FINANCIAL WARNING MODELS FOR COMMUNITY HOSPITALS IN THAILAND

KRITCHALAT NINKARNJANAKUN

**A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR
THE DEGREE OF INDUSTRIAL ENGINEERING
FACULTY OF GRADUATE STUDIES
MAHIDOL UNIVERSITY
2016**

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Thesis
entitled

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Kritchalat Ninkarnjanakun

Mr.Kritchalat Ninkarnjanakun
Candidate

Lect. Jirapan Liangrokapart,
Ph.D. (Industrial Engineering)
Major advisor

Asst. Prof. Ronnachai Sirovetnukul,
Ph.D. (Industrial Engineering)
Co-advisor

Sirirat Wong

Asst. Prof. Sirirat Wongprakornkul,
Ph.D. (Industrial Engineering)
Co-advisor

Prof. Patcharee Lertrit,
M.D., Ph.D. (Biochemistry)
Dean
Faculty of Graduate Studies
Mahidol University

Asst. Prof. Thanakorn Naenna,
Ph.D. (Engineering Science)
Program Director
Master of Engineering program in
Industrial Engineering
Faculty of Engineering,
Mahidol University

Thesis
entitled

FINANCIAL WARNING MODELS FOR COMMUNITY HOSPITALS IN THAILAND

was submitted to Faculty of Graduate Studies, Mahidol University
for the degree of Master of Engineering (Industrial Engineering)
on
May 31, 2016

Kritchalat Ninkarnjanakun
.....
Mr.Kritchalat Ninkarnjanakun
Candidate

.....
Cpt. Tongkarn Kaewchalermtong,
Ph.D. (Ocean Engineering)
Chair

.....
Lect. Jirapan Liangrokapart,
Ph.D. (Industrial Engineering)
Member

Ronnachai Sirovetnukul
.....
Asst. Prof. Ronnachai Sirovetnukul,
Ph.D. (Industrial Engineering)
Member

Sirirat Wong
.....
Asst. Prof. Sirirat Wongprakornkul,
Ph.D. (Industrial Engineering)
Member

.....
Prof. Patcharee Lertrit,
M.D., Ph.D. (Biochemistry)
Dean
Faculty of Graduate Studies
Mahidol University

.....
Asst. Prof. Jackrit Suthakorn,
Ph.D. (Robotics)
Dean
Faculty of Engineering
Mahidol University

ACKNOWLEDGEMENTS

As for the success of this research, I would hereby like to thank Dr. Jirapan Liangrokapart, my research adviser, who devoted her time to provide helpful recommendations, advices and assistances until the research was successfully completed.

In addition, I would like to thank all of my instructors who kindly taught me as well as the institute that provided me the primary education to date, including all officials of the Department of Industrial Engineering, Faculty of Engineering, and, more importantly, officials of the Health Insurance Group, Office of the Permanent Secretary Ministry of Public Health, Ministry of Public Health, which facilitated me for everything. Moreover, I would like to greatly thank my parents, brothers, sisters and all of my family members who have encouraged me constantly. Finally, I would like to thank all of my friends who have encouraged, listened and provided support throughout my research.

I hope that this research will be useful for those interested, more or less. I will be highly delighted if this research can generate benefits to society as a whole. If there is any error in this research, I would hereby apologize and embrace it solely.

Kritchalat Ninkarnjanakun

FINANCIAL WARNING MODELS FOR COMMUNITY HOSPITALS IN THAILAND

KRITCHALAT NINKARNJANAKUN 5436252 EGIE/M

M. Eng. (INDUSTRIAL ENGINEERING)

THESIS ADVISORY COMMITTEE: JIRAPAN LIANGROKAPART, Ph.D., RONNACHAI SIROVETNUKUL, Ph.D., SIRIRAT WONGPRAKORNKUL, Ph.D.

ABSTRACT

Community hospitals are healthcare centers for many communities in Thailand, which has more than 10 million households in the country requiring a wide range of healthcare services. More than ten years ago, many community hospitals faced financial problems in different ways and needed to solve these urgent problems many times to remain viable. The purpose of this study is to develop a model which will provide warning signals to distressed community hospitals. Researchers gathered financial data during the period of 2011 - 2015 to evaluate the risk factors which effect a community hospital's financial system. Factor Analysis was used to minimize Multicollinearity. Then models are generated from the techniques of Multiple Discriminant Analysis (MDA) and Multinomial Logistic Regression (MLR) to predict financial crises for community hospitals. Comparisons of both techniques are presented. The models are warning tools for predicting financial distress in community hospitals, which, can help community hospitals, To prevent, or minimise problems.

KEY WORDS: FINANCIAL WARNING MODEL / COMMUNITY HOSPITALS / MULTIPLE DISCRIMINANT ANALYSIS / MULTINOMIAL LOGISTIC REGRESSION

104 pages

แบบจำลองเตือนภัยทางการเงินของโรงพยาบาลชุมชนประเทศไทย
FINANCIAL WARNING MODELS FOR COMMUNITY HOSPITALS IN THAILAND

กฤชชลัช นิลกาญจนกุล 5436252 EGIE/M

วศ.ม. (วิศวกรรมอุตสาหการ)

คณะกรรมการที่ปรึกษาวิทยานิพนธ์: จิรพรรณ เลี่ยงโรคาพาธ, Ph.D., รณชัย ศิโรเวฐนุกุล , Ph.D., ศิริรัตน์ วงศ์ประกรณ์กุล, Ph.D.

บทคัดย่อ

โรงพยาบาลชุมชนเป็นศูนย์กลางของการดูแลสุขภาพของชุมชนมากมายในประเทศไทย สิบกว่าปีที่ผ่านมาโรงพยาบาลชุมชนต้องเผชิญกับปัญหาทางการเงินในรูปแบบต่างๆและจำเป็นต้องแก้ปัญหาเฉพาะหน้าหลายครั้งเพื่อให้ผ่านพ้นวิกฤติทางการเงินไปได้การศึกษานี้จึงมีวัตถุประสงค์ในการพัฒนาแบบจำลองเพื่อเป็นสัญญาณเตือนภัยทางการเงินของโรงพยาบาลชุมชนวิธีการศึกษาคือผู้วิจัยได้รวบรวมข้อมูลทางการเงินในช่วงระหว่างปี 2551-2555 จากกระทรวงสาธารณสุขประเทศไทยเพื่อประเมินปัจจัยเสี่ยงที่ส่งผลกระทบต่อระบบการเงินของโรงพยาบาลชุมชนโดยใช้การวิเคราะห์องค์ประกอบ (Factor Analysis) เพื่อลดปัญหาความสัมพันธ์ของตัวแปรและสร้างแบบจำลองความเสี่ยงทางการเงินโดยเทคนิคการวิเคราะห์จำแนกประเภทพหุ (Multiple Discriminant Analysis) และการวิเคราะห์ความถดถอยโลจิสติคพหุกลุ่ม (Multinomial Logistic Regression) ผลการวิเคราะห์พบว่าแบบจำลองความเสี่ยงทางการเงินสามารถพยากรณ์สถานะของโรงพยาบาลชุมชนได้อีกทั้งยังช่วยแก้ไขหรือลดปัญหาก่อนที่จะเกิดวิกฤติทางการเงินของโรงพยาบาลชุมชนได้

104 หน้า

CONTENTS

CONTENTS (cont.)

CONTENTS (cont.)

LIST OF TABLES

LIST OF TABLES (cont.)

LIST OF FIGURES

CHAPTER I
INTRODUCTION

Over the past years, many countries all over the world were affected by the economic recession due to the interaction and rapidly expansion of economic system between these countries. Advances in communication technology and transportation brought the world together. However, trade and investment came with problems. Thailand, among other countries, faced economic crisis several times and it took quite a long time to recover. Each crisis affected the overall economy of the country. Many industries, from small to large, suffered a financial loss, went bankrupt, and finally went out of business. This caused inevitable problems in many aspects such as unemployment, poverty, crime, quality of life, income distribution, and other social problems. These accumulated problems, if not solved, would create a domino effect between industries or even between small enterprises.

In Thailand, most hospitals are under the Ministry of Public Health. Each province has at least one provincial hospital and several community hospitals, which are directly under the supervision of the Office of the Permanent Secretary for Public Health. There are two types of provincial hospitals: regional hospitals with more than 500 beds and general hospital with 120-500 beds (Jinafoey, 2012). Hospitals located in the district level are called community hospitals, which have a capacity of 10-120 beds (Padoongtod, 2006). These hospitals are large and important units in service industry that serves several million people each year.

Thai government had a policy to help people by setting up the universal health coverage program or Universal Health Coverage scheme. It was a change in Thailand's health care system to help every group of people to have access to health care service without paying too much and reduce social inequality in this way. However, there were some problems about the policy itself and the payment system such as lack of budget and delay in disbursement. The problem of delayed delivery and receipt of documents between the hospitals and the National Health Security Office leaves the

financial burden on community hospitals. These problems caused some community hospitals to advance the expenses and have accumulated losses. The hospitals therefore had to be liable for any health care expenses inevitably. (Ariyasriwattana, 2008)

The following is a collection of news headlines, contents and years of publication regarding public hospitals under the Ministry of Public Health in Thailand as well as community hospitals as part of the health system in Thailand that provide services to the people at most in order to indicate the overall financial crisis and the trend of problems that will happen and affect the financial performance and risks among public hospitals as shown in the Table 1.1:

Table 1.1 Collection of news headlines, contents and years of publication regarding Public hospitals

Year	News Headline	Selected Content
2010	Hospitals under the Ministry of Public Health face a serious loss – coma 11.04% by "Gold Card"	On September 27, 2010, Dr. Jed Siratannont, a senator, questioned Jurin Laksanawisit, Minister of Public Health at that time, regarding a financial crisis in hospitals under the Ministry of Public Health. The Minister accepted that it really occurred and 191 of 824 hospitals experienced a loss. According to a report on the financial status of hospitals under the Ministry of Public Health for second quarter of 2010, each hospital experienced an average loss of 2.27 million baht and the reserved fund status was likely to decrease continuously. 91 of 824 hospitals had negative reserved fund and negative monthly income at 11.04%, while 376 hospitals had positive reserved fund with negative income at 45.63%, 100 hospitals had negative reserved fund and positive income at 12.41%, and 257 hospitals had positive reserved fund and positive monthly income at 31.19%. Based on 258 hospitals with no liquidity, community hospitals had lowest liquidity, followed by general hospitals and public health service centers. (Source: http://www.cueid.org/content/view/4034/71/)

Table 1.1 Collection of news headlines, contents and years of publication regarding Public hospitals (Cont.)

Year	News Headline	Selected Content
2011	10 years of complete health security result in over 7 billion baht loss by public hospitals	Since the Thai public health system has provided its complete health services in 2001, the situation of public hospitals have been increasingly facing with a loss and their contributions have clearly decreased. According to a report on the 2010-2011 fiscal situations of 823 public hospitals under the Ministry of Public Health in Thailand, the financial problems for public hospitals can be summarized as follows: All levels of hospitals experienced a loss and an increasingly serious crisis that resulted in a financial problem for management and medical personnel. It was expected that this situation would not recover soon. Public health service centers, general hospitals, and community hospitals experienced an average loss of 46.2, 22.4 and 2.7 million baht, respectively. In addition, the report states that the reason of reduced contributions of hospitals because they had more debts because the National Health Security Office did not pay the hospitals as billed with a huge outstanding payment and therefore their contributions were spent instead. The problems found include: 1. Income from medical treatment services in 2010 was 22, 145 million baht, but outstanding debt was 27, 009 million baht and payment increased for 31, 444 million baht. 2. Medical personnel expenses (salaries, compensations, and wages) increased for 59, 390, 65, 795 and 68, 593 million baht in 2008, 2009 and 2010, respectively. 3. Outstanding debt in terms of medical treatment service charges according to the national health security caused by increased services provided resulted in the expenses of medical supplies increased for 27, 009 million baht.

Table 1.1 Collection of news headlines, contents and years of publication regarding Public hospitals (Cont.)

Year	News Headline	Selected Content
		In addition, the report specified that the higher expense in terms of personnel was caused by the increased number of patients who received the services of the complete health security system and the hospitals therefore were required to employ temporary employees, especially professional temporary employees, together with higher overtime compensations. 304 of 832 hospitals seriously experienced this problem. (Source: http://thaipublica.org/2011/09/10-years-healthcare/)
2012	496 hospitals experience a financial crisis, "compensations – control of Gold Card budget", resulting in a continuously decreased amount of contributions	The situation of public hospitals under the Ministry of Public Health is likely to be increasingly critical because of the policy of 3-year constant individual payments of the Health Security Office as well as of the compensations for medical personnel that have resulted in a decreased amount of hospitals' contributions. Prachumporn Booncharoen, the president of the Federation of Public Health Service Centers and General Hospitals, said that in the late 2011 the National Health Security Office had transferred the budget of individual payments to 50% of all hospitals so the situation relaxed more or less. However, in 2012 especially the second half of the year, the budget decreased and therefore it faced with a financial problem again. According to the information, there are 91 public health service centers and general hospitals nationwide and only 19 hospitals still have their liquidity. Community hospitals, smaller-sized hospitals, also faced this problem. Dr. Supat Hasuwannakit, the president of Chana Hospital, Songkhla, said that the contributions for hospitals obviously decreased. In 2012, hospitals had 66 million baht incomes

Table 1.1 Collection of news headlines, contents and years of publication regarding Public hospitals (Cont.)

Year	News Headline	Selected Content
		and 70 million baht payments, with a loss of 4 million baht. Thus, these hospitals were required to use their contributions and to wait for the budget to be transferred before payment of debts. He also suggested that the 3-year individual payments should not be maintained because it will highly impact the hospitals, especially community hospitals because most of their incomes come from the health security system, which is different from public health service centers and general hospitals that have incomes from other channels, such as social security system and bureaucratic welfare system. According to the information on June 30, 2012, 336 of 832 hospitals under the Ministry of Public Health had a profit of 5, 238 million baht and 496 hospitals had a loss, including 464 community hospitals had a loss of 3, 135 million baht, 22 general hospitals has a loss of 672 million baht, 9 public health service centers had a loss of 696 million baht, and one community medical center had a loss of 1, 246 million baht. There are seven levels of loss crisis. 175 hospitals were at the highest level of crisis, 7^{th} level, and it was expected that the number of hospitals under the Ministry of Public Health experiencing a financial crisis problem at the severe level will be likely to increase in 2013. (Source: http://www.hisro.or.th/main/?name=news&file=readnews&id=441)
2013	Nationwide community hospitals are being made bankrupt	Dr. Supat Hasuwannakit said that since the complete health security project has been launched in 2002, there has been a drastic change in the Thai health system. All people should have their health security because the medical expenses

Table 1.1 Collection of news headlines, contents and years of publication regarding Public hospitals (Cont.)

Year	News Headline	Selected Content
		are very high. When 99% of Thai people have this security, a risk condition towards a bankrupt falls to the public hospitals, especially community hospitals, which are non-profit organizations. However, hospitals need to manage themselves to have higher receipts than payments to prevent a loss. There are many payments for community hospitals, such as water supply, electricity, medical supplies, salaries for medical personnel, and repair of medical devices. There are two ways of their receipts, firstly, the budget from the health security system that may be allocated in advance or after the hospitals have provided their services, which is quite constant, and secondly, the money directly collected from patients, which depends on the hospitals' policy as to how much the patients are responsible for the expenses. These two portions of receipts are collectively called the contributions, which can be spent according to the governmental regulation. Because of the pressure of limited budget and the high and unavoidable expenses of medical treatment services, hospitals have sought a way to reduce their payments as much as possible, such as reductions of purchasing medical devices, employing medical personnel, and constructing buildings. As a result, more than 200 community hospitals have experienced an accumulative loss for many years, and they may have already been bankrupt if they are private hospitals. In addition, more than 400 hospitals have had higher payments than receipts so they have faced with an accumulative loss continuously. (Source: http://riskcomddc.webofficedesign.com/en/news/newspaper-detail.php?id=19380)

According to above summary of news headlines and contents, we can see the overall of financial crisis problem that the hospitals under the Ministry of Public Health in Thailand have faced for many years. It has highly affected the management of these hospitals and reflects various problems, such as improvement of modern and competitive hospitals against private or foreign hospitals by purchasing medical devices, building more buildings to support many patients, and improving existing tools. The budget for this improvement is reduced and used for other purposes. Moreover, according to the compensation increment policy, medical personnel cannot be paid by hospitals with loss performance. Some hospitals are required to terminate the employment of some personnel so the remaining workers need to do more work with the same compensation.

Over the past years, the community hospital under Thailand's Ministry of Public Health faced economic crisis from both inside and outside the hospitals. They were pressured by the rapid change of the environment and economy. Most community hospitals experienced financial problems, outstanding debts and accumulated losses. Due to the fact that the community hospitals under the Ministry of Public Health could not go bankrupt or go out of business, they had to be liable for the debts until the Ministry of Public Health approved the budget. Therefore, the community hospitals had to adapt themselves to the situation in order to avoid financial risks.

In 2015, ten ASEAN countries (Cambodia, Brunei Darussalam, Myanmar, Philippines, Malaysia, Lao PDR, Vietnam, Singapore, Indonesia and Thailand) will unite to form ASEAN Economic Community. The universal health coverage policy will result in more and more customers coming to the hospital under the Ministry of Public Health. The community hospitals are service units that support alien workers, both legal and illegal. However, due to the lack of medical personnel and equipment, some community hospitals may need to advance the budget used to suitably hire medical personnel or buy medical equipment to catch up with development and higher competition.

Having considered the economic problems affecting the community hospitals under the Ministry of Public Health, it has been found that there are six major problems that the community hospitals are facing.

1.1 Problems of Unemployment

Nowadays the unemployment rate in Thailand is higher and higher due to the economic recession that affects every group of industries, from small to large. Both public and private sectors experience accumulated losses and finally go out of business. In service industry, hospitals are also affected from industrial lay-offs. Unemployment is a situation where someone of working age is not able to get a job, sick, waiting for a new job or has been laid off. When there is no job, it means that the total income decreases.

Being laid off results in workers lacking of living expenses. The unemployed workers tend to avoid any activities that create costs. When the workers or their family members have health problems, they tend to avoid going to hospitals. Even though there are social assistance programs such as social security fund and health security fund, serious illnesses that require hospitalization, operation, and multiple visits to hospitals cause extra costs and add burdens for these workers. Therefore, they would try to avoid going to hospitals and buy medicine from drug stores instead. Sometimes, if the symptom were bearable, they would just rest without taking any medicine. When there aren't enough customer bases, hospitals do not get service income yet they still have to pay the fixed operating cost. If this situation continues, hospitals will face accumulated losses.

