

Application of the Method of Mathematical Regression to Financial Status Analysis

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As a commonly-used method of mathematical and statistical analysis, regression analysis is based on existing observation data to establish reasonable dependent relations between two or more variables. It aims to discover hidden rules from the data, with which the company can make further predications, decision-makings and control. Currently, as domestic and global economic situations are improving and developing constantly, the validity and reliability of a company's financial data is of great importance for its managers, existing investors, and potential investors as well, which directly influence the company's investment directions and development directions. On the basis of a certain company's financial data, the paper used the method of mathematic regression to analyze the component indicators of the company's operating power, earning power, solvency, and capacity development. This helped acquire knowledge of overall conditions of operation and earnings in the company, which would serve for forecasting the company's future development directions.

1. Introduction

A company's financial status exerts vital effects on its expansion. In light of financial analysis, financial reports and other accounting data (Han, 2013) serve as the foundation for analyzing and assessing the financial status and operating outputs of the company. A summarization of its financial activities for a certain period is conducive to sorting out details of the company's development conditions, and can also provide quantitative basis for the next financial predications and decisions. Therefore, the quality of financial status analysis influences directly the development and operation of the company, and hence weigh heavily in company management (Ma, 2011).

2. Fundamental theories of regression analysis

Mathematic regression analysis is a commonly-used method of statistical analysis. By identifying reasonable dependent relations between two or more variables, regression analysis (He, 2008) helps discover hidden rules from the data, with which the company can make further predications, decision-makings and control. In regression analysis, unary linear regression analysis refers to the one where there is only one dependent variable and one independent variable, and where the relation between them is near to linear. (Wang, 2014) According to long-term mathematic development and statistical development, regression analysis is scientific and reliable in a proper data environment due to its analysis procedure (Mark, 2013). First, it is supposed to refer to the scatter diagram of a group of data to observe whether there is possible linear relations between the data. For data of good linear relations, the linear regression model is preferred; for data of faint linear relations, exponential regression models or logistic regression models are alternative. Next, a mathematic model is established to identify the quantitative relations between some variables. Through methods of parameter estimation such as the least square method (Fang, 2014), the yet unknown parameters are estimated (Vahid and Mohammad, 2013). Then, by identifying R, P, and F of the parameters, the paper checks the reliability of the regression model. Finally, the obtained regression equation is used to predict or control a certain production process (Liu and Li, 2014).

3. Establishment of the regression model of financial indicators

On the basis of a certain company's financial data, the paper undertook regression analysis on the change trend of various indicators of the data (Li, 2014). With the rules, the development conditions of various powers of the company in 2016 would be predicable. The following is analysis of the overall financial conditions of the company, aiming to further analyze component indicators of the company's operating power, earning power, solvency, and capacity development as well and to discover rules of the data (Tian, 2014).

3.1 Regression analysis of the total financial assets and the total liabilities

The first step was to analyze the overall financial status of the chosen company. There was about a total asset of ¥77.08 million and a total liability of ¥22.41 million in the company, where the net asset was ¥54.67 million. Specific data was shown in Table 1.

Table 1: The financial data of the company from 2011 to 2015

Date of Report	2011	2012	2013	2014	2015
Main business income(ten thousand Yuan)	1746	812	1556	1077	1107
Total profits (ten thousand Yuan)	1042	677	385	-794	110
Net profits (ten thousand Yuan)	888	572	386	-735	100
Total assets (ten thousand Yuan)	11442	10078	8568	7920	7708
Total liabilities (ten thousand Yuan)	6583	4550	2417	2564	2241

As can be seen clearly from data in Table 1, the main business income was basically flat, but total profits and net profits reduced gradually, even recording a deficit by 2014; also, total assets and total liabilities of the company declined year on year.

Through a regression analysis of the financial data from 2011 to 2015 (Figure 2), it could be seen that there was obvious linear trends for total assets and total liabilities of the company. The regression equation concerning total assets and report dates was expressed as $y = -962.6x + 2X10^6$, $R^2 = 0.9224$, denoting that there was good linear correlation; the regression equation concerning total liabilities and report dates was expressed as $y = -1067x + 2X10^6$, $R^2 = 0.8077$, denoting that there was good linear correlation. However, the linear correlations between report dates and main business income, total profits, and net profits, respectively, were found to be weak, which were also explained by data in Figure 1. (Wang and Chen, 2011)

