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Using Mathematical Programming for Investment Assessment and Optimal Investment

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***Abstract*— The corporate goal of financial management is to maximize its profit, and investment by using financial management minimizes the risk of the investment. It is very critical for companies to find a way to maximize the benefits of the company. Companies in the economic situation need to improve their future value by making an investment. This paper aims to determine the optimal investment plan by using the mathematical programming method such as linear programming in investment. In this paper, the concept of maximization of profit is defined as the concept of financial management. In addition, it evaluates the direct investment plan for analysis with expected return and risk. The concept of investment decisions is also discussed. Finally, by means of linear programming in mathematical programming, it mathematically defines the investment plan, which is directly modeled to derive the optimal investment plan.**

Keywords*— *Financial management, Investment, Mathematical programming

I. INTRODUCTION

The business operation can be seen as profit maximization in the narrow sense. In the investment using the financial management to minimize the risk of investment, company profit maximization is very important. Investment may reduce the risk by providing analytically economic value in situations that do not know the future value, and lead to maximize profits. To do this, we optimized the investment proposal in this paper by using the mathematical programming method such as linear programming to evaluate the economics in the capital projects. Thus, this paper shows the significance of financial management in Chapter 2, the way to investigate the relationship between the rate of return and portfolio describing the risk of investment in Chapter 3. In Chapter 4, it suggests investment decision and how to optimize the investment proposal in mathematical programming method application in Chapter 5. Finally, the definition of the problem and optimized investment proposal by applying linear programming to define Weingartner problem and to model L.P (linear programming) will be shown. Then, the last analysis optimization to make an investment and the definition of the problem to deduct optimal solution will be introduced.

II. SIGNIFICANCE OF FINANCIAL MANAGEMENT

A. Financial Management field and Business Operation

Financial management evaluates the value of the company or marketable securities in order to increase its value. It is the study of what decision should be made. In the field of management, efficiently raising funds is required by the company, and research has financial management with a related theory and technology and able to operate the delegated funds efficiently. Since economics is the research that is based on the basic principle, it may be referred to as financial economics [2]. Modern financial management is divided into finance of companies and theory of investment, corporate accounting of them, dealing with the various factors of financial decision-making in order to achieve the goal of management which is the maximization of corporate value. In business finance, companies are the main subjects of analysis that financial decision is closely related to investment decision for themselves, capital finance and dividend decision making, company management structure and M&A(Mergers and Acquisitions). They can carry through liquid asset or manage fixed assets. According to the theory of investment after analysis of the securities market, portfolio theory can deal with the problem of equilibrium pricing of financial assets in the academic decisions of securities prices to study how they are done through CAPM, APT, options, futures, and so forth. It can regard consumers as funds and the market in which the provider is formed. Securities and shares are included in derivative financial instruments of debt and several types of securities market, the groups of corporate, and governments. It can be issued by the local governments and other organizations' securities, or markets to raise the necessary funds. However, it can be considered as the two fields, which are in fact the same principles applied by [1]. Analysis target of corporate finance is a company, the value of the analyzed securities of theory of investment, by investing in companies and securities, the obtained value is determined by the future cash flows [2]. Treasurers of companies, such as the collection of various types of financial data required for decision-making in connection with the cash flow, but will make some of the analysis activities, investment decisions, and capital procurement decision-making, so it is possible to make a decision. In order to maximize the corporate value, this paper introduces what type of investment decision can increase the asset and what the best decision-making is. It

