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Economic and Environmental Potential of Machine Learning in Demand Forecasting

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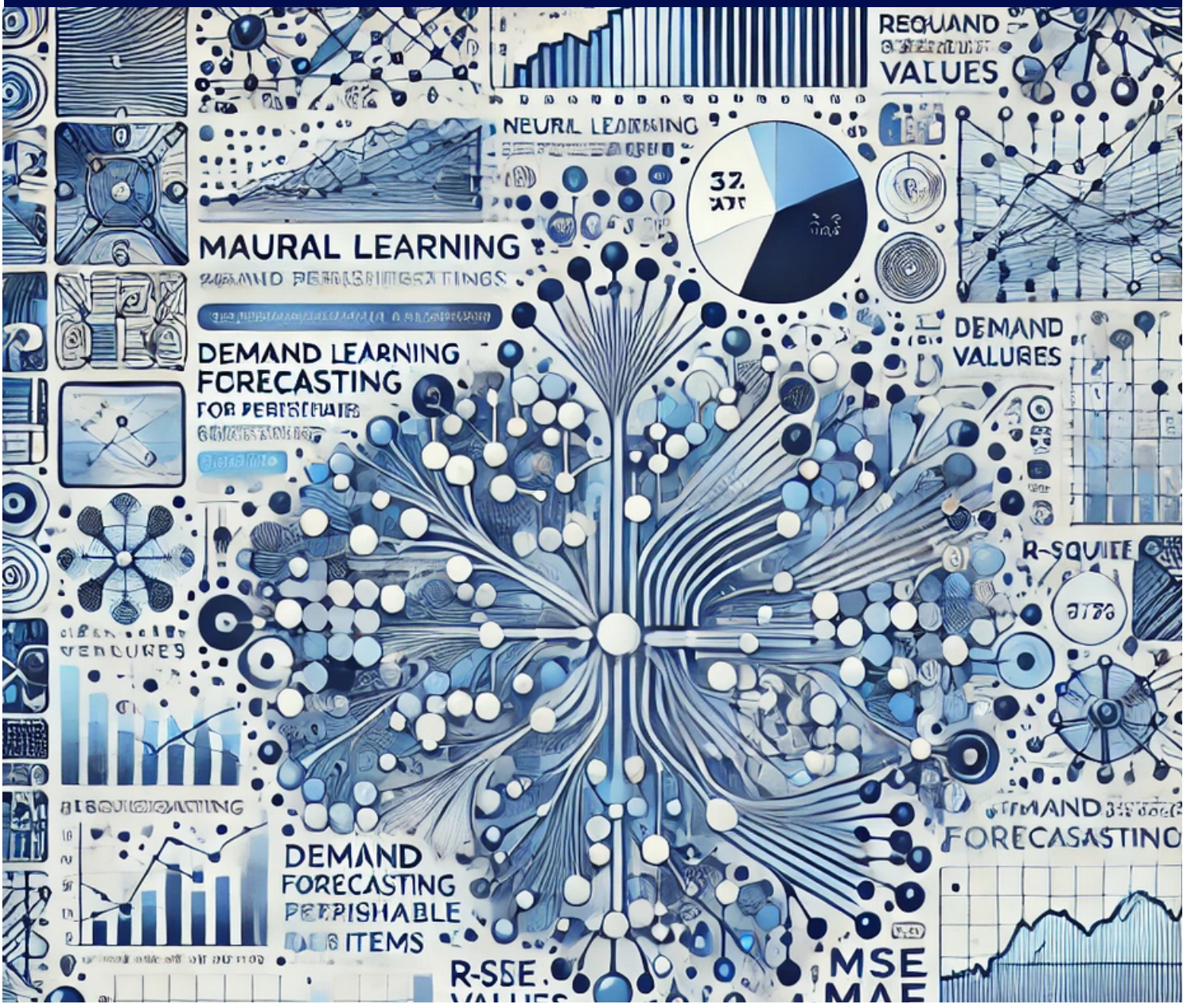

I, **Morten Knudsen**, declare that this thesis titled, “Economic and Environmental Potential of Machine Learning in Demand Forecasting” and the work presented in it are my own. I confirm that:

- This work was done wholly or mainly while in candidature for a bachelor’s degree at the University of Stavanger.
- Where I have consulted the published work of others, this is always clearly attributed.
- Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work.
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"Torture the data, and it will confess to anything."

– Ronald Coase

Abstract

Demand forecasting precision is essential for suppliers of perishable items to be able to meet customer demand and avoid over-stocking goods that will inevitably spoil. Accurately predicting demand enables optimal logistical organization that maximize sales and minimize waste, allowing for increased profitability and decreased environmental impact. Machine learning have the potential to improve demand forecasting accuracy in comparison with traditional methods, with a number of established approaches documented to increase precision. This bachelor thesis will implement an LSTM network to create a demand forecasting model for perishable items supplied from a regional distribution center, detailing the associated challenges and strategies for handling them. Data quality and cleaning is essential for successful model implementation, along with careful feature engineering and optimization of hyperparameters. Access to computational resources is necessary to determine optimal model configuration by testing large numbers of model architectures. Combinations of hyperparameters are systematically tested to create an initial model with selected features. Feature relevancy is tested through a series of experiments on the initial model, forming the foundation for further model optimization. Evaluation of model architecture and performance conclude further dataset and feature improvements are necessary to reach an acceptable level of demand forecasting precision, pointing to features describing the availability and type of items as intriguing avenues of future research.

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Contents

Chapter 1

Introduction

This bachelor thesis is concerned with demand forecasting for perishable items, and the associated economic and environmental effects. Increased accuracy in demand predictions enable suppliers to optimize stock levels and streamline logistical processes, allowing them to meet total customer demand as efficiently as possible while minimizing waste from expired products. Improved stock levels are assumed to increase profitability by optimizing logistical efficiency, ensuring maximum sales and reducing waste, with increased logistical efficiency and limited waste reducing environmental impact. This thesis explores and implements solutions for increasing the accuracy of demand forecasting for perishable items, with the intent of contributing to increased profitability and decreased environmental impact.

1.1 Background and Motivation

Demand forecasting precision is essential for suppliers of perishable items to maximize profits and minimize waste. Perishable items must be sold before they spoil, leaving a limited time window available for processing, storage and distribution. Accurate predictions about future customer demand enables suppliers to purchase ideal amounts of stock to ensure maximized sales by meeting the total demand for goods, while also minimizing unnecessary costs by avoiding overstocking items that will inevitably spoil if not sold while fresh. Purchasing optimal quantities of each article is likely to increase the logistical efficiency of suppliers by limiting unnecessary operations related to restocking and waste management,

allowing businesses to organize in a manner geared toward maximal sales with minimal costs, thereby maximizing profit while reducing environmental impact. The motivation for improving demand forecasting precision for suppliers of perishable items is driven by both factors of increasing profitability and reducing environmental impact, creating benefits for suppliers by increasing profitability and efficiency, for customers by ensuring availability of coveted goods, and for the public at large by improving the environment and optimizing use of resources.

Artificial intelligence (AI), and specifically machine learning (ML), can increase forecasting precision when compared to traditional methods by creating automated systems that reduce the need for expert knowledge and manual calculations, reducing dependence on time-consuming and costly labor while potentially increasing the accuracy of predictions. The ability of ML to detect patterns and make inferences from large and complex datasets can be superior to humans, but is dependent on high input data quality and knowledge-based feature engineering. Further challenges include implementation of functional and understandable model architecture and access to computational resources. The benefits and associated challenges of using ML for demand forecasting are considered to implement predictive models for a specific dataset.

This bachelor thesis is written in cooperation with Coop Norge SA (Coop), one of Norway's largest suppliers of groceries. They have shared data about customer demand and active campaigns for all fruits and vegetable articles sold from a regional distribution center that supplies a number of supermarkets. The dataset contain 840 days of customer demand from supermarkets, along with an overview of specific campaigns that have been active. The supplied dataset serves as the foundation for developing models to predict future demand, with the quality of the data evaluated during cleaning. The provided dataset supplies target data for the predictive models, and form the basis for creating relevant sample features.

The accuracy of the implemented demand forecasting models is dependent on the quality of the input data and the ability of sample features to accurately and exhaustively describe factors that determine customer demand. Inconsistencies in the dataset and lack of information about product availability challenges prediction accuracy. The introduction of more descriptive features have the potential to increase model performance. The implemented models are based on the limited available information, and the selected features are determined by the time constraints of this bachelor thesis. Tracking availability and clustering articles by

type to create more informative features is likely to increase model performance, but remain beyond the scope of this thesis. The result is a relatively simple ML model that fully automates the calculation of customer demand with varying success for different articles, both confirming the possible potential of ML for demand forecasting and acknowledging the associated challenges.

1.2 Objectives

The objective of this bachelor thesis is to explore and implement ML models that can increase demand forecasting precision for fruits and vegetables supplied from a specific regional distribution center.

The information in the available dataset is evaluated to decide which features are relevant and possible to extract. Sales for a given article on a specific date serves as target data for a sample consisting of selected features. All samples contain the same features, where the relevancy of each feature is tested to determine if the information is helpful for making accurate predictions about future sales. Considerations are made about how to handle challenges and inconsistencies in the dataset during the operationalization of input data.

Different AI approaches are considered to decide on a specific approach for implementation of demand forecasting models. Long short-term memory (LSTM) neural networks with supervised training for regression predictions are established as viable alternatives for demand forecasting. The Keras framework for Python is used to implement LSTM models, providing a powerful and user-friendly API for creating neural networks. Model architecture is measured using established evaluation metrics to determine the optimal combination of hyperparameters.

Predictive performance on training data is compared to performance on test data to determine if the models are successfully predicting future sales, and the results for specific articles are evaluated to investigate challenges in model functionality. Possible explanations for problematic predictions are given, and potential solutions are considered.

1.3 Approach and Contributions

A review of related works is conducted to understand the basics of AI and ML in relation to demand forecasting. Different ML approaches are investigated and compared, concluding that LSTM networks are broadly supported as appropriate solutions for predicting demand.

The sales information supplied by Coop is extracted from Excel files and stored in a single csv file sorted by article numbers, with samples further sorted by dates. Each line contains article number, year, month, day, holiday status and sales. Holiday status indicate if it was national holiday in Norway on the given date, including fixed and moving holidays. The csv file serve as the source of sales information when operationalizing the dataset.

A dictionary with article numbers as keys is created from an Excel file that connect article numbers to their names, allowing translations from article numbers to their descriptive names. The dictionary also contains translations for normalization of the article numbers, which is employed for one-hot-encoding. A second dictionary using the one-hot-encoded value as keys is created to ensure fast translation back to the original article number.

A function for extracting campaigns from Excel files is utilized to create a dictionary with article numbers as keys, where each key contain campaign objects that are attached to that article for a specific date and particular store. The dictionary is used to determine if any campaigns were active for an article on a sample date, listing the supermarkets that hosted the campaigns.

Samples are converted to include the features article number, holiday status, active campaigns, weekday, month and number of sales, with all the information one-hot-encoded. A function returns a dictionary containing this information sorted by article numbers, where the dataset is split into a training portion and a test portion.

Samples are organized in sequences to be fed into the LSTM neural networks, with associated sales as target data. The input data of the sequences contain samples with all features except sales spanning the number of days determined by the sequence length. The output data for each sequence is the number of sales on the day immediately following the last day in the sequence.

Keras is used to create a very simple initial LSTM model with one layer is created by testing a number of different combinations of hyperparameters that in-

clude number of neurons, learning rate and dropout rate. The accuracy of the different models is evaluated by their coefficient of determination (R^2). The model with the highest accuracy is used to test the relevancy of the selected features by removal and reintroduction, evaluating the effect of introducing new features on prediction accuracy.

Further LSTM model optimization is performed after confirming the relevancy of selected features, delving deeper into an investigation of more computationally expensive model configurations and combinations of hyperparameters.

The performance of the optimized LSTM model is evaluated by investigating the articles with the most accurate predictions, comparing them to article predictions with the lowest accuracy. Challenging sale patterns are investigated to determine effects on model accuracy, leading to further adjustments of the dataset to increase prediction precision.

The objective is to create a model with the highest possible R^2 score, with the intent of improving current demand forecasting prediction. Obstacles to increasing model accuracy are identified, and suggestions for further improvements are made.

This bachelor thesis add to an existing body of work that point to ML as a source of improved demand forecasting precision, with specific focus on the performance of LSTM networks. It demonstrates that it is now possible to easily implement relatively light-weight solutions to automate the process of demand forecasting for a sizable range of articles, while also affirming the challenges to prediction accuracy established in current literature concerning input data quality, feature engineering, model architecture and access to computational resources.

1.4 Outline

Chapter 2 describe the value of increased demand forecasting precision for suppliers of perishable items, and investigate related works about AI technologies that are relevant for demand forecasting. The basics of ML in relation to demand prediction is explained, and the associated challenges are determined. Established evaluation metrics for prediction accuracy is introduced, and a number of applicable ML models for demand forecasting is reviewed and compared. The chapter conclude that LSTM networks have the broadest support in the reviewed

literature.

Chapter 3 explain the choice of LSTM networks for demand forecasting implementation. The dataset provided by Coop is described, detailing challenges and associated strategies to handle them. Different patterns of sales and their implications for prediction accuracy are discussed, introducing a set of articles to investigate in relation to model performance.

Chapter 4 begins by describing a series of intended experiments that include initial model creation, testing feature relevancy and further model and dataset optimization. The second part of the chapter reports the results from the experiments, concluding that dataset validity must be further investigated and recommending the introduction of more descriptive features to raise model performance to an acceptable level.

Chapter 5 evaluates model architecture, promoting simplicity to increase efficiency. Evaluation metrics of the initial and optimized model performance are investigated to conclude that the current prediction precision is unacceptable for real-world application, suggesting that improvements of the dataset and selected features are necessary to increase model performance.

Chapter 6 summarizes the previous chapters, reaching conclusions about disappointing model performance and the need for future work on dataset validation and introduction of more descriptive features to improve it. It acknowledges the established challenges of input data quality, feature engineering, model architecture and access to computational resources as credible obstacles for successful demand forecasting precision in ML.

Chapter 2

Related Work

This chapter investigates related works about the importance of demand forecasting precision for perishable items and the potential of AI and ML to increase accuracy. It gives a very simple introduction of basic machine learning concepts that are relevant for demand forecasting, before reviewing challenges of machine learning implementations. A brief introduction of common evaluation metrics is followed by an investigation of applicable models for demand forecasting.

2.1 Demand forecasting and perishable items

Demand forecasting precision is essential for the sale of perishable products because it enables suppliers to maximize sales and minimize waste, making their operations more efficient, profitable and environmental. Huber et al. [1] argue that suppliers of perishable goods can increase income by having enough stock to meet customer demand while avoiding over-stocking products that will inevitably spoil if not sold on time. They argue that the implications of running out of stock beyond immediate loss of income from missed sales are complex and hard to measure, potentially leading to customer dissatisfaction and reduced loyalty that affect future income, while the economic loss from products spoiling is easier to determine. Both the loss of sales and expiration of perishable stock have a negative effect on the profitability of a business. Increased precision in demand forecasting has the potential to reduce loss of sales by ensuring enough stock to meet customer demand, while preventing over-stocking perishable goods that incur costs when they expire. Accurate predictions enable purchases of ideal stock sizes, per-

mitting suppliers to organize their logistical operations to ensure optimal flow of goods. Aamer et al. [2] and Nasseri et al. [3] argue that efficiency in supply chains is an immediate source of increased profit, with demand forecasting precision playing a pivotal role. Purchasing optimal amounts of stock allows suppliers to sell a maximum of articles while keeping waste to a minimum, thereby increasing logistical efficiency that maximize income and profitability while reducing environmental impact.

2.2 Potential of artificial intelligence and machine learning in demand forecasting

Emerging technologies in the field of AI have the potential to increase the accuracy of demand forecasting when compared to traditional approaches. Janiesch et al. [4] describe AI as systems that approach and solve complex problems in a largely independent fashion that is similar or superior to humans, and point to ML as a common underlying technology for many modern AI systems. They view ML as a program that ”seeks to automatically learn meaningful relationships and patterns from examples and observations”, since it is not dependent on receiving specific instructions about how to interpret data, but instead make independent evaluations to find hidden patterns and make inferences that can surpass human performance. Several publications support the claim that ML is better equipped than humans to find patterns in large and complex datasets, concluding that the introduction of ML can improve demand forecasting compared to traditional approaches that rely on statistical and expert knowledge [2, 3, 5, 6, 7]. One review point to research showing that the introduction of ML can reduce demand forecasting errors with up to 30% [5]. There has been increasing employment of AI-based demand forecasting since 2010, with a dramatic increase in the number of published research articles between 2021 and 2024 that mark the growing importance of this technology [6]. AI-based demand forecasting is likely to provide superior demand forecasting compared to traditional methods.

2.3 Basic machine learning and demand forecasting

It is reasonable to approach demand forecasting as a supervised learning problem. Machine learning can be split into supervised and unsupervised learning. Supervised learning entails having input data comprised of descriptive features connected to a specific target output data. A sample of data consist of a number of features that describe the circumstances of the instance, which is then linked to a specific resulting outcome represented by the target output data. A supervised learning model can use knowledge learned from training data to predict outcomes from the features of a new sample. Unsupervised training models are trained exclusively on input data, enabling them to detect patterns in the training data rather than making specific predictions [2, 4, 8]. While supervised learning is ideal for making predictions, unsupervised learning is more suitable for clustering samples. Connecting historical sales to sample features enables future predictions about sales based on the features of a new sample.

Prediction of continuous values for future sales makes demand forecasting a type of regression problem. Supervised learning can be used for regression and classification analysis. Regression produces a continuous numerical value based on a sample, while classification categorizes the sample [4, 8]. Demand forecasting can be seen as a supervised regression problem, where historical sales are directly linked to samples to enable the prediction of a specific value for future sales [3]. Supervised training link historical sales values to samples based on their features, allowing demand forecasting models to predict numerical values for future sales.

2.4 Machine learning challenges for demand forecasting

Successful implementation of ML for demand forecasting face several challenges. Authors describe problems related to data quality, feature engineering, overfitting, model complexity and access to computational resources as obstacles that must be overcome to unlock the potential of ML in general [4, 8], and specifically for demand forecasting [5, 6]. Careful mitigation of associated challenges is

necessary to create an ML demand forecasting model with high accuracy.

2.4.1 Data quality

The input data of any ML model must be consistent and unbiased to produce optimal predictions. Training data quality is a critical component of any ML driven model, requiring proper preprocessing of the data to ensure it correctly represents the nature of a given phenomena [4, 5, 6, 8]. Presence of human bias in input data can severely affect ML prediction accuracy, making models vulnerable to mistakes in collection and operationalization of the data [4, 8]. Missing values must be handled correctly, either by replacement or by using models that tolerate them [7, 8]. Inconsistencies and outliers must be removed, and values must be normalized within a certain range. Features must be extracted in an appropriate manner to ensure optimal functionality [5]. The accuracy of ML predictions is directly dependent on the quality of the input data and its preprocessing.

2.4.2 Feature engineering

Feature engineering require careful deliberation when operationalizing input data. ML forecasting models can replace the role of human experts in the calculation of customer demand, but domain-specific knowledge remains crucial to ensure correct feature selection and model design that considers all relevant factors. A single feature describes one specific aspect of a sample, with the sum of all features describing the sample completely [4, 5, 8]. Poorly chosen or badly engineered features can negatively impact model accuracy by misrepresenting a sample, making it important to ensure that all features are representative of the sample and relevant for predictions [7]. Well-engineered relevant features can increase the accuracy of a model [5]. Feature engineering must ensure accurate and relevant representation of samples to enable prediction accuracy.

Different ML models require varying degrees of feature engineering. Janiesch et al. [4] distinguish between shallow neural networks and deep learning (DL) networks by the number of hidden layers, noting that DL models typically have more than one hidden layer, but declare that there is no exact definition between the two in current literature. They write that shallow ML models require knowledge-based manual feature engineering, while DL networks are able to automatically extract features from noisy data. Tree-based ensemble learners

are advantageous in not needing feature scaling, while neural network accuracy is improved by scaling features [3]. The choice of ML model determines the required level of feature engineering.

2.4.3 Overfitting and generalizability

ML models need to be able to generalize predictions learned from training sets to real-world situations. Datasets used to create supervised learning models are usually split into a training set and a test set, where the model is trained on target data from the training set and its performance is evaluated against the test set. Test set accuracy indicate a model's ability to make accurate predictions about samples with unknown outcomes [3, 8]. ML models should accurately predict target values of training sets, and be able to generalize this knowledge to make predictions about unknown test data with similar accuracy.

Predictive ML models are vulnerable to under- and overfitting. Underfitting occurs when a model has poor prediction accuracy on both the training and test set, while overfitting happens when acceptable training set accuracy is considerably higher than test set accuracy. Models that are too simple or have uninformative features are prone to underfitting, while increased complexity or problematic datasets can lead to overfitting. Model optimization can require compromising between simplicity and complexity, trading reduced training set accuracy for improved accuracy on the test set [8]. High prediction accuracy require informative features and satisfactory model complexity.

The hyperparameters of an ML model need to be specifically tuned to optimize its ability to generalize. Loss function and learning rate can have an immediate effect on overfitting [8]. Abbasimehr et al. [9] point to several hyperparameters of LSTM networks as important to increase accuracy of test results, focusing on sequence length, number of hidden layers and respective neurons, dropout rate and learning rate as hyperparameters that can be fine-tuned to achieve optimal model performance. Optimal hyperparameter tuning is essential for producing high generalized prediction accuracy.

2.4.4 Model complexity and interpretability

ML model complexity obscure decison-making mechanisms, making model architecture uninterpretable and performance unpredictable. ML models include

complex factors like learning mechanisms, feature engineering and hyperparameter settings, which can increase complexity, demand more computational resources and impede model interpretability [4]. Lack of interpretability obscure which factors influence decision making [4, 5, 10]. Lack of transparency can decrease users' trust in the system, which is crucial in situations where automated decisions have high stakes [10]. Missing knowledge about the inner workings of a model is referred to as a "black box" problem, sometimes leading stakeholders to implement less accurate models with simpler, more interpretable architecture to increase trust [4, 8, 10]. Simpler ML models and decision trees are inherently interpretable [10], while support vector machine models, random forests and DL networks are considered unpredictable by lacking transparency [4]. Efforts are being made within explainable AI to expose mechanisms driving decisions to increase the accountability of "black box" models [4, 10]. Demand forecasting large volumes of perishable items has high economic stakes, potentially leading users to require simple and transparent model architecture to establish trust.

2.4.5 Computational resources

Different ML architectures require varying amounts of computational resources. Sistla et al. [5] point to extensive need for computational resources, expertise and large datasets to implement ML approaches as an impediment for smaller businesses, noting that recurrent neural networks (RNN) and LSTM networks that perform well for demand forecasting require large datasets and are computationally demanding. Badillo et al. [8] explain how dimensionality reduction reduce the computational costs by reducing the number of sample features in a dataset. Other methods such as tree ensembles have achieved higher accuracy than LSTM networks, and are easier to implement and less computationally expensive with lighter training sets [3, 8]. Gradient boosting methods also require less computational resources and provide good results [8]. Janiesch et al. [4] write that businesses must compromise between model accuracy and computational cost according to their budgets, managing an acceptable combination of "architecture, hyperparameters and training data". ML model development for demand forecasting is limited by the availability of computational resources, affecting model architecture and training time.

2.5 Evaluation metrics

Established evaluation metrics are used to evaluate the performance of ML demand forecasting. Nasseri et al. [3] point to four established evaluation metrics shown in table 2.1 as common indicators of model accuracy; mean absolute error (MAE), mean absolute percentage error (MAPE), root mean squared error (RMSE) and the coefficient of determination (R^2). Eiglsperger et al. [7] point to R^2 as a good metric for evaluating demand forecasting performance, with values ranging from negative infinity to 1, where 1 represents perfect accuracy. MAE, MAPE, RMSE and R^2 are accepted measures of model accuracy, with R^2 offering a simple score that gives an indication of performance without needing specific knowledge about acceptable ranges of error.

$$\text{MAE} = \frac{1}{n}\sum_{t=1}^{n}|\hat{y}_t - y_t|$$

$$\text{MAPE} = \frac{1}{n}\sum_{t=1}^{n}\left|\frac{\hat{y}_t - y_t}{y_t}\right|$$

$$\text{RMSE} = \sqrt{\frac{1}{n}\sum_{t=1}^{n}(\hat{y}_t - y_t)^2}$$

$$R^2 = 1 - \frac{\sum_{t=1}^{n}(\hat{y}_t - y_t)^2}{\sum_{t=1}^{n}(y_t - \bar{y})^2}$$

Table 2.1: Common evaluation metrics used for ML model performance [3].

2.6 Applicable models for demand forecasting

There are several successful computer-based approaches to automating demand forecasting that outperform manual calculations. Approaches range from statistical methods that require explicit programming to AI-based methods that automatically infer patterns from training data. Hybrid methods combine elements of both strategies to enhance performance.

2.6.1 Statistical methods

Statistical methods use computers to automate demand forecasting, but are dependent on explicit manual programming and weighting of variables. Moving average and exponential smoothing are commonly employed statistical methods for demand forecasting. ARIMA is another popular statistical method that use ”autoregression, integration and moving average” to evaluate linear components of time series. Models like ARCH and GARCH expand this method to handle specific non-linear components, but lack the flexibility to model unexpected non-linear demand that ML models are capable of [9]. Huber et al. [1] suggest using a statistical approach to improve demand forecasting called ARIMAX, using linear combinations of former sales and forecasting errors together with external weighting factors like seasonality. They suggest hierarchical clustering of products to improve this statistical approach, arguing that similar articles can be grouped together and viewed holistically to ensure alternative items are available for customers if a similar article is out of stock. Methods such as ETS and TBATS have also been used successfully in demand forecasting [6]. Statistical methods can be efficient for automating linear and specific non-linear demand calculations, but lack the flexibility of ML and require cumbersome manual tuning of parameters and variables that is vulnerable to human error.

2.6.2 Machine learning methods

AI-based models forecast demand based on patterns in prior sales without explicit programming. The ability of ML models to discover complex patterns in large datasets and make inferences based on the data removes the need for explicitly programming rules for demand forecasting models, limiting potential human errors resulting from oversight of important details [4]. ML approaches to demand forecasting are increasingly replacing traditional statistical methods due to greater accuracy [6]. There is a variety of different ML approaches suitable for demand forecasting [2, 3, 5, 6, 7, 9]. ML can be applied to increase prediction accuracy and reduce the need for explicit programming.

Machine learning algorithms

Many demand forecasting models can be constructed by using one of many single machine learning algorithms. Linear and logistic regression is often successfully used for simple demand forecasting, but does not work well for non-linear sales [5]. Artificial neural networks can contain several layers, allowing for non-linear calculations [3, 4]. Aamer et al. [2] conducted a review of articles published between 2010 and 2019 that focused on which machine learning algorithms had been employed in specific industries, and found that neural networks was the most publicized approach for demand forecasting. They write that this finding support claims of neural networks improving demand forecasting when compared to traditional methods, while maintaining that the high rates of research articles represent the academic popularity of the algorithms without necessarily attesting to their efficacy. They underline this by pointing to research suggesting some of the algorithms with the fewest published papers, such as extreme machine learning and support vector regression, produced better results than neural networks. Convolutional neural networks and RNNs are appropriate for demand forecasting due to their efficiency in detecting patterns in complex datasets [5]. Especially RNNs are considered appropriate for analyzing sequence data [3, 5, 6, 7, 9], with increasingly sophisticated models such as LSTM networks and hybrid models now improving the results of traditional regression models by providing non-linear predictions [6]. RNNs allow signals to move in different directions, and enable a short-term memory by storing activations [9]. RNNs do however suffer from vanishing and exploding gradient problems, which have been solved by the introduction of LSTM networks [7, 8, 9]. Abbasimehr et al. [9] found that their proposed generalized approach to constructing an LSTM network for demand forecasting, based on systematic testing of different combinations of hyperparameters, was the superior alternative for demand forecasting. There are numerous ML algorithms that can be used for demand forecasting.

Ensemble methods

Ensemble methods employ several ML algorithms to provide a diversified interpretation of data. Ensemble methods like gradient boosting and random forest algorithms have been shown to be efficient to make non-linear predictions about demand, outperforming traditional statistical methods [5]. Nasseri et al. [3] in-

vestigate the performance of tree ensemble methods in comparison to LSTM networks, describing an ensemble as a combination of different algorithms within one individual method. Combining different algorithms give increased diversity of strengths when analyzing a complex dataset. They point to numerous articles showing that ensemble approaches that combine different ML techniques improve demand forecasting accuracy when compared to traditional methods and simpler ML models. Their suggested model of extra tree regression (ETR) performed better than their implementation of an LSTM network for all three categories in their dataset that contained sales numbers for fruits, fresh meat and soft drinks. The most significant improvement was for fresh meat, while there was only a minimal difference for fruits. Their review point to several articles where LSTM networks have produced the best results, but they show more support for ETR and other tree ensembles as the optimal approach for demand forecasting. Their implementations of three other ensembles, random forest regressor, gradient booster regressor and XGBoost performed similarily to ETR. They underline that they are not able to conclude that ETR is superior to LSTM networks since they cannot be certain that the hyperparameters of their LSTM model were optimal, highlighting that the implementation of their ensemble methods is considerably easier and does not require fine-tuning of hyperparameters. Optimizing neural network hyperparameters require a time-consuming series of experiments, and have direct impact on model accuracy [11]. There is a lack of literature on optimal model architecture and hyperparameters for specific tasks [4], making the construction and tuning of demand forecasting models an endeavor of trial and error. Nasseri et al. [3] conclude that ETRs are simpler to implement than LSTM networks since they require less data preparation, have fewer hyperparameters and are faster to train. Eiglsperger et al. [7] found the ensemble method XGBoost to be superior for demand forecasting when used for seasonal horticultural articles, noting that the result of an LSTM network was competitive. Employing ensemble techniques can increase the accuracy of demand forecasting compared to both statistical methods and individual AI algorithms.

Hybrid methods

Hybrid methods can combine statistical methods with ML algorithms or ensemble models. Douaioui et al. [6] found that combining statistical methods with ML

generally have been shown to be more efficient at reducing demand forecasting errors than standalone ML algorithms, and specifically point to a method called SARIMA-LSTM-BP that combines seasonal ARIMA with LSTM network and back propagation to increase the performance of standalone LSTM error reduction by an additional 18%. Statistical methods that yield initially inferior results can add a synergistic effect that increase overall performance when combined with ML models.

Comparison of methods

There are several available methods to improve demand forecasting precision. The literature reviewed on demand forecasting show an overwhelming support for the employment of ML to improve precision [2, 3, 5, 6, 7], with different researchers pointing to a variety of methods as being superior. Table 2.2 show a review of current ML models for demand forecasting in comparison to popular linear statistical methods conducted by Douaioui et al. They find that LSTM networks is the single algorithm that provide the largest increase in accuracy compared to statistical methods, but point to the hybrid model SARIMA-LSTM-BP that combines statistical methods and ML to reduce errors with another 18% compared to standalone LSTM networks as the most effective, bringing the total improvement of demand forecasting precision up as high as 38%. Nasseri et al. [3] point to ETR and tree ensembles in general as the optimal approach, while Eiglsperger et al. support the ensemble XGBoost as the best approach. Abbasimehr et al. [9] claim their generalized LSTM network is the superior alternative, but have not specifically compared it to hybrid or ensemble approaches. Sistla et al. [5] acknowledge the merits of ensemble learners, but point to LSTM networks as superior in detecting temporal and non-linear patterns in datasets. They admonish the robustness of ensembles in their resistance to overfitting, and note that LSTM networks require more computational resources to implement. LSTM networks also require more data preparation and have a complex structure that require extensive fine-tuning of hyperparameters [3]. The difference of performance between ETR and LSTM was limited, and negligible for fruits [3], while the improvement upon LSTM by using the hybrid approach SARIMA-LSTM-BP was significant [6]. Diversified methods like ensembles and hybrids seem to have great potential for improving demand forecasting precision, while there was wide

support for the merits of LSTM networks by several authors, even if they did not necessarily consider it the optimal approach [3, 5, 6, 7, 9]. Evaluations of different approaches have concluded that different methods produce superior predictions, including SARIMA-LSTM-BP, ETR and LSTM. LSTM is broadly supported by many authors, and rival the accuracy of superior models in most of the reviewed comparisons.

AI Method	**Improved accuracy**
SARIMA-LSTM-BP	33-38%
Long Short-Term Memory network (LSTM)	15-20%
Support Vector Machine	12%
Random Forest	10%
Extreme Gradient Boosting	8-10%

Table 2.2: Improved demand forecasting accuracy of selected ML models compared to statistical linear models found by Douaioui et al. [6].

Chapter 3

Approach

This chapter explains the choice of using an LSTM network to implement a demand forecasting model, and introduce the dataset supplied by Coop. Dataset inconsistencies and challenges are investigated along with cleaning strategies. Data operationalization is detailed, focusing on data extraction, feature selection, one-hot encoding and sequence creation. The general approach for construction and implementation of an LSTM network for demand forecasting is introduced, setting the stage for systematic testing of features and hyperparameters to follow in chapter 4.

3.1 Choice of demand forecasting model

Several ML models can be implemented to increase the accuracy of demand forecasting predictions. The investigation of related works in chapter 2 finds that the use of ML in demand forecasting is increasing, with considerable research supporting the potential to improve prediction accuracy [2, 3, 5, 6, 7, 9]. The literature review reveals a wide variety of models that can be successfully implemented, all with their own advantages and disadvantages. Section 2.6.2 summarizes a comparison of discussed methods, with SARIMA-LSTM-BP [6], ETR [3] and LSTM networks [9] considered superior alternatives listed in descending order. SARIMA-LSTM-BP appear to have the highest accuracy, while ETR and LSTM networks achieve more similar results. The ranking of these approaches is based on a single study per method, while there is broad support for the use of LSTM as an appropriate and efficient method for analyzing time series data

among most of the authors [3, 5, 6, 7, 9]. Implementation of SARIMA presupposes expert knowledge about statistical measurements and appropriate weighting of parameters, which is beyond the scope of this bachelor thesis. ETR and other tree ensemble methods are considered relatively simple to implement and not as computationally demanding as LSTM, providing a light-weight approach to demand forecasting with impressive accuracy. The choice of model for this bachelor thesis is implementation of an LSTM network in spite of the merits of ensemble approaches, due to the broad support it has in the reviewed literature.

3.2 Dataset

The specific dataset offers a satisfactory starting point for developing an LSTM demand forecasting model, but comes with a set of challenges that requires addressing.

3.2.1 Description of dataset

	A	B	C	D	E	F	G	H	I	J	K
1	Lokalisering	Produkt	23.05.2022	24.05.2022	25.05.2022	26.05.2022	27.05.2022	28.05.2022	29.05.2022	30.05.2022	31.05.2022
2	DC09	714078201	0.000	24.000	0.000	16.000	-2.000	0.000	0.000	24.000	8.000
3	DC09	714544201	22.000	80.000	-8.000	-2.000	-9.000	77.000	0.000	16.000	143.000
4	DC09	715124301	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	DC09	715179101	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	DC09	715179201	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	DC09	715246301	-2.000	-1.000	-8.000	-5.000	-11.000	-8.000	0.000	-5.000	-3.000
8	DC09	715251701	419.000	561.000	-40.000	860.000	121.000	644.000	-1.000	271.000	449.000
9	DC09	715333701	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	DC09	714077101	190.000	281.000	-76.000	617.000	47.000	638.000	-5.000	281.000	363.000
11	DC09	714078301	30.000	129.000	-20.000	80.000	-6.000	91.000	0.000	67.000	168.000
12	DC09	714688201	33.000	250.000	-41.000	213.000	18.000	178.000	-1.000	-18.000	83.000
13	DC09	714756601	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14	DC09	714754801	601.000	732.000	-51.000	1,344.000	-23.000	944.000	-9.000	527.000	663.000
15	DC09	715141601	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	DC09	715331601	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	DC09	715579901	212.000	276.000	14.000	555.000	-25.000	446.000	-3.000	198.000	295.000
18	DC09	714200901	951.000	434.000	22.000	693.000	26.000	1,028.000	-3.000	349.000	405.000
19	DC09	715125601	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	DC09	715287401	17.000	59.000	-5.000	18.000	10.000	39.000	-2.000	15.000	26.000

Figure 3.1: Snippet from the start of the dataset in original Excel format.

The dataset used for developing a demand forecasting model includes sales of 429 different fruit and vegetable articles from a specific distribution center that supplies a region of supermarkets. The data spans 840 days from 23 May 2022

to 8 September 2024. Recorded sales show ordered quantities rather than delivered, avoiding misrepresenting demand for out of stock articles. Numbers for demand are referred to as sales when discussing the dataset and demand forecasting model. The dataset was initially meant to include all articles with registered movement at any point during the given time span.

The original dataset is provided in Excel files, with column 1 and 2 detailing location and article number, with the following columns listing sales for individual dates. Each row contains location, a specific article number, and all associated sales for that article in the time period covered by the Excel sheet. Figure 3.1 shows a snippet from one of the original Excel files, displaying how the data was structured.

Additional information that was provided included translation of article numbers to descriptive names and lists of campaigns that had been active during the time period covered by the dataset. Campaign information included article number and name, campaign title, starting date and week, end date and week, sale price and which supermarket hosted the campaign. Figure 3.2 shows a snippet of the format of the original Excel sheet with the campaign overview.

