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VIETNAMESE MILK INDUSTRY FORECASTING: A GREY SYSTEM THEORY CASE OF VINAMILK

Lai Wang Wang

Department of Industrial Engineering and Management, National Kaohsiung University of Applied Sciences, Taiwan

Thanh Tuyen Tran[†]

Department of Industrial Engineering and Management, National Kaohsiung University of Applied Sciences, Taiwan

ABSTRACT

Since Vietnam was officially admitted to the World Trade Organisation (WTO) in November 2006, its domestic enterprises have been facing many new opportunities and challenges with energy. However, to survive and grow in this emerging market, a firm requires more cutting-edge or advantageous strategies to outperform their competitors. This necessitates the direction and goals for a firm in the way that it can predict its revenue in the coming future. This is because revenue is a specific indicator which may reflect the results of the enterprise more accurately. In this study, we apply Grey System Theory-GM (1, 1) based on the statistics provided by the Vietnam dairy Products Joint-Stock Company (Vinamilk) from 2005 to 2012 and make prediction values for two years, i.e., 2013 and 2014. The results which help enterprises to figure out the target in the near future are shown with low tolerance proven by Mean Absolute Percent Error (MAPE). From this study, a useful method can be provided in the case of the Vietnam dairy Products Joint–Stock Company and the results may shed insight into decision-making concerning the direction of a firm, to improve economic efficiency and to determine the financial performance of the business now, and it is the basis for determining results of operations for production the following period. These results are very valuable for both academic study and business field in the future.

Keywords: Grey system, Vinamilk, Dairy product, Forecasting, GM(1,1), Revenue.

Contribution/ Originality

This study contributes in the existing literature of Grey System theory with the applied GM(1,1) to investigate the case of Vinamilk. The paper's primary contribution is finding that the sales are increasing based on the predicted results which can be documented and further researched

† Corresponding author
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to the development of the company, in particular and other aspect of society and economics, in general.

1. INTRODUCTION

Vietnamese dairy consumption has expanded significantly in the last 15years, large driven by the increase in domestic consumption, as well as the rising per capita income facilitating milk consumption. In fact, per capita milk consumption in Vietnam has doubled in between 2000 and 2009to 12kg per person per year. Despite this increase, the country remains below the regional milk average of 65kg. This is because though the milk production has been increasing over the years, the products the producers in Vietnam are manufacturing are neither cheese nor butter. In addition, condensed milk and yoghurt are also highly popular dairy products in the country. Thus, it is expected the country to be increasingly reliant on dairy imports to meet its domestic needs.

In 2010/11, the growth rate of 7.2%in milk has made milk production up to 315,500tons. As to 2014/15, the Vietnamese fluid milk production growth rate is forecast at 39.5% with the production up to 410,700 tons. This huge increase in cattle numbers and increased public and private sector investment can reduce the country's import dependency and became the main boost to the nation's economic growth. A sustained period of high global milk prices thanks to rising global demand and sluggish supply can justify production-supportive and encourage producers to embrace long-term operation concept in cattle farming. Finally, the farm sector can benefit from the continued increase in yields, as the increase in the last decade by almost 130% which may further give the new private investments for the producers. In this regard, business operation in decision making plays a vital role.

Vietnamese dairy consumption growth will remain strong over our forecast period to2015. Strong economic growth may help increase per capita income, and spur demand for non-essential foodstuffs. From now till 2015, we expect fluid milk consumption growth rate of 31.4%, the production of 238,600 tons, and the demand for butter, cheese and whole milk powder will soar up to 73.1%, 192.9% and 3.1% respectively. Increasing urbanization, owning western goods and the ongoing spread of modern and organized retail will prove supportive of strong dairy consumption growth, in spite of the forecast of higher global dairy prices to some extent limiting the growth outlook. Indeed, Business Monitor International's (BMI) forecasts for GDP per capita growth rate of 114% from US$1,160 in 2010 to US$2,484 in 2015 may serve to reinforce our bullish outlook.

Table-1. Vietnamese Milk Introduction and Consumption (2010-2015)

	2010[f]	**2011[f]**	**2012[f]**	**2013[f]**	**2014[f]**	**2015[f]**
Milk Production[1,2], (Unit: '000 tones)	294.4	315.5	339.6	363.4	387.2	410.7
Liquid Milk Consumption[3], '000 tones)	181.6	190.7	198.3	209.7	223.8	238.6

Note: [f] BMI forecasts. [1] In all instances year indicates data for harvest year ending that calendar year i.e. 2011 = 2008-09; **Sources**: [2] General Statistics Office of Vietnam, BMI. [3] FAPRI, BMI.

