UDC 332.133.:338.242
JEL Classification: P11,P25,Q56, Q57, Q58, G18

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MATHEMATICAL MODELING OF PRICE FORECAST IN A COMPETITIVE ENVIRONMENT

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In this article, the research in the areas of competitive environment detection, pricing formation, and pricing methods has been conducted. A competitive environment is emerging in different markets and areas. To identify a competitive environment, we can use the following methods: analytical, expert and simulation. So, the application of basic mathematical models of price forecasting in a competitive environment has been investigated and described. Stage pricing in market conditions is an important element in the development of economic mechanism of production, provides supply and demand balance, influences the interests and needs of society. The basic methods of detection of the competitive environment, the most common methods of pricing and the time series method and the method of neural network forecasting for conducting the price forecast in the competitive environment are considered. It is updated that subjective forecasting of the same number of variables on a regular basis can be very time-consuming. It was determined that there was a way to achieve maximum effect in the field of forecasting with the help of «artificial intelligence», when the computer itself can learn, because by increasing the amount of information resources used in the model, the accuracy of the prediction increases, and the damage associated with uncertainty in decision making, they decrease, and it is possible through the use of neural networks. Finance is extremely non-linear, and sometimes stock price data can even seem completely random. Traditional time series methods, such as the ARIMA and GARCH models, are only effective if the series is stationary, which is a limiting assumption that requires pre-processing the series by receiving journal returns (or other transformations). However, the main problem arises when implementing these models in a real trading system, as there is no guarantee of stationarity when adding new data. They are struggling with it through neural networks that do not require any stationarity. In addition, neural networks are inherently effective in linking data to using it to predict (or classify) new data.

Keywords: modeling, forecasting, data analysis, price, competitive environment.

DOI: 10.32434/2415-3974-2019-10-2-25-30

Introduction

The key concept that expresses the essence of market relations is the concept of competition (Latin Concurrere – encounter, compete). Competition is an essential feature of the various activities in which conflicts of interest occur. One of the first scientists who formulated the concept of competition was A. Smith, who viewed it as a rivalry that raises prices (with a reduction of supply) and increases prices (with an excess of supply). The interpretation of competition given by Smith implies the presence of other elements that characterize the competitiveness of participants in trade relations. As a result, A. Smith defines five conditions of competition:

1. Competitors must act independently and not in concert;
2. The number of competitors, potential or existing, must be sufficient to exclude extraordinary income;
3. Economic units must have an adequate knowledge of market opportunities;
4. There must be freedom (from social relations) to act in accordance with this knowledge;
5. It takes enough time for the direction and volume of the flow of resources to respond to the wishes of the owners.

The founder of competition theory, M. Porter interprets the term «competitive environment» as a

set of qualitative and quantitative indicators that characterize the state of competition. Thus, the competitive environment can be considered as the main characteristic of the market, which is determined by a set of factors and conditions that affect the functioning of business entities, as well as their relationships in the process of competition, and it is denoted by a system of qualitative and quantitative indicators [1].

A competitive environment is emerging in different markets and areas. To identify a competitive environment, we can use the following methods: analytical, expert and simulation. For a better understanding, a table for identifying a competitive environment is compiled (Table).

Stage pricing in market conditions is an important element in the development of economic mechanism of production, provides supply and demand balance, affects the interests and needs of society [2]. Need to know and be able to use pricing methods correctly, because the inefficient use of these methods will have a negative impact on the development of production and consequently on the economy of the country.

The main purpose of national producers is to set prices based on costs, changes in the market structure, research on the competitive environment and consumer sensitivity to prices. All this is required to formulate a strategy for the development of business entities and to solve pricing problems [3]:

– determine pricing methods;

– adaptation of the price to the constantly changing market environment;

– the elasticity of demand and the impact of price changes on consumers;

– the impact of competition on pricing.

The pricing policy of the company for the planning period is based on the following basic principles: orientation to increase sales; focus on increasing profits; focus on maintaining its existing market segment; focus on keeping costs and profits at a level already reached at the beginning of the planning period.

