5-20-2011

Developing A Rule Based Expert System For Non-Experts In Financial Decision Making

Zahid B. Zamir

Dakota State University, zbzamir@pluto.dsu.edu

Developing A Rule Based Expert System For Non-Experts In Financial Decision Making; With special reference to the stock market investment

Zahid B. Zamir
Dakota State University
zbzamir@pluto.dsu.edu

ABSTRACT

The Problem of deciding on the part of a consumer or a novice individual investor when to invest in the stock market and how to select what company's share to buy in order to be able to get a good portfolio growth in the highly volatile stock market demands the development of expert systems for the novice investors. Many earlier studies have demonstrated how expert systems enhance the performance and decision making capability of managers and employees in an organization. This paper suggests development of a rule based expert system that will formulate rules by accumulating the knowledge of an expert in the field based on companies' earnings per share, measurement of risk associated with each company share, ratio analysis for those selected companies, and trend analysis of performance for those selected companies over a number of years. This paper also demonstrates once the proposed artifact is created how it should be evaluated from time to time so that it can always assist novice investors in making better decisions in a highly complicated and fluctuated stock market of today.

Keywords
Expert System, Financial Problems, Stock Market.

INTRODUCTION

To get a good return from an investment depends on the ability to make good decisions and also making them on time. Although the institutional investors spend most of their time in routine and complex decision making process as to maximize the return on the investment that they are going to make given the expertise that they have in that field, a novice (Non-expert) individual investor who lacks knowledge and expertise in the field cannot and will not be able to make wise decision before making any investment decision specially investing in the very volatile stock market. Just like an organization, success of an individual's investment in any project depends on the ability to make good decisions. Unlike a novice investor, an investor who is well-informed and also understands the importance of stock research can benefit from the researched and well-investigated information in their daily investing decisions. The motivation of this research primarily comes from an immense need of developing a rule based expert system in financial decision making which will reduce the cost, time, and thereby helping novice investors investing in stock market which will eventually help increase the portfolio growth of an investor. This paper is therefore aimed at suggesting a rule based expert system in financial decision making with special reference to investing in stock market that can solve complex financial problems by incorporating both the structured and unstructured financial problems. Expert systems are software packages that codify the knowledge of a recognized expert into a program so that user can share this advanced understanding in making operations decisions[2]. Rule based expert system has the ability to imitate the tactic and presentation of human domain expert and to provide quality performance in a problem domain just like an expert in the field [5], [6]. If a novice investor comes to know the information and knowledge provided by the expert system then a novice individual investor can then use business information and expert knowledge in deciding how and where to invest in order to get a good return.

LITERATURE REVIEW

Financial institutions have been using different artificial intelligence (AI) systems for quite some time because of their ability to enhance human productivity, thought process and thereby providing a cost effective solution in managing assets, investing in the stock markets and performing other financial operations. Among the different artificial intelligence systems, expert system is widely used in the financial market for diagnostic and prescriptive solutions [6]. Shaw and Gentry(1998) developed an expert system based on rules that mimics the thought process of a lending officer at a commercial bank. Their user friendly expert system can help lending officers, credit analysts, and loan review committees to improve the evaluation of loan applicants[11]. Plath and Kloppenborg (1998) demonstrated that expert system can help commercial banks' loan managers make better decision and also help improve human productivity[9]. Development of an expert system in a support

role can help users make better decisions [3]. Yiu and Kong (1992) have developed an expert system in financial decision making by identifying some criteria and methodologies for selecting the appropriate problem domain [12]. Ragothaman, Naik and Ramakrishnan (2003) developed an expert system that employs uncertainty representation and predicts acquisition targets. They have outlined the features of machine learning tools (IXL) that was used to induce rules [10].

IT ARTIFACT

Artifact that will be developed in this paper is the rule based expert systems using the production systems model for data driven problem solving. The design of this model must seek to meet the following objectives: i) provide the list of companies based on the earning per share basis, ii) measure the risk associated with each company share iii) Provide a ratio analysis for those selected companies, and iv) Provide a trend analysis of performance for those selected companies over a number of years.