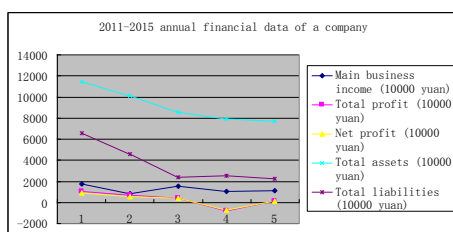


Figure 1: The financial data of a certain company from 2011 to 2015

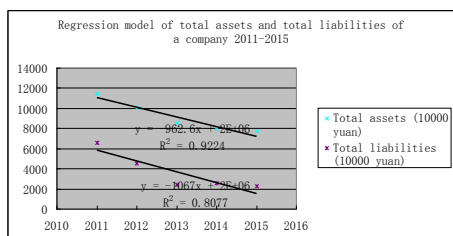


Figure 2: The regression model of total assets and total liability

With the regression equations of total assets and total liabilities, it could be forecasted that the total assets by 2016 would be around ¥59.398 million, and that the total liabilities around ¥15.107 million. These data would provide reliable supports for operation and decision-making of the company in 2016.

3.2 Regression analysis of operating power indicators

A company's operating power determines whether it functions well. Generally, it refers to the ratio between the output and fund employment of the company. Through analysis of its business performance, the company can identify potential troubles in asset running, and thus optimize economic benefits.

Below is analysis of company running with three indicators, namely receivables turnover ratio, inventory turnover ratio, and total assets turnover ratio. It intends to discover underlying problems in asset turnover, to seek for methods of accelerating asset turnover, and to further optimize resource allocation, which leads to successful maintenance and appreciation of assets value. Table 2 shows indicators of operating power ratio of the company from 2011 to 2015.

Table 2: Indicators of operating power ratios of a certain company from 2011 to 2015

Date of report	2011	2012	2013	2014	2015
Receivables turnover ratio (time)	4.83	11.36	26.91	14.8	23.62
Days sales outstanding (day)	74.58	31.7	13.38	24.32	15.24
Inventory turnover (time)	8.68	7.19	40.82	517.39	708.2
Days sales of inventory (day)	41.5	50.04	8.82	0.7	0.51
Total Assets Turnover (time)	0.14	0.08	0.17	0.13	0.14
Days of turnover of total assets	2491.35	4768.21	2156.98	2754.4	2540.58
Current assets turnover (time)	1.57	1.05	0.91	0.38	0.4
Days of turnover of current assets	229.53	343.25	396.52	949.62	901.8

As can be seen from Table 2, the increase of receivable turnover ratios that are showed in the indicators of operating power ratios from 2011 to 2015 proved a fast account collection, a short account age, a strong short-term solvency, and a favorable cash flow as well. The days sales of inventory dropped from the number of 41.5 by 2011 to the number of 0.51 by 2015, which meant that the company was witnessing a rapid inventory turnover, a gradually advancing realization of inventories, and upgrading management levels. The days of turnover of current assets saw a climbing trend from 230 days by 2011 to 902 days by 2015, denoting a slow turnover of current assets. The company's targeted solution of replenishing current assets constantly resulted in sluggish capital usage and thus lowered the company's operating capacity.

Figure 3 is a line chart of the company's indicators of operating power ratios from 2011 to 2015, with changes of indicators as plain as print.

The regression analysis of the company's operating power indicators from 2011 to 2015 (Figure 4) demonstrated a good linear trend of its receivables turnover ratios, inventory turnover ratios, and turnover ratios of total assets. For instance, the regression equation concerning days of turnover of current assets and times was $y=195.09x-392154$, $R^2=0.8431$, with a good relevance; the regression equation concerning inventories turnover ratio and times was $y=190.92x-384074$, $R^2=0.8244$, with a good relevance.

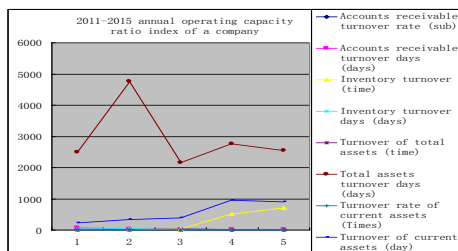


Figure 3: Indicators of operating power ratios from 2011 to 2015

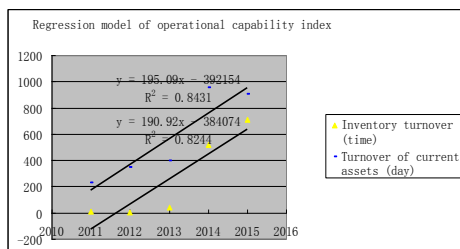


Figure 4: The regression model of operating power indicators

With the above two regression equations, it could be forecasted that the days of turnover of current assets by 2016 would be about 1147.4 days, and the inventories turnover ratio would be around 820.72 times. These data provided reliable support for decision-making and operation of the company in the year of 2016.

