CIS 422/522
PROJECT 1
TIME SERIES CONCEPTS

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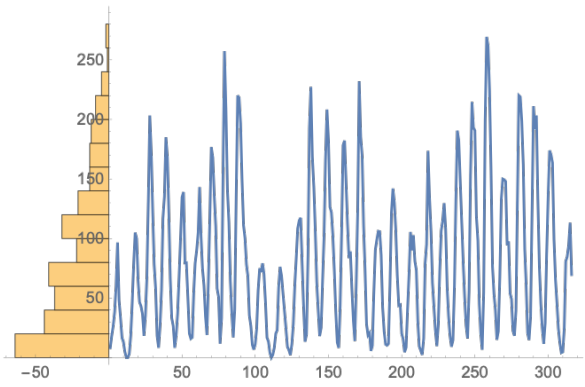
TIME SERIES CONCEPTS

- Time Series
- Preprocessing
- Forecasting Models
- Forecasting
- TS2DB



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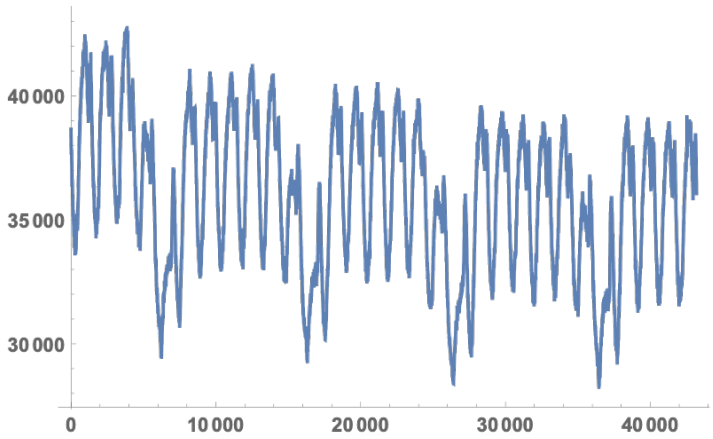
TIME SERIES

$(x_t)\ t \in [1,T]$



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Time Series Forecasting

Time Series Forecasting Methods

- Cualitative
  - Subjetive
  - No data available (new products)
  - Experts Opinion
- Cuantitative
  - Use historical data
  - Mathematical/Statistical Model
  - Models behavior patterns
  - Proyects those patterns to the future

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Time Series Forecasting

Quantitative Methods

- Regression
- Smoothing
- ARIMA
- Artificial Intelligence

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Preprocessing

- Statistical Analysis
- Noise
- Outliers
- Missing Data
- Autocorrelation
- Chaos

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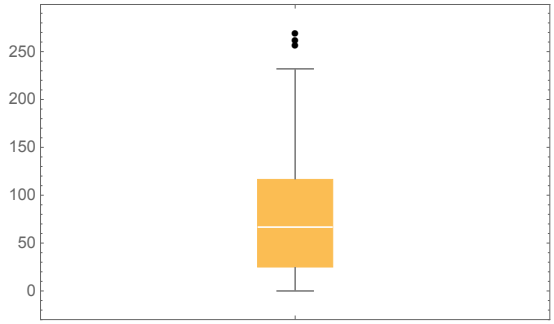
Statistical Analysis

5-number summary
{0.,24.9,66.7,116.3,269.3}

Mean = 79.5032
SD = 62.0572



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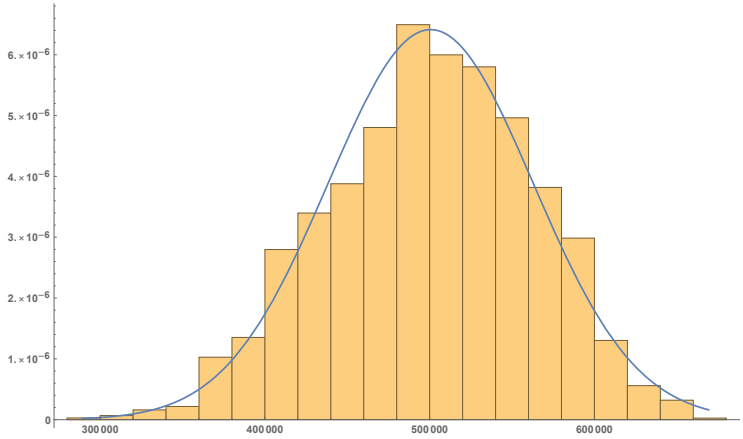
Statistical Analysis