Earnings per share is an important determinant in investing in the stock market as it represents residual income to the stockholder that is paid out in the form of dividends or reinvested to generate future profit and dividends [1]. In analyzing the companies listed on the stock market, expert system must also be able to measure the risk that is inherent in the company's operation. Financial ratios provide an important indicator in stock market investment. Financial ratios such as: Profitability ratios in terms of profit margin, return on assets, and return on equity, Asset utilization ratios in terms of receivable turnover, fixed asset turnover, and total asset turnover, Liquidity ratios in terms of current ration, and quick ratio, Debt utilization ration in terms of Debt to total assets, times interest earned and fixed charge coverage are used to weigh and evaluate the operating performance of a company [1]. Trend analysis is another important factor in deciding whether to invest in a company because what happened in the past will give an idea about what will happen in the future and the proposed expert system must be able to incorporate the trend analysis of a company over a number of years in its knowledge base and formulate them into rules.

The efficient market theory is the theoretical basis for the proposed IT artifact (rule based expert systems) designed to help novice investors in investing in the stock market. Efficient-market theory states that stocks in general should be traded based on their real value and a market is said to be efficient if prices in that market reflect all available information [1].It is expected that through the efficient market theory, above mentioned requirements will be addressed in designing the rule based expert systems.

Leonard-Barton and Sriokia (1998) demonstrated how a rule based expert system can reduce the time devoted to the analysis and improve the decision making process that can substantively benefit the user of the system. Rule based expert system is considered to be one of the oldest techniques for presenting domain knowledge in the expert system. Rules that are represented in the form of IF…then usually referred as productions in an expert system and are the most popular way of representing and manipulating knowledge in expert systems [5]. Most of the design research papers, in relation to the development of an expert system, use experimental method in a simulated business environment to help designers avoid any unrealistic user expectations [3].
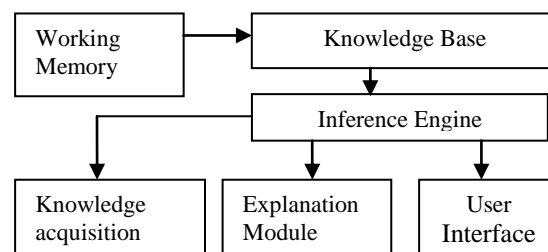

Figure 1.(Derived from the diagram presented in Luger & Stubblefield (1999) and Yiu & Kong (1992).

The proposed IT artifact will have the following components: Working memory, knowledge base, inference engine, knowledge acquisition, explanation module and the user interface. Knowledge base is considered to be the heart of an expert system, where all Rules with the help of experts in the field and the knowledge engineer will be stored. The reliance on the knowledge of a human domain expert for the system's problem solving strategies is a major feature of expert systems [9]. Knowledge engineer, as an expert system designer is responsible for implementing the knowledge of the domain expert in a program that is both effective and seemingly intelligent in its behavior [9]. Inference engine in an expert system applies the knowledge to the solution of actual problem by examining the rules in the knowledge base. Knowledge acquisition subsystem captures the knowledge from an expert and explanation module explains how an expert system comes up with the solution.

Here are some of the rules that are part of the hundreds of different rules to be stored in the knowledge base in order to help a non-expert investor make a better investment decision. Prolog software is widely used to formulate the knowledge into rules and store them in the knowledge base because of Prolog's easy implementation, forward and backward chaining control structure, straight forward logic, low cost as well as its ability to make inferences or deductions from sets of facts and rules.

rises (bond price) :- falls (interest rate).

falls (bond price) :- rises (interest rate).

falls (interest rate):- rises (dollar value).

rises (interest rate):- falls (dollar value).

buy (bond):- falls (bond price).

falls (investment):- rises (interest rate).

rises (Investment):- falls (interest rate).

rises (interest rate):- rise (stock price).

falls (interest rate):- falls (stock price).

To run this knowledge base, a data driven approach or a backward chaining system will compare the contents of working memory with the conditions of each rule in the rule base using the ordering of the rule base and if the data in working memory supports a rule's firing the result is placed in the working memory and the control moves on to the next rule [8]. Using the backward chaining system, if a piece of information that makes up the premise of a rule is not the conclusion of some other rule then that fact will be deemed "askable" when control comes to the rules where that information is needed [8].

The complexity in the financial market requires an expert system that will not only be able to understand the expert knowledge but also be able to formulate rules based on the four objectives explained above so that it can provide the best possible solution to the novice investor given the economic condition prevalent at that time.