Vinamilk is not the only dairy firm ramping up local production. In May 2010, Dutch dairy cooperative Royal Friesland Campina expects to invest US$12mn in the expansion of factory

production capacity in Vietnam. The company hopes to meet the growing demand for dairy products with its Dutch Lady, YoMost and Friso brands. The factory in Binh Duong is scheduled to be fully operational by the end of 2012. Meanwhile, New Zealand-based Fonterra has also been ramping up its domestic production and exploring new regional export markets, including Vietnam.

Vinamilk company's businesses mainly are the manufacture, and trading of milk and other dairy products in Vietnam. It was founded in 1976 under the name of Southern Coffee-Dairy Company. Vinamilk started a small firm with dairy operation, which mostly had "infant formula powdered milk". Then was renamed in1978 and the last time is in 1993named Vietnam Dairy Company.

The objective of the current research is to apply the predicted values to calculate again the net sales and provide them to the Company in the future and to get the good prediction for production and business operation policies. As the statistics provided by the Vietnam dairy Products Joint – Stock Company (Vinamilk) shows that the net sales are increasing in past years, this study applies Grey System Theory to have the good forecasting in the next two years. As the results, the research would see the numbers in future. This is the very important objective; since if it's predicted well or even likely exactly, the Company can have their calculation applied to this change in the strategy management. Whenever, we know the good forecast, it is easier to build the strategy.

2. LITERATURE REVIEW

2.1. Previous Studies Using GM (1, 1)

The Grey method has numerous applications, as any issue of the Journal of Grey System will testify. Extensive research has been done to attempt to explain the phenomenon of geography, geology, agriculture and earthquakes. Meanwhile, other researchers have studied social phenomenon including financial operating performance, stock markets, supply and demand for electronic power, the market for air travel and management decisions. Numerous works have examined scientific technologies such as military weapons ,the textile industry and medicines and have applied the Grey forecasting model, GM (1,1) or GM (1,N) to these areas. The GM(1,N) model is suitable for application to systems, analysis, data processing, modeling, prediction, decision-making and control. The GM (1,1) model uses the most up-to date data to predict future values, and poor forecasting may result when the data are random with central symmetry. Many professional papers have sought to improve upon the GM(1,1) model. The Grey system theory was developed by Deng in 1982, and has been widely used since then in many different contexts, and can be used effectively forn on-identified systems or those with incomplete data. Grey-forecasting Model (GM) is adopted discrete data array, and Accumulated Generation Operations (AGO) and Inverse Accumulated Generating Operations (IAGO) are used to generate a new series of data. In general, the researcher constructs the GM by utilizing a differential equation, with GM (1,1) being a simple and linear first order differential equation that has been widely used in many fields. For example, Wu et al. used the GM (1,1) model to evaluate the supply and demand of remote-island doctors in Taiwan, while Mao and Chirwa estimated the frequency of vehicle accident risks. In addition, Akay and Atak predicted power supply demand and Chen and Chen forecast the growth trend of the Taiwanese wafer fabrication industry using GM (1,1). Therefore, the study selects the

GM (1,1) model to forecast the market trends for the development of the online game industry in Taiwan. Specifically, researchers examine the relationship between the number of Internet users and the amount of online game revenues in Taiwan. They collected the number of Internet users, online game players, and revenues of Taiwan's online game industry during the period of 2003–2010 for analysis. The grey forecasting GM (1, 1) model, a simple analysis method, was used to predict the growth trend of these three values, and to examine the relationships among them. The findings can help to understand supply and demand in Taiwan's online games market, and provide a reference for both academics and practitioners. Since the Greater China area, including Taiwan, Hong Kong, Macau and Mainland China, has a similar culture and also a huge potential market, the research results in this paper may be helpful for international game companies interested in entering or expanding in this market. Whereas, Grey model was used to predict the manpower of undergraduate educational systems in Vietnam (Wang and Nguyen, 2013).