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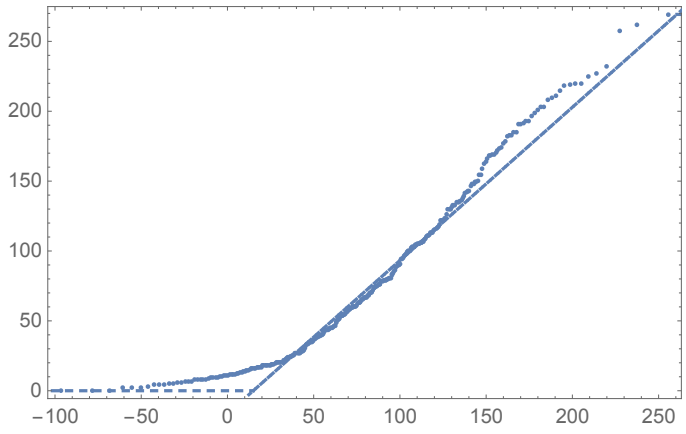
Statistical Analysis

The null hypothesis that the data is distributed according to the NormalDistribution[79.5032,62.0572] is rejected at the 5% level, based on the Cramér-von Mises test.



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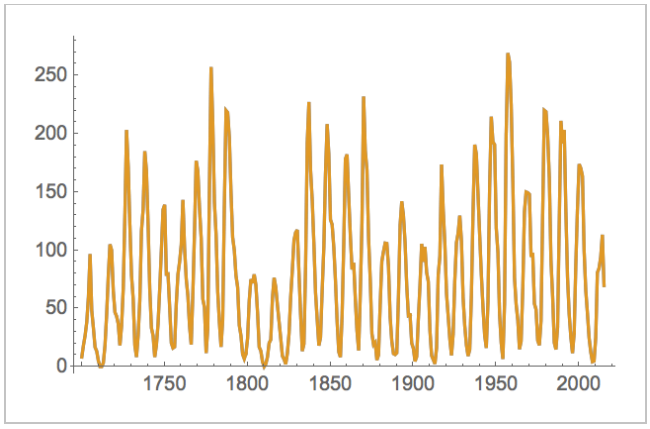
Noise Removal

- Moving average
- Moving medians



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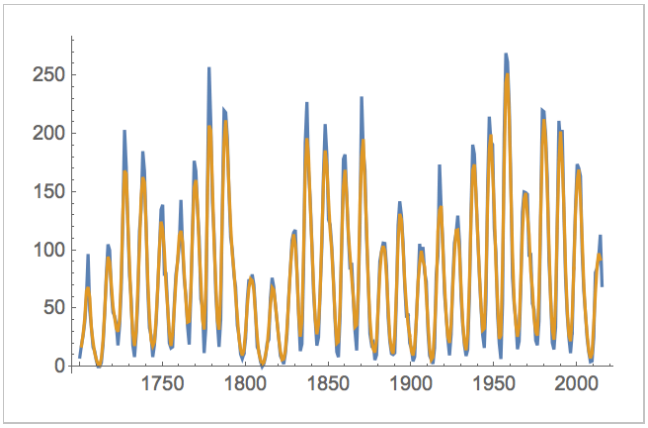
Noise Removal

- Moving average
- Moving medians



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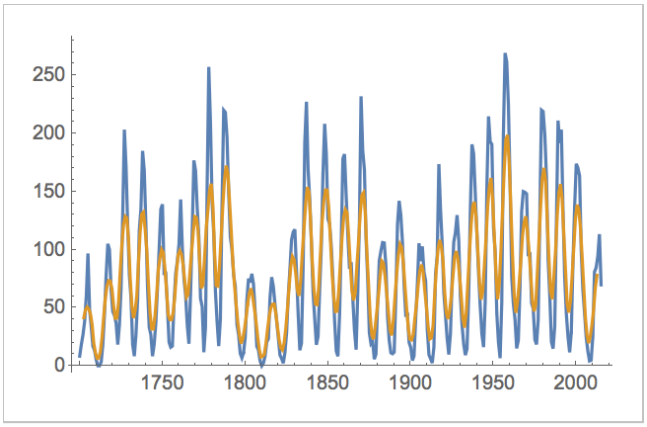
Noise Removal

