Research on HR management based on RNN expectation theory

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Abstract. RNN convolutional neural network is an important part of deep learning algorithm. Compared with fully connected neural network, the biggest difference is that the hidden units are not independent of each other. Not only the hidden layer neurons are irrelevant to each other, but also the state of the current hidden layer cells is affected by the historical input data. This feature enables it to extract the temporal relationship of temporal data structure. One of the current outputs of one sequence is also related to the previous output. The specific expression is that the network will memorize the information before and apply it to the calculation of current output, the nodes between hidden layers are no longer connected but connected. Moreover, the input of hidden layer includes not only the output of input layer but also the output of hidden layer at the last time. RNN neural network is widely used in natural language processing (NLP): machine translation, speech recognition, image description generation, text similarity calculation. The DAFDC-RNN model in this paper is verified by the financial and real estate industry data from 2019 to 2020, which shows that the model has excellent stability and sensitivity. Compared with CNN model, it increases by 34.3% and 24.9%. The advantages of data processing as follow: it can process a large number of time series data, the processing capacity of data set is large, it can process 1000 + data, and it has more data base for time series prediction. The disadvantage as follow: Compared with CNN model, the working time of CNN model is increased by 48%, but the model has strong stability and adaptability. Taking the data from 2019 to 2020 as the input of DAFDC-RNN time series forecasting model, the salary forecast of real estate and financial industry in 2021 is obtained. Based on this data, the industry expectation of Finance and real estate industry under human resource management under expectation theory is reduced.

1. Introduction
In recent years, with the increasing population, human resource management has gradually become the focus of people's vision. When China's talent strategy was implemented to 2015, the recruitment policy and internal environment have changed greatly. The number of new recruits has decreased significantly, and the number of existing highly educated talents has been reduced or transferred with an average annual turnover rate of 0.6%. The drastic reduction of employment posts and the rapid loss of high-quality talents indicate a signal that China's human resource time management also needs to enter a new height. In order to understand the development law of human resources, this paper uses a certain sampling time sequence: the salary index from 2019 to 2020 to observe, and establishes the DAFDC-RNN model to predict and judge the development trend of human resources management by using the expectation theory [1].
The commonly used traditional time series prediction models mainly include AR model, MA model, ARMA model and ARIMA model. However, the traditional time series prediction method does not take into account of the causal relationship between external factors and the predicted object. Instead, it attributes all the influencing factors to time, and only models the predicted object from the time dimension. RNN model refers to a structure that happens repeatedly over time [2]. It has excellent application in many fields such as natural language processing. The biggest difference between RNN model and other networks is that RNN can realize some memory function and is the best choice for time series analysis [3]. In this paper, deep learning technology is used to model the related characteristics of time series, and DAFDC-RNN model is created [4]. This model establishes a RNN recurrent neural network of expectation value for human resource management to predict the theory of human resource expectation.

2. Principle and algorithm
RNN convolutional neural network (recurrent neural network) is an important part of deep learning algorithm. Compared with fully connected neural network, the biggest difference is that the hidden units are not independent of each other. The hidden layer neurons are not only related to each other, but also the state of the current hidden layer cells is affected by the historical input data. This feature makes it very effective extracting the temporal relationship of temporal data structure. RNN is a kind of neural network which is used to process sequence data. At different time steps, RNN circulates the weight and connects across time steps [1].

When RNN calculates the current state, it not only depends on the current input, but also depends on the output of the previous state, that is, the current input xt and the previous state st-1 jointly determine the current state st. The hidden layer and output layer of RNN at the current time t can be calculated by the following formula:

\[ o_t = g(V_s) \]  \hspace{1cm} (1) 
\[ s_t = f(Ux_t + Ws_{t-1}) \]  \hspace{1cm} (2)

\( x_t \) is the input layer vector; \( s_t \) is the value of the hidden layer; \( o_t \) is the value of the output layer; \( Ux_t \) is the weight matrix between the hidden layer and the input layer; \( V \) is the weight matrix between the output layer and the hidden layer; \( Ws_{t-1} \) is the weight matrix between the hidden layer and the hidden layer at different times; \( F \) and \( g(V_s) \) are the activation functions.
3. Experimental design
Due to the rich research results of RNN model in the field of time prediction, and achieved fruitful experimental conclusions and models, this paper will use DAFDC\textsubscript{-RNN} model to predict the time of real estate and finance in human resource management practice from 2019 to 2020 under the expectation theory.