2.2. The Difference between Gross Sales and Net Sales

Gross sales mean what you are charged as the overall total of your bill and net is all other deductions subtracted with whatever balance is left being your Net. Gross sales is defined to be the total invoice value of sales, before deducting customers' discounts, returns, or allowances. Net sales-the amount of sales are generated by a company after the deduction of returns, allowances for damaged or missing goods and any discounts allowed. The sales number reported on company's financial statements is a net sales number, reflecting these deductions. For easier understanding, gross sale is what is accounted for as sales and net sales is what is received on account of the transaction. Taxes; gross sales indicate total amount received before any applicable tax is taken out. Net sale is the total of gross sale minus taxes, before tax payments, royalties, etc. You pay your income tax based on gross.

The difference between gross sales and net sales can come from two sources:

(1) Sales returns; and (2) Customer discounts or allowances: In accounting, the difference between gross sales and net sales can be made up of more than one factor. Gross sales revenues is all the sales revenues that have been earned by a firm during a given time period. The items that are netted out of, or deducted from, gross sales in order to arrive at net sales can be different in different industries. For example, in the book publishing industry the two items mentioned above would be deducted from gross sales to get to net sales. In the magazine publishing industry, there would be an additional deduction for advertising agency commissions. In general, however, "gross sales" reduced by the sum of :[(1) the dollar amount of refunds for items bought and then returned by customers and (2) the dollar amount of purchase discounts taken by customers] equals "net sales". A gross sale is the sale that needs some amount to be deducted from it. And net amount is final sale that is in actual figure after deducting all other things like allowances etc. I might suggest that an example would help. e.g. if you sell your house for £300,000, that would be your gross sale. But if you then deduct the cost of selling it (like estate agents fees) of say £30,000 then you get £270,000 which would be your net sale.

2.3. The Statistics and Revenue Forecasting

Statistical forecast is a tool to promote sales potential as well as limiting the potential risk of net sales fluctuations, allowing the company to look right on their strengths, from which business policies in line case. Statistical forecast of net sales show out all of specific natures and the law of revenue through as indicated by the number and determine the future of turnover studies, as a reliable basis for decision-making in management. Through business sales statistics will indicate the changes and trends in business development activities as the basis for the selection solutions to strengthen and develop business enterprises achieve high efficiency. Enterprise data using revenue as a basis for analysis reliable for the leaders to make decisions in direct economic business, improve economic efficiency and determine the results of financial operations now, at the same time it is the basis for determining the results of business operations for the subsequent period. Analysis and revenue forecast as precaution possible risks for enterprises to create conditions for improving business operation performance. Determining the proper revenue as a basis for evaluating the performance of businesses, as a basis for now set the direction strive to match ability and conditions for businesses to promote the strengths and to limit weaknesses private solutions for company.

3. METHODOLOGY

Although it is not necessary to employ all the data from the original series to construct the GM (1, 1), the potency of the series must be more than four. In addition, the data (Liu and Lin, 1998) must be taken at equal intervals and in consecutive order without bypassing any data The GM (1, 1) model constructing process is described as following.

Denote the variable primitive series $X^{(0)}$ as formula:

$$X^{(0)} = (X^{(0)}(1), X^{(0)}(2), ..., X^{(0)}(n)), \quad n \geq 4 \tag{1}$$

Where $X^{(0)}$: a non-negative sequence. n: The number of data observed.

Accumulating Generation Operator (AGO) is one of the most important characteristics of grey theory with the aim at eliminating the uncertainty of the primitive data, and smoothing the randomness. The accumulated generating operation (AGO) formation of $X^{(0)}$ defined as:

$$X^{(1)} = (X^{(1)}(1), X^{(1)}(2), ..., X^{(1)}(n)), \quad n \geq 4 \tag{2}$$

Where:

$$X^{(1)}(1) = X^{(0)}(1)$$

$$X^{(1)}(k) = \sum_{i=1}^{k} X^{(0)}(i), \quad k = 1, 2, 3, ..., n \tag{3}$$

The generated mean sequence $Z^{(1)}$ of $X^{(1)}$ is defined as:

$$Z^{(1)} = (Z^{(1)}(1), Z^{(1)}(2), ..., Z^{(1)}(n)) \tag{4}$$

Where Z(1) (k) is the mean value of adjacent data, i.e.

$$Z^{(1)}(k)=\frac{1}{2}\left(X^{(1)}(k)+X^{(1)}(k-1)\right), \quad k=2,3,...n \tag{5}$$

From the AGO sequence $X^{(1)}$, a GM (1,1) model which corresponds to the first order different equation $X^{1}(k)$ can be constructed as follows:

$$\frac{dX^{1}(k)}{dk}+aX^{(1)}(k)=b \tag{6}$$

Where: parameters a and b are called the developing coefficient and grey input, respectively.

