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Trend Prediction Method of Regional Innovation and Entrepreneurship Based on LSTM Neural Network

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Abstract: In order to ensure the sustainable and long-term development of enterprises in the future and give full play to the real value of prediction data, LSTM neural network is introduced to build a prediction model to predict the development level of enterprise innovation and entrepreneurship. To somewhere innovation entrepreneurship development trend forecast, for example, the application of LSTM model contrast traditional regression analysis and BP neural network model, found that LSTM neural network prediction effect is good, the basis of local innovation entrepreneurship development investment is good, and has a strong technical output level, innovation entrepreneurship development efficiency is significant, can make up for innovation development of human resources investment, as the future innovative entrepreneurial development goals and the important reference of security policy.

Keywords: LSTM neural network; Innovation and entrepreneurship; Enterprise development; Forecast

1. Introduction

Innovation is the soul of social development and progress, and entrepreneurship is an important way to promote the rapid development of the economy and society and improve people's livelihood. In fact, innovation and entrepreneurship are all connected and symbiotic relationships. Build the "double gen" upgrade, promote the development of innovative entrepreneurial quality speed, to promote and enhance the ability of entrepreneurship to create more employment opportunities, to enhance the level of science and technology innovation and the development of industry vitality, to create and provide high quality resources supply and expand effective market demand, the economy to achieve rapid benign development, has important endogenous dynamic significance[1]. There are also studies aimed at assessing the innovative characteristics of companies that expand their activities by investing in renewable energy, and identifying which organizational support factors have the greatest impact on these characteristics. The analysis is based on research on 30 companies that follow their entrepreneurial strategies by investing in renewable energy.

2. Influencing factors and selection indicators for the development of enterprise innovation and entrepreneurship

2.1 Influencing factors and data

In fact, the development of innovation and entrepreneurship is a typical closed-loop investment and output system, which should include four stages in the process, namely: investment- -research and development- -promotion of science and technology- -transforming productivity. On the premise that data can be collected, consider as many relevant data that affects the development of innovation and entrepreneurship. The data used in this paper are all from the local statistics bureau, and 20 experts in the field of innovation and entrepreneurship research are invited to score and obtain the Innovation and Entrepreneurship Development Index. The measurement index of innovation and entrepreneurship development usually includes investment, research and development, science and technology, and productivity transformation, etc. The innovation and entrepreneurship development index, scored and weighted by experts, has high reliability and good adaptability after normalization[2].

2.2 Performance evaluation index

In order to reflect the deviation level of model prediction, the error rate and root mean square error are used. In order to prove the

model fitting level, the root mean square log error and determination coefficient are used. The error rate E and the root mean square error RMSE are as follows[3]:

$$E = \frac{Y_o - Y_P}{Y_O} \tag{1}$$

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n}(Y_0 - Y_p)^2}{n}} \tag{2}$$

The root mean square ms log error RMSLE and R^2 determination coefficient are as follows:

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}[\lg(Y_o + 1) - \lg(Y_p + 1)]^2} \tag{3}$$

Where sample number is expressed by n; original value is represented by Yn; predicted value is represented by Yp; mean value is represented by Ymean.

3. Empirical analysis of LSTM modeling of innovation and entrepreneurship trends prediction

3.1 Normalization treatment

LSTM model is a variant of the recurrent neural network. It builds a special memory storage unit and trains the known data repeatedly through the time reverse propagation algorithm, which can solve the problem of gradient disappearance and no long-term dependence generated and existing by the recurrent neural network. In this paper, the following methods are used to normalize the original data, and the results can fall into the [0,1] interval through linear transformation. The conversion formula is as follows[5]:

$$X = \frac{x - \min}{\max - \min} \tag{4}$$

Where the maximum value of sample data features is min; the minimum value is max; raw data and normalized data are x and X respectively.

3.2 Number of hidden layer nodes

At present, the number of nodes in the hidden layer has not been clearly stipulated in the academic circle. The general determination formula of the number of nodes is as follows:

Where the number of hidden nodes is represented by N; the number of input nodes is represented by n; the number of output

$$N = \sqrt{n + m} + a \tag{5}$$

nodes is represented by m; the constant between 1 and 10 is represented by a.