can help to determine whether the assets a company owns might be increased by its investment activities. It is an important function in the debit side. The objective of this study also is that investment decisions of capital procurement are the maximization of corporate value. This is an important feature to represent the shape of the funds. The company has raised asset investment. When the corporation produces funds by issuing the stocks, there is a method to proceed in the borrowed capital. Financial managers consider pros and cons to perform optimization construction of equity capital and the borrowed capital that was capital procurement decision-making about capital financial matters. Finally, companies reinvest the cash obtained from operating activities in the business to become and to be paid as a dividend to shareholders. Financial officers need to consider how operating results and future investment opportunities affect to reinvest in many companies in case of paying a dividend to shareholders. It is necessary to decide whether it is possible to maximize the value and which the decision-dividend is. In this way, financial management is generally described as the center of the balance sheet. The reason is that the droppings of the balance sheet show the form of funding because the provided funds of debit indicate a situation that is operating [1]. The function of these financial managements is not independent of one another. The goal of financial management is that it has to achieve the objectives of the company, and has organic association of one another. From several views in the field of academics, the purpose of the company is the financial management that is dealt with in this paper. In addition, the maximization of corporate value is regarded as the goal of the company. Company shareholders, creditors, managers, workers, and local communities have a lot of stakeholders. These are to maximize the more difficult enterprise value, but it is impossible to maximize all the profits. It is a prerequisite for a company to survive in a competitive situation between companies. Maximization of corporate value specifically means that it can be seen to understand the balance sheet. It is displayed in the market value. The debit item in the balance sheet, all the assets of the type and the intangible is recorded in its market value. It is possible to see the total and corporate value. The total of the balance sheet, shareholders' equity and the borrowed capital have been registered in the market value. And therefore, the market value in debit and the market value of each asset are determined on the basis of future cash flows. It is possible to earn using its assets, the market value from the total market value and others capitals, and sum of the market value. Consequently, maximization of the market value may be a value obtained by maximizing the sum of the shares of value and liabilities [2].

B. Modern Financail Management of the Develop Process

Researches and interests in financial management have followed the same path as the history of the modern enterprise. However, an academic root of the current learning on financial management has been established since the late 1950s. The basis of decision-making of the investment has been completed by some scholars. Then, financial management, research related to dividends and capital structure, and portfolio theories have rapidly grown on the basis of such a service representative theory. Development of portfolio theory in the modern sense will be initiated through the paper of Markowitz, which was published in "Portfolio Selection" by Markowitz in the 1950s. Markowitz investors that made up for the portfolio risk figured out how the revenue considers the conflict relationship of income to prove whether or not it can be maximized in a systematic manner. Markowitz variation of the rate of return showed that there is something to be a good measure of the risk of the portfolio. The concept of efficient investment line was presented, and the relationship between the portfolio of risk and return was introduced. He showed the effectively diversified investment portfolio throughout the course of the optimization. In the 1960s, as theoretical studies in the field of financial management evolved the question, these theories are practical relevance. A database which can perform empirical analysis did not exist. However, CRSP database that stock material has been piled in the School of Management of the University of Chicago has been constructed. The empirical analysis, which was developed by Fama and his colleagues, were so unrealistic that there is a reality within the existing research results. While classifying the research, a new and improved theory had a major impact on the development of the theory. In 1970s, Black and Schloes developed an option pricing model, which it can be effectively manage the investment risk associated with factors such as raw materials' price volatility and interest rates, currency exchange rates. It brought an innovative turning point in the development of products. In the 1980s, Jensen and many scholars proceeded in the study to deal with the problems caused by conflicts of interest between the stakeholders of the company. Analysis of these agency problems, governance structure of the company, and the merger and acquisition market, of course, have had a major impact understanding of such decisions and dividend decisions of capital structure. In the late 1990s and later, the basic home is assumed in the traditional financial management considering human psychological factors. Students in the field of behavioral finance proposed the theory of investment that shows the relationship between pricing and investment behavior of assets. It has appeared in the new area [2].

III. RISK AND RETURN ON INVESTMENT

A. Rate of Return

General revenue information is conveniently expressed as a percentage rather than that shown in monetary. The reason is that investors actually depend on the magnitude of the amount of invested money in terms of the rate of return. Furthermore, as per investment unit, it means what can earn an income of $ 1 per ten thousand. Rate of return on investment can be calculated by dividing the total revenue and total loss won investment initial amount. This is, of course, the case of real investment. It can calculate the profits configured in the same way in the case of investment in the securities.

