Goal and motivation:

I hope this correspondence reaches you in good health. My name is Muzammil Mushtaq, I am currently pursuing a degree in Data Science while gaining valuable experience through a two-year part-time position at KFC. I am reaching out to you to share a comprehensive report on my sales forecast analysis for KFC.

Driven by my passion for data analysis, science and machine learning, I started this project to showcase my skills and suggest improvements that could optimize the daily sales forecasting process. My goal is to contribute to KFC's overall performance and profit margins.

Target:

The main objective of this analysis was to predict and understand KFC's sales patterns. By using machine learning techniques, I wanted to provide actionable insights to optimize sales strategies and contribute to the overall success of the store.

Daily sales forecast report for KFC
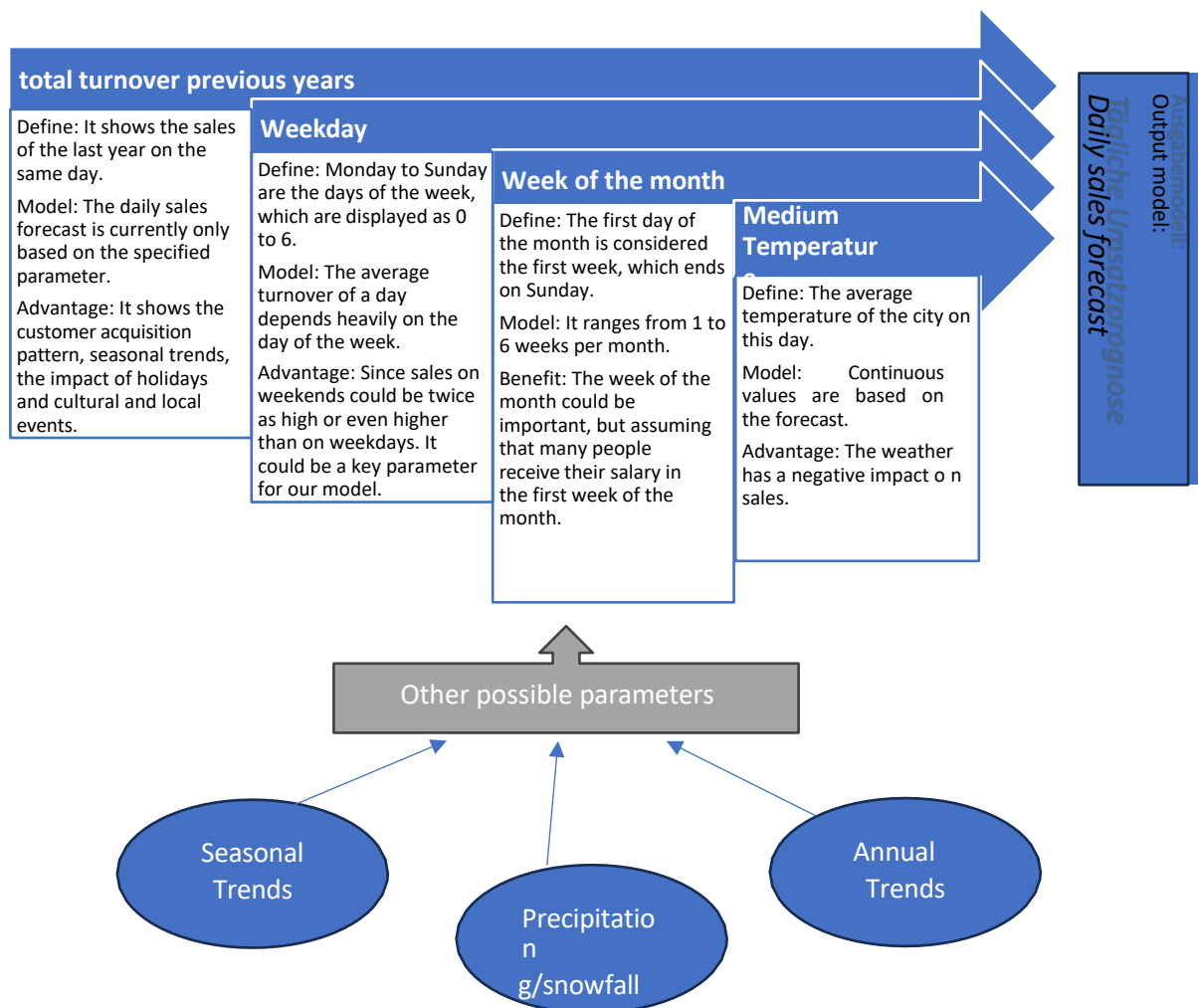
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Data procurement:

I have collected and analyzed historical sales data based on the daily "Forecast" reports published by KFC's store managers at the end of each day. Currently, access to sales data is limited to the period from June to September 2023 and the first 20 days of December 2023. My focus is on predicting daily sales based on "sales previous years total", taking into account various factors such as the day of the week, the week of the month, seasonal trends and external influences such as weather conditions.

Methodology:

Model development:

I applied machine learning algorithms such as linear regression and random forest to train the model using historical sales data to predict future daily sales. To ensure the effectiveness of the model, I incorporated historical sales data considering weekly and monthly fluctuations. The following are the input parameters that were used for the machine learning model. However, due to the limited data set, I could not include any other factors as mentioned below.

total turnover previous years

Define: It shows the sales of the last year on the same day.

Model: The daily sales forecast is currently only based on the specified parameter.

Advantage: It shows the customer acquisition pattern, seasonal trends, the impact of holidays and cultural and local events.

Weekday

Define: Monday to Sunday are the days of the week, which are displayed as 0 to 6.

Model: The average turnover of a day depends heavily on the day of the week.

Advantage: Since sales on weekends could be twice as high or even higher than on weekdays. It could be a key parameter for our model.

Week of the month

Define: The first day of the month is considered the first week, which ends on Sunday.

Model: It ranges from 1 to 6 weeks per month.

Benefit: The week of the month could be important, but assuming that many people receive their salary in the first week of the month.

Medium Temperatur e

Define: The average temperature of the city on this day.

Model: Continuous values are based on the forecast.

Advantage: The weather has a negative impact o n sales.

Ausgabemodell: Output model:
Tägliche Umsatzprognose
Daily sales forecast

Other possible parameters

Seasonal Trends

Precipitatio n g/snowfall

Annual Trends

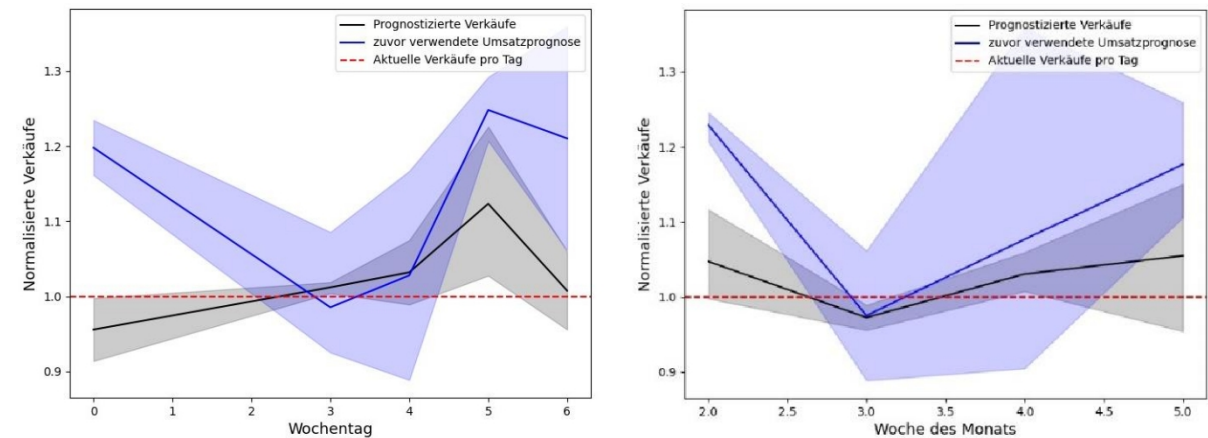# Daily sales forecast report for KFC

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Key findings:

Currently, all KFC stores rely solely on "previous year's sales" for sales forecasting. However, in this study, I expanded the scope by including three additional parameters: "Day of the week", "Week of the month" and "Mean temperature". With a dataset of 120 daily sales records, I used machine learning by randomly splitting the dataset into training data (90% of the total data) and test data (10% of the total data). The algorithms used delivered remarkable results.

	Forecasted sales	previously used Sales forecast
Correlation	73%	72%
Mean absolute error	270 Euro	350 Euro

Table 1 shows a comparison of the correlation and mean absolute error between my daily sales forecast model and the previously used forecast model. The analysis shows a 22% reduction in the variance between the daily sales forecasts of my model compared to the previous model. It is important to note that even a small improvement in sales forecasting can have a significant impact on the overall business model, especially when optimizing the "total hours" management, which ultimately increases the productivity of the business.

I firmly believe that the accuracy of the sales forecast model can be further improved by extending the data set and introducing additional relevant parameters. The following figure shows the normalized sales against the independent parameters in the test dataset. Normalization helps to assess the authenticity of the model, with values close to 1 indicating higher reliability. Compared to the previous model, my model shows a significant decrease in sales deviation for all independent parameters, on average only 5%, compared to the previous 15%.

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SHAP proves to be an extremely effective tool for capturing and fine-tuning models, providing detailed insights into the contribution of each model feature (independent parameter) to the prediction process.
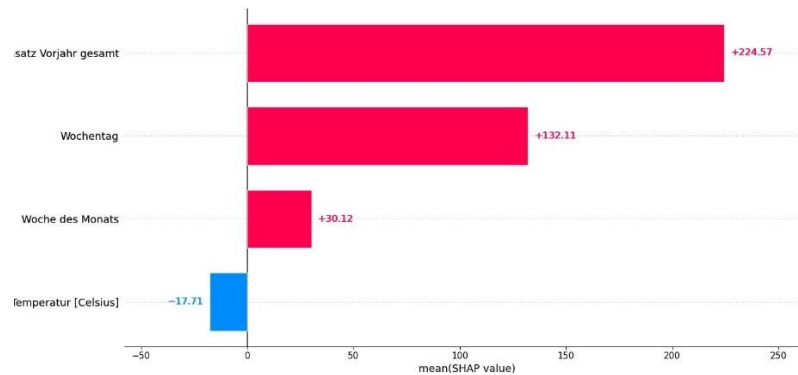
The bar chart above effectively highlights the most important features. For each characteristic, we calculate the mean SHAP value across all observations, which represents a consolidated score. Each characteristic is represented by a single bar; for example, "previous year's sales" has the highest mean SHAP score.

Characteristics that have significant positive or negative effects are characterized by larger mean SHAP values. For example, "Weekday" (day of the week) significantly influences the model's predictions. In addition, "Mean temperature" has a negative impact, indicating that higher temperatures in the city lead to lower sales. Consequently, this chart serves a similar purpose to a feature weighting chart, helping to understand the relative importance of each feature to the model's predictions.

Conclusion:

I work part-time at KFC in Heidelberg, Germany, while studying Data Science with a great passion for getting insights from data. In this short report, I would like to highlight key insights on daily sales forecasting at KFC Heidelberg. Using machine learning algorithms, I analyzed crucial factors such as "previous year's sales", "day of the week", "average temperature" and "week of the month" to evaluate their influence on daily sales. The results show that my model outperforms the current method used by KFC and shows an improvement of 22%. This machine learning model not only increases labor performance, but also enables better prediction of "total hours", which increases store productivity.