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Article

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Financial Literacy of Youth. A Sensitivity Analysis of the Determinants

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Abstract

This paper reports on the potential use of Neural Network as a sensitivity modeling tool for the determinants of financial literacy. The financial literacy modeling in this research has been attempted to measure the literacy of youth in the Australian society with respect to their financial knowledge of Credit Cards, Loans and Superannuation (Pensions scheme in Australia that allows for choice of funds and investment decisions by the member). Based on the financial literacy related parameters, Neural Networks results showed good promise and capability for efficient financial literacy determinants, and represent a potentially robust and fault tolerant approach. The findings indicate that the determinants of credit card are significantly dependent on a student's year of study, credit card status and daily routine, which has a strong relevance to respondents' knowledge of credit cards. (n=1070; 9.0070 and 10.5898 respectively). This study did not have the intention to explore the skills of youth in order to measure the level of financial literacy but the objective was to test the basic financial knowledge of key products that is common to youth in Australian society. In so doing, the researchers were keen to identify the determinants of financial knowledge.

Keywords: Financial Literacy and/ or Knowledge, Youth Finance, Credit Cards, Superannuation

JEL classification: I22 and G18

1. Introduction

Financial literacy has been an issue in many countries including developed and westernized societies. The cost of low financial literacy rates is substantial for the society and has been clearly identified by researchers (Joo & Garman: 1998, Cuter & Delvin: 2000). This paper reviews the definitions and reports on financial literacy among the different studies as well as reviewing the various researches on this important topic. The motivation for this study is due in part to the extensive research done in Australia by commercial banks with an interest on the Australian society's knowledge of financial issues. The importance of financial literacy was addressed by the Australian federal government through the Consumer and Financial Literacy Taskforce (2004) and thus, committed substantial resources to the development of a literacy foundation.

The perimeters and definition of financial literacy in this study attempts to understand the literacy of youth in our Australian society with respect to financial decisions on Credit cards, Loans and Superannuation.

The above topics are limited in order to contextualize the issues in relation to the youth between the ages of 16 and 24. The first part of the paper reviews the definitions of financial literacy. This is followed by a review of literature on the issues of financial literacy. Following the literature review, the methodology of the study is explained. Discussion of the findings and future research is in the fourth section of this paper.

2. Defining Financial Literacy

Financial literacy is defined as the 'ability of an individual to make informed judgments and to take effective decisions regarding the use and management of money' (ASIC: 2003, Noctor, Stoney and Stradling: 1992). A more comprehensive definition appeared in the Journal of Financial Service Professionals which stated that 'personal financial literacy is the ability to read, analyse, manage and communicate about the personal financial conditions that affect material well being' (Anthes: 2004). From the many definitions of financial literacy, a few important paradigms have been considered in this study, namely the individual, level of financial knowledge and informed judgments. In terms of the individual, one has to consider that not everybody requires or need

the same level of financial knowledge. With respect to the level of knowledge and informed judgments, it is important to be aware that developed societies such as Australia, the UK and the USA tend to have financial products that are complex in their make up with diverse scenarios applicable to different financial needs. This environment facilitates a plethora of financial products that can create uninformed decision making among consumers due to simply the complexity of technical jargon and competition among financial institutions.

