Implementation of the Backpropagation Method to Predict the Percentage of Women as Professionals on the Island of Sumatra

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ABSTRACT

This study aims to obtain information on the best algorithm from the two algorithms that will be compared based on the smallest/lowest performance value or MSE value, which can later be used as a reference and information for solving women's problems as professional workers on the island of Sumatra. The data used in this study are women as professional workers (percent) 2012-2021 at the Central Statistics Agency (BPS). The algorithm used is Backpropagation Neural Network. Data analysis was carried out using the Artificial Neural Network method using Matlab R2011b(7.13) software. In this review, 5 structural models were used, namely: 4-10-1, 4-15-1, 4-20-1, 4-25-1, 4-30-1, out of five models.

1. INTRODUCTION

Female professionals, as part of the workforce in general, have certain physical and mental qualities that make them unique in relation to male specialists. Nowadays, women are expected to be independent, far from looking weak and even though they can adapt to the increasingly wild competitive environment. The potential of female experts is in a troublesome position, this happens because the man-centric culture is still strong, although the correspondence issues of orientation, privilege and opportunity have been felt locally, but unfair practices are still experienced. In articles 5 and 6 of the Regulation of the Republic of Indonesia no. 13 of 2003 "every expert has the same open door and without separation to look for a new field of work. Broadly speaking, there are three inspirations that encourage women to take part in the world of work, namely: 1). The financial component is to track extra pay. 2). Social elements, especially to work on economic welfare in the eyes of the community. 3). Self realization towards family and society (Nasution et al., 2020).

Strengthening women being developed is very important considering that women are taking on an important role coming soon to a country (Bhatta et al., 2005). When a woman is activated, especially in non-industrialized countries, she can make positive improvements in her family and surroundings (Kar et al., 1999). Women workers are very important in resilience and furthermore in increasing family wages (Anker, 1983); (Kelly, n.d.). Even Todaro (1994) states that knowledgeable mothers can improve conditions for their children and can increase human resources for society in the future. The empowerment of women should be made possible through wealth guidance, improved health, increased education, and increased women's finances (Hung et al., 2012).
2. RESEARCH METHODS

2.1 Data collection

This research using data Women as professional workers (Percent) on the island of Sumatra. Data sources from the Agency Center for Statistics (BPS) 2021.

| Province/City | 2012   | 2013   | 2014   | 2015   | 2016   | 2017   | 2018   | 2019   | 2020   | 2021   |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Aceh          | 52.12  | 53.14  | 53.28  | 52.43  | 51.7   | 54.71  | 54.69  | 53.92  | 52.73  | 54.42  |
| North Sumatra | 51.62  | 50.67  | 52.46  | 53.47  | 52.59  | 52.46  | 54.51  | 54.16  | 54.26  | 53.95  |
| West Sumatra  | 54.19  | 55.32  | 57.05  | 56.75  | 58.17  | 57.64  | 55.48  | 55.36  | 58.97  | 59.09  |
| Riau          | 46.46  | 49.12  | 52.94  | 49.24  | 52.45  | 53.67  | 51.95  | 51.18  | 52.58  | 55.44  |
| Jambi         | 48.62  | 49.35  | 48.88  | 48.66  | 49.79  | 51.91  | 53.58  | 51.36  | 50.51  | 51.56  |
| South Sumatra | 49.34  | 51.32  | 52.09  | 53.31  | 52.37  | 49.25  | 53.66  | 55.28  | 54.37  | 56.15  |
| Bengkulu      | 50.07  | 51.66  | 50.75  | 52.27  | 50.91  | 48.99  | 49.02  | 52.67  | 51.9   | 51.31  |
| Lampung       | 51.21  | 49.14  | 51.08  | 46.24  | 54.13  | 50.52  | 50.48  | 50.75  | 53.05  | 53.06  |
| Kep. Bangka   | 45.73  | 47.03  | 47.87  | 49.64  | 48.99  | 49.36  | 48.94  | 53.15  | 51.7   | 54.1   |
| Kep. Riau     | 46.22  | 42.97  | 38.43  | 46.41  | 45.81  | 41.63  | 37.98  | 43.16  | 46.12  | 47.79  |

2.2 Backpropagation Algorithm

Calculation backpropagation is a managed evaluation calculation and is often used by perceptrons with various display screens to change the load on the secret cluster (Cynthia & Ismanto, 2017). Backpropagation is a simple and basic iterative computation that generally performs good, even with complex information (Wanto, 2018). The reason for backpropagation is to adjust the load to prepare the brain organization to properly handle the erratic contribution to produce (Devireddy & Rao, 2009). Layered perceptrons can be prepared using backpropagation calculations. The goal is to read the load for all relationships in a complex organization (Dutton et al., 1997). The basic blunder capability in the weight space is determined using a slope reduction strategy. The resulting weights that offer basic error capabilities are the answer to the learning problem (Mochammad Haldi Widianto, 2021).

2.3 Artificial Neural Network

Artificial Neural Network is one of the fake pictures of people which generally seeks to reflect the impelling encounter in the human psyche. The term artificial is used here because this neural network is carried out using a PC program that can complete various estimation processes during the educational experience (Andrijasa & Mistianingsih, 2016).