	A	B	C	D	E	F	G	H	I
1	Distribusjonskanal	Tilb.navn	Start uke	Tilbudsstart	Slutt uke	Tilbudsslutt	Produkt-ID	Beskrivelse	Tilbudspris
2	COOP MARKED (04)	gulrot og blomkål 2 for 38	202201	03.01.2022	202201	08.01.2022	704198001	BLOMKÅL STK	38.00
3	COOP MARKED (04)	gulrot og blomkål 2 for 38	202201	03.01.2022	202201	08.01.2022	704201401	X GULROT 1KG POSE	38.00
4	MATKROKEN (08)	gulrot og blomkål 2 for 38	202201	03.01.2022	202201	08.01.2022	704198001	BLOMKÅL STK	38.00
5	MATKROKEN (08)	gulrot og blomkål 2 for 38	202201	03.01.2022	202201	08.01.2022	704201401	X GULROT 1KG POSE	38.00
6	COOP MARKED (04)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	3149226	EPLE RØDE KG IMP	30.00
7	COOP MARKED (04)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	6487342	EPLE RØDE KG NO	30.00
8	COOP MARKED (04)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	704285401	EPLER GULE KG	30.00
9	COOP MARKED (04)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	704285501	EPLER GRØNNE KG	30.00
10	COOP MARKED (04)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	704285801	APPELSIN KG	30.00
11	COOP MARKED (04)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	704286001	PÆRE KG	30.00
12	COOP MARKED (04)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	704880601	X EPLE RØD CRIPPS KG IMP	30.00
13	COOP MARKED (04)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	704881301	EPLE KANZI KG IMP	30.00
14	COOP MARKED (04)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	704881701	EPLE RED CHIEF KG IMP	30.00
15	COOP MARKED (04)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	704881801	X EPLE RØD GALA KG IMP	30.00
16	COOP MARKED (04)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	704881901	EPLE RØD ROYAL GALA KG IMP	30.00
17	COOP MARKED (04)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	704882101	EPLE RØDE ELSTAR KG NO	30.00
18	COOP MARKED (04)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	704882701	X EPLE RØDE RUBINSTEP KG NO	30.00
19	COOP MARKED (04)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	704883101	EPLE RØDE KG DIV NO	30.00
20	MATKROKEN (08)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	3149226	EPLE RØDE KG IMP	30.00
21	MATKROKEN (08)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	6487342	EPLE RØDE KG NO	30.00
22	MATKROKEN (08)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	704285401	EPLER GULE KG	30.00
23	MATKROKEN (08)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	704285501	EPLER GRØNNE KG	30.00
24	MATKROKEN (08)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	704285801	APPELSIN KG	30.00
25	MATKROKEN (08)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	704286001	PÆRE KG	30.00
26	MATKROKEN (08)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	704880601	X EPLE RØD CRIPPS KG IMP	30.00
27	MATKROKEN (08)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	704881301	EPLE KANZI KG IMP	30.00
28	MATKROKEN (08)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	704881701	EPLE RED CHIEF KG IMP	30.00
29	MATKROKEN (08)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	704881801	X EPLE RØD GALA KG IMP	30.00
30	MATKROKEN (08)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	704881901	EPLE RØD ROYAL GALA KG IMP	30.00
31	MATKROKEN (08)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	704882101	EPLE RØDE ELSTAR KG NO	30.00
32	MATKROKEN (08)	epler pærer og appelsin -30%	202201	03.01.2022	202201	08.01.2022	704882701	X EPLE RØDE RUBINSTEP KG NO	30.00

Figure 3.2: Snippet from original Excel campaign overview.

3.2.2 Dataset challenges and cleaning strategies

Articles with zero sales

The dataset contained articles that had no sales during the spanned time period. 27 articles had totals of zero sales or less, counting 14 articles with total sales equal to zero and 13 with negative totals. Section 3.2.2 further expounds on the presence of negative sales and their consequences after dealing with issues of zero sales and discontinued articles. The articles with totals of zero sales had no movement in the dataset, and the negative totals had no positive sales. These articles do not contribute any useful information to the model since the items are not being sold, instead they pose a potential threat to prediction accuracy and increase training time by inflating the data. These articles were removed from the training data.

Notice article 715246301 with all negative sales in figure 3.1 that show the beginning of the dataset. This article had 76 negative sales and no positives, and was duly removed.

Removing unnecessary articles reduce training data and sample dimensionality, which positively affects training time. Removing articles with zero sales have reduced the total number of articles from 429 to 402, with a corresponding reduction in samples from 360030 to 337680. This reduction also has a positive effect on the dimensionality of the samples since the article numbers are one-hot encoded, which is further explained later in section 3.3.4, reducing the dimensionality of samples from 457 to 428. Improving the quality of input data leads to higher model accuracy, and reduction in sample dimensionality reduces training time [8]. Pruning the dataset improves input data quality, and reduces the computational cost of training the model by the associated reduction in number of samples and their dimensionality.

Discontinued articles

The dataset includes articles that have no sales for the last year, leading to the conclusion that these articles are now discontinued. Figure 3.3 show a typical example of a discontinued article. Discontinued articles are likely to affect the overall accuracy of the model negatively by creating an expectation of sales that is ultimately not met when the article is discontinued, leading to a series of faulty

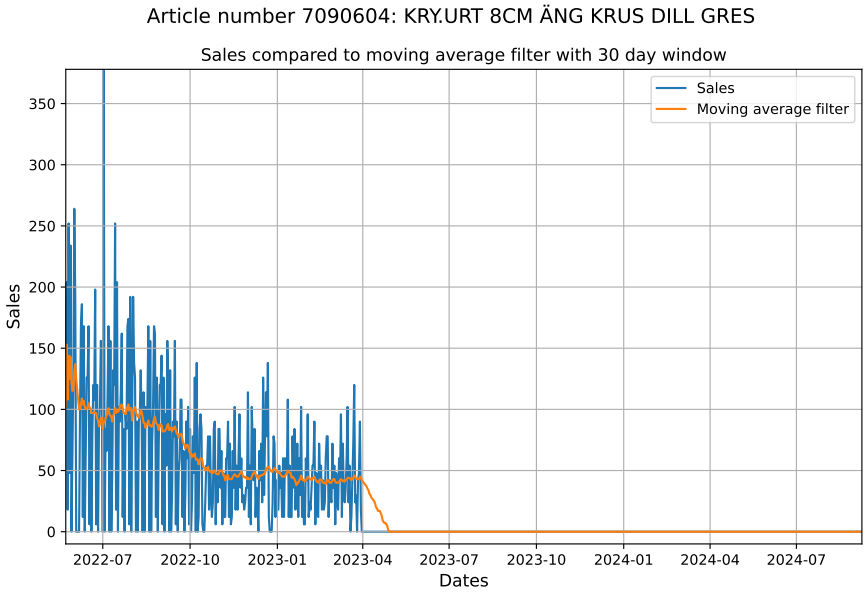

Figure 3.3: Example of discontinued article with zero sales for the last year.

predictions. This consideration lead to the removal of articles with no sales for the last year. This reduced the total number of articles to 325, with a total of 273 000 samples, making a total reduction in samples of 24% from the original dataset. The dimensionality of the samples was further reduced to 351, totaling a 23% reduction.

Negative sales

The consistency of the dataset is challenged by the inclusion of negative sales. A total 331 of the original 429 articles have sporadic occurrences of negative sale values during the period between 23 May 2022 and 4 October 2022. The numbers of negative sales per article ranged from 1 to 110, with an average of 24 per article. 254 articles with negative sales remain in the dataset after pruning articles that are discontinued or have no positive sales. Coop explain these negative values as most probably resulting from goods being returned due to quality issues. They acknowledge that the dates where returns have been registered could have also contained sales, with the returns potentially outnumbering sales to make the total

negative. This problematic practice can have affected recorded values where the sum of sales and returns was positive, leaving no perceivable trace of the reclamation. It also raises doubts about the registered sales being exclusively based on ordered quantities instead of delivered. The unclear nature of the negative values, and the unknown repercussions the underlying practice has had on other positive values, raises concerns about the validity of the dataset.

The high number of articles with negative values, combined with the significant duration of the affected time period, covers such a considerable portion of the limited time span of the total dataset that removing the section is not a viable option. The dataset is complete in the sense that it contains sales data for all articles on all dates, but the nature of the negative sales constitute missing values that require action. Missing values can negatively impact the performance of ML models, and should be addressed to preserve the integrity of the dataset. A common approach is to replace the missing values with the mean, but this can increase the risk of overfitting [8]. LSTM networks are however capable of handling missing values [3], suggesting it is possible to zero out the negative sales. The decision was made to initially replace all negative values with zero, allowing for replacement with mean values at a later point to investigate the effect on model accuracy.

Several examples of items that remain included in the dataset with negative sales are visible in figure 3.1.

Inconsistent sales

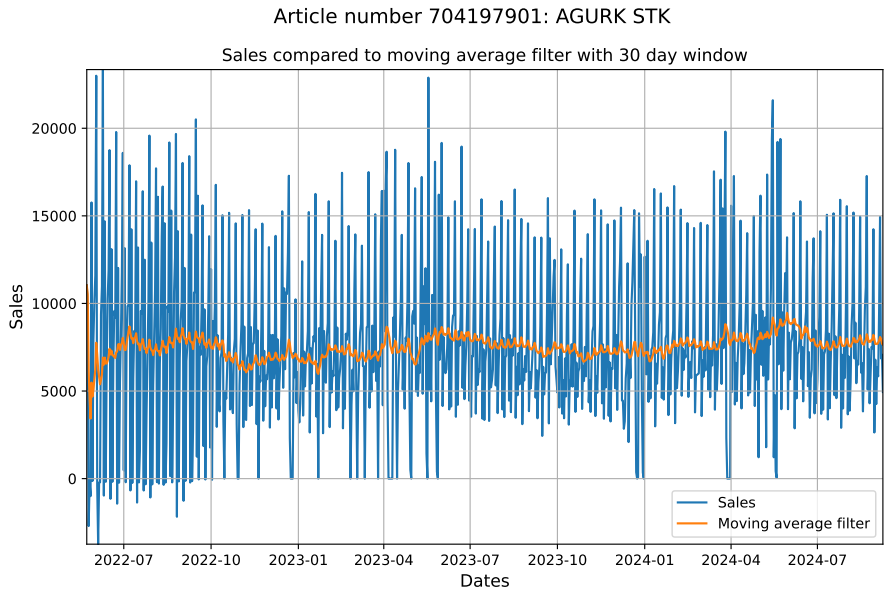

Figure 3.4: Example of article with regular sales.

Predictions may be inaccurate for articles with irregular sales. Figure 3.4 shows an example of an article with largely regular sales, which should provide a basis for sensible predictions. Sales may be inconsistent for articles that have recently been discontinued, are unavailable or have just been introduced. The predictive model is likely to more accurately foresee sales that follow a consistent pattern than those with irregular patterns.

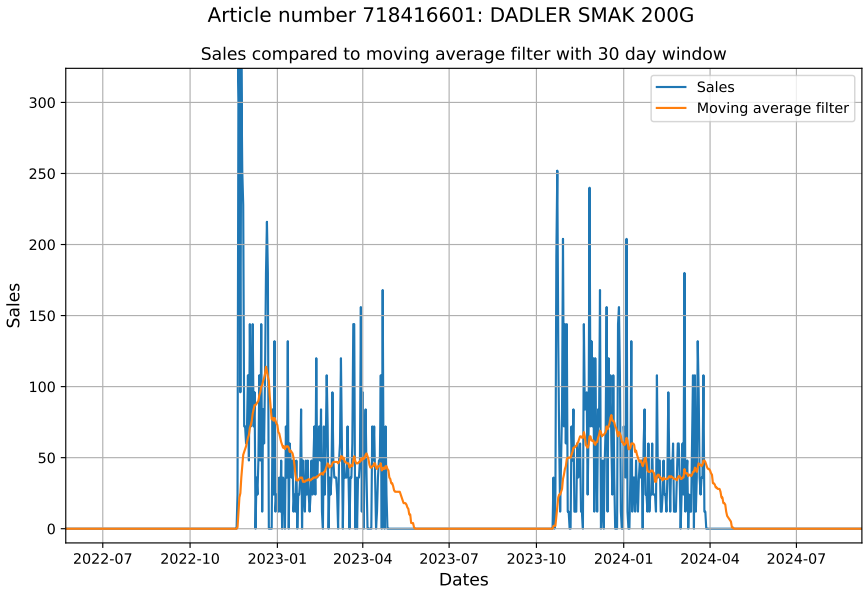

Figure 3.5: Example of article with seasonal sales.

Removing discontinued articles based on zero sales for the last year prunes the dataset for some of the inconsistencies, relieving the model of the burden of making predictions about articles that are no longer in sale. The limit of one year ensures that seasonal articles remain in the dataset, but prevents removal of articles that have been recently discontinued. Figure 3.5 shows an example of an article with regular seasonal sales, while figure 3.6 shows an example of a discontinued article that is not removed due to sales within the last year. Proper pruning of the dataset requires more specific knowledge about the discontinuation of articles, which has not been made available for this bachelor thesis.

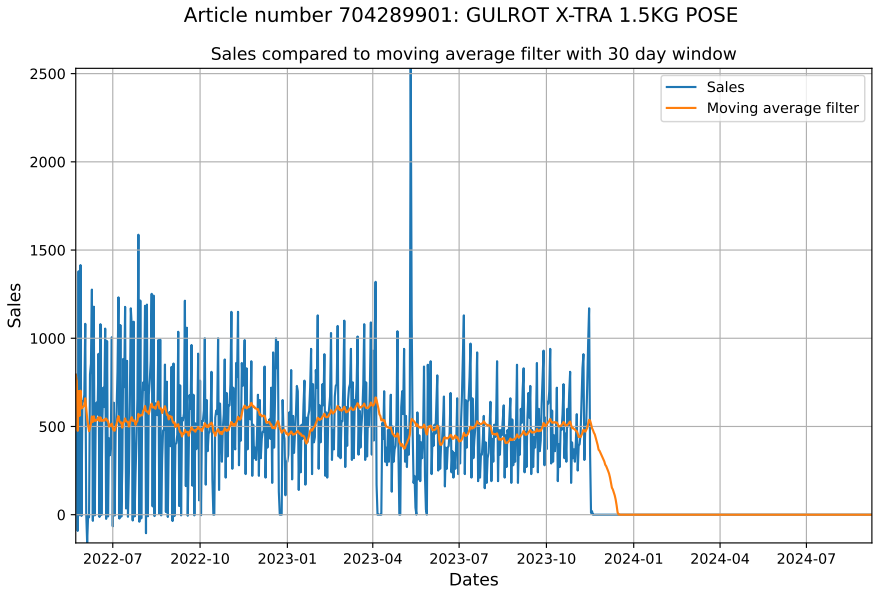

Figure 3.6: Example of article that has been discontinued within the last year.

Articles that are unavailable for periods of time that does not follow a seasonal pattern can also be challenging, since there is a dip in sales that cannot be explained by the features of the sample. Figure 3.7 shows sales of an article that seems to have been unavailable for a period of time, before sales start again at the end of the tracked time period.

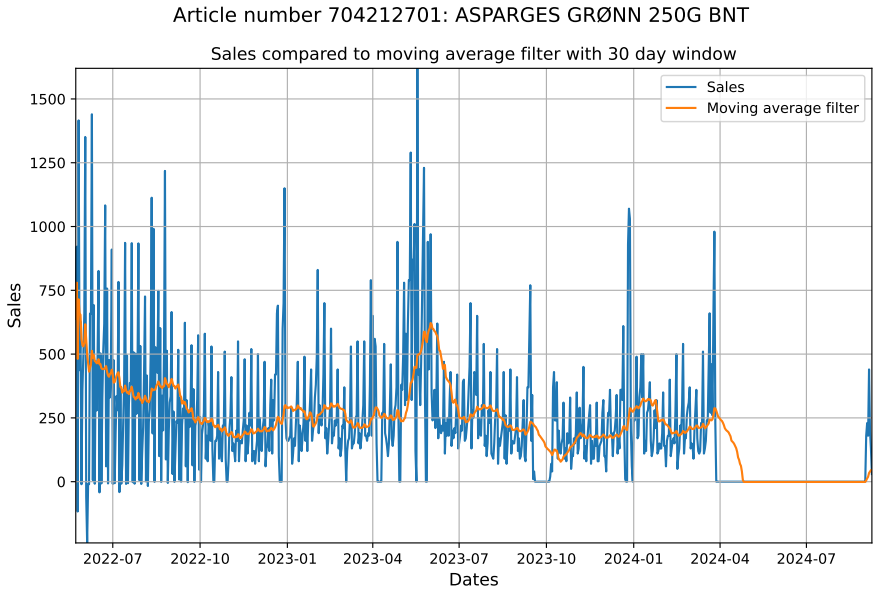

Figure 3.7: Example of article with unexplainable dip in sales.

The introduction of new articles is also potentially challenging, giving the model a more limited foundation for making predictions. Figure 3.8 shows an example of a recently introduced article. The model does however have the potential to learn what to expect from these inconsistencies after observing a number of them, and may derive rules from the provided data that support sensible predictions. The ideal solution to these challenges would be to have information from Coop about product availability for each article article on all dates, which would likely explain inconsistent patterns. This solution is further discussed in section 3.3.3 about feature selection.

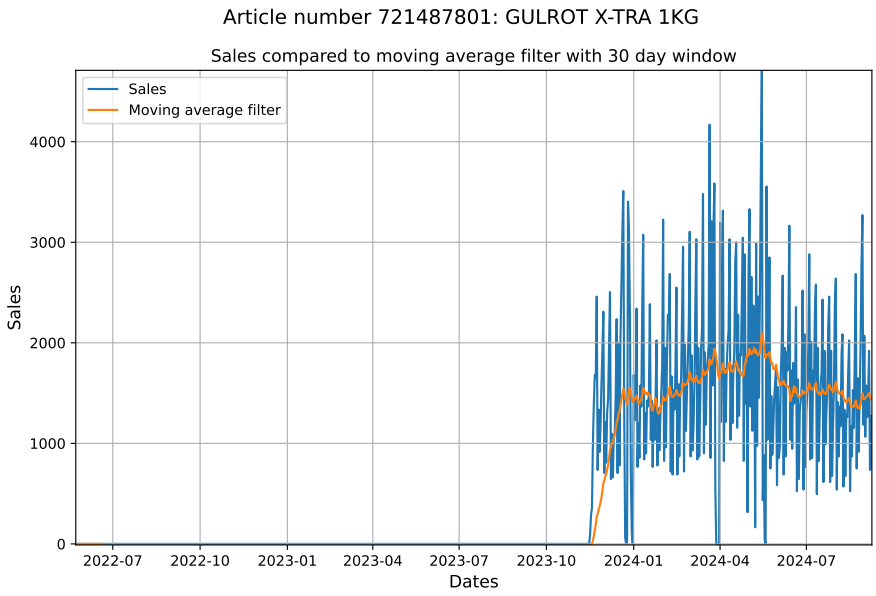

Figure 3.8: Example of recently introduced article.

Limited time span

The relatively short time span of the dataset may challenge the accuracy of model predictions. The dataset spans 840 days, and must serve as both training and test data. Ideal model creation supposes a three way split of the dataset into a training, testing and validation part, where the validation set is used to help set hyperparameters. K-fold validation can be employed with small datasets, rotating which part of the dataset is used for validation during training [8]. Part of the model's feature creation is based on the effect of holidays on sales, with moving holidays potentially presenting an interesting trend that follows their distribution. Since the dataset barely covers 2 years, and a test set is absolutely necessary to evaluate model performance, there is not enough data to provide a validation set. K-fold validation is not employed, because it requires more training time to rotate the validation set, making model implementation increasingly computationally expensive.

The short time span of the data set reduces the model's ability to learn and increases the possibility of overfitting. With a 80/20 split between training and

test data, the training data does not cover two full years, leaving few examples of how sales develop cyclically through the course of a year. Small training sets make models vulnerable to overfitting [8]. The lack of several yearly cycles limits the model's opportunity to learn patterns regarding seasons, holidays and the general economic development of the business and their market share, potentially making the model prone to overfitting.

3.3 Dataset operationalization

Information from the dataset is operationalized to provide input and output data for the LSTM demand forecasting model.

3.3.1 Data extraction

The dataset provide the informational foundation of the demand forecasting model. The dataset provide dates with associated sales for specific articles, in addition to information about active campaigns.

Sales data

Sales data was extracted from Excel files to a csv file to make processing simpler. All the sales data was extracted from the original 6 sheets in the two Excel files of the dataset, and processed into a single file with separate lines for each sale. This included extracting the dates from the header, and matching them with the sales data from each row. Figure 3.1 shows how the dates are in the header and each row contains numerous sales for a specific article, while figure 3.9 shows how the sales data is presented in the final csv file. Each line contains article number, year, month, day, holiday status and sale separated by semicolons. Holiday status is determined by checking if there was a national Norwegian holiday on the given date, and is coded as 0 for inactive or 1 for active. The applied sequence of extraction ensured the csv files are ordered by article numbers, with all sales in chronological order.

```
704036801;2024;9;5;0;714.0
704036801;2024;9;6;0;324.0
704036801;2024;9;7;0;306.0
704036801;2024;9;8;0;234.0
704037301;2022;5;23;0;63.0
704037301;2022;5;24;0;54.0
704037301;2022;5;25;0;-10.0
704037301;2022;5;26;1;95.0
```

Figure 3.9: Examples of lines in the dataset csv file. Each line contains article number, year, month, day, holiday status and sale.

Article names and numbers

Translations from article numbers to names is extracted from the original Excel file to a dictionary with article numbers as keys, with their names as values. The articles are assigned a value from 1 to 325, which is used for indexing during one-hot-encoding. Figure 3.10 shows an excerpt from the article dictionary. Another dictionary was created with the one-hot encoded values as keys to ensure optimal search time during translations. Both dictionaries are stored as json files for easy access.

```
704197901: {'name': 'AGURK STK', 'number': 1}
704036701: {'name': 'AGURK ÄNGLAMARK STK', 'number': 2}
704317401: {'name': 'ANANAS STK', 'number': 3}
704285801: {'name': 'APPELSIN KG', 'number': 4}
704306201: {'name': 'APPELSIN RØD SMAK 1KG NETT', 'number': 5}
704203501: {'name': 'APPELSIN X-TRA 2KG NETT', 'number': 6}
720042001: {'name': 'APPELSIN ÄNGLAMARK STK', 'number': 7}
704211001: {'name': 'APRIKOS SMAK 350G KURV', 'number': 8}
704212701: {'name': 'ASPARGES GRØNN 250G BNT', 'number': 9}
704041601: {'name': 'AUBERGIN IMP STK', 'number': 10}
```

Figure 3.10: Article dictionary with translations from article number to name and one-hot encoded index value.

Campaign data

Campaign data is extracted directly from the two Excel files that contain it when needed. The information is stored in objects of a campaign class, which prevents the dictionary from being stored in json format because of the nature of the objects. Figure 3.11 shows the class that was constructed to store information about campaigns, including article number, start date, end date and hosting supermarket. The class is used to store an object for every campaign that is hosted by a specific supermarket for a given article, and it includes a method for checking if a campaign is active on a specific date. Active campaigns are appended to a list that is used for a single sample, keeping track of all supermarkets hosting a campaign for the product on a given date.

```
# Campaign class.
class Campaign:

    # Start and stop of campaigns for specific store.
    def __init__(self, article_no, start_date, stop_date, store_no):
        self.article_no = article_no
        self.start_date = start_date
        self.stop_date = stop_date
        self.store_no = store_no


    # Standard print of object.
    def __str__(self):
        return f"{self.article_no}: {self.start_date}, \
            {self.stop_date}, {self.store_no}"


    # Checking if campaign is active for specific date.
    def check_campaign(self, date, campaign_list):
        if self.start_date <= date <= self.stop_date \
            and self.store_no not in campaign_list:
                campaign_list.append(self.store_no)
```

Figure 3.11: Constructed class for campaign objects.

3.3.2 Feature selection

The selection of features intends to provide enough information about each sample to exhaustively describe all factors driving demand. The suggested features are detailed below. These serve as the starting point for creating an initial model, where the relevancy of the different features is tested. Features that increase model accuracy are included in further model optimization.

Article number

The simplest way to differentiate a variation in sales is to separate the different articles from each other by article numbers. This is the most important feature since there is a considerable difference in sales for the different articles, making the inclusion of article number indispensable.

Holiday status

Certain holidays affect the sales of specific articles. One tested feature determines if it is a national holiday in Norway in the specific time step for the sample. This is likely to be especially important for moving holidays with seemingly erratic patterns like Easter. The effect on model performance of introducing the holiday feature is evaluated.

Active campaigns

Active campaigns are likely to affect the sales of products. Different chains of supermarkets have their own profile and key demographics, meaning that active campaigns for certain articles are likely to have outcomes that vary according to which supermarket is hosting the campaign. The samples have a feature that determines if there is an active campaign on a given date, and which stores are hosting the campaign.

Month and weekday

The temporal dimension of the data affects sales. The most logical feature in a time series analysis is assumedly the point in time itself. The LSTM network does

not necessarily need specific dates, since the distance between each sample is constant by one day. The network models the development of sales in the time series, and make predictions based on its movements [12]. LSTM networks are specifically developed to find temporal patterns in time series, and can detect long and short-term dependencies using three gates that control the flow of information in and out of the memory cell at each timestep. The input gate allows information deemed as important to be stored in the memory cell, while the forget gate discard information deemed to no longer be important from the memory cell. Lastly, the output gate controls the information output from LSTM network. It is this retention of important information in the memory cell for each time step that enables the network to detect long-term dependencies [13]. Trials are made to determine if references to months or weekdays are necessary, considering if the model performs similarly based on sequential data without any reference to dates other than holiday status.

3.3.3 Missing features

Having additional relevant features can potentially increase the accuracy of the prediction model. Some relevant features are not implemented because they are either unavailable or beyond the scope of this bachelor thesis due to time constraints.

Availability

Information about article availability has not been made accessible for this bachelor thesis. Using availability as a feature is likely to increase model accuracy considerably. This feature can ensure that unavailable articles always are correctly predicted with sales of zero. Information about unavailability can also explain inconsistencies in sale patterns like discontinuation of articles or unexpected dips in sales, as well as determining which dates seasonal goods are available.

Clustering article types

Clustering similar articles together can help the model anticipate variations in individual sales based on changes in the group. Huber et al. [1] make a case for

clustering similar articles together to be able to make predictions about the aggregated demand for an article group in addition to each individual item. They argue that this top-down perspective enables suppliers to validate the sum of individual predictions for types of articles, increasing the ability to monitor changes for specific articles that can affect the demand for other items in the cluster, with the unavailability of one item increasing demand for other similar items. They write that demand forecasting based on clustering is especially beneficial for suppliers when a product is highly substitutable, preventing customer dissatisfaction by providing a replacement for items that are out of stock. Clustering the articles in Coops dataset can mitigate problematic effects of inconsistent sale patterns. Figure 3.3 shows the discontinuation of 1.5 kg bags of carrots at Coop, and figure 3.8 shows the introduction of 1 kg bags happening at the same point in time. This intuitively logical switch of products is inconvenient for a demand forecasting model that does not know that there is a relationship between the two items. Having a feature that connects the two articles to the same cluster combined with information about availability can help the model predict an increase in the sale of one product determined by the decreased sales of the other. The combination of clustering and availability features is likely to have a positive synergistic effect on model performance.

Sale prices

Having sale prices for articles would be beneficial, but is not made available for this thesis. This is partially because the distribution center supplies a range of supermarkets that all operate with their own prices. There is available pricing for specific product campaigns, but there are no regular prices to use as a reference point for comparison. Developments in sale prices are likely to affect customer demand, making a feature for price probable to increase forecasting precision.

Weather

Information about weather could explain spikes in sales for different articles. Sales of certain fruits and vegetables are likely to vary with the weather, rendering a weather feature as potentially relevant for prediction precision. Weather data could potentially be gathered for the region of supermarkets, but would constitute an extensive effort that is beyond the scope of this bachelor thesis.

3.3.4 One-hot encoding

Numerical features have inherent value that can affect model training. The suggested features of article numbers, holiday status, date and active campaigns all have a numerical dimension in the training data. ML models require categorical data to be translated to numerical values, which initially have an inherent ordinal value. One-hot encoding categorical values removes the ordinal value by having a single binary feature for each option that is either activated by the number 1, or deactivated by 0. This avoids ranking different values that have no intrinsic comparative worth, giving increased diversity in the perception of categorical features and making a better foundation for training. One-hot encoding increases the dimensionality of samples significantly, thereby increasing complexity and impacting training time negatively, with a heightened potential for overfitting. Careful selection of a minimum of features can mitigate these negative effects [14]. One-hot encoding remove ordinal value from the selected features article number, holiday status, active campaigns, weekday and month.

The majority of the considered features have inherent ordinal value. Article numbers have high values that are arbitrarily ordered in relation to each other, which necessitates one-hot encoding to separate them. This dramatically increases sample dimensionality since there are 325 different articles, but is the decidedly most important feature since it is indispensable for the creation of a demand forecasting model. Holiday status is initially a one-hot encoded value, the alternative would be to have a number representing each individual holiday, which would create a hierarchy where value is inferred. It is also possible to have an individual one-hot encoded category for each holiday that is either active or not, but this increases the dimensionality without adding more information since the holidays are cyclical within the sequential data. Months and weekdays are all numerical values that can be one hot encoded, with 12 months and 7 weekdays. One-hot encoding months and weekdays remove any misperception of ordinal comparative value, with the consequences of increasing sample dimensionality, complexity and processing time while potentially improving model accuracy. Active campaigns are hosted by supermarkets which have an individual numerical code, which again implies an ordinal relationship to the other stores. One-hot encoding stores remove the implied values, and ensure that several stores can have a campaign for a single article simultaneously, which increase the quality

and flexibility of the training data. The ordinal values of the selected features are neutralized by one-hot encoding them.

3.3.5 Sequence creation

The input data for the LSTM model needs to be organized in sequences. LSTM networks take a specific number of samples in each sequence as training input, and link it to the sale for the next sample after the last in the sequence. The trained network needs an input sequence with a specific number of samples to provide a prediction for the next sample. The samples of a sequence shift by one for each new sample, meaning a sequence with 3 samples use the last 2 samples from the preceding sequence for the next sequence [15]. The number of samples in a sequence are referred to as sequence length. Figure 3.12 shows the function that creates the sequences used for training and testing, taking a dictionaries with samples and target data as input parameters to return numpy arrays with sequences. Input sequences are organized with a determined length, and have a corresponding target output that constitute the sale of the sample immediately following the last of the sequence.

Figure 3.13 shows a simple example of how to organize the lines from the dataset in sequences with length 3, where the lines contain article number, year, month, day, holiday status and sales. The sales are target data that is not used for input in the model, but serve as output data for the sequences. Each sequence predicts the sales of the next sample or time step. This is a simplified example for demonstration purposes only, as the actual sequences that are used are one-hot encoded with far higher dimensionality. A quick way to understand the example is by paying attention to the fourth column showing the day of the month, observing a sliding window from one sequence to the next that moves one day at a time. Notice that the input sequences are nested in an overarching list containing them all, with each sample nested as a list within the sequence. The output sequence is just a single list with target data corresponding to each input sequence. The input sequences in the example have shape (2, 3, 5), meaning there are 2 sequences with 3 samples, where each sample has 5 features. The output sequence have shape (2,), denoting that there are 2 target values corresponding to the 2 input sequences.

```
# Creates sequences based on sequence length
# from input and output dictionaries.
def create_sequences(input_dict, output_dict, seq_length):

    # Function creates sequences for input and corresponding output data.
    # input_dict = one-hot encoded input data
    # output_dict = target data.
    # seq_length = length of input sequences.

    # Creating lists to hold input features and output targets.
    input_sequences = []
    output_sequences = []

    # Looping through all articles in input dictionary.
    for article in input_dict:

        # Creating sequence starting from index i in input.
        for i in range(len(input_dict[article])-seq_length):

            # Creating list with input sequence.
            input_sequence = input_dict[article][i:i+seq_length]

            # Appending input sequence to list of input sequences.
            input_sequences.append(input_sequence)

            # Appending single target value for input
            # sequence to output list.
            output_sequences.append(output_dict[article][i+seq_length])

    return {'input': np.array(input_sequences), \
        'output': np.array(output_sequences)}
```

Figure 3.12: Function that creates sequences for training and testing.

```
Original data:

704884301;2022;11;1;0;152.0
704884301;2022;11;2;0;360.0
704884301;2022;11;3;0;616.0
704884301;2022;11;4;0;88.0
704884301;2022;11;5;0;256.0

Input sequences:

[[[704884301, 2022, 11, 1, 0],
[704884301, 2022, 11, 2, 0],
[704884301, 2022, 11, 3, 0]],
[[704884301, 2022, 11, 2, 0],
[704884301, 2022, 11, 3, 0],
[704884301, 2022, 11, 4, 0]]]

Output:

[88.0, 256.0]
```

Figure 3.13: Original data with target data converted to input sequences of length 3, with corresponding output.

3.4 Proposed Solution

Based on the review of related works and evaluation of the dataset and features, the intention is to implement an LSTM network for demand forecasting. The approach to create a generalized LSTM model proposed by Abbasimehr et al. [9] serves as a starting point. Figure 3.14 show a diagram describing the processes necessary to create their LSTM model, from data preprocessing and operationalization to hyperparameter tuning and model testing. Systematically testing combinations of hyperparameters is intended to optimize a model for a specific dataset, focusing on 7 hyperparameters that include sequence length, number of hidden layers, number of neurons in each layer, dropout rate, learning rate, batch

size and number of training epochs.

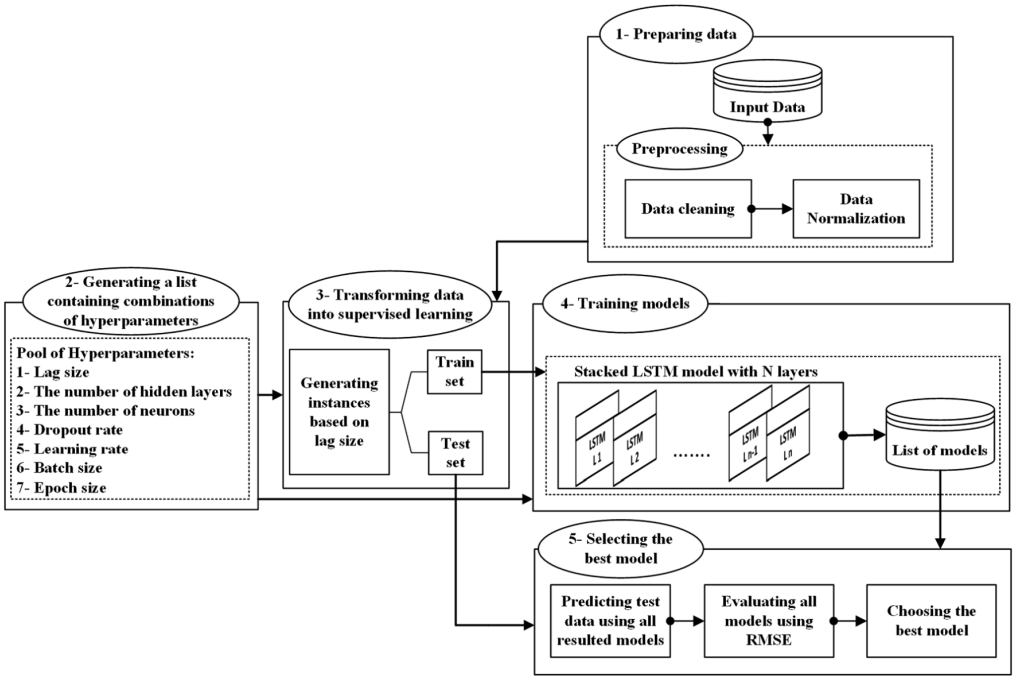

Figure 3.14: Steps to construct generalized LSTM model as detailed by Abbasimehr et al. [9].

Introductory experimentation leads to an initial starting point with an LSTM model with one-hot encoded features for article number, holiday status, campaigns, weekday and month. The sequence length is set to 5 days based on experimentation during the exploration phase of the thesis, compromising between having enough days to make accurate predictions and keeping the sequences short enough to be able to train within reasonable time. The sequence length of 5 is considered to be long enough to see clusters of holidays in relation to each other, such as Easter that consists of a number of consecutive days. Table 3.1 shows hyperparameter settings suggested by Abbasimehr et al. [9]. The suggested values are too computationally demanding to investigate within a reasonable time for this bachelor thesis, but their proposed approach serves as a general strategy for model creation.

The initial model is used to test which features are advantageous for model

Hyperparameter	Values
Sequence length	[10, 11, 12, 13]
Number of hidden layers	[2, 3, 4]
Number of neurons per layer	[4, 8, 16, 32, 64, 128]
Dropout rate	[0.05, 0.1, 0.15, 0.2, 0.25]
Learning rate	[0.01, 0.001, 0.0001]
Batch size	[1, 5, 10, 20]
Epoch size	[50, 100, 200, 300, 400, 500]

Table 3.1: LSTM hyperparameters suggested by Abbasimehr et al. [9] for a generalized demand forecasting model.

performance, assuming the effects of feature selection on prediction accuracy for one model are transferrable to other configurations of LSTM networks. Further testing of hyperparameters ensues after deciding features, with the goal of finding the optimal architecture for demand forecasting based on the available dataset. Implemented model architecture is simpler than the model proposed by Abbasimehr et al. [9] to ensure computational resources are available to conduct the experiments. The results of different combinations of hyperparameters are evaluated to determine their effects.

The LSTM implementations are created using the Python library Keras. Keras is a high-level language API that runs on top of TensorFlow to simplify the process of building and training neural networks, lowering the threshold for beginners to implement functional LSTM machine learning models. It allows for fast and simple testing of neural networks [16]. The simplicity of the Keras API enables fast implementation and testing of LSTM models for demand forecasting.

Chapter 4

Experimental Evaluation

This chapter describes experiments conducted to create and evaluate an LSTM demand forecasting model for the dataset supplied by Coop. Initial models with a distinct set of features are created by testing different combinations of hyperparameters, where the highest performer is chosen for testing the relevancy of selected features. The intial model is evaluated after validating selected features, and further optimized by expanding hyperparameter testing. The resulting optimized model has slightly more complex architecture with marginally higher performance. Strategies such as stacking LSTM layers, replacing missing values with mean and removing problematic articles are tested to increase performance for the optimized model, showing no improvement in R^2 score. The experimental results indicate that introducing more descriptive features and validating the quality of the dataset may be helpful strategies for improving model performance.

4.1 Experimental Setup and Data Set

The original dataset contains demand data for 429 articles spanning 840 days, which has been reduced to 325 articles during the initial data cleaning process. Light-weight combinations of LSTM hyperparameters are tested to determine which of the simple models has the highest accuracy, serving as a starting point for testing feature relevancy. Further testing of hyperparameters is conducted after validating features in an attempt to increase prediction accuracy, where performance for specific articles is investigated to determine model strengths and weaknesses. Applicable adjustments to missing values and problematic articles

in the dataset are tested in an attempt to further increase accuracy.

4.1.1 Dataset

The dataset is split into a training set that contains the first 80% of the data, and a test set that contains the remaining 20%. Out of the total 840 days, 672 days are used for training and 168 for testing. The training period spans from 23 May 2022 to 24 March 2024, and the test period spans from 25 March 2024 to 8 September 2024. The split dataset is organized into sequences to be used as input to the LSTM network.

4.1.2 Initial model creation and feature selection

The initial phase of experimentation begins with a number of assumptions about feature selection and model architecture. Decisions about initial features are made to have a starting point for evaluating the performance of an LSTM model, and are based on investigative experimentation in the preparation phase of the bachelor thesis. The number of features is a good determinant for the number of neurons in a model [17]. Testing starts with half as many neurons as features, then continue to multiply by two until model performance decreases. Models with more than 702 neurons are computationally expensive to train, and have not been included in the initial model creation. A series of lightweight models are created to assess which model performs the best with the given training data and selected features. The best performing model is chosen to test the relevancy of the features by removal and reintroduction. The 351 initial features are listed table 4.1.