1.2 Problems of Outdated Medical Equipment

Hospitals have to purchase medical devices and equipment to give a wide variety of medical services. Different brands and sizes are bought to support, facilitate, and standardize various types of services. Hospitals plan to place a purchase order once and maintain the equipment regularly. But as technology gets better and diseases evolve, the existing devices and equipment become outdated. The results of this problem are (Ariyasriwattana, 2008)

1. High cost of repairs and maintenance of outdated medical equipment
2. Some of the existing outdated medical devices and equipment are usable and functional but may give less accurate diagnostic results and diminish the effectiveness of the treatments

3. Technicians who operate medical equipment lack training or experience and some equipment are discontinued. Therefore, hospitals have to give in-house training by their own staff, which may cause error and harm when applied to real patients.

1.3 Problems of Relocation And Shortage of Medical Personnel

It is well known that public hospitals, especially hospitals under the Ministry of Public Health, have more customers than they can serve and don't have enough medical personnel, which give physicians only about 2-3 minutes to diagnose a patient. Another problem is that some senior physicians refuse to diagnose patients and work overtime. The fact that they're too many patients causes each doctor to work 90-120 hours a week (including overtime). (Ariyasriwattana, 2008)

The rush of diagnosis and the lack of rest for the doctors increases the risks associated with treatments. As a result, physicians are blamed and sued by patients or their relatives for mistakes that were made by doing their job. Physicians are stressful and some choose to resign and work for private hospitals instead. In private hospitals, physicians receive better salaries or payments and suitable working hours. Therefore, there are not enough physicians working in public hospitals. Meanwhile, students who get accepted in medical school give up which result in the lack of medical personnel in the future.

1.4 Problem in Treatment Quality

Community hospitals are not able to give standard treatments to patients due to protocol, which limits the doctors' freedom of choice in decisions about each patient's care. The National Health Security Committee has specified medicine lists, so doctors cannot prescribe medicine at their discretion. (Ariyasriwattana, 2008)

The specification and limitation of medicine of the National Health Security Committee is considered "patient rights violations" and "medical rights and freedoms violations." As a result, patients may not receive suitable treatment and medicine and the ineffective treatment can lead to chronic illness or even loss of life. Apart from the limitation of medicine, the National Health Security Committee also delays and/or

pays a partial amount of the total cost that community hospitals incur to treat patients. The hospitals do not reach the break-even point despite having “Health Security Fund.” (Ariyasriwattana, 2008)

In fact, a big portion of the national budget is allocated to the Health Security Fund, but as a public service unit, community hospitals receive insufficient budget to operate and hundreds of them run up debts. As a result, the hospitals may not be able to give suitable medicine to their patients. (Ariyasriwattana, 2008)

Another issue is that the risk of making mistakes by medical personnel is increased, because there are so many patients going to community hospital all year round but there are not enough doctors. Some physicians have to spend time on policy administration. Physicians in community hospitals have to work long hours, especially surgeons. Some surgeons have to perform operations all night and still have to take care of emergency patients in the morning. This kind of workload affects the quality of the performance of physicians. More physicians have been sued after National Health Security Act; B.E. 2545 (2002) was promulgated (Ariyasriwattana, 2008). The study also shows that, from the report of the Health Security Office, after the law went into effect, medical malpractice lawsuits went up from 4-5 lawsuits a month at the beginning to 75-80 lawsuits a month and they were based on section 41 of the National Health Security Act, B.E. 2545.

1.5 Problems of Operating Costs

Community hospitals under the Ministry of Public health are running at a loss and severely lacking liquidity. Since the budget allocated to community hospitals by the National Health Security Committee includes personnel’s salaries, the actual budget given to community hospitals under the Ministry of Public health is unknown.

When the budget allocated to community hospitals is not enough, the hospitals then don’t have money to pay for management and hospital personnel. The community hospitals have to use subsidies in payment for hospital personnel’s remuneration. (Ariyasriwattana, 2008)

The financial status of community hospitals has been adversely affected by the change of budget allocation system. The hospitals used to receive budget directly

from the government through the Ministry of Public Health. Now the budget varies depending on the population in a hospital's responsible area. Many community hospitals' incomes are less than their expenditures and it leads to financial crises. While the salaries of government employees who work in these hospitals come from the budget received from the Ministry of Public Health through several health funds, community hospitals have to use their own money to hire temporary personnel. The financial crises are even worse when the hospitals have to allot the already insufficient income to temporary professional employees in order to meet the immediate needs of the people in their responsible areas. (Health Systems Research institute, 2012) The crises are obvious in community hospitals that have to compete with private hospitals. To keep health professionals from leaving, public hospitals need monetary motivation, which is higher than that of private hospitals, and this means a higher financial burden. Some private hospitals offer starting salary for registered nurses up to 100,000 baht. (Health Systems Research institute, 2012) Unable to compete with that, the community hospitals with financial problems are not able to hire enough personnel and their health services are inevitably affected. From the study of Situation and Efficiency of Financial and Health Resources Management in Wang Chin Hospital (Boonbunpan, 2008), it is found that personnel expenses were quite high and resulted in high operating cost of the hospital. The study suggests that the hospital should have an effective data storage system and analyzes hospital's personnel expenses to prevent unnecessary costs.

1.6 Problems of Non Thai workers

When speaking of the impact of millions of transnational migrant workers on Thai health care system, one issue that always comes up is that there are more transnational migrant workers using the service than Thai people who live in the area. Hospitals' expense budgets are spent on treating transnational migrant workers who (most of them) do not have health insurance. The community hospitals have to deal with outstanding debts while lacking health professionals. The question for Thai society is how to find a suitable solution that helps both Thai people and transnational migrant workers. Another issue is that not only do transnational workers not have health insurance,

but also that there are so many aliens in Thailand. The question is how government's health care system handles this situation.

There are many "Non Thai" that do not have any health insurance. They prefer buying medicine from drug stores if their sickness is not severe. Unless the sickness is severe, they will not go to public hospitals and pay medical fees on their own. In case they cannot pay the medical fees or can pay only a partial amount, the hospitals may consider using subsidies to compensate for the fees. But in reality, public health officers may not be willing to serve these people because they feel uncomfortable with the increased burden and communication problems. The study of Health Insurance for People with Citizenship Problems and Inpatient Service (Supannachaimart et al., 2014) suggests that since 2002, Thailand has successfully developed public health infrastructure and health financing systems to reach universal health coverage for Thai nationals. The 3 main health insurance systems are Universal Coverage scheme covering 47 million Thai nationals, the civil service welfare system for civil servants and their families covering more than 6 million people, and Social Security for private employees covering more than 9 million people. Theoretically, 'every Thai national' has access to health insurance. However, there are many immigrants and aliens living in Thailand as well. And the following problem is that Thai government has to allocate budget to take care of and provide primary health care services for these people. Health Insurance Office under the Office of the Permanent Secretary for Public Health has continually allocated budget to these people in order to protect their rights to gain access to health care services. For example, the budget of 918,137,000 baht was allocated to people with citizenship problems in fiscal year 2011. (Supannachaimart et al., 2014)

It is expected that there will be more problems after AEC establishment in 2015. Preceding plans for health resources management, especially medical personnel, are based on the needs of Thai citizens only. Having aliens and transnational workers in the health care system inevitably means adding more work to community hospital personnel.

It can be seen that the problems mentioned above are all related to each other and therefore reflect the performance of community hospitals, which can be checked and extracted from the financial status account system into a financial report. The financial information from the Ministry of Public Health identifies seven levels of

the crisis of these community hospitals. This study considers only levels 6 and 7, which may imply the critical level of community hospitals in Thailand. According to Table 1.2, during 2011-2015, the total number of small community hospitals (F3), medium community hospitals (F2), and large community hospitals (F1) at the critical levels 6 and 7 is 719 hospitals. This figure include: 271 hospitals in 2011, 37.53%, 186 hospitals in 2012, 26.16%, 191 hospitals in 2013, 26.45%, 135 hospitals in 2014, 18.44%, and 123 hospitals in 2015, 16.90%. The number of community hospitals at the critical levels 6 and 7 is declining every year. However, considering on a yearly basis, the number of medium community hospitals (F2) at the critical levels 6 and 7 is still moderate and their percentage is relatively high compared to the total number of all community hospitals. Also, the trend of medium community hospitals (F2) is still unclear whether the number will be reduced every year. Considering their importance, medium community hospitals (F2) have 30-90 beds, are distributed in various districts across the country, and reach the people with low income. So, if the financial status of these hospitals is critical, it cannot be denied that it will affect health services to the people. However, this situation can be resolved prior to the occurrence of financial problems as shown in the Table 1.2:

Table 1.2 Number of small community hospitals (F3), medium community hospitals (F2), and large community hospitals (F1) at critical levels 6 (Distress Zone) and 7 (Distress Zone)

	2011		2012		2013		2014		2015	
	HOSPITAL	%	HOSPITAL	%	HOSPITAL	%	HOSPITAL	%	HOSPITAL	%
F3(6)	10	1.39	10	1.41	8	1.11	9	1.23	9	1.24
F3(7)	12	1.66	3	0.42	4	0.55	3	0.41	2	0.27
F2(6)	89	12.33	115	16.17	113	15.65	105	14.34	66	9.07
F2(7)	133	18.42	39	5.49	46	6.37	9	1.23	33	4.53
F1(6)	12	1.66	19	2.67	17	2.35	9	1.23	12	1.65
F1(7)	15	2.08	0	0.00	3	0.42	0	0.00	1	0.14
Total	271	37.53	186	26.16	191	26.45	135	18.44	123	16.90

It can be seen that the problems mentioned above are connected and reflect the performance of community hospitals. The performance of community hospitals can be examined by the accounting system that shows financial status in the form of

financial report. This study uses financial information between 2011 and 2015 of 719 community hospitals under the Ministry of Public Health to predict variables that cause loss to the hospitals and find if any hospitals have a tendency to accumulated deficit. This is thus the origin of this research titled Financial Warning Model for Community Hospitals in Thailand.

This result is interested to answer the following questions,

1. How did each community hospital perform in term of financial status in the past?
2. How the community hospitals in distress zone solve their problems?

This research uses community hospitals under the Ministry of Public Health in Thailand to test the model. It has been already said in the introduction that these community hospitals are highest in the number of Thailand, serve the highest number of patients, and have suffered with financial crisis problem, i.e. accumulated loss, for many years. Therefore, it is very interesting to research and determine the conclusion on the forecast of financial failure as a research.

1.7 Objectives

1. To purpose Financial Distress Model (FDM) to classify the community hospital's status.
2. To do sensitivity analysis and be prepare to solve the problems beforehand.

1.8 Scope of Research

This study used retrospectively five-year financial information or financial statements from 2011 to 2015. Financial statement used in this study included balance sheet, statement of cash flows and income statement. Data was collected from Health Insurance Division, Office of the Permanent Secretary of Public Health, Ministry of Public Health. Quantitative analysis is a warning sign of financial problems for community hospital administrators through statistical procedures.

1.9 Expected Benefits

1. Financial Distress Model (FDM) can be classified the current community hospital's financial status.

2. The community hospital can be used result of sensitivity analysis for future improvement.

CHAPTER II
LITERATURE REVIEW

This chapter will be present Literature review and method for support this research including

2.1 Current Situation and importance of Community Hospitals in Thailand

2.1.1 Hospitals and Medical Establishments with beds.

2.1.2 Distribution of Community Hospitals under the Ministry of Public Health in Thailand.

2.1.3 Number and Distribution of Beds in Community Hospitals under the Ministry of Public Health, Thailand.

2.2 Financial warning indicators

2.3 Financial warning models

2.1 Current Situation and importance of Community Hospitals in Thailand

Hospital is a facility for providing health services with a focus on promotion, prevention, treatment and rehabilitation of both physical and mental illness or diseases. In Thailand, (Bureau of Policies and Strategy, Permanent Secretary Offices, Ministry of Public Health, 2011) there are health services provided in public hospitals, private hospitals, and general clinics as follows:

1. Public hospitals

1.1 University hospitals and colleges of medicine

1.1.1 Hospitals and medical centers in universities that do not produce physicians

1.2 Hospitals with medical education at clinical level

1.3 Central hospitals

1.4 Regional hospitals

1.4.1 Public health centers

1.4.2 General hospitals

1.4.3 Crown Prince hospitals

1.4.4 Community hospitals

1.4.5 Tambon health promotion hospitals

1.5 Specialized hospitals

1.6 Hospitals under other organizations

1.6.1 Red Cross

1.6.2 Medical Office, Bangkok Metropolitan Administration

1.6.3 Army Medical Department, Ministry of Defense

1.6.4 Naval Medical Department, Ministry of Defense

1.6.5 Air Force Medical Department, Ministry of Defense

1.6.6 Medical Office, Royal Thai Police

1.6.7 State Railway of Thailand

1.6.8 Port Authority of Thailand

1.6.9 Metropolitan Electricity Authority

1.6.10 Ministry of Finance

1.6.11 Ministry of Justice

2. Private hospitals

2.1 Private hospitals in Bangkok and its perimeters

2.2 Regional private hospitals

2.1.1 Hospitals and Medical Establishments with beds

Total number of Hospitals and Medical Establishments with beds in Thailand was 1,348 classified as public sector 1,027 representing 76%. The Total Number of Public beds was 146,994 representing 79% and classified as private sector 321 representing 24% The Total Number of Private beds was 30,687 representing 21% (Bureau of Policies and Strategy, Permanent Secretary Offices, Ministry of Public Health, 2011) as follow in Figure 2.1-2.2.

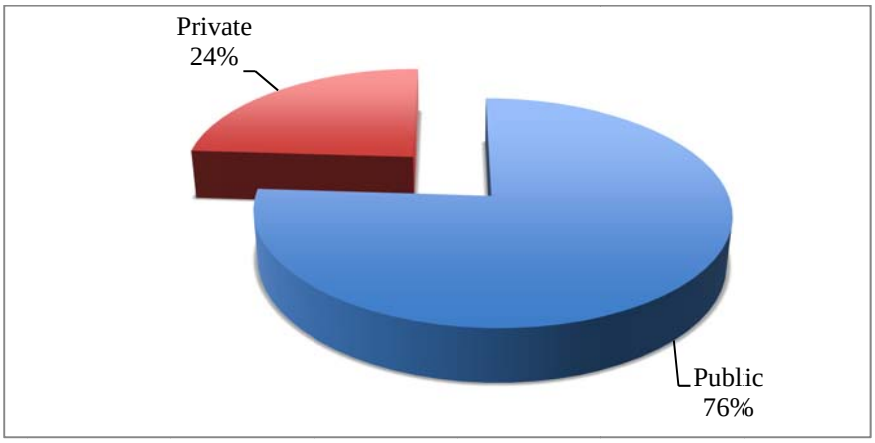

Figure 2.1 Hospitals and Medical Establishments with beds, Public and Private, 2011

Source: Bureau of Policies and Strategy, Permanent Secretary Offices, Ministry of Public Health, 2011

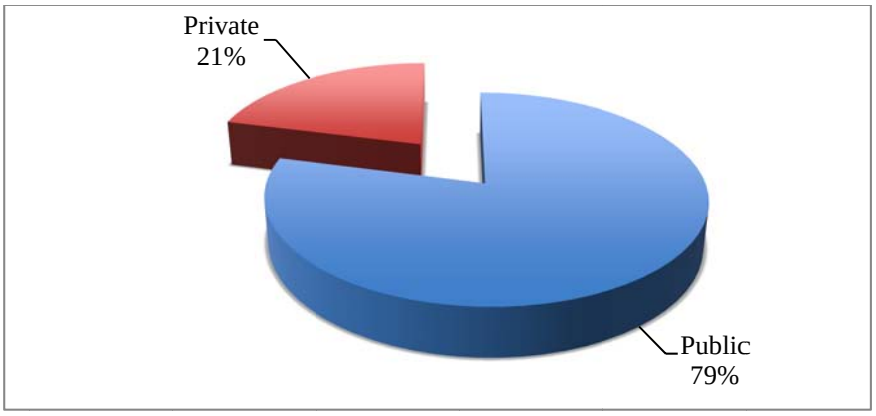

Figure 2.2 Number of beds in hospitals and Medical Establishments, Public and Private, 2011

Source: Bureau of Policies and Strategy, Permanent Secretary Offices, Ministry of Public Health, 2011

Table 2.1 Number of hospitals and Medical Establishments with beds in Thailand, 2011

		Ministry of Public health	Other Ministries	State enterprises	Independent Organizations	Local Government	Private	Total
Whole Country	Total count	912	90	2	11	12	321	1,348
	Number of beds	93,487	14,630	170	2,584	2,628	30,583	144,082

Source: Bureau of Policies and Strategy, Permanent Secretary Offices, Ministry of Public Health, 2011

Table 2.2 Number of Regional hospitals, General hospitals and Community hospitals beds in Thailand, 2011

		Regional Hospitals	General Hospitals	Community Hospitals	Total
Whole Country	**Total count**	28	68	719	815
	Number of beds	19,604	23,042	35,435	78,081

Source: Bureau of Policies and Strategy, Permanent Secretary Offices, Ministry of Public Health, 2011

This research uses community hospitals under the Ministry of Public Health in Thailand as a case study. Therefore, the following is general description of these community hospitals.

Community hospitals under the Ministry of Public Health in Thailand are small hospitals following the general hospitals (Padoongtod, 2006) with 10,30,60,90 and 120 patient bed. They are located in every Amphur (district) in Thailand. With being responsible for caring patients in every district, these community hospitals are very close to the middle- and low-class people who are the majority in Thailand. As a result, patients do not have to travel far to go to get service from other hospitals and have been taken care with ease and convenience. In addition, the burden of large hospitals can be reduced. Within these hospitals, there are medical staffs available to advise so

the people in the areas have taken care of thoroughly, including the levels of individuals, families and communities, with good quality. Currently, there are more than 700 community hospitals in Thailand, where relevant resources, including medical personnel and equipment, are effectively managed. Therefore, it can be said that these community hospitals can take care of people thoroughly.