Investors acquire shares, but hold up to a certain point in time. It is assumed that when you dispose of the shares. Rate of return on equity during the period is in proportion to the total revenue. It was calculated by dividing the total amount of investment and was obtained by equity investment. The total revenue obtained by the equity investment during this period is composed of the sum of capital gains and dividends. Capital gains from the total sale amount is a variation of the stock price during the holding period and minus from the total investment. In regard to the stock price during the period, when a stock which investors hold will fall, there is the loss of occurred capital [6].

Rate of return on equity for this development is as following below.

$$R = \frac{P_1 - P_0 + D_1}{P_0} \qquad (1)$$

Here (1) P_0 the week of the price of an investment point, that is, at the purchase price, P_1 the week of the price of selling time, D_1 means the cash dividend during the holding period. Examples of the monthly rate of return, equity earnings ratio R_t of t month, $t-1$ calculated as of the final trading price of next to the sale of shares in the last trading price P_t of the t month is the acquisition of equity formula.

$$R_t = \frac{P_t - P_{t-1} + D_t}{P_t} \qquad (2)$$

Here (2) D_t in means the cash dividend that was paid every t month. Thus, yields were calculated by dividing the ROI into underlying price is referred to as a simple yield.

B. Expected rate of return and risk

The purpose of asset investments, which are able to obtain the future profits, in order to obtain high revenue through successful investments, it is important to predict the return which will occur in the future. However, in terms of the future rate of return in a future situation, it is difficult to predict the result because of uncertainty of the changes associated with each element. If there is revenue to expect when people make an investment in projects, it is only when it is the predicted average, and is not intended as a great deal of exact revenue is generated. When viewed from the future situation, or less than revenues had expected depending on the economic conditions, not only can a greater benefit, it could also be seen as any more losses. It makes a decision of analysis in the invested probability distribution, and revenue seems to occur with respect to it in such unsettled situation. The rate of return is the expected average in the investment, and expected rate of return is the sum of the value obtained by multiplying the probability of occurrence of a feasible rate of return situation when each situation has occurred. Each of the cities to return realizes through the boom and the recession, the expected rate r_1 and r_2 refer to the probability that P_1 return occurs in each situation and can be calculated as follows [6].

Future comes out that the result has not been decided to a single value, depending on future conditions. There is a risk that the result can show. Risks and results which come out in the future are generated in order to be uncertain. For example, when the expected rate in both the investments is assumed to be the same, since the revenue in the future has not been determined to a certain amount because of uncertainty. It can be seen to involve risks. However, the degree of risk in the investment is different. That is, depending on the cases of boom and depression, it is possible to intuitively determine the scale of risk in the investment. It is the same as measuring the uncertainty that has investment proposals to measure the risk. Uncertainty, the probabilistic concept can be measured as the rate of return variables depending on whether any future situation occurs. The degree of risk is also different while investments are different. The larger the degree is, the more widely the probability distribution of the rate of return has spread. It can be seen to be more dangerous than its investment plan and the extent of such probability distributions. It will be measured by the variance or standard deviation. The variance of the yield will be normally expressed as σ^2 the expected value of the difference squared value between the rate of returns on each situation is realized when it occurred and its expected rate of return. Standard deviation is expressed as σ^2 in the square root of the variance. Cities and respectively a return r_1 and r_2 realized boom and recession, and rather the probability that return occurs P_1 and P_2 in each situation, the dispersion can be calculated as follows.

$$\sigma^2 = p_1[r_1 - E(r)]^2 + p_2[r_2 - E(r)]^2 \qquad (3)$$

In other words, the variance is the intended rate of return that occurs in each situation to measure the extent of the variance from the expected rate of return. The greater the expected rate of return is, the larger variance is. In this paper, there is a high uncertainty of the expected rate of return.