- Moving average
- Moving medians



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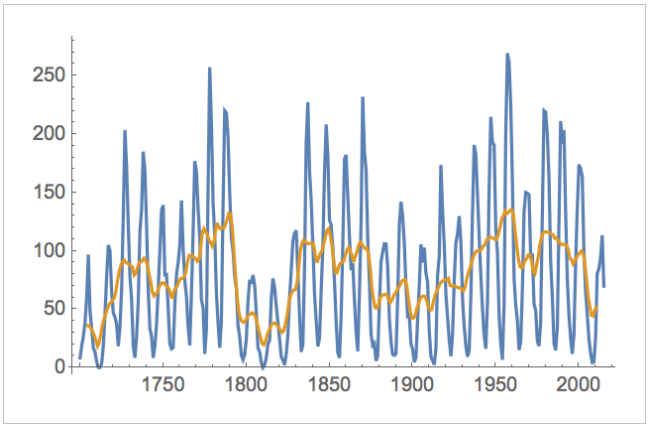
Noise Removal

- Moving average
- Moving medians



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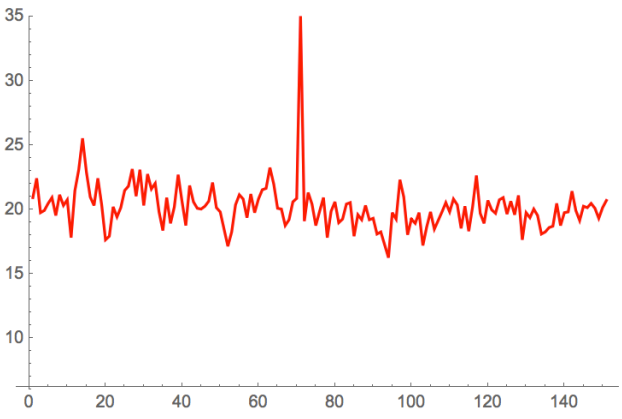
Outliers

- Context sensitive
- Air Temperature TS
- Synthetic Outlier



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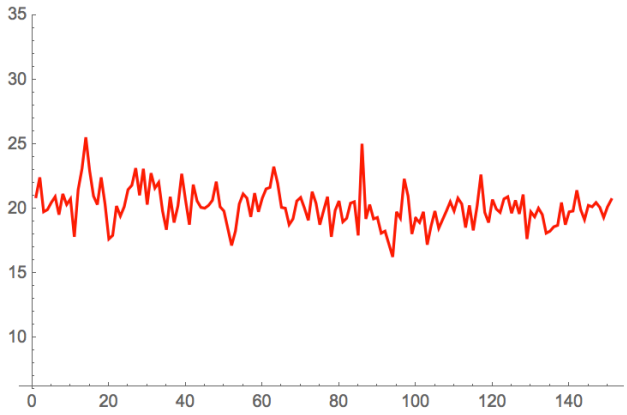
Outliers

- Synthetic outlier
- Can you spot it?



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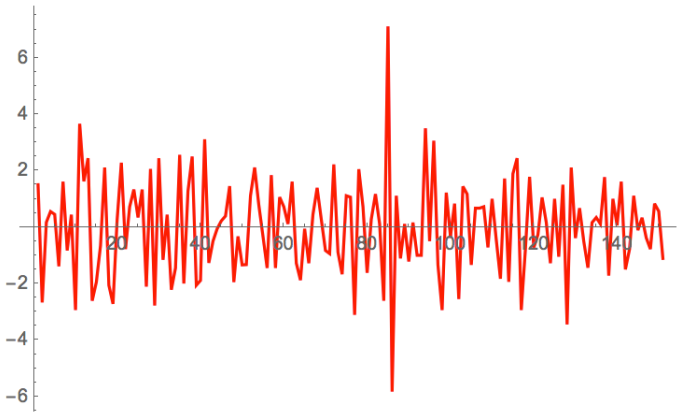
Outliers

- Difference $T_i - T_{i-1}$



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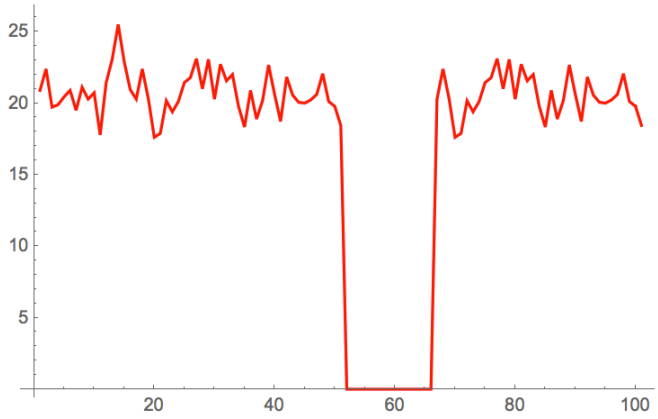
Missing Data