3. Literature review

The financial literacy construct is very broad in that it does not specify the areas to which it is to be quantified. For example, it may be inappropriate to conclude that an individual is financial illiterate if they lack the knowledge of credit card interest rates or minimum balance payment; for that person may simply not believe in being in a debt situation or lifestyle. There are some sections of the society that do not concur to a debt lifestyle and may not be aware of credit card issues or loan interest rates such as compound interest or effective interest rates (EIR). Therefore, the definition of financial literacy does not identify the level or depth of an individual's literacy; therefore, it can be construed as being the least delineated construct. As stated by Mason and Wilson (2000), that there is an inadequate conceptualizing of financial awareness, this is due to the synonymous use of the term to mean financial awareness. Studies have shown that financial literacy does not mean that a person would be able to make the right financial decision, as that person may not be familiar with the financial awareness of the financial construct or particular instrument (Marriott and Mellett: 1996). Similar to the tests of Marriott and Mellett, there are a number of such tests and learning programs administered or established by financial institutions, governments and citizens websites. One such test revealed significant differences in the statistical analysis when structured modeling were applied to the data as compared to treating the evaluations as independent and disregarding the inherent correlation structures can result in erroneous conclusions (Fry et al.: 2006). In this study, the authors are applying similar modeling structure i.e. neural networks.

It has been shown that stress is a resultant feature of financial illiteracy. Research studies suggest that financial stress is common among low-income families

(Worthington: 2006), however there is no evidence to suggest that these low-income families are financially illiterate. Financial stress could be related to many social issues such as unemployment, large families and poor economic conditions. However, the authors would argue against the classification of financial literacy purely based on a questionnaire, test or in depth surveys conducted on individuals. The study conducted by Chen and Volpe (1998) can be criticized on the grounds that it was an accounting test with complex financial terminology. Stereotyping non-business major students as having a lower level financial illiteracy can be seen as being harsh especially when these students may not be financially knowledgeable in all aspects of financial matters.

The complex nature of a variety of accounts that are offered as differentiated products by financial institutions can be ‘mind boggling’. In the current financial world there is a web of financial terminologies such as Annualized Interest Rate (APR), compound rates of interests and hybrid rates. There is also a plethora of products that involve fine prints and legal clauses that even a professional would struggle to comprehend. The youth of today is faced with financial intricacies such as interest rates, complex nature of repayments options and investment options when they apply for loans or credit and even when they want to save for the future.

In Australian society as is the case in most western democracies, from the age of 15, a typical teenager learns to drive, starts part time work and receives superannuation (pension) from the employer of the minimum statutory requirement of 9%. At 18, the youth buys a car, gets a credit card (normally offered through promotion by banks with special rates to university students) and works longer hours and or studies full time or part time. This scenario is typical as the youth is involved in complex and highly responsible and possibly demanding situations and has to make financial decisions on income and expenses, budgets and future investments.

In a major review of the Banking Code in Britain by Atkinson and Kempson (2004), it was disclosed that there were 6 million youth; most of them are single and living at home. Approximately, half of them are in full time employment and the rest are in full time education. The following is a summary from the review of the literature pertaining to youth between the ages of 16-24:

- Banking relationships normally start when they move into work
- Common financial products are current account, an overdraft facility, a credit card and a savings account
- Half of youth surveyed had an overdraft facility
- 83% had a current account, 50% had overdraft facilities and 34% had credit cards.

As is the case in the UK, Australian youth debts levels are also a major concern, in a major study by the ANZ in 2003 found that low levels of financial literacy was associated with low levels of employment, single and ages between 18-24 (ANZ:2005).

In the USA, undergraduate students carried an average of three credit cards and had an average credit card debt of \$2,327 in 2002. This was a 15% increase since 2000 (Nellie Mae: 2002 cited by Tucker, J.A. (2003).

Financial literacy can be considered to be low among youth as most of the research had shown that it was due to the level of complexities and variety in the financial world. On the other studies in the UK have shown that numeric skills are also low among youth (Atkinson & Kempson: 2004). Numerical skills are important in assisting the understanding of financial skills. There is support in many countries such as Australia and the UK to have financial skills taught at middle school levels across the curriculum (ASIC: 2003, Atkinson & Kempson: 2004). This could be achieved in the mathematics syllabus when students are taught financial terminologies such various types of interest rates. Such studies should be compulsory for all students regardless of their streams of studies or careers.

