EXPLORATION OF THE CONSTRUCTION PATH OF ARTIFICIAL INTELLIGENCE BIG DATA "INTEGRATED" INNOVATION AND ENTREPRENEURSHIP ECOSYSTEM FROM THE PERSPECTIVE OF LAND USE ECOLOGICAL SUITABILITY

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ABSTRACT

Ecological environment has always been an important prerequisite while reflecting people and nature. The construction reflects the degree of development and civilization of a country as a whole, so it is related to the future of mankind. The deep integration of land use is a major breakthrough in solving the complex problems in the process of ecological civilization development and transformation. By establishing a "fusion" innovation and entrepreneurship ecological civilization system, this paper applies artificial intelligence and big data in the construction path of innovation and entrepreneurship ecological system from the perspective of land use and ecological suitability. Simulation studies were conducted in parasitic mode, biased symbiosis mode, asymmetric symbiosis mode, and symmetric symbiosis mode respectively through Matlab software. According to the results of the study, the subject size of the relevant subjects in the parasitic mode is only 70.43% of the subject size of the entrepreneurial enterprise. In the biased symbiosis model, the subject size of the relevant subject is 87.82% of the subject size of the entrepreneurial enterprise.

KEYWORDS

Land use; artificial intelligence; big data; ecological civilization construction; innovation and entrepreneurship.

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1. INTRODUCTION

Innovation and entrepreneurship is the main theme of the current society and is an important engine to promote China's economic development. In the process of ecological system construction, all sectors should meet the needs of social and ecological development. In addition, it is a new way to combine the "fusion" innovation and entrepreneurship approach with system construction in the context of artificial intelligence, combined with the rational use of land. To build an innovation and entrepreneurship ecosystem that "continuously deepens the reform of the ecological system and integrates entrepreneurship whole ecological civilization construction" is the goal of current development.

Land use change is a core area of contemporary global environmental change research, and scholars in China and abroad have been advancing their research work in both depth and breadth over the past 30 years [1-3]. Driven by human economic and social activities, land use change always has its "reasonable" and "unreasonable" sides [4-6]. Reasonable land use change means that land users can obtain better economic and ecological benefits by correctly choosing land use according to the inherent suitability of the land [7,8]. An unreasonable land use change means that people violate the law of land suitability, which will cause serious consequences in terms of ecological degradation [9,10]. We need a reasonable calculation method to explore the path of ecosystem construction from the perspective of land use and ecological suitability.

Artificial intelligence. This describes the action form. Artificial intelligence is a complex category that includes multiple disciplines [11-13]. Big data is also called a huge amount of data, which refers to the collection of data that cannot be extracted, summarized, and processed in a short period of time due to the huge and cumbersome content of the data[14-16]. Later, other methods can be used to integrate these disorganized data and transform them into our use [17-19].

In the long history of human development, the human and the natural environment are interrelated and inseparable. Its value system profoundly affects the development direction and degree of ecological civilization [20-23]. Ecosystem construction is a non-independent systematic project, and the "integrated" innovation and entrepreneurship ecosystem is to build a benign and intelligent ecosystem that integrates ecologically suitable land use and artificial intelligence big data [24,25]. As ecological civilization is closely related to territorial spatial planning, regional spatial planning from the perspective of ecological civilization is becoming more and more popular. Lu et al. [26] took Yongan, Chengdu as an example, and discussed the development path of territorial space planning. Finally, the corresponding development strategy and planning are put forward for Yongan Town. They practice the concept of conservation in the planning of land and space. In addition, they have formulated measures and specific planning schemes for the ecological compensation system, hoping to provide certain theoretical guidance for the national land and space planning of other cities and towns. Ma et al. [27] sorted out the relevant policies. The research shows that the protection policy is sufficiently perfect, but the correlation between marine policy points and marine support policies is not high. These influence the coupling of marine ecological civilization and ecological society to a certain extent. Yang et al. [28] studied the civilization pilot city policies emissions based on the pollution discharge of multiple cities in China. They found that this of cities, especially for small cities. Xie et al. [29] studied the relationship between quality and economics. They found that while economic growth has risen steadily in recent years, environmental pollution, as measured by emissions of wastewater and air pollutants, is still decreasing, and at a markedly faster rate. This can provide a practical and effective path for the construction of ecological civilization in other countries. Meng et al. [30] first combined the evaluation framework of the ecological civilization pilot area with academic research to build a comprehensive framework and index system. Then, they calculated the coupled coordination number (CCD) for each experimental plot based on the entropy weights. Finally, they used relative development coefficients to measure ecological and economic development and studied different development patterns of cities. The results show that the regional economy and CCD are closely related, which shows that the relationship between economy and ecology is complementary.