Two types of results from investment proposals appearing in the future have not been determined in one value, depending on future conditions. On the contrary, the two or more types of results risk assets have possible future realization. The rate of return is reliable assets. In other words, risk-free assets expected rate of return. The rate of return in the future implements the same, so the question about what assets have no risk can be answered that the standard deviation of the rate of return is zero. In practice, it is regarded as assets with short-term bonds the government issued. For example, it is a yield of short-term financial securities that the United States government has issued. The reason about the short-term financial securities can be explained that the government low assets may not be able to meet its obligations. The received amount at maturity is fixed because there is no uncertainty in the nominal yield. In the case of Korea, it regards the rate of return on assets as the interest rates of certificates of deposit for three months maturity.

C. Expected rate of the portfolio and risk

Yield, to invest in one of the investment cannot or assets through the expected return and risk, how to measure the risk, it was possible to investigate whether measure risk superiority while not invest. But, realistically without having to invest in one of the assets, because if you want to invest in multiple asset occurs frequently, you will need to measure the overall risk when you invest in a number of investment.

Portfolio refers to a collection of assets. Investors are allowed to invest in assets that have been made by their own valuation. In the normal case, it would be invested in a number of assets. It refers to the entire portfolio of such investments. Where investment assets and securities other than shares, funds, deposits, real estate, precious metals, calligraphy, etc. are included subject to all of the investment. To invest in only one of the assets, and may be referred to as a special portfolio. In such a case, it regarded as a portfolio that consists of one of the investment assets.

Portfolio, by setting the specific gravity of the investment different for each individual assets, but may take on a variety of configurations, and can be frequently used special portfolio.

First, it is an equal-weighted portfolio. The specific gravity of the investment assets that are configured in portfolio refers to the case all equal. Then, it is worth a value-weighted portfolio. Refers to the portfolio that you allocate investments in proportion with market capitalization of individual assets. There is a market portfolio in the terms that are frequently used in financial management (market portfolio), and the market portfolio. It is worth to invest in the subject of all the investments that exist in proportion in this world on the value of each investment. It means a medium portfolio. However, it is used because valuation is difficult for all the investments, common stock and all stocks listed on the market, typically some of the stocks that have been described in the investment configuration portfolio as a substitute for the market portfolio. In the case of Korea, it is common to use KOSPI as a substitute for the market portfolio. The composite stock price index is one value which consists of all of the stocks. They are traded in the Korea Exchange securities market to represent the value of the medium portfolio in the index.

IV. INVESTMENT DECISION

A. Definition of capital budgeting

It is necessary for financial officers in enterprises to determine what investment in any assets can maximize the value of the company. Such decision for investment or capital budgeting can be made by a company, but will acquire a lot of assets for the expansion of existing businesses, acquisition of assets. It determines the earnings of companies, changes the value of the company. It is referred to obtain the assets from investment, and investment decisions of companies lead to their growth and are closely related to companies. The effect is particularly long-term investments. It has a significant impact on the growth of the company, the capital budget a comprehensive plan on these investments [2]. The comprehensive plan for investment is for the required investment in order to select a reasonable investment, and it includes various activities such as cash flow of measurement. However, capital budget in the financial field is usually used in a narrow sense. Measuring the cash flow of investment focuses on the process of making for the best investment decisions through the economic analysis. Most investments for capital budgets require more expenses in the initial investment by investing a large capital to produce facilities, companies. It can cause possible loss of liquidity. However, during the period, its flexibility which can switch the facilities installed for other purposes can be decreased. Thus, it will suffer a catastrophic loss if the investment fails, resulting in a large influence on the existence and growth. Additionally, the capital budgets can directly influence the corporate value. As a result, it can be seen as an important strategic decision, which is directly connected with the success or failure of business. Actually, the capital budget will require a lot of time as its process is too complex to fulfill. Depending on the circumstances which companies are facing, the process and way of the capital budget is different. Generally, Setting an investment purpose -> > not Settling several investment alternatives -> Estimating expected cash flow from each investment proposal -> Evaluating economic feasibility in each investment proposal -> Investment decision and execution [7].