In this research, students at a major institution from all faculties were randomly chosen to participate in the research. The questions were not typically based on testing financial skills but knowledge of key financial aspects relevant to youth. The instrument endeavors to capture the level of knowledge held by the respondents. It is envisaged that the study would reveal the respondents in depth knowledge with respect to credit cards, superannuation and loans based on descriptive and characteristic variables of the respondents. Through neural network techniques, the researchers were confident that this study would reveal

the relationships between the 17 input variables that included the basic knowledge and characteristics of the respondents.

4. Research methodology

This paper examines the potential use of neural networks to analyse the data (n=1010) on financial understanding of youth at a major Australian university. This technique captures the relationship between education, financial independence, work status, financial stress, age, gender and marital status and financial variables such as Loans, Credit cards and Superannuation.

Neural networks may give accurate predictions of future events or recommend decisions that turn out to be reasonable, but they cannot explain how they arrived at the results or why they should be trusted. Many users find this disconcerting, especially since other decision support tools have at least some explanatory capability. Causal decision models, such as mathematical programming models and simulations can provide information describing the consequences of a change in a proposed parameter, and certain intelligent systems can call on their internal symbolic structures to explain the chain of reasoning that led to a particular conclusion.

Several attempts have been made to provide the same functionality in neural nets. Measures of the relative importance or relative strength of inputs to the net have been developed. If the connection strengths associated with a particular input and output are large relative to the other weights, these measures report a high degree of importance or strength.

Neural networks have been criticized for their lack of explanatory capability. Unlike traditional statistical methods, it is difficult to interpret the significance of the input variables and understand the role played by the elements in the hidden layer. Various researchers have attempted to identify the contribution of various components of the network. For example, Barlett (1994) used entropy to compute the Information Theoretic Interdependency Analysis (ITIA) to measure the association between the input and output of the net. In order to assess the contribution of the input variables, Yoon *et al.* (1993, 1994) and Garson (1991) have developed measures based on the input-hidden layer and hidden-output layer connection strengths when the net stabilizes in training.

The networks used for Financial Literacy Modeling consist of a 17 unit input layer variables, more than 30 unit for two hidden layers and a six unit output layer trained using back-propagation. If we attempt to process elements in the hidden layers, it will be challenging. Removal of features method is the suggested method for this study. This means the 17 input candidates will be removed from training and classification. A variation in the contributions for a particular feature over different networks may also indicate that the given feature is not important in the classification. It is also possible that only the features with large contribution are useful.

The survey instrument was administered as a paper version initially to university students in the business and non business courses from Monash University. While financial academics can write any amount of multi-choice questions to test financial knowledge and skills, researchers have to keep the questionnaire as brief as possible in order to capture the general themes that can identify the minimum level of financial literacy. Therefore, the approach taken in this study is not to test specific financial questions but general and basic questions applicable to the general population of youth.

Under the credit card section the questions asked were not to test the specific knowledge but the range between the correct answer and the wrong answer. Other questions in this category looked at whether the respondent is aware of interest being charged for cash withdrawals, the interest free period days and the minimum monthly payment rates.

Superannuation is similar to pensions in the UK and USA. The marked differences in Australia is that every employer has a statutory obligation (currently 9%) to contribute into a super fund for his employees. This fund can be self managed or institution managed. In either way, individuals have full choice in deciding how and where their funds are to be invested and in a wide range of financial options. As such the Australian youth need to be fully informed of their rights and choices that would affect their retirement benefits. Under this section the questions are sought on the knowledge of respondents on the balance of their accounts, administration charges by fund managers, return of their funds and co contribution incentives.

On the section of loans and savings, the respondents had to answer questions in relation to knowledge of interest rates, difference in interest rates between personal loans and credit cards, ability to save , budget and knowledge of savings interest rates.

Descriptive and frequencies of data analysis

Applying SPSS, the following table details the descriptives of the analysis.

