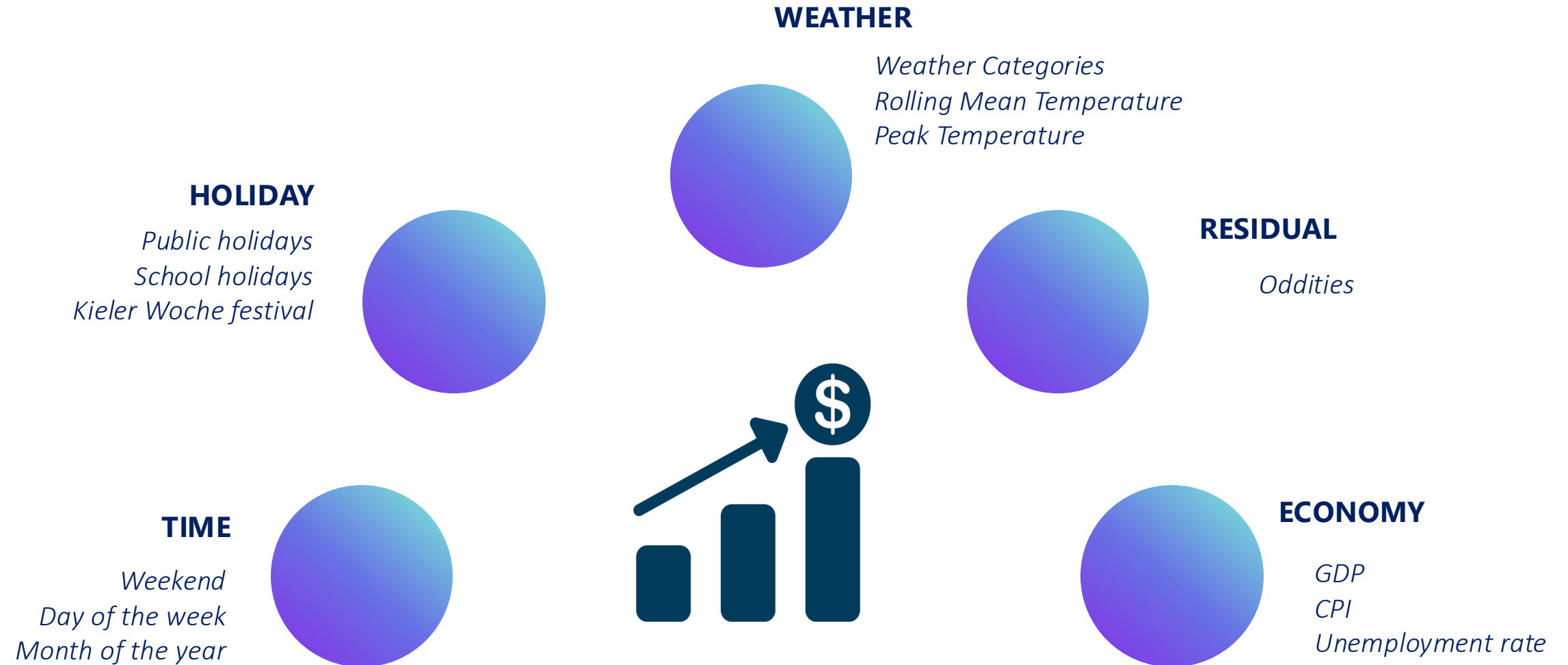


PROJECT REPORT

Bakery sales prediction

*Matthias Faust
Ngoc Linh Nguyen
Thorsten Köhler*

VARIABLES by group



Weather features



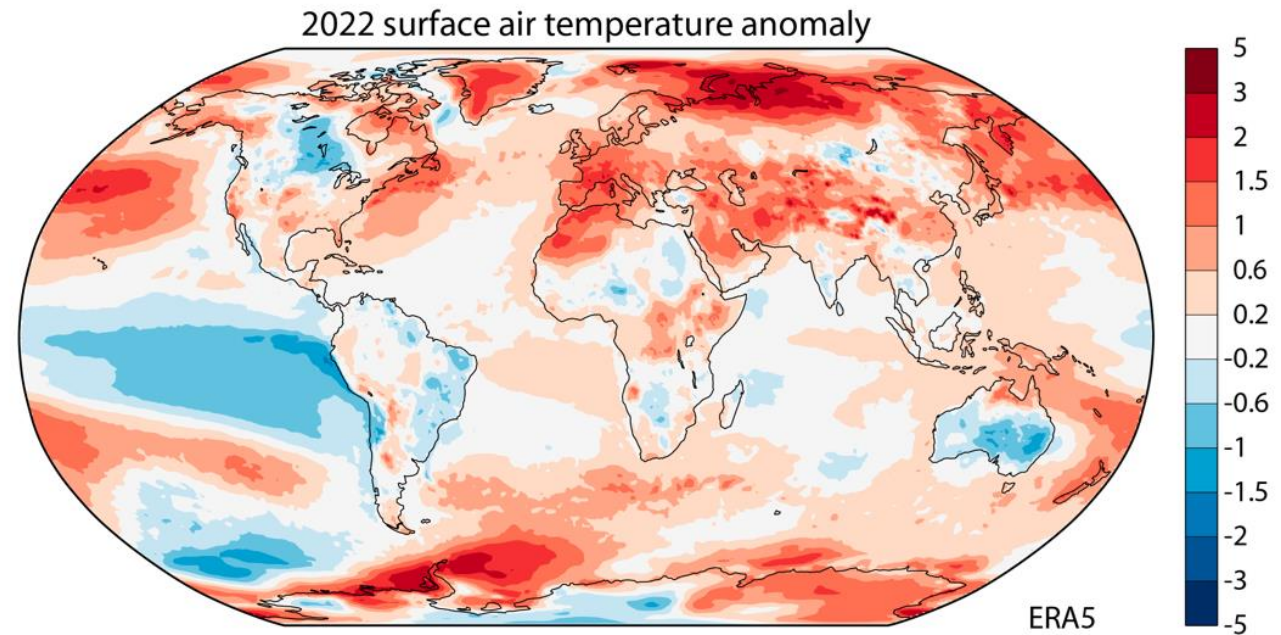
Varname	Original variable	Description
Weather_category	Wettercode (Weather code)	Rain, After rain, Showers & Thunderstorms, Snow & Ice, Fog, Others
Temperature_class	Temperatur (Temperature)	Cold, Cool, Mild, Warm, Unknown
Cloud_class	Bewoelkung (Cloud cover)	Sunny, Cloudy, Unknown
Wind_class	Windgeschwindigkeit (Wind speed)	Breeze, Wind, Storm, Unknown
Temperatur		Temperature
Rolling_temp_mean		Mean temperature of the last 5 Days
Temperature above/below mean		Significant difference to the rolling temp mean