B. Comparison of net present value method and internal of return method

In order to analyze the cash flow in the investment preferentially and to understand the financial statements of companies, financial statements include a table that has a summary of the same content as the financial condition and management achievements of companies through the accounting language. The accounting language will be used to organize the financing activities. The outcome is financial statements [6]. Financial statements in this way become a report that provides financial information about the company for the user of the company. Management results are included information such as financial condition change, the balance sheet, and comprehensive income statement. It is composed of a cash flow statement. In the balance sheet, the most important in the financial information can be obtained from the financial statements on the same concept as the existing balance sheet and a cash flow. On the basis of the benefits that business owners have calculated using the financial statements, the reality is that they make the investment decision. There are four problems. Valuation in the investment reflects the economic substance to which it must be carried out on the basis of the cash flow. First, net income could be a profit on the books. In the items of income and expense that are included in the process of calculation of net income, they contain the actual return items without cash income, and actual cash expenditure is not a cost item. Second, benefit is that it does not consider the expenditure as non-current assets. For example, if a company has a capital investment of 1 billion won, even though it has been that amount of cash expenditure, this would not a cost. Because the non-current assets is treated as spending has increased. Income statements did not have any effect on the profit, but actually companies are those one billion won, the cash was flowing out. Third, by accrual accounting principles that are recognized revenue and expenses when incurred, profits and cash flow a company has created is something that can be mismatch. If the company raised sales of 1 billion won in trauma, recognition point of sales is not a time to receive the money, because sales is a point in time that occurred, profits while not actually received the cash ,increase is processed as if fully set. Finally, the benefit is that it does not account for variations in net working capital. In net working capital compared to last year, when the more increased, it means that the current assets increased number compared to this current liabilities, and therefore, although he had additional cash, net it does not affect at all the profit calculation. Cache this net income, which is calculated in the income statement as the duration of one year, unlike the cash flow that has flowed to the company, and therefore valuation in the investment, which reflects the economic substance. It shall be performed based on the flow. And though not unless protect the two types of basic principles in estimating the cash flow principle independent evaluation increment criterion is that. ,, All cash flows required by capital budget, because the incremental cash flow of several investments that according to the standards of the increment result of selecting the investment proposed company generated directly, it refers to changes in flow. The principle of independent evaluation is that it takes into account only the investment ophthalmology-related cash flow, cash flow in the investment, operating cash flow, net capital expenditure, consists of three elements: variation of net working capital, is, the first operating cash flow, and the daily production of the company, is the cash flow generated from the sales activity. Net capital expenditure refers to the net expenditure by subtracting the sale in the purchase of non-current assets. Finally, the variation of net working capital, measured in net change amount of current assets compared to current liabilities that occurred during that period, we want to sense the amount of money that has been spent on the net working capital. In conclusion, the total cash in the investment can be calculated by subtracting the variation in net capital expenditure and net working capital operating cash flow.

V. MATHEMATICAL PROGRAMMING FOR INVESTMENT IN OPTIMIZATION THEORY

A. Theory of Linear Programming

It is an acronym of this Linear Programming to represent the linear programming method and the LP. The theory of linear equation all linear equation, that is those which can be represented linearly programming mean that programming, under the plan activities using several methods, other, production calculation technique of the one primary function to the maximum or minimum in the background, but activity plan, but broadly speaking is the most advantageous overall adjustment to each other related activities. Definition of mathematics, when the number of variables is subject to several limitations in the form of linear inequalities is an analysis of the problem of the linear first-order function of the variable to the maximum or minimum. Since the linear programming method is limited to the primary function, but it seems it would not deer be used only if it was limited, in around us, it is more about such problems immeasurable. For example, production planning, transportation planning, mixing planning, and many other types of corporate production activities and further can be applied up to the theoretical economic analysis. And to satisfy some of the constraints in many applications, it is very often to find the value of a variable what function is to have a maximum or minimum value. In particular, many if to be determined variables ,when considering matters condition often complicated, it is impossible to solve the problem at hand and estimates, to develop a mathematical model of the situation by using the model, it must be possible computational cost, while reducing, asked how to find a harm having the minimum or maximum. Linear programming can been studied after the mathematics is started, during the Second World War becomes necessary numerical techniques in order to optimize the use of strategies. Therefore, served by spurred the development, after coming beyond the digital age linear programming problem is important in the development of computer and made to be able developed optimization techniques seek rapid optimum solution it was supposed to get a lot of results. Linear programming problem, independent variables that are configured with a finite variable to satisfy the linear inequalities