Table 1 Descriptives of the population

| Descriptives | % | | Descriptives | % |
|---------------------|----------|--|---------------------|----------|
| 17-20 | 60 | | Living at home | 70 |
| 21-23 | 30 | | Credit card | 35 |
| 24-26 | 6 | | Mobile phone plan | 65 |
| above 26 | 4 | | Personal / Car loan | 10 |
| Male | 44 | | Budget | 53 |
| Local | 75 | | Fulltime work | 5 |
| 1st year | 40 | | Parttime work | 28 |
| 2nd year | 29 | | Casual | 37 |
| 3rd year | 16 | | Not working | 31 |
| 4th year | 8 | | Business course | 54 |
| 5th year | 7 | | | |

The biggest age group is from 17 to 20 years old. Males were 44% of the respondents. This study revealed that 70% of students in this study were living at home. 35% of the students had a credit card and only 10% had a personal or car loan. As for work status, a large group worked on a casual basis (37%) and a large proportion of students did not work at all. The analysis does seem to show a positive picture of the student profile of this university. The profile of the university as being an established and a well renowned educational institution attracts high achieving students. As this study is concentrating on the age groups between 16-24, data from age groups between 25 onwards were ignored. The age group that was ignored accounted for less than 10% of the data set.

Removal of Features:

Three training runs were carried out (Table 2), Credit Cards, Loan modeling. 17 inputs were selected and will be removed one by one to testing the different results before and after removal. The percentage of contribution will be calculated by the rule below:

$$Contribution\ of\ Input_i = \frac{\max(results) - result_i}{\sum_{i=1}^{i=17} \max(results) - result_i}$$

Where max (results) is the results with all the inputs and it did display better results than any other result combination after removal.

Table 2: 17 inputs (coded) from questionnaires.

- | | | |
|-----------------------|-------------------------------|--------------------------|
| (1) Age (AG) | (7) Employment Length (EL) | (13) Budget Status (BS) |
| (2) Gender (GN) | (8) Living Status (LS) | (14) CSP (CS) |
| (3) Student Type (ST) | (9) Marital Status (MS) | (15) Work & Study (WOS) |
| (4) Study Year (SY) | (10) Credit Card Status (CCS) | (16) Hours for Work (HW) |
| (5) Course (CO) | (11) Phone Plan Status (PPS) | (17) Daily Routine (DR) |
| (6) Work Status (WS) | (12) Loan Status (LO) | |

Survey questionnaire

The survey was based on the following inputs;

(1) Age of respondent ranges between 16 to 24, (2) male or female, (3) student type is based on international or local, (4) study year ranging from 1-5 years, (5) course is based on business or non business only, (6) work status is full time or part time work, (7) length of employment 1- 2, 2-3, 3-4 and 5 years or more, (8) living status is at home or others, (9) marital status is based on married, single or de facto, (10) credit card status is based on ownership, (11) phone plan status is based on phone plan or otherwise, (12) loan status is based on possession, (13) budget status is determined by action, (14) CSP is the possession of government subsidized student fees debt or otherwise, (15) work & study is based on the effects of working on studying or otherwise, (16) hours of work is based on less than 10, 11-20 and more than 20 hours, (17) daily routine is based on the effects of financial stress on daily routine of students or otherwise.

John et al (1994) gave the following definition for the relevance of features in a classification and a method for feature selection using induction algorithms (Table 3).

Table 3: Definition for the relevance of features

| | |
|---------------------------|--|
| Strongly relevant feature | The feature is necessary and can not be removed without decreasing the number of correct classification. |
| Weakly relevant feature | The feature sometimes contributed to the classification. |
| Irrelevant feature | The feature will never contribute to the classification. |

5. Findings and discussions

The results by removing each input, is the average for 60 independent runs. The results of credit cards are shown as a bar chart in figure 1 and table 4 (total contribution is 100):