2.1.2 Distribution of Community Hospitals under the Ministry of Public Health in Thailand.

In 2011, 262 community hospitals under the Ministry of Public Health in Thailand were located in the northeastern region, 35.99% of all community hospitals across the country, followed by 147 in the central region, 20.19%, 130 in southern region, 13.19%, 96 in northern region, 7.86, 55 in eastern region, 7.55%, and 38 in western region, 5.22%, as shown in the Figure 2.3:

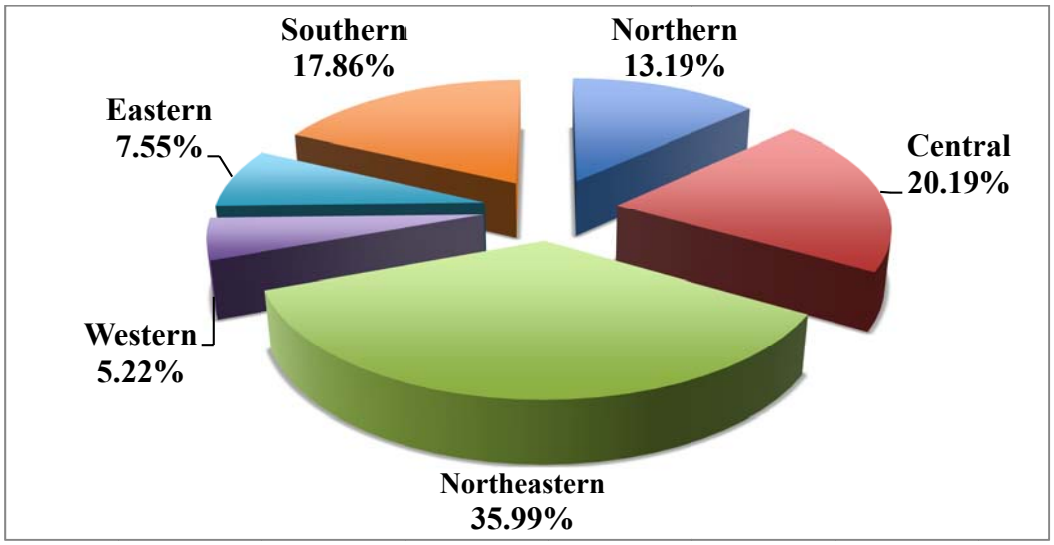

Figure 2.3 Number of Community Hospitals

Source: Geographical Health Resources Information System

This research does not include the central hospitals located in Bangkok and Bungkan, a province newly established in 2011. Therefore, 728 community hospitals under the Ministry of Public Health in Thailand are used as a case study here.

2.1.3 Number and Distribution of Beds in Community Hospitals under the Ministry of Public Health, Thailand.

There are various sizes of community hospitals under the Ministry of Public Health in Thailand. They can be classified by the number of beds as mentioned above. The number of beds can be classified in each region as shown in the following Tables 2.3-2.4:

Table 2.3 Number of Beds in Community Hospitals

	Number of beds			Total
	F3	F2	F1	
Northern	7	81	8	**96**
Central	17	107	23	**147**
Northeastern	9	206	47	**262**
Eastern	1	34	3	**38**
Western	2	42	11	**55**
Southern	14	107	9	**130**
Total	**50**	**577**	**101**	**728**

Source: Geographical Health Resources Information System

Table 2.4 Number of Beds in Community Hospitals (%)

	Number of beds (%)			Total (%)
	F3	F2	F3	
Northern	0.96	11.13	1.10	**13.19**
Central	2.34	14.70	3.16	**20.19**
Northeastern	1.24	28.30	6.46	**35.99**
Eastern	0.14	4.67	0.41	**5.22**
Western	0.27	5.77	1.51	**7.55**
Southern	1.92	14.70	1.24	**17.86**
Total (%)	**6.87**	**79.26**	**13.87**	**100**

Source: Geographical Health Resources Information System

According to the graph showing the number of beds in community hospitals, there are 50 hospitals with small community hospitals (F3) 0-29 beds, the largest number, representing 6.87%, followed meduim community hospitals (F3) by 577 hospitals with 30-89 beds of all community hospitals in Thailand, representing 79.26%, and followed large community hospitals (F1) 101 hospitals with 90-120 beds, representing 13.87%, The distribution of the number of beds can be classified as follows Figure 2.4.

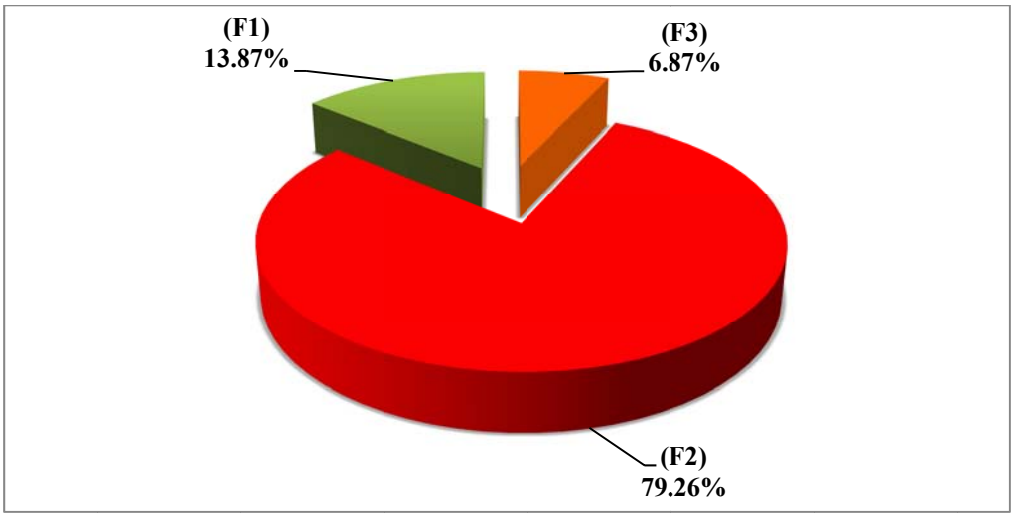

Figure 2.4 Number of Beds in Community Hospitals (%)
Source: Geographical Health Resources Information System

2.2 Financial Warning Indicators

Since community hospitals under the Ministry of Public Health are health organizations that need to provide services for many people in Thailand and that do not mainly expect profits from their services, they are willing to provide their best services for people. However, as health services or patient treatments are costly, the control of their receipts or payments may not be conducted as same as general industries or businesses. Profits are therefore the only thing that all managements of these community hospitals need it to be positive with no loss so that their hospitals can survive stably, ensuring their medical personnel's willpower and highest effectiveness of patient treatments. Thus, an analysis of financial conditions of community hospitals is important

by taking into account key financial indicators of these hospitals to make aware of the potential of these hospitals. These financial indicators or ratios of community hospitals can be seen from their previous financial statements.

Financial ratios are financial figures that can indicate the relationship of important items within a financial statement, such as assets, liabilities, incomes or expenses. These financial figures are made proportional and therefore called financial ratios. The study of (Sujiwattanarat and Pajongwong, 2010) found that these financial ratios could be classified into five groups as follows:

1. Liquidity ratios are used to measure the capability of paying a short-term debt, such as working capital, current ratio or quick ratio. Generally, the management or creditors use this type of ratios to evaluate the capability of a business in paying current liabilities.

2. Efficiency ratios are used to indicate the effectiveness of managing the assets of a business, such as account receivable turnover, inventory turnover, fixed asset turnover, and total asset turnover.

3. Leverage ratios are used to indicate the capability of creating a debt of a business, such as debt to asset ratio and debt to equity ratio. In this case, creditors will consider the business's performance.

4. Profitability ratios are used to measure the capability of creating a profit from asset investment and also to measure the capability of the management's performance, such as return on sales and return on total asset.

5. Market value ratios are related to a company's share price that can affect its profits. (This research does not use these ratios because community hospitals under the Ministry of Public Health in Thailand have no sales of their shares or registration in the stock market and therefore there are no these ratios shown in their financial statements)

According to (Kulsrivanarat's report, 2013) classified financial ratio for examining hospital's financial efficiency into these following groups, namely Liquidity ratio, Efficiency ratio, profitability ratio, The efficiency of cost management and Operational performance. Similarly, (Boonumpan, 2008) examined hospital's financial management efficiency and classified financial ratio into 4 groups, including Liquidity ratio, Efficiency ratio, profitability ratio and The efficiency of cost management.

Researches suggest that the efficiency of cost management is important for analysis of financial ratio. Thus, considering from the work of (Sujiwattanarat and Pajongwong, 2010), it can be seen that financial ratio appropriate for prediction of financial risk can be separated into 5 groups, namely Liquidity ratio, Efficiency ratio, profitability ratio, Leverage ratio and the efficiency of cost management.

Financial ratios are used to analysis and determine a number of conclusions in general businesses, industrial factories, and public and private organizations. According to a retrospect study, there are commonly used ratios as follow Table 2.5.

Table 2.5 Financial ratios are used in general businesses

Financial ratio	Gomez et al. 2004	Leksrisakul 2005	Chung et al. 2008	Nilsson 2008	Mukhopadhyay 2013	Lee 2014
Long Term Debt To Total Asset	✔	✔		✔	✔	✔
Short and Long Term Debt to Equity	✔	✔	✔	✔		✔
Short and Long Term Debt to Total Assets		✔	✔	✔		
Cash-Holdings to Total Assets	✔			✔		
Equity Share of Total Assets				✔		
Current ratio	✔	✔	✔	✔	✔	✔
Quick Ratio		✔	✔	✔		✔
Net working capital		✔	✔		✔	
Cash to Long and Short Term Debt			✔	✔		
Return on Equity		✔	✔	✔		✔
Return on Assets		✔	✔	✔	✔	✔
Net Profit Margin		✔	✔	✔		✔
Gross Profit Margin			✔	✔		✔
Operating Profit Margin	✔	✔	✔			✔
Cash Flow to Sales		✔		✔		
Cash Flow to Total Assets		✔		✔		

Table 2.5 Financial ratios are used in general businesses (Cont.)

Financial ratio	Gomez et al. 2004	Leksrisakul 2005	Chung et al. 2008	Nilsson 2008	Mukhopadhyay 2013	Lee 2014
Cash Flow to Long and Short term debt				✔		
Sales to Total Assets		✔		✔		
Fixed Asset turnover		✔				✔
Retained Earnings to Total Assets		✔		✔		
Financial Expenses to Sales				✔		
Accounts Receivable to Sales		✔	✔	✔		
Accounts Receivable to Total Assets				✔		
Inventory to sales			✔	✔		
Inventory turnover		✔	✔			
Equity turnover			✔			
Total Asset turnover			✔			

According to the Table 2.5 above, there are a number of generally used financial ratios based on each case study considered. Gomez et al. (2004) chose financial ratios to analyze a relationship to forecast the business in Spain and to achieve their objectives. Key financial ratios include current ratio, operating margin, and debt to total assets. Mukhopadhyay (2013) reported that he used current ratio, net working capital, debt to total asset, and return on asset to forecaste a bankruptcy of Indian companies. These ratios are widely used indices for all industries. Similarly, Lee (2014) concluded that good financial ratios can indicate a relationship among failed businesses. Leksrisakul (2005) and Chung et al. (2008) also suggested that financial ratios obtained from financial data of companies in a stock market can be used as good indicators using the Multiple Discriminant Analysis to forecast a company that may fail in the future. Moreover, Nilsson (2008) supported that financial ratios can help make a business forecast more accurate and correct. According to these previous studies, it can be seen that these financial ratios used in a business forecast are related to both shareholders

and returns for shareholders and are analyzed to mainly aim to the profitability. However, public hospitals have no shareholders and therefore are different from above studies.

This research considers only financial ratios used in the hospitals because other industries or businesses have different financial ratios. Even private hospitals with or without registration in the stock market have slightly different ratios from public hospitals. Since private hospitals sell their shares for further development, they manage their businesses to mainly aim to profitability. This does not mean that public hospitals that are mostly funded by the government do not need to seek a profit, rather they more focus on treating sick people. However, public hospitals still need a profit because in case of no profit, or loss, their improvement will be affected and eventually a lack of effectiveness can occur. Therefore, it is important to understand that financial ratios of community hospitals, which are largely budgeted by the government, are different from those used in private hospitals or in other businesses. Accordingly, there are a number of studies or financial reports of public hospitals in Thailand as shown in the Table 2.6:

Table 2.6 Financial ratios used in the hospitals

Financial ratio	Mick et al., 1994	Minnesota Department of Health 2001	Carpenter et al., 2003	Adams et al. 2006	Pink et al. 2006	Fass et al. 2008	Coyne 2008	Boonbunpan 2008	Das 2008	Holmes et al. 2013
Current Ratio	✔	✔		✔		✔		✔	✔	✔
Cash and Cash equivalence to Monitory debt Ratio		✔	✔	✔		✔	✔		✔	✔
Quick Ratio								✔	✔	
Net Working Capital								✔		
Net profit Margin (exclude depreciation and amortization)	✔			✔	✔	✔		✔	✔	✔
Operating profit Margin (exclude depreciation and amortization)	✔	✔	✔		✔	✔	✔		✔	✔
Return on asset										
Average Collection period for UC Account Receivables				✔		✔	✔	✔	✔	✔
Average Collection period for Non UC Account Receivables				✔		✔	✔	✔	✔	✔
Average Payment period for Medical Account Payables				✔		✔		✔	✔	✔
Average Payment Period for Total Account Payables				✔		✔		✔	✔	✔
Average Payment period for Account Payables on Refer Patients				✔		✔		✔	✔	✔

Table 2.6 Financial ratios used in the hospitals (Cont.)

Financial ratio	Mick et al., 1994	Minnesota Department of Health 2001	Carpenter et al., 2003	Adams et al. 2006	Pink et al. 2006	Fass et al. 2008	Coyne 2008	Boonbunpan 2008	Das 2008	Holmes et al. 2013
Long-term debt to capitalization				✔					✔	✔
Debt to total asset ratio									✔	
Fixed Asset Turnover				✔					✔	
Current Asset Turnover									✔	
Total Asset Turnover				✔					✔	
Total Cost per Day								✔		
Service Operating Cost per IPD R.W.								✔		
Service Operating Cost per OPD Visit								✔		
Total Cost per IPD R.W.								✔		
Total Cost per OPD R.W.								✔		
Salary per total expense								✔		

Table 2.6 Financial ratios used in the hospitals (Cont.)

Financial ratio	Draffin 2010	Grauman et al. 2010	Annual Report Ban Paew hospital 2011	Annual Report Loei Hospital 2011	Hahn et al. 2012	Annual report Nongbualumphu provincial public health 2012	Annual report Choomponburi hospital (Surin) 2012	Kulsrivanarat 2013	Richards 2014
Current Ratio	✔		✔	✔		✔	✔	✔	✔
Cash and Cash equivalence to Monitory debt Ratio	✔	✔		✔	✔	✔	✔	✔	✔
Quick Ratio			✔	✔		✔	✔	✔	
Net Working Capital							✔	✔	✔
Net profit Margin (exclude depreciation and amortization)				✔	✔	✔	✔	✔	✔
Operating profit Margin (exclude depreciation and amortization)	✔	✔			✔				✔
Return on asset			✔						
Average Collection period for UC Account Receivables		✔		✔	✔	✔	✔	✔	✔
Average Collection period for Non UC Account Receivables		✔		✔	✔			✔	✔
Average Payment Period for Total Account Payables	✔	✔			✔	✔	✔	✔	✔
Average Payment period for Account Payables on Refer Patients	✔	✔			✔			✔	✔

Table 2.6 Financial ratios used in the hospitals (Cont.)

Financial ratio	Draffin 2010	Grauman et al. 2010	Annual Report Ban Paew hospital 2011	Annual Report Loei Hospital 2011	Hahn et al. 2012	Annual report Nongbualumphu provincial public health 2012	Annual report Choomponburi hospital (Surin) 2012	Kulsrivanarat 2013	Richards 2014
Long-term debt to capitalization		✔			✔				✔
Debt to total asset ratio			✔						
Fixed Asset Turnover			✔						✔
Current Asset Turnover									✔
Total Asset Turnover			✔						✔
Total Cost per Day								✔	
Service Operating Cost per IPD R.W.								✔	
Service Operating Cost per OPD Visit								✔	
Total Cost per IPD R.W.						✔		✔	
Total Cost per OPD R.W.						✔		✔	
Salary per total expense									

According to the Table 2.6 above, some financial ratios of public hospitals are different from those of other businesses as mentioned above. In addition, there are ratios relating to the hospital's costs that are used to measure the management's effectiveness of managing their costs, such as service operating cost and total cost (Annual Report: Nongbualumphu provincial public health, 2012; Boonbunpan, 2008; and Kulsrivanarat, 2013). Moreover, a study by Boonbunpan (2008) used salary per total expense for analysis because this ratio is used to estimate the personnel expense of a hospital, which is a fixed cost and main expense of the hospital. She compared all operating expenses and indicated the personnel expenses using current ratio, quick ratio, networking capital, net profit margin operating profit margin, return on asset, and fixed asset turnover. Most studies (Mick et al., 1994; Minnesota Department of Health, 2001; Carpenter, 2003; Draffin, 2010; and Grauman et al., 2010) used these financial ratios because they are basic ratios that all businesses or hospitals need to use for their financial analysis. Financial ratios used to measure the effectiveness of best asset management were presented in (The annual report Ban Paew hospital, 2011; Adams et al., 2006; and Das, 2008). (Hahn et al., 2012; Richards, 2014; Kulsrivanarat; 2013; and Annual report Choomponburi hospital Surin, 2012) suggested that average collection period for UC account receivables and average collection period for non UC account receivables are ratios used to measure the capability of collecting and changing a debt into cash, which can help forecast a financial risk of a hospital.

Table 2.7 The similarity of financial ratio between general businesses and hospital

Hospital	General businesses
Current ratio	Current ratio
Cash and Cash equivalence to Monitory debt Ratio	Cash to Long and Short Term Debt
Quick Ratio	Quick Ratio
Net Working Capital	Net working capital
Net profit Margin (exclude depreciation and amortization)	Net Profit Margin
Operating profit Margin (exclude depreciation and amortization)	Operating Profit Margin
Return on asset	Return on Assets
Long-term debt to capitalization	Long Term Debt To Total Asset
Debt to total asset ratio	Short and Long Term Debt to Total Assets
Fixed Asset Turnover	Fixed Asset turnover
Total Asset Turnover	Total Asset Turnover

Table 2.8 The difference of financial ratio between general businesses and hospital

Hospital	General businesses
Average Collection period for UC Account Receivables	Short and Long Term Debt to Equity
Average Collection period for Non UC Account Receivables	Short and Long Term Debt to Total Assets
Average Payment period for Medical Account Payables	Cash-Holdings to Total Assets
Average Payment Period for Total Account Payables	Equity Share of Total Assets (Solvency)
Average Payment period for Account Payables on Refer Patients	Return on Equity
Current Asset Turnover	Gross Profit Margin
Total Cost per Day	Cash Flow to Sales
Service Operating Cost per IPD R.W.	Cash Flow to Total Assets
Service Operating Cost per OPD Visit	Cash Flow to Long and Short term debt
Total Cost per IPD R.W.	Sales to Total Assets
Total Cost per OPD R.W.	Retained Earnings to Total Assets
Salary per total expense	Financial Expenses to Sales

Table 2.8 The difference of financial ratio between general businesses and hospital (Cont.)