Buyers, competitors, and costs have the biggest impact on pricing. In setting prices, the manager must look at the product through the eyes of the consumer.

The purpose of the research is to study and describe the application of basic mathematical models of price forecasting in a competitive environment.

The main material

Knowing the technology of competing firms, their production capacity, production space, logistics, development strategy is easier to set prices for their products.

The market economy development strategy is embodied in the development of strategic, forward-looking and current plans (budgeting).

The basis for pricing must be the normative (planned) cost (or estimate) of products according to the planned nomenclature, assortment and norms as of the beginning of the planning period using cost calculation using the «coverage» method. Moreover, the baseline must characterize the level of costs and profit already achieved at the beginning of the planning period.

The most common pricing methods are the method of pricing based on the use of cost information and enterprise costs.

An economically justifiable form of cost-based pricing is pricing on principle «cost-plus». If the market does not impose rigid conditions, then the manager setting the price, must be guided by the following formulas: production variable costs plus margin; total variable costs plus margin; production cost plus margin; full cost plus margin.

The mark-up can be calculated on the basis of: variable production costs; full production cost; total variable costs; total cost.

Consider the models of calculating the price per unit of production for different pricing methods [4].

1) a pricing model based on variable production costs:

$$P_0 = vc + vc \times M / 100, \quad (1)$$

where P_0 – the price per unit of production, UAH; M – mark-up, %; vc – variable production costs per unit, UAH.

$$M = \frac{bp + fpc + oe}{x \times vc}, \quad (2)$$

Methods for identifying a competitive environment

Title	Analytical method	Expert method	Simulation method
The essence	Non-contact valuation methods (statistical characteristics of the activity of competitive enterprises in the market, marketing matrices reflecting the competitive position of the firm and its goods, methods of economic espionage)	Expert assessment methods, hypotheses and forecasting options for market behavior, tactics and strategy	The use of simulation models that are developed on the basis of marketing observation and allow to «play» on the computer various variants of competition

where bp – budget profit, UAH; fpc – fixed production costs, UAH; oe – operating expenses, UAH; x – production volume, units.

2) a model of pricing based on full production cost:

$$P_0 = pc + pc \times M / 100, \quad (3)$$

where pc – is the production cost of a unit of production.

$$M = \frac{bp + oe}{x \times pc}, \quad (4)$$

3) a pricing model based on common variable costs:

$$P_0 = tvc + tvc \times M / 100, \quad (5)$$

where tvc – total variable costs, UAH.

$$M = \frac{bp + tfc}{x \times tvc}, \quad (6)$$

where tfc – total fixed costs, UAH.

4) full cost pricing model:

$$P_0 = tc + tc \times M / 100, \quad (7)$$

where tc – total cost of a unit of production, UAH.

$$M = \frac{bp}{x \times tc}. \quad (8)$$

Various methods can be used to forecast prices in a competitive environment, such as the balance method, the peer review method, the regulatory method, and the extrapolation method.

Consider time series models. Today there are many methods for predicting time series. The most common of these are moving averages, autoregressive methods, neural network methods, and singular spectrum analysis. Some of them work well for stationary time series, while the success of predicting non-stationary series depends heavily on their subject area.

Time series is statistics collected at different points in time about the values of any parameters (in the simplest case of one) of the process under study. Detecting the structure of the time series is necessary in order to build a mathematical model of the phenomenon that is the source of the time series being analyzed.

An autoregressive model is a time series model in which the values of the time series are now linearly dependent on the previous values of the same series. The autoregressive order process is defined as follows:

$$x_t = c + \sum_{i=1}^{p} a_i \times x_{t-i} + \varepsilon_t, \quad (9)$$

where a_1,....., a_p – model parameters (autoregression coefficients); c – constant; ε_t – white noise.

The Moving Average Autoregression Model (ARMA) is a mathematical model for analyzing and predicting stationary time series, which is a generalization of the autoregressive model and the moving average model.

