

DEMAND FORECASTING IN RETAIL GROCERY STORES IN THE CZECH REPUBLIC

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ABSTRACT

Demand forecasting plays a key role in the management of logistics processes in retailing. The quality of the resulting forecasts has a direct impact on the efficiency of processes not only in retail stores, but also throughout the supply chain they are part of. Retail stores are in fact in daily contact with end customers in the supply chain, and therefore they are largely involved in forecasting in the application of collaborative strategies in supply chain management (e.g. Quick Response, Effective Consumer Response, Collaborative Planning, Forecasting and Replenishment).

The level of demand forecasting in retail grocery stores in the Czech Republic was the subject of the quantitative research. The main objective of the research was to find out what methods are used in demand forecasting, what factors affecting demand for food are considered and what sources of information retail stores use to base the forecasting on. When analyzing the data obtained through personal inquiries in 75 retail outlets, methods of descriptive and inferential statistics were used.

The research showed that retailers rely in demand forecasting mainly on their own intuition and experience in retailing, and therefore qualitative methods of forecasting are applied most frequently. Although retailers consider a variety of factors influencing the demand, the research has identified an absence of statistical methods that are able to effectively implement the influence of factors into the final predictions. The article also discusses the differences among stores with sales area of different sizes and depending on the affiliation of the store with a retail chain. A low rate of applying quantitative forecasting methods in retail stores and the availability of a small base of input information on the demand of end customers can have a negative impact on the implementation of modern methods in supply chain management.

Keywords: demand forecasting, grocery stores, sales forecasting, supply chain, retail

INTRODUCTION

In the current turbulent market environment, forecasting the volume of demand and the future development has of an irreplaceable role in the management of every retail business. Reliable demand forecasting is a prerequisite for efficient and effective customer satisfaction. It makes possible to efficiently use resources and reduce costs associated with excess, or lack of goods within the supply chain, as relevant. The quality of the demand forecasting process in the retail sector is closely linked with the choice of appropriate forecasting methods that rely on relevant information from

information sources available to retailers and at the same time are able to translate into the resulting forecasts influences of all internal and external factors that significantly affect future customer demand in the B2C markets.

In the B2C markets, demand is primarily influenced by social, cultural, psychological and personality factors [1]. Every customer has his/her own priorities, but also reasons to buy certain goods. The crucial point is thus the customer's personality and lifestyle. When choosing food, customers also consider a number of factors inherent in the particular food. Most often, they evaluate the freshness, nature and cost of the particular food [2]. According to research [3], demand for food is influenced by many factors. Besides the quality of goods and habitual behaviour of purchasers and price of the commodity, it also mentions various forms of sales promotion in retail business, recommendations from other customers, brand loyalty, etc.

Retailers can choose from a wide variety of forecasting methods. Using qualitative forecasting methods (retailers' opinions, expert estimations, marketing studies) is not typical for predicting demand for a wide range of goods on the consumer markets, because it is very time consuming and costly [1]. Retailers therefore mostly work with time series analysis of past sales, which allows them relatively easily to identify seasonal fluctuations in sales as well as changes in the trend during the entire product life cycle. In order to quantify the impact of product prices and sales promotion on the demand, regression models [4] or data mining techniques are used [5], which are based on a large database of information about customer behaviour in the form of point of sales data (POS data). It is a database of past sales in the context of the implementation of various forms of sales promotion and combinations thereof, price sensitivity of consumers, cannibalization effects, impact of weather, etc. POS data represent a valuable source of information about demand, as data on sales in the retail trade are not distorted by chain-related effects and are also readily available from the retail information system [6].

The quality of the forecasting process is primarily reflected in the accuracy of forecasts produced, which is one of the major causes of bullwhip effect in supply chains [7]. Inaccurate forecasts by retailers generate inadequate orders for links further down the supply chain and cause many difficulties in coordinating material flows within the supply chain. This can be demonstrated, for example, with a case study reported in the literature [8], in which the bullwhip effect was identified in a Czech manufacturer of food products, especially due to the frequent realization of price sales promotion, to which partners in the supply chain failed to react effectively.