Hospital	General businesses
	Accounts Receivable to Sales
	Accounts Receivable to Total Assets
	Inventory to sales
	Inventory turnover
	Equity turnover

However, when comparing between the financial ratios used in general businesses and those used in hospitals, it can be found that similar financial ratios as shown in the following Table 2.7 include current ratio, Cash and Cash equivalence to Monitory debt Ratio, quick ratio, network capital, net profit margin, operating profit margin, return on asset, fixed asset turnover, Total Asset Turnover, Long-term debt to capitalization, and debt to total asset ratio, while different financial ratios or ratios in addition to those used in general businesses include short and long term debt to equity, short and long term debt to total assets, short and long term debt to total assets, return on equity, equity share of total assets, gross profit margin, cash flow to sales, cash flow to total assets, cash flow to long and short term debt, sales to total assets, retained earnings to total assets, financial expenses to sales, accounts receivable to sales, accounts receivable to total assets, inventory to sales, inventory to sales and inventory to sales.

Meanwhile, financial ratios used in hospital from previous research and diverge in general businesses but these ratios have a same important indicators for help forecast a financial risk of a hospital as shown in the following Table 2.8 include average collection period for UC account receivables, average collection period for non UC account receivables, average payment period for medical account payables, average payment period for total account payables, average payment period for account payables on refer patients, current asset turnover, total asset turnover, total cost per day, service operating cost per IPD R.W., service operating cost per OPD visit, total cost per IPD R.W., total cost per OPD R.W and salary per total expense. Therefore, it can be concluded that there are nineteen financial ratios used to forecast a risk of

community hospitals under the Ministry of Public Health in Thailand and that the definitions and formula of these ratios are as follow in chapter 3.

2.3 Financial warning models.

The research shows that the failure of a business can be divided into two categories, i.e. economic failure and financial failure, which have the following meanings:

Economic failure means an event that the return on the investment, including the risk premium, is lower than the return on the investment that should be received or than the return on the investment in a similar business or that the income of the business cannot cover all the costs. (Narungsri, 2005)

Financial failure means a failure caused by an inability of the business to perform a payment contract to its creditors, which may be divided into two categories. Firstly, liquidity, or technical insolvency, is a failure caused by an inability of the business to pay current liabilities when due, although the value of all assets of the business is more than all liabilities. In other words, it indicates the positive net worth of the business but its liquidity is insufficient to repay the current liabilities. Second, insolvency in bankruptcy means that the book value of all liabilities of the business is more than the over the value of asset market. This condition is considered severe and is a sign of economic failure, which can lead to the liquidation or bankruptcy according to the bankruptcy law. (Narungsri, 2005)

Financial failure is often initially caused by an inability to repay the liabilities on time as scheduled or when the expected cash flow is insufficient to repay the debt and the company cannot fix it in time. There are two important causes of financial failure of the business, i.e. internal causes, including lack of good administration, ignorance and corruption, and external causes, including economic conditions such as recession, inflation, conditions of money market, such as lack of credit or shortage of funds, etc.

Forecasting a business failure has become popular after the economic problems throughout the world. This has made many businesses or organizations getting lost and closing. To avoid any risk that might occur, there is a lot of research using various methods and models as a tool to help send prior warning signals. This may

help reduce the financial risk or effect as well as guide the decisions by the executives. Therefore, the study of forecasting a business failure is important and necessary.

Approaches to forecast a business failure as a financial warning sign are based on a model developed to predict by means of statistical methods. The models used for this forecast have been developed and improved from the sample group over time to keep pace with changes in the current situations. Popular models include multiple discriminant analysis, artificial neural network, Multinomial logistic regression, hazard model, and Altman Z score. (Zhang et al., 1999) (Ahmadi et al., 2012) (Cole and Wu, 2009) (Yap et al, 2010) (Altman, 2000).

2.3.1 Altman Z Score

Research relating to the models for financial warning found that these models have been continuously developed and improved. The most popular model used in various industries is the model of Altman, which was invented in 1968. Li (2012) has been improved and compared to many other research to test its efficiency in predicting the bankruptcy of different enterprises.

This model has been very popular in the prediction of business failure, although it has been developed and improved, and compared with other methods. It can be found that the theory of Altman is able to forecast the financial failure of up to three years in advance (Anjum, 2012). The research in predicting business failures in Pakistan found that this model could also predict three years in advance. Lifschutz and Jacobi (2010) conducted a research on the financial warning signal in Israel regarding predicting the bankruptcy from 2000 to 2007 by means of the financial warning model of Altman. The results showed that the model can predict bankruptcy at 95% in the first year and 85% in the second year, which has a very high accuracy. However, there are some limitations, i.e. the sample companies used as a case study are not as many as should it be, as well as they come from the U.S. where their financial basis is already good. In Ghana, the research improved the model of Altman in order to forecast the stock market and found that the model could predict correctly in some companies and incorrectly in many companies. However, it shows that this model is not applicable to some companies in Ghana (Appiah, 2011). At the same time, research on the aviation industry of India used this model to predict the companies in the aviation industry that

were likely to get bankruptcy and showed that the model can provide the reliable results as a good financial warning sign (Kumari and Chaudhry, 2012). Also, Meeampol et al. (2014) suggests that the model of Altman can be used to well predict a bankruptcy of companies in the Stock Exchange of Thailand. However, there are some studies that do not support the model of Altman. For example, Muminovic (2013) tested the model of Altman with cosmetic companies in the Stock Exchange of Serbia and found that the results obtained were not good as it should be. In addition, the research conducted on this country could not perform a prediction. Moreover, Lui (2002) found that there were many limitations of this model that was not stable when it was used to to test the bankruptcy among telecommunications companies. This research is also advisable to try to use other techniques, such as multiple discriminant analysis (MDA) or logistic regression. This is consistent with the research of Pang and Kogel (2013), who found that the model of Altman could predict the bankruptcy poorly and it was compared with the MDA technique, which provides better prediction.

However, the method of data analysis is of interest to investors and executives because most tools used in the financial analysis are too complex and requires many factors. Although there are many arguments in research on financial warning signals, the author performed a retrospective study to see if there were other techniques to predict the bankruptcy of the business and found that there are many techniques used in the research. One of them found is the multiple discriminant analysis.

2.3.2 Multiple Discriminant Analysis (MDA)

This method has been widely used. Previously, a method used to separate the bankrupt and not-bankrupt businesses away from each other was done by setting an assumption which factors have a linear correlation and lead to a business failure. However, with many limitations, such as financial factors are interrelated, it was impossible to separate failed businesses out of not-failed businesses. Subsequently, there was a development that led to the analysis of the common factors in predicting business bankruptcy. This scheme is based on the regression analysis of the linear relationship and the dependent variable acts as the group variable and the independent variable acts as the quantitative variable, such as bankruptcy or non-bankruptcy of the business and businesses belonging to the same or similar groups (Narungsri, 2005).

MDA was first used for forecasting in the late 1960s as a way of discriminating between two groups. Initially, it was found to be less significantl. However, it was developed and much improved. Now, it is one of the statistical methods that is most frequently used in predicting the financial signal with or without a failure of the business (Goentoro, 1997). In Malaysia, there is a report (Yap el al., 2010) on the use of MDA as a tool for forecasting a business bankruptcy in 64 companies based on use 16 factors of financial ratios. It was found that the accuracy of prediction was in the range of 88-94% in five years prior to failure. Also, MDA is seen as a statistical tool to predict accurately and reliably. Pervan et al. (2011) support that MDA can be used to predict the failure of a business actually and correctly. Based on a sample of 156 companies, it was found that this tool can analyze and predict the results of 78 companies with possible bankruptcy at an accuracy of 79.5%. Nilson (2008) opines in the same direction. It was found that MDA could forecast the companies with possible bankruptcy at 82.8%, 78.1%, and 75.4% in the three years prior to the failure based on a sample of 6,154 firms. In the Stock Exchange of Taiwan, MDA was used to analyze a business failure using financial data from 2003 to 2009 of 128 companies listed on the stock exchange and it was found that the model can forecast the companies with financial risk at 87.93%, which was considered at a relatively high level of accuracy. However, according to the previous research, it was found that many studies support MDA on the analysis and forecast of businesses with financial risk. For example, MDA was used to predict the companies with financial risk in the Stock Market of the Netherlands (Mous, 2005), MDA was used to forecast the banks in Nigeria (Uchennal and Okelue, 2012), MDA was used to predict the industrial groups in India, (Mukhopadhyay et al., 2013), MDA was used to predict financial risk in the small industrial groups in Hungary (Szeverin and Laszlo, 2014), and MDA was used to predict the risk of insolvency in the banking industry in the U.S. (Serrano Cinca and Gutierrez nieto, 2011).

According to a retrospective study on the tools used in forecasting business failure, it was found that some studies demonstrated that there is a tool with a higher accuracy than MDA, i.e. Multinomial Logistic Regression (MLR). Pervan et al. (2011) studied past financial data for 156 companies in Croatia using 15 analysis factors of financial ratios based on two tools, including multiple discriminant analysis and logistic regression, in order to compare which tool is more accurate. The study indicated that

MDA is accurate in predicting at 79.5% while MLR is at 85.9%, which is more accurate compared to MDA. However, the report does not show which tool provides better prediction, but it just shows that the accuracy is higher. Therefore, the following is a study of Multinomial logistic regression (MLR).

2.3.3 Multinomial Logistic Regression (MLR)

Multinomial Logistic regression (MLR) is used to predict a business risk and is one of popular techniques used to analyze the factors of financial risk to predict business failure. (Hassani and Parsadmehr, 2012) used a sample of 141 companies in the Stock Exchange of Iran based on the data in 2002-2009 data and found that this technique can predict the business risk reasonably well. Likewise, Jouzbarkand et al. (2013) used MLR in predicting business failure for a sample of 60 companies in the Stock Exchange of Iran using financial information in 2003-2011 and found that it can predict business risk. A Romanian research Daniel and Lonut (2013) proposed a use of MLR based on a sampling group of 4,327 companies and found that this tool can predict the business failure at an accuracy of 70.35% for up to 5 years prior to the failure. In the U.S., Bredart (2013) used MLR in predicting the business bankruptcy using 870 companies in its Stock Exchange based on the financial data from 2000-2012 and found that this model can provide the results at 83.82%, which is relatively accurate. They also suggested that the model used in forecasting business failure was still limited in some aspects, such as the model cannot be applied to all environments. MLR technique can be compared with other techniques for more precision. The research in Turkey (Erdogan, 2008) also opined in the same direction in which LR was used to predict business failure based on 42 banks and 20 factors of financial ratios. It was found that the accuracy was as high as 95%. In Malaysia, Bakar (2013) reported that MLR technique showed the accuracy in predicting failure at 100%, which is very high.

2.3.4 Artificial Neural Network (ANN)

However, Hao wena et al. (2012) compared LR to other techniques. One of the interesting techniques is Artificial Neural Network (ANN). Once compared to LR, ANN provides a slightly higher accuracy of forecasting. They also suggested that the performance of both models was equal, depending on factors and applications in

each case. Therefore, the following is a study of Artificial Neural Network (ANN), which has agreed to Turkan et al. (2011) and Schafer ll and Barkan (2008).

2.3.5 Factor Analysis

There is also another interesting technique, factor analysis, a technique for grouping or combining variables that are correlated in the same group. It can help reduce the number of variables. Variables in the same group are more relevant with each other, whether in the positive or negative direction, while different groups of variables are not correlated or have only a few correlation. A research in Turkey Erdogan (2008) used this technique to separate extract the financial ratios. Factors that are related are grouped together that can help solve many problems regarding variables as well as help disclose what common factors are. Likewise, Ludvigson and Ng (2007) used this method in combining many risk factors in the Stock Exchange and found that the variables that are related could be arranged in the same group, which then can be analyzed more easily and efficiently. Factor analysis is thus an interesting tool because it can be used to group financial factors that are related each other into the same group for ease of analysis.

2.3.6 Comparison of three models

Multinomial Logistic Regression (MLR) is a model that uses a statistical analysis in the form of probability of relevant events based on appropriate functions. It chooses suitable variables to make the correct and highest percentage of forecast. Its application and efficiency of forecast is similar to those of Multiple Discriminant Analysis, a method used to classify various variables. Both models weight the independent variables to determine the Z-score. Multinomial Logistic Regression depended on the probability, while Multiple Discriminant Analysis uses the coefficient. Artificial Neuron Network learns the data by adjusting the weight of each node to determine the lowest error, but it can be better used than other models if the data are not linear. Multinomial Logistic Regression has the crossing point of 0.5, while Multiple Discriminant Analysis has many phases of crossing points, which cannot be clearly defined (Khermkhun, 2013) as shown in the Table 2.9:

Table 2.9 Comparison of models used to forecast a financial failure

Principle	**Multinomial Logistic Regression**	**Multiple Discriminant Analysis**	**Artificial Neuron Network**
B value	Probability	Coefficient	Weight
Crossing point of grouping	< 0.05 is in failure group	> 1.11 will result in a failure	Crossing point is unknown and model will group by weights
	> 0.05 is in failure group	1.1 – 2.6 is suspect of high chance of a failure < 2.6 will not result in a failure	

Source: Khermkhun, 2013

2.3.7 Advantages and limitations of tools used to forecast a financial failure

Tools used to forecast a financial failure have different pros and cons depending on the application for analysis (Khermkhun, 2013). Multinomial Logistic Regression (MLR) depends on the probability and may be more difficult to interpret than the coefficient. Its advantage is that it can select the forecasting factors by taking into account the relationship of variables. Multiple Discriminant Analysis (MDA) is suitable for the classification of many variables by determining whether the means of each group of independent variables are equal. Statistical significance is tested to determine the distance between the means of classification scores in each group. The test can explain which classification by what variables can result in an effective forecast of a financial failure. Artificial Neuron Network works like a human brain by weighting the data, learning and remembering the features to indicate what variables in which groups. The advantage of this technique is that when the model has found the data that it used to remember or learn, it can forecast accurately, which is different from other models that only remember and cannot process when finding different data. The limitation of this model is that firstly it needs to be examined to ensure the data for analysis have

no multicollinearity and heteroscedasticity, otherwise the model will learn incorrectly and therefore there may be mistakes in its application as shown in the Table 2.10:

Table 2.10 Comparison of advantages and limitations of tools used to forecast a financial failure

Tool	Advantage	Limitation
Multinomial Logistic Regression	1. Easy to understand 2. Good forecast result in case of linear correlation	1. Only for linear functions 2. Explanation of variables in terms of probability
Multiple Discriminant Analysis	1. Good explanation of many groups of many variables 2. Good forecast result in case of linear correlation	1. Only for linear functions
Artificial Neural Network	1. High flexibility 2. For non-linear variables 3. Data learning and diverse applications 4. For highly complicated data	1. Poor explanation of correlation of variables as simple functions 2. Definite variables must be known before application 3. Complication and multi-step evaluation 4. No clear principle in defining the structure

Source: Khermkhun, 2013

Due to the economic crisis in recent years, businesses in many industries have had the financial liquidity and therefore experienced a long-term loss. One of the important industries is the health industry, which may be classified in the service industy. Hospital is a very large unit in the service industry and provides health services to patients, which mainly relies on medical staff to advise, care and support patients. There are hospitals under the Ministry of Health and private hospitals. Various operations in a hospital are required to be disclosed as its performance. There are many types of

performance as a qualitative indicator of a hospital, and financial performance is an important and widely used indicator. This research only focuses on the community hospitals under the Ministry of Public Health in Thailand. We cannot deny that community hospitals are also experiencing an accumulative loss caused by both external and internal factors and their rehabilitation will take a long time. Therefore, the tools used to forecast the financial risk are so important. In Thailand, the tools used to forecast the financial warning signs among various businesses have been much researched, such as a prediction of financial failure of small and medium-sized enterprises in Thailand (Narungsri, 2005), tools for forecasting the financial failure (Khermkun, 2013), a forecast of business failure from the financial information of the companies in the Stock Exchange of Thailand (Leehaavas and Padhoongsit, 2009), an application of the tools in predicting the failure of the companies (Pannarong, 2010), and a model for predicting the repayment ability of savings and credit cooperatives (Chammuangpad, 2011). However, there are no studies regarding a prediction of failure in community hospitals under the Ministry of Public Health in Thailand, which is vital to the health industry system of Thailand.

Forecasting the failure of community hospitals under the Ministry of Public Health in Thailand is done by using a model of financial warning and the financial data in the form of financial ratios, which can show the previous performance and therefore lead to the prediction of failure. Although past studies have not concluded the best method of forecast, the researcher believes that the appropriate method can be known via a process of thinking, analysis and comparison. Accordingly, the research wishes to perform a test by means of multiple discriminant analysis (MDA) and Multinomial Logistic regression (MLR) because they are most commonly used methods in predicting the failure of a business.

2.3.8 Method

2.3.8.1 Method of Multiple Discriminant Analysis

Multiple discriminant analysis (Kaiyawan, 2012) is a tool used to predict or classify people, organizations, or others into groups or cases. Multiple discriminant analysis is therefore the allocation or classification of cases with interval-level data that one wants to predict or classify into one of the groups of pre-defined

dependent variable. The analysis is called discriminant analysis (DA) when there are two groups of dependent variable and is called multiple discriminant analysis when there are more than two groups of dependent variable. This technique is to find one type of relationship when there are at least 1 quantitative variables and one dependent variable (y). The analysis is similar to regression analysis, except the dependent variable of multiple discriminant analysis is categorical variable while the dependent variable of regression analysis is quantitative variable.

1. Rules of Multiple Discriminant Analysis (Kaiyawan, 2012)

1.1 Combination of independent variables is linear combination.

1.2 The correlation between independent variables can be examined from correlation matrix.

1.3 Sample must come from normal population distribution.

1.4 Within-group variances are equal or close to each other.

1.5 Independent variables are quantitative variables measured on interval scale and dependent variable might have 2 groups or more.

1.6 In this research, there are more than two criterion variables as follows:

Level 1 ➔ Save Zone
Level 2 ➔ Save Zone
Level 3 ➔ Save Zone
Level 4 ➔ Save Zone
Level 5 ➔ Save Zone
Level 6 ➔ Distress Zone
Level 7 ➔ Distress Zone

2. Results from Multiple Discriminant Analysis (Kaiyawan, 2012)

2.1 To create discriminant function, which is a linear combination of variables. The discriminant equation is then used to estimate the discriminant score (y).

The function of discriminator is in the form of linear as below:

$$Y_k = a + b_1X_1 + b_2X_2 + b_3X_3 + \ldots + b_pX_p$$

Where
- Y = dependent variable or discriminant score
- a = intercept
- b_i = Discriminator Coefficient
- X_i = Discriminator Variable
- i = $1, 2, \ldots, p$
- P = Number of variables of groups
- K = Number of groups

The coefficient b in discriminant function is similar to the coefficient b in regression analysis. It is the coefficient that maximizes the differences between the group means. (Kaiyawan, 2012)

2.2 To examine the differences between groups if there is any statistical significance.

2.3 To find out which independent variables affect differences between groups the most.

3. Variables of Multiple discriminant Analysis (Kaiyawan, 2012)

3.1 Independent variables are quantitative variables measured on interval scale.

3.2 Dependent variable is a categorical variable, which can be divided into two or more groups. However, too many groups will result in error and the lack of clarity.