In practice, parameters a and b are not calculated directly from Eq. (6). Hence, the solution of above equation can be obtained using the least square method. That is:

$$\hat{X}^{(1)}(k+1)=\left[X^{(0)}(1)-\frac{b}{a}\right]e^{-ak}+\frac{b}{a} \tag{7}$$

Where X(1) (k+1) denotes the prediction X at time point k+1 and the coefficients $[a,b]^{T}$ can be obtained by the Ordinary Least Squares (OLS) method:

$$[a,b]^{T}=(B^{T}B)^{-1}B^{T}Y \tag{8}$$

And

$$Y=\begin{bmatrix} x^{(0)}(2) \\ x^{(0)}(3) \\ ..... \\ ..... \\ x^{(0)}(n) \end{bmatrix} \quad B=\begin{bmatrix} -z^{(1)}(2) & 1 \\ -z^{(1)}(3) & 1 \\ ..... & \vdots \\ ..... & \vdots \\ -z^{(1)}(n) & 1 \end{bmatrix} \tag{9}$$

Where: Y is called data series, B is called data matrix, and $[a,b]^{T}$ is called parameter series.

We obtained $\hat{X}^{(1)}$ from Eq. (15). Let $\hat{X}^{(0)}$ be the fitted and predicted series.

$$\hat{X}^{(0)}=X^{(0)}(1),\hat{X}^{(0)}(2),.....,\hat{X}^{(0)}(n) \qquad Where \qquad \hat{X}^{(0)}(1)=X^{(0)}(1 \tag{10}$$

Applying the inverse accumulated generation operation (IAGO). Namely:

$$X^{(0)}(k+1)=\left[X^{(0)}(1)-\frac{b}{a}\right]e^{-ak}(1-e^{a}) \tag{11}$$

The grey model prediction is a local curve fitting extrapolation scheme. At least four data sets are required by the predictor (15) to obtain a reasonably accurate prediction (Deng, 2002).

3.1. Sample of Forecasting of Model GM (1, 1)

This paper conducts a practical forecasting on the Net sales in the Academic years 2005~2012 (provided by the Vietnam dairy Products Joint – Stock Company) adopting the above Model GM (1, 1), and checks the predicted results by means of relative error test.

3.2. Sample Data Collection

The Net sales (as sample) in the Vietnam dairy Products Joint – Stock Company from academic years 2005 to 2012 is listed as in table 2. From table 2, it is apparent that the Net sales during the eight years from 2005 to 2012 increased from 5,659,290 million to 13,797,114 million VND, proving this number at a stage of rapid growth.

Table-2. The Net Sales of Vietnamese Dairy Products Joint-Stock Company from 2005-2012

Years	Net Sales (million VND)
2005	5,659,290
2006	6,112,923
2007	6,348,193
2008	6,348,193
2009	7,208,035
2010	9,614,824
2011	11,081,466
2012	12,327,428

Source: The Financial Statement of Vietnam Dairy Products Joint – Stock Company (from 2005 to 2012)

3.3. Accuracy Inspection Analysis of Forecasting Ability

Numerous methods exist for judging forecasting model accuracy and no single recognized inspection method exist for forecasting ability. Mean Absolute Percentage Error (MAPE) is often used to measure forecasting accuracy.

(MAPE) is measure of accuracy in a fitted time series value in statistics, specifically trending. It usually expresses accuracy as a percentage (1) wikipedia.org. Smaller MAPE value indicates better forecasting ability.

$$MAPE = \frac{1}{n}\sum \frac{|Actual - Forecast|}{Actual} \times 100$$ n : Forecasting number of step

Table-3. The Results of GM(1,1) process

Values / Years	Original	Prediction	Error (%)	AGO
2005	5,659,290	5,659,290	0	5,659,290
2006	6,112,923	5,850,366	4.2951	11,772,213
2007	6,348,193	6,776,042	6.7397	18,120,406
2008	7,208,035	7,848,184	8.881	25,328,441
2009	9,614,824	9,089,965	5.4589	34,943,265
2010	11,081,466	10,528,228	4.9925	46,024,721
2011	12,327,428	12,194,060	1.0819	58,352,159
2012	13,797,114	14,123,469	2.3654	72,149,273