Feature	**One-hot encoding**
Article number	Categories from 1 to 325
Holiday	Single category (active/inactive)
Campaigns	Categories from 1 to 6 (hosting supermarket)
Weekday	Categories from 1 to 7 (Monday to Sunday)
Month	Categories from 1 to 12 (January to December)

Table 4.1: Input features used for initial LSTM model creation.

54 models are created with training data containing the features listed in table

4.1. The models are made by systematically creating all combinations of the hyperparameters in table 4.2. Sequence length, the number of neurons and amount of training epochs have been set low to keep training time to a minimum.

Feature	**Values**
Optimizer	Adam
Number of features	351
Sequence length	5
Number of epochs	5
Loss function	Mean squared error
Batch size	32
Number of neurons	[176, 351, 702]
Learning rate	[0.01, 0.001, 0.0001]
Dropout rate	[0.00, 0.05, 0.10, 0.15, 0.20, 0.25]

Table 4.2: Constant and variable hyperparameters of initial models.

The optimizer Adam and loss function mean squared error are according to suggestions made by Abbasimehr et al. [9] for their proposed generalized demand forecasting LSTM model, agreeing with findings from the initial exploration phase of this thesis. The implemented code produces plots and printed statistics for all models, and their performance is sorted by R^2 score. The best performing model is chosen for testing feature relevancy.

4.1.3 Feature evaluation

Feature experimentation begins with the highest ranking initial model, checking the effects of removing features and reintroducing them on prediction accuracy. R^2 score is an evaluation metric that gives an intuitive understanding of prediction accuracy by determining the percentage of variation around the mean that is explained by the features of a sample, with scores equal to 1 representing 100% [18]. Adding and removing features have a direct effect on R^2 score, giving quick feedback if the features increase prediction accuracy [19]. New models are created with different training sets that contain the combinations of features listed in table 4.3. Each test has one model with the same amount of neurons as the initial best performer, and another model where the amount of neurons is determined by the new number of features.

Section	Feature Combinations
4.2.2	Article number
4.2.2	Article number and holiday status
4.2.2	Article number, holiday status and active campaigns
4.2.2	Article number, holiday status, active campaigns and weekday
4.2.2	Article number, holiday status, active campaigns, weekday and month
4.2.2	Article number, holiday status, active campaigns, weekday, month and year

Table 4.3: Combinations of features to be tested to determine relevancy.

It is inherently problematic to optimize a model for a set of features, and then use the optimized model to test the relevancy of the features. This is a simplistic approach to get an indication if the selected features improve model performance without employing considerable computational resources. A more appropriate method would be to optimize the model for each set of features, and comparing results across different models, requiring much more time and computational resources. Different configurations of hyperparameters have direct effects on model accuracy, but manually tuning hyperparameters to determine the optimal combination is a time-consuming affair that requires numerous experiments [20]. The initial model is very simple, and serve as a starting point for testing features and further performance optimization.

4.1.4 LSTM model optimization

Model performance is investigated after testing the relevancy of the selected features, with the intention of improving prediction accuracy.

Initial model evaluation

Further LSTM model optimization starts with the initial model that was used for testing the relevancy of the features. The same model is created with the number of training epochs ranging from 1 to 20 to evaluate the effect of increasing the number of epochs. A model converges at a point where the predictions and loss stabilizes. Convergence happens at a point of minimum errors, but the minimum can be a local saddlepoint rather than the global minimum, which can give a false indication that the model has reached optimal configuration [21, 22]. A

plot detailing the development of prediction accuracy for the test and training set during 20 training epochs is used to determine if and where the model converges, trying to identify an ideal number of training epochs. Models with 50 and 100 epochs are created to investigate the effect of further increasing the number of training epochs. The difference in R^2 for test and training predictions indicates if the model is overfitting.

LSTM hyperparameters optimization

The search for an optimal model is continued by extending the search with more computationally expensive methods. 160 new models are created by combining all the different hyperparameters in table 4.4. The number of epochs has been doubled compared to the initial models, a network with 1404 neurons is added, and experiments are now conducted with different sequence lengths. The span of learning rates and dropout rates have been narrowed to limit the number of models created.

Feature	**Values**
Optimizer	Adam
Number of features	351
Sequence length	[5, 7, 10, 15]
Number of epochs	10
Loss function	Mean squared error
Batch size	32
Number of neurons	[176, 351, 702, 1404]
Learning rate	[0.01, 0.001]
Dropout rate	[0.05, 0.10, 0.15, 0.20, 0.25]

Table 4.4: Constant and variable hyperparameters used to further optimize the initial demand forecasting model.

The model with the combination of hyperparameters from table 4.4 that has the highest accuracy is selected for further experimentation. The number of training epochs is increased to determine if it improves accuracy. 10 models are created with training epochs numbering from 10 to 100, with steps of 10 epochs between. The effects are evaluated to determine if the model converges with higher accuracy after increasing the amount of training epochs. A number of epochs is

run around the area of convergence in an attempt to fine-tune the optimal training cycle.

Stacking LSTM layers

The number of layers is increased for the optimized model to determine the effect on prediction accuracy. Stacking LSTM layers is a common strategy to increase model performance[23], but it requires more computational resources and increase chances of overfitting [24]. The initial strategy for neuron selection is used for a second LSTM layer, halving the number of neurons in the preceding layer and continuing to multiply it with two while there is a continued increase in accuracy. The initial process tests 4 different sets of neurons to test if accuracy improves.

Optimized model evaluation

The highest ranking model is compared to the initial model. Articles with high and low accuracy are investigated to determine if there are any patterns that determine performance. Test results for articles with specific sale patterns discussed in section 3.2.2 are plotted to determine how the model adapts to different patterns.

Revising missing values

The strategy for handling missing dataset values is changed to attempt to increase prediction accuracy. The negative sales that have originally been replaced with zeroes during initial data cleaning are now replaced with the training period mean. Badilllo et al. [8] have listed this as a common approach to mending missing values, but warn against increased danger of overfitting. Changes in prediction accuracy for the training and test set is evaluated to determine if this change has any effect, checking if it improves test accuracy or leads to more overfitting.

Revising article reduction

A final adjustment of the dataset attempts to increase prediction accuracy by improving input data quality. Articles with no sales during the test period are removed to check if this can improve model performance. This removes articles

that have been recently discontinued or unavailable during the test period, preventing the model from making inaccurate sales predictions about them. This is not a viable long-term solution since it also removes seasonal articles that are not in sale during the test period, but it may reveal which strategy is best for handling missing values.

4.2 Experimental Results

This section report the results of the experiments described in section 4.1. It starts with the creation of an initial model that is used for testing feature relevancy, and proceeds to tune the hyperparameters of the initial model for further optimization. The final stage makes adjustments to the dataset to determine the importance of input data for prediction accuracy.

4.2.1 Initial model creation results

54 simple LSTM models were created to find a starting point for testing which features are relevant. Table 4.2 show the initial hyperparameters that were systematically tested to find the optimal combinations. Table 4.5 show the 54 models ranked by R^2 scores, with the best performing model achieving a score of 0.5879. Appendix C shows a comprehensive list of initial model performance for each individual article sorted by R^2 score. It is worth noting that this model with 351 neurons won by a narrow margin of 0.0061, closely followed by other models with 176 neurons. The R^2 score changes slightly every time a new model is created with the same configuration, meaning models may be ranked differently for another training cycle. This issue can be handled by creating a set number of each model and taking the average R^2 score, but this would increase processing time considerably. It is fair to assume top model ranking is partially coincidental since other models with different numbers of neurons and dropout rates performed similarly, but the ranking gives an indication of which combinations of hyperparameters are beneficial.

Initial models ranked by R^2 score				
Optimizer = Adam Epochs = 5		Features = 351 Loss function = MSE	Sequence length = 5 Batch size = 32	
Neurons	**Learning Rate**	**Dropout Rate**	**RMSE**	**R^2**
351	0.01	0.0	741.52	0.5879
176	0.01	0.0	743.99	0.5852
176	0.01	0.1	748.93	0.5797
702	0.001	0.0	750.23	0.5782
176	0.01	0.15	750.60	0.5778
702	0.01	0.0	751.22	0.5771
176	0.01	0.05	752.09	0.5761
176	0.01	0.2	754.83	0.5730
702	0.001	0.2	756.68	0.5709
351	0.01	0.05	756.78	0.5708
351	0.01	0.1	757.82	0.5696
351	0.01	0.2	758.54	0.5688
351	0.01	0.25	758.88	0.5684
702	0.001	0.1	759.77	0.5674
702	0.001	0.05	759.86	0.5673
176	0.01	0.25	760.46	0.5666
702	0.001	0.25	766.32	0.5599
702	0.01	0.1	766.58	0.5596
702	0.001	0.15	769.77	0.5559
351	0.01	0.15	771.12	0.5544
702	0.01	0.25	777.63	0.5468
702	0.01	0.05	781.83	0.5419
702	0.01	0.2	785.70	0.5374
702	0.01	0.15	787.10	0.5357
351	0.001	0.05	809.86	0.5085
351	0.001	0.0	812.73	0.5050
351	0.001	0.1	814.45	0.5029
351	0.001	0.15	817.79	0.4988
351	0.001	0.25	819.76	0.4964

Neurons	Learning Rate	Dropout Rate	RMSE	R^2
351	0.001	0.2	824.42	0.4906
176	0.001	0.0	872.67	0.4293
176	0.001	0.05	877.55	0.4229
176	0.001	0.1	878.01	0.4223
176	0.001	0.15	882.63	0.4162
176	0.001	0.2	890.10	0.4062
176	0.001	0.25	891.32	0.4046
702	0.0001	0.0	983.02	0.2758
702	0.0001	0.05	988.66	0.2675
702	0.0001	0.15	989.73	0.2659
702	0.0001	0.1	989.97	0.2655
702	0.0001	0.2	991.30	0.2636
702	0.0001	0.25	995.35	0.2575
351	0.0001	0.05	1049.77	0.1741
351	0.0001	0.15	1051.33	0.1717
351	0.0001	0.1	1051.43	0.1715
351	0.0001	0.0	1052.27	0.1702
351	0.0001	0.2	1055.31	0.1654
351	0.0001	0.25	1056.95	0.1628
176	0.0001	0.05	1104.62	0.0856
176	0.0001	0.1	1105.01	0.0849
176	0.0001	0.0	1105.57	0.0840
176	0.0001	0.2	1107.36	0.0810
176	0.0001	0.15	1109.07	0.0782
176	0.0001	0.25	1110.96	0.0750

Table 4.5: 54 initial models ranked by performance, with variable hyperparameters and test scores specified for each model.

Similarities in top R^2 scores for different configurations indicate that several model architectures have similar abilities to provide predictions at approximately the same level for the specific dataset. The learning rate determines how fast

a network adjusts weights during training. Higher learning rates require fewer training epochs to converge, but is vulnerable to converging at points with sub-optimal accuracy. Smaller learning rates require more training time, and run the risk of not converging at all [25]. Having as few as 5 training epochs is likely to favor a higher learning rate, which is apparent in the model ranking. The list shows that a higher learning rate of 0.01 tends to produce more accurate predictions for models with 176 and 351 neurons, while models with 702 neurons seem to benefit from a lower learning rate of 0.001. The worst performing models consistently have the lowest learning rate of 0.0001. Models with fewer neurons have the very poorest performance with the lowest learning rate, indicating that lower learning rates need more neurons to produce accurate results at low numbers of training epochs. The highest ranking model in figure 4.1 is chosen for testing features.

```
Number of features: 351
Sequence length: 5
Number of epochs: 5
Learning rate: 0.01
Loss function: mse
Batch size: 32
Number of neurons: 351
Dropout rate: 0

Test results:
Mean absolute percentage error: 2.72e+17
Root mean squared error: 741.52
Mean absolute error: 233.31
R squared: 0.5879
```

Figure 4.1: Configuration and test scores for the highest ranked initial model with an R^2 score of 0.5879.

4.2.2 Feature evaluation results

Testing of feature relevancy begin with the highest performing LSTM model. All features except article number are removed, then reintroduced one by one. The models where the removal and introduction of features are tested has mostly the

same configuration as the highest ranked initial model described in figure 4.1, except changing numbers of features and neurons. Two models are created for each test since the number of neurons is initially based on the amount of features, one with 351 neurons like the initial model, and one with the same amount of neurons as the tested number of features. This ensures some consistency in architecture, where the best performing model of the two is selected for comparison to the initial model.

Article number

First step is to remove all features except article number, reducing number of features to 325 from 351. The article number features separate the sales of different articles from each other, and is therefore considered indispensable. There is a considerate drop in R^2 score after removing the other features, with the best test model achieving 0.3940 with 351 neurons. The complete configuration and test results is displayed in figure 4.2. The reduction in R^2 score implies that some of the removed features are important for increasing model accuracy.

```
Number of features: 325
Sequence length: 5
Number of epochs: 5
Learning rate: 0.01
Loss function: mse
Batch size: 32
Number of neurons: 351
Dropout rate: 0

Test results:
Mean absolute percentage error: 3.14e+17
Root mean squared error: 899.24
Mean absolute error: 270.67
R squared: 0.3940
```

Figure 4.2: Model configuration and test results with article number as only feature. There is a clear drop in R^2 from 0.5879 for the initial model to 0.3940 with the current model.

Article number and holiday status

Next step is to add holiday status to the features of the model. The holiday feature consists of only one dimension, increasing total number of features to 326. One model with 351 neurons and one with 326 is created. Adding holiday status lead to a negligible increase in R^2 score to 0.3957 for the model with 326 neurons. The configuration and test results are shown in figure 4.3. Intuitively the holiday status should improve accuracy by identifying holidays, with special importance for moving holidays such as Easter where sales are zero during the period. The holiday status provide a marker to separate holidays from the surrounding non-holidays. The positive effect on R^2 is negligible, but the rationale for including holiday status to identify moving holidays is intuitively sound.

```
Number of features: 326
Sequence length: 5
Number of epochs: 5
Learning rate: 0.01
Loss function: mse
Batch size: 32
Number of neurons: 326
Dropout rate: 0

Test results:
Mean absolute percentage error: 3.39e+17
Root mean squared error: 897.96
Mean absolute error: 278.99
R squared: 0.3957
```

Figure 4.3: Model configuration and test results with features article number and holiday status, showing a negligible increase in R^2 score after adding the holiday feature.

Article number, holiday status and active campaigns

The next experiment adds active campaigns to sample features, increasing total number of features to 332. One model with 332 neurons is created, and one with

351. Now there is a distinct rise in R^2 score from 0.3957 to 0.4575 using the model with 351 neurons, giving a clear indication that adding features that track active campaigns increase the accuracy of the model. The configuration and test results of this model is listed in figure 4.4.

```
Number of features: 332
Sequence length: 5
Number of epochs: 5
Learning rate: 0.01
Loss function: mse
Batch size: 32
Number of neurons: 351
Dropout rate: 0

Test results:
Mean absolute percentage error: 3.16e+17
Root mean squared error: 850.80
Mean absolute error: 268.47
R squared: 0.4575
```

Figure 4.4: Model configuration and test results with features article number, holiday status and active campaigns, showing a distinct increase in accuracy from R^2 score of 0.3957 to 0.4575 after adding active campaigns.

Article number, holiday status, active campaigns and weekday

Now the total number of features is increased to 339 by adding features for denoting the day of the week. Two models are created again, one with 339 neurons and one with 351. The introduction of weekdays raise the current R^2 value from 0.4575 to 0.5226 for the model with 339 neurons, giving a very clear indication that features for weekdays improve model accuracy. This finding implies that the inclusion of weekdays help the LSTM network detect weekly cyclical patterns. Figure 4.5 show the configuration and test results for this model.

```
Number of features: 339
Sequence length: 5
Number of epochs: 5
Learning rate: 0.01
Loss function: mse
Batch size: 32
Number of neurons: 339
Dropout rate: 0

Test results:
Mean absolute percentage error: 2.85e+17
Root mean squared error: 798.12
Mean absolute error: 234.48
R squared: 0.5226
```

Figure 4.5: Model configuration and test results with features article number, holiday status, active campaigns and weekdays. Model accuracy rose from R^2 score of 0.4575 to 0.5226 by introducing weekday features.

Article number, holiday status, active campaigns, weekday and month

The experiment has reached full circle, returning to the starting point that included all features. The initial model is the experiment of this section, which had an R^2 score of 0.5879, showing another distinct increase from the last experiment that had R^2 score equal to 0.5226. This implies that explicitly defining the months help the LSTM model detect the temporal pattern of monthly and yearly cycles, enabling better predictions.

Training run	R^2 score
1	0.5141
2	0.5506
3	0.5953
4	0.5523
5	0.5807

Table 4.6: Training reruns with 351 features.

For the sake of science, the model is created again to report the current R^2 score after adding features for months back. The model now scores 0.5191, which is considerably worse than its original score, and shows a decrease by adding the month features. This result demonstrate how model performance fluctuate during different training runs, emphasizing that the highest ranked model may have had the best score based on coincidence rather than merit. The training cycle is rerun a total of 5 times, with the results spanning from 0.5141 to 0.5953 listed in table 4.6. The initial starting point of an R^2 score of 0.5879 indicate that adding month features increases the model accuracy, and 4 out of 5 of the listed test runs also confirm this. The fluctuations in R^2 scores does however raise doubt about the selected model's superiority. The configuration and test scores of the most successful run is listed in figure 4.6.

```
Number of features: 351
Sequence length: 5
Number of epochs: 5
Learning rate: 0.01
Loss function: mse
Batch size: 32
Number of neurons: 351
Dropout rate: 0

Test results:
Mean absolute percentage error: 2.74e+17
Root mean squared error: 734.83
Mean absolute error: 231.33
R squared: 0.5953
```

Figure 4.6: The most successful training run with all 351 features, implying that adding features for months increase model accuracy.

Article number, holiday status, active campaigns, weekday, month and year

The initially clear indications of increased accuracy from adding the temporal dimensions of weekdays and months to the model features was dampened by the

conflicting and fluctuating results in section 4.2.2. A final experiment is done to check if the introduction of year features has an impact on model performance. The achieved test score of 0.5564 does not imply any added value from the introduction of year features, which is in accordance with assumptions about weekday and month features already implying weekly, monthly and yearly cycles for the LSTM model. The introduction of features that determine the year seem to be superfluous. Model configuration and test scores are listed in figure 4.7.

```
Number of features: 354
Sequence length: 5
Number of epochs: 5
Learning rate: 0.01
Loss function: mse
Batch size: 32
Number of neurons: 351
Dropout rate: 0

Test results:
Mean absolute percentage error: 5.04e+17
Root mean squared error: 769.35
Mean absolute error: 301.74
R squared: 0.5564
```

Figure 4.7: Model configuration and test results with features article number, holiday status, active campaigns, weekdays, months and year. Introducing features for years led to a slight decrease in R^2 score.

4.2.3 LSTM model optimization results

Findings in section 4.2.2 indicate that all the selected features are relevant for the initial model, legitimizing their further use in model development. This section continues to optimize the initial model hyperparameters to improve accuracy.

Initial model evaluation results

The initial model is trained with different numbers of epochs to determine the optimal training cycle. 20 new models are made from the same mold as the initial model with the hyperparameters listed in figure 4.1, and the number of training epochs spanning from 1 to 20. Figure 4.8 show the development of R^2 score for test and training set predictions for the initial model, and figure 4.9 show the development in RMSE mirroring the movement of R^2.

Figure 4.8: R^2 score development across training epochs for the initial model. The model converges after approximately 4 epochs.

Prediction accuracy for the test and training set seem to converge between 4 and 6 epochs. Model accuracy is converging at around 0.5600 for the test set and 0.7800 for the training set, and does not increase with more training epochs. The higher accuracy on the training set compared to the test set shows that the model is overfitting [8]. Some overfitting can be expected, but ideally the difference in R^2 for the training and test set should be smaller to show a greater ability to generalize predictions for the test set and the future beyond. Running the current model 50 and 100 epochs confirm that R^2 score does not increase with more

epochs and that the difference between training and test set remain somewhat constant, returning an R^2 score of 0.5447 and 0.5591 for the test and training set at 50 epochs, and 0.7692 and 0.7536 at 100 epochs. This suggests that the model has reached its predictive potential with the current dataset, features and hyperparameters, provided it has not reached a saddle point obscuring a higher peak of accuracy.

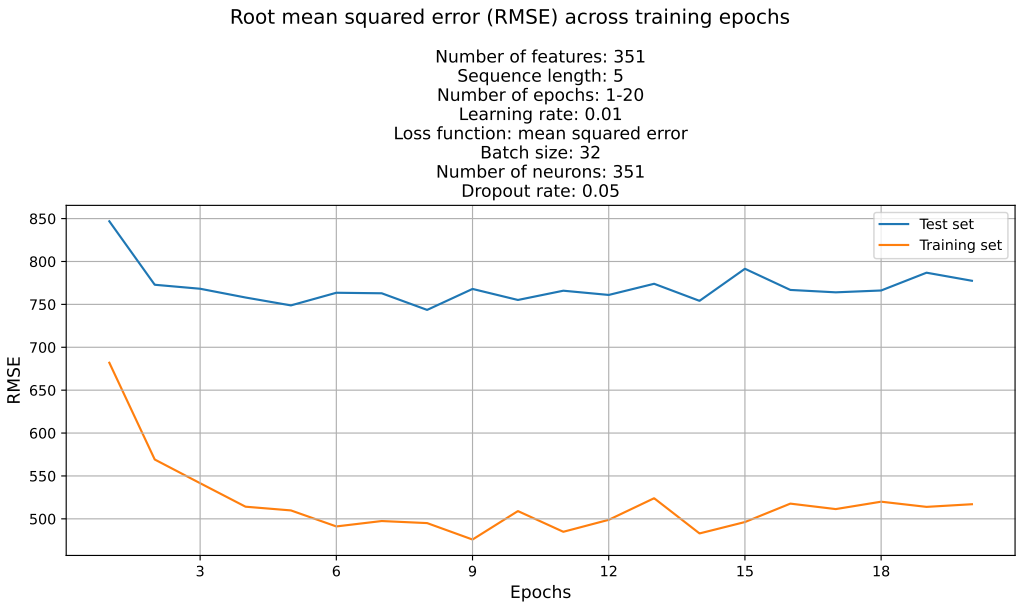

Figure 4.9: RMSE development across training epochs for initial model.

LSTM hyperparameters optimization results

Further tuning of hyperparameters is necessary to determine if it is possible to increase accuracy with the current dataset and features. 160 new models are created by combining all the different configurations of hyperparameters listed in table 4.4. The top 26 optimized models are listed in table 4.7. The highest performing model returns an R^2 score of 0.6154, narrowly improving on the highest ranked initial model. Appendix D shows a comprehensive list of optimized model performance for each individual article sorted by R^2 score.

Top 26 optimized models ranked by R^2 score					
Optimizer = Adam		Features = 351			
Epochs = 10		Loss function = MSE	Batch size = 32		
Sequence	**Neurons**	**Learning**	**Dropout**	**RMSE**	**R^2**
15	702	0.001	0.1	723.17	0.6154
7	702	0.001	0.05	728.38	0.6068
15	1404	0.001	0.2	743.14	0.5939
10	1404	0.001	0.05	740.31	0.5935
15	702	0.001	0.15	744.06	0.5929
7	1404	0.001	0.15	741.43	0.5926
10	702	0.001	0.15	741.58	0.5921
7	702	0.001	0.25	741.92	0.5921
7	702	0.001	0.15	742.68	0.5912
5	702	0.001	0.2	738.62	0.5911
15	702	0.001	0.25	746.00	0.5908
7	176	0.01	0.05	743.39	0.5905
7	1404	0.001	0.25	745.20	0.5885
5	176	0.01	0.25	741.15	0.5883
5	702	0.001	0.25	742.64	0.5867
10	1404	0.001	0.25	746.96	0.5862
7	351	0.001	0.05	747.79	0.5856
5	176	0.01	0.05	743.85	0.5853
5	1404	0.001	0.05	743.99	0.5852
7	176	0.01	0.2	748.18	0.5852
10	1404	0.001	0.2	749.50	0.5834
5	702	0.01	0.25	747.21	0.5816
7	1404	0.001	0.2	752.05	0.5809
15	351	0.001	0.25	755.24	0.5806
10	1404	0.001	0.1	753.13	0.5793
7	702	0.001	0.2	753.50	0.5792

Table 4.7: Top 26 optimized models ranked by R^2 score, with variable hyperparameters test scores listed.

The number of training epochs is increased to check if accuracy improves. A series of 10 optimized models are created with training epochs ranging from 10 to 100. The R^2 score is plotted in figure 4.10 to determine if the model convergences at a particular point.

Figure 4.10: R^2 development across 100 training epochs for optimized model, with steps of 10 epochs.

The development in R^2 is dropping from 10 epochs and up, with a growing difference in test and training results show that the model is increasingly overfitting with higher numbers of training epochs. The model seem to converge around 100 epochs at 0.5500 for the test set and 0.9500 for the training set. Training the model up to 300 epochs in steps of 50 epochs confirms this tendency. Figure 4.11 shows the development of R^2 over 300 epochs.

Figure 4.11: R^2 development across 300 training epochs for the optimized model, with steps of 50 epochs.

The highest accuracy is achieved around 10 epochs. Another 20 optimized models are created with training epochs spanning from 1 to 20. R^2 scores are investigated to determine what happens around peak accuracy, hoping to fine-tune a number of training epochs that provide optimal model accuracy. Figure 4.12 plot the development in R^2 score during 20 training epochs, showing that the highest prediction accuracy occur at exactly 10 epochs. R^2 scores hover around 0.6000 between 10 and 20 epochs. The area between 10 and 20 epochs seem to provide the highest accuracy with the least overfitting. Figure 4.10 show that training set accuracy continue to rise for 100 epochs, while test set accuracy slowly converge around 0.5500 by 60 epochs. The optimized model reaches peak performance at 10 epochs, with a minimum of overfitting.

Figure 4.12: R^2 development across 20 training epochs for the optimized model.

Stacking LSTM layers results

Adding an extra layer to the optimized model resulted in a slight decrease in prediction accuracy. An extra layer with neurons ranging from 351 to 2808 was added on top of the original 702 neuron layer. Table 4.8 shows the different stacked configurations ranked by R^2 scores. R^2 scores are in the same area as the initial and optimized models. The increase in model complexity did not improve accuracy, leading the changes to be discarded.

Optimized model with extra LSTM layer ranked by R^2 score			
	Features = 351		
Sequence length = 15	Epochs = 10	Loss function = MSE	
Batch size = 32	Learning Rate = 0.001	Dropout rate = 0.1	
Neurons	**Dropout Rate**	**RMSE**	**R^2**
702, 702	0.1	761.10	0.5740
702, 2808	0.1	770.44	0.5635

Neurons	RMSE	R^2	
702, 351	0.1	770.61	0.5633
702, 1404	0.1	774.17	0.5593

Table 4.8: Optimized model with stacked LSTM layers. Test results show a slight decrease in performance from adding an extra layer.

Optimized model evaluation

The optimized model with the configuration detailed in figure 4.13 delivers an R^2 score of 0.6154, and RMSE of 723.17. Predictions for the 5 articles with the highest R^2 scores are investigated along with predictions for the 5 articles with the lowest scores to determine strengths and weaknesses of the model. The different sales pattern discussed in section 3.2.2 are scrutinized for further model evaluation.

```
Number of features: 351
Sequence length: 15
Number of epochs: 10
Learning rate: 0.001
Loss function: mse
Batch size: 32
Number of neurons: 702
Dropout rate: 0.1

Test results:
Mean absolute percentage error: 2.11e+17
Root mean squared error: 723.17
Mean absolute error: 210.54
R squared: 0.6154
```

Figure 4.13: Optimized model configuration with R^2 score of 0.6154.

The 5 articles with the highest R^2 values are all seasonal articles where the

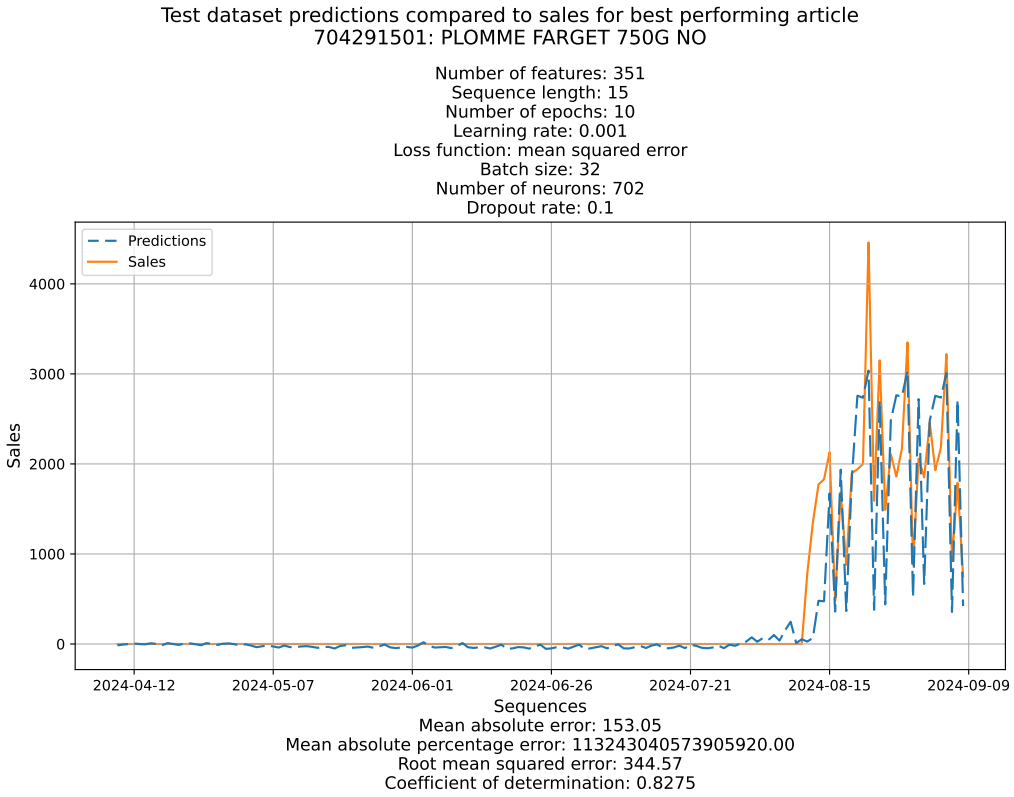

Figure 4.14: Predictions compared to actual sales for the article with the highest R^2 score (0.8275). The sales pattern follow a seasonal pattern.

predicted pattern is very similar to the actual sales. Figure 4.14 shows the predictions compared to actual sales for the best performing article, and figure 4.15 displays all sales for the article across the dataset. The training data for the article follow a specific seasonal pattern consistently, which is repeated in the test set. This shows that the model accurately gauges the yearly cycle, which is likely to be based on the weekday and month features in combination with the development of sales across time steps. This result also indicate that model accuracy is higher for articles with predictable and consistent sales.

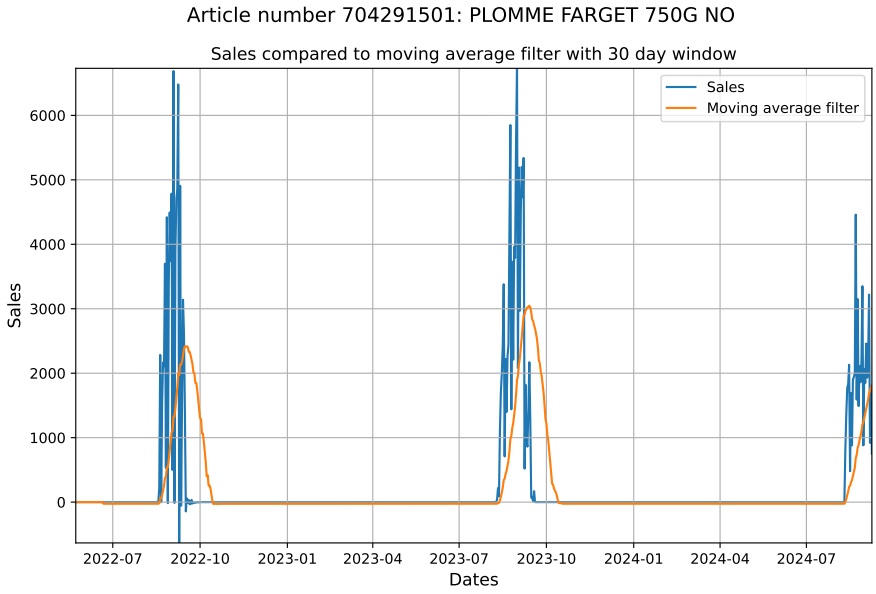

Figure 4.15: Actual sales across entire dataset for the article with the highest R^2 score.

The 5 articles with the lowest R^2 scores all have close to zero sales, while predictions vary widely. The worst performing article plotted in figure 4.16 has predicted sales over and under zero, while actual sales are constantly zero until the end of the test period. Sales below zero occur for other articles also, and are surprising considering all negative sales have been removed from the dataset. The negative sales raise concerns about prediction calculations. Figure 4.17 display the sales spanning the entire dataset for the worst performing article, showing that articles with virtually no sales during the test period create prediction problems for the demand forecasting model. Sales for this article dropped to zero at the start of the test period and spiked at the very end, making it impossible for the model to provide accurate predictions without any input marking the article as unavailable during the dip in sales.

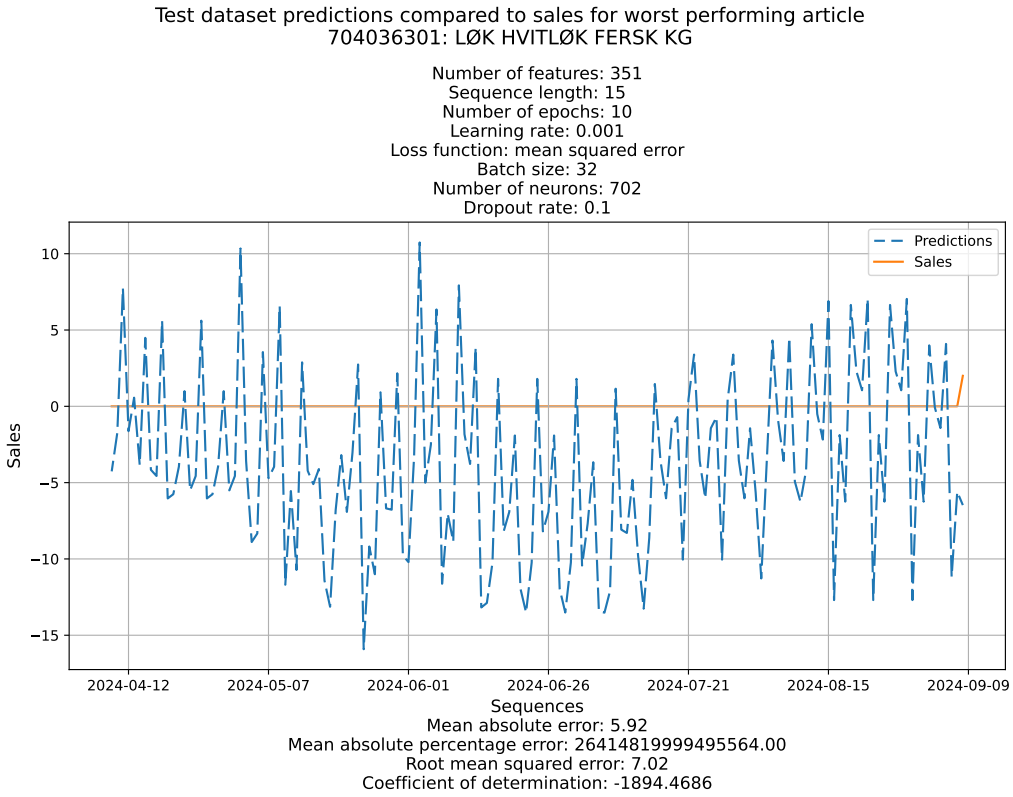

Figure 4.16: Predictions compared to actual sales for the article with the lowest R^2 score (-1894.4686).

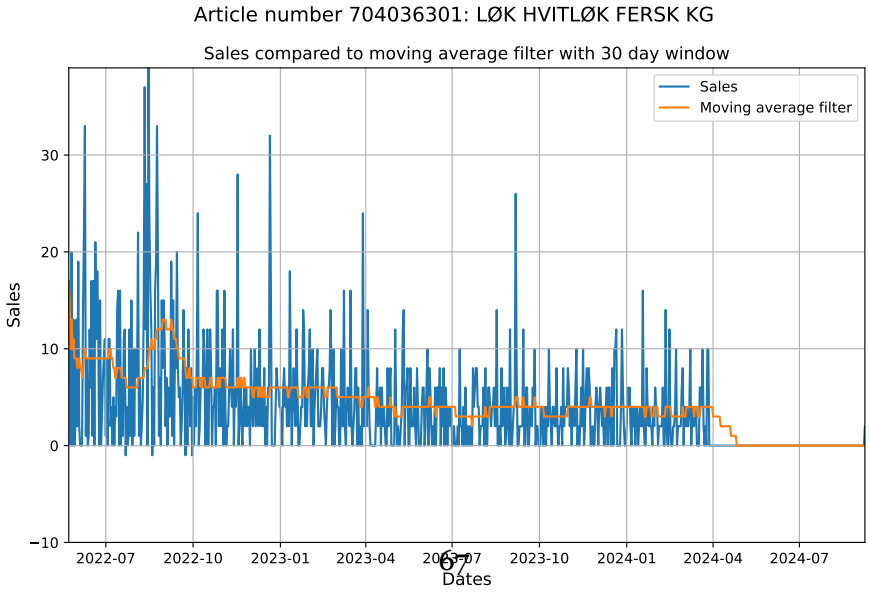

Figure 4.17: Actual sales across entire dataset for article with the lowest R^2 score.

Figure 4.18 shows the predictions for an article with regular sales discussed in section 3.2.2, with all dataset sales displayed in figure 3.4. R^2 score is 0.1690 for this article, reflecting the inaccuracy of the predictions shown in the plot. This article has regular cyclical sale spikes that should be possible to predict, but the model is more successfully gauging the dips in sales rather than the peaks. The R^2 score for this article is relatively low, but the pattern of predictions is reasonable and produce a considerably lower MAPE than the best performing article in figure 4.14. The model has not fully adapted to the demand for this item, but the consistency of sales across the training and test period seem to encourage sensible predictions.