3.1. Construction of DAFDC\textsubscript{-RNN} model
The salary growth rate of real estate industry and financial industry from 2019 to 2020 are as follows:

![Figure 1. Structure of RNN.](image-url)
Figure 2. Salary growth rate of real estate industry and financial industry.

The data from 2019 to 2020 are taken as the input of the model and input into the DAFDC-RNN model as the initial input.

The inputs of DAFDC-RNN model are multivariable time series $X$ composed of input features from 1 to $T-1$ and univariate time series $y$ composed of predicted features from 1 to $X-1$ univariate time series $Y$.

$$X = (x_1, x_2, \ldots, x_t, \ldots x_{T-1}) = (x^1, x^2, \ldots, x^k, \ldots, x^n)^T \in \mathbb{R}^{n \times (T-1)}.$$  

$$Y = (y_1, y_2, \ldots, y_t, \ldots, y_{T-1})^T \in \mathbb{R}^{(T-1) \times 1}, T$$ is the step size of time series, $n$ is the number of input features; $x_t \in \mathbb{R}^{m \times 1}$, is the set of eigenvalues of $N$ features at time $t$; $x^k \in \mathbb{R}^{(T-1) \times 1}$ is the time series composed of $K$ time features from 1 to $t-1$ time; $y_t \in \mathbb{R}$ is the eigenvalue of predicted features at time $t$.

The goal of dafdc-rnn model is to predict the eigenvalue $y_T$ of the predicted feature at time $t$, to learn a nonlinear relationship $F$, so that $f$ satisfies the following formula:
\[ y_T = F(X, Y) \] (3)

### 3.1.1. Model description

The DAFDC-RNN model uses the encoder decoder structure, introduces target attention mechanism and full dimension convolution (FDC) mechanism in the encoder, and introduces temporal attention mechanism in the model decoder. Among them, target attention is used to learn the correlation between input feature and predicted feature, FDC is used to learn the correlation between input features, and temporal attention is used to study the long-term time dependence of time series. The output of decoder is the prediction target of the model.

![Figure 3. DAFDC-RNN Pattern structure.](image)

In order to quantify the correlation between the all feature and the predicted feature, DAFDC-RNN model introduces target attention mechanism to learn the correlation between the input feature and the predicted feature. First, the full-text vector is defined for the all feature context^k_t, this context^k_t = tanh(W_t[h_{t-1};s_{t-1}] + U_tX^k_t + b_t), as follows: W_t, U_t, b_t represents the parameters that the model needs to learn, b_t represents the offset term, W_t \in R^{(T-1)\times 2m}, U_t \in R^{(T-1)\times c}, b_t \in R^{(T-1)\times 1}, m is the size of the encoder hidden layer. \[[h_{t-1};s_{t-1}].Indicates the state of the encoder when target attention processes xt..

Since [Ht-1; St-1] is associated with XK in the form of linear addition, context^k_t represents the context representation of the all feature in the model input in the current state of the encoder.