Evaluation of MAPE forecasting ability is divided forecasting ability is evaluated as follows: < 10 Excellent forecasting ability; 10~20 Good forecasting ability; 20~50 Reasonable forecasting ability; >50 Poor forecasting . In order to ensure that the GM (1,1) based on MATLAB has high accuracy for application in predicting the number in reality, this paper takes out the Net sales (as sample) in the financial statement of Vietnam dairy Products Joint – Stock Company from

academic years 2005–2012 estimates by GM (1,1) based on Matlab as 5,850,366.2 which is very close to the original number 6,112,923 and the error is 4.2951%.

Moreover, repeating above processes in the table 6 showing the sample calculation by GM (1, 1) based on MATLAB, it points out that the forecasting error ranging from 1.0819% to 8.881% in the sample predicted academic years with the Net sales in 2012 will be 14,123,469.0591 (compared to 13,797,114 in origin). The result reveals that Grey prediction is a good method for prediction.

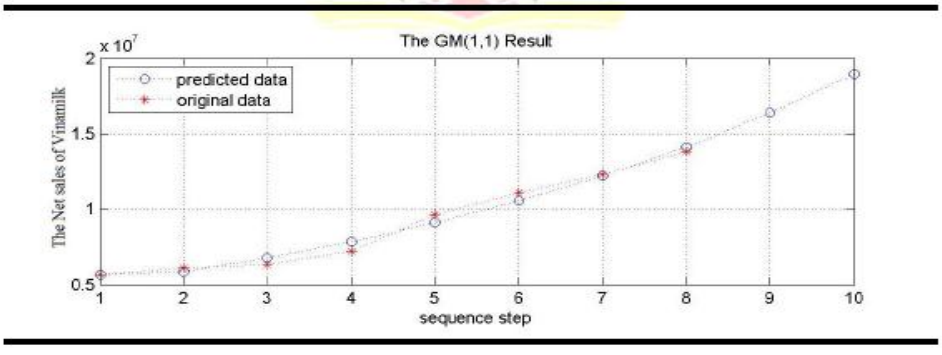
3.4. The Net Sales of Vietnam Dairy Products Joint–Stock Company

Do the calculations on the Net sales of Vietnam dairy Products Joint – Stock Company in recent academic years (2005-2012), and make prediction values for two years 2013 and 2014. The following grey prediction GM (1, 1) model estimates Net sales in 2013 and 2014 will be 16,358,159.4825 and 18,946,434.5151, respectively.

Table-4. Net Sales as Predicted

Values / Years	Original	Prediction	Error (%)	AGO
2005	5,659,290	5,659,290	0	5,659,290
2006	6,112,923	5,850,366	4.2951	11,772,213
2007	6,348,193	6,776,042	6.7397	18,120,406
2008	7,208,035	7,848,184	8.881	25,328,441
2009	9,614,824	9,089,965	5.4589	34,943,265
2010	11,081,466	10,528,228	4.9925	46,024,721
2011	12,327,428	12,194,060	1.0819	58,352,159
2012	13,797,114	14,123,469	2.3654	72,149,273
2013	?	16,358,159.4825	?	?
2014	?	18,946,434.5151	?	?

Figure-1. Predicted and Original Data



4. FORECASTING ANALYSIS

4.1. Vinamilk Products

Vinamilk is the biggest dairy company in Vietnam. Based on the UNDP 2007 Top 200 largest firms in Vietnam report, it is also the 15th largest company in Vietnam. In 2010, it is the first company in Vietnam to be included in the Forbes Asia's 200 Best Under A Billion list that

highlights 200 top-performing small- and mid-sized companies with annual revenue under US$1 billion. The company was established in 1976 as the Southern Coffee-Dairy Company, to take over the operations of three nationalized dairy factories in South Vietnam: Thống Nhất (belonging to a Chinese company), Trường Thọ (formerly owned by Friesland Foods), and Dielac (Nestlé). It was then renamed to United Enterprises of Milk Coffee Cookies and Candies I in 1978 and finally Vietnam Dairy Company was formally established in 1993. In 2003, follows its IPO to the Ho Chi Minh Stock Exchange, the company legally change its name to Vietnam Dairy Products Joint Stock Company (Vinamilk). The principal activities of the Vinamilk are produce and distribute condensed milk, powdered milk, fresh milk, soya milk, yogurts, ice-cream, cheese, fruit juice, coffee and other products derived from milk.