There is no study that would assess the current level of the forecasting process in retail stores in the Czech market. Therefore, the aim of this paper is to evaluate the level of the forecasting process, based on a quantitative research among Czech retail stores with food goods, namely in terms of adequate forecasting techniques, considering the relevant factors affecting the demand for food, and the use of appropriate sources of information for making forecasts.

RESEARCH METHODOLOGY

To achieve the set objectives, a quantitative research was conducted in 75 selected retail stores in the Czech Republic. The sample included only retail stores where groceries

predominate in the range of goods. Data collection took place in the period of March-April 2015 using face-to-face interviews with predetermined questions. The respondents first commented on the possible use of demand forecasting in inventory management of goods in retail business. In retail stores, where demand forecasts are generated and used, open-ended questions were used to ascertain:

- frequency of use of selected forecasting methods,
- factors considered in forecasting the demand,
- sources of information used for forecasting the demand.

In the surveyed stores, the possible affiliation with retail chains and the size of the sales area were also identified. The sample of retail stores was comprised of 52 percent of independent retail stores and 48 percent of stores that are part of retail chains. In terms of the size of the sales area, four groups of retail stores can be identified in the sample, namely stores with a sales area of up to 50 m² (41 %), stores with an area of 51 m² to 200 m² (33 %), stores with an area of 201 m² to 400 m² (12 %) and stores with an area greater than 400 m² (14 %).

The data were processed by means of the statistical software IBM SPSS Statistics (v. 22). In data analysis, methods of descriptive statistics (multiple response analysis) and inferential statistics (statistical hypothesis testing) were used. In each research area, we first analyzed the frequency of responses for all the respondents and then analyzed the differences between different groups of respondents. The divergence of the empirical distribution of responses of the respondents according to the foregoing attributes was tested using Exact Pearson χ^2 -test at the 0.05 level of significance (based on Monte Carlo sampling).

RESEARCH RESULTS

Based on data analysis, it was found that the majority of retail stores (91 %) creates their own demand forecasts and uses them to support decision making in the management and replenishment of goods in the retail business. Other respondents who do not make forecasts most often replenish their goods according to revenues from past sales or work with predictions taken from the retail chain headquarters. Since the research was focused on the method of demand forecasting in the retail trade, these respondents were excluded from the next part of the survey. The new structure of the respondents according to selected classification criteria is shown in Table 1.

Table 1 Structure of respondents

Classification criteria		Frequency
Affiliation	Independent store	50%
	Retail chain	50%
Sales area	$\leq 50 \text{ m}^2$	41%
	51 - 200 m ²	34%
	201 - 400 m ²	10%
	$> 400 \text{ m}^2$	15%

In another part of the research, the respondents chose any number of the available methods, which are used in retail demand forecasting. The ability to specify a different forecasting method that did not occur in the menu was not used by any of the respondents. The frequency distribution of the responses is shown in Table 2.

Table 2 Forecasting methods used

Forecasting method	Responses		Percent of cases
	Frequency	Percent	
Judgmental method	63	40%	94%
(Moving) Average	33	21%	49%
Naive method	30	19%	45%
Customer expectations	14	9%	21%
Unknown methods implemented in software	8	5%	12%
Analogy method	6	4%	9%
Simple regression	4	3%	6%
Time series decomposition	1	1%	1%
Exponential smoothing	0	0%	0%
ARIMA models	0	0%	0%
Advanced forecasting models	0	0%	0%
Total	159	100%	x

Retail businesses clearly prefer the judgmental method (retailers' opinions), which is used in forecasting by almost all respondents (94 %). Nearly half of the respondents also rely on a naive method or the average of past sales values. With the exception of the method of customer expectations, other prediction methods are rarely used in retail stores, and none of the methods of advanced time series analysis was marked by the respondents.