2.3.8.2 Method of Multinomial Logistic Regression

Multinomial Logistic Regression is a statistical technique used for predicting the outcome of dependent variable based on independent variables. There are two models of logistic regression: 1.Binary logistic regression model and 2. Multinomial Logistic Regression Model. The dependent variable of binary logistic regression model is a dichotomy (Dichotomous Variable) and the dependent variable of multinomial logistic regression model is Polytomy (Polytomous Variable). In this study, we used multinomial logistic regression model as a tool to predict financial failure of community hospitals under the Ministry of Public Health, Thailand. The independent and dependent variables were identified as shown below have been derived from previous research. (Kaiyawan, 2012)

1. Objectives of Multinomial Logistic Regression (Kaiyawan, 2012)

1.1 To find out which variables can be used to predict the odds of an outcome occurring of dependent variable and to examine the relationship between predictor variables.

1.2 To predict the odds of outcome occurring from a proper equation by selecting variable that maximizes the percentage of prediction accuracy.

2. Rules of Multinomial Logistic Regression (Kaiyawan, 2012)

2.1 Independent variables or predictor variables are variables with interval scale data, while dependent variable is defined by groups of variable.

2.2 The average deviation is zero, i.e. e = 0.

2.3 There must not be high correlation between independent variables (multicollinearity).

2.4 In this research, there are more than two criterion variables as follows:

Level 1 ➔ Save Zone

Level 2 ➔ Save Zone

Level 3 ➔ Save Zone

Level 4 ➔ Save Zone

Level 5 ➔ Save Zone

Level 6 ➔ Distress Zone

Level 7 ➔ Distress Zone

There are seven levels of variables and the baseline group (category) is K. When comparing to Group I, the following Multinomial Logistic Regression model is obtained: (Kaiyawan, 2012)

$$\text{Log}\left(\frac{p(member\ i)}{p(member\ k)}\right) = b_{i0} + b_{i1}x_1 + \ldots + b_{ip}x_p$$

Coefficients b_{i0} , b_{i1} , b_{i2} , … , b_{ip} of Group I and baseline group (category) will be $0 = {}_pb = ... = {}_1b = {}_0b$. Analysis provides the following results:

If there are four dependent variables (y), or K = 7, three sets of coefficients will be obtained from K-1, but there are four coefficients in baseline group (category) according to dependent variables (y) in the following three sets: (Kaiyawan, 2012)

Set 1 indicates the coefficient of y = 1 comparing to y = 7

Set 2 indicates the coefficient of y = 2 comparing to y = 7

Set 3 indicates the coefficient of y = 3 comparing to y = 7

Set 4 indicates the coefficient of y = 4 comparing to y = 7

Set 5 indicates the coefficient of y = 5 comparing to y = 7

Set 6 indicates the coefficient of y = 6 comparing to y = 7

Set 7 indicates the coefficient of y = 0 comparing to y = 7

2.4 Summary

According to reports, in the past there were so many techniques that used to predict the risk of financial, which some of them are benefit and disadvantage tools that used in prediction. However, in analyze progress, some of them used different inclusion and variable to analyze the information this also cause the differences in a result.

Therefore, steps of set inclusion and variables in the study was very important because if this step is error or misconception it would lead to cause error in the analyze process and next chapter will be discuss about the progress of research.

CHAPTER III
RESEARCH METHODOLOGY

In this chapter, research methodology consists of 7 steps for this research as shown in Figure 3.1:

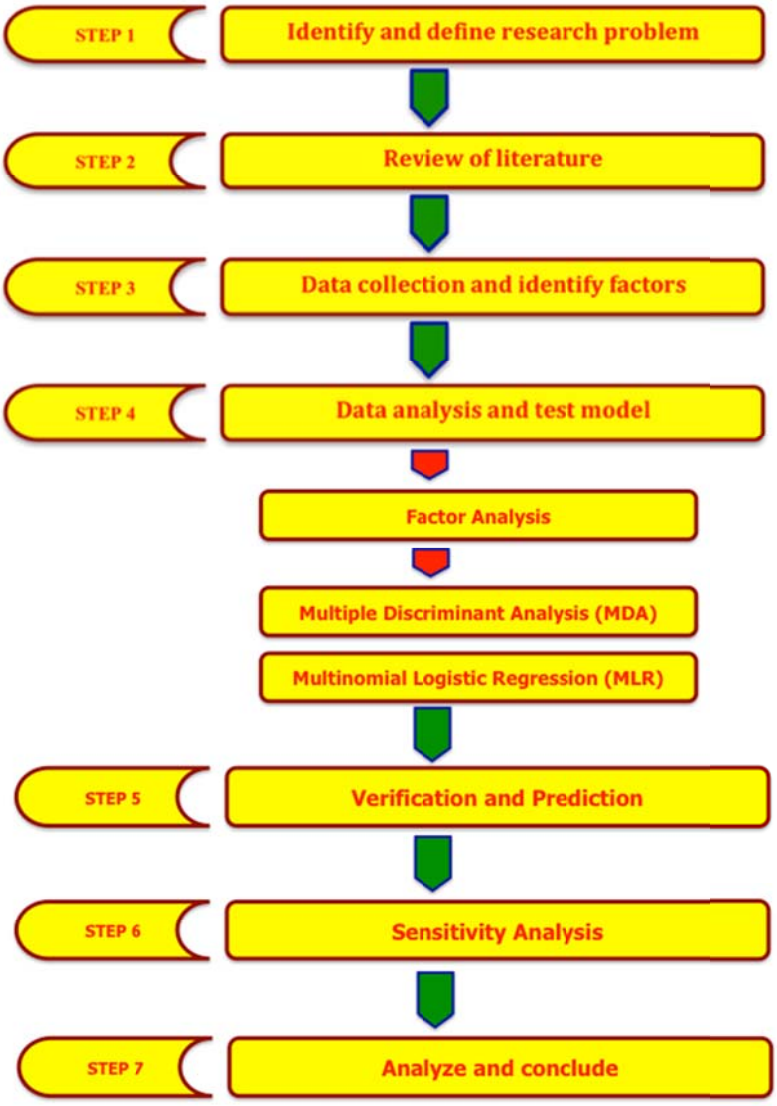

Figure 3.1 Steps of research methodology

3.1 Research Methodology

The research methodology selected for this research is a secondary research methodology using existing quantitative data. Data will be collected from various databases, formatted appropriately, and then analyzed using appropriate statistical techniques. This is a common approach in econometric research because similar studies require data that is too extensive for the researcher to collect. Instead, standard databases are consulted in order to determine what raw data should be used, and data can be combined from several databases in order to provide an appropriate set of variables. This approach means that it is possible for the researcher to conduct a much more thorough and wide-ranging study than would otherwise be applicable. The main concerns with this approach are that the researcher must take care to select the data and variables appropriately, since otherwise the findings may be inaccurate or inappropriately skewed.

In this research, methodology consists of 6 steps to answer the objectives. They can be explained as follow in Figure 3.1.

3.1.1 Identify and define research problem.

Research problem is a crucial part of this research. Therefore, we give priority to identify problems as mentioned in chapter 1. The problem can be separated into 3 major groups, including Economy deteriorate problem, Problem of Universal Health Coverage scheme and The problems of AEC readiness. The economy deteriorate problem consists of unemployment, outdated medical equipment, relocation and shortage of medical personnel Universal Health Coverage scheme problem consists of the quality of treatment problem. Lastly AEC of readiness problem consists of operating costs and alien workers. All of the problems have evaluated the financial distress for community hospitals. Therefor, it is considerate to evaluate a financial distress model (FDM) to classify each hospital's financial performance.

3.1.2 Review of literature

The success of this research relies on various factors. One among them is review of previous studies regarding financial failure prediction, for example, community hospital context, selection of financial ratio, and financial failure prediction theory.

Researches conducted on industries, businesses and hospitals were reviewed, leading to the use of financial ratio for prediction. Theories from previous studies were applied for prediction. The review of literature regarding the financial warning indicators has shown in Chapter 2.

3.1.3 Data collection and identify factors

3.1.3.1 Data collection

Data used in this research are obtained from 719 community hospitals under the Ministry of Public Health in Thailand, which are shown in their 2011-2015 financial statements submitted to the Ministry of Public Health in Thailand. The number of these community hospitals located in each region can be classified as follows Table 3.1:

Table 3.1 Number of Community Hospitals

Community hospital	Beds Size	Number of hospitals
Small community hospitals (F3)	Less than 30	65
Medium community hospitals (F2)	30-90	574
Large community hospitals (F1)	90-120	80
Total		719

Source: Geographical Health Resources Information System

In this research, data are used to forecast the financial risks of community hospitals under the Ministry of Public Health in Thailand by means of Factor Analysis in order to group the relations of variables. These data are then analyzed by Multiple Discriminant Analysis (MDA) and Multinomial Logistic Regression (MLR) based on their previous financial data, i.e. 2011 – 2015 financial statements. Each hospital must file a financial statement on an annual basis with the Ministry of Public Health Thailand Office of the Permanent Secretary (Health Insurance Group). The data used in this survey will include all hospitals for a period of five years

3.1.3.2 Identify factors

Financial ratios used in this research were determined from previous studies. We firstly examined researches on businesses to see what financial ratios were used for financial failure prediction. Furthermore, we reviewed researches on hospitals to see what financial ratios were used for analysis of hospital's financial efficiency. From the selection of appropriate financial ratios, it was found that there were 19 potential factors to be used for financial failure prediction as follow in Table 3.2:

Table 3.2 The definitions and fomular of Financial Ratios

Dimension		Financial Ratio	Meaning	Definition
Liquidity Ratio	X_1	**Net Working Capital**	A ratio used to measure how much reserved fund a hospital has. Having reserved fund is good but if it is too much it may indicate that such hospital cannot use its existing assets to produce highest income and effectiveness.	(Total current asset) – (Total current liability)
	X_2	**Cash and Cash equivalence to Monitory debt Ratio**	A ratio used to measure how rapid and appropriate a hospital is capable of paying current liabilities with its current assets.	$\frac{\text{(Cash and items equivalent to cash)}}{\text{(Debt to be paid by money)}}$
	X_3	**Quick Ratio**	A measure of capability of paying short-term debts because the calculation will include only the assets with high liquidity, i.e. cash or items equivalent to cash (current assets) without taking into account the remaining products.	$\frac{\text{(Cash and items equivalent to cash) +(net debtor) + (outstanding fund)}}{\text{(Current liability)}}$
	X_4	**Current Ratio**	An analysis of financial liquidity of a hospital to measure the capability of payment of short-term debts. It can be said that it current liabilities have been paid, it is whether the hospital has enough money to operate its business. The higher ratio means that such hospital has higher liquidity. Short-term creditors will highly see this ration because it indicates a chance of being repaid on due. In addition, this ratio can be used to compare between departments with different current assets and liabilities and to compare the liquidities of the hospital in each year.	$\frac{\text{(Net current asset)}}{\text{(Current liability)}}$

Table 3.2 The definitions and fomular of Financial Ratios (Cont.)

Dimension		Financial Ratio	Meaning	Definition
Profitability Ratio	X_5	**Net profit Margin (exclude depreciation and amortization)**	A ratio used to indicate the effectiveness of producing a net profit of a hospital (excluding depreciation and amortization)	(Income higher (lower)than net expense (excluding depreciation and amortization)) / (Including medical treatment expense and personnel budget) + (Income from UC – P&P Community-based)+ (Other P&P incomes) +(Supportive income from other organizations) + (Income from governmental and other budgets) +(Income from donations) + (Income from interests)+(Assets transferred from network (not uc money))+(Debts lost by payment criteria)+ (Income from exceeding medical treatment service charges) + (Refunded debts lost) + (Refunded income of UC fund in previous year) + (Other incomes, such as fees) + (Income from governmental budgets and contributions) + (Income from UC-CF)
	X_6	**Operating profit Margin (exclude depreciation and amortization)**	A ratio used to indicate the effectiveness of producing a net operating profit (loss) of a hospital (excluding depreciation and amortization)	(Income higher (lower)than operational and project expenses (excluding depreciation and amortization)) / (Including income from medical treatment service charges and personnel budget)
Leverage Ratio	X_7	**Debt to total asset ratio**	Ratio used to indicate the relationship between all total liabilities and all total assets. This ratio indicates that ratio of a hospital's capital in terms of all assets to its debts, which is used to measure its debt load.	(Total liabilities) / (Total assets)
Efficiency Ratio	X_8	**Average Collection period for Universal Coverage Account Receivables**	A ratio used to measure the capability of collecting the debts and sufficiency of medical treatment service charges under universal coverage.	Period (days) / (Income from net UC payments)/ (debtors of medical treatment service charges according to average net UC payments)

Table 3.2 The definitions and fomular of Financial Ratios (Cont.)

Dimension		Financial Ratio	Meaning	Definition
Efficiency Ratio	X_9	**Average Collection period for Non Universal Coverage Account Receivables**	A ratio used to measure how much a hospital has a capability of collecting the debts and an effort in changing its debtors into cash in order to produce more cash current.	(Period (days)) / (Non uc income from medical treatment service charges)- (non uc debts suspect of loss)– (non uc debts lost)/ (debtors of average net non-uc medical treatment service charges)
	X_{10}	**Average Payment period for Medical Account Payables**	A ratio used to indicate how long the circulation of remaining materials takes and to measure whether the level of remaining materials reserved by the hospital, such as medicines and non-medicine medical supplies, is too much or less as compared to the use. This can indicate the effectiveness of reserving the remaining materials.	(Period (days))x (Creditors of average expenses of medicines, medical supplies and materials) / (Values of all medicines, medical supplies and materials purchased in that time)
	X_{11}	**Average Payment Period for Total Account Payables**	A ratio used to measure the capability of paying all types of trading debts of a hospital.	(Period (days)x creditors of average trades) / (Values of all materials purchased in that time)
	X_{12}	**Average Payment period for Account Payables on Refer Patients**	A ratio used to measure the capability of paying the debts of medical treatment service charges of a hospital.	(Period (days)) x (creditors of medical treatment service charges according to average payments) / (Medical treatment service charges according to all payments in that time)
	X_{13}	**Fixed Asset Turnover**	A ratio used to measure the effectiveness of using permanent assets in a hospital's operations to produce highest income.	(Total operating revenue) / (Net fixed assets)
	X_{14}	**Total Asset Turnover**	A measure used to evaluate whether all assets of a hospital can produce income. It reflects the highest effectiveness of using the hospital's resources.	(Total income) –(Income from investment budget) – (Income from UC fund (investment budget)) / (Total asset – debts suspect of loss – uncollected debtors) / (number of months reported)

Table 3.2 The definitions and fomular of Financial Ratios (Cont.)

Dimension		Financial Ratio	Meaning	Definition
The efficiency of cost management	X_{15}	**Service Operating Cost per IPD R.W.**	A measure used to indicate the effectiveness of managing a hospital's operating costs against the services provided to its inpatients.	$\frac{\text{(Costs of medical treatment service charges)-(medical treatment service charges according to payments)}}{\text{(Sum AdjRW)+ \{(OPDvisit/16.10) x (SumAdjRW/IPDcase)\}}}$
	X_{16}	**Service Operating Cost per OPD Visit**	A measure used to indicate the effectiveness of managing a hospital's operating costs against the services provided to its outpatients.	$\frac{\text{(Service Operating Cost (IPDRW) x (SumAdjRW/IPDcase))}}{\text{(16.10)}}$
	X_{17}	**Total Cost per IPD R.W.**	A measure used to indicate the effectiveness of managing a hospital's costs against the services provided to its inpatients.	$\frac{\text{(Costs of medical treatment service charges)+(Depreciation)(medical treatment service charges according to payments)}}{\text{(Sum AdjRW)+ \{(OPDvisit/16.10) x (SumAdjRW/IPDcase)}}$
	X_{18}	**Total Cost per OPD R.W.**	A measure used to indicate the effectiveness of managing a hospital's costs against the services provided to its outpatients.	$\frac{\text{(Total Unit Cost (IPDRW) x (SumAdjRW/IPDcase))}}{\text{(16.10)}}$
	X_{19}	**Personnel expense per Operating cost**	A ratio used to evaluate a hospital's personnel expenses that are its fixed costs and main expenses by comparing all operating expenses to show its personnel expenses.	$\frac{\text{(Personnel expenses + compensations) X 100}}{\text{(Total expenses of operations))-expenses transferred)}}$

Source: Health Insurance Group under the Ministry of Public Health are health organizations in Thailand, 2012

However, since each financial ratio value differs or they fall on different range, the analysis is difficult to perform. Therefore, to balance these financial ratio values and place them on the same range, one has to reassign new values to financial ratios from method of T-Score as follow: (Chanabumrung, 2013)

1. Nineteen independent variables are used to determine the Sum ($\sum x$), Mean ($\overline{x}$) and Standard deviation (S.D.).

2. When all three values from step 1 are obtained, they are used to determine Z-Score by the following equation: (Montgomery and Runger, 2011)

$$Z = \frac{(x-\mu)}{\sigma}$$

Where, Z = Z-Score
x = Independent variable
μ = Mean of independent variables
σ = Standard deviation

3. When Z-Score from step 2 is obtained, it is then used to determine T-Score by the following equation:

$$T = 50+10Z$$

Where, T = T-Score
Z = Z-Score

Calculation of the critical conditions (dependent variables) is divided into seven levels according to the standard of the Ministry of Public Health (Level 1 = 1 Point, Level 2 = 2 Points, Level 3 = 3 Points, Level 4 = 4 Points, Level 5 = 5 Points, Level 6 = 6 Points, and Level 7 = 7 Points; and Level 6 = severe, Level 7 = very severe, and Level 1 = least severe). When the scores of all conditions established are obtained, they are then combined as the financial critical states in levels 1-7 where: (Health Insurance Division, Office of the Permanent Secretary of Public Health, Ministry of Public Health, 2013)

- Current Ratio of less than 1.5 = 1 point
- Quick Ratio of less than 1 = 1 point
- Cash & Cash Equivalence Ratio of less than 0.8 = 1 point

- Networking Capital in negative value = 1 point

- Networking Capital / Annual Net Income = 2 points
  Less than 3 months
- Networking Capital / Annual Net Income = 1 point
  Between 3 and 6 months

Where, Levels 1-5 = Save Zone
Levels 6-7 = Distress Zone (Critical point in this research)

Dependent variable is Financial Distress Model. After prediction, the group will be assigned with one value to determine which group the hospital belongs to. The group classification is as follows.