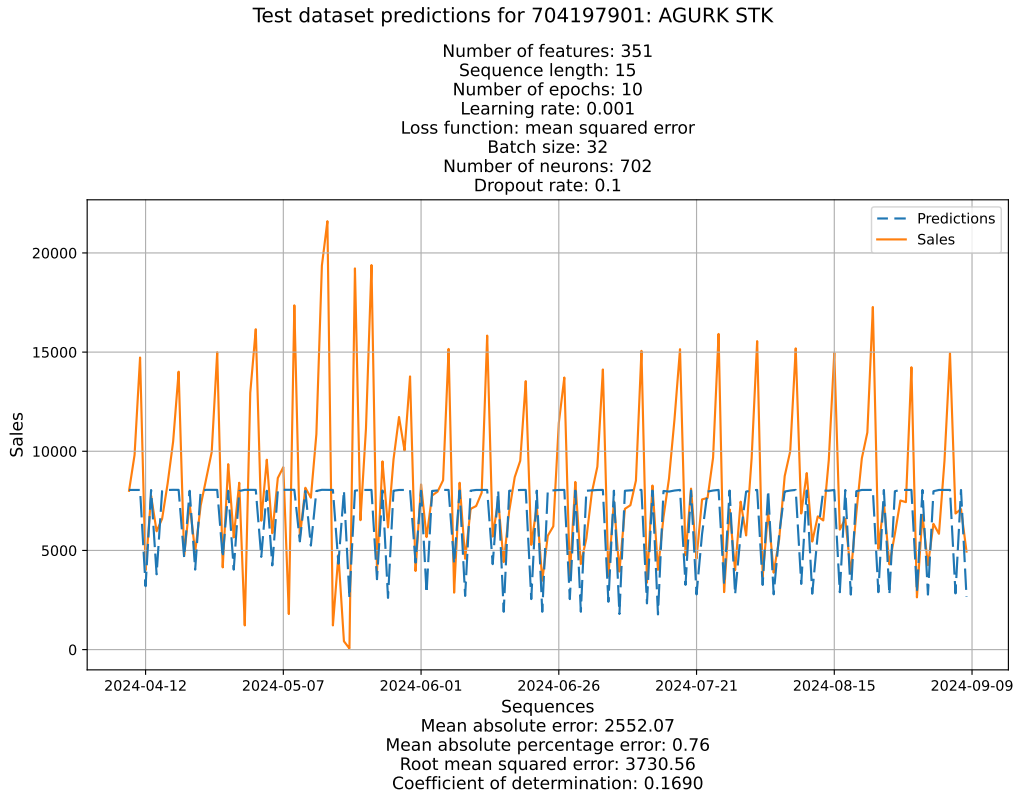

Figure 4.18: Predictions for article with regular sales discussed in section 3.2.2. All sales across dataset are displayed in figure 3.4.

Figure 4.19 show predictions compared to actual sales for the seasonal article displayed in figure 3.5 in section 3.2.2. The predictions for this article are poorer than the seasonal article in figure 4.14, resulting in an R^2 score of 0.0000. The test period begins right after the seasonal sales have completed, confusing the predictions. The model fails to predict that sales should equal zero for this period, even predicting negative sales. This problem could be solved with a descriptive feature marking the article as unavailable for the time period.

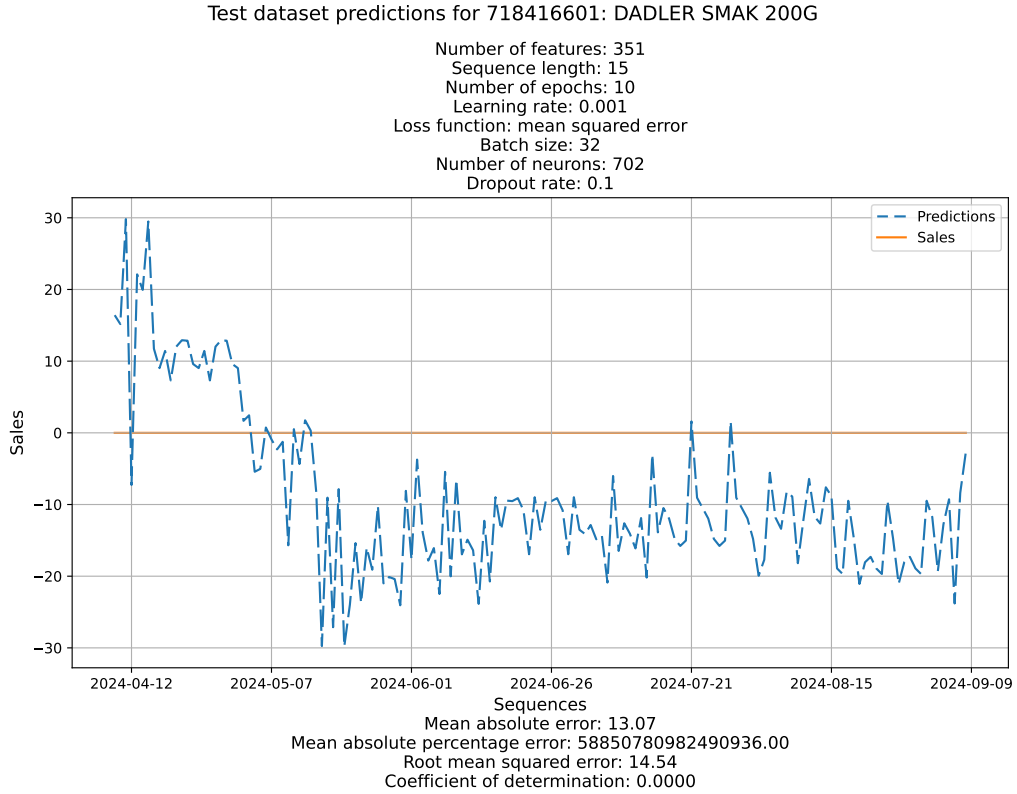

Figure 4.19: Article discussed in section 3.2.2 with seasonal sales. All article sales across the dataset are displayed in figure 3.5.

Figure 4.20 shows an article discussed in section 3.2.2 that was discontinued within the last year. Plotted sales for the entire dataset is displayed in figure 3.6. This article is discontinued near the end of the training set, creating an expec-

tation of sales during the test period. These faulty predictions could have been avoided with a feature describing the article as unavailable.

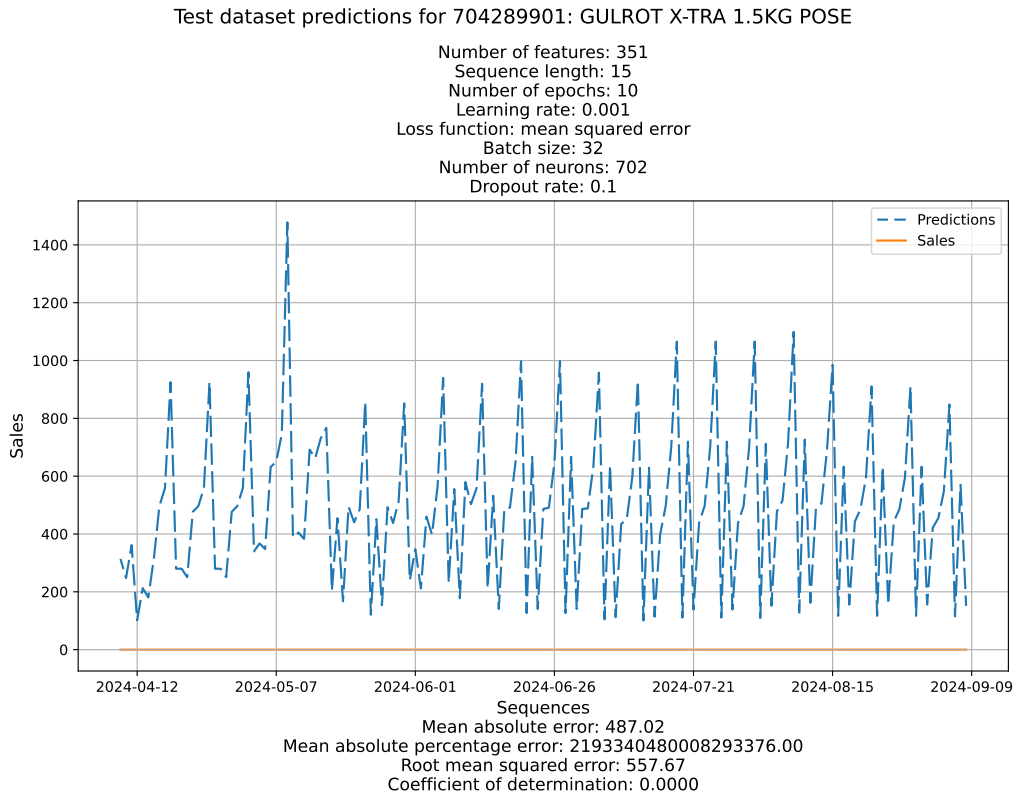

Figure 4.20: Article discussed in section 3.2.2 that was discontinued within the last year. All article sales across the dataset are displayed in figure 3.6.

Figure 4.21 displays predictions compared to actual sales for an article that has an unexplainable dip in sales during the test period, as displayed in figure 3.7 showing all sales. This creates an expectation for sales that could have been tempered with information about unavailability. This leads to a negative R^2 score of -204.0061, showing that the predictions are far from accurate.

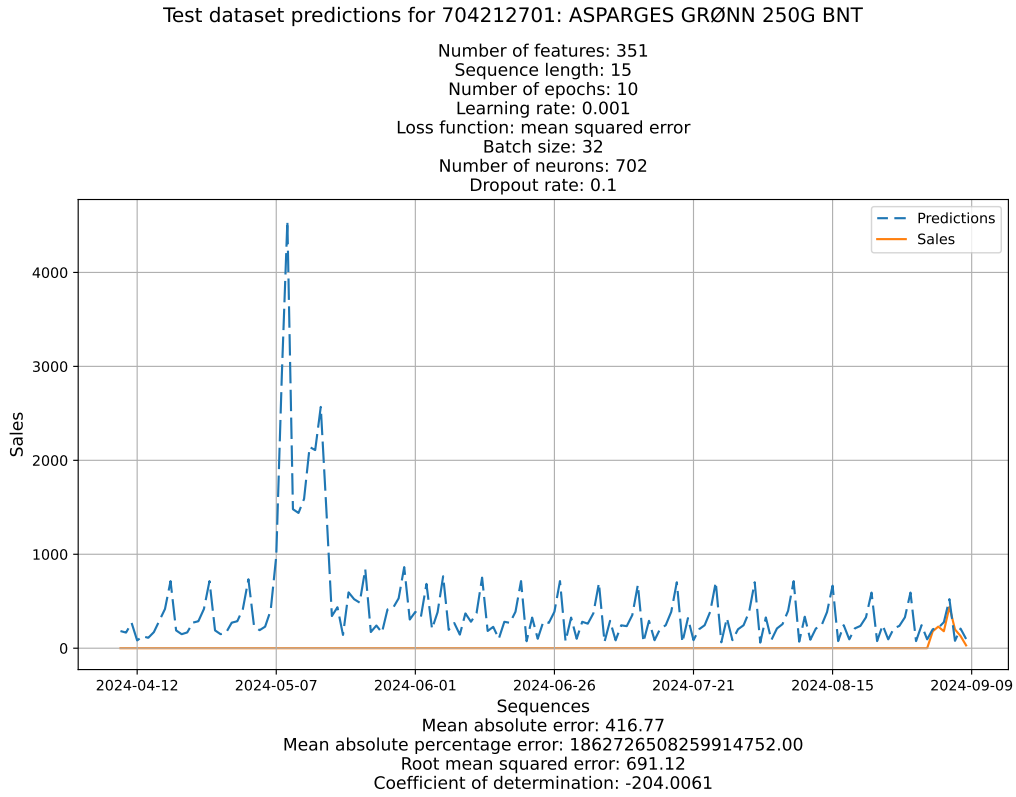

Figure 4.21: Article with unexplained dip in sales discussed in section 3.2.2. All article sales across the dataset are displayed in figure 3.7.

Figure 4.22 show predictions for a recently introduced article discussed in section 3.2.2. Figure 3.8 display sales for the entire dataset, showing that the article was introduced at the very end of the training set. The limited data leads to very conservative expectations of sales that lay close to zero, resulting in a negative R^2 score of -3.9158. This is another example of a sales pattern that is likely to benefit from a feature determining if it is available or not.

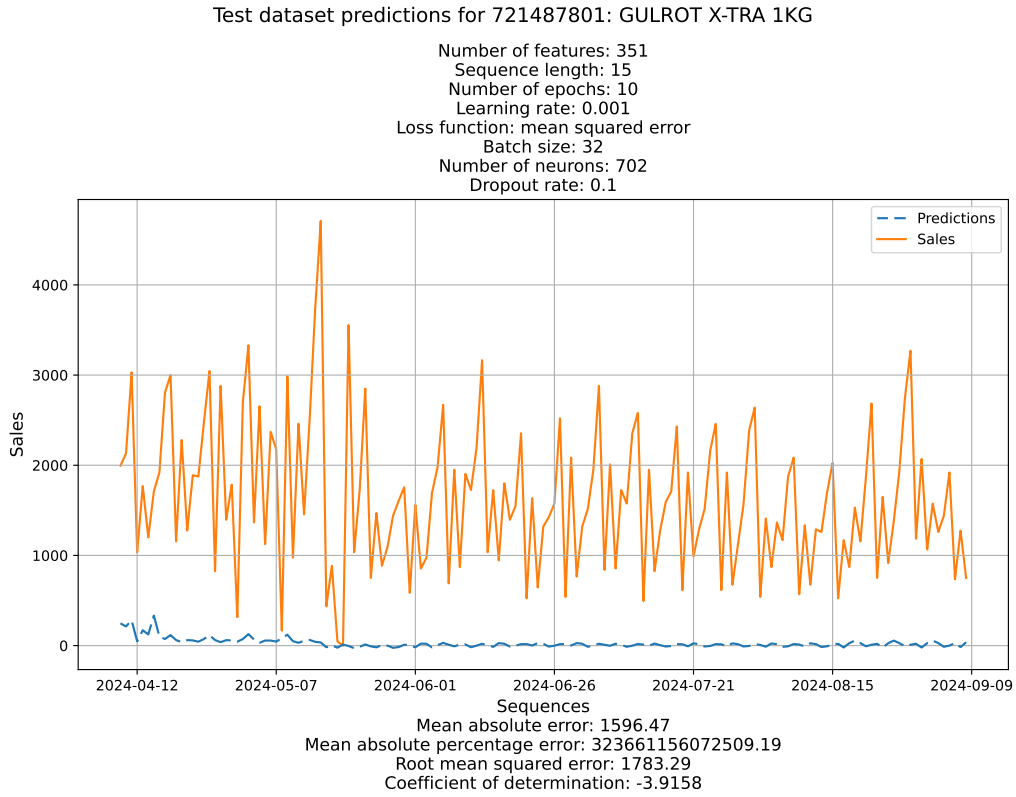

Figure 4.22: Recently introduced article discussed in section 3.2.2. All article sales across the dataset are displayed in figure 3.8.

Revising missing values results

The negative sales registered in the dataset have initially been replaced with zeroes. These values are replaced with the mean of sales to determine if this can affect model performance positively. The optimized model is retrained on the updated dataset to determine if this revision improve prediction accuracy or lead to increased overfitting. The newly trained model has an R^2 score of 0.5578 for the test set and 0.7846 for the training set, showing a sizable decrease in accuracy from 0.6145 for the test set, and a negligible increase from 0.7734 for the training set. This is a modest increase in overfitting, with a notable reduction in prediction test accuracy that lead the changes in the dataset to be reversed.

Revising article reduction results

Articles with no sales during the last year has been removed from the training data. Figure 4.20 show that articles that have been discontinued during the last year may cause the model to make faulty predictions, potentially affecting overall accuracy negatively. A simple fix to this problem is to remove all articles that have zero sales during the test period, with the intention of increasing the overall prediction accuracy of the model. This fix is problematic since it removes seasonal items that are not in sale during the test period, rendering the solution inadequate for long-term predictions for all articles. This experiment does however give an indication of the effect of pruning problematic articles on overall model accuracy.

41 articles that are not in sale during the test period are removed from the dataset. Total number of articles is reduced to 284, with a total of 238560 samples and 310 features. Two optimized model are created with 702 neurons and 620 models to investigate if removing zero sale articles positively affects prediction accuracy, with the models returning R^2 scores of 0.5962 and 0.5914 respectively. There is no increase in model performance from removing some of the problematic articles, indicating that these problematic articles are not affecting the overall performance of the current model.

Chapter 5

Discussion

This chapter reviews the implemented model architectures, favoring simplicity over needless complexity. It evaluates the poor performance of the optimized model, arguing that similar model performance for different architectures indicates that the predictive potential with the current dataset and features has been reached. The chapter concludes that improvements to the dataset and selected features are necessary to further increase model performance.

5.1 Complexity of model architecture

Similar performance of different model architectures make simpler models strategic choices. Prediction accuracy is mostly converging with an R^2 score between 0.5500 and 0.6000 for the best performing models. 106 of the 160 optimized models had an R^2 score above 0.5000, along with 27 out of the 54 initial models. The optimized model achieved the highest R^2 score of 0.6154, marginally outperforming the initial model's score of 0.5879. Pruning neural networks can be done to reduce the computational costs of training and running them, often reducing model complexity at the expense of performance [26]. The initial model with 351 neurons, 5 epochs and sequence length 5, can be considered more efficient than the optimized model with 702 neurons, 10 epochs and sequence length 15, due to the minimal difference in accuracy despite differing complexity. The reduction in complexity also increases model transparency, making the system easier to trust [10]. There are models with 176 neurons performing at high levels in table 4.5 listing initial models and table 4.7 listing optimized models. One configura-

tion requires 5 epochs with sequence length 5 to produce an R^2 score of 0.5852. The difference in performance from the optimized model is negligible, and the coincidental nature of training can potentially result in a new ranking for both models at retraining. The scientific approach of this bachelor thesis has been to consistently choose the highest ranking models for testing, but the performance and efficiency of less complex models warrant further investigation. The optimal model may be the least complex network that can provide prediction accuracy close to the maximum.

5.2 Model performance

The performance of the implemented models is too low to be utilized in a real-world setting. The optimized model has an R^2 score of 0.6154 accompanied by RMSE of 723.17 and a skyhigh MAPE of 2.11e+17. The R^2 score shows that the sample features is accounting for about 60% of the variance from the mean [18, 27], but the high errors show that the majority of test set predictions are far from the actual values. Figure 4.14 show that predictions can be quite accurate with a high R^2 score combined with a high MAPE, while figure 4.18 demonstrate that a far lower R^2 can be accompanied by a relatively low MAPE. Figures 4.16, 4.20 and 4.21 demonstrate that the tendency for very low R^2 scores is to be accompanied by very high MAPE values. R^2 score seem to be a decent measure of how well the model predicts patterns of sales, but the high values of errors suggest that the predicted patterns do not align correctly with the actual sales, resulting in poor demand forecasting precision. The large number of articles with low R^2 scores, and the generally high rates of errors for most articles, demonstrate that the optimized model is not performing at a level that gives acceptable predictions about customer demand.

5.3 Limitations of current dataset and features

Similar performance of different LSTM networks may indicate that the predictive potential of the current dataset and features have been reached. The testing of hyperparameters conducted so far is not exhaustive, but the current results indicate that an R^2 score of 0.6000 is about the highest accuracy that is possible to

achieve with basic LSTM architecture for the current dataset and features. The presence of negative sales in the dataset, and the unclear nature and range of the practices that produced them, raise concerns about the validity of the dataset. Adjustments to missing values and removal of articles with zero sales during the test period had no positive effects on prediction accuracy. Models with low R^2 score can be providing predictions that are as good as possible for data that has large proportions of unexplainable variation [18]. The dataset can naturally contain values that fluctuate so erratically that they are challenging to predict, or the data can be corrupted to the point it appears random and becomes difficult to predict. It is likely that more descriptive features can explain more of the variation in the dataset, with a feature indicating the availability of items potentially being a game-changer. Clustering article types is also likely to explain dynamic relationships between sales of similar articles, where an increase in sale of one might lead to decreased sales of another. The combination of features that indicate availability and article type can have a synergistic effect on improving performance, explaining sale patterns that seem inconsistent with the current features. The experimental results indicate that improvements to the dataset and features are necessary next steps that may increase model performance.

Chapter 6

Conclusions

This bachelor thesis has highlighted the importance of accurate demand forecasting for suppliers of perishable items. High precision predictions enable purchases of ideal amounts of stock that meet total customer demand with a minimum of waste. Optimizing stock levels allow suppliers to streamline their logistical operations to maximize income and minimize costs. Correct utilization of improved demand forecasting for perishable items increase profitability and decrease environmental impact.

The review of current literature on ML in demand forecasting point to several articles that consider the introduction of ML to improve predictions when compared to traditional methods. Hybrid, ensemble and LSTM methods have been shown to increase demand forecasting precision considerably, with differing demands for implementation. Hybrid methods that combine statistical approaches with ML require explicit programming and specific domain knowledge, while implementation of LSTM networks require more preprocessing and hyperparameter tuning than many ensemble methods. All ML approaches are dependent on high input data quality and varying degrees of feature engineering, sensible model architecture and access to computational resources.

The provided dataset has been investigated, cleaned and operationalized to create input samples and corresponding output target data for supervised learning. Data inconsistencies have been highlighted and attempted mitigated. A simple initial LSTM model was created by systematically testing combinations of hyperparameters, where selected features were validated by testing their effect on prediction accuracy. Further optimization increased model complexity and

marginally improved performance, suggesting simpler implementations have similar performance with lower computational costs. Several strategies were unsuccessfully employed to improve the optimized model's performance, including stacking LSTM layers, replacing missing values with mean and removing some problematic articles from the dataset.

The implemented demand forecasting models had disappointing results, with model performance measured in R^2 scores largely stagnating between 0.5500 and 0.6000. The optimized model predictions were inaccurate for many of the investigated articles, having particular challenges with inconsistent sale patterns. Predictions for articles with high R^2 scores had large errors in comparison to actual sales, demonstrating that although the implemented model can account for some of the variations in sales, it is not precise enough to be utilized for real-world demand forecasting.

The recurring stagnation in R^2 scores for different model architectures in a specific range, indicate that the model has reached its predictive potential with the current dataset and features. Higher quality input data and more descriptive features is likely necessary to improve model performance. The presence of negative values in the dataset, and uncertainty about the practices surrounding them, raise concerns about the validity of the dataset. Future work should address these concerns by investigating the background of the supplied demand data, and correcting any problematic issues to ensure that the dataset has the highest possible degree of quality. The introduction of more descriptive features is partially dependent on more background information, theorizing that the inclusion of a feature describing the availability of articles is likely to increase prediction accuracy for articles with inconsistent sale patterns, thereby contributing to increased overall performance. Information about product availability should be included in an improved dataset. Future work should also investigate the potential of clustering articles by type, assuming changes in demand or availability for specific articles affect sales of similar items. This can help the model understand when changes in sales of one article influence changes in sales of another, whether it is due to campaigns, temporary unavailability, discontinuation or the introduction of new articles. Combining clustering articles by type with a feature determining product availability may have a beneficial synergistic effect on prediction accuracy.

The successful implementation of LSTM networks is dependent on optimal

model architecture and hyperparameter tuning, necessitating numerous time-consuming experiments that are dependent on access to computational resources to perform exhaustive trials. The difficulty of implementing optimal LSTM configurations is underlined by the lack of scientific literature with specific instructions for how to build specialized models, further adding to the mysterious ”black box” nature of neural networks. This bachelor thesis contributes to an existing body of work that acknowledges the potential of ML to improve demand forecasting precision, while also affirming the established challenges of LSTM network implementation, detailing the experienced problems with dataset quality, lack of exhaustively descriptive features, the difficulty of optimizing hyperparameters and model architecture, and the constant need for computational resources to continue the search for optimal configurations.

Appendix A

Instructions to Compile and Run System

- Section A.1 describes the Github repository for this bachelor thesis.
- Section A.2 describes the Python environment the code was created in.

A.1 Github repository

The code for this project is available on Github:

`https://github.com/Mortymus/ML_demand_forecasting`

The repository has been created using Git LFS due to storage of models exceeding 100MB. It is recommended to have Git LFS installed to be able to clone the repository correctly.

`https://git-lfs.com/`

A.1.1 Model folders

The Github repository contains a number stored LSTM models in the folder named `models`. Models are stored in subfolders denoting their roles in conducted experiments, with each network stored in an individual folder named by its hyperpa-

rameters. Network folders contain a keras model file along with plots and text files with statistics. Table A.1 links experiments from specified sections to their associated model folders.

Section	Experiment	Folder
4.2.1	Creating 54 initial models	`models/initial_models`
4.2.2	Testing relevancy of features	`models/feature_testing`
4.2.3	Initial model, 1-20 epochs	`models/initial_model_20epochs`
4.2.3	Creating 160 optimized models	`models/optimized_models`
4.2.3	Optimized model, 10-100 epochs	`models/optimized_model_10-100epochs`
4.2.3	Optimized model, 50-300 epochs	`models/optimized_model_50-300epochs`
4.2.3	Optimized model, 1-20 epochs	`models/optimized_model_1-20epochs`
4.2.3	Stacking optimized model	`models/optimized_model_stacking`
4.2.3	Revising missing values	`models/revised_missing_values`
4.2.3	Revising article reduction	`models/revised_article_reduction`

Table A.1: Linking experiment sections to folders containing model files and statistics in Github repository.

A.1.2 Codebase

The codebase consists of 3 central files:

- `extraction.py`
- `neural_network_builder.py`
- `model_tester.py`

The central files provide support functions for each other, which can be detangled by following references in specific functions. The intention is to provide descriptive function names to make the code easy to read, with the explicit code available in the support functions. Users that are familiarized with the code can switch between datasets by updating functions, but this can be cumbersome and requires specific knowledge. The uninitiated user encounters a set of functions that is specifically geared towards using a dataset with 325 articles where samples have a total of 351 features.

The codebase includes a set of scripts:

- `create_all_articles_sales_plots.py`
- `create_article_dictionary_lookup.py`
- `create_article_dictionary.py`
- `create_csv_from_excel.py`
- `create_csv_sales_sorted_by_article_and_date.py`
- `create_initial_files.py`
- `create_lstm_network.py`
- `create_lstm_plots.py`
- `create_lstm_test.py`
- `create_model_ranking.py`
- `create_model_sorting.py`
- `create_zero_sale_dictionary.py`

All Python files beginning with the word ”create” are scripts that draw on functions from the codebase. The code is dependent on csv files and json dictionaries that have been created during the cleaning and operationalization of the dataset. The initial process of creating necessary csv and json files can be largely recreated, but is dependent on the file `data/json/zero_sale_dictionary.json` being present. Running the script `create_initial_files.py` will recreate all other necessary files.

Users can easily create new LSTM models using the `create_model_sequences()` and `create_lstm_neural_network()` functions from `neural_network_builder.py`. Use the script `create_lstm_network.py` for an example of how to run the code. Models are stored in directories named by their hyperparameters. Users can create subfolders to store models by using the `model_path` parameter as demonstrated in the example script.

Users can use a saved model to plot predictions for specific articles by running the `plot_articles_from_saved_model()` function from `model_tester.py`. Use the script `create_lstm_plots.py` for an example of how to run the code. Plots and prints will be stored to the model directory. Paths for saved models are derived from the specified hyperparameters. Users can specify which subfolder to find the model by using the `model_path` parameter as demonstrated in the example script.

Users can run tests on saved models by using the `test_saved_model()` function from `model_tester.py`, producing the plots and prints that are normally produced when the model is created. Run the script `create_lstm_test.py` for an example of how to run the code. Paths for saved models are derived from the specified hyperparameters. Users can specify which subfolder to find the model by using the `model_path` parameter as demonstrated in the example script.

`create_all_articles_sales_plots.py` creates plots of all article sales, storing each plot to an individual pdf. The script also merges all the pdf files into a single file to make viewing them easier. Sales plots are stored in the folder `plots/article_sales`.

Models in a folder and subfolders can be ranked by R^2 score on test and training sets by using `rank_rootdir_models.py` from `model_tester.py`. Subfolders to be avoided can be entered as a function parameter. Results are stored to the directory entered to the function for ranking. See the script `create_model_ranking.py` for an example of how to use the function.

All models in a folder and subfolders can be sorted by hyperparameters by using `sort_rootdir_models()` from `model_tester.py`. Subfolders to be avoided can be entered as a function parameter. Results are stored to the directory entered to the function for sorting. See the script `create_model_sorting.py` for an example of how to use the function.

The remaining scripts are used for intializing the necessary files for the project, and can be found in `create_initial_files.py`.

A.1.3 Dataset

The folder `data/excel` contains the original dataset supplied by Coop Norge SA. Minor adjustments were made to copies of the Excel files, which were then saved under new names to simplify processing.

Extracted Excel sheets are stored in csv format in the folder `data/csv`. The dataset was derived from these files and stored in the `training_data` folder. There are currently 4 different files with varying numbers of articles, resulting from different iterations of dataset cleaning.

A.2 Python environment

The bachelor thesis was written on a Windows 11 machine using Python 3.11.9. Apologies for any unforeseen errors for anyone using a different operating system.

The following Python packages are installed in the environment the project was created in:

```
Package                       Version
----------------------------- -----------
absl-py                       2.1.0
asttokens                     2.4.1
astunparse                    1.6.3
certifi                       2024.8.30
charset-normalizer            3.3.2
colorama                      0.4.6
comm                          0.2.2
contourpy                     1.3.0
cycler                        0.12.1
debugpy                       1.8.5
decorator                     5.1.1
et-xmlfile                    1.1.0
executing                     2.1.0
flatbuffers                   24.3.25
fonttools                     4.53.1
gast                          0.6.0
google-pasta                  0.2.0
grpcio                        1.66.1
h5py                          3.11.0
holidays                      0.56
```

idna	3.8
ipykernel	6.29.5
ipython	8.27.0
jedi	0.19.1
joblib	1.4.2
jupyter_client	8.6.2
jupyter_core	5.7.2
keras	3.5.0
kiwisolver	1.4.7
libclang	18.1.1
Markdown	3.7
markdown-it-py	3.0.0
MarkupSafe	2.1.5
matplotlib	3.9.2
matplotlib-inline	0.1.7
mdurl	0.1.2
ml-dtypes	0.4.0
namex	0.0.8
nest-asyncio	1.6.0
numpy	1.26.4
openpyxl	3.1.5
opt-einsum	3.3.0
optree	0.12.1
packaging	24.1
pandas	2.2.2
parso	0.8.4
pillow	10.4.0
pip	24.2
platformdirs	4.3.3
prompt_toolkit	3.0.47
protobuf	4.25.4
psutil	6.0.0
pure_eval	0.2.3
Pygments	2.18.0
pyparsing	3.1.4

pypdf	4.3.1
python-dateutil	2.9.0.post0
pytz	2024.1
pywin32	306
pyzmq	26.2.0
requests	2.32.3
rich	13.8.1
scikit-learn	1.5.1
scipy	1.14.1
setuptools	65.5.0
six	1.16.0
stack-data	0.6.3
tensorboard	2.17.1
tensorboard-data-server	0.7.2
tensorflow	2.17.0
tensorflow-intel	2.17.0
tensorflow-io-gcs-filesystem	0.31.0
termcolor	2.4.0
threadpoolctl	3.5.0
tornado	6.4.1
traitlets	5.14.3
typing_extensions	4.12.2
tzdata	2024.1
urllib3	2.2.2
wcwidth	0.2.13
Werkzeug	3.0.4
wheel	0.44.0
wrapt	1.16.0

Appendix B

Acronyms

Here is a comprehensive list of acronyms used in this bachelor thesis.

- AI: artificial intelligence
- Coop: Coop Norge SA
- DL: deep learning
- ETR: extra tree regression
- LSTM: long short-term memory
- MAE: mean absolute error
- MAPE: mean absolute percentage error
- ML: machine learning
- R^2: coefficient of determination
- RMSE: root mean squared error
- RNN: recurrent neural network

Appendix C

Initial model performance for individual articles

Initial model performance for each individual article ranked by R^2 score.

```
    Test dataset for all articles

        LSTM hyperparameters:
        Number of features: 351
        Sequence length: 5
        Number of epochs: 5
        Learning rate: 0.01
        Loss function: mse
        Batch size: 32
        Number of neurons: 351
        Dropout rate: 0

        Test results:
        Mean absolute percentage error: 2.721519157474432e+17
        Root mean squared error: 741.5175331372247
        Mean absolute error: 233.30713506737314
        R squared: 0.5879320098234406

1. Article number: 704312101
```

Article name: POTET TIDLIG NO KG
Mean absolute percentage error: 6.076029713609576e+17
Root mean squared error: 1059.1140603503463
Mean absolute error: 658.9508032184438
R squared: 0.7184722240676888

2. Article number: 720809801
Article name: DRUE COTTON CANDY 400G
Mean absolute percentage error: 3.124028289967421e+17
Root mean squared error: 1276.6490338288593
Mean absolute error: 645.121797081883
R squared: 0.6696517663119246

3. Article number: 714496301
Article name: NYPOTET NORSKE RØDE 1.5KG
Mean absolute percentage error: 3.266013821513397e+17
Root mean squared error: 395.6683017373672
Mean absolute error: 231.80739721052487
R squared: 0.6425469902978882

4. Article number: 704197701
Article name: DRUE GRØNN KG
Mean absolute percentage error: 2.605504771562541e+17
Root mean squared error: 491.65647303696284
Mean absolute error: 266.54520209142765
R squared: 0.6032899136108887

5. Article number: 704197301
Article name: HODEKÅL KG
Mean absolute percentage error: 9.308253380035063e+17
Root mean squared error: 586.3382174305776
Mean absolute error: 399.2750376133831
R squared: 0.5644574947801853

6. Article number: 704288401
Article name: NEKTARIN KURV 1KG STK
Mean absolute percentage error: 5.835694391540678e+17
Root mean squared error: 1113.7587668078008
Mean absolute error: 742.4435390285188
R squared: 0.5450113928641396

7. Article number: 704198001
    Article name: BLOMKÅL STK
    Mean absolute percentage error: 5.800043905886341e+16
    Root mean squared error: 879.8391846940822
    Mean absolute error: 614.0536076364342
    R squared: 0.5445147269576986
8. Article number: 704204501
    Article name: BÆR BRINGEBÆR 300G NO
    Mean absolute percentage error: 2.2600011306774784e+17
    Root mean squared error: 314.48289942370366
    Mean absolute error: 206.1111921181708
    R squared: 0.517510587037638
9. Article number: 714496201
    Article name: NYPOTET NORSKE GULE 1.5KG
    Mean absolute percentage error: 4.893330183859942e+17
    Root mean squared error: 655.8094793069702
    Mean absolute error: 375.3548014003075
    R squared: 0.49908594225956404
10. Article number: 704207601
    Article name: LØK HVITLØK 100G
    Mean absolute percentage error: 4.4895201448853704e+16
    Root mean squared error: 406.60453526869054
    Mean absolute error: 280.0674887815136
    R squared: 0.42402864408045793
11. Article number: 715333801
    Article name: POTET KOKEFAST SMÅ GULE 850G
    Mean absolute percentage error: 2.4294319928184675e+17
    Root mean squared error: 149.7097231491823
    Mean absolute error: 107.42911544752998
    R squared: 0.40611638468119193
12. Article number: 704886401
    Article name: POTET 2KG ASTERIX NO
    Mean absolute percentage error: 3.291799298494594e+17
    Root mean squared error: 231.77374875574972
    Mean absolute error: 132.36668276640535