In order to establish the correlation between context^k_t and the time series y composed of the predicted features, the point product scoring function in attention mechanism is introduced:

\[ u^k_t = Y^T \cdot \text{context}^k_t, \] (4)

The softmax function is introduced to convert \( u^k_t \) into \( a^k_t \) weight:

\[ \alpha^k_t = \exp(u^k_t) / \sum_{i=1}^{n} \exp(u^i_t) \] (5)

According to the weights assigned by the model for different features, the output \( x^t \) of target attention at time \( t \) can be obtained:
\[ x_t = (\alpha_1^1 x_1^1, \alpha_2^2 x_2^2, \ldots, \alpha_n^n x_n^n)^T. \]  

(6)

For the convenience of description, the expression of \( c^k = \alpha_i^k x_i^k (k = 1, 2, \ldots, n) \) can be further simplified as:

\[ x_t = (c_1^1, c_2^2, \ldots, c_n^n)^T \]

(7)

### 4. Results and discussion

By associating the context vector \( \beta_i \) of the decoder with the \( y_i \) eigenvalue of the predicted feature through the perceptron, the input of the decoder hidden layer at time \( t \) can be obtained as: [4]

\[ y_t = W_\gamma^t [\beta_t; y_t] + b \]

(8)

Finally, the multi-layer perceptron is used to correlate the context vector of T-1 time decoder with the hidden unit state of time decoder:

\[ y^T = v^T (W_y [h_{T-1}^t; \beta_{T-1}^t] + b_w) + b_v. \]

(9)

In 2021, the salary growth rates of real estate industry and financial industry are as follows:

**Figure 4.** Salary growth rate of real estate industry and financial industry in 2021.

Expectation theory holds that if an individual expects a certain behavior to bring about a certain result and the result is attractive to himself, the individual often takes such behavior. The relationship between demand and goal can be expressed by expectation theory formula:

\[ M = VE \]

(10)

Where \( M \) represents the incentive level. \( V \) stands for potency, which is the importance of the result or reward that can be obtained from work to the individual.

Expectation theory shows three relationships: the relationship between effort and performance, the relationship between performance and reward, and the attraction of reward to people. It can be seen from the predicted data in 2020: with the release of various regulatory policies of the financial market, customer assets flow from investment banks to asset management companies. In 2021, the salary increase of private equity management industry has a slight rebound, with the salary increase of 7.75%,
and the growth rate of securities industry is expected to decline at 6.2%. Fintech expects salary to rise 9.1% in 2021.

5. Conclusions
In this paper, the deep learning technology is used to model the correlation characteristics of time series, and a time series prediction model called DAFDC-RNN is established. The prediction ability of DAFDC-RNN is tested through correlation experiments. The experimental results show that DAFDC-RNN model can accurately and quickly obtain the data results of time series by using the existing data. In this paper, the salary data before 2019 is input into RNN model, and the time series forecast of 2019 – 2121 is obtained.

The average difference between the data set and the real data is 6.92%. There are 10 data whose error between the data set and the real data is within 0.1, accounting for 39.3% of the total data. Therefore, considering the error, we draw a conclusion that the DAFDC-RNN model has strong stability and sensitivity.

This paper lists the salary and industry valence data of financial industry and real estate industry as the model input.

The results show that in 2021, the salary increase of private equity management industry has a slight rebound, with the salary increase up to 7.75%, while the growth rate of securities industry is expected to decline to 6.2%. Fintech expects salary growth of 9.1% in 2021. In 2021, the real estate industry in the first tier cities and the second tier cities broke out. The brain drain in the first tier cities is more serious, and the pay gap is getting smaller and smaller. The culture and tourism real estate is blooming everywhere in the first tier cities, and the pay of the culture and tourism real estate in the new first tier cities is even lower than that in the first tier cities. The average turnover rate of the real estate industry in 2021 is 25% in 2019, 23.9% in 2020, and 29.3% in 2021, an increase of 5.4% compared with 2020.

When the expectation theory is applied to human resource management, the industry salary growth rate from 2018 to 2019 decreases significantly, and the turnover rate increases by 5.4%. It can be seen that the salary potency and industry expectation of real estate in the financial industry in 2021 are significantly lower than those in 2018 to 1019. According to the expectation theory calculation formula: \( M = VE \), it is concluded that the industry expectation of the financial and real estate industry decreases.

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