Fred and Robert's proposal	Simple Exponential	Holt Winters
MAPE	-	10,34%	8,48%
MAPE for 85<=t<=96	4,00%	6,73%	6,10%

Fred and Robert's proposal:

- Lowest mean absolute percentage error.

Simple Exponential:

- Highest mean absolute percentage error.

Holt Winters:

- Intermediate mean absolute percentage error.

Forecasting system proposal

Comparison between methods

Fred and Robert's proposal:

- Forecast considers values from previous years for same month which mimics seasonality;
- Predicts up to a full year ahead.

Holt Winters:

- Forecast considers seasonality;
- Predicts up to a full year ahead.

Simple Exponential:

- Overall not suited for time series which involve seasonality;
- Predicts a month ahead.

Forecasting system proposal

Comparison between methods

Advice

Not Advisable:

Simple Exponential Smoothing method:

- Although for the same period of 86<=t<=96 the MAPE is quite similar to the MAPE obtained using the Holt Winters' method, this method was intended for stationary time series without seasonality.

Forecasting system proposal

Comparison between methods

Advisable:

Fred and Robert's proposal:

- MAPE is much lower than for the other two methods, but this can be explained by the fact it only considers the most recent years and this time period is not affected by the events mentioned before (e.g. **Jan-15**) that caused significant disruption in the demand pattern.

Fred and Robert's proposal & Holt Winters' method:

- Both consider trends and seasonality;
- Both predict up to a year ahead.

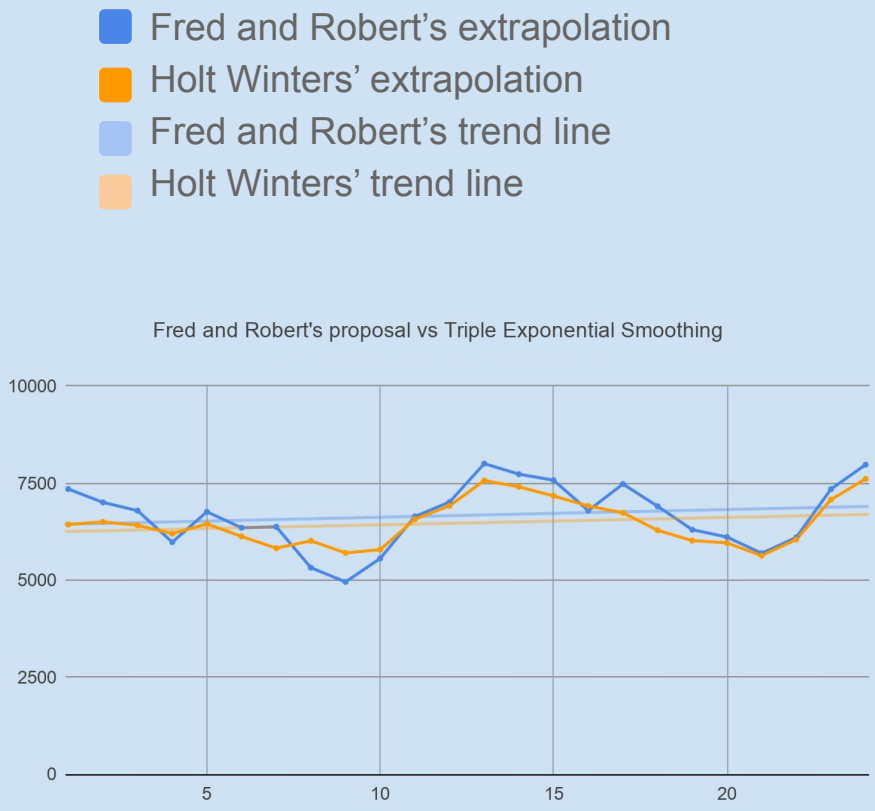
Forecasting system proposal

Comparison between methods

Similar extrapolations and, consequently, very **similar trend lines**;
However, the Holt Winters' method provides a **smoother extrapolation with lower estimates** than Fred and Robert's proposal.

Since both provide similar results, both would be a reasonable option for Phrygian to adopt.

We would, however, consider the Holt Winters' method more seriously since it holds some importance over Fred and Robert's proposal as it is a method **recognised by the scientific community**.



THANK YOU