All in all, through analysis of various indicators of asset turnover, it could be seen that the company's operating power was not ideal. It is suggested that the company should improve asset usage efficiency, increase the proportion of quick assets and assets held for trading.

3.3 Regression analysis of earning power indicators

Earning power reflects a business's ability to generate profit from conducting its operations in a certain period. Generally, companies with strong earning power develop better. The common earning power indicators include: gross profit margin and net profit margin. Table 3 shows the values of indicators concerning the chosen company's earning power from 2010 to 2015.

Table 3: The values of indicators concerning the chosen company's earning power

Date of report	2011	2012	2013	2014	2015
Operating profit margin (%)	54.73	35.74	-0.8	-48.76	6.85
Net profit margin on sales (%)	59.45	82.28	24.8	-73.75	9.91
Profit margin on net assets (%)	19.46	11.15	6.71	-14.64	1.96
Profit rate on cost and expenses (%)	42.41	54.56	19.98	-66.34	9.43

Table 3 shows that the company's net profit margin on sales, profit margin on net assets, and profit rate on cost and expenses increased first and then decreased, which showed that the company had unstable earning power. The operating profit margin dropped year on year, and rebounded until the year of 2015. The results of regression analysis showed that the company had weak relevance between the earning power and time. How to improve profit margin is worth considering.

Through the regression analysis of earning power indicators, the paper found that the linear correlation between all the four indicators (operating profit margin, net profit margin on sales, profit margin on net assets, and profit rate on cost and expenses) and time were poor. For example, the coefficient of determination was 0.5731 in the regression model concerning profit margin on net assets and time (Figure 6).

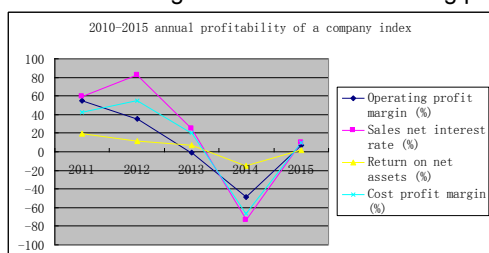


Figure 5: Indicators of earning power ratio from 2011 to 2015

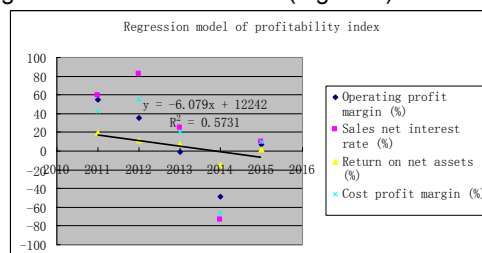


Figure 6: The regression model of earning power indicators

It could be seen from these indicators that the company witnessed the optimal development in 2012 and an unstable development in the following three years, illustrating a poor earning power. The company was supposed to take measures to improving current business.

3.4 Regression analysis of solvency indicators

Solvency is the ability of a company to bear matured debts, and connects to the company's expansion and growth. Analysis of solvency helps unveil a company's financial status and anti-risk capability and helps the company to take correct borrowing and lending decisions. Here is a main analysis of the chosen company's financial data in terms of short-term solvency.

Table 4: Indicators of solvency indicators of the company from 2011 to 2015

Date of report	2011	2012	2013	2014	2015
Liquidity ratio (%)	0.16	0.12	1.25	1.13	1.29
Quick ratio (%)	0.15	0.11	1.25	1.13	1.29
Cash ratio (%)	13.3	9.12	6.23	20.81	15.01

According to Table 4 and Figure 7, the change of liquidity ratio was consistent to that of quick ratio in that both of them climbed slowly during the four years; while cash ratio was unstable, showing signs of an irregular trend. The regression analysis of solvency indicators from 2011 to 2015 (Figure 8) demonstrated good linear correlations between the quick ratio & liquidity ratio and time. The regression equation concerning quick ratio and time was $y=0.33x-663.5$, $R^2=0.7515$, while the regression equation concerning cash ratio and time was $y=1.511x-3028.7$, $R^2=0.1813$, with barely no correlation.