The ARMA model (p, q), where p and q are integers that specify the order of the model, is called next process of generating a time series x_t:

$$x_t = c + \varepsilon_t + \sum_{i=1}^{p} a_i \times x_{t-i} + \sum_{j=0}^{q} b_j \times \varepsilon_{t-j}, \quad (10)$$

where b_0,....., b_q – moving average coefficients.

ARMA processes have a more complex structure than similar lybehavioral auto-regression models or sliding average models inpure form, but ARMA models are characterized by fewer parameters, which is one of the iradvantages [5].

Integrated sliding average autoregression model (ARIMA) is anextension of the ARMA model for non-stationary time series, which can be madestationary by determining the difference of some or derfrom the original time series (the so-called integrated or difference time series). It has the following form:

$$\Delta^d x_t = c + \varepsilon_t + \sum_{i=1}^{p} a_i \times \Delta^d x_{t-i} + \sum_{j=0}^{q} b_j \times \varepsilon_{t-j}, \quad (11)$$

where Δ^d – the operator of the difference of the time series of the order d (sequential determination of d times the differences of the first order – first from the time series, then from the obtained differences of the first order, then from the second order, etc.) [4].

ARIMA's approach to time series is that the stationarity of the series is evaluated first. Different tests reveal the presence of single roots and the order of integration of the time series (usually limited to the first or second order). Further, if necessary (if the order of integrability is greater than zero), the series is converted by determining the difference of the corresponding order, and already for the transformed model some ARMA model is built, since it is assumed that the obtained process is stationary, unlike the original non-stationary process (difference-stationary or integrated order d process) [6].

Consider the method of neural network prediction performed using neural networks. Thanks to scientific and technological progress there is a way to achieve the maximum effect in the field of

forecasting with the help of «artificial intelligence», when the computer itself can learn, because as the number of information resources used in the model increases, the accuracy of the forecast increases, and uncertainty in decision making is diminished, this is possible through the use of neural networks.

Neural networks are a section of artificial intelligence that uses phenomena similar to what happens in neurons of living things to process signals.

The main feature of the network, which testifies to its wide capabilities and high potential, is a technique that can significantly speed up the information processing process, and the network becomes resistant to errors that may occur on some lines. An artificial neuron is the basis of any artificial neural network. Neurons are relatively simple, the same elements that mimic the work of brain neurons.

Each artificial neuronis created by analogy of nerve cells in the human brain. The artificial neuronal so, like its natural prototype, has a group of synapses (inputs) that are connected to the outputs of other neurons, as well asanaxon – the output connection of that neuron – from where the excitation or inhibition signal comes to synapses of other neurons. It is obvious that the actions of the neural network depend on the magnitudes of the synoptic connections. Therefore, when designing a neural network structure that is appropriate for a particular task, the developer must determine the optimal values for all weights. This stage is called learning of the neural network, and how well it will perform depends on the ability of the network to so lveits problems.

The main parameters of training are the quality of selection of weights and time spent on training. Currently, all algorithms for learning neural networks can be divided in to two large classes: with a teacher and without a teacher. The network learns to give many outputs for some set of inputs. Each such input or output is considered by the developers as a vector. Training is done by consistently presenting the input vectors while a djusting the weights according to a certain procedure. In the process of learning the weights of the network gradually become such that each input vector producesan output vector.

Forecasting the short and long term trends of the stock markets includes the following steps:

1) gathering and preservation statistical information;

2) identification of the forecasted value instrument and a set of factors influencing the studied market;

3) determining the relationships between the predicted values and sets of influential factors in the form of a function;

4) calculating the required values and determining the type of forecast (long or short).

