**Multi-variate time series forecasting**

[**https://towardsdatascience.com/multivariate-time-series-forecasting-with-deep-learning-3e7b3e2d2bcf**](https://towardsdatascience.com/multivariate-time-series-forecasting-with-deep-learning-3e7b3e2d2bcf)

“In other scenarios, such as predicting sales, the data can potentially be erroneous, e.g. if holidays are not accounted for. The model would falsely predict low sales and the resulting large error would wrongfully be penalized during training.” 🡪 this is an issue with our data as there are days which don’t fit with the general pattern (e.g. Xmas)

<https://towardsdatascience.com/how-not-to-use-machine-learning-for-time-series-forecasting-avoiding-the-pitfalls-19f9d7adf424>

Time component often makes problems more difficult to handle. Time series data tends to be correlated in time, and exhibit a significant autocorrelation.

LSTM network is popular, but simple models are often just as good e.g. random forest, XGBoost and time delay neural networks. In these, temporal information can be included through a set of delays that are added to the input, so that the data is represented at different points in time.

Time series data differs from other types of data, in that the temporal aspect is important. This gives us additional information that can be used when building our machine learning model

Stationary time series – one where statistical properties such as mean, variance and autocorrelation are constant over time.

Be VERY CAREFUL when evaluating model performance in terms of prediction accuracy.

<https://www.linkedin.com/pulse/how-use-machine-learning-time-series-forecasting-vegard-flovik-phd-1f/>

Granger causality test.

<https://machinelearningmastery.com/arima-for-time-series-forecasting-with-python/>

**ARIMA model.** Autoregressive Integrated Moving Average:

* Autoregressive: a model that uses the dependent relationship between an observation and some number of lagged observations (a time series model that uses observations from previous time steps as an input to the regression equation to predict the value at the next time step)
* Integrated: the use of differencing of raw observations (e.g. subtracting an observation from an observation at the previous time step) in order to make the time series stationary
* Moving average: a model that uses the dependency between an observation and a residual error from a moving average model applied to lagged observations.