Vinamilk products such as powdered milk and condensed milk are also exported to the Middle East, Cambodia, Philippines and Australia. Exports accounted for $180m in 2012.Vinamilk's main competitors are Dutch Lady Vietnam, a division of Friesland Foods, Nestlé Vietnam, Abbott, Mead Johnson, Friso and Nutifood.

4.2. Factors Affecting Sales

4.2.1. The Quantitative Factors

1). The impact of factor price and quantity of goods. I have the following formula: *Revenue from sales of goods = Number of unit x Unit price*

Through the above formula was found when unit sales volume and selling price increases the revenue increase and the opposite. However, degree of influence of these two factors impact on revenue is not the same. The effect of the amount of goods sold to sales: The volume of goods sold is considered subjective factors impacting on revenue because businesses who decide the quantity of goods sold and hence revenue can be controllable. The effect of unit price to sales: Sales price is the objective factor to have affected sales, factors affecting the rate of price upon the revenue.

2). The impact of factors of workforce and labour productivity to revenues. In business, number of employees, labor distribution structure and labor productivity are factors that directly impact revenue. That relationship is expressed through the following formula: *Revenue = Number of employees x Average labor productivity*

Here the number of employees is considered objective factors, labor productivity considered subjective factor, when both factors are changes affecting revenue.

3). The effect of the speed of turnover factor and average business capital in the period: The relationship between the total revenue and the speed of turnover which is determined by the formula: *Revenue = Speed of turnover x Average capital*

According to the formula above we can see the speed of of turnover or average capital changes also entail changes. So if to push rapid the speed of turnover, it will shorten the capital turnover time which increases revenue.

4.2.2. The Qualitative Factors

There are two types of qualitative factors affecting sales: Objective factors and subjective factors. Analysis of qualitative factors includes the following contents:

(1) Objective factor: These factors in the business environment that business and managers often have to analyze, research. Market: To include market output and input of commodity products. Market factorssignificant decisions affecting sales.

Economic-social policy: The policy creates favorable conditions for businesses but also the difficult policy inhibits the development business. Political environment and law: The impact reflected through the action, the intervention of the macro-manager to business activities of enterprises.

Environment-culture-social: To effect on shopping behavior of customers thereby affecting consumption turnover of enterprises.

(2) Subjective factors:

Business items: A key factor determining the success or failure of business. Before embarking on the enterprise business to answer the question: Enterprises will sell something? Sell to whom? Choose the right items that market needs to make the consumption situation more quickly to accelerate the rotation of floating capital for research business networking organization in selecting business market. Reputation, brand and product: Reputation, brand and product will help consumers used to remember and distinguish them from other companies.

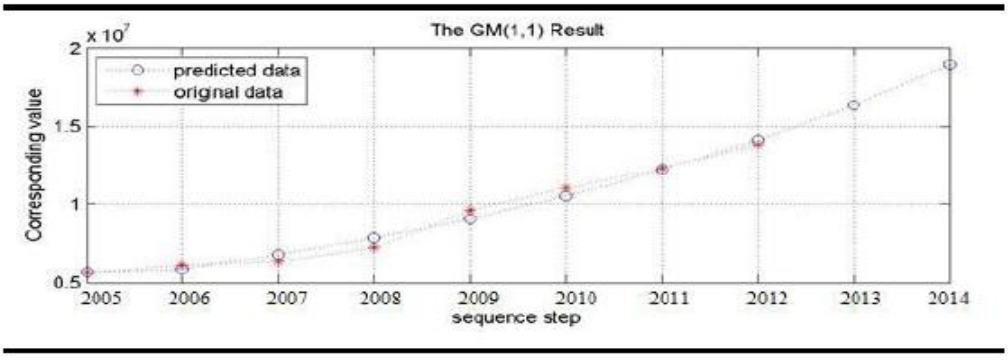
System organization and management lightweight: System organization and management lightweight will make operation business enterprises smoothly; thereby also active consumption of goods will be conducted rhythmically articulated. Facilities and capital of the business: Factories, warehouses, yards and advertising equipment, exhibition sales, etc. Employers: Labor is an important element of the production business process and through working, other new elements are used to exploit and effective.