- Blackout
- Transmission failure
- Sick day



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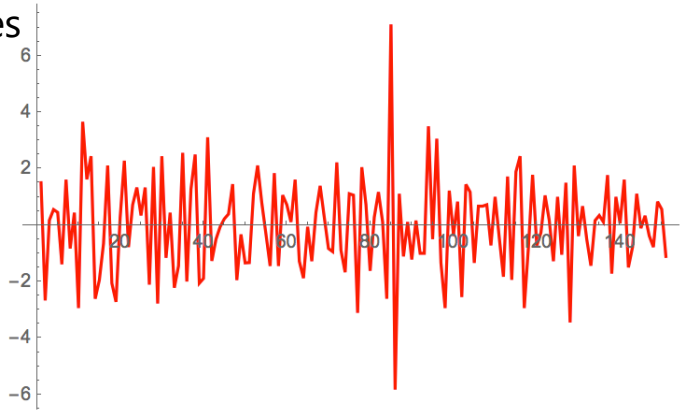
Differencing

- Difference also eliminates trend
- Discrete derivative



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Other Transformations

- Scaling/Normalization
- Standardization
- Logarithm
- Cubic Root

- y = (x - min) / (max - min)
- y = (x - μ) / σ
- Log(x)
- $\sqrt[3]{x}$

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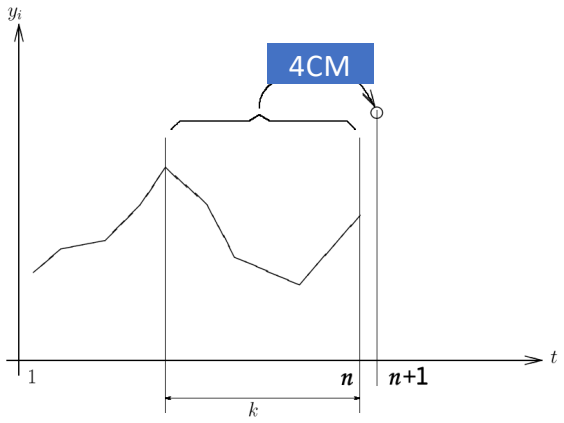
Forecasting Models

- Based on the TS history
- Determine the value at the next time instant



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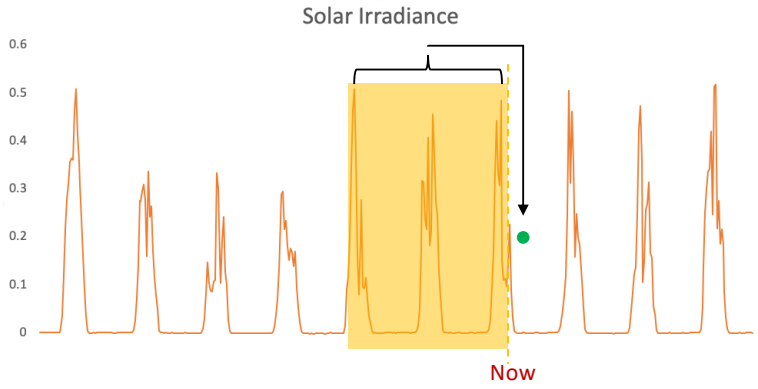
TS Forecasting

- Based on TS history
- Determine y_{n+1}



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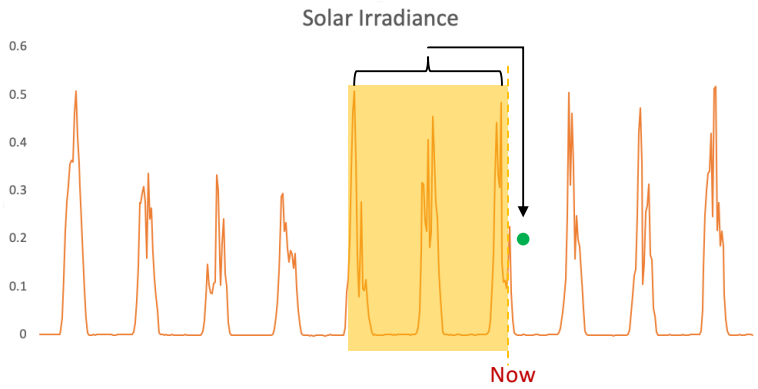
TS Forecasting

- OSA – One Step Ahead Forecasting
- Determine $<y_{n+1}, y_{n+2}, \dots, y_{n+k}>$
- One at a time