To sum up, the advanced ecological ethics concept is the value orientation, the developed ecological economy is the material basis, and the perfect ecological civilization system is the incentive and restraint mechanism. At present, from the ecological perspective of land use, there are still some vacancies "integrated" system. Combined with the topic of " drives the construction of ecosystems in our province and countermeasures - based on the perspective of innovation reefs", this paper takes artificial intelligence and big data as the background, combines intelligent algorithms with the construction of ecological civilization system, and proposes. This kind of "integrated" innovation and entrepreneurship ecological civilization system construction path. By creating an immersive and integrated intelligent environment, improving the intelligent literacy of human-human synergy, achieving the intelligent integration required by the whole ecology, and exploring the practical path of building an innovative ecological system.

2. THEORETICAL MODEL

A neural network is an information processing system formed by studying the structure and function of the human brain through physical and mathematical methods. A neural network has many nodes called neurons, each node is connected with each other, and each node is connected by a connecting line. When data is fed into a neural network, it spreads among the nodes, each of which then processes the data. In this case, the nodes in the ANN will find an optimal state, and this process is called training. From its basic working mechanism, if you find suitable training data to train the neural network model, you can easily deal with some problems that cannot be solved at present. Due to the particularity of neural network structure and

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processing methods, it has been widely used in many aspects such as image processing, robotics, and data mining.

2.1. BP NEURAL NETWORK ALGORITHM

BP has good adaptive ability, regularity, and high parallel processing information ability. It is a multi-layer feed-forward backward transfer that has excellent high-dimensional function mapping ability and can handle complex classification problems and overcomes the problems of exclusive or (XOR) that cannot be handled by simple perceptrons and the learning of hidden layer connections in multi-layer neural networks. Through long-term research and exploration, the BP neural network can solve problems such as prediction, classification, and evaluation.

Taking a simple BP neural network as an example, set the number of node neurons, single-layer hidden layer, and to be [2, 3, 1], respectively, and the activation function is the $\tan sig$ function, that calculates the output value of the output layer. The mathematical expression is as follows:

$$\begin{aligned} \mathrm{sim}y = & w_{11}^{(2,3)} \times \mathrm{tansig}\left(w_{11}^{(1,2)} \times x_1 + w_{21}^{(1,2)} \times x_2 + b_1^{(2)}\right) \\ & + w_{21}^{(2,3)} \times \mathrm{tansig}\left(w_{12}^{(1,2)} \times x_1 + w_{22}^{(1,2)} \times x_2 + b_2^{(2)}\right) \\ & + w_{31}^{(2,3)} \times \mathrm{tansig}\left(w_{13}^{(1,2)} \times x_1 + w_{23}^{(1,2)} \times x_2 + b_3^{(2)}\right) + b_1^{(3)} \end{aligned} \quad (1)$$

Where, x, w, b are variables.

The $\tan sig$ activation function is as follows:

$$f(u) = \frac{2}{1 + e^{-2u}} - 1 \quad (2)$$

The weight between nodes i and j is set to w_{ij}, b_j is the threshold of node j, x_j is the each node, and the specific calculation method value of each node is as follows:

$$S_j = \sum_{i=0}^{m-1} w_{ij} x_i + b_j \quad (3)$$

$$x_j = f\left(S_j\right) \quad (4)$$

Where, f is an activation function, usually the $sigmoid$ function is chosen.