According to the number of selected variables to know the input node is 15, the output node is 1, according to the above formula, hidden node 5~14, using 1 LSTM model test to determine 5~14 nodes corresponding error rate and error sum, judge the model deviation degree, select the appropriate number of hidden layer nodes, and the error rate and the root mean square error of the test set (see Table 1).

Table 1 Prediction of innovation and entrepreneurship development at different hidden nodes

panel point	E（2019）	E（2020）	E（2021）	E（2022）	RMSE
5	0.0054	0.00085	0.0003	0.0965	3052.089
6	0.0122	0.0113	0.0077	0.1140	3629.304
7	0.0005	0.0059	0.0056	0.1223	3228.962
8	0.0037	0.0143	0.0045	0.0943	3002.065
9	0.0067	0.0189	0.0188	0.0743	2476.742
10	0.0089	0.0031	0.0106	0.1027	3256.068
11	0.0126	0.0088	0.0078	0.0745	2378.019
12	0.0099	0.0036	0.0167	0.1096	3505.356
13	0.0059	0.0019	0.0045	0.1010	3186,756
14	0.0072	0.0059	0.0049	0.1023	3209.999

3.3 Empirical analysis

This empirical analysis design LENOVO desktop, 16GB memory, Windows10 enterprise edition, python3.5 development environment of PyCharm integrated development tools, establish LSTM neural network model. There are three sets of trials including traditional regression model and neural network model, including multiple nonlinear regression, BP neural network model, and long and short-term memory neural network model.17 pieces of data were selected for the training set and test set as the input samples to predict the innovation and entrepreneurship development index in the next year. The prediction results of the LSTM model, BP neural network model, and MUL model in the test set were trained through trials (see Table 2).

Table 2 The test set provides the prediction results

Year	original value	P（LSTM）	P（MUL）	P（BP）
2019	3.0101	2.9201	2.7005	2.7587
2020	3.1201	3.0736	2.7503	2.8386
2021	3.1401	0.0909	2.9072	3.0042
2022	3.1602	0.1179	3.3229	3.2891

The prediction results in the test set showed that the BP neural network and MUL regression model have no obvious rules, and the prediction accuracy is not high. However, LSTM showed high accuracy in 2019,2020,2021, and 2022. It is found that (see Table 3) For the performance index of each model, the LSTM model has the smallest RMSLE value, the R-square value is closest to 1, and the model fitting effect is the best. In terms of training time, LSTM had the slowest training time, but the gap from BP was much smaller than the training time between BP and MUL. So the LSTM model performs the best.

Table 3 Performance indicators of each model

model	RMSLE	R-square	Train-time/s
MUL	0.0765	0.8372	0.1856
BP	0.0433	0.9245	5.4280
LSTM	0.0237	0.9647	6.6909

Conclusion

Through the construction of the LSTM neural network innovation and entrepreneurship development prediction model, compared with the traditional regression model and BP neural network model, it is believed that the LSTM neural network model has a good prediction ability for the development level trend of innovation and entrepreneurship, and can provide accurate prediction index value for government departments, which is conducive to relevant departments to formulate scientific and accurate promotion programs. It is of guiding significance to the development evaluation of innovation and entrepreneurship.

References:

[1] Zhang J , Fu Y . Prediction Method of Innovation and Entrepreneurship Intention of Computer Majors Based on Artificial Intelligence Technology[J]. Journal of Physics: Conference Series, 2021, 1852(3):032011 (7pp).

[2] Wang W , Li X , Ding Y , et al. A Prediction Method of Trend-Type Capacity Index Based on Recurrent Neural Network[J]. The Journal of Quantum Computing (in English), 2021, 3(1):9.

[3] Zhou X , Kamruzzaman M M , Luo Y . Mathematical Model of Yield Forecast Based on Long and Short-Term Memory Image Neural Network[J]. IEEE Access, 2020, PP(99):1-1.

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