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TS Forecasting

- OSA – One Step Ahead Forecasting
- Determine $<y_{n+1}, y_{n+2}, \dots, y_{n+k}>$
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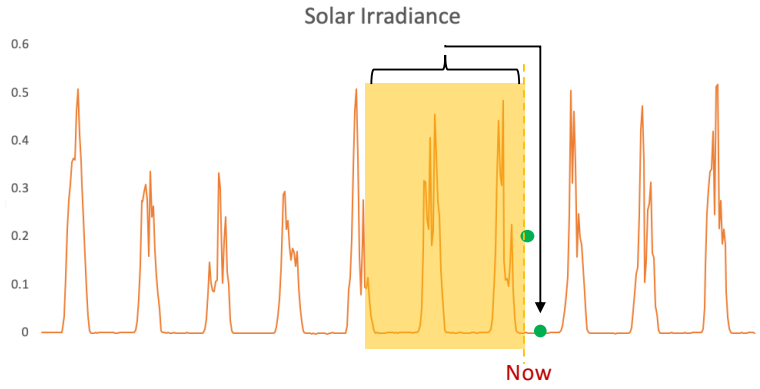

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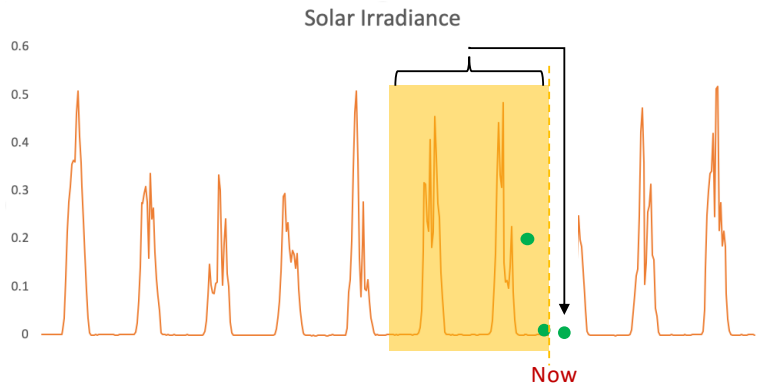
TS Forecasting

- OSA – One Step Ahead Forecasting
- Determine $<y_{n+1}, y_{n+2}, \dots, y_{n+k}>$
- One at a time



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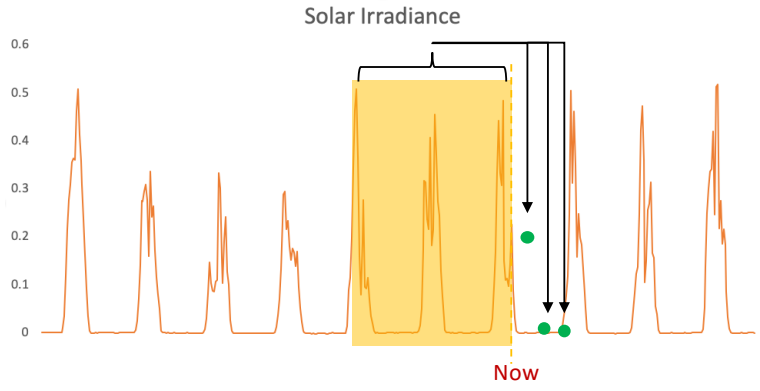
TS Forecasting

- MSS – Multiple Step Simultaneous
- Determine Determine <y_{n+1}, y_{n+2}, … , y_{n+k}>
- Simultaneously



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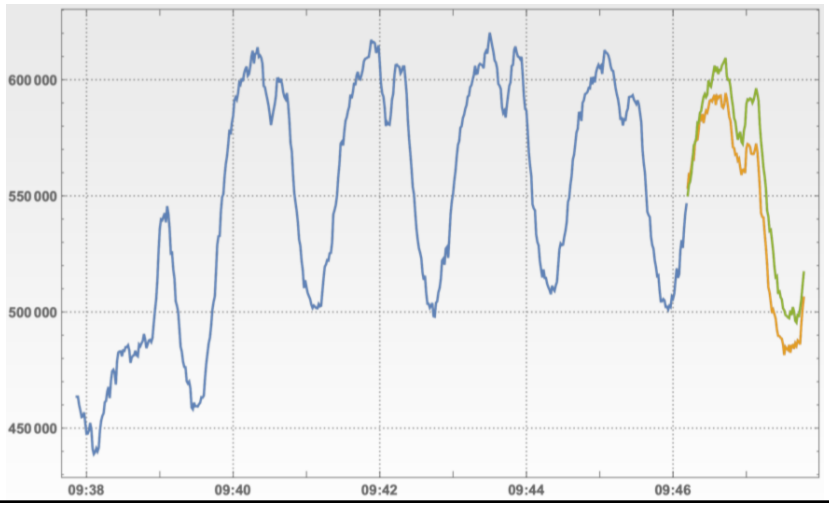
Point Forecasting