Assume that the full result of the output layer is w, and the error function is as follows:

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$$E(w,b)=\frac{1}{2}\sum_{j=0}^{n-1}\left(d_j-y_j\right)^2 \tag{5}$$

Using the gradient descent method, the gradient at the current position is proportional to the correction of the weight vector, so the j output node is:

$$\Delta w(i,j)=-\eta\frac{\delta E(w,b)}{\delta w(i,j)} \tag{6}$$

Assume that the chosen activation function is as follows:

$$f(x)=\frac{A}{1+e^{-\frac{x}{B}}} \tag{7}$$

Self-feedback network, as a widely used network model in BP neural network, transmits the error signal of its output layer to the connection weights between its other layers, so that the error tends to the minimum value. The expression is as follows:

$$E=\frac{\sum_1\left(T_1-y_1\right)^2}{2} \tag{8}$$

Where, T_1 is the expected output, y_1 is the output layer output, and E is the error signal.

In view of the characteristics of the transfer function and in order to meet the training requirements, the samples need to be normalized between $[-1,1]$, and the $\min-\max$ algorithm is used:

$$y=\left(y_{\max}-y_{\min}\right)\times\frac{\left(x-x_{\min}\right)}{\left(x_{\max}-x_{\min}\right)}+y_{\min} \tag{9}$$

Where, x is the original data, and y is the normalized data.

2.2. RANDOM FOREST

Random forest is one of the most widely used machine learning models, and it is also an ensemble learning method. Random forest improves the output without increasing the amount of computation and is not sensitive to multivariate collinearity. This algorithm is robust to missing data and unbalanced data, and can effectively predict thousands of different explanatory variables.

Random forest contains several decision trees, and there is no correlation between these decision trees. Random forest uses the different characteristics of multiple subsamples to construct multiple decision trees to make similar predictions for the

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same phenomenon. A random forest is a forest composed of multiple decision trees using the Bagging idea. Each decision tree is a weak classifier. In the classification problem, the result of each decision tree is voted to obtain the final result, thus forming a strong classifier.

Random forest uses random samples and random features, that is, random rows and columns, which reduces the correlation of the base model, that is, each tree, and can directly deal with categorical and numerical features, avoiding the occurrence of overfitting to a certain extent. The anti-overfitting and stability characteristics of Bagging allow random forests to trade-off between bias and variance by adjusting parameters. These characteristics of random forests make random forests unnecessary for feature selection. It is suitable for high-dimensional data and can perform parallel computing, which also makes the selection of effective factors more simple, efficient, and high-precision in this paper.

2.3. GAUSSIAN PROCESS REGRESSION ALGORITHM

It is suitable for dimensionality and nonlinearity and has good generalization ability.

$$f(x) \propto GP\left(u(x), k\,(x, x')\right) \quad (10)$$

$$y = f(x) + \varepsilon \quad (11)$$

Where, x, x' are arbitrary random variables, ε is noise, obey a Gaussian distribution with mean 0 and variance σ_n^2. $u(x)$ is the mean function and $k\,(x, x')$ is the covariance function. Since $f(x)$ follows a Gaussian distribution that is independent of ε, y follows a Gaussian distribution:

$$y \propto N\left(0, K(X, X) + \sigma_n^2 I_n\right) \quad (12)$$

where I_n is an n dimensional unit matrix and given an input variable x^*, the corresponding output is y^*, the joint distribution of the algorithm's prediction set y^* and training set y is, according to Bayes' principle:

$$\begin{bmatrix} y \\ y^* \end{bmatrix} = N\left(0, \begin{bmatrix} K\left(X, X + \sigma_n^2 I_n\right) & K\left(X, x^*\right) \\ K\left(x^*, X\right) & k\left(x^*, x^*\right) \end{bmatrix}\right) \quad (13)$$