Figure 1 Run results from credit cards

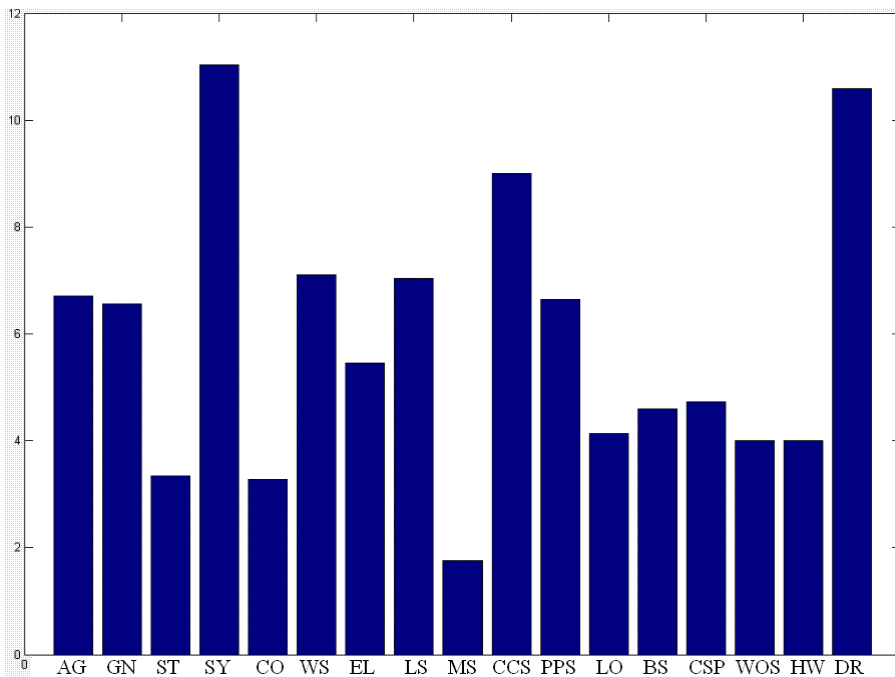


Table 4: Contribution percentage for credit card

| AG | GN | ST | SY | CO | WS | EL | LS | MS |
|---------------|---------------|---------------|----------------|---------------|---------------|---------------|----------------|-------------|
| 6.7044 | 6.5687 | 3.3503 | 11.0420 | 3.2787 | 7.1038 | 5.4494 | 7.0322 | 1.76 |
| CCS | PPS | LO | BS | CSP | WOS | HW | DR | |
| 9.0070 | 6.6403 | 4.1379 | 4.5939 | 4.7296 | 4.0060 | 4.006 | 10.5898 | |