Level 1 ➔ Save Zone
Level 2 ➔ Save Zone
Level 3 ➔ Save Zone
Level 4 ➔ Save Zone
Level 5 ➔ Save Zone
Level 6 ➔ Distress Zone
Level 7 ➔ Distress Zone

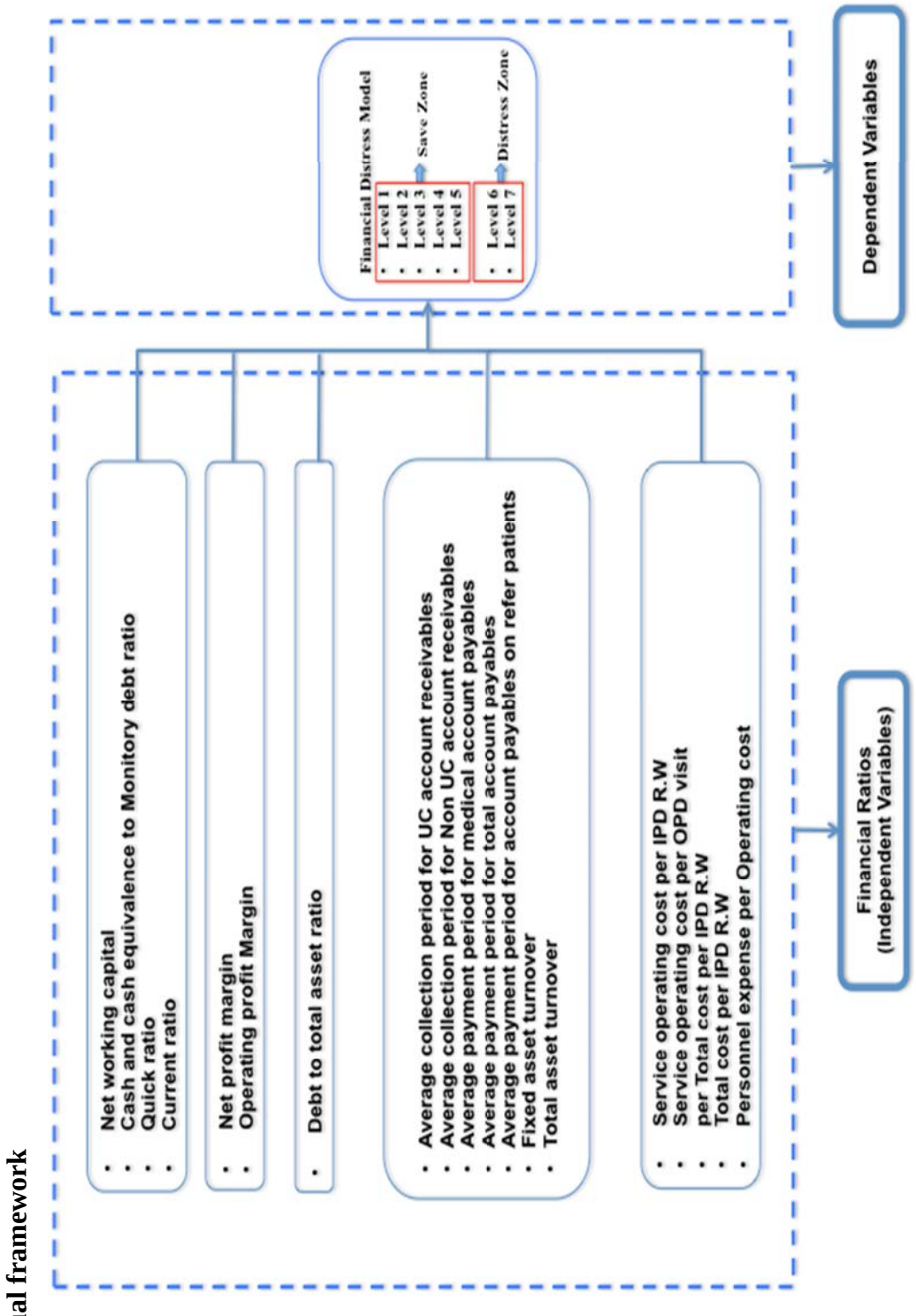

Figure 3.2 Conceptual framework

3.1.3.3 Conceptual framework

The independent and dependent variables identified for the conceptual framework as shown in Figure 3.2 have been derived from previous research. The dependent variable is the financial Distress Model.

The independent variables were derived from various sources in the literature. Independent variables include: liquidity ratios, profitability ratios, Leverage ratio efficiency ratios, The efficiency of cost management.

3.1.4 Data analysis and test model

3.1.4.1 Data analysis

The model to forecast the financial risks of community hospitals under the Ministry of Public Health in Thailand uses the following analysis technique:

1) 719 community hospitals throughout Thailand are classified into three groups based on The Ministry of Public Health in Thailand.

2) The financial ratio is calculated based on their 2011 – 2015 financial statements as an independent variable to develop a model for forecasting the financial risks.

3) An appropriate independent variables or financial ratio by Factor Analysis, a technique for grouping or combining variables that are correlated in the same group. It can help reduce the number of variables for developing a model is chosen using the SPSS program to prevent the multicollinearity among independent variables. Instruments chosen for statistical analysis include Multiple Discriminant Analysis (MDA) and Multinomial Logistic Regression (MLR) as follows:

3.1.4.2 Test models

1) Factor Analysis

Factor analysis is a statistical technique that will group or combine correlated variables into the same group and correlation may be both positive and negative. This aims to reduce the number of variables by combining many variables into the same component. This component is considered as a new variable that can determine the data of components created called Factor Score. Therefore, such components can be used as a variable for the next statistical analysis as well as used to solve the problem due to the multicollinearity of independent variables of the regression analysis. A

way to solve this problem is to combine correlated independent variables together by creating a new variable or component. The number of components obtained is determined by the Eigen value that equal to the number of variables and that can be calculated from: (Kaiyawan, 2012)

$$\text{Eigen value} = \sum(w)^2$$

Where, w = Factor Loading

The new components obtained will be renamed to be correlated to each other and can be calculated as an independent variable in the Multiple Discriminant Analysis (MDA) and Multinomial Logistic Regression (MLR) called Factor Score, which can be calculated from: (Kaiyawan, 2012)

$$F_{ik} = W_{i1}Z_{1k} + W_{i2}Z_{2k} + \ldots + W_{ip}Z_{pk}$$

Where,
- $k = 1,2,\ldots,n$
- $i = 1,2,\ldots,m$
- Z_{jk} = j factor of k case
- n = Number of data
- m = Number of factors
- W_{ik} = Factor loading of k variable in i factor
- F_{ik} = Factor Score of i factor of k case

Fundamental Agreement of Factor Analysis

- Variables chosen for factor analysis must be variables with continuity and correlation between them.
- Number of variables chosen for factor analysis should be more than 30.

2) Multiple Discriminant Analysis (MDA)

Analysis of classification is required to use two groups of variables, i.e. independent and dependent variables. Anova and Regression Analysis are used by creating a linear equation that indicates a relation between the nineteen forecasting independent variables (X) from Factor Analysis was called factor score, which divided many components and in this research, there are seven dependent (Y). The function of discriminator is in the form of linear as below: (Kaiyawan, 2012)

$Y_i = a + b_iX_1 + b_iX_2 + b_iX_3 + \ldots + b_pX_p$

Where, Y = Dependent variable or discriminant score

a = Constant

b_i = Discriminator Coefficient

X_i = Discriminator Variable

i = 1 , 2 , … , p

p = Number of variables of groups

2.1 Conditions of test using Multiple Discriminant Analysis (Kaiyawan, 2012)

1) Define clear variables that will be used to perform a forecast. Variables to be classified must have undergone a test of the means of independent variables between the groups of dependent variables whether there is a significant difference using the test of equality of group means. The result obtained should be Sig < 0.05, which means that the means of independent variables between the groups of dependent variables are different.

2) Test the covariances of common variables whether they are equal using the tests null hypothesis of equal population covariance matrices.

3) Consider the relationship between the independent variables within the same groups to prevent a multicollinearity problem that can lead to an incorrect estimate. The r-value should not exceed 0.80.

4) Create a discriminant function as K-1 (where K is the number of all groups of dependent variables). This research defines seven groups of dependent variables as follows:

In this research, it is divided into K groups (Kp ≥ 7), i.e. forecast of financial risks:

Level 1 ➔ Save Zone

Level 2 ➔ Save Zone

Level 3 ➔ Save Zone

Level 4 ➔ Save Zone

Level 5 ➔ Save Zone

Level 6 ➔ Distress Zone

Level 7 ➔ Distress Zone

Conditions of Multiple Discriminant Analysis in case of three groups and above are:

- p independent variables (X_1 , X_2 , … , X_p) based on multivariate e normal distribution
- Variance-Covariance matrix (pXp in size) of each group must be the same, i.e. $\Sigma_1 = \Sigma_2 = \Sigma_k$

Consideration of discriminant function whether is works is as below:

- Canonical correlation between variables in each group is considered against discriminant function. If it is at a high level, this indicates that the discriminant function can well classify the hospitals with financial risks into groups. In other words, discriminant function has a high relation with variables in that group.
- Eigenvalue, which is a variance value in a group that can be explained by independent variables, is considered. If it is at a high level, this means that discriminant function can well classify into groups based on the variables defined. However, if the analysis of discrimination performs with two groups of independent variables, only canonical correlation can be considered. However, since this research classifies the independent variables into three groups, consideration of eigenvalue can provide better result.
- Wilk's lambda, which is a value used to measure the classification of original independent variables before being separated from the discriminant function, is considered. It can be said that if it is at a high level, discriminant function obtained will be poor. Value of Wilk's lambda ranges from o to 1. If it approaches or equals to zero, it means that the means of the groups are different. In case of one, all groups have the same mean.

3) Multinomial Logistic Regression (MLR)

Multinomial Logistic Regression aims to explain the relation between the predictor variable and the probability of events based on the criterion variables.

3.1 Conditions of test using Multinomial Logistic Regression (Kaiyawan, 2012)

1) Define a relation between nineteen forecasting independent variables (X) from Factor Analysis was called factor score, which divided many components and in this research, there are seven dependent variables as follows:

Level 1 ➔ Save Zone
Level 2 ➔ Save Zone
Level 3 ➔ Save Zone
Level 4 ➔ Save Zone
Level 5 ➔ Save Zone
Level 6 ➔ Distress Zone
Level 7 ➔ Distress Zone

2) Examine the independent covariance (no autocorrelation).

- The Durbin-Watson value approaching 2 or ranging from 1.5 to 2.5 can be concluded that ei and ej are independent from each other.
- The Durbin-Watson value exceeding 1.5 means that the relationship between e_i and e_j is positive. The Durbin-Watson value approaching 0 means that the relationship between e_i and e_j is at a high level.
- Alternatively, it can be considered based on the Anova table by examining the significance of the Durbin-Watson's test statistics. If the significance is less than the level established, the H_0 hypothesis will be rejected. It may be concluded that there is a relationship between e_i and e_j.

3) Test the independent variables that they should not have a relationship to each other or multicollinearity using the Variance Inflation Factor (VIF). If every VIF of y on independent variables is more than 10, the relationship

between the independent variables should be prevented from being high or from multicollinearity problem.

4) Select the forecasting variables expected to affect the dependent variables using the forward stepwise: likelihood ratio. This method introduces the forecasting variables into the function one by one. These forecasting variables selected will result in more accurate forecasts of opportunity of relevant events. The criterion of selecting and introducing these forecasting variables into the function is based on the highest value of relationship with a statistical significance. When the forecasting variables have been examined, some will be removed or retained depending on the likelihood ratio or the change in -2LL. If -2LL decreases, it means such forecasting variable should be remained in the function.

5) The function obtained will be: (Kaiyawan, 2012)

$$g_i = a + b_iX_1 + b_iX_2 + b_iX_3 + \ldots + b_pX_p$$

Where, g_i = Dependent Variable

a = Constant

b_i = Coefficient

X_i = Independent Variable

i = 1 , 2 , … , p

P = Number of variables of groups

$$P_{\text{(Financial Distress Model at i)}} = \frac{\exp(g_i)}{\sum_{k=1}^{j} \exp(g_k)}$$

Where, i = 1, 2, 3,…,7 instead of forecasting groups

K = 1,2,…,j

J = Number of variables of groups

g_i = Dependent Variables

3.1.5 Verification and Prediction

Verification is a confirmation model that the analyze calculation. Verification is the model check for the confirmation of the analyze calculation with previous information. While, prediction is a comparison between the present information and model to check for the correction of model.

3.1.6 Sensitivity Analysis

The sensitivity analysis on the change in financial group or status of community hospitals is an analysis of the factors that have the most impact on the change in levels. The benefit from this sensitivity analysis will reveal how any variable that is not as predicted affects the change in financial status of community hospitals in order to find ways to prevent and control those variables in advance and to know the financial status of these hospitals, which causes maximum accuracy and efficiency.

3.1.7 Analysis and conclusion

After carrying out the analysis through Multiple Discriminant Analysis (MDA) and Multinomial Logistic Regression (MLR), financial status of each community hospital in Thailand is found. The accuracy of these tools is compared to see which tool is more accurate than another already and next chapter will be explained the results, research limitations, and the future research.

3.2 Summary

This chapter has discussed the research strategy and methods chosen to explore the research questions. The methods were designed to capture as many influences on financial risk as possible. The research method is quantitative analysis of data selected from existing databases (secondary data). This approach is commonly used in econometric and financial research because of the complexity of data set assembly. The chapter has also discussed the variables and conceptual framework that will be used in the study. The analysis is based on one dependent construct (Financial Distress Model) and five different sets of independent variable construct (Liquidity ratio, Profitability ratio, Leverage ratio, Efficiency ratio, The efficiency of cost management). Most of these categories include more than one variable, based on the literature and the need to encompass a broad set of variables. Data are used to forecast the financial risks of community hospitals under the Ministry of Public Health in Thailand by means of Factor Analysis in order to group the relations of variables. The analysis will use two approaches including Multiple Discriminant Analysis (MDA) and Multinomial Logistic Regression (MLR) in order to analyze the data and identify trends. Each of

these two methods is commonly used in bankruptcy analysis and prediction studies, and each has strengths and weaknesses that could make them more or less appropriate for the Thai context. The results of the research approach outlined in this chapter follow in the next chapters.

CHAPTER IV
FINDINGS AND DISCUSSION

This chapter follows research methodology described in chapter 3 and precious data analysis. The result from data analysis is show and the financial warning model was developed based on the Multiple Discriminant Analysis and Multinomial Logistic Regression to predict financial risk of community hospitals under the Ministry of Public Health in Thailand by using financial data dating back from the Ministry of Public Health for a period of four years from 2011 to 2014. The comparison of 2015 actual finance is also illustrated financial data of 719 community hospitals under the Ministry of Public Health were used in this study. The other community hospitals have incomplete data and were not include in this analysis.

4.1 Data analysis for forecasting a financial alarm

Part 1: Analysis results using Factor Analysis

Part 2: Analysis results using Multiple Discriminant Analysis

Part 3: Analysis results using Multinomial Logistic Regression

Part 1: Analysis results using Factor Analysis

Researcher used the Factor Analysis for grouping the independent variables. If there were many independent variables, they were grouped into factors or components. Variables in the same factor were related to each other. Statistic used to measure the relationship of variables was correlation coefficient, which consists of same or opposite directions of relationship. The purpose of Factor Analysis is to reduce the large number of variables to be in the same group with the best group factors and help solving problems. Multicollinearity can be used in the analysis (Multiple Discriminant Analysis and Multinomial Logistic Regression) in order to get the variables that can be used to best forecast the financial risk of community hospitals.

Only the Eigen values over one were considered. This means that the total variance in the original variables that can be explained by Factor or Eigen value was the sum value of Factor Loading square of each variable in Factor. The most important Factor was the first Factor because it can explain or retract the variance of data at most, while the second and third factors were less important. Any variable that should be in which Factor was determined by the value approaching one, either positively or negatively, and the variables with a lower Factor Loading (near zero) were grouped into the Factor with higher Factor Loading.

If the values were moderate or similar and they could not be decided which Factor they should be classified, such as Factor 1 = 0.897 and such as Factor 2 = -0.789, which was not much different (regardless of their signs), it was not clear whether such valuable should be grouped into Factor 1 or Factor 2. This was unable to make a clear definition of common factors so there must be a Factor Rotation, which aims to increase the Loading value of each variable in its common factors and to decrease it in other factors in order to know each variable is related to what other variables in the common factors. In addition, this Factor Rotation aims to show the clear structure of these common factors that can explain the meaning of each common factor. Factor Rotation includes Orthogonal Rotation and Oblique Rotation. Orthogonal Rotation used in this research was Varimax with the principle of making each variable have a higher Loading value in only one common factor and have a very low or near-zero value in other common factors. This method can product the least number of variables with higher Loading values in their common factors. Therefore, with this Factor Rotation, factors could be more clearly classified. Factor Analysis analyzed the data in years 2011-2014; as follows Appendix: Table A Rotated Component Matrix groups different variables into each Factor. Factor Analysis in Financial Report can group seven factors of independent variables were classified into each Factor as follows:

Cost	Service Operating Cost per IPD R.W., Service Operating Cost per OPD Visit, Total Cost per IPD R.W., Total Cost per OPD R.W.
Liquidity And Leverage	Networking capital, Cash Ratio, Quick Ratio, Current Ratio, Debt ratio
Profitability	Net profit margin, Operating profit margin,

Fixed And Total asset	Fix Asset Turnover, Total Asset Turnover
Payable Efficiency	Average Payment period for Medical Account Payables, Average Payment Period for Total Account Payables
Collection And Payment	Average Collection period for Universal Coverage Account Receivables, Average Collection period for Non Universal Coverage Account Receivables, Average Payment Period for Account Payables on Refer Patients
Personnel Expense	Personnel expense

Factor Analysis aims to categorize relevant variables into the same group. This paper chose the factors using the Principle Component Analysis and Varimax Rotation to group all 19 independent variables into 7 components with the factor loading values as presented in Appendix: Table B. Then, the factor scores were calculated and used as the values of original independent variables and used in predicting the financial status of community hospitals.

Part 2: Analysis of results using Multiple Discriminant Analysis

Multiple Discriminant Analysis is a technique that is used to classify variables into two or more small groups. Variables in the same group are similar and different if they are in different groups. If they are in a group, they will be only in such group. The process starts with collecting data where the number of groups and the group of such variables are known. Then, such data are used to create a relationship equation between the variables expected to make variables in different groups different from each other and such equation can be used to classify and forecast the groups. The objective is to determine what causes or factors that should be used to divide or differentiate the groups as well as that can be used to create a linear combination or discriminant function that shows the relationship between the independent and dependent variables or factors that make the difference of these groups.

In analyzing the data using Multiple Discriminant Analysis, the independent variables derived from factor analysis using factor score are tested to see which factors best influence the forecast of financial risk of community hospitals.