So the expression for the prediction set y^* is as follows:

$$y^* \mid X, y, x^* \propto N(\mu, \Sigma) \quad (14)$$

Where,

$$\mu = K\,(x^*, X)\left[K(X, X) + \sigma_n^2 I_n\right] \quad (15)$$

$$\sum = k\,(x^*, x^*) - K\,(x^*, X)\left[K(X, X) + \sigma_n^2 I_n\right]^{-1} K\,(X, x^*) \quad (16)$$

For the covariance function, this paper uses the most commonly used square exponential covariance kernel function:

$$K\left(x_i, x_j\right) = \sigma_f^2 \exp\left(-\frac{\| x_i - x_j \|^2}{2l^2}\right) \tag{17}$$

2.4. INPUT VARIABLE SELECTION METHOD

The Pearson correlation coefficient describes the degree of correlation between two spaced variables, generally represented by r, and its calculation formula is:

$$r = \frac{N\sum x_i y_i - \sum x_i \sum y_i}{\sqrt{N\sum x_i^2 - \left(\sum x_i\right)^2}\sqrt{N\sum y_i^2 - \left(\sum y_i\right)^2}} \tag{18}$$

Where, N is the number of samples, x_i, y_i are the current variables, $i \in N$. The larger the absolute value of r, the stronger the correlation between the two variables, and the closer the correlation coefficient is to 1 or -1. The weaker the correlation, the closer the correlation coefficient is to 0.

2.5. HYPERPARAMETER OPTIMIZATION METHODS

The choice of the number directly determines the quality of the model: if there are too many, the model will be over-fitted and the generalization will be poor. If the number is too small, it is difficult to complete the fitting of the samples.

In this paper, root mean square error (RMSE), mean error (MAE), mean absolute error (MAPE) and coefficient of determination (R^2) are used as model evaluation indexes to evaluate the effectiveness and generalization of the model.

Root Mean Square Error:

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(\hat{y}_i - y_i\right)^2} \tag{19}$$

Average error:

$$MAE = \frac{1}{n}\sum_{i=1}^{n}\left|\hat{y}_i - y_i\right| \tag{20}$$

Mean absolute error:

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$$MAPE = \frac{1}{n}\sum_{i=1}^{n}\left|\frac{\hat{y}_i - y_i}{y_i}\right| \times 100\,\% \tag{21}$$

Decisive factor:

$$R^2 = \frac{\sum_{i=1}^{n}\left(\hat{y}_i - \bar{y}_i\right)^2}{\sum_{i=1}^{n}\left(y_i - \bar{y}_i\right)^2} \tag{22}$$

Where, $y, \hat{y}$ represents the actual predicted model, n is the number of test samples, and $\bar{y}_i$ is the average value of the sample y_i.

This section describes how to process the original dataset, how to choose input and output variables, and how to optimize hyperparameters for best predictions when using machine learning methods. Provide theoretical guidance for follow-up work.

3. ANALYSIS AND DISCUSSION

3.1. MODEL SIMPLIFICATION

The $logistic$ growth function model can well describe the growth process of ecological populations in the ecosystem. The growth of population size is subject to external environmental factors such as resources, technology, policies, and institutions. In the entrepreneurial ecosystem, resources are limited, and the growth of entrepreneurial enterprises, large enterprises, investment institutions, intermediary service institutions, universities, and research institutes will be constrained by resources. With the increase in the population density of the subject, the growth of the subject will slow down, and the growth process of the subject conforms to the evolution process of the ecological population.

1. Participants in the entrepreneurial ecosystem include entrepreneurial enterprises, large enterprises, investment institutions, intermediaries, and universities and research institutes. Any type of subject other than start-up enterprises can be a relevant subject.