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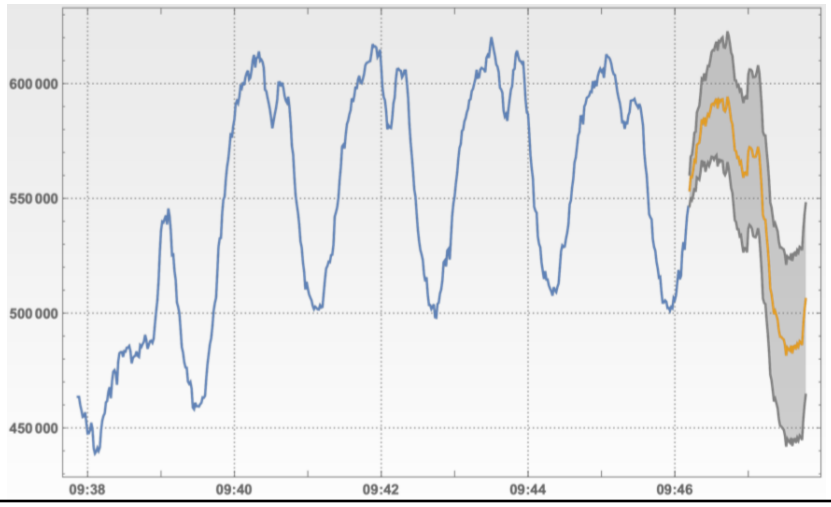
Interval Forecasting



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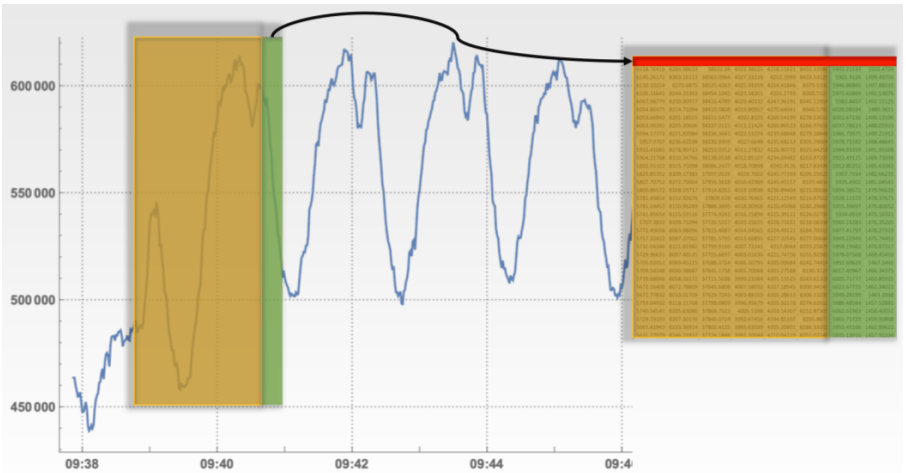
TS to DB



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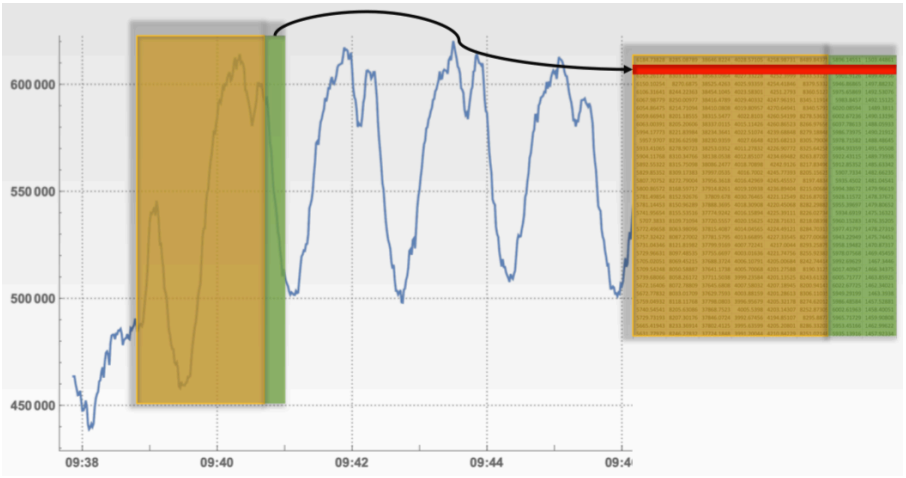
TS to DB