Creating an equation to predict the financial risk of community hospitals under the Ministry of Public Health in Thailand with Multiple Discriminant Analysis (MDA) analyzes financial data from four years in the past, including 2011,2012,2013 and 2014. Variables are included in the equation by entering all forecasting variables into the equation in a single step and the researcher will determine the significance of normal test (0.05) annually as follows:

Results using 2011-2014 financial data

The test of conditions aims to see whether the means of control variables between groups of dependent variables are significantly different (sig <0.05). According to Table 4.1 Test of equality of group means, Liquidity And Leverage, Profitability, Fixed And Total asset, Payable Efficiency, When considering the significance of the test, it is less than 0.05, in which the means of the independent variables are different between groups. Therefore, it should be taken as variables used to classify the groups.

Table 4.1 Tests of Equality of Group Means for 2011-2014 Financial Report

	Wilks' Lambda	F	df1	df2	Sig.
Cost	0.994	0.756	6	712	0.605
Liquidity And Leverage	0.49	123.544	6	712	0.000*
Profitability	0.951	6.104	6	712	0.000*
Fixed And Total asset	0.951	6.17	6	712	0.000*
Payable Efficiency	0.912	11.428	6	712	0.000*
Collection And Payment	0.985	1.848	6	712	0.087
Personnel expense	0.99	1.189	6	712	0.310

* Significance

In considering whether the Discriminant Function created is appropriate, Canonical Correlation and Eigenvalue between variables in each group are taken into account. If it is high, such Discriminant Function can well classify the population into groups.

According to Table 4.2, Canonical Correlation is 0.797 and Eigenvalue is 0.806, which are relatively high. It can be assumed that such Discriminant Function can well classify the population into groups. Wilk's lambda is used to determine whether such Discriminant Function performs well and can be converted into the Chi square distribution (χ^2) for significance testing (Sig <0.05). According to Table 4.3, Wilk's lambda is converted to Chi square that is equal to 748.812 and sig. is 0.000. That is, the equation can classify the groups with a significance of 0.000.

Table 4.2 Eigenvalue for 2011-2014 Financial Report

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	1.743	94.7	94.7	0.797

Table 4.3 Wilk's lambda for 2011-2014 Financial Report

Test of Function	Wilks' Lambda	Chi-square	df	Sig.
1	0.332	784.812	42	.000

Table 4.4 Classification Function Coefficients for 2011-2014 Financial Report

	Level						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Liquidity And Leverage	4.763	2.373	0.224	-0.562	-1.591	-2.444	-3.391
Profitability	0.958	0.629	0.053	0.078	-0.553	-0.626	-1.571
Fixed And Total asset	-0.775	-0.521	-0.271	0.016	0.432	0.786	1.381
Payable Efficiency	-1.307	-0.852	-0.211	0.023	0.618	1.048	2.298
(Constant)	-6.938	-3.248	-2.004	-2.034	-2.292	-3.458	-6.663

According to Table 4.4, Classification Function Coefficients are used to classify the groups and the Discriminant Function can be created as follows:

Y_1 = -6.938 + 4.763 Liquidity And Leverage + 0.958 Profitability – 0.775 Fixed And Total asset – 1.307 Payable Efficiency

Y_2 = -3.248 + 2.373 Liquidity And Leverage – 0.629 Profitability – 0.521 Fixed And Total asset – 0.852 Payable Efficiency

Y_3 = -2.004 – 0.224 Liquidity And Leverage + 0.053 Profitability – 0.271 Fixed And Total asset – 0.211 Payable Efficiency

Y_4 = -2.034 –0.562 Liquidity And Leverage – 0.040 Profitability – 0.173 Fixed And Total asset – 0.460 Payable Efficiency

Y_5 = -2.292 – 1.591 Liquidity And Leverage – 0.553 Profitability + 0.432 Fixed And Total asset + 0.618 Payable Efficiency

Y_6 = -3.458 – 2.444 Liquidity And Leverage - 0.626 Profitability + 0.786 Fixed And Total asset + 1.048 Payable Efficiency

Y_7 = -6.663 – 3.391 Liquidity And Leverage – 1.571 Profitability + 1.381 Fixed And Total asset + 2.298 Payable Efficiency

Where, Y = Level

Liquidity And Leverage = Networking capital, Cash Ratio, Quick Ratio, Current Ratio, Debt ratio

Profitability = Net profit margin, Operating profit margin,Fixed And Total asset, Fix Asset Turnover, Total Asset Turnover

Payable Efficiency = Average Payment period for Medical Account Payables, Average Payment Period for Total Account Payables

Table 4.5 Classification Results for 2011-2014 Financial Report

Level		Predicted Group Membership														Total
		1		2		3		4		5		6		7		
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Actual	1	20	64.5	9	29	2	6.5	0	0	0	0	0	0	0	0	31
	2	35	22.3	65	41.4	46	29.3	9	5.7	1	0.6	0	0	1	0.6	157
	3	0	0	26	16.8	79	51	35	22.6	8	5.2	3	1.9	4	2.6	155
	4	0	0	7	5	37	26.6	60	43.2	23	16.5	10	7.2	2	1.4	139
	5	0	0	0	0	10	7.7	31	23.8	41	31.5	36	27.7	12	9.2	130
	6	0	0	0	0	0	0	10	10.2	27	27.6	50	51	11	11.2	98
	7	0	0	0	0	0	0	0	0	0	0	5	55.6	4	44.4	9

According to Table 4.5 Classification Results, the results of financial risk forecasts of community hospitals under the Ministry of Public Health in Thailand using 2011-2014 financial report show the results obtained from the estimation of accuracy of such forecasts. Forecasting data of 719 hospitals are used to create the Discriminant Function as follows: community hospitals classified as Level 1 are 20 hospitals or 64.5%, Level 2 are 65 hospitals or 41.4%, Level 3 are 79 hospitals or 51%, Level 4 are 60 hospitals or 43.2%, Level 5 are 41 hospitals or 31.5%, Level 6 are 50 hospitals or 51%, and Level 7 are 4 hospitals or 44.4%. The accuracy in the classification of financial risks of community hospitals is accounted for 44.4%.

Part 3: Analysis results using Multiple Logistic Regression (MLR)

Creating an equation to predict the financial risk of community hospitals under the Ministry of Public Health in Thailand with Multiple Logistic Regression (MLR) analyzes financial data from four years in the past, including 2011,2012,2013 and 2014, which will consider them annually. Variables are included in the equation by entering all forecasting variables into the equation in a single step and the researcher will determine the significance of normal test (0.05) annually as follows:

Results using 2011-2014 financial data

Analysis of Multicollinearity is done by testing the tolerance. If the tolerance of any independent variables is less and approaching zero, it indicates that such independent variables are much correlated with other variables. In addition, VIF (Variance Inflation Factor) is tested. If this VIF exceeds 10, such independent variables are considered related to each other. The test shows that the tolerance of independent variables is equal to one that is away from zero and the VIF (Variance Inflation Factor) is equal to one, which is less than 10. Therefore, all seven independent variables used in this study do not have such multicollinearity so it can be analyzed in the next step as shown in Table 4.6;

Table 4.6 Tolerance and VIF (Variance Inflation Factor) to test the relationship between variables for 2011-2014 Financial Report

Variables	Collinearity Statistics	
	Tolerance	VIF
Cost	1.000	1.000
Liquidity And Leverage	1.000	1.000
Profitability	1.000	1.000
Fixed and Total Asset	1.000	1.000
Payable Efficiency	1.000	1.000
Collection And Payment	1.000	1.000
Personnel Expense	1.000	1.000

Table 4.7 Model Fitting Information for 2011-2014 Financial Report

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	2519.388			
Final	1462.576	1056.812	42	.000

Table 4.8 Likelihood Ratio Tests for 2011-2014 Financial Report

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	2052.508	589.932	6	.000
Cost	1463.375	0.799	6	.992
Liquidity And Leverage	2344.451	881.875	6	.000*
Profitability	1619.815	157.239	6	.000*
Fixed and Total Asset	1542.872	80.296	6	.000*
Payable Efficiency	1579.43	116.854	6	.000*
Collection And Payment	1476.456	13.88	6	.031*
Personnel Expense	1468.571	5.995	6	.424

* Significance

Table 4.9 Pseudo R-Square for 2011-2014 Financial Report

Cox and Snell	.770

According to the analysis results in Table 4.7, when considering -2 Log likelihood of the model with seven independent variables, -2 Log likelihood is 1062.576, which is less than -2 Log likelihood in the model with intercept only (-2 Log likelihood = 2052.508). When using the model testing statistics, the Chi-Square is 1056.812 and this means that the logistic regression coefficients of all independent variables are not equal zero with a statistical significance of 0.01. This means that seven independent variables influence the 2011-2014 forecast of financial risks of community hospitals. According to Table 4.8, Cost is insignificant, that is, if removing Cost out of the model, -2Log Likelihood will change into 1463.375 (Sig = 0.992). This means that Cost containing Service Operating Cost per IPD R.W., Service Operating Cost per OPD Visit, Total Cost per IPD R.W., Total Cost per OPD R.W. will not affect the forecast of 2011-2014 financial risks. And Personnel Expense is insignificant, that is, if removing Cost out of the model, -2Log Likelihood will change into 1468.571 (Sig = 0.424). This means that Personnel Expense containing personnel expense will not affect the forecast of 2011-2014 financial risks.When considering the predictability of Multinomial Logistic Regression, it can forecast for 77% (Cox & Snell R^2 = 0.770) as shown in Table 4.9.

Table 4.10 Parameter Estimates for 2011-2014 Financial Report

Variables	Regression Coefficient (β)					
	1	**2**	**3**	**4**	**5**	**6**
Intercept	10.003	13.037	14.248	13.986	11.571	5.894
Liquidity And Leverage	19.624*	18.847*	16.435*	14.307*	8.813*	2.434*
Profitability	4.32*	4.447*	3.911*	3.688*	2.035*	0.963*
Fixed And Total Asset	-2.731*	-2.376*	-2.065*	-1.546*	-0.776*	-0.394
Payable Efficiency	-4.186*	-3.539*	-2.51*	-2.136*	-1.197*	-0.562*
Collection And Payment	-1.451*	-0.687*	-0.651*	-0.38	-0.325	-0.814*

The reference category is Level 7

* Statistical significance of 0.05

In an analysis based on Table 4.10, a regression coefficient (β) (See in appendix: Table C) can be used to create an equation of forecasting 2011-2014 financial risks as follows:

Y_1 = 10.003 + 19.624 Liquidity And Leverage + 4.32 Profitability – 2.731 Fixed And Total Asset – 4.186 Payable Efficiency – 1.451 Collection And Payment

Y_2 = 13.037 + 18.847 Liquidity And Leverage + 4.447 Profitability – 2.376 Fixed And Total Asset – 3.539 Payable Efficiency – 0.687 Collection And Payment

Y_3 = 14.248 + 16.435 Liquidity And Leverage + 3.991 Profitability – 2.065 Fixed And Total Asset – 2.51 Payable Efficiency – 0.651 Collection And Payment

Y_4 = 13.986 + 14.307 Liquidity And Leverage + 3.688 Profitability – 1.546 Fixed And Total Asset – 2.136 Payable Efficiency – 0.38 Collection And Payment

Y_5 = 11.571 + 8.813 Liquidity And Leverage + 2.035 Profitability – 0.776 Fixed And Total Asset – 1.197 Payable Efficiency – 0.325 Collection And Payment

Y_6 = 5.894 + 2.434 Liquidity And Leverage + 0.963 Profitability – 0.394 Fixed And Total Asset – 0.562 Payable Efficiency – 0.814 Collection And Payment

Y_7 = 0

Where, Y = Level

Liquidity And Leverage = Networking capital, Cash Ratio, Quick Ratio, Current Ratio, Debt ratio

Profitability = Net profit margin, Operating profit margin, Fixed And Total asset Fix Asset Turnover, Total Asset Turnover

Payable Efficiency	=	Average Payment period for Medical Account Payables, Average Payment Period for Total Account Payables
Collection and Payment	=	Average Collection period for Universal Coverage Account Receivables, Average Collection period for Non Universal Coverage Account Receivables, Average Payment Period for Account Payables on Refer Patients

Table 4.11 Classification Results for 2011-2014 Financial Report

Actual	Predicted							Percent Correct
	1	2	3	4	5	6	7	
1	3	26	2	0	0	0	0	9.70%
2	5	113	32	7	0	0	0	72.00%
3	0	31	77	43	3	1	0	49.70%
4	0	9	28	72	30	0	0	51.80%
5	0	0	6	18	86	20	0	66.20%
6	0	0	0	0	29	68	1	69.40%
7	0	0	0	0	0	7	2	22.20%
Overall Percentage	1.10%	24.90%	20.20%	19.50%	20.60%	13.40%	0.40%	58.60%

According to Table 4.11 Classification Results, the results of financial risk forecasts of community hospitals under the Ministry of Public Health in Thailand using 2011-2014 financial report show the results obtained from the estimation of accuracy of such forecasts. Forecasting data of 719 hospitals are used to create the Logistic Response Function as follows: community hospitals classified as Level 1 are 3 hospitals or 9.7%, Level 2 are 113 hospitals or 72%, Level 3 are 77 hospitals or 49.7%, Level 4 are 72 hospitals or 51.8%, Level 5 are 86 hospitals or 66.2%, Level 6 are 68 hospitals or

69.40%, and Level 7 are 2 hospitals or 22.2%. The accuracy in the classification of financial risks of community hospitals is accounted for 58.6%.

4.2 Results of Effectiveness Comparison of Forecasting Financial Risks of Community Hospitals Under The Ministry of Public Health In Thailand Between Multiple Discriminant Analysis (MDA) and Multinomial Logistic Regression (MLR)

Table 4.12 Forecast results for 2014 Financial Report using Multiple Discriminant Analysis (MDA) and Multinomial Logistic Regression (MLR) compared to actual level

Level	Actual		MDA		MLR	
	Hospitals	%	Hospitals	%	Hospitals	%
Save Zone	594	100	581	97.81	620	95.62
Distress Zone	125	100	138	86.60	99	79.20

According to the forecast results of the financial status of 719 community hospitals, which are divided into two groups: save zone consisting of levels 1 – 5 and distress zone consisting of levels 6 – 7 as shown in Table 4.12, and when forecasting by Multiple Discriminant Analysis (MDA) and Multinomial Logistic Regression (MLR) compared to actual level, Multiple Discriminant Analysis (MDA) forecasted 581 hospitals in save zone, representing 97.81%, and 138 hospitals in distress zone, representing 86.60%, and Multinomial Logistic Regression (MLR) forecasted 620 hospitals in save zone, representing 95.62%, and 99 hospitals in distress zone, representing 79.20%, while actual level consists of 594 and 125 hospitals in save zone and distress zone, respectively.

4.3 Sensitivity Analysis

This study found that the ability to forecast the financial risks can provide the results near the actual states of community hospitals. This is a good warning for preparedness. So, when knowing the hospital is in the Distress Zone, an appropriate solution must be defined. This can be done by considering the coefficient in the forecasting equation and increasing or decreasing the coefficient of such factor when knowing that such factor can move the hospital from Distress Zone to Save Zone. After that, the ratio in such factor is determined and resolved. It may be said that such financial ratio affects the financial status of community hospitals.

For example, according to financial data of community hospitals A in the notheastern region of Thailand forecast by Multiple Discriminant Analysis (MDA) and Multinomial Logistic Regression (MLR), Hospital A is in group 6 and 7 or Distress Zone and wants to remove itself from Distress Zone to Save Zone. Therefore, the value in the variables must be considered as shown in Tables 4.13;

Table 4.13 Change in variables of community hospital A in level 6 (distress zone) using MDA and in level 7 (distress zone) using MLR

Variable	Percent of change	Change level	
		MDA	MLR
Liquidity and leverage	20%	5	5
Profitability	5%	6	6
Fixed and total asset	0%	N/A	N/A
Payable efficiency	15%	5	6
Collection and payment	25%	6	6

Table 4.13 shows the sensitivity analysis. When changing the following variables: liquidity and leverage, profitability, payable efficiency, and collection and payment, the status of community hospitals A is changed from its old to new status with the following details:

1. If the liquidity and leverage are positively changed for 20%, the old status of community hospital A in level 6 (distress zone) using MDA and in level 7 (distress zone) using MLR will be changed into level 5 (distress zone) using MDA and

into level 5 (distress zone) using MLR, which will affect the variables in the liquidity and leverage. According to Table 4.14, the liquidity and leverage are positively changed for 25% so both total current liability and total liability are decreased by 25%, i.e. from 80,065,899.63 to 106,754,532.84. If changing the values in this group, it can indicate the financial liquidity. If the community hospital A is highly liquid, this will cause a positive impact on it.

Table 4.14 Change in variables of community hospital A from distress zone to save zone (liquidity and leverage)

Variable	Percent of change	New value	Old value
Total current liability	-25%	80,065,899.63	106,754,532.84
Total liability	-25%	80,065,899.63	106,754,532.84

Table 4.15 Change in variables of community hospital A from distress zone to save zone (profitability)

Variable	Percent of change	New value	Old value
Net profit margin (excluding depreciation and amortization)	10%	7,982,084.20	7,256,440.18
Operating profit margin (excluding depreciation and amortization)	10%	-25,342,113.20	-25,342,113.20

2. If the profitability is positively changed for 5%, the old status of community hospital A in level 6 (distress zone) using MDA and in level 7 (distress zone) using MLR will be changed into level 6 (distress zone) using MDA and into level 6 (distress zone) using MLR, which will affect the variables in the profitability. According to Table 4.15, the profitability is positively changed for 5% so the net profit margin (excluding depreciation and amortization) is increased by 10%, i.e. from 7,256,440.18 to 7,982,084.20, and the operating profit margin (excluding depreciation and amortization) is increased by 10%, i.e. from 25,342,113.20 to -25,342,113.20. If changing the values in this

group, it can indicate the profitability. If the community hospital A is highly profitable, this will cause a positive impact on it. However, since changing the profitability does not change the status of this community hospital, other variables may need to be considered together.

Table 4.16 Change in variables of community hospital A from distress zone to save zone (payable efficiency)

Variable	Percent of change	New value	Old value
Drug creditor	-20%	29,737,738.21	37,172,172.76
Medical supply and material creditor	-20%	11,880,414.37	14,850,517.96
Medical science material creditor	-20%	3,667,438.21	4,584,297.76
Other material creditor	-20%	2,005,864.30	2,507,330.38
Other creditors	-20%	1,303,848.87	1,629,811.09
Durable article creditor	-20%	2,936,896.12	3,671,120.15

3. If the payable efficiency is positively changed for 15%, the old status of community hospital A in level 6 (distress zone) using MDA and in level 7 (distress zone) using MLR will be changed into level 5 (distress zone) using MDA and into level 6 (distress zone) using MLR, which will affect the variables in the payable efficiency. According to Table 4.16, the payable efficiency is positively changed for 15% so the drug creditor is decreased by 20%, i.e. from 37,172,172.76 to 29,737,738.21, the medical supply and material creditor is decreased by 20%, i.e. from 14,850,517.9 to 11,880,414.37, the medical science material creditor is decreased by 20%, i.e. from 4,584,297.76 to 3,667,438.21, Other material creditor is decreased by 20%, i.e. from 2,507,330.38 to 2,005,864.30, Other creditors are decreased by 20%, i.e. from 1,629,811.09 to 1,303,848.87, and durable article creditor is decreased by 20%, i.e. from 3,671,120.15 to 2,936,896.12. If changing the values in this group, it can indicate the payable efficiency. If the community hospital A has a high payable efficiency, this will cause a positive impact on it. However, since changing the payable efficiency does not change the status of this community hospital, other variables may need to be considered together.

