

Impact of Environmental Factors

on Acute Myocardial Infarction

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- Implementation and comparison of models for series prediction.
 - Seasonal Autoregressive Integrated Moving Average (SARIMAX)
 - Long Short-Term Memory (LSTM)
- Applied to hospital admission data from 2010 to 2018, stratified by province, sex, and age.

Dataset & Data Preparation

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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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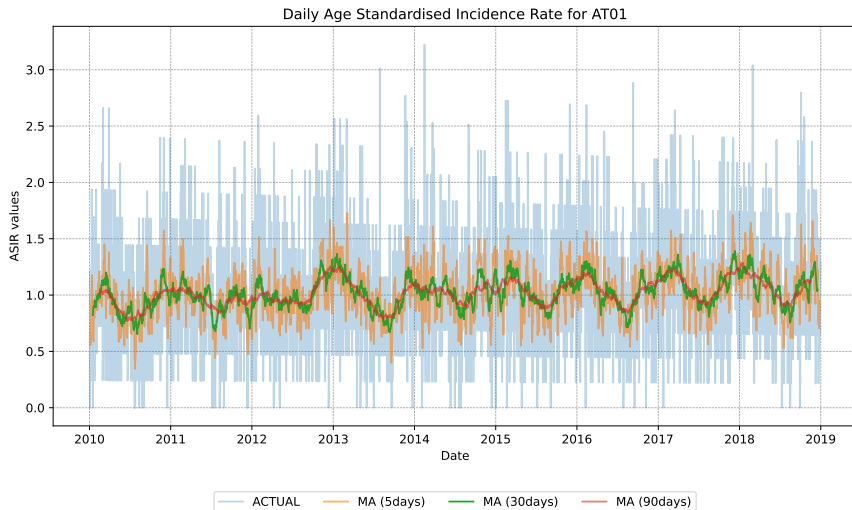
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- Allows comparisons between regions or over time periods.

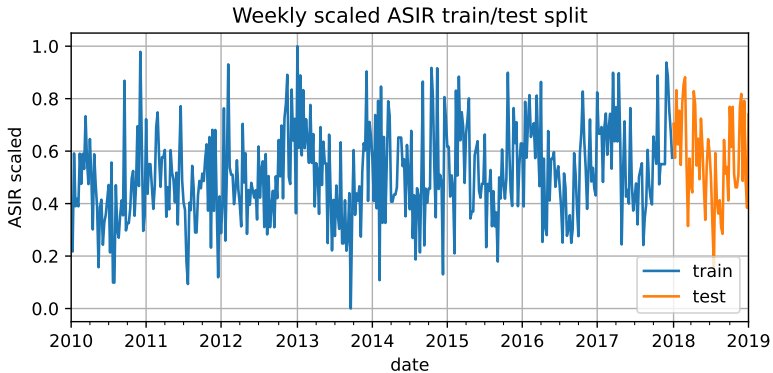
Target Variable - ASIR



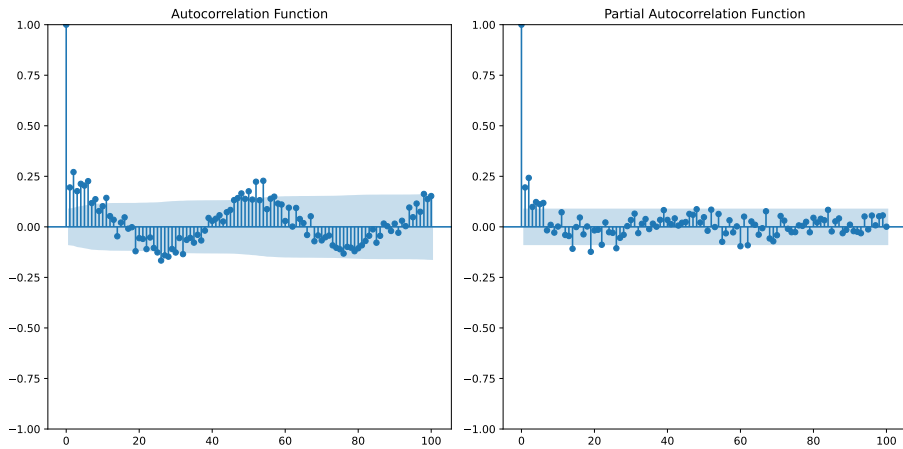
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SARIMAX

