Food Demand Forecasting

Using Time Series Analysis

Prepared by:

Muhammad Talha Qureshi
BSCS23122

The problem

Motivation

Accurate food demand forecasting is crucial in minimizing food waste, optimizing inventory management, and enhancing the efficiency of the food supply chain. Manual forecasting is often inaccurate, leading to understocking or overstocking.
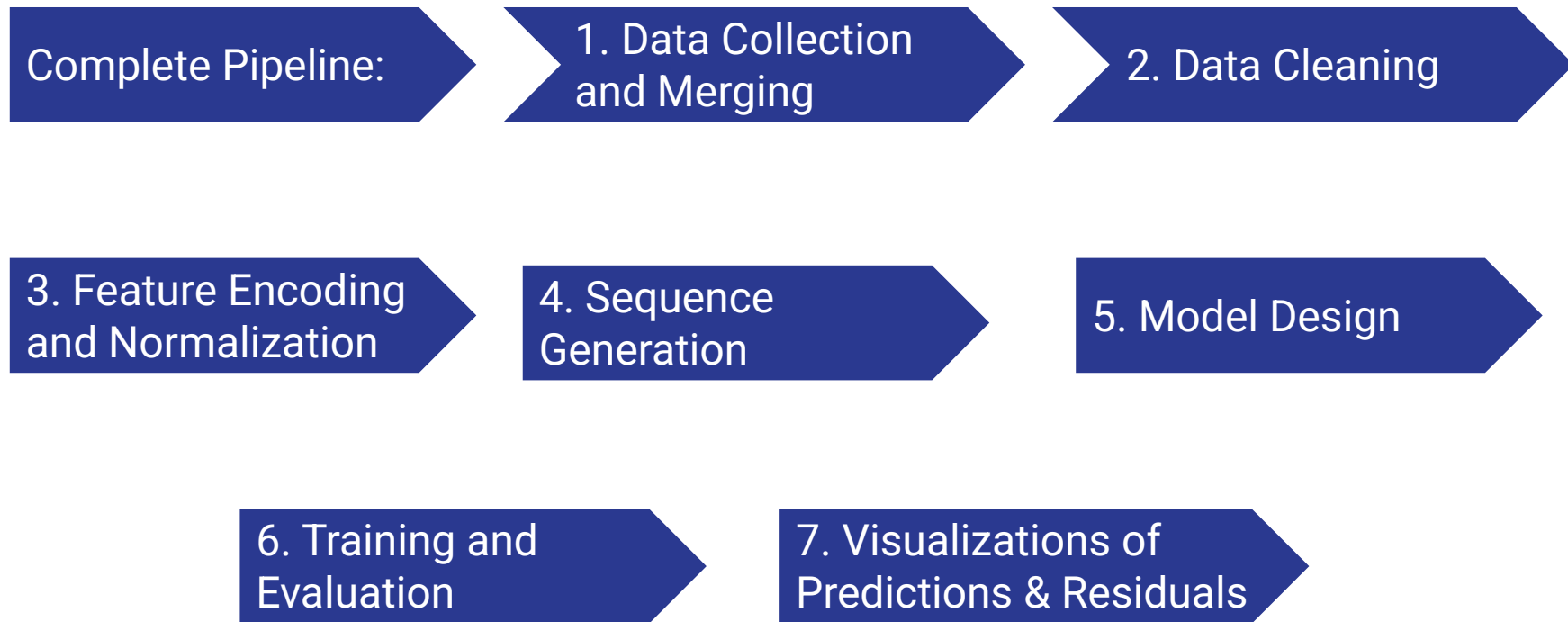
Context

Accurate demand forecasting is essential for optimizing inventory levels. By developing a time series forecasting model using LSTM neural networks, businesses can predict future demand and make data-driven decisions to improve supply chain efficiency.

Problem statement

Given historical food demand data from multiple fulfillment centers, develop a time series forecasting model to predict future demand. The goal is to build a model that captures temporal and feature-based patterns using LSTM (Long Short-Term Memory) neural networks.

Proposed Methodology

Complete Pipeline: → 1. Data Collection and Merging → 2. Data Cleaning

3. Feature Encoding and Normalization → 4. Sequence Generation → 5. Model Design

6. Training and Evaluation → 7. Visualizations of Predictions & Residuals

Dataset Details

Source: Kaggle
(https://www.kaggle.com/datasets/kanna
naikkal/food-demand-forecasting)

Format: Tabular CSV
Rows: ~450,000

Key Features:
- week (temporal)
- center_id (categorical)
- meal_id (categorical)
- checkout_price, base_price (numerical)
- emailer_for_promotion, homepage_featured (binary)
- num_orders (target variable)

———

Experiments and Results

- Feedforward NN (baseline)
- Simple LSTM (1 layer)
- Stacked LSTM (2 layers)

- R² Score: Up to 0.85
- Accuracy (100 - MAPE): ~86%
- RMSE: ~70
- MAE: ~50

| Experiments | Parameters & Training | Quantitative Results | Failure Cases |
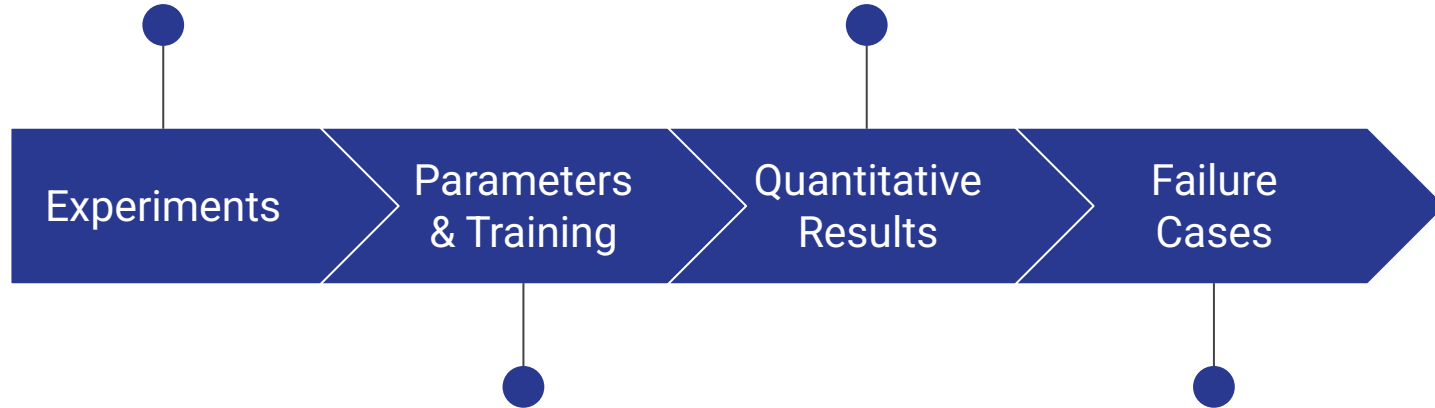
- Sequence Length: 10
- Hidden Size: 128
- Epochs: 100
- Optimizer: Adam
- Loss: MSE

- Sudden spikes in demand due to promotions or external events were less accurately predicted.
- Extremely low or high outliers reduced prediction performance.

Conclusion

We successfully implemented a PyTorch-based LSTM model for food demand forecasting.

- Captured weekly patterns and promotional effects.
- Achieved high accuracy (MAPE < 15%) on test data.
- Useful for real-world applications in supply chain and inventory planning.