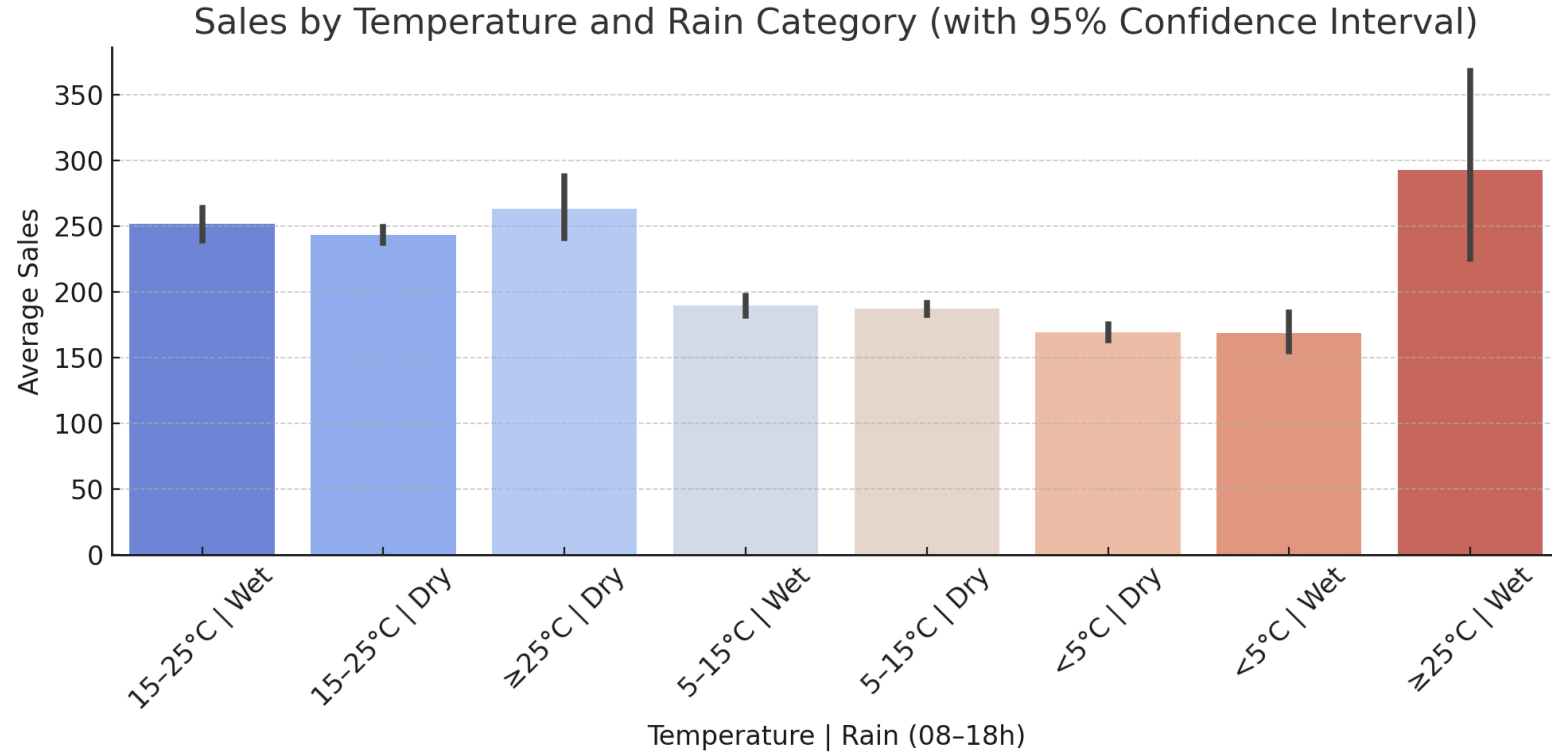
MISSING VALUE IMPUTATION

ERA5 Reanalysis Data

- Simulation of the past weather, prompted by measurements
- Data openly available from 1940 to present
- Hourly time resolution