2.4 Professional

Professional, shows two things. To begin with, the individual who has the calling; for example, “he’s an expert”. Second, the presence of individuals in managing their business according to their calling. In the following sense, the term proficient appears differently in relation to “nonprofessional or novice” (Sururi, 2002).

2.5 Research Framework

The Framework is the fundamental theoretical design used to overcome or deal with confusing issues. This term is often used, among other things, in the field of programming reusable, as well as in the executive field to illustrate an idea that allows the treatment of different types or elements of a business homogeneously. As for the skeleton research work can be illustrated in the following figure:
2.6 Data Used

The data sources used are women as professional workers in 2012-2021. The training data uses data from 2012-2015 and 2016 is the target. On the other hand, data testing using data from 2017-2020 and 2021 is the target (Oh et al., 2021). Next meeting with testing the consequences of data handling by testing using programming Matlab R2011b (7.13.) And until the final assessment stage, the goal is to see if the results formed are correct (Thomas & Harden, 2008).

2.7 Data processing

Before information handled, the information is standardized first using Sigmoid (never reaches 0 or 1), this information will later be transformed to an information between 0 to 1 before trying training and testing using an artificial neural network. The formula used to perform normalization is:

\[ x' = \frac{0.5(x-a)}{b-a} + 0.1 \]  \hspace{1cm} (1)

Information:

\( x' \) = Normalized data, \( x \) = Data to be normalized, \( a \) = Lowest data, \( b \) = Highest data

| Province/City       | Woman as Power Professional (Percent) | Training Data            |
|---------------------|---------------------------------------|--------------------------|
|                     | 2012 | 2013 | 2014 | 2015 | 2016 (Target) |
| Aceh                | 52.12| 53.14| 53.28| 52.43| 51.7          |
| North Sumatra       | 51.62| 50.67| 52.46| 53.47| 52.59         |
| West Sumatra        | 54.19| 55.32| 57.05| 56.75| 58.17         |
| Riau                | 46.46| 49.12| 52.94| 49.24| 52.45         |
| Jambi               | 48.62| 49.35| 48.88| 48.66| 49.79         |
| South Sumatra       | 49.34| 51.32| 52.09| 53.31| 52.37         |
| Bengkulu            | 50.07| 51.66| 50.75| 52.27| 50.91         |
| Lampung             | 51.21| 49.14| 51.08| 46.24| 54.13         |
| Kep. Bangka Belitung| 45.73| 47.03| 47.87| 49.64| 48.99         |
| Kep. Riau           | 46.22| 42.97| 38.43| 46.41| 45.81         |

**Table 2.** Data on Initial Training for 2012-2015/Target for 2016
3. RESULTS AND DISCUSSIONS

3.1 Architectural Design and Results

Architecture used and results which is obtained in This research can be seen in the table below.
Table 6. Network Architecture

| Characteristics       | Specification |
|-----------------------|---------------|
| Input Data            | 4             |
| Hidden Layers         | 10,15,20,25,30|
| Goal                  | 0.01          |
| Maximum epoch         | 1000          |
| Learning Rate         | 0.1           |

Table 7. Training Results and Test

| Model     | Epoch | Mse       |
|-----------|-------|-----------|
| 4-15-1    | 74    | 0.00549583|
| 4-30-1    | 121   | 0.01054370|
| 4-45-1    | 174   | 0.01470704|
| 4-60-1    | 109   | 0.01985139|
| 4-75-1    | 340   | 0.07773210|

Figure 2. Results of Training Data With Architecture 4-30-1

Based on the results of training and testing, the Model architecture 4-30-1 is the best architecture with epochs of 340 iterations with a fairly fast time of 6 seconds.

Table 8. Best Architectural Model 4-30-1

| Target | actual | Error | SSE     | Target | actual | Error | SSE     | Results |
|--------|--------|-------|---------|--------|--------|-------|---------|---------|
| 0.6378 | 0.6380 | -0.0002| 0.00000004 | 0.7230 | 0.4518 | 0.2712 | 0.07356152 | 1       |
### 4. CONCLUSION

Given the exploration that has been carried out, in this study several objectives can be obtained, namely: (1) Of the five compositional models used for testing, the best technique is obtained which produces an emphasis value of 340, with a period of 00:06, and an MSE of 0.07773210, namely Design 4-30-1. (2) In testing the five structures described above, different consequences of the accuracy of the backpropagation calculations are made. (3) The architectural model decision is very interesting to get the ideal level of performance.

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| Target actual | Training Data | Testing Data |
|---------------|---------------|--------------|
|              | SSE           |              |
| 0.6739       | 0.6737        | 0.0002       |
| 0.9000       | 0.9004        | -0.0004      |
| 0.6682       | 0.6686        | -0.0004      |
| 0.5604       | 0.5600        | -0.0004      |
| 0.6649       | 0.6648        | 0.0001       |
| 0.6058       | 0.6061        | -0.0003      |
| 0.7363       | 1.0000        | -0.2637      |
| 0.5280       | 0.5280        | 0.0000       |
| 0.3991       | 0.3992        | -0.0001      |
| Amount       | 0.06955339    | Amount       |
| MSE          | 0.00695354    | MSE          |

Description: 1 = True / True 0 = False / False

100%
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