Table 3 Forecasting methods used depending on the type of retail store

Forecasting method	% within affiliation		% within sales area (m ²)			
	Independent	Retail chain	<=50	51-200	200-400	>400
Judgmental method	42%	37%	45%	38%	40%	30%
Customer expectations	9%	9%	13%	5%	7%	7%
Analogy method	6%	1%	6%	4%	0%	0%
Naive method	18%	20%	16%	18%	27%	22%
(Moving) Average	19%	22%	16%	24%	27%	22%
Time series decomposition	0%	1%	0%	0%	0%	4%
Simple regression	1%	4%	0%	5%	0%	4%
Unknown methods	4%	6%	3%	5%	0%	11%
Total	100%	100%	100%	100%	100%	100%

The comparison of the frequency distribution of responses in each group of retailers (see the results in Table 3) exposes a slightly increased tendency to use qualitative methods in small shops and stores that are not part of retail chains. Even so the judgmental method is the most preferred forecasting method in all of the monitored

groups of retailers. Due to the low number of the respondents, however, it was not possible to prove any statistical significance of the differences between stores depending on the affiliation with retail chains ($\chi^2 = 5.661$, $df = 7$, Exact Sig. = 0.600) or depending on the size of the sales area ($\chi^2 = 20.047$, $df = 21$, Exact Sig. = 0.535).

In demand forecasting, we can consider a number of factors that may affect future demand. Factors and frequency of consideration thereof in the surveyed retail stores is part of Table 4.

Table 4 Factors considered in demand forecasting

Factor affecting demand	Responses		Percent of cases
	Frequency	Percent	
Price of the product	60	13%	90%
Seasonality of sales	47	10%	70%
Freshness of the product	44	10%	66%
Origin of the product	41	9%	61%
Habitual behaviour of customers	40	9%	60%
Quality of the product	38	8%	57%
Promotion in retail trade	37	8%	55%
Ingredients of the product	36	8%	54%
Weather	33	7%	49%
Promotion by the producer	27	6%	40%
Brand of the product	23	5%	34%
Product life cycle	21	5%	31%
Other	1	1%	1%
Total	448	100%	x

Virtually all factors examined were mentioned at least by one third of the respondents. One of the respondents in the research additionally stated cannibalization effects that were not listed in the menu of factors. On the basis of the analysis, the most often considered factors may include the price of the product (90 % of the respondents) and seasonality of sales (70 % of the respondents). More than a half of the respondents also consider factors closely related to the quality of food products (freshness, origin, ingredients and quality of the product), and habitual behavior of purchasers. The research results confirm good knowledge of consumer behavior of customers at most retailers because, in accordance with survey [3], quality, customs, and the price are the main factors that influence the customer's choice of food, and thus have the greatest impact on the demand. Although retailers realize that a change of the price and the seasonal nature of the products significantly affect the demand, they do not use adequate forecasting methods (simple regression, exponential smoothing, time series decomposition or other techniques of time series analysis) in the quantification of the impact of these factors on the demand for food in most cases, but usually only qualitative estimates in combination with naive and average methods. These simple statistical estimates, however, are applicable only in forecasting the development of sales time-series, undistorted by the trend, changing prices of products and seasonal fluctuations.

Table 5 compares the differences in the consideration of factors among the surveyed groups of retailers. Significant differences were detected between independent stores and stores from retail chains ($\chi^2 = 24.111$, $df = 12$, Exact Sig. = 0.014). When making forecasts, independent stores often consider the quality parameters of products, while stores of retail chains put more emphasis on the habitual behavior of purchasers, sales seasonality, weather changes and implementation of marketing communication directly in the retail store or through the manufacturer. The differences depending on the size of the retail sales area cannot be considered statistically significant ($\chi^2 = 33.497$, $df = 36$, Exact Sig. = 0.592).

Table 5 Factors considered depending on the type of retail store

Factor affecting demand	% within affiliation		% within sales area (m ²)			
	Independent	Retail chain	<=50	51-200	200-400	>400
Price of the product	13%	13%	13%	13%	13%	16%
Quality of the product	10%	7%	10%	9%	7%	4%
Ingredients of the product	12%	4%	12%	7%	4%	2%
Origin of the product	10%	8%	9%	9%	11%	7%
Freshness of the product	12%	8%	12%	9%	7%	9%
Brand of the product	6%	4%	5%	6%	2%	5%
Product life cycle	4%	5%	6%	4%	4%	2%
Habitual behaviour	7%	11%	8%	9%	9%	11%
Weather	6%	9%	6%	8%	11%	7%
Seasonality of sales	9%	12%	10%	9%	13%	12%
Promotion in retail trade	7%	10%	5%	9%	11%	12%
Promotion by the producer	4%	8%	3%	6%	9%	12%
Total	100%	100%	100%	100%	100%	100%

The last area of the research focused on the selection of information sources necessary for forecasting the demand in retail business. The respondents could mark any number of the available resources that are used in retail demand forecasting. The ability to specify a different source, which did not occur in the menu, was not used by any of the respondents. The frequency distribution of the responses is part of Table 6.