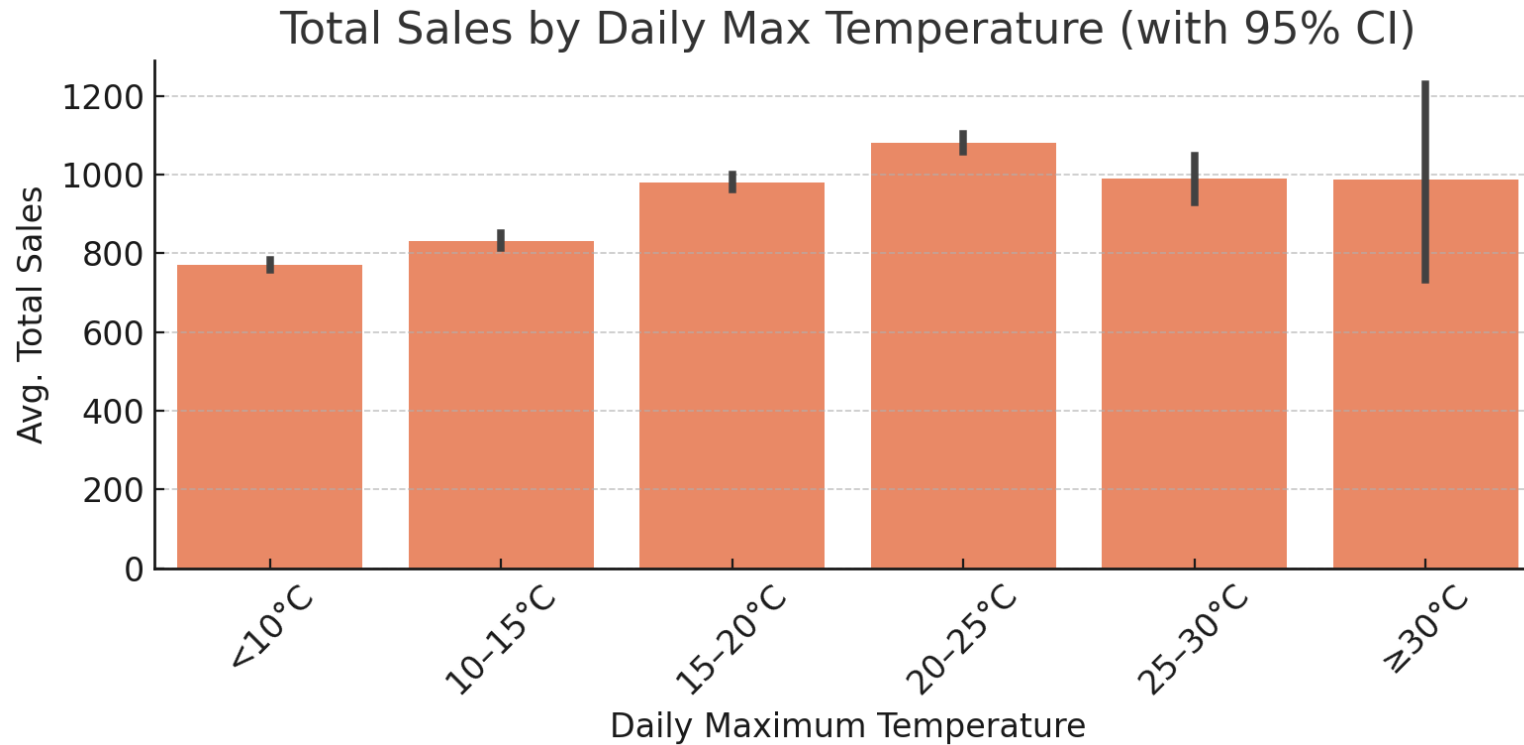


Weather variable