4.3. Data Analysis

In the prediction for number in many fields, a lot of methods and technologies can be used to adapt with the needs. Besides, these are the methods with high-speed computing power, fine technical analysis of prediction becoming the hopeful factor for management decision-making. In this, Grey prediction requires neither a wide range of time-series data nor the good sequence to have correction forecasting. With this advanced characteristic, Grey model GM (1, 1) grey prediction model is able to achieve fine prediction results when data show as table pattern of growth trend. Though there is still much change in the context of economic situation, the difficult macroeconomic one as in 2011 and 2012 has occurred. Evolution of the economic crisis makes goods not easy to be sold. Despite that, Vinamilk is still one of the profitable businesses in the industry. Annual net sale growth remains high and stable, this is one positive sign. One of the advantages of the enterprise is to produce and sell goods where the demand is still high in society.

Although the Vinamilk plant was running at full capacity, Ms Mai Kieu Lien—Chairman and CEO VNM—said the company lost revenue from of 3-5 billion VND daily due to lack of goods. As mentioned above, this research uses the Grey model to make forecasting on the Net sales of Vietnam dairy Products Joint-Stock Company, i.e., the calculation in years (2005-2012), and prediction for 2013 and 2014.

Figure-2. The Trend in Recent Years and Next 02 Years as Predicted



The line graph above shows the trend in recent years and next two years as predicted. Net sales increased double from 2006 to 2011 (for 5 years) and result forecast also show that Net sales will grow double from 2009 to 2014 (for 5 years), more than double from 2008 to 2013 (for 5 years).

4.4. Forecasting Accuracy

In order to verify the quality of our GM (1, 1) forecast, we need some specific methods for measuring and controlling it. Forecasts always exists errors. Forecasts errors can be classified as bias errors and random errors. Bias errors are the result of consistent mistakes- the forecast is always too high or too low. These errors often are the results of neglecting or not accurately estimating patterns of demands, such as trend, seasonal, or cyclical patterns. The other type of forecast error, random errors results from unpredictable factors that cause the forecast to deviate from the actual demand. Forecasting analysts always try to minimize the effects of bias and random errors by selecting appropriate forecasting models.

It should be no surprise that forecasts are not always accurate; they are essentially about prediction the future in uncompleted information. Thus, in this paper, the MAPE (Mean Absolute Percentage Error) is employed to measure of accuracy of a method for constructing fitted time series values in statistics. It usually expresses accuracy as a percentage, and is defined by the formula and in this research; we compute the net sale of Vinamilk in 2012 (n=1) as an example.

MAPE = 2.3654%

So, the mean absolute percentage error (MAPE) is the average absolute percentage error. To arrive at the MAPE one must take the sum of the ratios between forecast error and actual times 100 (to get the percentage) and divide by n (with n=8) $[(\Sigma \mid \text{Actual} - \text{forecast} \mid \div \text{Actual}) \times 100 \div n]$.

Using the data from table 6: The original and prediction values and errors and AGO (2005~2012)

MAPE can be computed as follows:

(0%+4.2951%+ 6.7397%+ 8.881%+ 5.4589%+4.9925%+1.0819%+2.3654%) ÷ 8 = 4.2268%

The errors for Net sale of Vinamilk Company are mentioned as 0%, 4.2951%, 6.7397%, 8.881%, 5.4589%, 4.9925%, 1.0819%, and 2.3654% for the prediction of years 2005, 2006, 2007, 2008, 2009, 2010, 2011, and 2012, respectively.

5. MANAGERIAL IMPLICATIONS

In this study, we apply Grey System Theory-GM (1, 1) based on the statistics provided by the Vietnam dairy Products Joint-Stock Company (Vinamilk) from 2005 to 2012 and make prediction values for two years, i.e., 2013 and 2014. The results which help enterprises to hit the target in the near future are shown with low tolerance proven by Mean Absolute Percent Error (MAPE). From this study, a useful method can be provided in the case of the Vietnam dairy Products Joint–Stock Company and the results may shed insight into decision-making concerning the direction of a firm, to improve economic efficiency and to determine the financial performance of the business now, and it is the basis for determining results of operations for production the following period.

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