Impact of Environmental Factors

on Acute Myocardial Infarction

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UNIVERSITAT DE BARCELONA

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  - Long Short-Term Memory (LSTM)
- Applied to hospital admission data from 2010 to 2018, stratified by province, sex, and age.

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- **Response variable:** Age Standardised Incidence Rate (ASIR)
- A total of **5** predictors - Humidity, Temperature, Ozone levels, Particulate Matter, Public holidays

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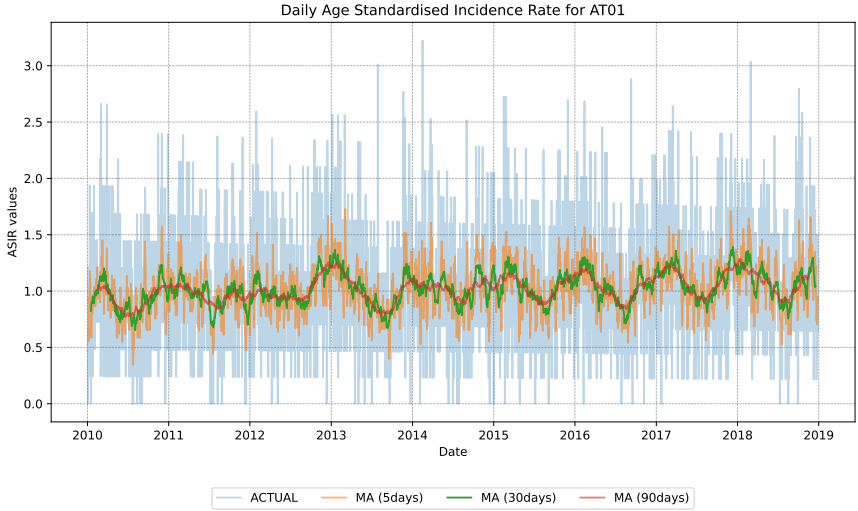
- Adjusts for age as a confounding factor, providing a more accurate representation of AMI incidence.
- Allows comparisons between regions or over time periods.

Target Variable - ASIR



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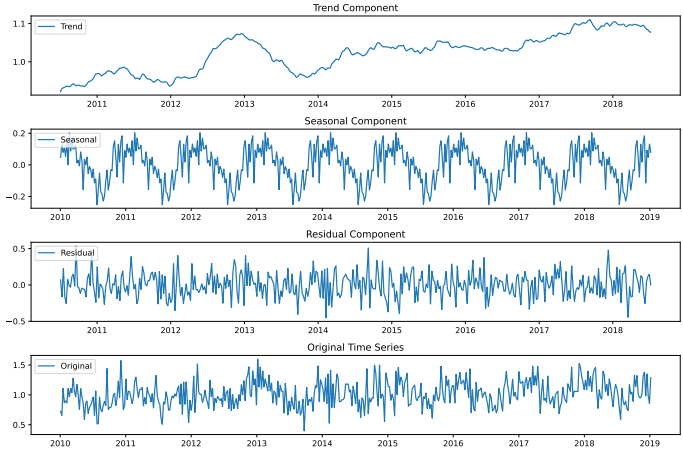

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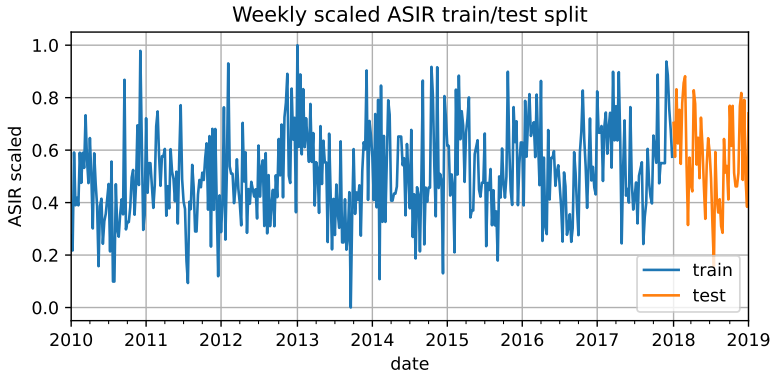

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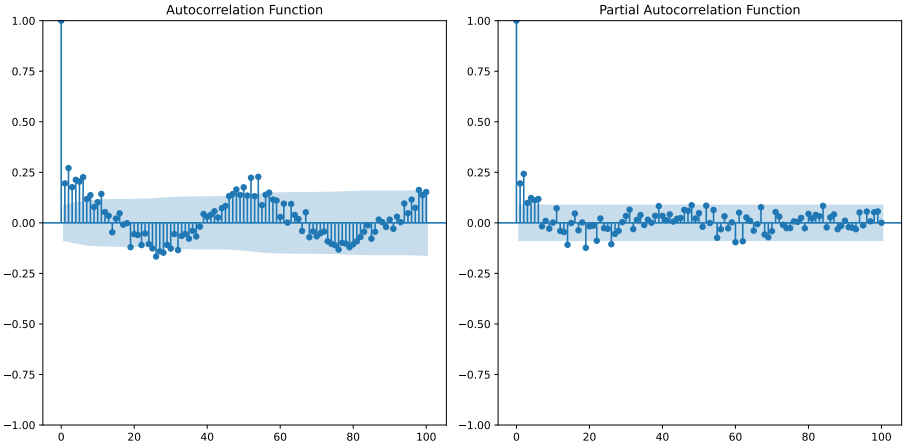

SARIMAX

SARIMAX model can be represented as:

$$Y_t = \beta X_t + \epsilon_t$$

- Y_t is the observed ASIR at time t,
- X_t represents the vector of exogenous variables at time t,
- β is the vector of coefficients for the exogenous variables,
- ϵ_t is the error term following a stationary ARIMA process.