and linear equations, with the optimization problem of determining the independent variable is a linear function of the objective function is to have the maximum or minimum value is there [5].

B. Optimizing investment

Definition of investment, we can rely on what kind of work and capital of the business in order to obtain the benefit, would pour time and mind. But investment can be obtained in the future revenue current economic expense, where important point, no one is that of not being able to confirm the future revenue. Compensation at the time of risk, such as the stock has invested in high assets, rather than some other reward , the higher the future uncertainty , is required to have more adequate compensation for the risk. At this time the compensation will be greater than the compensation for the risk is small investment, the degree of compensation will vary depending on the degree of risk of the investment. When investors to assess what investment proposal, it will be evaluated from the point of view of the risk associated with the investment and revenue expected from the investment. Investment risk is small, low expected rate of return, in order to increase the expected rate of return is the reverse, reciprocal relationships that unless underwriting an additional risk exists. And, therefore, from the investor's perspective, the expected revenue under risk given where possible is high, or I will be looking for a specified investment risk is less efficient under the expected return. Investors, in order to achieve these purposes, rather than a single asset, a plurality of assets, namely to invest Configure the portfolio, and not in relation to expected return and risk of individual assets portfolio ,the relationship between the overall risk expected return is an important concern. Traditional portfolio optimization problem is a problem of rate of return and risk will find the proposal of the business that reasonably constitute a balance. Investors hope that the risk for the current investment becomes increasingly less than in the past of the danger. Therefore, in this study, it is necessary portfolio model that can these investors needs are reflected. In the stock market there are many uncertainties, upon us to the same decision-making and to select the investment stocks, and to be called to select the option that provides the best results from among many choices ,how much serious thing is difficult, investors are aware. And, therefore, these stock market, accompanied by always danger. However, the stock investments which can be divided into systematic risk and non-systematic risk, in particular non-systematic risk, to the revenue investment, the diversification through the portfolio structure in order to obtain an ideal negotiation ,in, it can be lowered. Therefore, in order to disperse the risk of these cases, it is how to configure the portfolio, it becomes gather great interest of investors [2].

VI. LINEAR PROGRAMMING FOR OPTIMIZING INVESTMENT IN PROBLEM DEFINITION

A. Weingartner problem definition

For the formation of the solid financial structure of the company, it is essential to stable investment and project execution in consideration of the cash flow and the constraints of the tangible and intangible that the current companies are faced was. One solution that has been proposed as a measure for solving the problems on the business is just Weingartner problem. Weingartner problem is to consider the cash flows of the unit period. It is possible to efficiently model community of interest, selection variable projects, the inflow and outflow processes capital. Following this picture, by applying the Weingartner model, detailed cash from present situation on the project execution of the virtual enterprise in the flow chart of the processed virtual enterprise of cash for the optimization in the investment [4].