R squared: 0.4053360809593468

13. Article number: 704291501

    Article name: PLOMME FARGET 750G NO

    Mean absolute percentage error: 6.913905770358817e+17

    Root mean squared error: 625.7455684635471

    Mean absolute error: 280.6565606871997

    R squared: 0.40077787285074806

14. Article number: 704893701

    Article name: BANAN X-TRA KG

    Mean absolute percentage error: 1.012833854605415e+17

    Root mean squared error: 772.228037582923

    Mean absolute error: 577.4361725789638

    R squared: 0.39166498122002125

15. Article number: 704884301

    Article name: POTET 2KG FOLVA NO

    Mean absolute percentage error: 3.134513658446897e+17

    Root mean squared error: 172.3268021190658

    Mean absolute error: 107.1775673942332

    R squared: 0.3863388799168772

16. Article number: 704287001

    Article name: REDDIK BUNT

    Mean absolute percentage error: 9.339403017686843e+16

    Root mean squared error: 115.33177752462481

    Mean absolute error: 78.73178242174394

    R squared: 0.38425923206799073

17. Article number: 704202401

    Article name: LØK RØD STRØMPE 400G

    Mean absolute percentage error: 7.137699634033459e+16

    Root mean squared error: 623.1658726223641

    Mean absolute error: 435.93092673834116

    R squared: 0.3787317552599381

18. Article number: 704295601

    Article name: SOPP SJAMPINJONG X-TRA 250G

    Mean absolute percentage error: 3.3691445251069336e+16

    Root mean squared error: 361.9613774783882

Mean absolute error: 267.8381574197781

R squared: 0.37545585011764016

19. Article number: 710034501

Article name: DRUE GRØNN X-TRA 500G

Mean absolute percentage error: 3.581203892566335e+16

Root mean squared error: 201.80386700932866

Mean absolute error: 147.87693571313028

R squared: 0.37418985432221863

20. Article number: 704211001

Article name: APRIKOS SMAK 350G KURV

Mean absolute percentage error: 1.8534775592957568e+17

Root mean squared error: 187.2957584542423

Mean absolute error: 131.06062825910885

R squared: 0.362416229788047

21. Article number: 704285301

Article name: BANAN KG

Mean absolute percentage error: 4.020751456947204e+17

Root mean squared error: 2301.430456651919

Mean absolute error: 1686.9207404201015

R squared: 0.36013550224807744

22. Article number: 704879101

Article name: POTET ASSORTERT LØS KG NO

Mean absolute percentage error: 9.343977052459113e+17

Root mean squared error: 945.5960311592173

Mean absolute error: 525.6151045348747

R squared: 0.34411134719035763

23. Article number: 715388201

Article name: POTET KOKEFAST GUL 1.2KG

Mean absolute percentage error: 2.5869785618787082e+17

Root mean squared error: 124.20017144322081

Mean absolute error: 82.52636241327765

R squared: 0.34096427247350825

24. Article number: 704198101

Article name: BROKKOLI STK

Mean absolute percentage error: 1.2429975579272626e+17

Root mean squared error: 1074.617015433805

Mean absolute error: 828.6037304650055

R squared: 0.34074866913871515

25. Article number: 704197901

Article name: AGURK STK

Mean absolute percentage error: 3.8473777652914406e+17

Root mean squared error: 3420.237138107013

Mean absolute error: 2464.2112340634585

R squared: 0.3382649366026321

26. Article number: 704199301

Article name: ISBERG STK

Mean absolute percentage error: 1.4408432417737189e+17

Root mean squared error: 1130.3791590880771

Mean absolute error: 794.310373317976

R squared: 0.33233952765297525

27. Article number: 704197201

Article name: SITRON KG

Mean absolute percentage error: 3.6198633622186e+16

Root mean squared error: 271.4868078094078

Mean absolute error: 188.5999793772317

R squared: 0.31478329437152053

28. Article number: 720482401

Article name: FERSKEN PARAGUAYO SMAK 500G

Mean absolute percentage error: 1.0631232546194434e+17

Root mean squared error: 1525.3346350830652

Mean absolute error: 790.0384615330609

R squared: 0.314396523827833

29. Article number: 704197401

Article name: LØK KG

Mean absolute percentage error: 3.587390247521726e+16

Root mean squared error: 281.47709850817495

Mean absolute error: 200.81640538408712

R squared: 0.3064571467863808

30. Article number: 704200001

Article name: VÅRLØK BNT

Mean absolute percentage error: 5.021061671748147e+16

Root mean squared error: 465.0425161569693

Mean absolute error: 324.81322474567435

R squared: 0.3044049498096435

31. Article number: 704292901

Article name: POTET NY ASSORTERT KG IMP

Mean absolute percentage error: 1.763080390294953e+18

Root mean squared error: 2431.257561724027

Mean absolute error: 1407.9043866491024

R squared: 0.2871092196036069

32. Article number: 704205801

Article name: KIWI GRØNN STK

Mean absolute percentage error: 1.1762570334845066e+17

Root mean squared error: 1056.3696861497726

Mean absolute error: 751.6551757063602

R squared: 0.2809655871616137

33. Article number: 704199901

Article name: LØK SJALOTT 250G

Mean absolute percentage error: 5.680017203043598e+16

Root mean squared error: 281.8569998930602

Mean absolute error: 185.5331732627073

R squared: 0.2757144696868238

34. Article number: 704198801

Article name: KINAKÅL STK

Mean absolute percentage error: 1.8605243932947412e+16

Root mean squared error: 168.19467231352644

Mean absolute error: 120.5200277925269

R squared: 0.26084685868034174

35. Article number: 720809701

Article name: DRUE CANDY GRAPES 400G

Mean absolute percentage error: 8.522166526933592e+16

Root mean squared error: 192.68018197819202

Mean absolute error: 109.30849420512381

R squared: 0.25375643380108104

36. Article number: 715333901

Article name: POTET MANDEL SMÅ 850G

Mean absolute percentage error: 9.951792476669773e+16

Root mean squared error: 108.05549911921572

Mean absolute error: 55.59862670430376

R squared: 0.24536739057575396

37. Article number: 704286901

Article name: JORDBÆR 500G IMP

Mean absolute percentage error: 2.5076367621188316e+18

Root mean squared error: 7619.815481861984

Mean absolute error: 3897.6456912690146

R squared: 0.23103264728331208

38. Article number: 704286701

Article name: MELON VANN KG

Mean absolute percentage error: 8.146348598983216e+16

Root mean squared error: 3858.686896081145

Mean absolute error: 2738.080342111412

R squared: 0.2255214346169293

39. Article number: 704038201

Article name: SALAT CRISPI BGR 150G

Mean absolute percentage error: 1.0142364402051909e+17

Root mean squared error: 1250.7262611217611

Mean absolute error: 942.2081413035013

R squared: 0.21363497079434002

40. Article number: 704892401

Article name: TOMAT PERLE 175G

Mean absolute percentage error: 1.2736542692968451e+17

Root mean squared error: 1258.9484322779829

Mean absolute error: 917.5463528311326

R squared: 0.2078694887819279

41. Article number: 704290001

Article name: TOMAT BIFF KG

Mean absolute percentage error: 5.06612814173705e+16

Root mean squared error: 63.19639211693014

Mean absolute error: 47.4096464145403

R squared: 0.20557347955306415

42. Article number: 714143001
    Article name: POTET NY 1.5KG IMP
    Mean absolute percentage error: 2.2829747394720803e+17
    Root mean squared error: 895.7041945460854
    Mean absolute error: 451.3919636779036
    R squared: 0.20555371678255874
43. Article number: 704303801
    Article name: SALAT BABYLEAF VASKET 65G STK
    Mean absolute percentage error: 2.541808063038988e+16
    Root mean squared error: 177.5218524663592
    Mean absolute error: 135.85064023257763
    R squared: 0.2029332469677687
44. Article number: 704036801
    Article name: LØK X-TRA 1KG PK
    Mean absolute percentage error: 2.9838014505630236e+16
    Root mean squared error: 174.47471561654856
    Mean absolute error: 135.31859975943536
    R squared: 0.19937140765454853
45. Article number: 704285901
    Article name: KLEMENTIN KG
    Mean absolute percentage error: 1.309555651130919e+17
    Root mean squared error: 2079.557243410946
    Mean absolute error: 1061.702637830395
    R squared: 0.19926007856390537
46. Article number: 704881301
    Article name: EPLE KANZI KG IMP
    Mean absolute percentage error: 1.09397393830589e+17
    Root mean squared error: 671.181060987486
    Mean absolute error: 524.1124893492716
    R squared: 0.1971195080759065
47. Article number: 714755001
    Article name: DADLER 600G PK
    Mean absolute percentage error: 1.5787063040310692e+16
    Root mean squared error: 75.67284756915129
    Mean absolute error: 57.04443454157355

R squared: 0.18218216691593658

48. Article number: 704318601

    Article name: LIME KG

    Mean absolute percentage error: 1.4477347597424728e+16

    Root mean squared error: 105.95608417010504

    Mean absolute error: 76.41665459849352

    R squared: 0.1667818604039375

49. Article number: 704207301

    Article name: EPLER X-TRA 1KG POSE

    Mean absolute percentage error: 3.312144881093535e+16

    Root mean squared error: 224.07312121031327

    Mean absolute error: 166.20586184636215

    R squared: 0.165890629495406

50. Article number: 714748301

    Article name: SALAT FAVORITTSALAT 200G

    Mean absolute percentage error: 1.965850819606385e+16

    Root mean squared error: 214.3161029861854

    Mean absolute error: 165.252724770388

    R squared: 0.16364947922886774

51. Article number: 704286001

    Article name: PÆRE KG

    Mean absolute percentage error: 9.874286603524848e+16

    Root mean squared error: 1152.80600831736

    Mean absolute error: 745.7055813842024

    R squared: 0.14965526485554748

52. Article number: 704286101

    Article name: MORELLER KG

    Mean absolute percentage error: 1.1081237549646587e+17

    Root mean squared error: 602.6476963558675

    Mean absolute error: 334.04364438437244

    R squared: 0.14898087017370576

53. Article number: 704203201

    Article name: LØK 2STK

    Mean absolute percentage error: 4.170771049446097e+16

    Root mean squared error: 308.5109454741214

Mean absolute error: 239.399645752702

R squared: 0.14506842461997205

54. Article number: 704211301

Article name: PERSILLEROT 200G

Mean absolute percentage error: 1.2511405629653494e+16

Root mean squared error: 66.34482846360714

Mean absolute error: 52.156905730077824

R squared: 0.13747321715684768

55. Article number: 704199801

Article name: STANGSELLERI STK

Mean absolute percentage error: 1.6428980736727128e+16

Root mean squared error: 151.28412985073254

Mean absolute error: 103.78920228642188

R squared: 0.13452421910196122

56. Article number: 721749301

Article name: BROKKOLI ÄNGLAMARK 300G

Mean absolute percentage error: 6.812966969333949e+16

Root mean squared error: 62.39611088584497

Mean absolute error: 41.371025495002606

R squared: 0.13402083738452952

57. Article number: 704890601

Article name: DRUE GRØNN STFR 500G

Mean absolute percentage error: 1.1546484259004064e+17

Root mean squared error: 840.2066494833617

Mean absolute error: 608.5786573725975

R squared: 0.13107246843608344

58. Article number: 704201001

Article name: SELLERIROT KG

Mean absolute percentage error: 1.2259747738784272e+16

Root mean squared error: 155.25027237889995

Mean absolute error: 105.37551262042274

R squared: 0.1306565749663583

59. Article number: 704317401

Article name: ANANAS STK

Mean absolute percentage error: 8548867326792308.0

Root mean squared error: 124.39991309066552

Mean absolute error: 83.57724505699485

R squared: 0.12473464331700213

60. Article number: 704882701

Article name: EPLE RØDE RUBINSTEP KG NO

Mean absolute percentage error: 1.8439971072385837e+17

Root mean squared error: 116.795100956466

Mean absolute error: 69.20733495138906

R squared: 0.11929134322806423

61. Article number: 704287301

Article name: SØTPOTET KG

Mean absolute percentage error: 2.706734048340001e+16

Root mean squared error: 120.28917967512014

Mean absolute error: 87.85661606115798

R squared: 0.11522330110828571

62. Article number: 704208101

Article name: LØK RØD X-TRA 1KG PK

Mean absolute percentage error: 1.7267831378997726e+16

Root mean squared error: 112.57935254494858

Mean absolute error: 88.8141167763552

R squared: 0.111367286131828

63. Article number: 704884101

Article name: DRUE FARGET STFR 500G

Mean absolute percentage error: 1.3759142133287498e+17

Root mean squared error: 933.4495712486895

Mean absolute error: 706.5779194276025

R squared: 0.1004742909371572

64. Article number: 704882801

Article name: EPLE RØDE SUMMERRED KG NO

Mean absolute percentage error: 3.2278035980624365e+17

Root mean squared error: 444.03032470919624

Mean absolute error: 154.01551532160286

R squared: 0.09133393885222041

65. Article number: 711831201

Article name: BÆR BLÅBÆR 400G

Mean absolute percentage error: 1.2691433795026542e+16
Root mean squared error: 1562.4949741577657
Mean absolute error: 595.9423083907988
R squared: 0.09013725105775217

66. Article number: 704317501
Article name: BÆR BLÅBÆR 225G SHAKER
Mean absolute percentage error: 7.179475848149613e+16
Root mean squared error: 876.9241223012381
Mean absolute error: 547.772904940178
R squared: 0.08463778437736036

67. Article number: 720482101
Article name: NEKTARIN SMAK 460G
Mean absolute percentage error: 5.932126165606973e+16
Root mean squared error: 124.03809757353311
Mean absolute error: 76.34387104057826
R squared: 0.08081116379281073

68. Article number: 717608201
Article name: EPLE RØDE POSEPAKKET KG NO
Mean absolute percentage error: 1.575219308617742e+17
Root mean squared error: 132.78708139949282
Mean absolute error: 64.95327921440266
R squared: 0.07390376229784956

69. Article number: 704199201
Article name: GRANATEPLE STK
Mean absolute percentage error: 1.7742925800167412e+16
Root mean squared error: 205.29415001469428
Mean absolute error: 125.15031249391521
R squared: 0.0696156650188865

70. Article number: 704292001
Article name: BÆR BRINGEBÆR 125G
Mean absolute percentage error: 6.200400710525481e+16
Root mean squared error: 1136.083545159802
Mean absolute error: 696.2521705861471
R squared: 0.06231358362022921

71. Article number: 703911201

Article name: FENNIKEL 200G
Mean absolute percentage error: 1.1044012820406926e+16
Root mean squared error: 97.03492767617287
Mean absolute error: 62.180311004077
R squared: 0.05723428771046535

72. Article number: 707106001
Article name: SOPP AROMA 200G
Mean absolute percentage error: 1.0019115050864564e+16
Root mean squared error: 72.51966239157372
Mean absolute error: 54.673317341716746
R squared: 0.055020416079995305

73. Article number: 704883101
Article name: EPLE RØDE KG DIV NO
Mean absolute percentage error: 2.9207624891408755e+17
Root mean squared error: 466.4811421363454
Mean absolute error: 143.29897708541776
R squared: 0.04936664370410093

74. Article number: 704206901
Article name: EPLE PINK LADY 6STK
Mean absolute percentage error: 2.16344376755153e+16
Root mean squared error: 361.409830351827
Mean absolute error: 229.93266322130074
R squared: 0.04906754762343846

75. Article number: 716595501
Article name: SALAT RUCCOLA VASKET 65G
Mean absolute percentage error: 4.5714634412231624e+16
Root mean squared error: 700.1193301172398
Mean absolute error: 567.7629992713227
R squared: 0.04545066147925958

76. Article number: 714754901
Article name: SALAT SPINAT BABY VASK 100G
Mean absolute percentage error: 1.3461747594164342e+17
Root mean squared error: 148.54931655255822
Mean absolute error: 116.97835568855145
R squared: 0.043250973362073064

77. Article number: 704208501
    Article name: SELLERI BUNT
    Mean absolute percentage error: 8.974646643624904e+16
    Root mean squared error: 56.28129260935546
    Mean absolute error: 31.798718540215052
    R squared: 0.04180854418522395
78. Article number: 704200701
    Article name: KÅLROT KG
    Mean absolute percentage error: 8.343646685566219e+16
    Root mean squared error: 748.6128842510632
    Mean absolute error: 466.83030476014306
    R squared: 0.032464819480210294
79. Article number: 704286401
    Article name: NYKÅL KG
    Mean absolute percentage error: 1.0737667785504746e+17
    Root mean squared error: 520.217201677835
    Mean absolute error: 368.6002954354315
    R squared: 0.03140944480494412
80. Article number: 704880801
    Article name: EPLE RØDE DISCOVERY KG NO
    Mean absolute percentage error: 9.070382004817341e+17
    Root mean squared error: 729.482211473189
    Mean absolute error: 343.1867396231809
    R squared: 0.031153372171108695
81. Article number: 704041601
    Article name: AUBERGIN IMP STK
    Mean absolute percentage error: 9812337302182176.0
    Root mean squared error: 98.79223664712683
    Mean absolute error: 74.88939023164153
    R squared: 0.024143503258490018
82. Article number: 715385001
    Article name: POTET KOKEFAST RØD 1.2KG
    Mean absolute percentage error: 3.5117388390191814e+17
    Root mean squared error: 149.58682472378254
    Mean absolute error: 105.73008334856092

R squared: 0.017748941570809307

83. Article number: 704038801
    Article name: BROKKOLI ØKO 300G STK
    Mean absolute percentage error: 3.196033893610677e+17
    Root mean squared error: 92.06595969448333
    Mean absolute error: 70.96620832337923
    R squared: 0.0
84. Article number: 704039501
    Article name: SPIRE KLØVER ØKO 50G
    Mean absolute percentage error: 1.5553996023415126e+17
    Root mean squared error: 38.9522929340908
    Mean absolute error: 34.5368090202472
    R squared: 0.0
85. Article number: 704039901
    Article name: SALAT ROMANOMIKS 200G
    Mean absolute percentage error: 5.482649249199961e+17
    Root mean squared error: 136.5423827958333
    Mean absolute error: 121.73926864811249
    R squared: 0.0
86. Article number: 704041501
    Article name: SQUASH ÄNGLAMARK 250G IMP STK
    Mean absolute percentage error: 2.4645142595694426e+17
    Root mean squared error: 78.38745419586401
    Mean absolute error: 54.72320950982029
    R squared: 0.0
87. Article number: 704041801
    Article name: CHILI GRØNN 50G
    Mean absolute percentage error: 3.093218270925935e+17
    Root mean squared error: 75.04291799039194
    Mean absolute error: 68.68324289146376
    R squared: 0.0
88. Article number: 704201301
    Article name: PITAHAYA KG
    Mean absolute percentage error: 1.2308196524503216e+17
    Root mean squared error: 34.41851291268342

Mean absolute error: 27.3296863462296

R squared: 0.0

89. Article number: 704201401

Article name: GULROT 1KG POSE

Mean absolute percentage error: 9.103464668966916e+18

Root mean squared error: 2373.109682300875

Mean absolute error: 2021.3752158697398

R squared: 0.0

90. Article number: 704202501

Article name: ROMANESCO STK

Mean absolute percentage error: 7.346064475894741e+16

Root mean squared error: 20.860857806581

Mean absolute error: 16.31153984303855

R squared: 0.0

91. Article number: 704204201

Article name: POMELO STK

Mean absolute percentage error: 9.850061507133923e+16

Root mean squared error: 26.950356045406718

Mean absolute error: 21.871530158388104

R squared: 0.0

92. Article number: 704204901

Article name: KAKI KG

Mean absolute percentage error: 1.4102378544728389e+17

Root mean squared error: 43.387708348294

Mean absolute error: 31.31357072467453

R squared: 0.0

93. Article number: 704205401

Article name: SITRONGRESS 50G

Mean absolute percentage error: 9.484393872759234e+16

Root mean squared error: 25.0131884709358

Mean absolute error: 21.059584904302117

R squared: 0.0

94. Article number: 704206001

Article name: KLEMENTIN X-TRA 1KG NETT

Mean absolute percentage error: 1.9750541103095837e+17

Root mean squared error: 58.454962900876495
Mean absolute error: 43.85501096292507
R squared: 0.0

95. Article number: 704206701
Article name: ASPARGESTOPP 200G
Mean absolute percentage error: 1.9706018065042595e+17
Root mean squared error: 52.8828426883765
Mean absolute error: 43.75614995897913
R squared: 0.0

96. Article number: 704209001
Article name: EPLE RØD SMAK 6 STK NO
Mean absolute percentage error: 1.395400853586507e+17
Root mean squared error: 42.00817169171114
Mean absolute error: 30.98412312466674
R squared: 0.0

97. Article number: 704210501
Article name: KLEMENTIN ÄNGLAMARK 750G
Mean absolute percentage error: 1.862608295090075e+17
Root mean squared error: 57.91935629328269
Mean absolute error: 41.35821230133618
R squared: 0.0

98. Article number: 704289601
Article name: PHYSALIS 100G
Mean absolute percentage error: 1.357042115436349e+17
Root mean squared error: 35.365859138584604
Mean absolute error: 30.132388038869284
R squared: 0.0

99. Article number: 704289901
Article name: GULROT X-TRA 1.5KG POSE
Mean absolute percentage error: 2.1209235259743885e+18
Root mean squared error: 526.0876496216747
Mean absolute error: 470.93962640118747
R squared: 0.0

100. Article number: 704292201
Article name: BÆR RIPS 125G IMP

Mean absolute percentage error: 1.2750747657007301e+17
Root mean squared error: 32.817212951479995
Mean absolute error: 28.312347259989547
R squared: 0.0

101. Article number: 704293601
Article name: PAPAYA STOR KG
Mean absolute percentage error: 2.096751315650088e+17
Root mean squared error: 54.25936853099011
Mean absolute error: 46.55723175095634
R squared: 0.0

102. Article number: 704300301
Article name: STANGSELLERI ØKO 350G
Mean absolute percentage error: 2.1308603143543376e+17
Root mean squared error: 58.20556338073917
Mean absolute error: 47.31460366512369
R squared: 0.0

103. Article number: 704302101
Article name: BÆR TYTTEBÆR 650G
Mean absolute percentage error: 1.750711769298435e+17
Root mean squared error: 48.36325655484234
Mean absolute error: 38.87361031514735
R squared: 0.0

104. Article number: 704305501
Article name: POTET KERRS PINK 2KG
Mean absolute percentage error: 8.675515124869072e+16
Root mean squared error: 23.65823548101729
Mean absolute error: 19.263513284226867
R squared: 0.0

105. Article number: 704311101
Article name: SALAT RUCCOLA 65G
Mean absolute percentage error: 1.6880054233711345e+18
Root mean squared error: 510.4507654663933
Mean absolute error: 374.81249734375376
R squared: 0.0

106. Article number: 704312501

Article name: KOKEBANAN KG
Mean absolute percentage error: 9.198235442373282e+16
Root mean squared error: 24.905636961938264
Mean absolute error: 20.42418554809196
R squared: 0.0

107. Article number: 704313801
Article name: PURRE BNT 3STK
Mean absolute percentage error: 1.3799284283619226e+17
Root mean squared error: 38.36095034556339
Mean absolute error: 30.640566270044246
R squared: 0.0

108. Article number: 704880701
Article name: EPLE RØDE AROMA KG NO
Mean absolute percentage error: 2.2799894357631648e+17
Root mean squared error: 71.07282899235898
Mean absolute error: 50.6259353497277
R squared: 0.0

109. Article number: 704881701
Article name: EPLE RØD RED CHIEF KG IMP
Mean absolute percentage error: 1.6152919120986656e+17
Root mean squared error: 47.488100709928815
Mean absolute error: 35.86668544605466
R squared: 0.0

110. Article number: 704882101
Article name: EPLE RØDE ELSTAR KG NO
Mean absolute percentage error: 1.1019817572721234e+17
Root mean squared error: 33.76501286631962
Mean absolute error: 24.468910392808038
R squared: 0.0

111. Article number: 704882201
Article name: EPLE RØDE GRAVENSTEIN KG NO
Mean absolute percentage error: 2.5170452262028067e+17
Root mean squared error: 76.09809903652722
Mean absolute error: 55.88963128306383
R squared: 0.0

112. Article number: 704889101
    Article name: BÆR TRANEBÆR 250G
    Mean absolute percentage error: 8.78195683561477e+16
    Root mean squared error: 23.501143435749796
    Mean absolute error: 19.499861360327596
    R squared: 0.0
113. Article number: 704890701
    Article name: GRESSKAR BUTTERNUT KG IMP
    Mean absolute percentage error: 1.637927597082337e+17
    Root mean squared error: 43.27618050495133
    Mean absolute error: 36.36929861899534
    R squared: 0.0
114. Article number: 704891701
    Article name: JORDSKOKK KG
    Mean absolute percentage error: 6.732077932005318e+16
    Root mean squared error: 19.85401893775575
    Mean absolute error: 14.948215847366427
    R squared: 0.0
115. Article number: 704893601
    Article name: SIKORI 300G
    Mean absolute percentage error: 9.670511416415058e+16
    Root mean squared error: 24.315355482959372
    Mean absolute error: 21.472848868808864
    R squared: 0.0
116. Article number: 704894001
    Article name: KLEMENTIN 5KG STK
    Mean absolute percentage error: 1.7057275450348067e+17
    Root mean squared error: 47.95647652016407
    Mean absolute error: 37.87475988469972
    R squared: 0.0
117. Article number: 704894301
    Article name: PEPPERROT TUBE STK
    Mean absolute percentage error: 1.240890970799758e+17
    Root mean squared error: 31.330731649460038
    Mean absolute error: 27.553314536627084

R squared: 0.0

118. Article number: 705222601
Article name: POTET X-TRA MANDEL 2KG
Mean absolute percentage error: 1.8211656012576464e+17
Root mean squared error: 48.31708539458186
Mean absolute error: 40.43799964343112
R squared: 0.0

119. Article number: 706345601
Article name: CHILI HABANERO 50G
Mean absolute percentage error: 1.7974632782731834e+17
Root mean squared error: 44.78692288635255
Mean absolute error: 39.91170234914206
R squared: 0.0

120. Article number: 708204901
Article name: BROKKOLI ÄNGLAMARK 300G
Mean absolute percentage error: 2.1272763364715072e+17
Root mean squared error: 60.608482687129275
Mean absolute error: 47.23502336981838
R squared: 0.0

121. Article number: 708914401
Article name: GRESSKAR HALLOWEEN KG
Mean absolute percentage error: 3.2480952042527494e+17
Root mean squared error: 117.57589047667415
Mean absolute error: 72.12220163871906
R squared: 0.0

122. Article number: 709170701
Article name: POTET MANDEL ENGELØYA 900G
Mean absolute percentage error: 9.291252276348749e+16
Root mean squared error: 27.833541849497134
Mean absolute error: 20.630724409606557
R squared: 0.0

123. Article number: 710760301
Article name: TOMAT AROMA 350G
Mean absolute percentage error: 1.0749943006508776e+18
Root mean squared error: 358.7576343105848

Mean absolute error: 238.69668478468444

R squared: 0.0

124. Article number: 711008101

Article name: SOMMERMIX MINIAGURK 250G

Mean absolute percentage error: 7.534097268256485e+17

Root mean squared error: 211.09856247617728

Mean absolute error: 167.2905651396769

R squared: 0.0

125. Article number: 711929301

Article name: BÆR BLÅBÆR 125G NO

Mean absolute percentage error: 2.3629312197740528e+17

Root mean squared error: 64.65327173716149

Mean absolute error: 52.46761291597519

R squared: 0.0

126. Article number: 711934801

Article name: BLOMKÅLRIS 200G

Mean absolute percentage error: 2.3790830540179197e+17

Root mean squared error: 59.56473328070711

Mean absolute error: 52.82625568132459

R squared: 0.0

127. Article number: 714077101

Article name: SOMMERMIKS MINIPAPRIKA 160G

Mean absolute percentage error: 1.027752758989811e+18

Root mean squared error: 266.2578327475856

Mean absolute error: 228.2069553305035

R squared: 0.0

128. Article number: 714200901

Article name: BÆR BRINGEBÆR 225G

Mean absolute percentage error: 2.843252447506218e+17

Root mean squared error: 79.4968457754023

Mean absolute error: 63.13288664086465

R squared: 0.0

129. Article number: 714688201

Article name: KIWI GRØNN SPISEMODEN 4PK

Mean absolute percentage error: 3.37676339552377e+17

Root mean squared error: 80.24113279020196
Mean absolute error: 74.97920940843828
R squared: 0.0

130. Article number: 715302101
Article name: RØDBETE ÄNGLAMARK 750G
Mean absolute percentage error: 3.116951889202775e+17
Root mean squared error: 76.47657229966832
Mean absolute error: 69.21023508083601
R squared: 0.0

131. Article number: 715331601
Article name: POTET CERISA DELIKAT SMAK 650G
Mean absolute percentage error: 9.095138889303142e+16
Root mean squared error: 24.53240187344777
Mean absolute error: 20.195265214136043
R squared: 0.0

132. Article number: 715333701
Article name: POTET CELANDINE DEL. SMAK 650G
Mean absolute percentage error: 9.57150088970429e+16
Root mean squared error: 26.180918958595186
Mean absolute error: 21.253001335939746
R squared: 0.0

133. Article number: 715990801
Article name: GULROT BEGER 700G STK
Mean absolute percentage error: 1.8911109745411512e+18
Root mean squared error: 469.26593429170714
Mean absolute error: 419.91098921138087
R squared: 0.0

134. Article number: 716521001
Article name: EPLE RØD COSMIC CRISP 4PK
Mean absolute percentage error: 1.023340225738464e+17
Root mean squared error: 31.904631673860017
Mean absolute error: 22.72271761279896
R squared: 0.0

135. Article number: 716543801
Article name: KIWI GRØNN ÄNGLAM. 300G

Mean absolute percentage error: 2.0434922282174365e+17
Root mean squared error: 67.70376085822747
Mean absolute error: 45.37464244819126
R squared: 0.0

136. Article number: 717575301
Article name: EPLE NORSK 2KG
Mean absolute percentage error: 1.3181671432968059e+17
Root mean squared error: 36.2017714318979
Mean absolute error: 29.26919025584964
R squared: 0.0

137. Article number: 717576501
Article name: GULROT REGNBUE SMAK BNT
Mean absolute percentage error: 7.993259633138254e+16
Root mean squared error: 25.055679657051208
Mean absolute error: 17.748601773033844
R squared: 0.0

138. Article number: 717639901
Article name: POTET MANDEL X-TRA 5KG
Mean absolute percentage error: 1.1017437022541168e+17
Root mean squared error: 29.405285733432894
Mean absolute error: 24.46362450956567
R squared: 0.0

139. Article number: 717686601
Article name: GRESSKAR HALLOWEEN 12KG
Mean absolute percentage error: 1.2689917787508821e+17
Root mean squared error: 36.54337977385588
Mean absolute error: 28.177277816585235
R squared: 0.0

140. Article number: 717789901
Article name: PAPRIKA SNACK 200G IMP
Mean absolute percentage error: 4.294956041183123e+18
Root mean squared error: 1053.2844644466918
Mean absolute error: 953.671817334883
R squared: 0.0

141. Article number: 718416601

Article name: DADLER SMAK 200G
Mean absolute percentage error: 1.1809055730281104e+17
Root mean squared error: 32.995309458677156
Mean absolute error: 26.221371141679448
R squared: 0.0

142. Article number: 720042001
Article name: APPELSIN ÄNGLAMARK STK
Mean absolute percentage error: 3.7321441068257126e+17
Root mean squared error: 113.96283735115253
Mean absolute error: 82.87024637233992
R squared: 0.0

143. Article number: 720482501
Article name: FIKEN STK
Mean absolute percentage error: 1.0663510864362314e+17
Root mean squared error: 30.526688577382004
Mean absolute error: 23.67775056991109
R squared: 0.0

144. Article number: 720997901
Article name: DADLER 500G PK
Mean absolute percentage error: 1.1386117252375242e+17
Root mean squared error: 30.167209519660545
Mean absolute error: 25.282259069337435
R squared: 0.0

145. Article number: 704292801
Article name: TOMAT FLAVANCE SMAK 400G
Mean absolute percentage error: 2.3624169229993644e+16
Root mean squared error: 286.9957997767772
Mean absolute error: 198.1778128688321
R squared: -5.223524009556613e-05

146. Article number: 704290301
Article name: SUKKERERT RUNDE 150G
Mean absolute percentage error: 3.229589011751465e+16
Root mean squared error: 295.70951659671863
Mean absolute error: 207.93390179265495
R squared: -0.001735309185562306

147. Article number: 704213401
    Article name: AVOKADO STK
    Mean absolute percentage error: 4.610557572105579e+16
    Root mean squared error: 600.8589472052873
    Mean absolute error: 421.19603434369606
    R squared: -0.0018734600983698613
148. Article number: 704206201
    Article name: MANGO X-TRA
    Mean absolute percentage error: 2.62356054689107e+16
    Root mean squared error: 164.91140102407974
    Mean absolute error: 118.81347291162409
    R squared: -0.007290378624640326
149. Article number: 704213101
    Article name: SQUASH STK
    Mean absolute percentage error: 3.4880196918836844e+16
    Root mean squared error: 433.71023897716833
    Mean absolute error: 330.4334120955204
    R squared: -0.009092109425559824
150. Article number: 715179201
    Article name: LØK GUL BUNT
    Mean absolute percentage error: 7.361581007008021e+16
    Root mean squared error: 31.938778302612924
    Mean absolute error: 24.85193107464562
    R squared: -0.029160485829528904
151. Article number: 704287201
    Article name: SALAT HJERTE 2STK
    Mean absolute percentage error: 5.099337371669269e+16
    Root mean squared error: 789.0972359247182
    Mean absolute error: 572.5861605310732
    R squared: -0.030072653139878724
152. Article number: 716353401
    Article name: POTET AMANDINE 1.5KG
    Mean absolute percentage error: 8.956982539275349e+16
    Root mean squared error: 351.2297552660158
    Mean absolute error: 174.36359899321948

R squared: -0.03409558488770115

153. Article number: 704884801
   Article name: POTET 2KG PIMPERNELL NO
   Mean absolute percentage error: 1.2561269936465128e+17
   Root mean squared error: 55.710884783928805
   Mean absolute error: 37.71263062880814
   R squared: -0.036301530078106437

154. Article number: 704202601
   Article name: GULROT BUNT POSE
   Mean absolute percentage error: 4.032807825389465e+17
   Root mean squared error: 724.9850789872286
   Mean absolute error: 448.60168513198573
   R squared: -0.0465678598732886

155. Article number: 710769101
   Article name: TOMAT SØDME 300G
   Mean absolute percentage error: 3.1492263476969772e+16
   Root mean squared error: 613.6245902774691
   Mean absolute error: 399.66477816529067
   R squared: -0.08767700058474781

156. Article number: 704040801
   Article name: LØK HVITLØK 500G FLETTE
   Mean absolute percentage error: 1.4823258361158222e+16
   Root mean squared error: 29.45888725406903
   Mean absolute error: 22.76749530160354
   R squared: -0.11417230729832584

157. Article number: 704285401
   Article name: EPLER GULE KG
   Mean absolute percentage error: 4.737097447930497e+16
   Root mean squared error: 334.5983874530152
   Mean absolute error: 250.28317101601442
   R squared: -0.11496605092935508

158. Article number: 704204401
   Article name: JORDBÆR 500G NO
   Mean absolute percentage error: 9.534496010618188e+17
   Root mean squared error: 2709.930539823098

Mean absolute error: 1648.1489392965118

R squared: -0.12086160445774552

159. Article number: 722283901

Article name: POTET KOKEFAST 2KG IMP

Mean absolute percentage error: 5.834448480550972e+16

Root mean squared error: 298.1358546521799

Mean absolute error: 122.06892237048939

R squared: -0.14467090941618288

160. Article number: 704209901

Article name: SPISSKÅL RØD STK

Mean absolute percentage error: 4418136260155279.5

Root mean squared error: 64.53573894997469

Mean absolute error: 40.07432584236005

R squared: -0.14559402544204958

161. Article number: 706961801

Article name: MANGO SPISEMODEN STK

Mean absolute percentage error: 8.35206806772387e+16

Root mean squared error: 560.774933594356

Mean absolute error: 412.54501174271473

R squared: -0.148234620894383

162. Article number: 718941901

Article name: TOMAT HVERDAGSTOMAT 400G

Mean absolute percentage error: 5.861964623299425e+16

Root mean squared error: 930.5781981679706

Mean absolute error: 755.7596416824434

R squared: -0.16694586618602902

163. Article number: 704285501

Article name: EPLER GRØNNE KG

Mean absolute percentage error: 3.6323449271532664e+16

Root mean squared error: 269.2462756980792

Mean absolute error: 195.62220492684767

R squared: -0.17201129752299193

164. Article number: 704197601

Article name: PURRE KG

Mean absolute percentage error: 2.199954256904614e+16

Root mean squared error: 156.74878231626386
Mean absolute error: 119.54902066189818
R squared: -0.17635539303622272

165. Article number: 704199001
Article name: REDDIK 150G PK
Mean absolute percentage error: 1.7017982285938246e+17
Root mean squared error: 85.77266351422354
Mean absolute error: 64.20631700059387
R squared: -0.18281068670481337

166. Article number: 704308501
Article name: SPIRE ALFALFA ØKO STK
Mean absolute percentage error: 3245993468066835.0
Root mean squared error: 40.40231420711163
Mean absolute error: 32.00646848620081
R squared: -0.18288194896755416

167. Article number: 704200501
Article name: SOPP SJAMPINJONG KG
Mean absolute percentage error: 2.663403509273968e+16
Root mean squared error: 237.76474446921057
Mean absolute error: 153.90424253311625
R squared: -0.20144690367796936

168. Article number: 704892001
Article name: KRY.URT ÄNGLAM 8CM KORIANDER
Mean absolute percentage error: 1.1975981410195946e+16
Root mean squared error: 154.9655593599677
Mean absolute error: 107.80759593752995
R squared: -0.20546600773980428

169. Article number: 715251701
Article name: AVOKADO NETT 800G
Mean absolute percentage error: 2.4219140773206404e+16
Root mean squared error: 209.32421605917614
Mean absolute error: 151.83089765302975
R squared: -0.2067467658636628

170. Article number: 708625001
Article name: SALAT WOKMIKS 300G

Mean absolute percentage error: 7032794040738244.0
Root mean squared error: 62.779306946395806
Mean absolute error: 49.179237588051635
R squared: -0.21148545524589557

171. Article number: 704197501
Article name: PAPRIKA RØD KG 70+
Mean absolute percentage error: 5.511170244604944e+16
Root mean squared error: 435.24203737193716
Mean absolute error: 320.0068394947637
R squared: -0.2131754884871262

172. Article number: 704291601
Article name: AVOKADO MODNET 2PK
Mean absolute percentage error: 2.400994502644505e+17
Root mean squared error: 1404.132878734999
Mean absolute error: 986.7494892518213
R squared: -0.22252436925424512

173. Article number: 720446001
Article name: TØRKET FERSKEN 200G
Mean absolute percentage error: 2.8352269590972276e+16
Root mean squared error: 67.4560732379762
Mean absolute error: 49.38311052614926
R squared: -0.23232552654324512

174. Article number: 704038501
Article name: TOMAT CHERRY X-TRA 250G STK
Mean absolute percentage error: 6.053980163603274e+16
Root mean squared error: 668.4668668585882
Mean absolute error: 472.7687295550949
R squared: -0.23597339352087432

175. Article number: 722418401
Article name: SALAT ISBERGMIKS 250G
Mean absolute percentage error: 6.435846369897848e+16
Root mean squared error: 331.95943372173645
Mean absolute error: 245.29895852679854
R squared: -0.2675430149622513

176. Article number: 704202801

Article name: PAPRIKA SNACK 300G IMP
Mean absolute percentage error: 2.2724855566400532e+16
Root mean squared error: 2537.876706696005
Mean absolute error: 1820.871393285646
R squared: -0.2715012274606603

177. Article number: 704201701
Article name: SPISSKÅL STK
Mean absolute percentage error: 6927795844786189.0
Root mean squared error: 85.04504736882174
Mean absolute error: 58.91278229461857
R squared: -0.27248897377391534

178. Article number: 704889301
Article name: PASTINAKK 200G
Mean absolute percentage error: 4208143609879118.5
Root mean squared error: 147.81060926117746
Mean absolute error: 83.27952884603863
R squared: -0.2935745001846364

179. Article number: 717579701
Article name: SALAT SPINAT 200G
Mean absolute percentage error: 1.0255781476959816e+17
Root mean squared error: 161.7431880075799
Mean absolute error: 73.79951413862544
R squared: -0.30600854096831687

180. Article number: 704286501
Article name: MELON HONNING KG
Mean absolute percentage error: 1.192084899662711e+16
Root mean squared error: 254.8060479788048
Mean absolute error: 182.49661748687183
R squared: -0.32590090968076435

181. Article number: 721427801
Article name: GULROT 400G
Mean absolute percentage error: 3.1347483871049564e+16
Root mean squared error: 679.704780734851
Mean absolute error: 405.8109817504883
R squared: -0.3323627291440794