2. The scale changes of entrepreneurial enterprises and related entities represent the growth process of the entities. As the entrepreneurial ecosystem evolves, the size of each entity represents its growth process. The larger scale of the subject, the greater the number and types of resources in the entrepreneurial ecosystem, and the better the growth. Conversely, the smaller the scale of the main body, the less the number and types of resources in the entrepreneurial ecosystem, and the worse the growth.

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3. The scale changes of various entities affect each other, and their growth processes all serve the growth law of $logistic$. Due to the limited number of resources, the growth of subjects is constrained by resources, so in the model of this paper, the growth of one type of subject will be affected by the density of another type of subject. The increase in the density of another type of main body will bring about a decrease in the growth rate of this type of main body.

4. the subject is growing and enters a stable state.

3.2. SIMULATION CALCULATION

Through Matlab software, under the same parameter background, when setting the relevant subjects, it is found that the of entrepreneurial enterprises, entrepreneurial enterprises, entrepreneurial enterprises and intermediaries, entrepreneurial enterprises and universities and scientific research institutions is consistent. Due to space reasons, this paper takes the symbiotic evolution path of entrepreneurial enterprises and investment institutions as an example to simulate. The maximum scale between start-ups and related entities under specific resource constraints is 1000. The initial size of both types of entities is 100. The evolution cycle is 800 simulation times. By exploring the relationship between different A and B, we can obtain the evolution process, and path.

1. Parasitism. Taking A as -0.15 and B as 0.15, respectively, the parasitic evolution results, when A takes a negative value, the entrepreneurial enterprise belongs to the party with increased interest in the parasitic relationship, and the related enterprises play a positive the growth of the entrepreneurial enterprise, and the steady state value exceeds its maximum capacity for independent growth. B takes a positive value, the relevant subject is on the side of the parasitic relationship with impaired interests. The startup plays a negative role in weakening the growth of the size of the relevant subject, and the steady state value is less than its maximum capacity for independent growth. After stabilisation, the subject size of the entrepreneurial enterprise reaches 1150 and the subject size of the related subject is only 810, which is only 70.43% of the subject size of the entrepreneurial enterprise.

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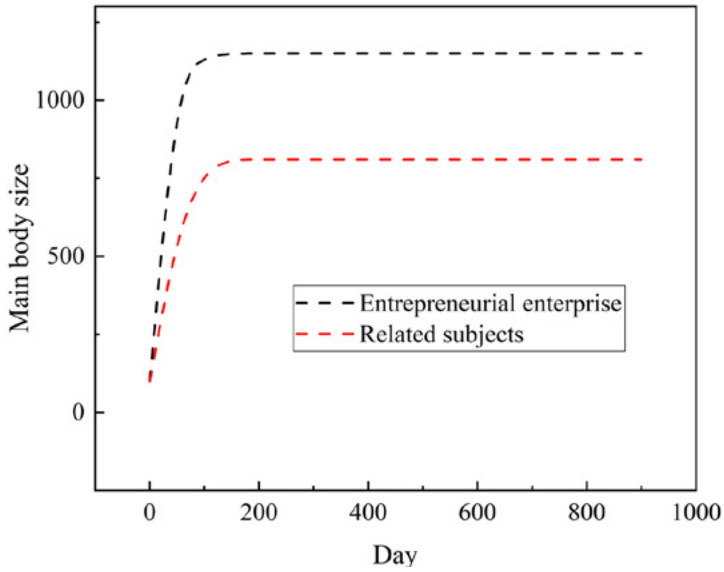

Figure 1. Symbiotic evolution results in a parasitic mode

2. Symbiosis of partial benefit. Taking A as -0.15 and B as 0, respectively, the result of partial benefit, when A takes a negative value, the entrepreneurial enterprise belongs to the party with increased interests in the symbiotic relationship of partial interests. The steady-state value exceeds the maximum capacity of independent growth. When B is 0, the relevant subject belongs to the party whose interests are not affected by the symbiosis of partial interests. Entrepreneurial enterprises have no effect on the growth of the scale of related entities, and the steady state value is equal to the maximum capacity of independent growth. In the stable simulation stage, the main body scale of entrepreneurial enterprises has reached 1150, and the main body scale of related entities is 1010, which is only 87.82% of the main body scale of entrepreneurial enterprises.