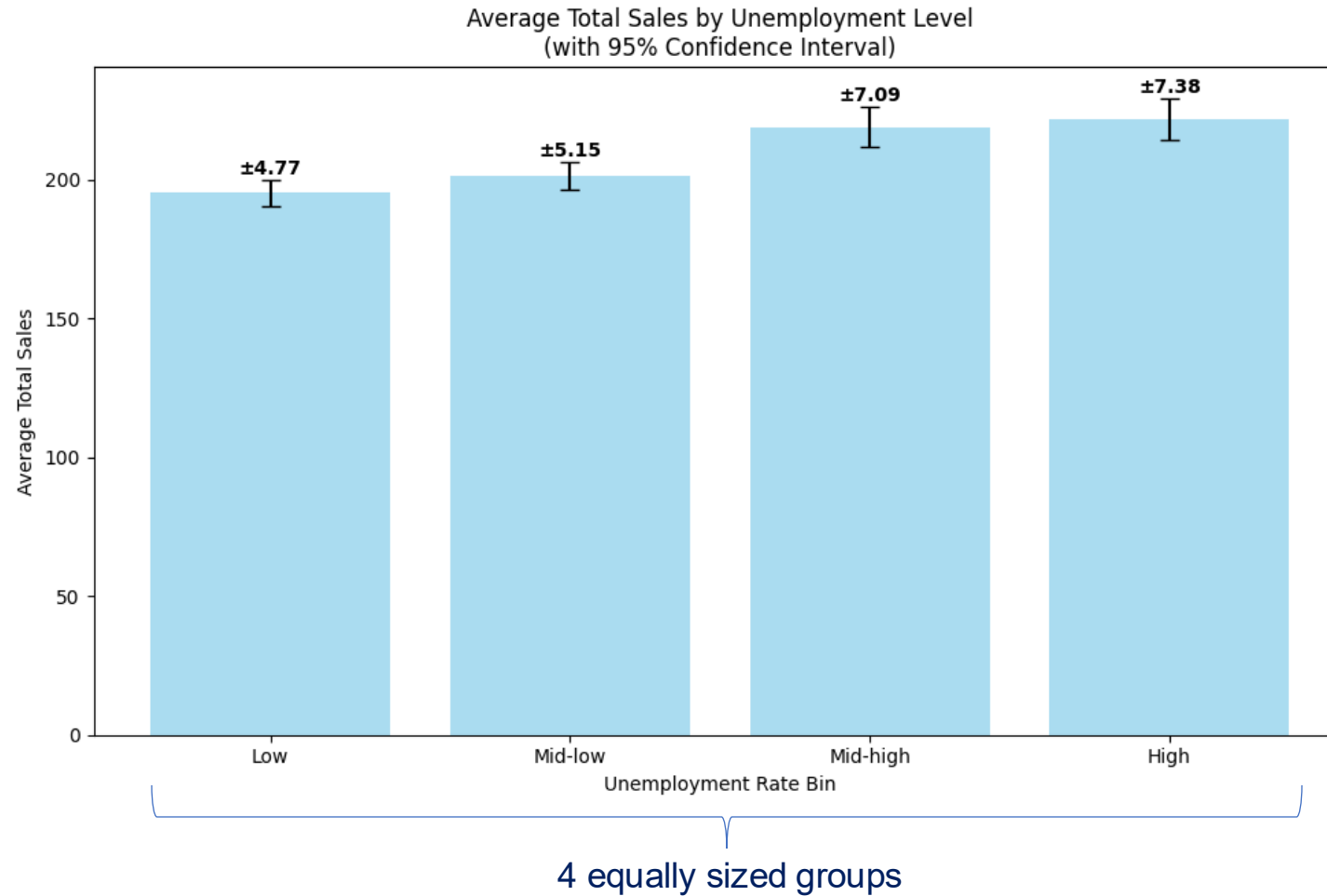
Combination of rain and high temperature increases sales

