ROSSMANN Store Sales Challenge

Time Series Analysis for Sales Forecast

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neuefische Capstone Project - Gesellenstück

Project Overview

- Rossmann operates over 4,000 drug stores in 8 European countries
- Store managers are tasked with predicting their daily sales for up to six weeks in advance
- Store sales are influenced by many factors: promotion, holidays, seasonality…

This project aims to accurately predict sales for the upcoming six weeks

Data Description

Rossmann provided 3 raw data-sets

- train.csv:
  - historical data including ‘sales’
  - timeframe: January 1, 2013 - July 31, 2015
- test.csv:
  - historical data excluding ‘sales’
  - timeframe: August 1, 2015 - September 17, 2015
- store.csv:
  - supplemental information about 1,115 stores

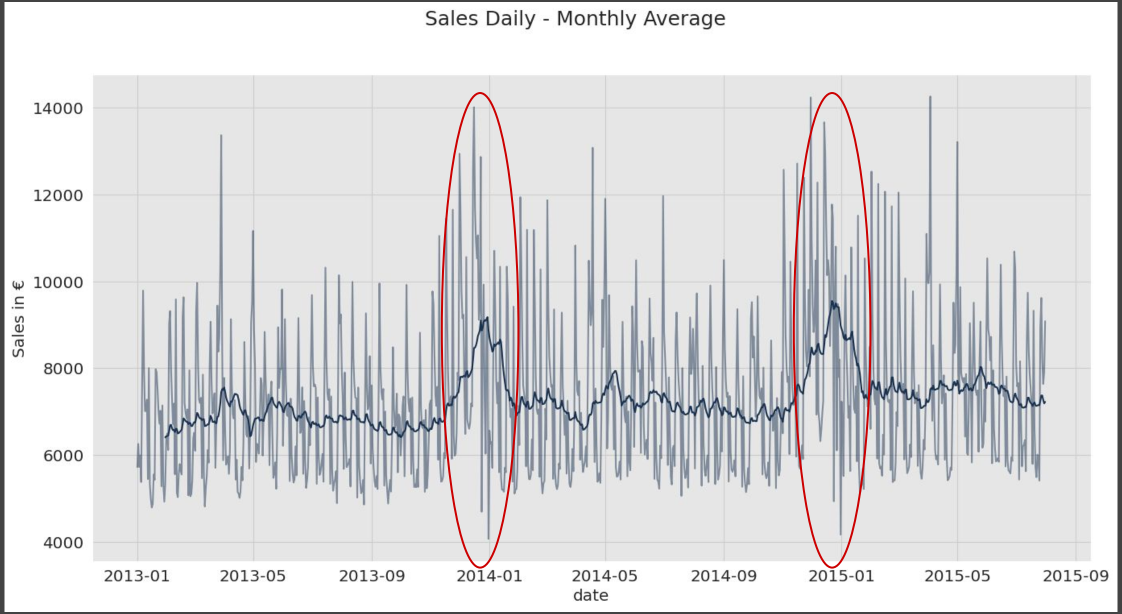
Evaluation Metric

- Sales forecast for six-weeks
  - target timeframe in test.csv excludes ‘sales’, not possible to train on test-dataset
- Evaluation being done by minimizing the Root Mean Square Percentage Error - *RMSPE*

$$RMSPE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(\frac{y_i - \hat{y}_i}{y_i}\right)^2}$$

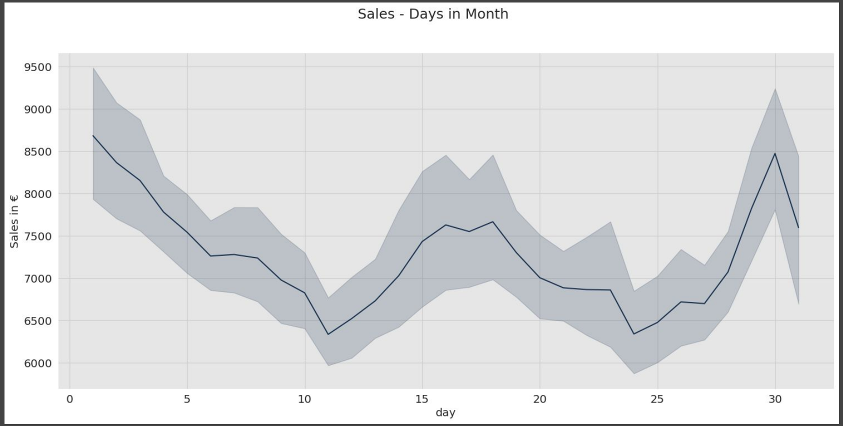
Visualisation of daily sales over three years

Sales increases by the end of each year (Christmas sales) followed by a steep decline before normalizing