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By integrating both temporal and environmental variables, it enables more robust forecasting, taking into consideration seasonality

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- The LSTM cell has a memory cell and three gates: input gate, forget gate, and output gate
- LSTM networks are capable of learning long-term dependencies in sequential data, making them suitable for time series forecasting tasks.
- can capture complex patterns and relationships to forecast future ASIR.

Hyperparameter optimization

SARIMAX Model Optimization:

- Utilized grid search over a range of parameters (p, d, q, P, D, Q, s).
- Evaluated using time series cross-validation (TimeSeriesSplit).
- Identified best parameters:
  - $\mathbf{p = 1}$, $\mathbf{d = 0}$, $\mathbf{q = 1}$
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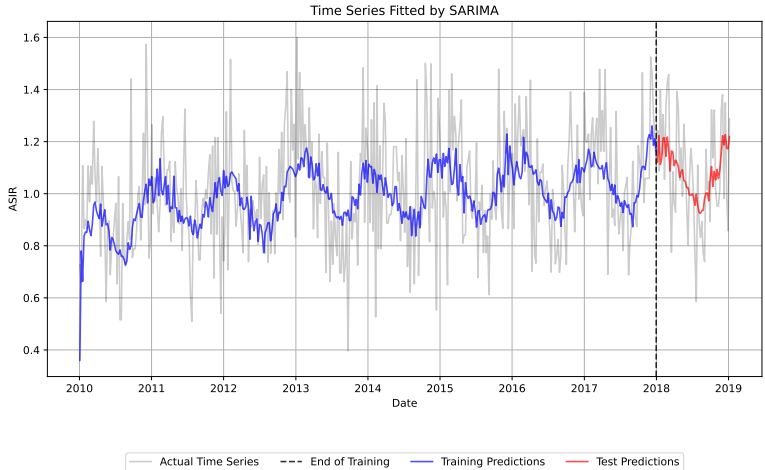
LSTM Model Optimization:

- Conducted random search over the search space for hyperparameters.
- Executed multiple trials with different configurations.
- Best hyperparameters:

  Units: **150**
  Activation: **ReLU**
  Dropout: **0.2**
  Number of layers: **1**
  LSTM layer 0 units: **150**
  Optimizer: **Adam**
  LSTM layer 1 units: **150**

Results - SARIMAX



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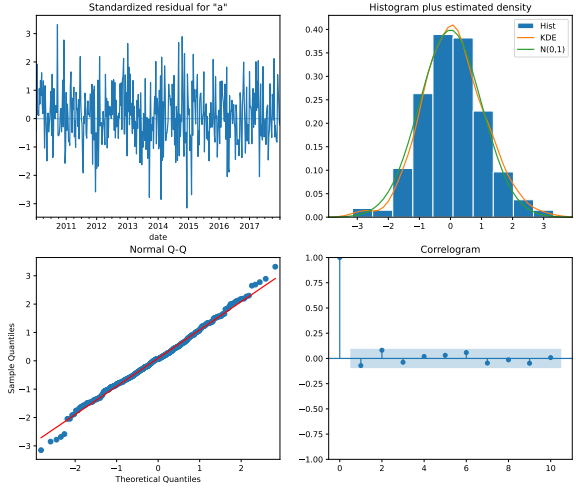
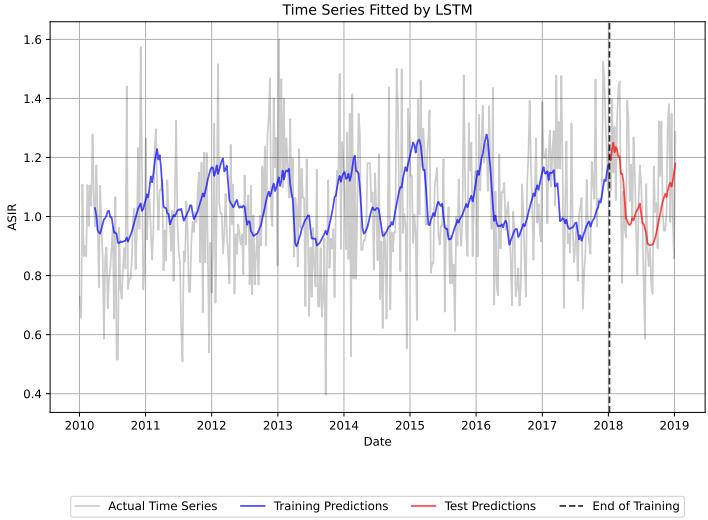
- Mean PM10 concentration (`mean_PM10`): An increase of 1 $\mu g/m^3$ in mean PM10 concentration is associated with an increase of approximately 0.146 units in ASIR of AMI.

Diagnostics - SARIMAX



Results - LSTM



Comparison

Table 1: Results

	SARIMAX	LSTM
MAE	**0.12**	0.15
MSE	**0.02**	0.03
RMSE	**0.15**	0.19
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- SARIMAX outperforms LSTM in terms of both MAE and MSE, making it a more suitable choice for this forecasting task.
- However, the LSTM model exhibits substantially lower AIC and BIC values compared to SARIMAX, indicating a potentially better fit to the data and superior long-term forecasting capabilities

Thank you for your attention