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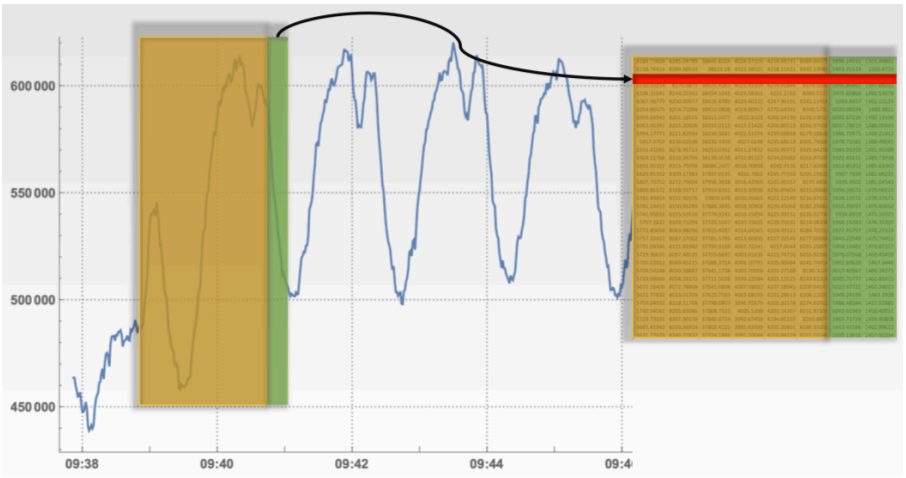
TS to DB



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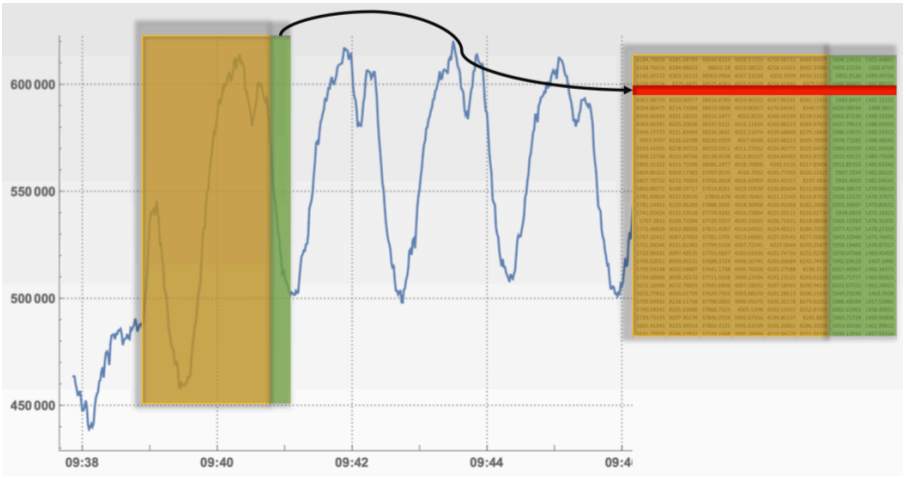
TS to DB



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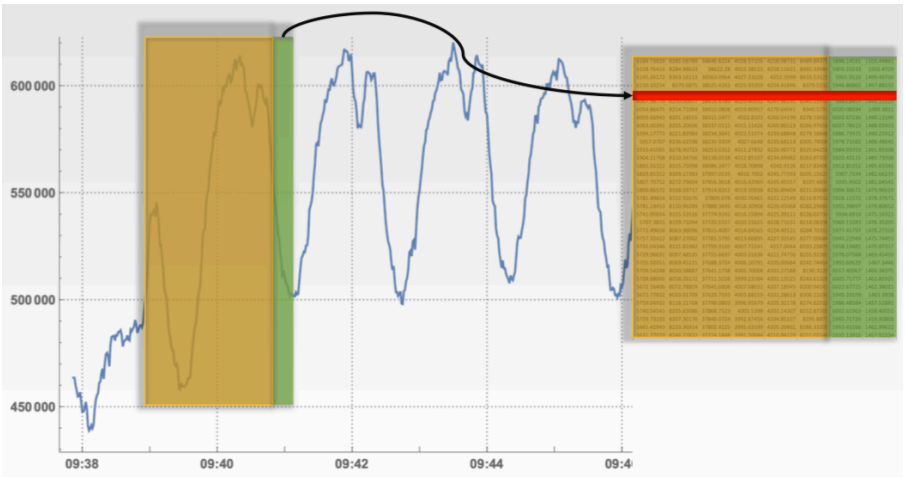
TS to DB