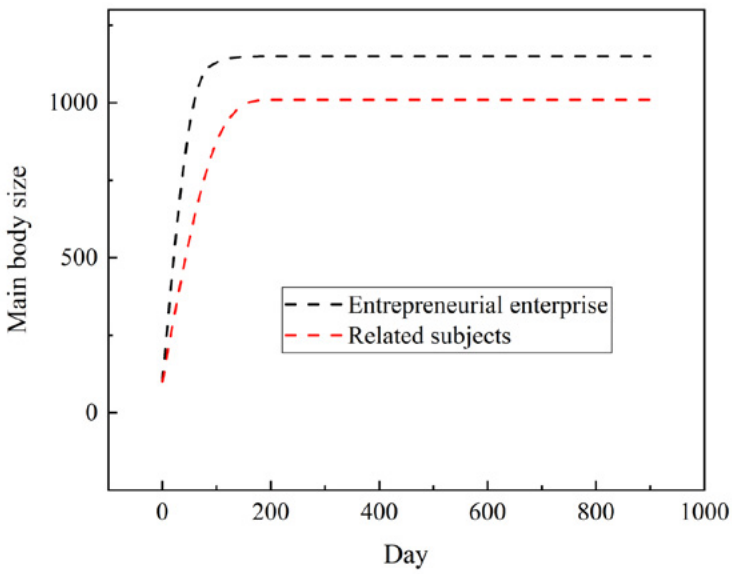

Figure 2. Symbiotic evolution results under the partial benefit symbiosis model

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3. Asymmetric mutualism. Taking A as -0.35 and B as -0.15, respectively, the results of asymmetric reciprocal A and B have negative values, and the scale growth of start-ups and related entities benefited from the other entity. The scale growth of start-ups and related entities is positively promoted by each other, and the steady state values of the two types of entities both exceed the maximum capacity of their independent growth. However, when |A|>|B|, it means that the relevant subject has a greater influence on the entrepreneurial enterprise. In the stable simulation stage, the main body scale of entrepreneurial enterprises has reached 1400, and the main body scale of related entities is 1250, which is only 89.28% of the main body scale of entrepreneurial enterprises. Therefore, the steady-state scale of entrepreneurial enterprises is larger than the steady-state scale of related entities.

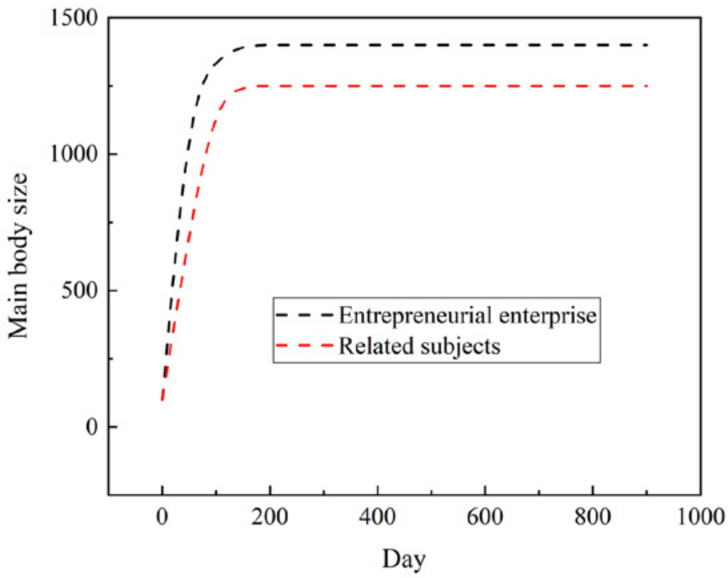

Figure 3. The results of symbiotic evolution under the asymmetric symbiotic model

4. Symmetrical mutualism. Take -0.35 for A and -0.35 for B, respectively, to obtain the symmetrical reciprocal. Both A and B take negative values, and |A|=|B|, the scale growth of entrepreneurial enterprises and related entities both benefit from the other entity and are affected to the same extent. The steady-state scale of entrepreneurial enterprises is equal to the steady-state scale of related entities, and both are larger than the maximum scale of their independent growth. In the late stage of simulation, the scale of the main body of entrepreneurial enterprises has reached 1570, and the scale of the main body of related entities has also reached 1570, but the simulation time is slightly longer.