For good forecast it is necessary to use qualitatively prepared data, as well as a neuropackage with higher functionality. A large number of specialized programs are assigned to work with neural networks, some of which are more versatile and other sarehighly specialized. Let us brie fly look at some ofthe programs used [7]:

1) Matlab – desktop laboratory for mathematical calculations, design of electrical circuits and modeling of complex systems;

2) Statistica – a powerful enough tool that is used to find and analyze data and identify statistical patterns;

3) NeuroShellDayTrader – a neural network system that takes into account the specific needs of traders, although it is easy to use, the program is very specialized, it is suitable for trading, but in essence very close to the black box;

4) BrainMaker – this package is intended for solving such problems for which formal methods and algorithms are not found yet, the input data is incomplete, noisy and contradictory.

Conclusions

In this article, studies were conducted in the areas of competitive environment detection, pricing formation and pricing methods. Competition is a mechanism of competition, the struggle of market structures for the right to find their buyer and for the opportunity to sell their goods on the most favorable terms. The competitive environment can be identified by three methods: statistical analysis, expert judgment and simulation models. To set the price for a product or service correctly, you need to know the market and your competitors and then use the pricing methods considered to set your price.

Purely econometric forecasting does not provide very accurate forecasts of the time, size and duration of economic cycles. This is especially true for long-term economic forecasts. However, the flexibility and continuous refinement of econometric forecasting in comparison with estimated forecasting do make efforts to build an econometric model and forecasting useful. Econometric models are in themselves cannot track business cycles well, they provide a clear and well-organized structure within which to make predictions to improve the power of theory. The advantage of econometric models is that they can be easily identified and, therefore, attempt to correct the weaknesses in the model structure and the assumptions underlying the forecast. Subjective forecasting of the same number of variables on a regular basis can be very time consuming.

Finance is extremely non-linear, and sometimes stock price data can even seem completely random. Traditional time series methods, such as the ARIMA and GARCH models, are only effective if the series is stationary, which is a limiting assumption that requires pre-processing the series by receiving journal

returns (or other transformations). However, the main problem arises when implementing these models in a real trading system, as there is no guarantee of stationarity when adding new data. They are struggling with it through neural networks that do not require any stationarity. In addition, neural networks are inherently effective in linking data to using it to predict (or classify) new data.

REFERENCES

1. Proydakov, F.P. (2007). Faktory i usloviya formirovaniya konkurentnoy sredy [Factors and conditions for the formation of a competitive environment]. *Vestnik Taganrogskogo instituta upravleniya i ekonomiki – Bulletin of the Taganrog Institute of Management and Economics, 1,* 40-43 [in Russian].

2. Fedulova, S., Komirna, V., Naumenko, N. & Vasyliuk, O. (2018). Regional Development in Conditions of Limitation of Water Resources: Correlation Interconnections. *Montenegrin Journal of Economics, 14, 4,* 57-68 [in English].

3. Krasnostanova, N.E. & Horholyuk, YA.YU. (2017). Osoblyvosti tsinoutvorennya v suchasnykh umovakh [Features of pricing in modern conditions]. *Ekonomika ta upravlinnya natsional№nym hospodarstvom – Features of pricing in modern conditions. Economy and management of the national economy, 5,* 50-55 [in Ukrainian].

4. Osadcha, H.H. & Vlasenko, I.M. (2010). Tsinoutvorennya na produktsiyu kharchovoyi promyslovosti [Pricing for food products]. *Oblik ta finansy APK – Accounting and finance of the agro-industrial complex, 2,* 33-37 [in Ukrainian].

5. Nazarenko, O.M. & Karpusha, M.V. (2012). Modelyuvannya ta prohnozuvannya nestatsionarnykh chasovykh ryadiv [Modeling and prediction of non-stationary time series]. *Visnyk Nats. tekhn. un-tu «KHPI» – Bulletin of the National. tech. University «KhPI, 2,* 162-171 [in Ukrainian].

6. Kovalyuk, T.V. & Pererva, A.S. (2018). Porivnyal№nyy analiz metodiv prohnozuvannya statsionarnykh ta nestatsionarnykh chasovykh ryadiv [Comparative analysis of prediction methods for stationary and non-stationary time series]. *Zhurnal naukovyy ohlyad – Journal of Scientific Review, 3,* 81-87 [in Ukrainian].