SARIMAX model can be represented as:

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

- Y_t is the observed ASIR at time t ,
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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:
 - $p = 1$, $d = 0$, $q = 1$
 - $P = 1$, $D = 1$, $Q = 1$, $s = 52$

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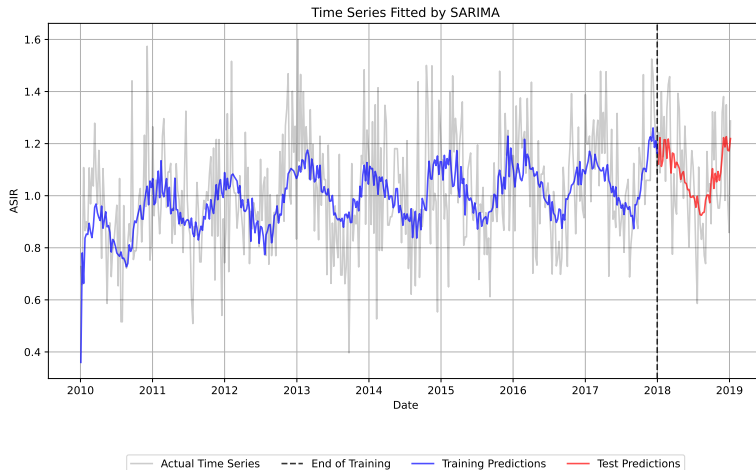
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LSTM Model Optimization:

- 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



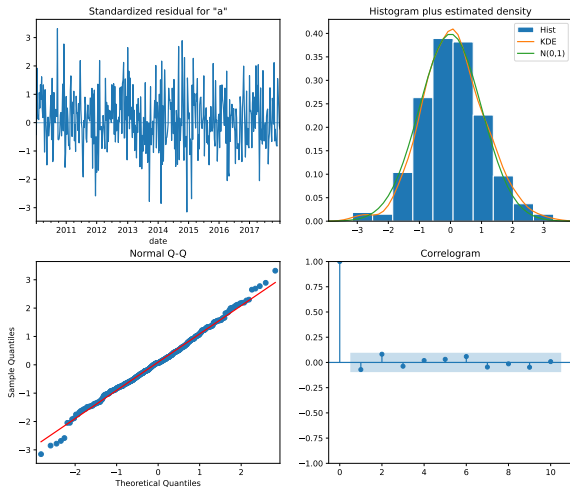
Results - SARIMAX

- Maximum temperature (`max_temp`): A decrease of 1°C in maximum temperature is associated with a decrease of approximately 0.345 units in the Age-Standardized Incidence Rate (ASIR) of AMI.

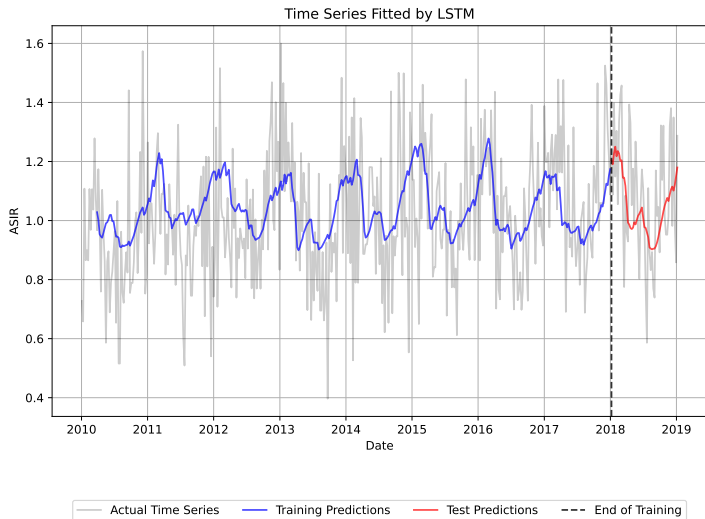
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- Maximum temperature (`max_temp`): A decrease of 1°C in maximum temperature is associated with a decrease of approximately 0.345 units in the Age-Standardized Incidence Rate (ASIR) of AMI.
- Mean PM10 concentration (`mean_PM10`): An increase of $1\ \mu\text{g}/\text{m}^3$ 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 |
| MAPE | 26.60 | 14.53 |
| AIC | -327.86 | 909872.17 |
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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