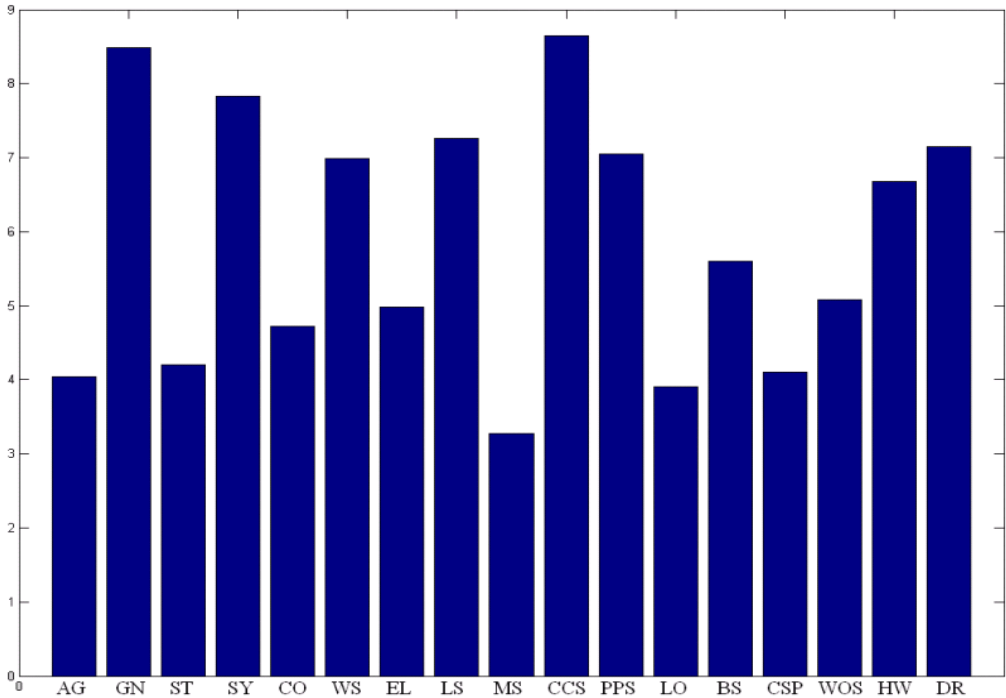
From table 4 and figure 1, year of study, credit card status and daily routine has strong relevance to respondents' knowledge of credit cards. Work status and living status has a small relevance to the knowledge of respondents. The findings indicate that a student's level of knowledge of credit card is determined whether they have a credit card and the effects of financial stress on their daily routine. This finding complements a quantitative and qualitative research study of youth in New South Wales (NSW) (OFT: 2003) which found that debt problems ranked above unemployment and youth suicide. In addition the NSW study found that a quarter of youth experienced debt that caused them some grief. Credit cards have traditionally been costly as interest rates on them are typically high and as stated in the NSW report, credit is too readily available (OFT: 2003).

With respect to loans, respondents' knowledge was strongly influenced by credit card status and gender. Living status, phone plan status, work status, daily routine, hours of work and year of study have relevance to the knowledge of respondents (table 5 and figure 2). Interesting findings reveal that gender has a bearing in this research and other studies (OFT: 2003, Fry et al, .2006). Studies conducted by the welfare agency in Australia (WRC: 2002) found that educational studies are affected by the level of welfare payments for youth who are unable to manage their finances.

Table 5: Contribution percentage for loans

| AG | GN | ST | SY | CO | WS | EL | LS | MS |
|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| 4.0466 | 8.4878 | 4.2013 | 7.8263 | 4.7236 | 6.9906 | 4.9789 | 7.2575 | 3.2728 |
| CCS | PPS | LO | BS | CSP | WOS | HW | DR | |
| 8.6464 | 7.0525 | 3.8996 | 5.6018 | 4.1007 | 5.0834 | 6.6772 | 7.1531 | |