7. Malyshenko, K.A. & Anashkina, M.V. (2014). Ispol'zovaniye neyrosetey dlya tseley prognozirovaniya fondovogo rynka [The use of neural networks for forecasting the stock market]. *Yelektronniy zhurnal «Yefektivna yekonomika» – Online Magazine «Effective Economics», 2.* Retrieved from http://www.economy.nayka.com.ua/?op=1&z=2744 [in Russian].

Received 10.10.2019
Reviewer: Doct. of Econ. Sc., Ass. Prof. Harmider L.D.

МАТЕМАТИЧНЕ МОДЕЛЮВАННЯ ПРОГНОЗУ ЦІН В КОНКУРЕНТНОМУ СЕРЕДОВИЩІ

Федулова С.О., Комірна В.В., Кошелєва В.Ю., Писарькова В.Р.

У даній статті були здійснені дослідження в сферах виявлення конкурентного середовища, формування ціноутворення і методів розрахунку прогнозу цін. Конкуруюче середовище утворюється на різних ринках і сферах. Для виявлення конкурентного середовища можна використовувати такі методи: аналітичний, експертний і імітаційний. Отже, досліджено та описано застосування основних математичних моделей прогнозу цін в конкурентному середовищі. Етап формування ціни в ринкових умовах виступає важливим елементом розвитку господарського механізму виробництв, забезпечує врівноваження попиту та пропозиції, впливає на інтереси та потреби суспільства. Розглянуто основні методи виявлення конкурентного середовища, найбільш поширені методи встановлення ціни і вивчено метод часових рядів та метод нейромережевого прогнозування для здійснення прогнозу цін в конкурентному середовищі. Актуалізовано, що суб'єктивне прогнозування одного і того ж числа змінних на регулярній основі може бути дуже трудомістким. Визначено, що з'явився спосіб досягти максимального ефекту в області прогнозування за допомогою «штучного інтелекту», коли комп'ютер сам може навчатися, адже при підвищенні кількості інформаційних ресурсів, які використовуються в моделі, підвищується точність прогнозу, а збиток, пов'язаний з невизначеністю при прийнятті рішень, зменшуються, і це можливо завдяки використанню нейронних мереж. Фінанси вкрай нелінійні, і іноді дані про ціни на акції можуть навіть здаватися абсолютно випадковими. Традиційні методи часових рядів, такі як моделі ARIMA і GARCH, ефективні тільки в тому випадку, якщо ряд є стаціонарним, що є обмежуючим допущенням, яке вимагає попередньої обробки ряду шляхом отримання журнальних повернень (або інших перетворень). Проте, основна проблема виникає при реалізації цих моделей в реальній торговельній системі, так як немає гарантії стаціонарності при додаванні нових даних. З цим борються за допомогою нейронних мереж, які не вимагають будь-якої стаціонарності. Крім того, нейронні мережі за своєю природою ефективні в знаходженні зв'язків між даними і використанням їх для прогнозування (або класифікації) нових даних.

Ключові слова: моделювання, прогноз, аналіз даних, ціна, конкурентне середовище.