Table 4.17 Change in variables of community hospital A from distress zone to save zone (collection and payment)

Variable	Percent of change	New value	Old value
Reimbursement of medical expenses from debtor's organization	-30%	312,568.20	446,526.00
Reimbursement of medical expenses from Social Security Office	-30%	5,569,770,50	7,956,815.00

4. If the collection and payment are positively changed for 25%, the old status of community hospital A in level 6 (distress zone) using MDA and in level 7 (distress zone) using MLR will be changed into level 6 (distress zone) using MDA and into level 6 (distress zone) using MLR, which will affect the variables in the collection and payment. According to Table 4.17, the collection and payment are positively changed for 25% so the reimbursement of medical expenses from debtor's organization is decreased by 30%, i.e. from 446,526.00 to 312,568.20, and the reimbursement of medical expenses from Social Security Office is decreased by 30%, i.e. from 7,956,815.00 to 5, 569,770.50. If changing the values in this group, it can indicate the collection and payment. If the community hospital A has a high rate of collection and payment, this will cause a positive impact on it. However, since changing the collection and payment does not change the status of this community hospital, other variables may need to be considered together.

CHAPTER V
CONCLUSIONS, DISCUSSION AND SUGGESTIONS

This research aims to examine the model for forecasting financial risks of community hospitals under the Ministry of Public Health in Thailand using comparison between Multiple Discriminant Analysis (MDA) and Multinomial Logistic Regression (MLR). Financial Distress Model (FDM) can indicate the status or forecast the financial risks of community hospitals as well as can get prepared to solve the problems of community hospitals at risk.

Financial data used in this study are obtained from the Ministry of Public Health in Thailand from 2011-2015 using data of four years in the past during 2011-2014 in order to forecast the financial risks and compare them to actual data in 2015. These financial data are those of community hospitals under the Ministry of Public Health in Thailand and are classified as year: 719 hospitals Bed size of these hospitals is classified as (F3) Less than 30 beds, (F2) 30-90 beds, (F1) 90-120 beds.

The researcher examined the factors that affect the forecast of financial risks of these community hospitals and the analyzed by using Factor Analysis to minimize the Multicolinearity. The technique for grouping or combining variables that are correlated in the same group. It can help reduce the number of variables. Multiple Discriminant Analysis (MDA) and Multinomial Logistic Regression (MLR) are also used to examine the factors that affect the forecast of financial risks of community hospitals.

5.1 Conclusions

Results can be concluded as follows:

1. According to the Factor Analysis to minimize the Multicolinearity, there are factors that can be grouped as new factors affecting the forecast of financial risks of community hospitals as follows:

Cost	=	Service Operating Cost per IPD R.W., Service Operating Cost per OPD Visit, Total Cost per IPD R.W., Total Cost per OPD R.W.
Liquidity and Leverage	=	Networking capital, Cash Ratio, Quick Ratio, Current Ratio, Debt ratio
Profitability	=	Net profit margin, Operating profit margin,
Fixed And Total asset	=	Fix Asset Turnover, Total Asset Turnover
Payable Efficiency	=	Average Payment period for Medical Account Payables, Average Payment Period for Total Account Payables
Collection And Payment	=	Average Collection period for Universal Coverage Account Receivables, Average Collection period for Non UniversalCoverage Account Receivables, Average Payment Period for Account Payables on Refer Patients
Personnel Expense	=	Personnel expense

2. According to the Multiple Discriminant Analysis (MDA), there are four factors that affect the forecast of financial risks of community hospitals as follows:

Liquidity And Leverage	=	Networking capital, Cash Ratio, Quick Ratio, Current Ratio, Debt ratio
Profitability	=	Net profit margin, Operating profit margin,
Fixed And Total asset	=	Fix Asset Turnover, Total Asset Turnover
Payable Efficiency	=	Average Payment period for Medical Account Payables, Average Payment Period for Total Account Payables

These forecast results are obtained from the 2011-2014 financial reports using the Multiple Discriminant Analysis (MDA) by bringing independent variables into the financial risk prediction model that can be divided into seven groups according to

the principles of the Ministry of Public Health in Thailand with a predictive accuracy of 44.4%.

3. According to the Multinomial Logistic Regression (MLR), there are five factors that affect the forecast of financial risks of community hospitals as follows:

Liquidity And Leverage	=	Networking capital, Cash Ratio, Quick Ratio, Current Ratio, Debt ratio
Profitability	=	Net profit margin, Operating profit margin,
Fixed And Total asset	=	Fix Asset Turnover, Total Asset Turnover
Payable Efficiency	=	Average Payment period for Medical Account Payables, Average Payment Period for Total Account Payables
Collection And Payment	=	Average Collection period for Universal Coverage Account Receivables, Average Collection period for Non Universal Coverage Account Receivables, Average Payment Period for Account Payables on Refer Patients

These forecast results are obtained from the 2011-2014 financial reports using the Multinomial Logistic Regression (MLR) by bringing independent variables into the financial risk prediction model that can be divided into seven groups according to the principles of the Ministry of Public Health in Thailand with a predictive accuracy of 58.6%.

4. The comparison of analysis results between the current status and the forecast values obtained from the technique Multiple Discriminant Analysis (MDA) and Multinomial Logistic Regression (MLR) suggests that their forecast efficacies are similar, but the results of MLR are slightly better. Considering individual groups, it can be seen that the results of both techniques may deviate slightly. When community hospitals have known that they are included in the distress zone based on a forecast using Multiple Discriminant Analysis (MDA) and Multinomial Logistic Regression (MLR), it can be known that what variable affects the financial status of these hospitals

in order to find ways to prevent and control those variables in advance and to know the financial status of these hospitals, which causes maximum accuracy and efficiency.

According to the comparison of analysis results for 2014 Financial Report between actual states and forecast results obtained from Multiple Discriminant Analysis (MDA) and Multinomial Logistic Regression (MLR) forecasted 581 hospitals in save zone, representing 97.81%, and 138 hospitals in distress zone, representing 86.60%, and Multinomial Logistic Regression (MLR) forecasted 620 hospitals in save zone, representing 95.62%, and 99 hospitals in distress zone, representing 79.20%, while actual level consists of 594 and 125 hospitals in save zone and distress zone, their forecasting effectiveness very similar. However, when considering as groups, they may be somewhat inaccurate.

5. According to the Sensitivity Analysis, the ability to forecast the financial risks can provide the results near the actual states of community hospitals. This is a good warning for preparedness. So, when knowing the hospital is in the Distress Zone, an appropriate solution must be defined. This can be done by considering the coefficient in the forecasting equation and increasing or decreasing the coefficient of such factor when knowing that such factor can move the hospital from Distress Zone to Save Zone. After that, the ratio in such factor is determined and resolved. It may be said that such financial ratio affects the financial status of community hospitals. When coefficients of independent variables are changed, the financial status of community hospitals can also be changed from distress zone to save zone.

The results of the sensitivity analysis indicate the variables that affect the change in financial status of the community hospitals if the following variables are changed: liquidity and leverage, profitability, fixed and total assets, payable efficiency, and collection and payment, under five assumption cases as below.

Case 1: If the liquidity and leverage are increased by 20%, the status of community hospitals is changed from level 6 using MDA and level 7 using MLR to level 5 and level 5, respectively, because these hospitals have different expenses. Therefore, they will a high financial liquidity if their expenses or expense-causing liabilities are decreased so their liquidity problem can be solved and thus their crisis level is decreased.

Case 2: If the profitability is increased by 5%, the status of community hospitals is changed from level 6 using MDA and level 7 using MLR to level 6 and level 6, respectively. These hospitals will be regarded as loss by taking into account many factors, including their revenue and expense structures. Most revenues of these community hospitals come from national health insurance system, medical welfare system for government officials, social security, and general patients, while their expenses are, for example, compensations for medical personnel, medical supplies, and wages for staff. Therefore, the profitability of community hospitals is different from those of private hospitals because most revenues are allocated by the government while the revenues of private hospitals come from many sources so their profitability is different. Other variables may be considered to have a better effectiveness of forecast.

Case 3: Fixed and total assets measure the asset usability of community hospitals. One unit of assets is considered to see how much it can create revenue to the hospitals. As mentioned above, when comparing to general businesses, the revenue of these community hospitals mainly comes from their sales. However, since they are funded by the government, they cannot use their assets to create revenue or sales total for themselves. Therefore, other variables must be considered.

Case 4: If the payable efficiency is increased by 15%, the status of community hospitals is changed from level 6 using MDA and level 7 using MLR to level 5 and level 6, respectively. This variable indicates how much these hospitals pay their trade creditors. Reducing these trade creditors will positively affect the community hospitals. Other variables may be considered to have a better effectiveness of forecast.

Case 5: If the collection and payment are increased by 25%, the status of community hospitals is changed from level 6 using MDA and level 7 using MLR to level 6 and level 6, respectively. This variable indicates how much these hospitals pay their trade creditors. This variable indicates how much these hospitals pay their trade creditors and debtors. Reducing these trade creditors and debtors will positively affect the community hospitals. Other variables may be considered to have a better effectiveness of forecast.

5.2 Discussion

According to the results presented above, it can be understand that they are consistent with the conceptual framework and research problem as follows:

1. According to the results of analysis to forecast financial risks of community hospitals under the Ministry of Public Health in Thailand using Multiple Discriminant Analysis (MDA) and Multinomial Logistic Regression (MLR), Financial Distress Model (FDM) can forecast the groups and provide the forecasting effectiveness similar to actual states of these hospitals.

2. In addition to forecast financial risks of community hospitals by Financial Distress Model (FDM), the researcher also found that the bed size affects the status of financial risks of these hospitals and that the medium community hospitals (F2) affect their financial status. This can be seen in the results in Chapter 4. For Distress Zone in year, there are more than community hospitals with other bed sizes. More deeply, meduim community hospitals with 30-90 beds are in Distress Zone at most compared to community hospitals with other bed sizes.

3. This study found that Financial Distress Model (FDM) can forecast the financial risks of community hospitals that can know the hospitals in Distress Zone. In addition, it can show which factors affect the forecast of financial risks as mentioned above.When coefficients of independent variables are changed, the financial status of community hospitals can also be changed from distress zone to save zone. Moreover, community hospitals with financial risks can determine a way to manage or get prepared for solving their problems.

5.3 Limitations

This study only examined the accounting data, which are quantitative data, without considering other areas of variables that may be related to the financial risks of community hospitals, such as economical, behavioral, and managerial and other qualitative factors of community hospitals. Selection and use of statistical analysis enable the researcher to determine the conclusions before examining other areas of qualitative data other than financial ratios. However, this study has other limitations, such as facts about accounting data, pre data analysis, and calculation of financial

ratios, as well as limitations regarding software used in such analysis. Therefore, other factors should be analyzed to provide the best effectiveness and benefits.

5.4 Suggestions for Future Research

1. This study divides the states into seven groups, which may be inconsistent with operating processes because the operations are dynamic processes. Therefore, for accuracy of forecast, it may be divided into different phases.

2. This study should also analyze qualitative factors to reflect the actual conditions of community hospitals better in order to have best effectiveness and benefits.

3. Techniques to forecast financial risks of these hospitals may be changed or modified to test the accuracy and to obtain clearer forecasting results.

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APPENDICES

APPENDIX A

ROTATED COMPONENT MATRIX FOR FACTOR ANALYSIS

Independent Variables	Component						
	1	2	3	4	5	6	7
X_{15}	0.998						
X_{16}	0.998						
X_{17}	0.998						
X_{18}	0.998						
X_3		0.96					
X_4		0.956					
X_2		0.933					
X_1		0.748					
X_7		-0.549					
X_5			0.88				
X_6			0.85				
X_{13}				0.928			
X_{14}				0.798			
X_{11}					0.855		
X_{10}					0.783		
X_8						0.74	
X_{12}						0.722	
X_9						0.501	
X_{19}							0.97

APPENDIX B
CATEGORIZATION OF RELEVANT VARIABLES INTO SAME GROUP BASED ON FACTOR LOADING VALUES

	Component	Factor Loading
	Cost	
X_{15}	Service Operating Cost per IPD R.W.	0.251
X_{16}	Service Operating Cost per OPD Visit	0.251
X_{17}	Total Cost per IPD R.W.	0.251
X_{18}	Total Cost per OPD R.W.	0.251
	Liquidity And Leverage	
X_1	Net Working Capital	0.253
X_2	Cash and Cash equivalence to Monitory debt Ratio	0.263
X_3	Quick Ratio	0.298
X_4	Current Ratio	0.296
X_7	Debt to total asset ratio	-0.081
	Profitability	
X_5	Net profit Margin (exclude depreciation and amortization)	0.536
X_6	Operating profit Margin (exclude depreciation and amortization)	0.498
	Fixed And Total asset	
X_{13}	Fixed Asset Turnover	0.577
X_{14}	Total Asset Turnover	0.434
	Efficiency	
X_{10}	Average Payment period for Medical Account Payables	0.548
X_{11}	Average Payment Period for Total Account Payables	0.406

	Component	Factor Loading
X_8	Collection And Payment Average Collection period for Universal Coverage Account Receivables	0.567
X_9	Average Collection period for Non Universal Coverage Account Receivables	0.331
X_{12}	Average Payment period for Account Payables on Refer Patients	0.541
X_{19}	Personnel expense Personnel expense per Operating cost	0.932

APPENDIX C
PARAMETER ESTIMATES

Level	Variables	B	Std. Error	Wald	df	Sig.	Exp(B)
1	Intercept	10.00	1.75	32.54	1	0.0000	
	Cost	0.25	0.46	0.30	1	0.5840	1.284
	Liquidity And Leverage	19.62	1.58	154.64	1	0.0000	333,151,949.29
	Profitability	4.32	0.61	49.91	1	0.0000	75.191
	Fixed And Total asset	-2.73	0.51	28.19	1	0.0000	0.065
	Payable Efficiency	-4.19	0.62	46.32	1	0.0000	0.015
	Collection And Payment	-1.45	0.60	5.82	1	0.0160	0.234
	Personnel expense	0.12	0.49	0.06	1	0.8090	1.126
2	Intercept	13.04	1.68	59.97	1	0.0000	
	Cost	0.15	0.43	0.12	1	0.7340	1.159
	Liquidity And Leverage	18.85	1.57	144.88	1	0.0000	153,110,742.82
	Profitability	4.45	0.55	65.88	1	0.0000	85.388
	Fixed And Total asset	-2.38	0.42	31.35	1	0.0000	0.093
	Payable Efficiency	-3.54	0.41	73.99	1	0.0000	0.029
	Collection And Payment	-0.69	0.34	4.09	1	0.0430	0.503
	Personnel expense	0.37	0.46	0.64	1	0.4260	1.446
3	Intercept	14.25	1.68	72.28	1	0.0000	
	Cost	0.08	0.41	0.04	1	0.8460	1.082
	Liquidity And Leverage	16.44	1.54	113.31	1	0.0000	13,735,333.99
	Profitability	3.91	0.53	55.01	1	0.0000	49.930
	Fixed And Total asset	-2.07	0.41	25.95	1	0.0000	0.127
	Payable Efficiency	-2.51	0.36	49.73	1	0.0000	0.081
	Collection And Payment	-0.65	0.31	4.37	1	0.0370	0.521
	Personnel expense	0.33	0.45	0.54	1	0.4610	1.397
4	Intercept	13.99	1.68	69.67	1	0.0000	
	Cost	0.14	0.39	0.14	1	0.7100	1.155
	Liquidity And Leverage	14.31	1.52	88.76	1	0.0000	1,635,489.81
	Profitability	3.69	0.52	50.44	1	0.0000	39.978
	Fixed And Total asset	-1.55	0.39	15.65	1	0.0000	0.213
	Payable Efficiency	-2.14	0.34	38.75	1	0.0000	0.118
	Collection And Payment	-0.38	0.28	1.82	1	0.1770	0.684
	Personnel expense	0.27	0.45	0.38	1	0.5400	1.316

Level	Variables	B	Std. Error	Wald	df	Sig.	Exp(B)
5	Intercept	11.57	1.64	47.19	1	0.0000	
	Cost	0.07	0.36	0.04	1	0.8490	1.070
	Liquidity And Leverage	8.81	1.36	41.92	1	0.0000	6,721.588
	Profitability	2.04	0.45	20.15	1	0.0000	7.651
	Fixed And Total asset	-0.78	0.36	4.72	1	0.0300	0.460
	Payable Efficiency	-1.20	0.28	19.01	1	0.0000	0.302
	Collection And Payment	-0.33	0.24	1.88	1	0.1710	0.722
	Personnel expense	0.06	0.42	0.02	1	0.8890	1.061
6	Intercept	5.89	1.49	15.63	1	0.0000	
	Cost	0.06	0.35	0.03	1	0.8740	1.057
	Liquidity And Leverage	2.43	1.08	5.05	1	0.0250	11.408
	Profitability	0.96	0.41	5.59	1	0.0180	2.618
	Fixed And Total asset	-0.39	0.33	1.40	1	0.2360	0.675
	Payable Efficiency	-0.56	0.28	4.14	1	0.0420	0.570
	Collection And Payment	-0.81	0.31	7.03	1	0.0080	0.443
	Personnel expense	0.32	0.41	0.63	1	0.4270	1.379

The reference category is: 7.

BIOGRAPHY

NAME	Kritchalat Ninkarnjanakun
DATE OF BIRTH	29 May 1987
PLACE OF BIRTH	Surin, Thailand
INSTITUTE ATTENDED	Ubonratchathani University, 2007-2011: Bachelor of Engineering (Industrial Engineering) Mahidol University, 2011-2016 Master of Engineering (Industrial Engineering)
HOME ADDRESS	335 / 3-4, Nongdum RD., Muang Surin, Surin, Thailand 32000 Tel: 086-5698914 E-mail: vimpy_wooty@hotmail.com
PUBLICATION/ PRESENTATION	The Analytical Accuracy Prediction for Financial Warning Models between Multiple Discriminant Analysis and Multinomial Logistic Regression Analysis, The 12th Operations Research Network of Thailand Conference 2015 in Pattaya, Thailand (March 27, 2015).