Figure 2 Run results from loans

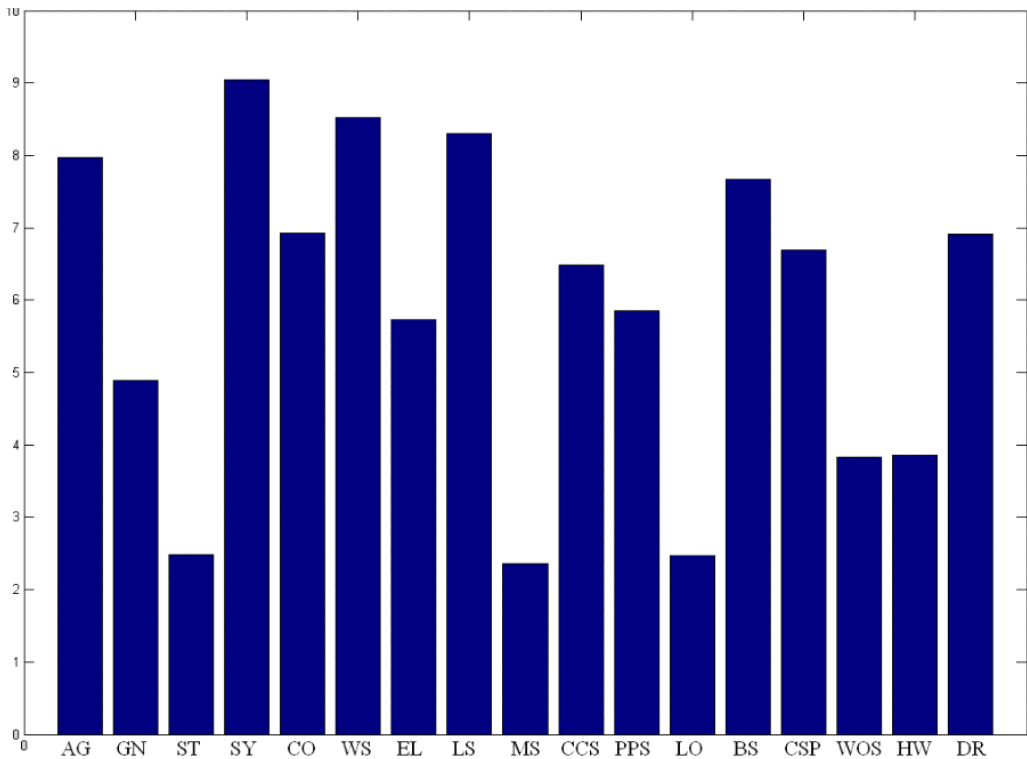


As for the run results of superannuation, work status, year of study, living status and budget status and age have strong relevance on respondents' knowledge of superannuation. Daily routine, CSP/ HECS debt, course type and credit card status has relevance to the knowledge of respondents in this category (table 6 and figure 3).

Table 6: Contribution percentage for superannuation

| | | | | | | | | |
|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| AG | GN | ST | SY | CO | WS | EL | LS | MS |
| 7.9775 | 4.8927 | 2.4761 | 9.0485 | 6.9202 | 8.5221 | 5.7348 | 8.2979 | 2.3615 |
| CCS | PPS | LO | BS | CSP | WOS | HW | DR | |
| 6.4900 | 5.8584 | 2.4624 | 7.6617 | 6.6960 | 3.8354 | 3.8537 | 6.9111 | |

Figure 3 Run results from superannuation



With Australia's move to super choice, it is crucial that youth of today understand the cost and investment decisions they have to make so as to protect their retirement funds. These findings indicate the relevance of work status and age as being very important indicators for assessing knowledge of superannuation.

5. Conclusions and Future research

We have used this sensitivity analysis method for determining the relative contribution of each input of a Neural Network on the output through our method differs from other neural net contribution measures in that it considers all input after the data preprocessing produce the best result. By removing the inputs one by one, we see that difference was made by the particular input. Obviously, each

training run will give you different results. That's the pitfall of the neural networks. More runs have to be done to overcome this problem.

Removing features with contribution close to zero and those with high variation in contribution still produced good results. It is yet to be determined at what point the contribution of a feature is close enough to zero and how much variation is required for a feature to be removed. It would not be as desirable to remove features that have a large contribution with variation as the fact remains it makes a large contribution. Of course, the number of input features that need to be removed will be determined by the data being used in the particular application.

This provides a possible explanation of the behavior of the neural network feature selection. Our work has three outputs; the problem of feature selection becomes more complicated. In the case where a network is to produce a number of classifications it may be that the optimal solution requires removal of different features for different classes. Thus, splitting up the classes over several networks, as is done in our case. It will be necessary to develop methods of selecting features for removal that are meaningful for networks that are more general.

This was the first attempt to understand financial literacy knowledge through the applications of neural networks. The results do indicate the logical application of this technique. As discussed, in the research undertaken with structured modeling (Fry et al.2006), neural networks could also provide a robust statistical analysis to the data. This application could reveal the complexities of understanding financial literacy or financial awareness. Further research with a larger population across the different society esp. the UK and other European countries will be undertaken further to test the reliability of the current study.

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