TABLE Ⅰ CASH FLOW THAT PERFORMED THE PROJECT IN THE VIRTUAL COMPANIES

		Project					
Variable type		1	2	3	4	5	6
Cash flow	0	-$1,000	-$1,200	-$2,000	-$2,500	-$3,000	$1,000
(each periods)	1	-$2,000	-$2,400	-$2,100	-$1,300	$900	-$700
	2	$2,000	$2,500	$3,000	$2,000	$1,400	-$700
	3	$2,900	$3,567	$2,621	$2,000	$1,600	$0
	4	$0	$0	$0	$2,000	$211	$0
	5	$0	$0	$0	$2,296	$0	$0
$\hat{a}_j$		$2,417	$2,973	$2,184	$4,384	$1,480	$0
Budgets (M_n)			n = 0		n = 1		n = 2
			$3,000		$5,000		$4,800
Lending rates			n = 0→1		n = 1→2		n = 2→3
			20%		20%		20%
Borrowing rates			n = 0→1		n = 1→2		n = 2→3
			20%		20%		20%

Project execution period in period 0, period 1, period 2 budget $ 3,000, $ 5,000, $ 4,800 each period, interest rate of the loan and rental, there is no limit, in the company are using 20% of the interest rate. Time horizon is up to period 2 to determine the value of the investment assets, try to maximize the total amount of cash at this point. However, most of the project has a still cash flow later period 2 the cash flow after period 2 change by applying a discount rate of 20%, at the time of the time

horizon. $\hat{a}_1$ is cash inflows in the period 3 point of project 1 ($ 2,900) 20% discount is applied per group, this can be seen in the $ 2,900 / (1 + 0.2) = $ 2416

$$
\begin{aligned}
&\underset{x_j, v_j, w_j}{Max} \sum_j \hat{a}_j x_j + v_N - w_N \\
\text{s.t.} \quad & -\sum_j a_j x_j + v_0 - w_0 \le M_0 \\
& -\sum_j a_{nj} x_j - (1+r)v_{n-1} + v_n + (1+r)w_{n-1} - w_n \le M_0, \quad n = 1, 2, \cdots, N \\
& x_j \le 1, \quad j = 1, \cdots, J \\
& x_j \ge 0, \quad j = 1, \cdots, J \\
& v_n w_n \ge 0, \quad j = 1, \cdots, J
\end{aligned}
\tag{4}
$$

The objective of type about this Weingartner time horizon model it can be seen as the sum of cumulative current assets period 2($v_2 - w_2$) and cash flow after period 2

($\hat{a}_j$). Cash flow equation is similar to the concept of the suspension present value, this is the role of constraints in the mathematical programming model for the optimization of cash flow. Constraints on Weingartner model can be expressed as follows. Present value (outflow of cash due to project execution + repayment including the current loan + interest – loans and interest payments of the previous period – the current loan) must be at the outside of the following investment. Model is included nonnegativity constraints.

B. LP modeling and optimal solution….

Given cash flow of information with the linear programming method Weingartner problem on the basis of the constraints, it is as follows.

LP

$$
\begin{aligned}
&\text{Max} \quad \$2{,}417x_1 + \$2{,}973x_2 + \$2{,}184x_3 + \$4{,}384x_4 + \$1{,}480x_5 + v_2 - w_2 \\
&\text{s.t.} \\
&\$1{,}000x_1 + \$1{,}200x_2 + \$2{,}000x_3 + \$2{,}500x_4 + \$3{,}000x_5 - \$1{,}000x_6 \\
&\qquad + \quad v_0 - w_0 \le 3{,}000 \\
&\$2{,}000x_1 + \$2{,}400x_2 + \$2{,}100x_3 + \$1{,}300x_4 - \quad \$900x_5 + \quad \$700x_6 \\
&\qquad - 1.2v_0 + v1 + 1.2w_0 - w_1 \le \$5{,}000 \\
&-\$2{,}000\text{x}_1 - \$2{,}500x_2 - \$3{,}000x_3 - \$2{,}000x_4 - \$1{,}400x_5 + \quad \$700x_6 \\
&\qquad - \quad 1.2v_1 + \text{v}_2 + 1.2w_1 - \quad w_2 \le \$4{,}800 \\
&\qquad x_1 \le 1 \\
&\qquad\quad x_2 \le 1 \\
&\qquad\qquad x_3 \le 1 \\
&\qquad\qquad\quad x_4 \le 1 \\
&\qquad\qquad\qquad x_5 \le 1 \\
&\qquad\qquad\qquad\quad x_6 \le 1 \\
&\text{all} \qquad x_j \ge 0, \qquad j = 1, \ldots, 6 \\
&\text{all} \quad v_n, w_n \ge 0, \qquad n = 0, 1, 2
\end{aligned}
\tag{5}
$$