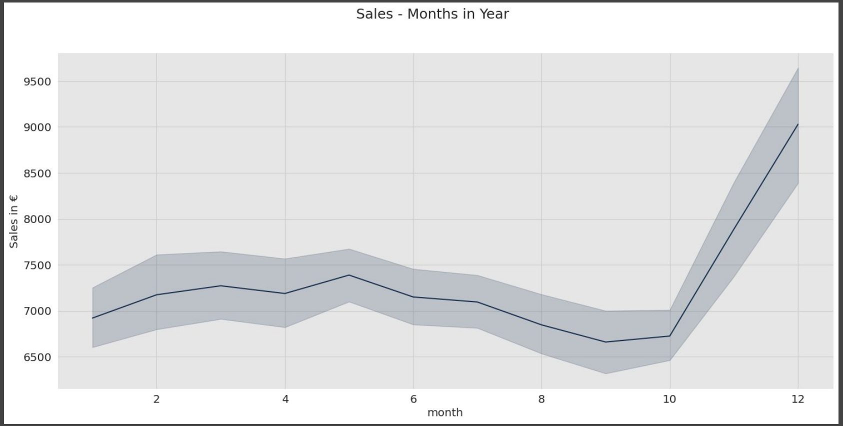


Visualisation of sales over a time period

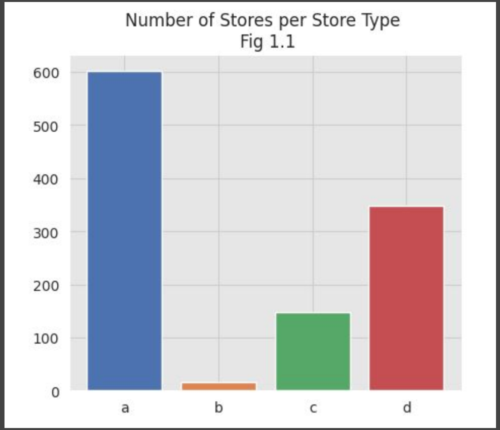
Daily sales over a month:



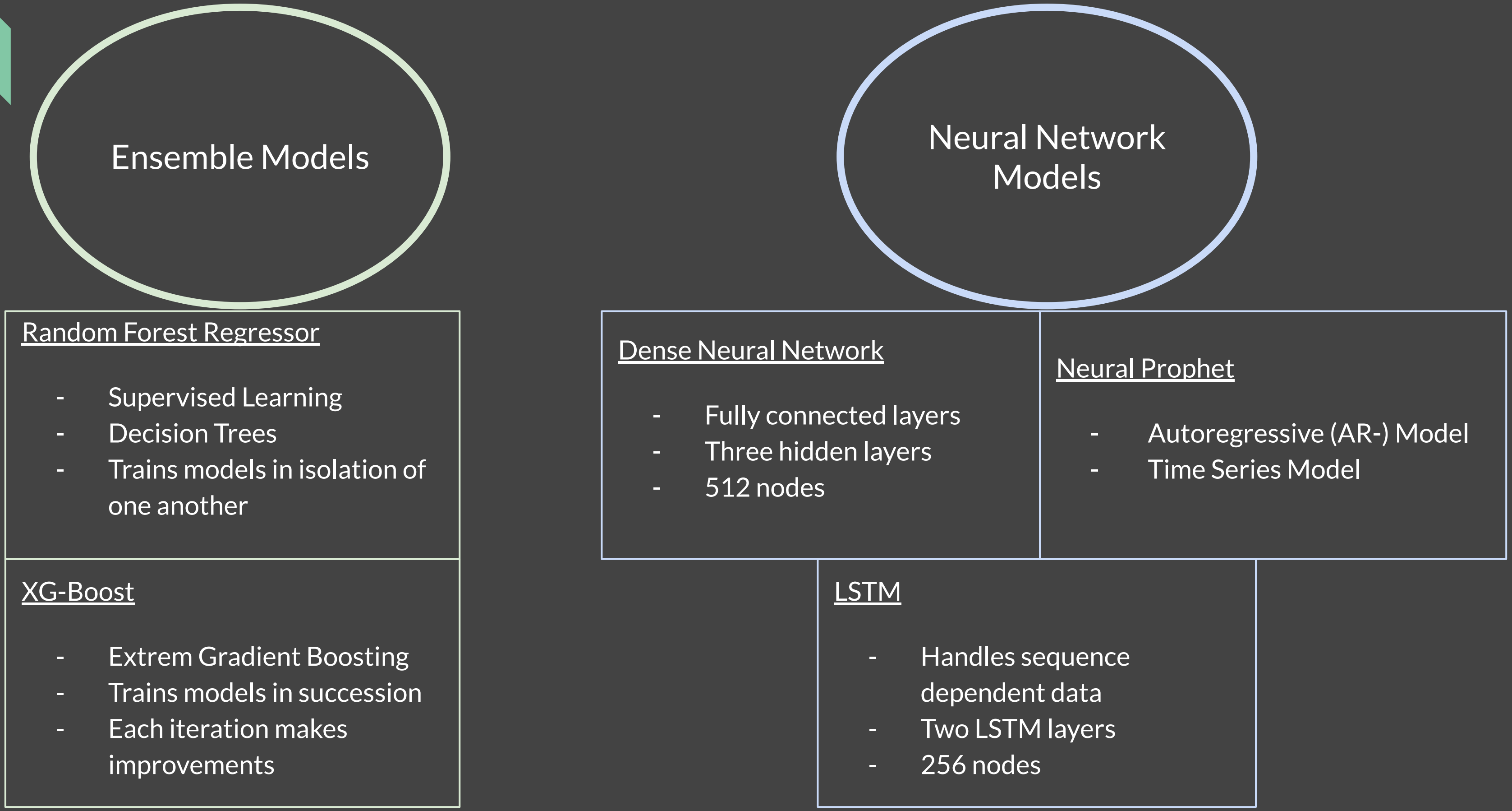
Monthly sales over a year:



EDA Results


Number of Stores per Store Type
Fig 1.1
600
500
400
300
200
100
0
a
b
c
d

Our Predictive Models



Ensemble Models

Random Forest Regressor

- Supervised Learning
- Decision Trees
- Trains models in isolation of one another

XG-Boost

- Extrem Gradient Boosting
- Trains models in succession
- Each iteration makes improvements

Neural Network Models

Dense Neural Network

- Fully connected layers
- Three hidden layers
- 512 nodes

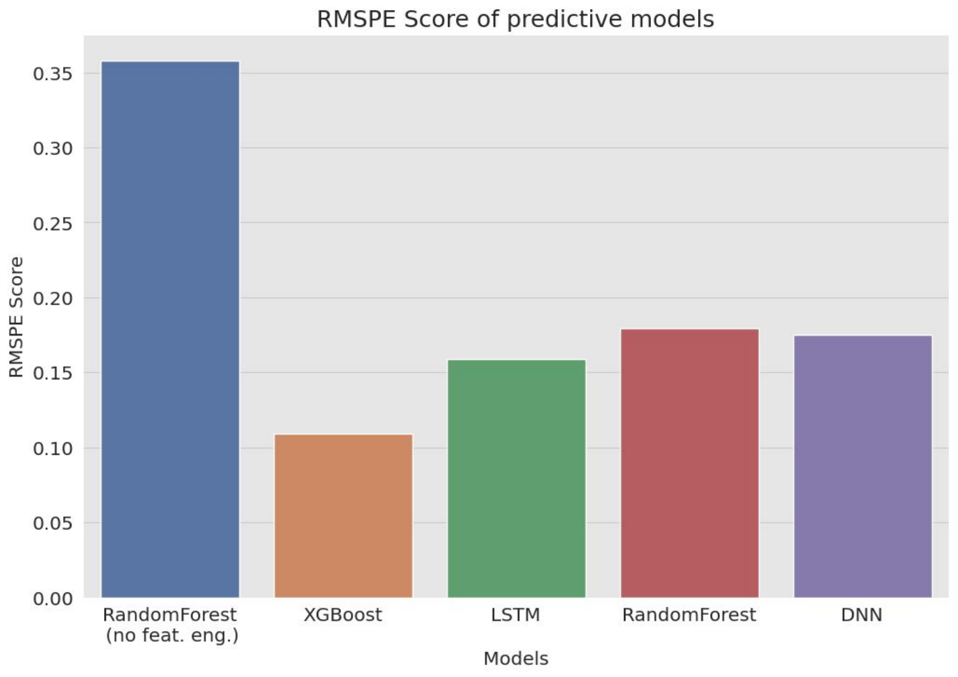
Neural Prophet

- Autoregressive (AR-) Model
- Time Series Model

LSTM

- Handles sequence dependent data
- Two LSTM layers
- 256 nodes

Predictive Model Results



Models	RMSPE Score	Train Duration
RFR (no feat. eng.)	0.357	< 3 min
XGBoost	0.109	~ 6 hours
LSTM	0.159	~ 8 hours (GPU)
RFR	0.179	< 3 min
DNN	0.175	~ 45 min (GPU)

Summary

- Out of over 3000 participants, we achieved 12th place with our best score
- RMSPE: 10.9% = by implication our predictions are 89,1% accurate
- Result could have been improved with external data (e.g. weather, geographical)
- Ensemble models outperform other methods
- Neural networks are robust estimators but have high cost

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