182. Article number: 720788101
    Article name: POTET ÄNGLAMARK 1.2KG NO
    Mean absolute percentage error: 8.389188547830957e+16
    Root mean squared error: 165.80349774755197
    Mean absolute error: 103.47314089207562
    R squared: -0.3412331887146125
183. Article number: 704202001
    Article name: LØK STRØMPE 700G
    Mean absolute percentage error: 3.4960238667150896e+16
    Root mean squared error: 479.0275064688576
    Mean absolute error: 362.63118467740486
    R squared: -0.39083172314925796
184. Article number: 704321301
    Article name: POTET BAKE FOLIE KG
    Mean absolute percentage error: 4501355388385619.0
    Root mean squared error: 100.65034360218428
    Mean absolute error: 72.9239187182093
    R squared: -0.40681046516097585
185. Article number: 703911401
    Article name: SALAT SPINAT VASKET 200G
    Mean absolute percentage error: 1.6980661581306688e+17
    Root mean squared error: 174.3339160577905
    Mean absolute error: 139.05573366317282
    R squared: -0.42216522150555136
186. Article number: 704041301
    Article name: BROKKOLINI 200G STK
    Mean absolute percentage error: 3264919043835464.5
    Root mean squared error: 100.02141159908768
    Mean absolute error: 75.22107986731032
    R squared: -0.4485045822226015
187. Article number: 717579601
    Article name: SALAT SPINAT BABY 100G
    Mean absolute percentage error: 1.308958551075693e+17
    Root mean squared error: 150.68812168779698
    Mean absolute error: 75.97415527390557

R squared: -0.4651326353576619

188. Article number: 704881901

Article name: EPLE RØD ROYAL GALA KG IMP

Mean absolute percentage error: 1.143004564034908e+17

Root mean squared error: 952.0563872529146

Mean absolute error: 743.4355087748335

R squared: -0.4749303069338948

189. Article number: 722521001

Article name: SALAT COLESLAWMIKS 250G

Mean absolute percentage error: 7.230188524305024e+16

Root mean squared error: 85.92057893310539

Mean absolute error: 67.63849497133968

R squared: -0.47788025238829146

190. Article number: 708657201

Article name: SALAT RÅKOST 250G

Mean absolute percentage error: 2.4476515370944576e+17

Root mean squared error: 83.79014617254083

Mean absolute error: 71.04777591213858

R squared: -0.5042957467906029

191. Article number: 704039001

Article name: SALAT GRØNNKÅL VASKET 150G

Mean absolute percentage error: 1.2321177681087734e+16

Root mean squared error: 80.2815500200335

Mean absolute error: 61.91217196645912

R squared: -0.5258014469436976

192. Article number: 704036201

Article name: TOMAT KG

Mean absolute percentage error: 6.985592149899061e+16

Root mean squared error: 878.9959345419994

Mean absolute error: 657.3205691846601

R squared: -0.554019118958234

193. Article number: 715179101

Article name: LØK RØD BUNT

Mean absolute percentage error: 1.0448359794996803e+17

Root mean squared error: 40.371308428540374

Mean absolute error: 31.975696809452735

R squared: -0.5891291615770282

194. Article number: 704038701

Article name: PAPRIKA SNACK SMAK 2STK

Mean absolute percentage error: 1.4740922641826938e+17

Root mean squared error: 176.32600780544246

Mean absolute error: 123.5904918038772

R squared: -0.5984359621731665

195. Article number: 704208001

Article name: PLOMME FARGET KG

Mean absolute percentage error: 8.251999661583656e+16

Root mean squared error: 45.284909637339126

Mean absolute error: 30.156415962734105

R squared: -0.6126388291807376

196. Article number: 704301101

Article name: POTET X-TRA 4 KG

Mean absolute percentage error: 2.7056043760289997e+17

Root mean squared error: 309.6089345414497

Mean absolute error: 214.33492592653613

R squared: -0.6201003288963967

197. Article number: 720475001

Article name: PLOMME SMAK 500G

Mean absolute percentage error: 3.3855767379778228e+16

Root mean squared error: 272.5397363791296

Mean absolute error: 196.0313803315894

R squared: -0.6295188399648379

198. Article number: 704285801

Article name: APPELSIN KG

Mean absolute percentage error: 5.977444778106612e+17

Root mean squared error: 1622.2431546984296

Mean absolute error: 839.4603440688431

R squared: -0.6809431949856832

199. Article number: 713124901

Article name: TOMAT PICCOLO SMAK 175G

Mean absolute percentage error: 3.156897970852006e+16

Root mean squared error: 364.63379764936815
Mean absolute error: 274.4753057561769
R squared: -0.6821119851574597
200. Article number: 704296001
Article name: LØK HVITLØK KINA 100G
Mean absolute percentage error: 3.998686792344949e+16
Root mean squared error: 154.22590764042758
Mean absolute error: 113.06524466298109
R squared: -0.7072416408258693
201. Article number: 714754801
Article name: SALAT MIDDELHAV 125G
Mean absolute percentage error: 2.340289841719007e+16
Root mean squared error: 338.52404405933163
Mean absolute error: 220.61128040617962
R squared: -0.7124401956467585
202. Article number: 720445901
Article name: TØRKET MANGO 200G
Mean absolute percentage error: 8120558432319325.0
Root mean squared error: 418.5474294138509
Mean absolute error: 291.9606430077114
R squared: -0.7779621321524062
203. Article number: 704891901
Article name: KRY.URT ÄNGLAM 8CM BASILIKUM
Mean absolute percentage error: 1.1858320596675578e+16
Root mean squared error: 163.6255175125508
Mean absolute error: 116.28316432274192
R squared: -0.795421480567978
204. Article number: 704200301
Article name: EPLER ÄNGLAMARK 600G
Mean absolute percentage error: 9062098106407302.0
Root mean squared error: 124.2155581091326
Mean absolute error: 93.93977034165084
R squared: -0.8466194988428764
205. Article number: 722147801
Article name: TØRKET ANANAS 200G

Mean absolute percentage error: 1.1461434473424908e+16
Root mean squared error: 70.35464803826505
Mean absolute error: 53.49923172465132
R squared: -0.9230053900946429

206. Article number: 704207501
Article name: JORDBÆR 400G IMP
Mean absolute percentage error: 1.1475883491207252e+18
Root mean squared error: 773.5144519416184
Mean absolute error: 346.7925936342017
R squared: -0.9478477217567505

207. Article number: 704288801
Article name: BÆR BJØRNEBÆR 125G
Mean absolute percentage error: 5516709371703373.0
Root mean squared error: 40.26502133955948
Mean absolute error: 32.097248720976474
R squared: -1.0995089269584404

208. Article number: 705297201
Article name: POTET MANDEL 2KG
Mean absolute percentage error: 1.4923569454557245e+18
Root mean squared error: 525.091308169981
Mean absolute error: 424.1300034786295
R squared: -1.1443787254770204

209. Article number: 712253001
Article name: BØNNE ASPARGES 200G
Mean absolute percentage error: 4589813270038391.0
Root mean squared error: 36.6332600071971
Mean absolute error: 29.24565622996699
R squared: -1.1691291031893467

210. Article number: 704315701
Article name: KNUTEKÅL KG
Mean absolute percentage error: 5.44909471338296e+16
Root mean squared error: 30.2013141857852
Mean absolute error: 25.93555286618098
R squared: -1.2311853285442664

211. Article number: 711770601

Article name: POTET NYPOTETER SMÅ 700G
Mean absolute percentage error: 6.598906491238985e+17
Root mean squared error: 301.1114003299852
Mean absolute error: 186.5606157852828
R squared: -1.231820502268306

212. Article number: 704891001
Article name: KRY.URT ÄNGLAM 8CM DILL
Mean absolute percentage error: 2192311196599579.5
Root mean squared error: 144.12815721411272
Mean absolute error: 101.49565713098444
R squared: -1.2469727481377135

213. Article number: 720457701
Article name: PAPRIKA X-TRA KG
Mean absolute percentage error: 1.24231636557432e+16
Root mean squared error: 252.64166986575748
Mean absolute error: 196.37196512748858
R squared: -1.2755754365779968

214. Article number: 710005001
Article name: DRUE FARGET X-TRA 500G
Mean absolute percentage error: 1.0308376517654369e+18
Root mean squared error: 719.244164563332
Mean absolute error: 538.7653289982146
R squared: -1.2778300386282537

215. Article number: 704892101
Article name: KRY.URT ÄNGLAM 8CM KRUSPERSIL.
Mean absolute percentage error: 5104178342611410.0
Root mean squared error: 133.47377679246065
Mean absolute error: 95.98889992134703
R squared: -1.369161302845249

216. Article number: 704037401
Article name: DILL 6STK PK
Mean absolute percentage error: 4849692308000995.0
Root mean squared error: 43.68976409057673
Mean absolute error: 34.77966507519681
R squared: -1.4066943386778448

217. Article number: 704894701
    Article name: POTET 2KG BEATE NO
    Mean absolute percentage error: 4.57025590089159e+17
    Root mean squared error: 184.5330318042876
    Mean absolute error: 123.29677432007585
    R squared: -1.446460014243943
218. Article number: 713865101
    Article name: TOMAT MINIPLOMME 500G
    Mean absolute percentage error: 8.589822487556686e+17
    Root mean squared error: 285.30272226843914
    Mean absolute error: 209.36080363923054
    R squared: -1.4542749394130134
219. Article number: 710760201
    Article name: COOP GP COLESLAWMIKS 300G
    Mean absolute percentage error: 2.662327203117347e+17
    Root mean squared error: 88.97610194015863
    Mean absolute error: 67.89765369672716
    R squared: -1.5813461796056445
220. Article number: 704290501
    Article name: BANAN ÄNGLAMARK KG
    Mean absolute percentage error: 2.723033886629898e+16
    Root mean squared error: 375.89732122485896
    Mean absolute error: 277.48838576802444
    R squared: -1.6179225602696672
221. Article number: 721219501
    Article name: MINIPAPRIKA UTEN FRØ 200G
    Mean absolute percentage error: 1.1624231335404374e+17
    Root mean squared error: 42.919010472156785
    Mean absolute error: 31.232896067613474
    R squared: -1.6277436293718583
222. Article number: 704311001
    Article name: SALAT MEKSIKANSK MIKS 270G
    Mean absolute percentage error: 6117734289252202.0
    Root mean squared error: 40.19006904856686
    Mean absolute error: 32.42694556347431

R squared: -1.6732023572987083

223. Article number: 704208301

Article name: LØK STJERNELØK 250G STK

Mean absolute percentage error: 6.300786159030719e+16

Root mean squared error: 37.52119145388388

Mean absolute error: 30.855318713041903

R squared: -1.8330174398565457

224. Article number: 720476901

Article name: SALAT SPINAT ÄNGLAM UVASK 150G

Mean absolute percentage error: 1942310688815746.0

Root mean squared error: 56.69976605325838

Mean absolute error: 44.512180925146936

R squared: -1.8504169235428245

225. Article number: 720997801

Article name: BETEMIX ÄNGLAMARK 550G

Mean absolute percentage error: 1.1041886906453579e+17

Root mean squared error: 53.60777244663533

Mean absolute error: 38.920289057164105

R squared: -1.8654870320085681

226. Article number: 704890301

Article name: KRY.URT ÄNGLAM 8CM MYNTE

Mean absolute percentage error: 3458395568646560.0

Root mean squared error: 106.77353824812997

Mean absolute error: 79.48067899130605

R squared: -1.8690881313348293

227. Article number: 704209401

Article name: ROTMIX ÄNGLAMARK 1KG BGR

Mean absolute percentage error: 1.392723958040876e+17

Root mean squared error: 47.71039848821499

Mean absolute error: 35.94562662744815

R squared: -1.8753135322716332

228. Article number: 704036501

Article name: KÅLROT ÄNGLAMARK KG

Mean absolute percentage error: 1.2662006939900816e+17

Root mean squared error: 57.1369169541306

Mean absolute error: 44.77693823363883

R squared: -1.9073894469968642

229. Article number: 704892301

Article name: KRY.URT ÄNGLAM 8CM TIMIAN

Mean absolute percentage error: 7167461238383245.0

Root mean squared error: 72.83354285782178

Mean absolute error: 55.36776578938303

R squared: -1.975447550354323

230. Article number: 704037301

Article name: KRUSPERSILLE PK

Mean absolute percentage error: 1.6323647427928014e+16

Root mean squared error: 27.03881450916141

Mean absolute error: 21.758737505579287

R squared: -2.118506640360827

231. Article number: 720477001

Article name: SALAT RUCCOLA ÄNGLAM UVASK 50G

Mean absolute percentage error: 3.5385612333544704e+16

Root mean squared error: 90.36922207390278

Mean absolute error: 65.79581446735405

R squared: -2.164426160807214

232. Article number: 721427201

Article name: GULROT 750G

Mean absolute percentage error: 2.3277867629506112e+17

Root mean squared error: 2217.5875469172606

Mean absolute error: 1894.1356156472048

R squared: -2.484483472445266

233. Article number: 710796101

Article name: SPIRE BØNNE ØKO 180G

Mean absolute percentage error: 4976280698511713.0

Root mean squared error: 27.53417523300331

Mean absolute error: 23.42969200508726

R squared: -2.484509284449586

234. Article number: 720997401

Article name: BÆR RIPS 300G NO

Mean absolute percentage error: 7.102959208735977e+16

Root mean squared error: 24.16471412002834
Mean absolute error: 19.558241592594452
R squared: -2.8251710914528947

235. Article number: 704297801
Article name: RØDBETE BNT NO
Mean absolute percentage error: 7.894814961781362e+16
Root mean squared error: 34.89347058892795
Mean absolute error: 28.321360114161955
R squared: -3.0982592956282637

236. Article number: 704286301
Article name: RABARBRA KG
Mean absolute percentage error: 5.131396852031096e+16
Root mean squared error: 24.375156131126378
Mean absolute error: 20.15159063982817
R squared: -3.303687157403937

237. Article number: 704037501
Article name: BLADPERSILLE PK
Mean absolute percentage error: 6249838787944600.0
Root mean squared error: 41.115364404546355
Mean absolute error: 34.363434493176044
R squared: -3.3490646351872586

238. Article number: 712232901
Article name: KRY.URT ÄNGLAM 8CM BLADPERSIL.
Mean absolute percentage error: 5588301575522066.0
Root mean squared error: 88.27334797552646
Mean absolute error: 65.20445221040877
R squared: -3.4543892996619094

239. Article number: 721487801
Article name: GULROT X-TRA 1KG
Mean absolute percentage error: 3.829248214018543e+16
Root mean squared error: 1742.3561268752965
Mean absolute error: 1562.9804113189136
R squared: -3.4548929332621627

240. Article number: 704206501
Article name: GULROT ÄNGLAMARK 700G

Mean absolute percentage error: 1.6486059640014308e+16
Root mean squared error: 169.87867992903458
Mean absolute error: 134.0042775862056
R squared: -3.5738406710173516

241. Article number: 704291401
Article name: BÆR BLÅBÆR 125G IMP
Mean absolute percentage error: 4.4926689303322776e+16
Root mean squared error: 452.16363289401875
Mean absolute error: 276.9797499955066
R squared: -3.7325222547767343

242. Article number: 704290901
Article name: ROSENKÅL 400G
Mean absolute percentage error: 2.591848779703669e+17
Root mean squared error: 82.78885746838465
Mean absolute error: 68.1093435697029
R squared: -3.762228055344698

243. Article number: 704198301
Article name: NEPE BNT
Mean absolute percentage error: 5.978978858214327e+17
Root mean squared error: 211.26442022759574
Mean absolute error: 160.07475859987224
R squared: -4.1812404857468435

244. Article number: 717576401
Article name: GULROT REGNBUE SMAK BGR 750G
Mean absolute percentage error: 6.606508465834167e+16
Root mean squared error: 25.305304852313384
Mean absolute error: 20.17353009885074
R squared: -5.067716805440997

245. Article number: 704042301
Article name: SALAT ISBERG MIKS 200G
Mean absolute percentage error: 2.2810792105156344e+18
Root mean squared error: 646.2141268145768
Mean absolute error: 538.0158550051824
R squared: -5.179128552652761

246. Article number: 704889801

Article name: KRY.URT ÄNGLAM 12CM BASILIKUM
Mean absolute percentage error: 9138734235500042.0
Root mean squared error: 54.10951361559513
Mean absolute error: 38.39316379804553
R squared: -5.498610109581791

247. Article number: 704040501
Article name: TOMAT PLOMME MINI ÄNGLAM 250G
Mean absolute percentage error: 4190021482839261.5
Root mean squared error: 127.97163708304984
Mean absolute error: 98.32516962765185
R squared: -5.584876945230968

248. Article number: 704206401
Article name: HODEKÅL RØD KG
Mean absolute percentage error: 1.3508014330970875e+17
Root mean squared error: 50.71796206671721
Mean absolute error: 42.42640697736682
R squared: -5.623734826042341

249. Article number: 704890401
Article name: KRY.URT ÄNGLAM 8CM ROSMARIN
Mean absolute percentage error: 4944380896075124.0
Root mean squared error: 121.83136578369768
Mean absolute error: 87.87083307511968
R squared: -5.738941247153469

250. Article number: 704041901
Article name: RØDBETE ÄNGLAMARK 500G
Mean absolute percentage error: 7668627955504136.0
Root mean squared error: 106.93721048619761
Mean absolute error: 83.19978646120411
R squared: -6.030495138058525

251. Article number: 704204301
Article name: LØK RØD ÄNGLAMARK 400G
Mean absolute percentage error: 1.3658743483686462e+16
Root mean squared error: 134.08924189093867
Mean absolute error: 88.41865698691527
R squared: -6.32542437576715

252. Article number: 704205001
    Article name: PÆRE X-TRA 1KG
    Mean absolute percentage error: 7.538054921468814e+17
    Root mean squared error: 208.87750525369148
    Mean absolute error: 177.20822205572773
    R squared: -6.797777717472788
253. Article number: 720040701
    Article name: SITRON ÄNGLAMARK STK
    Mean absolute percentage error: 7.509912063943398e+17
    Root mean squared error: 204.65658799494122
    Mean absolute error: 172.9509971010173
    R squared: -7.891612853959158
254. Article number: 720821801
    Article name: BÆR TYTTEBÆR 500G
    Mean absolute percentage error: 1.1601815316127814e+17
    Root mean squared error: 34.5999493323263
    Mean absolute error: 26.689032057311636
    R squared: -7.990523910404741
255. Article number: 704198601
    Article name: SALAT ROMANO STK
    Mean absolute percentage error: 6.04893904718514e+16
    Root mean squared error: 45.742044742671354
    Mean absolute error: 33.90227122394585
    R squared: -9.07905682659552
256. Article number: 704203501
    Article name: APPELSIN X-TRA 2KG NETT
    Mean absolute percentage error: 4.747299122489791e+17
    Root mean squared error: 179.85023574698505
    Mean absolute error: 117.74896423948323
    R squared: -10.674184734887806
257. Article number: 704200401
    Article name: BLOMKÅL ØKO STK
    Mean absolute percentage error: 2.3664342836349654e+17
    Root mean squared error: 137.31043938429775
    Mean absolute error: 90.40445347651382

R squared: -10.785154839291282

258. Article number: 704308701

Article name: SPIRE BROKKOLI ØKO 50G

Mean absolute percentage error: 5516001940525687.0

Root mean squared error: 24.033957935792262

Mean absolute error: 19.567373931042255

R squared: -11.072300954660122

259. Article number: 704891101

Article name: KRY.URT ÄNGLAM 8CM GRESSLØK

Mean absolute percentage error: 4938870163189938.0

Root mean squared error: 184.81820746349973

Mean absolute error: 135.6188130407977

R squared: -12.255928740532287

260. Article number: 704211501

Article name: VÅRLØK ÄNGLAMARK STK

Mean absolute percentage error: 1.3443189161685992e+17

Root mean squared error: 109.79988231148783

Mean absolute error: 68.3978450517713

R squared: -12.512602408798854

261. Article number: 704039401

Article name: SPIRE REDDIK ØKO 50G

Mean absolute percentage error: 1.193528519854324e+16

Root mean squared error: 25.139478911303655

Mean absolute error: 21.36105819421312

R squared: -13.378984191137814

262. Article number: 722499701

Article name: SALAT PIZZASALAT 65G

Mean absolute percentage error: 1.9109306733341248e+17

Root mean squared error: 289.6224149086379

Mean absolute error: 231.8434099068671

R squared: -13.849364310326553

263. Article number: 704313701

Article name: SQUASH ÄNGLAMARK NO STK

Mean absolute percentage error: 1.0638801764681368e+17

Root mean squared error: 86.38242337481688

Mean absolute error: 60.87986352838622

R squared: -14.093887996255393

264. Article number: 704201501

Article name: ISBERG ØKO STK

Mean absolute percentage error: 5.035166623652833e+16

Root mean squared error: 135.67681460518176

Mean absolute error: 84.12613567984177

R squared: -14.762315733297598

265. Article number: 7186328

Article name: KRY.URT ÄNG 8CM KRUS DILL GRES

Mean absolute percentage error: 6991494004112809.0

Root mean squared error: 16.961469940878402

Mean absolute error: 14.387815990330983

R squared: -15.688152454276658

266. Article number: 704204101

Article name: LØK ÄNGLAMARK 400G

Mean absolute percentage error: 9690111333668552.0

Root mean squared error: 163.24846140566098

Mean absolute error: 116.95488694547876

R squared: -15.958163196415615

267. Article number: 704884501

Article name: POTET 2KG NANSEN NO

Mean absolute percentage error: 4.62253014758036e+17

Root mean squared error: 176.1959028980904

Mean absolute error: 115.5813836992884

R squared: -17.433024770075278

268. Article number: 704203401

Article name: HODEKÅL SAVOY KG

Mean absolute percentage error: 6.462453987410885e+16

Root mean squared error: 21.593392228593913

Mean absolute error: 17.746072909583344

R squared: -20.850504665061738

269. Article number: 704889701

Article name: KRY.URT ÄNGLAM 12CM KRUSPERS.

Mean absolute percentage error: 2.2447632818108856e+16

Root mean squared error: 51.9104643974925
Mean absolute error: 36.548723653781636
R squared: -21.219797242361565

270. Article number: 7184904
Article name: KRY.URT ÄNG 8CM BASIL KORIAN
Mean absolute percentage error: 9228864677545950.0
Root mean squared error: 21.448351888705737
Mean absolute error: 17.712370890049847
R squared: -25.138528127768293

271. Article number: 704306201
Article name: APPELSIN RØD SMAK 1KG NETT
Mean absolute percentage error: 2.1849356110480426e+17
Root mean squared error: 107.3164013113078
Mean absolute error: 52.94923485129889
R squared: -27.114273014498092

272. Article number: 704038401
Article name: PAPRIKA SNACK ÄNGLAMARK 2STK
Mean absolute percentage error: 9.271355008233053e+17
Root mean squared error: 244.656315460583
Mean absolute error: 210.95268389930024
R squared: -28.007869365165792

273. Article number: 704304301
Article name: SALAT CRISPI ÄNGLAMARK 120G
Mean absolute percentage error: 4.2738294010218456e+16
Root mean squared error: 189.4459826041525
Mean absolute error: 110.71971662790497
R squared: -28.222017433357934

274. Article number: 704317101
Article name: STANGSELLERI ÄNGLAMARK 350G
Mean absolute percentage error: 1.4104090434374197e+17
Root mean squared error: 96.61300685018654
Mean absolute error: 60.245977705973054
R squared: -30.12880805319548

275. Article number: 712613401
Article name: SOPP SKIVET SJAMPINJONG 150G

Mean absolute percentage error: 2.7565561733028893e+17
Root mean squared error: 71.80127498090074
Mean absolute error: 62.80097618571089
R squared: -31.007919827987337

276. Article number: 704321601
Article name: TOMAT CHERRY RØD 250G STK
Mean absolute percentage error: 7.923304359928783e+17
Root mean squared error: 915.8149856707357
Mean absolute error: 538.9367765882995
R squared: -41.359308298393145

277. Article number: 704209101
Article name: GULROT SNACK 250G
Mean absolute percentage error: 2.0093218436272353e+18
Root mean squared error: 532.1372857500508
Mean absolute error: 447.6188939568455
R squared: -46.63408273999251

278. Article number: 704208601
Article name: BÆR BLÅBÆR ÄNGLAMARK 125G STK
Mean absolute percentage error: 4.435074393824144e+16
Root mean squared error: 51.22685828137826
Mean absolute error: 34.12864150298885
R squared: -49.556694662144956

279. Article number: 713084701
Article name: BÆR PHYSALIS 125G
Mean absolute percentage error: 3.55115943695314e+17
Root mean squared error: 92.65959636373799
Mean absolute error: 79.9526794527206
R squared: -52.22245866388874

280. Article number: 704210001
Article name: GRØNNKÅL ÄNGLAMARK 200G
Mean absolute percentage error: 3.0813025097001376e+16
Root mean squared error: 123.3479429968607
Mean absolute error: 66.89227277369586
R squared: -52.60411275476324

281. Article number: 715287401

Article name: RØDBETE SOUS VIDE ÄNGLAM. 500G
Mean absolute percentage error: 7.401141555529088e+16
Root mean squared error: 76.35105145689542
Mean absolute error: 50.23432698864147
R squared: -56.94804526460607

282. Article number: 720130901
Article name: GRAPEFRUKT STK
Mean absolute percentage error: 3.2283541743995245e+17
Root mean squared error: 84.11136933525194
Mean absolute error: 72.3628389791477
R squared: -58.06628757708377

283. Article number: 704302001
Article name: PERSILLEROT ÄNGLAMARK STK
Mean absolute percentage error: 1.6261839886855603e+17
Root mean squared error: 53.44090081824578
Mean absolute error: 39.73767664388645
R squared: -68.29607396235275

284. Article number: 704889901
Article name: KRY.URT ÄNGLAM 12CM KORIANDER
Mean absolute percentage error: 2.1757166550444956e+16
Root mean squared error: 114.95099794468793
Mean absolute error: 64.44131280161852
R squared: -70.7551668137792

285. Article number: 718998601
Article name: GUACAMOLE 150G
Mean absolute percentage error: 2.7223186480975494e+17
Root mean squared error: 69.52286324754958
Mean absolute error: 60.8806210968392
R squared: -74.71753492393935

286. Article number: 704207001
Article name: SOPP KANTARELL KG
Mean absolute percentage error: 8.136028277401592e+16
Root mean squared error: 23.593237073965952
Mean absolute error: 18.731612059236305
R squared: -77.05004254567584

287. Article number: 704207701
    Article name: SELLERIROT ÄNGLAMARK KG
    Mean absolute percentage error: 1.704295875919064e+17
    Root mean squared error: 72.57353843318792
    Mean absolute error: 49.94648560131986
    R squared: -80.92059308867489
288. Article number: 704041401
    Article name: CHILI RØD ÄNGLAMARK 50G
    Mean absolute percentage error: 2.6953203340097754e+17
    Root mean squared error: 75.76434325874644
    Mean absolute error: 61.991560403554715
    R squared: -82.65493867838248
289. Article number: 704309201
    Article name: GRESSKAR HOKKAIDO ÄNGLAM KG
    Mean absolute percentage error: 3.128334779896541e+17
    Root mean squared error: 122.4937402059642
    Mean absolute error: 84.0330008875373
    R squared: -86.5877744023382
290. Article number: 704036701
    Article name: AGURK ÄNGLAMARK STK
    Mean absolute percentage error: 1.3482171494833188e+18
    Root mean squared error: 370.85059374252785
    Mean absolute error: 305.4625173463412
    R squared: -92.60735910825974
291. Article number: 704310601
    Article name: KOKOSNØTT ØKO STK
    Mean absolute percentage error: 7.159961456079245e+16
    Root mean squared error: 21.280634984367502
    Mean absolute error: 17.207316392769844
    R squared: -93.09551337120159
292. Article number: 704319901
    Article name: SOPP AROMA KG
    Mean absolute percentage error: 1.4350959025656296e+17
    Root mean squared error: 36.92713079086989
    Mean absolute error: 32.64311595050835

R squared: -93.37998470850196

293. Article number: 713873701

Article name: KRY.URT ØKO SALVIE 12 CM

Mean absolute percentage error: 7.120282903990458e+16

Root mean squared error: 23.88588615213886

Mean absolute error: 17.766778793803024

R squared: -94.007014773771

294. Article number: 704200101

Article name: HODEKÅL ÄNGLAMARK KG

Mean absolute percentage error: 3.531813944603435e+17

Root mean squared error: 168.41193757762593

Mean absolute error: 107.04373628815259

R squared: -117.20633837079473

295. Article number: 704316501

Article name: DRUE FARGET ÄNGLAMARK 400G

Mean absolute percentage error: 1.585643537315528e+17

Root mean squared error: 59.650809388000845

Mean absolute error: 36.62113290330384

R squared: -120.56580437798978

296. Article number: 713865201

Article name: KRY.URT ØKO ESTRAGON 12 CM

Mean absolute percentage error: 8.099255210084717e+16

Root mean squared error: 25.65681790303441

Mean absolute error: 21.14968014348504

R squared: -139.8183322797072

297. Article number: 704198901

Article name: PAPRIKA MIX STK

Mean absolute percentage error: 1.2896798327669855e+18

Root mean squared error: 324.837632932726

Mean absolute error: 288.1573589301548

R squared: -141.1143825614881

298. Article number: 704211701

Article name: LØK HVITLØK ÄNGLAMARK 100G

Mean absolute percentage error: 4.7252414689605306e+17

Root mean squared error: 151.25303888534452

Mean absolute error: 108.31056092853196

R squared: -156.19701543068314

299. Article number: 707585701

Article name: SOPP SJAMPINJONG ÄNGLAM. 250G

Mean absolute percentage error: 2.520072303870322e+17

Root mean squared error: 84.92599657684003

Mean absolute error: 57.45174809321304

R squared: -168.68465492602186

300. Article number: 704890901

Article name: KRY.URT ÄNGLAM 8CM SITRONMELIS

Mean absolute percentage error: 1.180838710136624e+17

Root mean squared error: 175.0277862480123

Mean absolute error: 141.42009985520065

R squared: -177.5177948856164

301. Article number: 704041701

Article name: CHILI RØD 50G

Mean absolute percentage error: 1.9327324370332058e+18

Root mean squared error: 499.9494961301222

Mean absolute error: 430.99779814737707

R squared: -234.27794537087325

302. Article number: 714462801

Article name: KIWI GUL 4PK

Mean absolute percentage error: 3.233670492823361e+17

Root mean squared error: 89.89154219420956

Mean absolute error: 72.60144949836965

R squared: -271.16254126876146

303. Article number: 714078301

Article name: PAPRIKA PADRÓN 200G

Mean absolute percentage error: 2.5319094750994502e+17

Root mean squared error: 65.63097549489578

Mean absolute error: 56.98699823625249

R squared: -302.72604391738884

304. Article number: 721886401

Article name: KRY.URT ÄNG.12CM THAIBASILIKUM

Mean absolute percentage error: 1.1318591750198037e+17

Root mean squared error: 131.76596957464494
Mean absolute error: 79.16964017247861
R squared: -310.5902657791707

305. Article number: 704892201
Article name: KRY.URT ÄNGLAM 8CM OREGANO
Mean absolute percentage error: 1.6575379492618944e+17
Root mean squared error: 121.87177675894087
Mean absolute error: 92.2022664941893
R squared: -314.15517491730714

306. Article number: 704212701
Article name: ASPARGES GRØNN 250G BNT
Mean absolute percentage error: 2.312006432521857e+18
Root mean squared error: 889.8871455535705
Mean absolute error: 516.9258781152269
R squared: -360.3177821058976

307. Article number: 704212201
Article name: INGEFÆR KG
Mean absolute percentage error: 3.752294729001817e+17
Root mean squared error: 92.3991309736948
Mean absolute error: 83.8152243140285
R squared: -360.4090175343827

308. Article number: 704205501
Article name: PASJONSFRUKT 3STK
Mean absolute percentage error: 3.0728027230462464e+17
Root mean squared error: 76.50639215797572
Mean absolute error: 68.38568521277305
R squared: -369.0961823467996

309. Article number: 708522901
Article name: SOPP KANTARELL SMAK 200G
Mean absolute percentage error: 1.7046479288549235e+17
Root mean squared error: 43.95249379779242
Mean absolute error: 38.01451596453146
R squared: -381.9883822883395

310. Article number: 703911301
Article name: AVOKADO ØKO 300G STK

Mean absolute percentage error: 2.0666710826958224e+17
Root mean squared error: 51.66255433477951
Mean absolute error: 46.35857371464829
R squared: -402.5027064215528

311. Article number: 703911101
Article name: PAPRIKA GUL KG 70+
Mean absolute percentage error: 2.6713596115640592e+17
Root mean squared error: 67.50114030298884
Mean absolute error: 59.82512120673993
R squared: -497.415303927787

312. Article number: 709729401
Article name: CHILI RØD RAWIT 50G
Mean absolute percentage error: 1.1736639767544733e+17
Root mean squared error: 35.294195470090195
Mean absolute error: 26.285951836708865
R squared: -640.603561840543

313. Article number: 708857401
Article name: BÆR KIWIBÆR 125G
Mean absolute percentage error: 1.8054423868322653e+17
Root mean squared error: 52.67917841256278
Mean absolute error: 40.60549464547561
R squared: -977.079185579656

314. Article number: 704197801
Article name: PAPRIKA GRØNN KG 70+
Mean absolute percentage error: 2.6976347037502125e+17
Root mean squared error: 67.04302035653065
Mean absolute error: 60.3815991805375
R squared: -1185.5022675098078

315. Article number: 704039601
Article name: GURKEMEIE ÄNGLAMARK 100G
Mean absolute percentage error: 2.32575457730443e+17
Root mean squared error: 65.59704534603455
Mean absolute error: 52.0159078141663
R squared: -1515.5774246942099

316. Article number: 704894501

Article name: PAK CHOY STK
Mean absolute percentage error: 1.2544111352401262e+17
Root mean squared error: 31.521578570559882
Mean absolute error: 27.873890718799426
R squared: -1628.5815954965733

317. Article number: 704296201
Article name: SOPP SHI TAKE KG
Mean absolute percentage error: 5.230476319554338e+16
Root mean squared error: 16.349508815770125
Mean absolute error: 11.961902337571594
R squared: -1862.0809981523385

318. Article number: 704312301
Article name: SOPP ØSTERS KG
Mean absolute percentage error: 1.1846719352479432e+17
Root mean squared error: 31.3033253945259
Mean absolute error: 27.156489413208757
R squared: -2088.8149594232423

319. Article number: 704300501
Article name: LIME ÄNGLAMARK 3STK
Mean absolute percentage error: 3.577077936712847e+17
Root mean squared error: 105.75515787801936
Mean absolute error: 79.92782563519624
R squared: -2216.2857879481235

320. Article number: 704312201
Article name: SOPP PORTABELLO KG
Mean absolute percentage error: 7.58269266360631e+16
Root mean squared error: 21.454588933372698
Mean absolute error: 17.83881068083406
R squared: -2389.4797487499322

321. Article number: 704290101
Article name: MELON CANTALOUPE KG
Mean absolute percentage error: 5.281872829862822e+17
Root mean squared error: 141.64090373726648
Mean absolute error: 118.06615341514166
R squared: -2938.239849750198

322. Article number: 704559101
    Article name: CHILI JALAPENO GRØNN 50G
    Mean absolute percentage error: 1.8862973990610835e+17
    Root mean squared error: 47.09447382708835
    Mean absolute error: 42.147381554351995
    R squared: -3636.47562943961
323. Article number: 704312401
    Article name: CHILI RØD KG
    Mean absolute percentage error: 9.497172654700682e+16
    Root mean squared error: 25.63070610309672
    Mean absolute error: 21.165175396971907
    R squared: -8334.27001441101
324. Article number: 704289501
    Article name: DADLER KG
    Mean absolute percentage error: 1.1819572081547974e+17
    Root mean squared error: 31.433886148080013
    Mean absolute error: 26.36935609688788
    R squared: -10127.295490549637
325. Article number: 704036301
    Article name: LØK HVITLØK FERSK KG
    Mean absolute percentage error: 9.182409009607475e+16
    Root mean squared error: 23.962316457098066
    Mean absolute error: 20.584761321178974
    R squared: -23541.783109301396

Appendix D

Optimized model performance for individual articles

Optimized model performance for each individual article ranked by R^2 score.

```
Test dataset for all articles

    LSTM hyperparameters:
    Number of features: 351
    Sequence length: 15
    Number of epochs: 10
    Learning rate: 0.001
    Loss function: mse
    Batch size: 32
    Number of neurons: 702
    Dropout rate: 0.1

    Test results:
    Mean absolute percentage error: 2.1129947022383712e+17
    Root mean squared error: 723.1660759401212
    Mean absolute error: 210.53836749519397
    R squared: 0.6154203062313363
```

1. Article number: 704291501
    Article name: PLOMME FARGET 750G NO
    Mean absolute percentage error: 1.1324304057390592e+17
    Root mean squared error: 344.56670956351246
    Mean absolute error: 153.04923283196743
    R squared: 0.827490403269263
2. Article number: 720809801
    Article name: DRUE COTTON CANDY 400G
    Mean absolute percentage error: 6.441508678704285e+16
    Root mean squared error: 1039.3894976569575
    Mean absolute error: 476.8996985441719
    R squared: 0.7906950229716208
3. Article number: 704312101
    Article name: POTET TIDLIG NO KG
    Mean absolute percentage error: 4.8068317251813056e+17
    Root mean squared error: 1016.3161071853607
    Mean absolute error: 617.8642206192017
    R squared: 0.7452954539514483
4. Article number: 704197701
    Article name: DRUE GRØNN KG
    Mean absolute percentage error: 6.89393891673606e+16
    Root mean squared error: 445.58258862383207
    Mean absolute error: 203.45106311872894
    R squared: 0.6883202009404791
5. Article number: 714496201
    Article name: NYPOTET NORSKE GULE 1.5KG
    Mean absolute percentage error: 1.1622036203951659e+17
    Root mean squared error: 557.5627643505667
    Mean absolute error: 330.1101787791533
    R squared: 0.6443673499890876
6. Article number: 704295601
    Article name: SOPP SJAMPINJONG X-TRA 250G
    Mean absolute percentage error: 0.43406626846556245
    Root mean squared error: 295.4571348225877

Mean absolute error: 204.84869045681424

R squared: 0.5608711293553174

7. Article number: 704292901

Article name: POTET NY ASSORTERT KG IMP

Mean absolute percentage error: 8.672944891955876e+17

Root mean squared error: 1958.5767951921139

Mean absolute error: 1091.8643630158667

R squared: 0.55677848537937

8. Article number: 704036801

Article name: LØK X-TRA 1KG PK

Mean absolute percentage error: 4087709354164225.0

Root mean squared error: 128.81725109549723

Mean absolute error: 98.03237536062602

R squared: 0.5490575249633736

9. Article number: 704197201

Article name: SITRON KG

Mean absolute percentage error: 5858709081970434.0

Root mean squared error: 224.59717721625972

Mean absolute error: 165.7755576738345

R squared: 0.5250466263890952

10. Article number: 704197401

Article name: LØK KG

Mean absolute percentage error: 5630156186990820.0

Root mean squared error: 231.2496188772849

Mean absolute error: 170.15217600305095

R squared: 0.5198394955165727

11. Article number: 704198001

Article name: BLOMKÅL STK

Mean absolute percentage error: 9193078702108270.0

Root mean squared error: 930.9262308891382

Mean absolute error: 620.6264519784964

R squared: 0.5037189114958378

12. Article number: 704207601

Article name: LØK HVITLØK 100G

Mean absolute percentage error: 0.5749105579139177

Root mean squared error: 369.6247956304449
Mean absolute error: 276.82444533803107
R squared: 0.4837620905335851