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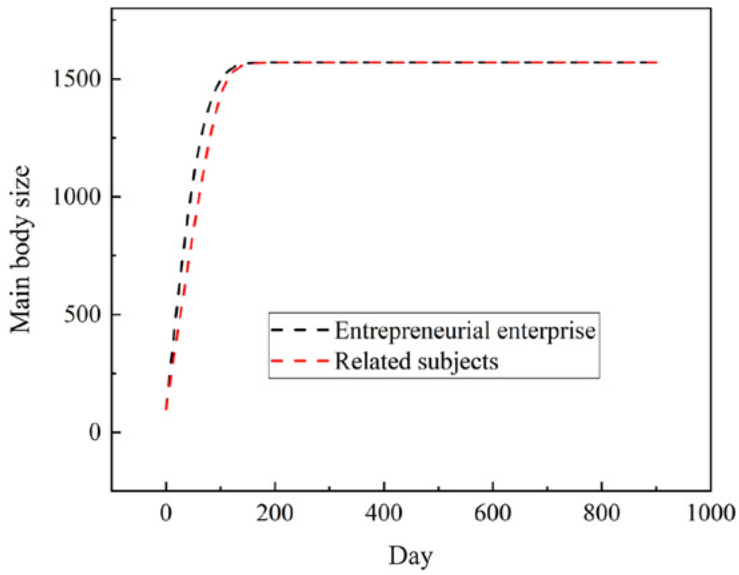

Figure 4. Symbiotic evolution results under the symmetrical symbiosis model

Through the above simulation results, it can be found that of A and B represent different symbiosis modes. Different symbiosis modes affect the stable equilibrium point, ultimately leading to different evolution paths of the subjects. It can be concluded that the path is affected by the symbiotic mode among multiple types of subjects. Observing Figures 1-4, it is found that different symbiosis coefficients represent different symbiosis modes. Under different symbiosis modes, the evolution equilibrium point of the main body is different, and the final stable scale of the main body is different.

4. RESULTS AND ANALYSIS

In the context of dual innovation, the entrepreneurial ecology of major cities in China is developing well and is becoming a world-leading entrepreneurial ecosystem. In this paper, we establish a "convergent" innovation and entrepreneurship eco-civilization system and apply it in the construction of the innovation and entrepreneurship eco-system from the perspective of land use and ecological suitability. Simulation studies were conducted in parasitic mode, biased symbiosis mode, asymmetric symbiosis mode, and symmetric symbiosis mode by Matlab software, respectively, and based on the results, the following conclusions can be drawn:

1. Different values are taken to represent different symbiosis patterns, and different symbiosis patterns affect the stability of symbiotics, which eventually leads to different evolutionary paths of the subjects. In the parasitic mode, the subject size of the relevant subject is only 70.43% of the subject size enterprise.

2. The steady state scale is related to its symbiosis coefficient and maximum scale and has nothing to do with initial population size and natural growth rate.

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Under the partial benefit symbiosis model, the scale of the main body of entrepreneurial enterprises has reached 1150, and the scale of the main body of related entities is 1010, which is only 87.82% of the scale of the main body of entrepreneurial enterprises.

3. Under the symmetrical symbiosis model, the main body scale of the relevant entities also reaches the optimum, reaching 1570, which is consistent with the main body scale of entrepreneurial enterprises. From this, it can be concluded that the equilibrium point is related to the symbiotic coefficient.

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