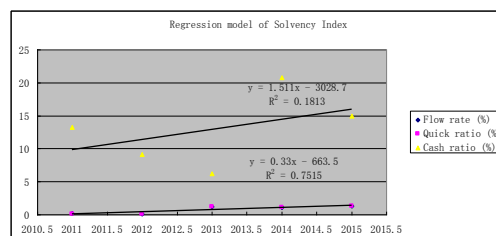
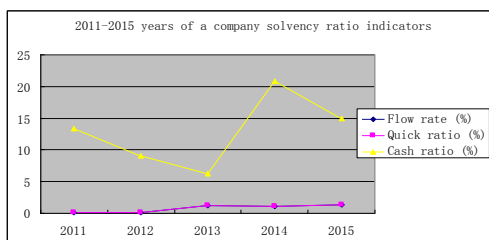


Figure 7: Indicators of solvency indicators of the company from 2011 to 2015

Figure 8: The regression model of solvency Indicators

According to the regression equation concerning quick ratio and time, the quick ratio in 2016 is forecasted to be 1.78. This value showed that the company's solvency would arise slowly.

3.5 Regression analysis of capacity development indicators

Capacity development indicators illustrate whether companies obtain, strengthen and maintain the capabilities to expand businesses and build up their strengths without endangering healthy survival. Analysis of capacity development acts as basis for investors to assess a company's growth. It also helps operators to find out key factors that affect the companies' development and thus implement correct borrowing and lending decisions.

Table 5: Capacity development indicators of the chosen company from 2011 to 2015

Date of report	2011	2012	2013	2014	2015
growth rate of main business income (%)	-53.37	-53.48	91.59	-30.77	2.76
growth rate of net assets (%)	27.16	13.75	11.28	-12.91	2.05
growth rate of total assets (%)	-10.04	-11.93	-14.98	-7.56	-2.69

According to Table 5 and Figure 9, despite slow increase of the growth rate of total assets from 2011 to 2015, the company witnessed a slow decrease of the growth rate of net assets; while the growth rate of main business income saw the peak in 2013. Through regression analysis of capacity development indicators of the company from 2011 to 2015, it could be seen that there was good linear correlation concerning the growth rate of net assets and time. The regression equation concerning the growth rate of net assets and time was $y=-7.688x+15484$, $R^2=0.6692$.

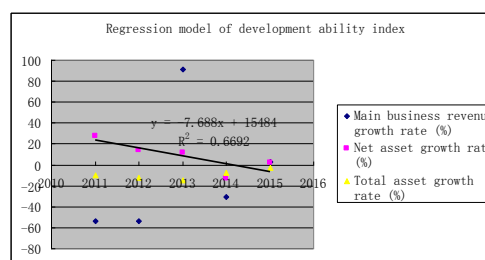
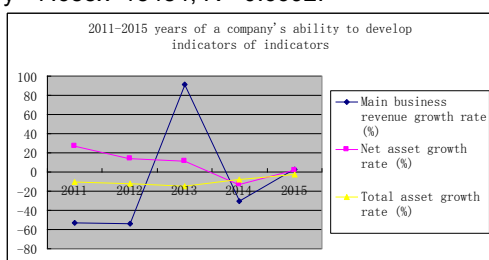


Figure 9: The indicators of solvency ratio from 2011 to 2015

Figure 10: The regression model of solvency indicators

According to the regression equation concerning the growth rate of net assets and time, the growth rate of net assets in 2016 is forecasted to be -15.008. This value showed that the company's net assets are dropping. Considering that the coefficient of determination of this regression model is 0.6692, the predicted value still waits for tests of practice.

4. Problems of financial status and cause analysis

The result of data analysis of the financial status in the company from 2011 to 2015 demonstrated that there were certain problems for the company's development, such as poor capability of assets operation, poor profitability, insufficient solvency, and unsteady growth rate of net assets. The reasons were that the company had low asset utility rate, low profit margin on costs and expenses, and little capital accumulations, and that the company lacked effective measures of supervision and control. Thus, it is supposed that the company should take measures to balance business management, to enhance operating powers, earning powers, and short-term solvency, and to increase capital usage efficiency.

5. Conclusions

In modern society, financial status acts as not only a significant assessment criteria of a company's standing, but also a powerful basis to measure a company's capacity development. For companies themselves, it is supposed to analyze previous events, predict future events, and cover the shortage as well. In this way, companies will finally have their internal management levels and external competitiveness enhanced. The paper applies the mathematical regression model to an in-depth analysis of the financial status of a company, and forecasted various financial indicators in 2016. Practice has proved that the method of mathematical regression analysis plays effective roles in analyzing data of financial status.

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