EVALUATION

Evaluation is needed to check the correctness of the proposed rule based expert system based on the user's requirements. I plan to evaluate my proposed IT artifact from both micro and macro perspectives. As part of micro evaluation, each rule in the knowledge base will be evaluated in which the design will be exercised by the designer. Once the program is written, it is necessary to refine its expertise through the process of giving it example problems to solve, letting the domain expert criticize its behavior, and making any required changes or modifications to the program's knowledge [9]. As part of macro evaluation any deviation from the expectations (whether the expert system not only provide the solution based on the rules stored in the knowledge base of the expert system, but can provide the list of companies based on price per share, measure the risk associated with each company share, provide a ration analysis for those selected companies, and provide a trend analysis of performance) must be explained from quantitative and qualitative perspectives. Evaluation will also include the comparing artifact's functionality with the solution objectives, verifying the rules entered in the knowledge base, quantifiable measure of system performance, such as response time of the system and the availability of the rules.

FUTURE RESEARCH AND CONCLUSION

Although Expert system is being widely used in the financial market to help make better decisions, it is yet to be seen how a complex problem such as investing in the highly volatile stock market in a prudent way ,can be solved using existing systems. It is highly expected that an individual or organization will benefit from the proposed system. In an investment venture there are different types of risk that must be taken into consideration in developing an expert system such as: Interest rate risk, timing risk, purchasing power risk as well as shortfall risk [4]. In a world of increasing complexity and uncertainty, as for a novice investor, knowing where to get the right information at the right time is of paramount importance especially when it comes to investing in the stock market. A well designed expert system can process the information on companies and can help investors make well-informed investing decisions. Cognitive biases of the stock market investors can sometime cause the prices to fluctuate. Hence there is a need for further research as to how the social and affective influence contributes to the volatility of the stock prices. Further Research should be conducted to identify the variables related to cognitive biases and rules related to those should be formulated and stored in the knowledge base of the expert system so that system can solve complicated financial problems in relation to stock market and guide the novice investors accordingly. In any case, an expert system must take into account both the realistic and unrealistic expectation of expert system users.

REFERENCES

1. Block, Stanley B., and Hirt, Geoffrey A. *Foundations of Financial Management*. McGraw-Hill Irvin, New York, USA, 2008.

2. Dawe, Richard L., "Why not Use Expert Systems?", *Transportation and Distribution* (35:5), May 1994.

3. Edwards, JS, Duan, Y., and Robins, PC., "An Analysis of expert systems for business decision making at different levels and in different roles", *European Journal of Information Systems,* Vol. 9, 2000, pp. 36-46.

4. Green, Alexander., "Four investment risks you cannot avoid", Chief Investment Strategist Monday, October 18, 2010, derived from the web site; http://www.investmentu.com/2010/October/four-investment-risks-you-cant-avoid.html.

5. Gulati, D., and Tanniru, Mohan R., "A Model-Based Approach to Investigate Performance Improvements in Rule-Based Expert Systems", *Decision Sciences* (24:1), Jan/Feb 1993, pp. 42-59.

6. Haag, Stephen., and Cummings, Maeve, *Management Information Systems for the Information Age*, McGraw-Hill Irvin, NY. USA, 2010.

7. Leonard-Barton, D. and Sriokia, J.J., "Putting Expert systems to Work." *Harvard Business Review* (march/April 1998), pp. 91-98.

8. Luger, George F., and Stubblefield, William A., *Artificial Intelligence; Structures and Strategies for Complex Problem Solving*, Addison Wesley Longman, Inc., MA, USA, 1999.

9. Plath, Anthony D., and Kloppenborg, Timothy J., "Do Expert Systems Help Make Better Lending Decisions?", *Journal of Retail Banking* (11:4), Winter 1989, pp. 27-37.

10. Ragothaman, Srinivasan., Naik, Bijayananda., and Ramakrishnan, Kumoli, "Predicting Corporate Acquisitions: An Application of Uncertain Reasoning Using Rule Induction", *Information Systems Frontiers* (5:4), Dec 2003, pp. 401-412.

11. Shaw, Michael J., and Gentry, James A., "Using an Expert System with Inductive Learning to Evaluate Business Loans", *Financial Management*, Autumn 1988, pp. 45-56.

12. Yiu, Kenneth L.K., and Kong, Andy W.K., "Choosing The Correct Expert System Development Method For Financial Decision-Making", *Journal of Systems Management* (43:11), Nov 1992, pp. 16-43.