13. Article number: 704200001
Article name: VÅRLØK BNT
Mean absolute percentage error: 1.0796315772178726e+16
Root mean squared error: 399.79606905591373
Mean absolute error: 289.3338221132366
R squared: 0.4795626116425382

14. Article number: 704197301
Article name: HODEKÅL KG
Mean absolute percentage error: 8.070785910355502e+17
Root mean squared error: 658.0472862286606
Mean absolute error: 353.49590980928707
R squared: 0.4788289205116083

15. Article number: 707106001
Article name: SOPP AROMA 200G
Mean absolute percentage error: 2078918677799929.2
Root mean squared error: 52.24696262229064
Mean absolute error: 39.892824958352485
R squared: 0.47652347824847685

16. Article number: 704892001
Article name: KRY.URT ÄNGLAM 8CM KORIANDER
Mean absolute percentage error: 0.49098763127464323
Root mean squared error: 101.56149210840736
Mean absolute error: 79.59534928066279
R squared: 0.4616424627616732

17. Article number: 710034501
Article name: DRUE GRØNN X-TRA 500G
Mean absolute percentage error: 1.08873706508681e+16
Root mean squared error: 186.3030981437753
Mean absolute error: 131.18886591094773
R squared: 0.45137019945570467

18. Article number: 714496301
Article name: NYPOTET NORSKE RØDE 1.5KG

Mean absolute percentage error: 1.0265592856024984e+17
Root mean squared error: 495.48448196478506
Mean absolute error: 285.28846971349776
R squared: 0.4499326009344716

19. Article number: 720482401
Article name: FERSKEN PARAGUAYO SMAK 500G
Mean absolute percentage error: 8.324252434610189e+16
Root mean squared error: 1408.016557822333
Mean absolute error: 770.2488195070255
R squared: 0.44076931821464727

20. Article number: 704198801
Article name: KINAKÅL STK
Mean absolute percentage error: 2930270126954670.5
Root mean squared error: 130.2141058071956
Mean absolute error: 93.34217749701605
R squared: 0.4267735117014412

21. Article number: 704211301
Article name: PERSILLEROT 200G
Mean absolute percentage error: 7284830908265439.0
Root mean squared error: 50.03672198261902
Mean absolute error: 36.851223341000626
R squared: 0.41976843546064124

22. Article number: 704203201
Article name: LØK 2STK
Mean absolute percentage error: 6034832160228827.0
Root mean squared error: 248.82775989832197
Mean absolute error: 188.59035656498926
R squared: 0.4187399807124187

23. Article number: 704204401
Article name: JORDBÆR 500G NO
Mean absolute percentage error: 1.4371117431358853e+17
Root mean squared error: 1987.7996242459897
Mean absolute error: 1049.040147133123
R squared: 0.4184697564765133

24. Article number: 704197501

Article name: PAPRIKA RØD KG 70+

Mean absolute percentage error: 6816908313350438.0

Root mean squared error: 287.6230241398916

Mean absolute error: 211.19420244802836

R squared: 0.4158287317687235

25. Article number: 704208101

Article name: LØK RØD X-TRA 1KG PK

Mean absolute percentage error: 2686439499941232.5

Root mean squared error: 91.31679948097477

Mean absolute error: 68.95877509023629

R squared: 0.4117307918218899

26. Article number: 704207301

Article name: EPLER X-TRA 1KG POSE

Mean absolute percentage error: 5165481822505589.0

Root mean squared error: 184.87351031177963

Mean absolute error: 136.6965676600637

R squared: 0.4114176595523814

27. Article number: 704286701

Article name: MELON VANN KG

Mean absolute percentage error: 1.568591171225214e+17

Root mean squared error: 3443.847966355835

Mean absolute error: 2422.3943218156405

R squared: 0.40078414346024893

28. Article number: 715333801

Article name: POTET KOKEFAST SMÅ GULE 850G

Mean absolute percentage error: 8.197965523730838e+16

Root mean squared error: 149.21735075148644

Mean absolute error: 76.68182446598227

R squared: 0.39987934449808593

29. Article number: 704208501

Article name: SELLERI BUNT

Mean absolute percentage error: 3.1608357895819344e+16

Root mean squared error: 46.17250560729102

Mean absolute error: 18.03362755370296

R squared: 0.39189430254448154

30. Article number: 704202401
    Article name: LØK RØD STRØMPE 400G
    Mean absolute percentage error: 0.5401009550257341
    Root mean squared error: 613.7659280602046
    Mean absolute error: 416.5144200543173
    R squared: 0.38897685008875205
31. Article number: 715179101
    Article name: LØK RØD BUNT
    Mean absolute percentage error: 3.347892501520887e+16
    Root mean squared error: 25.790621315634404
    Mean absolute error: 14.983780181485843
    R squared: 0.3858165887495345
32. Article number: 704291601
    Article name: AVOKADO MODNET 2PK
    Mean absolute percentage error: 0.597482447143864
    Root mean squared error: 998.4934763237743
    Mean absolute error: 709.5897599762561
    R squared: 0.38018470002072247
33. Article number: 704287001
    Article name: REDDIK BUNT
    Mean absolute percentage error: 3.531790211677437e+16
    Root mean squared error: 115.24784785779994
    Mean absolute error: 73.19224438636131
    R squared: 0.37348970465643194
34. Article number: 704285301
    Article name: BANAN KG
    Mean absolute percentage error: 8.070945700543355e+16
    Root mean squared error: 2217.949985708369
    Mean absolute error: 1724.416233436734
    R squared: 0.3665365562658328
35. Article number: 704318601
    Article name: LIME KG
    Mean absolute percentage error: 3634174282113828.0
    Root mean squared error: 92.6788856861996
    Mean absolute error: 70.2362169751934

R squared: 0.36587494203348403

36. Article number: 704879101
    Article name: POTET ASSORTERT LØS KG NO
    Mean absolute percentage error: 1.944650391016935e+17
    Root mean squared error: 703.7762771856669
    Mean absolute error: 262.89969376956714
    R squared: 0.3414426303808882
37. Article number: 704211001
    Article name: APRIKOS SMAK 350G KURV
    Mean absolute percentage error: 7.907164550477366e+16
    Root mean squared error: 192.5042803951192
    Mean absolute error: 120.96166958528407
    R squared: 0.34081373509604074
38. Article number: 704202001
    Article name: LØK STRØMPE 700G
    Mean absolute percentage error: 1.0567306673659995
    Root mean squared error: 327.1507941881275
    Mean absolute error: 234.82096209557227
    R squared: 0.3355749231035874
39. Article number: 704288401
    Article name: NEKTARIN KURV 1KG STK
    Mean absolute percentage error: 4.750530152644158e+17
    Root mean squared error: 1351.8775155894268
    Mean absolute error: 914.6194296007842
    R squared: 0.33096615305173627
40. Article number: 704205801
    Article name: KIWI GRØNN STK
    Mean absolute percentage error: 0.5782767143217926
    Root mean squared error: 1015.321783149169
    Mean absolute error: 665.3254779491549
    R squared: 0.3241219825441265
41. Article number: 704204501
    Article name: BÆR BRINGEBÆR 300G NO
    Mean absolute percentage error: 1.165891727339551e+17
    Root mean squared error: 380.8498180017019

Mean absolute error: 212.88184546177683

R squared: 0.3148026282938037

42. Article number: 704199901

Article name: LØK SJALOTT 250G

Mean absolute percentage error: 3.0448055076362308e+16

Root mean squared error: 279.0860720174442

Mean absolute error: 172.617990930096

R squared: 0.3034163217480218

43. Article number: 720809701

Article name: DRUE CANDY GRAPES 400G

Mean absolute percentage error: 2.6944480924631256e+16

Root mean squared error: 189.83334857038855

Mean absolute error: 103.78956954307806

R squared: 0.30283309008218384

44. Article number: 704886401

Article name: POTET 2KG ASTERIX NO

Mean absolute percentage error: 2.366985061657614e+17

Root mean squared error: 193.87017789912255

Mean absolute error: 97.38787181081335

R squared: 0.2991755065815134

45. Article number: 704303801

Article name: SALAT BABYLEAF VASKET 65G STK

Mean absolute percentage error: 5336352576836200.0

Root mean squared error: 165.26119391324914

Mean absolute error: 128.18614680470984

R squared: 0.29413999773388366

46. Article number: 704199301

Article name: ISBERG STK

Mean absolute percentage error: 2.113565151553212e+16

Root mean squared error: 1160.9829127829184

Mean absolute error: 795.6529425328074

R squared: 0.2892751499403018

47. Article number: 704038201

Article name: SALAT CRISPI BGR 150G

Mean absolute percentage error: 0.673687559828098

Root mean squared error: 1199.2633117410114

Mean absolute error: 837.0718794679331

R squared: 0.27790629290872937

48. Article number: 704200501

Article name: SOPP SJAMPINJONG KG

Mean absolute percentage error: 4698682094857517.0

Root mean squared error: 183.5056083440505

Mean absolute error: 124.72090298521752

R squared: 0.27780868280105897

49. Article number: 720482101

Article name: NEKTARIN SMAK 460G

Mean absolute percentage error: 4.4032368078439576e+16

Root mean squared error: 112.30071625567518

Mean absolute error: 69.90246648102804

R squared: 0.27056006002324406

50. Article number: 715179201

Article name: LØK GUL BUNT

Mean absolute percentage error: 3.203469886310901e+16

Root mean squared error: 27.59970253479751

Mean absolute error: 15.66038207758486

R squared: 0.27055289393695126

51. Article number: 716595501

Article name: SALAT RUCCOLA VASKET 65G

Mean absolute percentage error: 0.8833806744416924

Root mean squared error: 610.3325396694928

Mean absolute error: 487.09189989675883

R squared: 0.27053739490759066

52. Article number: 704041601

Article name: AUBERGIN IMP STK

Mean absolute percentage error: 2516511954114841.5

Root mean squared error: 84.0225094519718

Mean absolute error: 59.56829714307598

R squared: 0.2669017201966545

53. Article number: 704884101

Article name: DRUE FARGET STFR 500G

Mean absolute percentage error: 1.842262992963399e+16
Root mean squared error: 839.2106344043909
Mean absolute error: 640.9866544436785
R squared: 0.2660858771184702

54. Article number: 715388201
Article name: POTET KOKEFAST GUL 1.2KG
Mean absolute percentage error: 1.880909378742385e+17
Root mean squared error: 109.54441753354261
Mean absolute error: 67.28863691192826
R squared: 0.2645021473308299

55. Article number: 704285901
Article name: KLEMENTIN KG
Mean absolute percentage error: 1.255964586740491e+16
Root mean squared error: 2058.1086260365973
Mean absolute error: 1116.056279525258
R squared: 0.2564733343681693

56. Article number: 704198101
Article name: BROKKOLI STK
Mean absolute percentage error: 0.7084904997090187
Root mean squared error: 1128.5561341750188
Mean absolute error: 804.0238336301318
R squared: 0.25305420179156013

57. Article number: 704292801
Article name: TOMAT FLAVANCE SMAK 400G
Mean absolute percentage error: 0.48621343189734395
Root mean squared error: 220.58153985120796
Mean absolute error: 150.58521460240183
R squared: 0.23956221284876988

58. Article number: 704308501
Article name: SPIRE ALFALFA ØKO STK
Mean absolute percentage error: 1136159994207453.2
Root mean squared error: 30.150898407967603
Mean absolute error: 21.710316851248148
R squared: 0.23826531215061664

59. Article number: 704893701

Article name: BANAN X-TRA KG
Mean absolute percentage error: 0.4910223557551332
Root mean squared error: 837.6293297766642
Mean absolute error: 621.5387260087955
R squared: 0.23769290918424968

60. Article number: 704296001
Article name: LØK HVITLØK KINA 100G
Mean absolute percentage error: 1.7267184240970142e+16
Root mean squared error: 101.45190406135359
Mean absolute error: 75.76991596097261
R squared: 0.22345962607644176

61. Article number: 708625001
Article name: SALAT WOKMIKS 300G
Mean absolute percentage error: 2010299360824139.2
Root mean squared error: 48.26304311493604
Mean absolute error: 34.98722929113052
R squared: 0.21773775286386532

62. Article number: 704317401
Article name: ANANAS STK
Mean absolute percentage error: 3294530064933774.5
Root mean squared error: 118.62120209839472
Mean absolute error: 77.53031118555006
R squared: 0.2139324959103015

63. Article number: 704286901
Article name: JORDBÆR 500G IMP
Mean absolute percentage error: 2.2581016932129615e+18
Root mean squared error: 7888.786596378171
Mean absolute error: 3927.262175055111
R squared: 0.2134112417221916

64. Article number: 704881301
Article name: EPLE KANZI KG IMP
Mean absolute percentage error: 4.641444205414001e+16
Root mean squared error: 661.8961464545647
Mean absolute error: 521.796208200891
R squared: 0.21084235923481875

65. Article number: 704287301
    Article name: SØTPOTET KG
    Mean absolute percentage error: 6949188365451264.0
    Root mean squared error: 108.18869400754829
    Mean absolute error: 82.97624794953789
    R squared: 0.20213513576143938
66. Article number: 704890601
    Article name: DRUE GRØNN STFR 500G
    Mean absolute percentage error: 1.0309007547620572e+16
    Root mean squared error: 717.5203737170046
    Mean absolute error: 547.3879930084827
    R squared: 0.1945609253048488
67. Article number: 704286001
    Article name: PÆRE KG
    Mean absolute percentage error: 0.7402278175067828
    Root mean squared error: 936.5148663603986
    Mean absolute error: 544.9384448481541
    R squared: 0.1889025427630876
68. Article number: 704892101
    Article name: KRY.URT ÄNGLAM 8CM KRUSPERSIL.
    Mean absolute percentage error: 0.5917851350734188
    Root mean squared error: 77.8340493510754
    Mean absolute error: 57.074607736924115
    R squared: 0.17830110278090627
69. Article number: 704290901
    Article name: ROSENKÅL 400G
    Mean absolute percentage error: 4.4453584869028296e+16
    Root mean squared error: 35.45321878847129
    Mean absolute error: 18.677272266811794
    R squared: 0.17588643925078518
70. Article number: 704197901
    Article name: AGURK STK
    Mean absolute percentage error: 0.7631778037824991
    Root mean squared error: 3730.5574537209613
    Mean absolute error: 2552.071705537684

R squared: 0.16900271134648304

71. Article number: 714748301
    Article name: SALAT FAVORITTSALAT 200G
    Mean absolute percentage error: 0.6929038473719081
    Root mean squared error: 209.74181255115843
    Mean absolute error: 162.15764752556296
    R squared: 0.16666139193122242
72. Article number: 717608201
    Article name: EPLE RØDE POSEPAKKET KG NO
    Mean absolute percentage error: 1.0423571039284162e+17
    Root mean squared error: 130.68490375277446
    Mean absolute error: 54.185779459336224
    R squared: 0.1541912740344752
73. Article number: 721749301
    Article name: BROKKOLI ÄNGLAMARK 300G
    Mean absolute percentage error: 4.148481653603495e+16
    Root mean squared error: 62.987209553719495
    Mean absolute error: 37.15981226653055
    R squared: 0.1505731072639842
74. Article number: 722418401
    Article name: SALAT ISBERGMIKS 250G
    Mean absolute percentage error: 3.760099713948272e+16
    Root mean squared error: 260.73315298146355
    Mean absolute error: 194.8817907595167
    R squared: 0.14920932386339458
75. Article number: 715333901
    Article name: POTET MANDEL SMÅ 850G
    Mean absolute percentage error: 4.7147565012172264e+16
    Root mean squared error: 118.27129608800415
    Mean absolute error: 48.67106027540818
    R squared: 0.14433633262894363
76. Article number: 704290001
    Article name: TOMAT BIFF KG
    Mean absolute percentage error: 3.676283303651433e+16
    Root mean squared error: 64.62170191212884

Mean absolute error: 44.33550262451172

R squared: 0.1386627444192955

77. Article number: 704201001

Article name: SELLERIROT KG

Mean absolute percentage error: 1862376869401192.2

Root mean squared error: 156.5013466635621

Mean absolute error: 96.06849042107078

R squared: 0.13199321683395027

78. Article number: 704891901

Article name: KRY.URT ÄNGLAM 8CM BASILIKUM

Mean absolute percentage error: 0.6242438702074575

Root mean squared error: 111.31384291999763

Mean absolute error: 82.1693295746847

R squared: 0.12092761674290453

79. Article number: 704287201

Article name: SALAT HJERTE 2STK

Mean absolute percentage error: 9723617316443156.0

Root mean squared error: 738.4405074342642

Mean absolute error: 520.6239072512957

R squared: 0.11896159468923273

80. Article number: 704892401

Article name: TOMAT PERLE 175G

Mean absolute percentage error: 1.0584878340108497

Root mean squared error: 1333.7155005694008

Mean absolute error: 924.4831766365401

R squared: 0.11349533293612779

81. Article number: 704038501

Article name: TOMAT CHERRY X-TRA 250G STK

Mean absolute percentage error: 0.7672997662243322

Root mean squared error: 563.9977564534978

Mean absolute error: 417.83619959214155

R squared: 0.10473293308103004

82. Article number: 704883101

Article name: EPLE RØDE KG DIV NO

Mean absolute percentage error: 1.6747569671029357e+17

Root mean squared error: 467.95230870798184
Mean absolute error: 118.11450605454787
R squared: 0.10022585019171493

83. Article number: 704199001
Article name: REDDIK 150G PK
Mean absolute percentage error: 1.401501477598513e+17
Root mean squared error: 74.69711419798753
Mean absolute error: 56.85769503724341
R squared: 0.09892631816787534

84. Article number: 704199201
Article name: GRANATEPLE STK
Mean absolute percentage error: 3074298963842818.5
Root mean squared error: 185.48445992023343
Mean absolute error: 100.2260782079759
R squared: 0.09883930603423818

85. Article number: 704891001
Article name: KRY.URT ÄNGLAM 8CM DILL
Mean absolute percentage error: 0.6035738564750349
Root mean squared error: 92.1087168000194
Mean absolute error: 70.38144930671243
R squared: 0.0935856822964648

86. Article number: 711831201
Article name: BÆR BLÅBÆR 400G
Mean absolute percentage error: 4425612453360178.0
Root mean squared error: 1611.369676317666
Mean absolute error: 612.0348335216248
R squared: 0.08368290834174197

87. Article number: 704892301
Article name: KRY.URT ÄNGLAM 8CM TIMIAN
Mean absolute percentage error: 1391594331557326.2
Root mean squared error: 39.731538479584344
Mean absolute error: 30.61897304011326
R squared: 0.08333006226320383

88. Article number: 714143001
Article name: POTET NY 1.5KG IMP

Mean absolute percentage error: 1.1411494431179416e+17
Root mean squared error: 989.6973658552539
Mean absolute error: 468.0431546229942
R squared: 0.07390221894087023

89. Article number: 704286101
Article name: MORELLER KG
Mean absolute percentage error: 3.802087071413922e+16
Root mean squared error: 637.978042109794
Mean absolute error: 335.5335759337431
R squared: 0.07383282731177532

90. Article number: 704213401
Article name: AVOKADO STK
Mean absolute percentage error: 7468217141153231.0
Root mean squared error: 454.622018234898
Mean absolute error: 343.26598622440514
R squared: 0.07329535314474678

91. Article number: 718941901
Article name: TOMAT HVERDAGSTOMAT 400G
Mean absolute percentage error: 7612956528447890.0
Root mean squared error: 833.5614777598871
Mean absolute error: 638.311824873382
R squared: 0.07033146821198855

92. Article number: 704285501
Article name: EPLER GRØNNE KG
Mean absolute percentage error: 5657003045049257.0
Root mean squared error: 233.93898666160666
Mean absolute error: 174.69223705615872
R squared: 0.06961840111021922

93. Article number: 704292001
Article name: BÆR BRINGEBÆR 125G
Mean absolute percentage error: 1.267182569713391e+16
Root mean squared error: 1165.2165552196075
Mean absolute error: 792.777471903882
R squared: 0.047164123709352634

94. Article number: 704315701

Article name: KNUTEKÅL KG
Mean absolute percentage error: 1.9461097496020444e+16
Root mean squared error: 20.065877290382662
Mean absolute error: 14.688694810555651
R squared: 0.04635096220932855

95. Article number: 703911201
Article name: FENNIKEL 200G
Mean absolute percentage error: 7886491710714097.0
Root mean squared error: 79.62616176711241
Mean absolute error: 46.22802169650209
R squared: 0.01724688129030638

96. Article number: 704199801
Article name: STANGSELLERI STK
Mean absolute percentage error: 0.5293468668876057
Root mean squared error: 156.53417877487504
Mean absolute error: 102.00531728906569
R squared: 0.014628065023576942

97. Article number: 704202601
Article name: GULROT BUNT POSE
Mean absolute percentage error: 1.6116078136733146e+17
Root mean squared error: 721.2273325695547
Mean absolute error: 433.02622451034244
R squared: 0.0016356943349769004

98. Article number: 712253001
Article name: BØNNE ASPARGES 200G
Mean absolute percentage error: 1928542552968654.2
Root mean squared error: 22.125016882370964
Mean absolute error: 17.36161687015708
R squared: 0.00028329712145136465

99. Article number: 704038801
Article name: BROKKOLI ØKO 300G STK
Mean absolute percentage error: 1.5772073736126227e+17
Root mean squared error: 47.575266247697265
Mean absolute error: 35.021038815866106
R squared: 0.0

100. Article number: 704039501
    Article name: SPIRE KLØVER ØKO 50G
    Mean absolute percentage error: 3.3284416894328884e+16
    Root mean squared error: 9.30541717096436
    Mean absolute error: 7.390625199461295
    R squared: 0.0
101. Article number: 704039901
    Article name: SALAT ROMANOMIKS 200G
    Mean absolute percentage error: 5.2823430172458816e+17
    Root mean squared error: 133.76407467147584
    Mean absolute error: 117.29157683428596
    R squared: 0.0
102. Article number: 704041501
    Article name: SQUASH ÄNGLAMARK 250G IMP STK
    Mean absolute percentage error: 3.5670886154286944e+17
    Root mean squared error: 109.18106453734566
    Mean absolute error: 79.20527823454414
    R squared: 0.0
103. Article number: 704041801
    Article name: CHILI GRØNN 50G
    Mean absolute percentage error: 1.7208376560630115e+17
    Root mean squared error: 43.14351723506302
    Mean absolute error: 38.21027174806283
    R squared: 0.0
104. Article number: 704201301
    Article name: PITAHAYA KG
    Mean absolute percentage error: 3.971740116897487e+16
    Root mean squared error: 11.93733621433997
    Mean absolute error: 8.819034651214002
    R squared: 0.0
105. Article number: 704201401
    Article name: GULROT 1KG POSE
    Mean absolute percentage error: 1.0128517240785367e+19
    Root mean squared error: 2674.0854144216605
    Mean absolute error: 2248.982609206555

R squared: 0.0

106. Article number: 704202501

Article name: ROMANESCO STK

Mean absolute percentage error: 3.3537614423939676e+16

Root mean squared error: 8.920652596473387

Mean absolute error: 7.446846344891717

R squared: 0.0

107. Article number: 704203501

Article name: APPELSIN X-TRA 2KG NETT

Mean absolute percentage error: 5.209887411339658e+17

Root mean squared error: 178.66956604934467

Mean absolute error: 115.68273919548085

R squared: 0.0

108. Article number: 704204201

Article name: POMELO STK

Mean absolute percentage error: 4.2410257630773144e+16

Root mean squared error: 11.679594787100415

Mean absolute error: 9.416968900393817

R squared: 0.0

109. Article number: 704204901

Article name: KAKI KG

Mean absolute percentage error: 1.1824554972200638e+17

Root mean squared error: 29.55924192470175

Mean absolute error: 26.255786372166053

R squared: 0.0

110. Article number: 704205401

Article name: SITRONGRESS 50G

Mean absolute percentage error: 3.067306291095014e+16

Root mean squared error: 8.831816644680403

Mean absolute error: 6.810788135902555

R squared: 0.0

111. Article number: 704206001

Article name: KLEMENTIN X-TRA 1KG NETT

Mean absolute percentage error: 6.374254695338707e+16

Root mean squared error: 17.10707104798062

Mean absolute error: 14.15368865518009

R squared: 0.0

112. Article number: 704206701

Article name: ASPARGESTOPP 200G

Mean absolute percentage error: 1.4240557959999814e+17

Root mean squared error: 37.591791526708704

Mean absolute error: 31.620390661401686

R squared: 0.0

113. Article number: 704209001

Article name: EPLE RØD SMAK 6 STK NO

Mean absolute percentage error: 8.973312282792723e+16

Root mean squared error: 35.2866757836843

Mean absolute error: 19.92475580701641

R squared: 0.0

114. Article number: 704210501

Article name: KLEMENTIN ÄNGLAMARK 750G

Mean absolute percentage error: 9.360835588306272e+16

Root mean squared error: 26.103688299102398

Mean absolute error: 20.785230399736392

R squared: 0.0

115. Article number: 704289601

Article name: PHYSALIS 100G

Mean absolute percentage error: 3.0967396626741476e+16

Root mean squared error: 8.35873608315256

Mean absolute error: 6.876143349541558

R squared: 0.0

116. Article number: 704289901

Article name: GULROT X-TRA 1.5KG POSE

Mean absolute percentage error: 2.1933404800082934e+18

Root mean squared error: 557.6713547467594

Mean absolute error: 487.01942034952003

R squared: 0.0

117. Article number: 704292201

Article name: BÆR RIPS 125G IMP

Mean absolute percentage error: 5.113656102759639e+16

Root mean squared error: 15.973635373193071
Mean absolute error: 11.354597490597394
R squared: 0.0

118. Article number: 704293601
Article name: PAPAYA STOR KG
Mean absolute percentage error: 4.230465454691326e+16
Root mean squared error: 11.979059325476555
Mean absolute error: 9.393520305359285
R squared: 0.0

119. Article number: 704300301
Article name: STANGSELLERI ØKO 350G
Mean absolute percentage error: 1.1020534876726587e+17
Root mean squared error: 33.178043516843665
Mean absolute error: 24.470503127652837
R squared: 0.0

120. Article number: 704302101
Article name: BÆR TYTTEBÆR 650G
Mean absolute percentage error: 7.774459133798483e+16
Root mean squared error: 19.273335979453876
Mean absolute error: 17.262767068700853
R squared: 0.0

121. Article number: 704305501
Article name: POTET KERRS PINK 2KG
Mean absolute percentage error: 5.397654510307936e+16
Root mean squared error: 13.923009130312908
Mean absolute error: 11.98520063263139
R squared: 0.0

122. Article number: 704306201
Article name: APPELSIN RØD SMAK 1KG NETT
Mean absolute percentage error: 1.3142120972341629e+17
Root mean squared error: 40.96840411574011
Mean absolute error: 29.181370591805653
R squared: 0.0

123. Article number: 704311101
Article name: SALAT RUCCOLA 65G

Mean absolute percentage error: 1.2005426246845752e+18
Root mean squared error: 420.5312041073842
Mean absolute error: 266.57401279374665
R squared: 0.0

124. Article number: 704312501
Article name: KOKEBANAN KG
Mean absolute percentage error: 2.7467032527953116e+16
Root mean squared error: 7.373004245248829
Mean absolute error: 6.098906386132334
R squared: 0.0

125. Article number: 704313801
Article name: PURRE BNT 3STK
Mean absolute percentage error: 8.283687804711517e+16
Root mean squared error: 32.20853446508173
Mean absolute error: 18.393481859194686
R squared: 0.0

126. Article number: 704880701
Article name: EPLE RØDE AROMA KG NO
Mean absolute percentage error: 1.3504755896812034e+17
Root mean squared error: 34.38457380247751
Mean absolute error: 29.98658187716615
R squared: 0.0

127. Article number: 704881701
Article name: EPLE RØD RED CHIEF KG IMP
Mean absolute percentage error: 8.257959687382802e+16
Root mean squared error: 21.183550936964128
Mean absolute error: 18.336353962717492
R squared: 0.0

128. Article number: 704882101
Article name: EPLE RØDE ELSTAR KG NO
Mean absolute percentage error: 7.479347248533819e+16
Root mean squared error: 19.16755308351802
Mean absolute error: 16.60748704897812
R squared: 0.0

129. Article number: 704882201

Article name: EPLE RØDE GRAVENSTEIN KG NO
Mean absolute percentage error: 1.206178928176849e+17
Root mean squared error: 31.94275761605979
Mean absolute error: 26.782552357592614
R squared: 0.0

130. Article number: 704889101
Article name: BÆR TRANEBÆR 250G
Mean absolute percentage error: 5.000500355402935e+16
Root mean squared error: 12.748921794594468
Mean absolute error: 11.103341258429234
R squared: 0.0

131. Article number: 704890701
Article name: GRESSKAR BUTTERNUT KG IMP
Mean absolute percentage error: 8.406559986402758e+16
Root mean squared error: 22.088709926081858
Mean absolute error: 18.66631290959377
R squared: 0.0

132. Article number: 704891701
Article name: JORDSKOKK KG
Mean absolute percentage error: 2.1209109716708012e+16
Root mean squared error: 5.629045068721705
Mean absolute error: 4.709368387858073
R squared: 0.0

133. Article number: 704893601
Article name: SIKORI 300G
Mean absolute percentage error: 2.503943919755232e+16
Root mean squared error: 6.4938720327510735
Mean absolute error: 5.559872384164848
R squared: 0.0

134. Article number: 704894001
Article name: KLEMENTIN 5KG STK
Mean absolute percentage error: 6.786303280307292e+16
Root mean squared error: 18.057657477006305
Mean absolute error: 15.068620307772767
R squared: 0.0

135. Article number: 704894301
    Article name: PEPPERROT TUBE STK
    Mean absolute percentage error: 3.1920424942070548e+16
    Root mean squared error: 8.202961184510876
    Mean absolute error: 7.08775814530117
    R squared: 0.0
136. Article number: 705222601
    Article name: POTET X-TRA MANDEL 2KG
    Mean absolute percentage error: 1.0181292130618573e+17
    Root mean squared error: 24.58340515502564
    Mean absolute error: 22.607009887695312
    R squared: 0.0
137. Article number: 706345601
    Article name: CHILI HABANERO 50G
    Mean absolute percentage error: 6.5741759459677736e+16
    Root mean squared error: 17.25718133316307
    Mean absolute error: 14.597603006300583
    R squared: 0.0
138. Article number: 708204901
    Article name: BROKKOLI ÄNGLAMARK 300G
    Mean absolute percentage error: 1.0549761613766346e+17
    Root mean squared error: 33.85673649239606
    Mean absolute error: 23.42517649582009
    R squared: 0.0
139. Article number: 708914401
    Article name: GRESSKAR HALLOWEEN KG
    Mean absolute percentage error: 1.6114127233457565e+17
    Root mean squared error: 48.47231578202632
    Mean absolute error: 35.78055015264773
    R squared: 0.0
140. Article number: 709170701
    Article name: POTET MANDEL ENGELØYA 900G
    Mean absolute percentage error: 5.2854577196688696e+16
    Root mean squared error: 13.229998253906292
    Mean absolute error: 11.73607371211831

R squared: 0.0

141. Article number: 710760301

Article name: TOMAT AROMA 350G

Mean absolute percentage error: 1.0185739116176639e+18

Root mean squared error: 273.7005333828711

Mean absolute error: 226.16884179208793

R squared: 0.0

142. Article number: 711008101

Article name: SOMMERMIX MINIAGURK 250G

Mean absolute percentage error: 6.031136197705043e+17

Root mean squared error: 160.8458878786023

Mean absolute error: 133.91812542684718

R squared: 0.0

143. Article number: 711929301

Article name: BÆR BLÅBÆR 125G NO

Mean absolute percentage error: 9.71225218732926e+16

Root mean squared error: 32.309763196374156

Mean absolute error: 21.56553199867797

R squared: 0.0

144. Article number: 711934801

Article name: BLOMKÅLRIS 200G

Mean absolute percentage error: 1.6400727919582986e+17

Root mean squared error: 40.409030395056945

Mean absolute error: 36.41693151386735

R squared: 0.0

145. Article number: 714077101

Article name: SOMMERMIKS MINIPAPRIKA 160G

Mean absolute percentage error: 1.1608690726613844e+18

Root mean squared error: 297.43394621783403

Mean absolute error: 257.7647146087846

R squared: 0.0

146. Article number: 714200901

Article name: BÆR BRINGEBÆR 225G

Mean absolute percentage error: 1.9772637631192307e+17

Root mean squared error: 51.10397421484266

Mean absolute error: 43.90407511143903

R squared: 0.0

147. Article number: 714688201

Article name: KIWI GRØNN SPISEMODEN 4PK

Mean absolute percentage error: 1.8108799162080605e+17

Root mean squared error: 43.40987163117031

Mean absolute error: 40.20961155610926

R squared: 0.0

148. Article number: 715302101

Article name: RØDBETE ÄNGLAMARK 750G

Mean absolute percentage error: 1.7686269711585168e+17

Root mean squared error: 44.10653098891959

Mean absolute error: 39.27140770706476

R squared: 0.0

149. Article number: 715331601

Article name: POTET CERISA DELIKAT SMAK 650G

Mean absolute percentage error: 3.86542372599196e+16

Root mean squared error: 10.414258344169825

Mean absolute error: 8.582964841057272

R squared: 0.0

150. Article number: 715333701

Article name: POTET CELANDINE DEL. SMAK 650G

Mean absolute percentage error: 3.4520166737464996e+16

Root mean squared error: 8.977705183068377

Mean absolute error: 7.665016785166622

R squared: 0.0

151. Article number: 715990801

Article name: GULROT BEGER 700G STK

Mean absolute percentage error: 2.051899215729248e+18

Root mean squared error: 562.3546378256481

Mean absolute error: 455.61315070258246

R squared: 0.0

152. Article number: 716521001

Article name: EPLE RØD COSMIC CRISP 4PK

Mean absolute percentage error: 5.234784785988176e+16

Root mean squared error: 17.08908017521467
Mean absolute error: 11.623557196723091
R squared: 0.0

153. Article number: 716543801
Article name: KIWI GRØNN ÄNGLAM. 300G
Mean absolute percentage error: 1.4539741356360022e+17
Root mean squared error: 40.237743681815104
Mean absolute error: 32.284711251851
R squared: 0.0

154. Article number: 717575301
Article name: EPLE NORSK 2KG
Mean absolute percentage error: 4.8482249455043416e+16
Root mean squared error: 13.40334206122425
Mean absolute error: 10.76522192612193
R squared: 0.0

155. Article number: 717576501
Article name: GULROT REGNBUE SMAK BNT
Mean absolute percentage error: 4.840998677064662e+16
Root mean squared error: 13.00107421280665
Mean absolute error: 10.749176386914222
R squared: 0.0

156. Article number: 717639901
Article name: POTET MANDEL X-TRA 5KG
Mean absolute percentage error: 6.870333366630692e+16
Root mean squared error: 17.204795383216247
Mean absolute error: 15.255204580967723
R squared: 0.0

157. Article number: 717686601
Article name: GRESSKAR HALLOWEEN 12KG
Mean absolute percentage error: 7.659537082544883e+16
Root mean squared error: 20.149868008866193
Mean absolute error: 17.007588854023055
R squared: 0.0

158. Article number: 717789901
Article name: PAPRIKA SNACK 200G IMP

Mean absolute percentage error: 5.137846732735672e+18
Root mean squared error: 1361.8763579936785
Mean absolute error: 1140.8311479356553
R squared: 0.0

159. Article number: 718416601
Article name: DADLER SMAK 200G
Mean absolute percentage error: 5.8850780982490936e+16
Root mean squared error: 14.543402438547394
Mean absolute error: 13.067498412786746
R squared: 0.0

160. Article number: 720042001
Article name: APPELSIN ÄNGLAMARK STK
Mean absolute percentage error: 3.036959073429257e+17
Root mean squared error: 88.55093211617157
Mean absolute error: 67.43403776330885
R squared: 0.0

161. Article number: 720482501
Article name: FIKEN STK
Mean absolute percentage error: 2.975632566568818e+16
Root mean squared error: 8.278220599770906
Mean absolute error: 6.607231576458301
R squared: 0.0

162. Article number: 720997901
Article name: DADLER 500G PK
Mean absolute percentage error: 4.192844589762996e+16
Root mean squared error: 11.117127978288588
Mean absolute error: 9.309985204459794
R squared: 0.0

163. Article number: 704202801
Article name: PAPRIKA SNACK 300G IMP
Mean absolute percentage error: 1.0314754831439618e+16
Root mean squared error: 2183.3269234932322
Mean absolute error: 1573.0751868852603
R squared: -0.01001572608241763

164. Article number: 704288801

Article name: BÆR BJØRNEBÆR 125G
Mean absolute percentage error: 1820662518864903.0
Root mean squared error: 28.288289499846197
Mean absolute error: 19.676462310591553
R squared: -0.015554564536977455

165. Article number: 704311001
Article name: SALAT MEKSIKANSK MIKS 270G
Mean absolute percentage error: 1661133734510807.0
Root mean squared error: 24.49602129791802
Mean absolute error: 19.75875286027497
R squared: -0.03267468344561619

166. Article number: 704285801
Article name: APPELSIN KG
Mean absolute percentage error: 5154196108179150.0
Root mean squared error: 1153.0796947924352
Mean absolute error: 730.5547840392668
R squared: -0.03522174934875921

167. Article number: 712232901
Article name: KRY.URT ÄNGLAM 8CM BLADPERSIL.
Mean absolute percentage error: 970917948912499.9
Root mean squared error: 41.59768341661393
Mean absolute error: 30.989687938316195
R squared: -0.03985918705110514

168. Article number: 704200701
Article name: KÅLROT KG
Mean absolute percentage error: 4300571751102692.5
Root mean squared error: 786.2238205862103
Mean absolute error: 508.67315668841593
R squared: -0.04400913752879898

169. Article number: 714754801
Article name: SALAT MIDDELHAV 125G
Mean absolute percentage error: 0.7636745699932715
Root mean squared error: 260.9062732236909
Mean absolute error: 187.4234381781684
R squared: -0.0582572041911249