МАТЕМАТИЧЕСКОЕ МОДЕЛИРОВАНИЕ ПРОГНОЗА ЦЕН В КОНКУРЕНТНОЙ СРЕДЕ

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В данной статье были проведены исследования в сферах выявления конкурентной среды, формирования ценообразования и методов расчета прогноза цен. Конкурирующая среда образуется на различных рынках и сферах. Для выявления конкурентной среды можно использовать следующие методы: аналитический, экспертный и имитационный. Таким образом, исследовано и описано применение основных математических моделей прогноза цен в конкурентной среде. Этап формирования цены в рыночных условиях выступает важным элементом развития хозяйственного механизма производств, обеспечивает уравновешивания спроса и предложения, влияет на интересы и потребности общества. Рассмотрены основные методы выявления конкурентной среды, наиболее распространенные методы установления цены и изучены метод временных рядов и метод нейросетевого прогнозирования для проведения прогноза цен в конкурентной среде. Актуализировано, что субъективное прогнозирования одного и того же числа переменных на регулярной основе может быть очень трудоемким. Определено, что появился способ достичь максимального эффекта в области прогнозирования с помощью «искусственного интеллекта», когда компьютер сам может учиться, ведь при повышении количества информационных ресурсов, используемых в модели, повышается точность прогноза, а ущерб, связанный с неопределенностью при принятии решений, уменьшаются, и это возможно благодаря использованию нейронных сетей. Финансы крайне нелинейные, и иногда данные о ценах на акции могут даже казаться абсолютно случайными. Традиционные методы временных рядов, такие как модели ARIMA и GARCH, эффективны только в том случае, если ряд является стационарным, что является ограничивающим допущением, которое требует предварительной обработки ряда путем получения журнальных возвратов (или других преобразований). Однако, основная проблема возникает при реализации этих моделей в реальной торговой системе, так как нет гарантии стационарности при добавлении новых данных. С этим борются с помощью нейронных сетей, которые не требуют какой-либо стационарности. Кроме того, нейронные сети по своей природе эффективны в нахождении связей между данными и использованием их для прогнозирования (или классификации) новых данных.

Ключевые слова: моделирование, прогноз, анализ данных, цена, конкурентная среда.

MATHEMATICAL MODELING OF PRICE FORECAST IN A COMPETITIVE ENVIRONMENT

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Keywords: modeling, forecasting, data analysis, price, competitive environment.

REFERENCES

1. Proydakov, F.P. (2007). Faktory i usloviya formirovaniya konkurentnoy sredy [Factors and conditions for the formation of a competitive environment]. *Vestnik Taganrogskogo instituta upravleniya i ekonomiki – Bulletin of the Taganrog Institute of Management and Economics, 1,* 40-43 [in Russian].

2. Fedulova, S., Komirna, V., Naumenko, N. & Vasyliuk, O. (2018). Regional Development in Conditions of Limitation of Water Resources: Correlation Interconnections. *Montenegrin Journal of Economics, 14, 4,* 57-68 [in English].

3. Krasnostanova, N.E. & Horholyuk, YA.YU. (2017). Osoblyvosti tsinoutvorennya v suchasnykh umovakh [Features of pricing in modern conditions]. *Ekonomika ta upravlinnya natsional№nym hospodarstvom – Features of pricing in modern conditions. Economy and management of the national economy, 5,* 50-55 [in Ukrainian].

4. Osadcha, H.H. & Vlasenko, I.M. (2010). Tsinoutvorennya na produktsiyu kharchovoyi promyslovosti [Pricing for food products]. *Oblik ta finansy APK – Accounting and finance of the agro-industrial complex, 2,* 33-37 [in Ukrainian].

5. Nazarenko, O.M. & Karpusha, M.V. (2012). Modelyuvannya ta prohnozuvannya nestatsionarnykh chasovykh ryadiv [Modeling and prediction of non-stationary time series]. *Visnyk Nats. tekhn. un-tu «KHPI» – Bulletin of the National. tech. University «KhPI, 2,* 162-171 [in Ukrainian].

6. Kovalyuk, T.V. & Pererva, A.S. (2018). Porivnyal№nyy analiz metodiv prohnozuvannya statsionarnykh ta nestatsionarnykh chasovykh ryadiv [Comparative analysis of prediction methods for stationary and non-stationary time series]. *Zhurnal naukovyy ohlyad – Journal of Scientific Review, 3,* 81-87 [in Ukrainian].

7. Malyshenko, K.A. & Anashkina, M.V. (2014). Ispol'zovaniye neyrosetey dlya tseley prognozirovaniya fondovogo rynka [The use of neural networks for forecasting the stock market]. *Yelektronniy zhurnal «Yefektivna yekonomika» – Online Magazine «Effective Economics», 2.* Retrieved from http://www.economy.nayka.com.ua/?op=1&z=2744 [in Russian].