Weather variable



Sales increase with temperature but decrease if the maximum temperature is above 25°C

Unemployment rate



Higher unemployment rate is associated with slightly higher average total sales

LINEAR REGRESSION MODEL

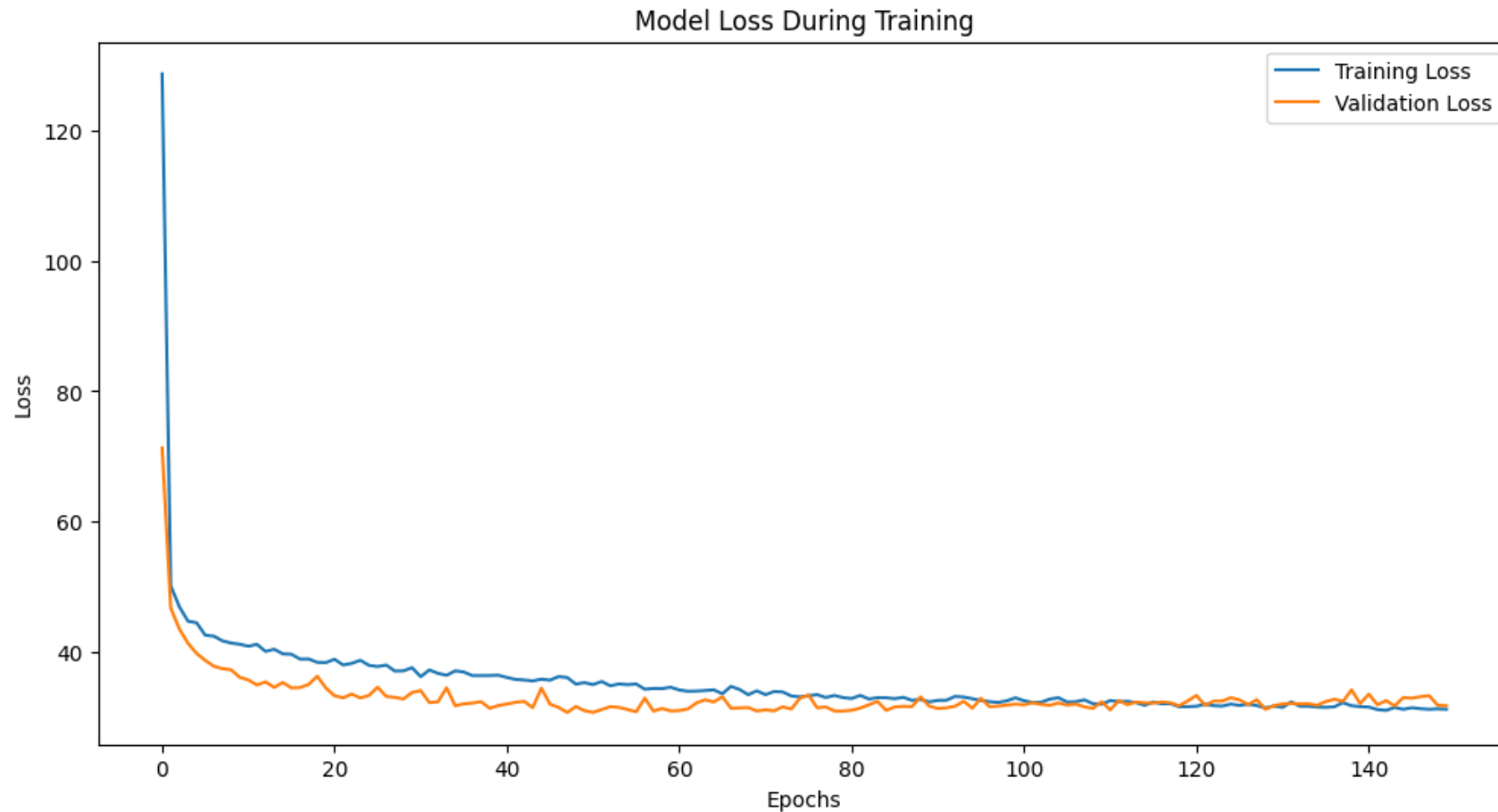
	Modell	R ²	Adj. R ²	Anzahl Parameter
14	Residual+Vollmodell+	0.8115	0.8103	48
13	Residual+Vollmodell	0.8114	0.8103	43
11	Vollmodell	0.7550	0.7536	42
12	Vollmodell+	0.7550	0.7535	47
10	Zeit+Wetter+Product	0.7363	0.7353	30
7	Zeit+Product	0.7355	0.7347	23
3	Product	0.6506	0.6503	6
9	Zeit+Holiday	0.1105	0.1081	21
8	Zeit+Ökonomie	0.1058	0.1034	21
6	Zeit+Stats	0.0989	0.0962	24
5	Zeit+Wetter	0.0989	0.0960	25
0	Zeit	0.0978	0.0957	18
2	Wetter+Stats	0.0539	0.0522	14
1	Wetter	0.0475	0.0466	8
4	Ökonomie	0.0268	0.0264	4

→ *Sales ~ Product + Time
+ Weather + Economy
+ Holiday + Residual*

NEURAL NETWORK

```
from tensorflow.keras.layers import Dropout
from tensorflow.keras.layers import Dense, InputLayer, BatchNormalization
model = Sequential([
    InputLayer(shape=(training_features.shape[1], )),
    BatchNormalization(),
    Dense(64, activation='relu'),
    Dropout(0.2),
    Dense(32, activation='relu'),
    Dense(1)
])
```

NEURAL NETWORK



Loss function: Huber

Learning rate: 0.001

Epochs: 150

Batch size: 32

MAPE

- *Training Data: 16.23%*
- *Validation Data: 17.99%*
 - *Bread: 18.97%*
 - *Roll: 11.98%*
 - *Croissant: 18.77%*
 - *Confectionery: 25.82%*
 - *Cake: 14.44%*
 - *Seasonal Bread: -- %*
(not in the validation period)

HIGHLIGHT

Worst fails:

- *Working with Git codespaces and Tensorflow*
- *The quite often seemingly esoteric effects of Feature Engineering and Model Optimization*

Best improvement:

- *Encoding date and weather features*
- *Talking things through as a team – very important to get a better understanding*

Thank You

An abstract graphic on the right side of the slide, composed of several overlapping, rounded shapes in various shades of blue and purple. The colors range from a light sky blue to a deep, vibrant purple. The shapes are fluid and organic, creating a modern, artistic background element.