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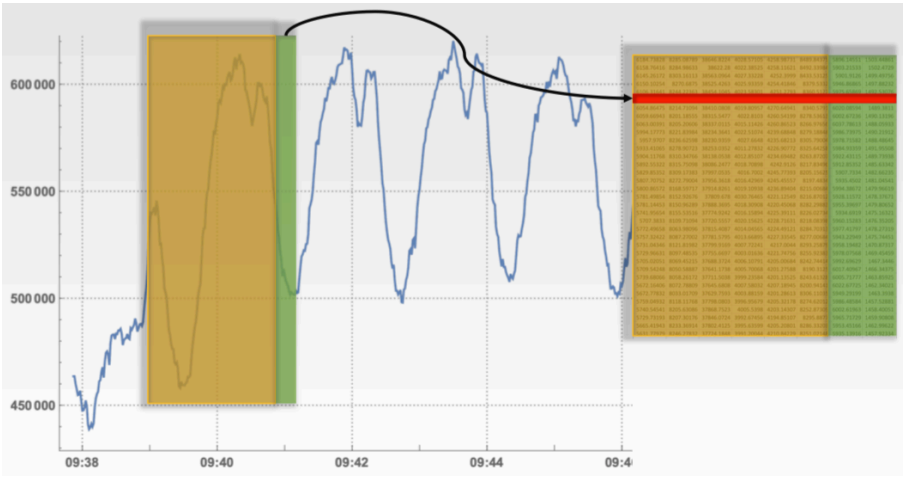
TS to DB



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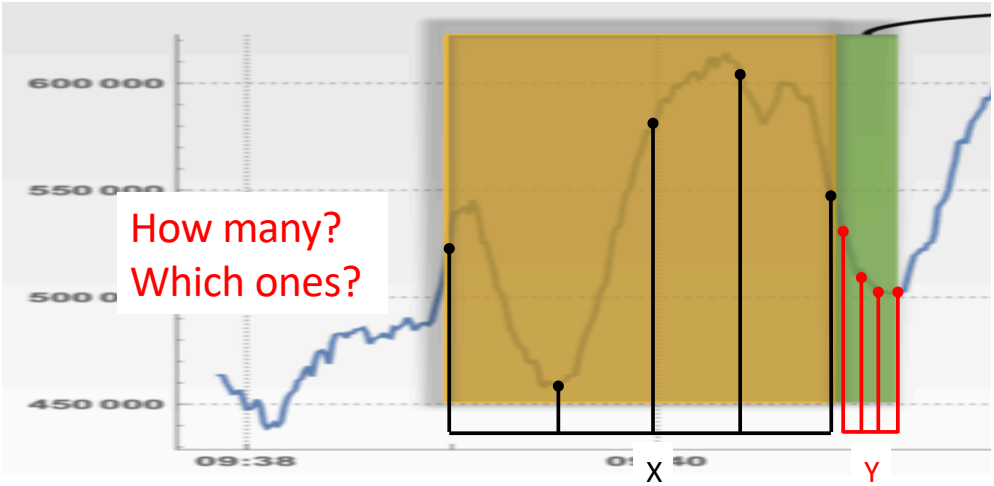
TS to DB



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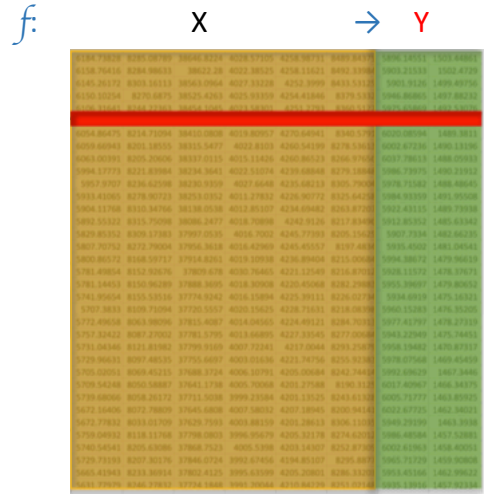
TS to DB

- Design Matrix
- Maps Forecasting to Regression
- Eliminates time (sequentiality)
- Shuffle records
- Be careful when splitting Training and Test sets



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Error

$$\text{MSE} = \frac{1}{n}\sum_{i=1}^{n}(Y_i - \hat{Y}_i)^2$$

$$\text{MAPE} = \frac{1}{n}\sum_{t=1}^{n}\left|\frac{A_t - F_t}{A_t}\right|$$

$$\text{SMAPE} = \frac{100\%}{n}\sum_{t=1}^{n}\frac{|F_t - A_t|}{|A_t| + |F_t|}$$

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