Table 6 Sources of information in forecasting the demand

Source of information	Responses		Percent of cases
	Frequency	Percent	
Experience of sellers	66	41%	99%
POS data	33	21%	49%
Information from suppliers	29	18%	43%
Information from the media	21	13%	31%
Primary market research	10	6%	15%
Secondary market research	1	1%	1%
Total	160	100%	x

The retail stores consider experienced sellers to be the main source of information about future demand (99 % of respondents reported this source of information). However, POS data containing objective information about customer behavior in retail stores are only used in a half of the cases. This fact is alarming if only because it is the only available source of quantitative data on historical sales. The use of the information mediated by suppliers (43 %) and information from the media (31 %) was identified relatively often with retailers. Conversely, marketing research, a representative of costly and time-consuming data sources, is hardly used.

A subsequent analysis of the data revealed that with an increasing sales area, but also in cases where the store is part of the retail chains, a tendency grows to abandon qualitative information sources (own sales experience and information from suppliers) and replace them with relevant data from the point of sale. The observed trend corresponds with a greater willingness of these stores to use quantitative forecasting models. As in the first part of the research, however, these differences could not be proven depending on the affiliation with retail chains ($\chi^2 = 9.278$, $df = 5$, Exact Sig. = 0.083) or depending on the size of the sales area ($\chi^2 = 14.943$, $df = 15$, Exact Sig. = 0.479). The comparison of the frequency distribution of responses in each group of retailers is part of Table 7.

Table 7 Sources of information depending on the type of retail store

Source of information	% within affiliation		% within sales area (m ²)			
	Independent	Retail chain	<=50	51-200	200-400	>400
Experience of sellers	43%	40%	45%	42%	37%	33%
POS data	15%	26%	15%	18%	26%	38%
Information from suppliers	25%	11%	23%	18%	16%	8%
Information from the media	10%	16%	10%	16%	16%	13%
Primary market research	8%	5%	8%	5%	5%	4%
Secondary market research	0%	1%	0%	0%	0%	4%
Total	100%	100%	100%	100%	100%	100%

CONCLUSION

In the current turbulent market environment, forecasting the volume of demand and the future development has of an irreplaceable role in the management of every retail business. When forecasting demand in the retail food stores, the choice of appropriate forecasting methods and sources of information play an important role, and so does the identification of all the factors that could significantly affect future demand of customers. Due to the nature of demand on consumer markets, as well as the availability of accurate data on customers' past sales (POS data), the literature recommends using mainly quantitative methods based on the time series analysis. In order to assess the level of demand forecasting in the Czech retail stores, a quantitative research was conducted that revealed completely different tendencies in their approaches to forecasting than those recommended by literature. Although a trend to replace qualitative approaches to forecasting demand with approaches based on time series analysis of past sales was identified in stores with a larger sales area as well as in stores

organized into retail networks, the differences detected cannot be considered significant. Throughout the investigated sample of stores, there is a prevalent use of qualitative methods, relying on intuition of retailers and their experience with the sale. Application of such methods in retail stores with a wide assortment of food products is very expensive and time-consuming, and therefore cannot be considered effective. An analysis in crosstabs also revealed the use of inadequate forecasting methods depending on factors whose impact on the demand is most often considered by the retailers.

The results of the primary study expose a low level of the forecasting process in Czech retail stores, which may lead to low precision forecasting with all its consequences. Besides emerging costs associated with an excess or shortage of goods in the retail logistics chain, it may have unwanted chain-related effects that also deplete other partners in the supply chain. Further research should therefore be focused on identifying the causes of the current level of demand forecasting in the retail business, including specifying the possibility of removing barriers to the implementation of more suitable approaches to demand forecasting in the surveyed retailers.

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