170. Article number: 715385001
    Article name: POTET KOKEFAST RØD 1.2KG
    Mean absolute percentage error: 3.060190403314842e+17
    Root mean squared error: 149.17732744309507
    Mean absolute error: 89.9638002059039
    R squared: -0.061998292486101336
171. Article number: 704286301
    Article name: RABARBRA KG
    Mean absolute percentage error: 1.6223883348576564e+16
    Root mean squared error: 12.380207447344096
    Mean absolute error: 8.653442706937104
    R squared: -0.062369258570425856
172. Article number: 704206201
    Article name: MANGO X-TRA
    Mean absolute percentage error: 4431971026119338.5
    Root mean squared error: 167.57358335160504
    Mean absolute error: 128.51066030863842
    R squared: -0.06373202121582544
173. Article number: 704882701
    Article name: EPLE RØDE RUBINSTEP KG NO
    Mean absolute percentage error: 1.0498043649977667e+17
    Root mean squared error: 105.82018650922345
    Mean absolute error: 45.36453481437334
    R squared: -0.07327137234177017
174. Article number: 704197601
    Article name: PURRE KG
    Mean absolute percentage error: 3975736581159246.5
    Root mean squared error: 148.12784085366073
    Mean absolute error: 109.6698470770144
    R squared: -0.08782273838571553
175. Article number: 716353401
    Article name: POTET AMANDINE 1.5KG
    Mean absolute percentage error: 5.4083596854143656e+16
    Root mean squared error: 372.1806331062577
    Mean absolute error: 177.03846680884268

R squared: -0.09845435438850547

176. Article number: 704213101

Article name: SQUASH STK

Mean absolute percentage error: 5456432451508398.0

Root mean squared error: 455.22409553593354

Mean absolute error: 323.62125187294157

R squared: -0.10260348189980317

177. Article number: 704286501

Article name: MELON HONNING KG

Mean absolute percentage error: 1.2559012189938434

Root mean squared error: 233.89908254840796

Mean absolute error: 176.70866234473934

R squared: -0.1027849461525503

178. Article number: 704208301

Article name: LØK STJERNELØK 250G STK

Mean absolute percentage error: 3.774402437876877e+16

Root mean squared error: 23.738235536433514

Mean absolute error: 18.21317470774931

R squared: -0.10337435357034663

179. Article number: 714755001

Article name: DADLER 600G PK

Mean absolute percentage error: 4398663414380450.5

Root mean squared error: 85.55216644135986

Mean absolute error: 60.99478117001602

R squared: -0.10648280561188628

180. Article number: 704317501

Article name: BÆR BLÅBÆR 225G SHAKER

Mean absolute percentage error: 1.4114473883863562e+16

Root mean squared error: 919.0012518327087

Mean absolute error: 607.0204788906123

R squared: -0.10787885664056107

181. Article number: 704200301

Article name: EPLER ÄNGLAMARK 600G

Mean absolute percentage error: 0.6548468535737415

Root mean squared error: 92.68206915522357

Mean absolute error: 69.05267877516404

R squared: -0.12148540613236114

182. Article number: 722283901

Article name: POTET KOKEFAST 2KG IMP

Mean absolute percentage error: 2.8046956978135308e+16

Root mean squared error: 276.16395439702563

Mean absolute error: 98.51935208389183

R squared: -0.12814243074585208

183. Article number: 704039001

Article name: SALAT GRØNNKÅL VASKET 150G

Mean absolute percentage error: 1831574149961367.0

Root mean squared error: 63.720994608278225

Mean absolute error: 48.80625340829488

R squared: -0.13683245092402396

184. Article number: 714754901

Article name: SALAT SPINAT BABY VASK 100G

Mean absolute percentage error: 1.3998154177265472e+17

Root mean squared error: 155.11340371691531

Mean absolute error: 117.59382968478732

R squared: -0.14513241345470163

185. Article number: 704882801

Article name: EPLE RØDE SUMMERRED KG NO

Mean absolute percentage error: 2.132030119586149e+17

Root mean squared error: 514.1702102067167

Mean absolute error: 151.7686824985579

R squared: -0.14693184207395893

186. Article number: 704037301

Article name: KRUSPERSILLE PK

Mean absolute percentage error: 6436661384228355.0

Root mean squared error: 15.630191940499959

Mean absolute error: 11.628244362625422

R squared: -0.15082774879373528

187. Article number: 704037401

Article name: DILL 6STK PK

Mean absolute percentage error: 2452302698329912.0

Root mean squared error: 29.92746523958033
Mean absolute error: 22.33395980386173
R squared: -0.15857310025941507

188. Article number: 708657201
Article name: SALAT RÅKOST 250G
Mean absolute percentage error: 1.7860737329788918e+17
Root mean squared error: 63.59480273661593
Mean absolute error: 54.82481117497862
R squared: -0.16252019054522604

189. Article number: 704286401
Article name: NYKÅL KG
Mean absolute percentage error: 3.514338354846838e+17
Root mean squared error: 525.6104596429095
Mean absolute error: 389.2473243763244
R squared: -0.1716517453210218

190. Article number: 715251701
Article name: AVOKADO NETT 800G
Mean absolute percentage error: 4879782619136750.0
Root mean squared error: 205.3172060043351
Mean absolute error: 145.72976240768932
R squared: -0.17229259862401092

191. Article number: 717579701
Article name: SALAT SPINAT 200G
Mean absolute percentage error: 5.326291742267887e+16
Root mean squared error: 158.34152567245872
Mean absolute error: 64.82201674716924
R squared: -0.18385482871460268

192. Article number: 704881901
Article name: EPLE RØD ROYAL GALA KG IMP
Mean absolute percentage error: 1.983693604825257e+16
Root mean squared error: 821.2571390449862
Mean absolute error: 636.6535927766289
R squared: -0.18891656916056743

193. Article number: 710796101
Article name: SPIRE BØNNE ØKO 180G

Mean absolute percentage error: 959498501094567.5
Root mean squared error: 15.797019363603324
Mean absolute error: 11.836886524374968
R squared: -0.19023538096948212
194. Article number: 704285401
Article name: EPLER GULE KG
Mean absolute percentage error: 5686367820667055.0
Root mean squared error: 344.48982594854925
Mean absolute error: 259.2446631637274
R squared: -0.19157107831449638
195. Article number: 704206901
Article name: EPLE PINK LADY 6STK
Mean absolute percentage error: 0.5718909908229716
Root mean squared error: 247.17817981599404
Mean absolute error: 175.99887543721917
R squared: -0.20218910862549055
196. Article number: 704206401
Article name: HODEKÅL RØD KG
Mean absolute percentage error: 4.1888641937318264e+16
Root mean squared error: 20.097862614806832
Mean absolute error: 15.10579329845952
R squared: -0.20478256075957701
197. Article number: 717579601
Article name: SALAT SPINAT BABY 100G
Mean absolute percentage error: 5.725118666226448e+16
Root mean squared error: 140.88199565850633
Mean absolute error: 57.98646863301595
R squared: -0.21051162955329317
198. Article number: 704198601
Article name: SALAT ROMANO STK
Mean absolute percentage error: 1.5451319733936824e+16
Root mean squared error: 16.0197263960632
Mean absolute error: 11.393037708756191
R squared: -0.2166821767123266
199. Article number: 704036201

Article name: TOMAT KG
Mean absolute percentage error: 1.400241262891795e+16
Root mean squared error: 768.555276462263
Mean absolute error: 587.184340034435
R squared: -0.2207765980761196

200. Article number: 704890401
Article name: KRY.URT ÄNGLAM 8CM ROSMARIN
Mean absolute percentage error: 0.7465412620244843
Root mean squared error: 49.9176973725313
Mean absolute error: 36.077469856910454
R squared: -0.2276430536872196

201. Article number: 704297801
Article name: RØDBETE BNT NO
Mean absolute percentage error: 2.768674576266057e+16
Root mean squared error: 19.88109797302396
Mean absolute error: 14.112620833652471
R squared: -0.28091976731915547

202. Article number: 710769101
Article name: TOMAT SØDME 300G
Mean absolute percentage error: 6019751603687076.0
Root mean squared error: 515.049902058164
Mean absolute error: 379.61352005503534
R squared: -0.29095603472126674

203. Article number: 704290301
Article name: SUKKERERT RUNDE 150G
Mean absolute percentage error: 1.3098614969179892e+16
Root mean squared error: 342.7292288097519
Mean absolute error: 241.09214338913463
R squared: -0.30127294578177244

204. Article number: 704209901
Article name: SPISSKÅL RØD STK
Mean absolute percentage error: 547899545865678.75
Root mean squared error: 69.28333586131457
Mean absolute error: 48.001721724965215
R squared: -0.30595347015632046

205. Article number: 704884301
    Article name: POTET 2KG FOLVA NO
    Mean absolute percentage error: 3.6850731411800966e+17
    Root mean squared error: 160.19111160638846
    Mean absolute error: 105.48021987216924
    R squared: -0.3094889463440522
206. Article number: 722521001
    Article name: SALAT COLESLAWMIKS 250G
    Mean absolute percentage error: 6.559990078835638e+16
    Root mean squared error: 76.94030412148089
    Mean absolute error: 61.13819916419734
    R squared: -0.3297802015909863
207. Article number: 704037501
    Article name: BLADPERSILLE PK
    Mean absolute percentage error: 3074650758157547.0
    Root mean squared error: 20.059362196375496
    Mean absolute error: 16.423515269958894
    R squared: -0.35054405589327287
208. Article number: 704891101
    Article name: KRY.URT ÄNGLAM 8CM GRESSLØK
    Mean absolute percentage error: 525728082533276.56
    Root mean squared error: 58.97931212107994
    Mean absolute error: 43.71426476372613
    R squared: -0.3538916002931829
209. Article number: 704889301
    Article name: PASTINAKK 200G
    Mean absolute percentage error: 873803910020692.1
    Root mean squared error: 153.84419817406388
    Mean absolute error: 85.00524388730915
    R squared: -0.361836209095169
210. Article number: 704040801
    Article name: LØK HVITLØK 500G FLETTE
    Mean absolute percentage error: 3552764777104003.0
    Root mean squared error: 32.69478336777789
    Mean absolute error: 22.656843821207683

R squared: -0.3695696639890409

211. Article number: 704290501

Article name: BANAN ÄNGLAMARK KG

Mean absolute percentage error: 0.6623534846706469

Root mean squared error: 255.9577681993463

Mean absolute error: 197.54574495203354

R squared: -0.3751445127014519

212. Article number: 720788101

Article name: POTET ÄNGLAMARK 1.2KG NO

Mean absolute percentage error: 6.591827413789547e+16

Root mean squared error: 172.94227917918303

Mean absolute error: 104.88540810229732

R squared: -0.38368909692571074

213. Article number: 721219501

Article name: MINIPAPRIKA UTEN FRØ 200G

Mean absolute percentage error: 5.1163860008159864e+16

Root mean squared error: 32.16034809338201

Mean absolute error: 17.23861261754254

R squared: -0.3885373202601903

214. Article number: 704208001

Article name: PLOMME FARGET KG

Mean absolute percentage error: 5.734142364443662e+16

Root mean squared error: 43.74683792514114

Mean absolute error: 26.317653805601832

R squared: -0.4235535954332883

215. Article number: 704880801

Article name: EPLE RØDE DISCOVERY KG NO

Mean absolute percentage error: 8.524013454326e+17

Root mean squared error: 913.4891026939589

Mean absolute error: 377.20190162908017

R squared: -0.4337457357129524

216. Article number: 720446001

Article name: TØRKET FERSKEN 200G

Mean absolute percentage error: 8218477130983250.0

Root mean squared error: 70.90253385085195

Mean absolute error: 49.03405279271743

R squared: -0.4701642204264087

217. Article number: 720997401

Article name: BÆR RIPS 300G NO

Mean absolute percentage error: 2.704062632207525e+16

Root mean squared error: 15.497244308372057

Mean absolute error: 11.371107026642443

R squared: -0.4925073962094437

218. Article number: 706961801

Article name: MANGO SPISEMODEN STK

Mean absolute percentage error: 1.4190346206457864

Root mean squared error: 635.3548502242531

Mean absolute error: 428.4638262480692

R squared: -0.504612499527644

219. Article number: 704321301

Article name: POTET BAKE FOLIE KG

Mean absolute percentage error: 1225315430628091.5

Root mean squared error: 104.21347274613962

Mean absolute error: 77.7723827112734

R squared: -0.5066281870538902

220. Article number: 704890301

Article name: KRY.URT ÄNGLAM 8CM MYNTE

Mean absolute percentage error: 0.7844433131295253

Root mean squared error: 78.95118811341888

Mean absolute error: 57.508118299097795

R squared: -0.5564901643910265

221. Article number: 704301101

Article name: POTET X-TRA 4 KG

Mean absolute percentage error: 2.7635014515352118e+17

Root mean squared error: 307.8363081770088

Mean absolute error: 207.7551433588165

R squared: -0.5822854041941676

222. Article number: 704039401

Article name: SPIRE REDDIK ØKO 50G

Mean absolute percentage error: 2670024247222647.5

Root mean squared error: 8.289185591485827
Mean absolute error: 6.475736892301272
R squared: -0.5974558866996891

223. Article number: 704207501
Article name: JORDBÆR 400G IMP
Mean absolute percentage error: 1.1372270740599581e+18
Root mean squared error: 481.70633537472764
Mean absolute error: 286.9069587358462
R squared: -0.6143847308346899

224. Article number: 704038701
Article name: PAPRIKA SNACK SMAK 2STK
Mean absolute percentage error: 2.0473879591576976e+17
Root mean squared error: 182.03823727907138
Mean absolute error: 137.96401724472545
R squared: -0.6787014259926547

225. Article number: 704041301
Article name: BROKKOLINI 200G STK
Mean absolute percentage error: 1321679225755501.5
Root mean squared error: 111.16308097942421
Mean absolute error: 89.4261657989103
R squared: -0.7812273550983442

226. Article number: 713124901
Article name: TOMAT PICCOLO SMAK 175G
Mean absolute percentage error: 5710689125668718.0
Root mean squared error: 300.6103912966998
Mean absolute error: 244.78975388271357
R squared: -0.7903616388493355

227. Article number: 703911401
Article name: SALAT SPINAT VASKET 200G
Mean absolute percentage error: 1.720881225558703e+17
Root mean squared error: 171.43748835604882
Mean absolute error: 127.53805327571295
R squared: -0.8050020147409411

228. Article number: 720475001
Article name: PLOMME SMAK 500G

Mean absolute percentage error: 8412361274523005.0
Root mean squared error: 296.6506673196455
Mean absolute error: 218.62123079237594
R squared: -0.866576412924984

229. Article number: 720445901
Article name: TØRKET MANGO 200G
Mean absolute percentage error: 3552498264558198.0
Root mean squared error: 438.80817943786684
Mean absolute error: 309.76593916400583
R squared: -0.8980847366498916

230. Article number: 704040501
Article name: TOMAT PLOMME MINI ÄNGLAM 250G
Mean absolute percentage error: 0.963342159990021
Root mean squared error: 69.20216103298402
Mean absolute error: 56.57844249251621
R squared: -0.9958798349562004

231. Article number: 717576401
Article name: GULROT REGNBUE SMAK BGR 750G
Mean absolute percentage error: 2.7546072502312908e+16
Root mean squared error: 13.337868858764605
Mean absolute error: 10.133800743452085
R squared: -1.0158695696930344

232. Article number: 704291401
Article name: BÆR BLÅBÆR 125G IMP
Mean absolute percentage error: 1.1156575607806126e+16
Root mean squared error: 304.18843465380365
Mean absolute error: 221.29612906462228
R squared: -1.0496666195224358

233. Article number: 710760201
Article name: COOP GP COLESLAWMIKS 300G
Mean absolute percentage error: 2.35911498772607e+17
Root mean squared error: 83.00582850638895
Mean absolute error: 60.21974622190388
R squared: -1.1114679650098087

234. Article number: 710005001

Article name: DRUE FARGET X-TRA 500G
Mean absolute percentage error: 1.0234063676272342e+18
Root mean squared error: 681.9238893231256
Mean absolute error: 506.50293547187755
R squared: -1.1126512171220893

235. Article number: 705297201
Article name: POTET MANDEL 2KG
Mean absolute percentage error: 1.3957415297455716e+18
Root mean squared error: 519.4674931458437
Mean absolute error: 384.97343310187847
R squared: -1.267639714579973

236. Article number: 704206501
Article name: GULROT ÄNGLAMARK 700G
Mean absolute percentage error: 3341175767789595.5
Root mean squared error: 119.75751343166039
Mean absolute error: 92.04082314485039
R squared: -1.3733789028269956

237. Article number: 704884801
Article name: POTET 2KG PIMPERNELL NO
Mean absolute percentage error: 7.0914683814858616e+16
Root mean squared error: 30.10097295141367
Mean absolute error: 19.146853764851887
R squared: -1.457245775619839

238. Article number: 720821801
Article name: BÆR TYTTEBÆR 500G
Mean absolute percentage error: 5.121724083731281e+16
Root mean squared error: 18.76577517274135
Mean absolute error: 12.7600793651506
R squared: -1.4843051746856775

239. Article number: 720457701
Article name: PAPRIKA X-TRA KG
Mean absolute percentage error: 1030250479870434.2
Root mean squared error: 248.12257141315806
Mean absolute error: 199.83280454897414
R squared: -1.4872815512386097

240. Article number: 704308701
    Article name: SPIRE BROKKOLI ØKO 50G
    Mean absolute percentage error: 2726448832676055.0
    Root mean squared error: 10.972153062616067
    Mean absolute error: 8.945960001228682
    R squared: -1.601243165442595
241. Article number: 704041901
    Article name: RØDBETE ÄNGLAMARK 500G
    Mean absolute percentage error: 3032228327522733.0
    Root mean squared error: 63.53384160388858
    Mean absolute error: 48.88340430166207
    R squared: -1.770887203360897
242. Article number: 721427801
    Article name: GULROT 400G
    Mean absolute percentage error: 7194915290705091.0
    Root mean squared error: 426.9905764815502
    Mean absolute error: 349.61761802473876
    R squared: -1.8004207474449467
243. Article number: 704198301
    Article name: NEPE BNT
    Mean absolute percentage error: 4.831619335905162e+17
    Root mean squared error: 164.7979017057873
    Mean absolute error: 126.90550824084313
    R squared: -1.9723378589753624
244. Article number: 704201701
    Article name: SPISSKÅL STK
    Mean absolute percentage error: 3733729995877571.0
    Root mean squared error: 134.20152356881977
    Mean absolute error: 57.52197918860741
    R squared: -2.016468389522566
245. Article number: 711770601
    Article name: POTET NYPOTETER SMÅ 700G
    Mean absolute percentage error: 7.362631736277039e+17
    Root mean squared error: 366.97655408381394
    Mean absolute error: 217.4760942521438

R squared: -2.1256420626415125

246. Article number: 720997801
Article name: BETEMIX ÄNGLAMARK 550G
Mean absolute percentage error: 1.2208408820472238e+17
Root mean squared error: 49.45284271807532
Mean absolute error: 42.33281361199672
R squared: -2.1381045763951136

247. Article number: 720476901
Article name: SALAT SPINAT ÄNGLAM UVASK 150G
Mean absolute percentage error: 109825626217158.67
Root mean squared error: 59.1170265254275
Mean absolute error: 48.22868832108242
R squared: -2.1930529294363468

248. Article number: 722147801
Article name: TØRKET ANANAS 200G
Mean absolute percentage error: 4887818362589157.0
Root mean squared error: 90.42442704910906
Mean absolute error: 74.89451713811339
R squared: -2.2784111507828233

249. Article number: 704036501
Article name: KÅLROT ÄNGLAMARK KG
Mean absolute percentage error: 1.6337232307703888e+17
Root mean squared error: 59.476778762242304
Mean absolute error: 47.46561315947888
R squared: -2.4138332117239747

250. Article number: 704204301
Article name: LØK RØD ÄNGLAMARK 400G
Mean absolute percentage error: 7087631386833352.0
Root mean squared error: 91.44135071479107
Mean absolute error: 68.2859168831819
R squared: -2.490981996058759

251. Article number: 704208601
Article name: BÆR BLÅBÆR ÄNGLAMARK 125G STK
Mean absolute percentage error: 1.416573698535108e+16
Root mean squared error: 13.87253544519694

Mean absolute error: 11.576132381663603

R squared: -2.669114454957459

252. Article number: 704203401

Article name: HODEKÅL SAVOY KG

Mean absolute percentage error: 2.3757836143205704e+16

Root mean squared error: 8.680773444740385

Mean absolute error: 6.777578995897879

R squared: -2.8636861929710897

253. Article number: 721427201

Article name: GULROT 750G

Mean absolute percentage error: 239794199905649.03

Root mean squared error: 2249.0146289341756

Mean absolute error: 1938.1252643797134

R squared: -3.115144847172693

254. Article number: 721487801

Article name: GULROT X-TRA 1KG

Mean absolute percentage error: 323661156072509.2

Root mean squared error: 1783.2895444873527

Mean absolute error: 1596.4690802081739

R squared: -3.915768963831355

255. Article number: 704894701

Article name: POTET 2KG BEATE NO

Mean absolute percentage error: 3.554818861214173e+17

Root mean squared error: 176.16345051578045

Mean absolute error: 89.6364621555104

R squared: -4.569129038241509

256. Article number: 7186328

Article name: KRY.URT ÄNG 8CM KRUS DILL GRES

Mean absolute percentage error: 2044716309279391.2

Root mean squared error: 9.927552697759097

Mean absolute error: 8.272246554006937

R squared: -4.598246318442184

257. Article number: 7184904

Article name: KRY.URT ÄNG 8CM BASIL KORIAN

Mean absolute percentage error: 1735986649118949.5

Root mean squared error: 10.929087964465024
Mean absolute error: 9.38712957793591
R squared: -5.679775331644207

258. Article number: 720477001
Article name: SALAT RUCCOLA ÄNGLAM UVASK 50G
Mean absolute percentage error: 9.118916777558851e+16
Root mean squared error: 136.33005236078893
Mean absolute error: 110.57807717915453
R squared: -6.534253826607452

259. Article number: 704205001
Article name: PÆRE X-TRA 1KG
Mean absolute percentage error: 7.677029109390523e+17
Root mean squared error: 209.7503623877903
Mean absolute error: 179.5500561209286
R squared: -6.5720193155375854

260. Article number: 704211501
Article name: VÅRLØK ÄNGLAMARK STK
Mean absolute percentage error: 9.279381741268077e+16
Root mean squared error: 85.49144037202683
Mean absolute error: 56.71714846293131
R squared: -6.89166883286316

261. Article number: 704042301
Article name: SALAT ISBERG MIKS 200G
Mean absolute percentage error: 2.2082543619506903e+18
Root mean squared error: 611.5215290326303
Mean absolute error: 513.111314412036
R squared: -8.258125958240475

262. Article number: 704317101
Article name: STANGSELLERI ÄNGLAMARK 350G
Mean absolute percentage error: 4.867438894356718e+16
Root mean squared error: 54.68261672859018
Mean absolute error: 36.4773041095609
R squared: -8.593773716528842

263. Article number: 704201501
Article name: ISBERG ØKO STK

Mean absolute percentage error: 3.956374879817551e+16
Root mean squared error: 108.86252590931834
Mean absolute error: 75.020814259847
R squared: -8.90187608903669

264. Article number: 704209401
Article name: ROTMIX ÄNGLAMARK 1KG BGR
Mean absolute percentage error: 1.6468095290085178e+17
Root mean squared error: 49.55959492950762
Mean absolute error: 38.9997302285986
R squared: -8.903721727027508

265. Article number: 718998601
Article name: GUACAMOLE 150G
Mean absolute percentage error: 1.0425533373348517e+17
Root mean squared error: 27.45679476329069
Mean absolute error: 23.774453094582153
R squared: -10.092677295266606

266. Article number: 704321601
Article name: TOMAT CHERRY RØD 250G STK
Mean absolute percentage error: 3.594878484366713e+17
Root mean squared error: 472.0883566176513
Mean absolute error: 281.95905564501396
R squared: -10.313233742614528

267. Article number: 704207001
Article name: SOPP KANTARELL KG
Mean absolute percentage error: 3.268251147524613e+16
Root mean squared error: 9.321222713818116
Mean absolute error: 7.972564622467639
R squared: -10.457533293573176

268. Article number: 704319901
Article name: SOPP AROMA KG
Mean absolute percentage error: 4.661229895821352e+16
Root mean squared error: 13.298038634570808
Mean absolute error: 10.747724944469976
R squared: -10.51320754217672

269. Article number: 704889801

Article name: KRY.URT ÄNGLAM 12CM BASILIKUM
Mean absolute percentage error: 6398831873718822.0
Root mean squared error: 72.16692186362226
Mean absolute error: 52.75934863246344
R squared: -10.771504096348231

270. Article number: 715287401
Article name: RØDBETE SOUS VIDE ÄNGLAM. 500G
Mean absolute percentage error: 4.639721496838744e+16
Root mean squared error: 34.65047210429865
Mean absolute error: 28.584110908258975
R squared: -11.170320419131237

271. Article number: 720040701
Article name: SITRON ÄNGLAMARK STK
Mean absolute percentage error: 9.302265915403612e+17
Root mean squared error: 250.41365984537273
Mean absolute error: 213.98474430258756
R squared: -11.527259479314212

272. Article number: 704204101
Article name: LØK ÄNGLAMARK 400G
Mean absolute percentage error: 7443600522060367.0
Root mean squared error: 149.1257985124371
Mean absolute error: 104.62170837751401
R squared: -13.133702805736215

273. Article number: 720130901
Article name: GRAPEFRUKT STK
Mean absolute percentage error: 1.6835004594080243e+17
Root mean squared error: 42.61652421084688
Mean absolute error: 38.32223902184979
R squared: -13.244262680475437

274. Article number: 722499701
Article name: SALAT PIZZASALAT 65G
Mean absolute percentage error: 1.4755717486687027e+17
Root mean squared error: 269.8715344057526
Mean absolute error: 227.75789388020834
R squared: -13.708680503675945

275. Article number: 704313701
    Article name: SQUASH ÄNGLAMARK NO STK
    Mean absolute percentage error: 9.05270452868583e+16
    Root mean squared error: 87.18957778800454
    Mean absolute error: 62.38533309238409
    R squared: -13.755533217971806
276. Article number: 704304301
    Article name: SALAT CRISPI ÄNGLAMARK 120G
    Mean absolute percentage error: 2.3521538944972816e+16
    Root mean squared error: 135.71131754627444
    Mean absolute error: 92.93459179822136
    R squared: -13.84756905177333
277. Article number: 704890901
    Article name: KRY.URT ÄNGLAM 8CM SITRONMELIS
    Mean absolute percentage error: 3.351697213739474e+16
    Root mean squared error: 51.421331430165885
    Mean absolute error: 40.22902311686597
    R squared: -13.906114648662637
278. Article number: 713865201
    Article name: KRY.URT ØKO ESTRAGON 12 CM
    Mean absolute percentage error: 2.5371205041127424e+16
    Root mean squared error: 8.598478218556991
    Mean absolute error: 7.227181989383074
    R squared: -14.528253050926393
279. Article number: 721886401
    Article name: KRY.URT ÄNG.12CM THAIBASILIKUM
    Mean absolute percentage error: 4.782686439448822e+16
    Root mean squared error: 29.820532251552088
    Mean absolute error: 26.88717643887389
    R squared: -15.022277902015773
280. Article number: 704889701
    Article name: KRY.URT ÄNGLAM 12CM KRUSPERS.
    Mean absolute percentage error: 1.9492603691803e+16
    Root mean squared error: 43.9027498457371
    Mean absolute error: 35.936429653292386

R squared: -15.294728034118961

281. Article number: 704210001

Article name: GRØNNKÅL ÄNGLAMARK 200G

Mean absolute percentage error: 3.3063582139795228e+16

Root mean squared error: 65.97992816246412

Mean absolute error: 51.73620271371081

R squared: -15.312084015838796

282. Article number: 704038401

Article name: PAPRIKA SNACK ÄNGLAMARK 2STK

Mean absolute percentage error: 7.727289525778994e+17

Root mean squared error: 194.50669460953893

Mean absolute error: 176.49652922387216

R squared: -16.240596108740743

283. Article number: 713873701

Article name: KRY.URT ØKO SALVIE 12 CM

Mean absolute percentage error: 3.0422998237157444e+16

Root mean squared error: 10.655901448511406

Mean absolute error: 9.18708664139891

R squared: -16.95591932178306

284. Article number: 713084701

Article name: BÆR PHYSALIS 125G

Mean absolute percentage error: 2.3180065195240064e+17

Root mean squared error: 61.00296220634675

Mean absolute error: 52.53431722852919

R squared: -20.6988759573909

285. Article number: 712613401

Article name: SOPP SKIVET SJAMPINJONG 150G

Mean absolute percentage error: 2.34741554846366e+17

Root mean squared error: 61.27828999046597

Mean absolute error: 53.14036508946637

R squared: -20.93570767668541

286. Article number: 704207701

Article name: SELLERIROT ÄNGLAMARK KG

Mean absolute percentage error: 1.1079334006432376e+17

Root mean squared error: 34.72813508441686

Mean absolute error: 28.360883475908267

R squared: -22.46431945231815

287. Article number: 704889901

Article name: KRY.URT ÄNGLAM 12CM KORIANDER

Mean absolute percentage error: 1.9974784174556636e+16

Root mean squared error: 63.401743293756745

Mean absolute error: 47.944536776324505

R squared: -23.194366965733643

288. Article number: 704309201

Article name: GRESSKAR HOKKAIDO ÄNGLAM KG

Mean absolute percentage error: 1.2326840056508443e+17

Root mean squared error: 73.10255315995863

Mean absolute error: 46.41450398264367

R squared: -28.500518938871917

289. Article number: 704310601

Article name: KOKOSNØTT ØKO STK

Mean absolute percentage error: 4.30428026728252e+16

Root mean squared error: 10.924258961684757

Mean absolute error: 10.038425856945562

R squared: -28.775076816959213

290. Article number: 704200401

Article name: BLOMKÅL ØKO STK

Mean absolute percentage error: 4.0436555630134854e+17

Root mean squared error: 228.34068101319406

Mean absolute error: 137.24422016019136

R squared: -32.35439136605945

291. Article number: 704209101

Article name: GULROT SNACK 250G

Mean absolute percentage error: 1.8578345057008855e+18

Root mean squared error: 501.2809763097759

Mean absolute error: 415.41765439899916

R squared: -38.70764593849863

292. Article number: 708522901

Article name: SOPP KANTARELL SMAK 200G

Mean absolute percentage error: 5.140718360445892e+16

Root mean squared error: 15.609305015682699
Mean absolute error: 11.539877286923478
R squared: -44.3762433611801

293. Article number: 709729401
Article name: CHILI RØD RAWIT 50G
Mean absolute percentage error: 3.460363210015384e+16
Root mean squared error: 10.221132551358142
Mean absolute error: 7.8160267250210635
R squared: -49.54510848120503

294. Article number: 704316501
Article name: DRUE FARGET ÄNGLAMARK 400G
Mean absolute percentage error: 1.3091487849919883e+17
Root mean squared error: 40.97307643960892
Mean absolute error: 30.62219773086847
R squared: -52.95586910093687

295. Article number: 704036701
Article name: AGURK ÄNGLAMARK STK
Mean absolute percentage error: 1.1551396884694418e+18
Root mean squared error: 299.5280836964798
Mean absolute error: 261.41563415527344
R squared: -56.451023260773816

296. Article number: 704884501
Article name: POTET 2KG NANSEN NO
Mean absolute percentage error: 3.9829000212453056e+17
Root mean squared error: 170.91831941712434
Mean absolute error: 99.05804419673346
R squared: -58.20137353286352

297. Article number: 704892201
Article name: KRY.URT ÄNGLAM 8CM OREGANO
Mean absolute percentage error: 7.725418130488851e+16
Root mean squared error: 55.07723396894386
Mean absolute error: 42.23811467488607
R squared: -64.25089254087914

298. Article number: 704041401
Article name: CHILI RØD ÄNGLAMARK 50G

Mean absolute percentage error: 2.671003107324025e+17
Root mean squared error: 73.24638973875857
Mean absolute error: 61.95640411875606
R squared: -72.54977873055776

299. Article number: 704198901
Article name: PAPRIKA MIX STK
Mean absolute percentage error: 9.367728897968192e+17
Root mean squared error: 254.3709528152144
Mean absolute error: 209.09286480323942
R squared: -80.86340969387398

300. Article number: 704312301
Article name: SOPP ØSTERS KG
Mean absolute percentage error: 2.4779561562140484e+16
Root mean squared error: 6.848965006691651
Mean absolute error: 5.773428225049786
R squared: -93.02953432150339

301. Article number: 703911301
Article name: AVOKADO ØKO 300G STK
Mean absolute percentage error: 1.0517754304779906e+17
Root mean squared error: 26.210382341116816
Mean absolute error: 23.558239319745233
R squared: -96.54471437683404

302. Article number: 704894501
Article name: PAK CHOY STK
Mean absolute percentage error: 3.0297251812822692e+16
Root mean squared error: 8.440539857074148
Mean absolute error: 6.744451984081393
R squared: -108.7184651620375

303. Article number: 714462801
Article name: KIWI GUL 4PK
Mean absolute percentage error: 2.5581738061149322e+17
Root mean squared error: 67.7373611289755
Mean absolute error: 57.269043616999205
R squared: -144.17198558726085

304. Article number: 707585701

Article name: SOPP SJAMPINJONG ÄNGLAM. 250G
Mean absolute percentage error: 3.021022469832014e+17
Root mean squared error: 88.52697628459393
Mean absolute error: 69.71898369383968
R squared: -172.407612664798

305. Article number: 714078301
Article name: PAPRIKA PADRÓN 200G
Mean absolute percentage error: 2.0717630904861014e+17
Root mean squared error: 51.41132722586189
Mean absolute error: 46.95636572245679
R squared: -174.37670916049007

306. Article number: 704212701
Article name: ASPARGES GRØNN 250G BNT
Mean absolute percentage error: 1.8627265082599148e+18
Root mean squared error: 691.1150664958319
Mean absolute error: 416.7713698842167
R squared: -204.00613460410176

307. Article number: 704302001
Article name: PERSILLEROT ÄNGLAMARK STK
Mean absolute percentage error: 2.4858719982153926e+17
Root mean squared error: 92.04798450319812
Mean absolute error: 56.37338853973189
R squared: -216.76516407424612

308. Article number: 704041701
Article name: CHILI RØD 50G
Mean absolute percentage error: 1.9478492104586304e+18
Root mean squared error: 512.818469115178
Mean absolute error: 433.9031822852839
R squared: -231.54676309480843

309. Article number: 704212201
Article name: INGEFÆR KG
Mean absolute percentage error: 3.114339445477058e+17
Root mean squared error: 76.73002350609546
Mean absolute error: 69.44794884226681
R squared: -233.12087841467022

310. Article number: 704200101
    Article name: HODEKÅL ÄNGLAMARK KG
    Mean absolute percentage error: 4.80992228904594e+17
    Root mean squared error: 228.9601335306578
    Mean absolute error: 142.17294990938473
    R squared: -240.24478747934478
311. Article number: 703911101
    Article name: PAPRIKA GUL KG 70+
    Mean absolute percentage error: 1.9727302241450618e+17
    Root mean squared error: 48.861292767202386
    Mean absolute error: 44.07818337982776
    R squared: -244.32612382367128
312. Article number: 704205501
    Article name: PASJONSFRUKT 3STK
    Mean absolute percentage error: 2.655362771132294e+17
    Root mean squared error: 67.06855863626926
    Mean absolute error: 59.13526766907935
    R squared: -266.11863564335465
313. Article number: 704211701
    Article name: LØK HVITLØK ÄNGLAMARK 100G
    Mean absolute percentage error: 5.3856000075027494e+17
    Root mean squared error: 208.91882161683878
    Mean absolute error: 122.16678193036248
    R squared: -280.9629157879615
314. Article number: 704312201
    Article name: SOPP PORTABELLO KG
    Mean absolute percentage error: 2.7952072223771896e+16
    Root mean squared error: 7.60753138573187
    Mean absolute error: 6.450445935617085
    R squared: -281.4822688429145
315. Article number: 704197801
    Article name: PAPRIKA GRØNN KG 70+
    Mean absolute percentage error: 1.5996688196624438e+17
    Root mean squared error: 40.03867977152774
    Mean absolute error: 35.73035089330735

R squared: -396.53041742075334

316. Article number: 708857401

Article name: BÆR KIWIBÆR 125G

Mean absolute percentage error: 9.444740317727992e+16

Root mean squared error: 35.17868936582885

Mean absolute error: 21.222609812917273

R squared: -408.730400010049

317. Article number: 713865101

Article name: TOMAT MINIPLOMME 500G

Mean absolute percentage error: 5.916296011896707e+17

Root mean squared error: 220.15341710311694

Mean absolute error: 135.5594228482714

R squared: -580.5405667081574

318. Article number: 704289501

Article name: DADLER KG

Mean absolute percentage error: 2.6855065095291416e+16

Root mean squared error: 7.816960579576674

Mean absolute error: 6.0182835697348604

R squared: -587.1595251219024

319. Article number: 704039601

Article name: GURKEMEIE ÄNGLAMARK 100G

Mean absolute percentage error: 1.549396345363827e+17

Root mean squared error: 43.550298090527626

Mean absolute error: 34.93153155707066

R squared: -626.9443271735857

320. Article number: 704312401

Article name: CHILI RØD KG

Mean absolute percentage error: 2.8398381925676428e+16

Root mean squared error: 7.504247969451963

Mean absolute error: 6.396114935282788

R squared: -670.2058468302661

321. Article number: 704296201

Article name: SOPP SHI TAKE KG

Mean absolute percentage error: 4.521516490485144e+16

Root mean squared error: 11.778153919508133

Mean absolute error: 10.35692115235173

R squared: -908.1297347076667

322. Article number: 704559101

Article name: CHILI JALAPENO GRØNN 50G

Mean absolute percentage error: 9.961440513749147e+16

Root mean squared error: 25.479495851956976

Mean absolute error: 22.16869233324637

R squared: -998.8179624957444

323. Article number: 704300501

Article name: LIME ÄNGLAMARK 3STK

Mean absolute percentage error: 2.8506539976101133e+17

Root mean squared error: 74.91320256101154

Mean absolute error: 63.690556482551926

R squared: -1044.148812780238

324. Article number: 704290101

Article name: MELON CANTALOUPE KG

Mean absolute percentage error: 4.400040593678895e+17

Root mean squared error: 109.39107519521252

Mean absolute error: 98.31869727489995

R squared: -1645.8055805016095

325. Article number: 704036301

Article name: LØK HVITLØK FERSK KG

Mean absolute percentage error: 2.6414819999495564e+16

Root mean squared error: 7.01646973865348

Mean absolute error: 5.92064240399529

R squared: -1894.468604136246

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