In Fig 1, we derive the optimal solution through the original to LINDO program the specified cash flow of information and constraints above obtained through modeling by the linear programming method Weingartner problem that is

based on the formula. x is the decision variable of the project to maximize benefit of company when investment is project 1, 2, 4. In this case, v and w, as current assets, but each means loans and loans, that figure is to say current assets at that time. In this data, the time horizon that judgment the value of investment assets because it is up to two terms, is the point of view of current assets also fit two terms.

Therefore, v is possible by loan assets have in loan two terms $ 8012, and can be seen as profits by using 20% of interest. In order to advance the project, it needs current assets loans, but this is by financing the Stage 0 $ 1700, Phase 1 $ 2740, must invest in the project. If even require loans two terms, the project cannot be seen to be optimum with no investment. Therefore second term loans must not, as seen in the picture< 1 >. In conclusion, it is invested in projects 1, 2, 4 times can create the benefits of maximum value as a company. Virtual enterprises can obtain a total $ 17,786 in period 2.

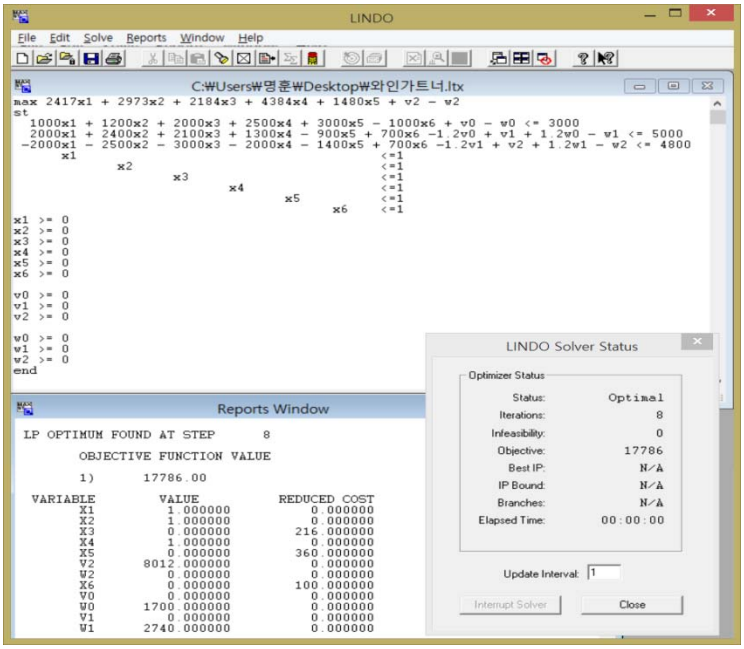

Fig 1. Lindo Program

VII. CONCLUSION

The company goal of financial management is to maximize its profit. In economy situation, companies grasp their capability and derive to maximize future value through the investment. This research aims to grasp the investment proposal by mathematical programming and to determine the optimized investment proposal. This research, as mentioned above, was defined through the concept of financial management. Specifically, the concept of maximizing profit is the ultimate goal of the enterprise. Also, evaluating investment proposal directly, based on the concept of investment decision, expected earnings and risks by analysis. Lastly, it applies the linear programming of mathematical programming to the definition of investment proposal mathematically. Besides, this paper models the investment proposal and draws optimized investment proposal. The critical point is that the research has not reached to dual problems. Also, at the beginning step of this research, it was planned to model the investment proposal with Gauss-Jordan method and simplex method to make this research mathematically. However, it was not fulfilled, so this point is the weakness in this paper. The future plan is to design the optimal investment plan based on the actual financial statements of companies by using Gauss-Jordan method and simplex method.

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