Scholars Journal of Physics, Mathematics and Statistics

OPEN ACCESS

Abbreviated Key Title: Sch J Phys Math Stat
ISSN 2393-8056 (Print) | ISSN 2393-8064 (Online)
Journal homepage: https://saspublishers.com

Research on Tourism City Income Distribution Based on Entropy

Zhao Chunxue[1*]

[1]School of Mathematics and Statistics, Anyang Normal University, Anyang, China

DOI: 10.36347/sjpms.2022.v09i03.002 | **Received:** 19.02.2022 | **Accepted:** 26.03.2022 | **Published:** 31.03.2022

***Corresponding author:** Zhao Chunxue
School of Mathematics and Statistics, Anyang Normal University, Anyang, China

Abstract | **Original Research Article**

Entropy is used to describe the uniform distribution of any kind of energy in space. The more uniform the energy distribution, the higher the entropy. When the energy of a system is uniformly distributed, the entropy of the system reaches its maximum. In this paper, we use the entropy to study the law of the tourism city income distribution, which makes us to better understand the internal rules, formulate strategies for the development of better tourism.

Keywords: Entropy, tourism, income distribution.

1 INTRODUCTION

The entropy is also used to measure the non-homogeneous nature of the network. hannon [1] first introduced the thermodynamic entropy into the information theory and see the entropy as the uncertainty of a random event and a measure of the amount of information.

Since the entropy is introduced, as a measure of the system stability [2, 3], it has become an important tool for studying the complex system and been extensively studied. For example, Cai [4] introduced a Caveman network and its evolution rules, the theoretical analysis and simulation experiments indicated that the Caveman network can effectively evaluated the sensitivity of different structure entropies on evolution process of the network and reflected the difference of ability to identify the properties of network complex of entropy indices. Shen [5] first took the micro-blog transmission network evolution as an example and applied the macro indicators in the study of the network's micro evolution based on the standard network structure entropy as a measurement index of ordering. Li [6] introduced four hybrid ratios into the unified hybrid network model, which were more in line with the randomness, the uncertainty and the variable growing in the real world network. Yan [7] proposed a new method for identifying key nodes in a complex network by means of combining the idea of the entropy weight method into the AHP algorithm. Cai [8] considered the difference between "node" and "edge" to define a new network structure entropy, and made theoretical analyses and the simulation experiments on regular network, random network and scale-free network. Zhao [9] proposed criteria stability entropy index based on the number of nonoverlapping paths for describing the invulnerability variation with nonoverlapping paths' number between nodes. Xu [10] proposed a virtual network mapping algorithm based on the entropy weight method. Long [11] explored a kind of network interaction mechanics process by taking advantage of entropy, built the network diffusion's system complexity of finite volume model and discussed the influence of local topology and routing capacity on the complexity. Liu [12] aligned clauses for Shi Ji ancient and modern parallel corpora using maximum entropy model and Back Propagation neural network model. He [13] proposed the uncertainty and complexity calculation method for network organization structure using entropy theory. Li [14] presented a evaluation method that can evaluate the switch performance in smart grid based on AHP-Entropy method and fuzzy-comprehensive evaluation theory. Zhu [15] proposed a computation model for network evolution based on entropy theory through summarizing the recent study of cooperation network evolution and provided more research perspectives for further analysis. Cheng [16] studied a novel network attack strategy evaluation method based on the conditional Shannon entropy and variable precision rough set. According to the diversity of micro grid's topology, through analyzing the theories of wavelet transform,

singular value decomposition and extended shannon-entropy, the wavelet singular entropy could measure the fault signal, a fault diagnosis methods for the micro grid system was proposed by integrating the wavelet singular entropy with the self organizing feature map neural network [17]. Because the real-time modeling is difficult on thermal system and the model precision is not high and the convergence rate of neural network decreases dramatically when there are too many inputs, the BP NN modeling method based on information entropy was proposed in which the attribute reduction based on the model of approximation decision entropy was used [18]. The precision of user identification is low since the subjective weighting algorithms ignore the special meanings and effects of attributes in applications, to solve the problem, an information entropy based multiple social networks user identification algorithm was proposed [19]. Pan [20] developed an adaptive traffic classification using entropy-based detection and incremental ensemble learning, assisted with embedded feature selection; in order to update the classifier timely and effectively, the entropy-based detection utilizes sliding window technique to measure the statistical difference between the previous and current traffic samples by counting and comparing all instances with respect to their feature stream membership. Wang [21] studied the entropy theory of distributed energy for internet of things.

In the paper, we study the tourism city income distribution by the entropy. The rest of the paper is organized as follows, we first review the definition and properties of entropy and get the entropy of the tourism city income distribution in section 2. Then distribution law of the tourism city income are given in section 3. Finally, the conclusions are given in section 4.

2 METHODS

We first recall that entropy is defined as follows. If the value of the random variable X is $x_i, i=1,2,\cdots,n$,and $x=\{x_i\}$ are pairwise incompatible, the probability of x_i is $p_i, i=1,2,...,n$, $\sum_{i=1}^{n} p_i = 1$, Shannon proved $H(X)=-c\sum_{i=1}^{n} p_i \log(p_i)$ $(c>0)$ is the only function satisfied the following conditions:

(i) H is the continuous function of $p_1, p_2,..., p_n$,

(ii) H get the maximum if and only if $p_1 = p_2 = ... = p_n$;

(iii) $H(X)=H(Y)+H(X/Y)$, where, $Y = f(X)$, $H(X/Y)$ is conditional entropy of X under the condition we know Y.

At the point, $H(X)$ is called the entropy of X. Let $c=1$, people called $H(X)=-\sum_{i=1}^{n} p_i \log(p_i)$ to the traditional entropy.

If the distribution of random variable X is continuous, which distribution density function is $f(x)$, the entropy of X is defined as follows: $H(X)=-\int_R f(x)\log(f(x))$, where, R is the definition domain of $f(x)$.

Since the entropy is introduced, as a measure of the system stability it has become an important tool for studying the complex system and been extensively studied. In this paper, we study the tourism city income distribution by the entropy, we calculate the entropy $H=3.69$. The higher the entropy, the more unstable the matter. The entropy of an isolated system always tends to increase, and eventually reaches the maximum state of entropy, which is the most chaotic state of the system. However, for the open system, due to the intervention of human factors and the influence of the external environment, the entropy of the open system decreases and reaches the ordered state. In the future, we will further study the change trend of the tourism city income distribution through entropy, which is beneficial for us to formulate corresponding strategies to guide the healthy development of tourism.

3 RESULTS AND DISCUSSION

We give the distribution law of the tourism city income in Figure 1. It shows that the proportion of cities with high incomes is smaller, i.e, cities with large tourism revenues are in the minority.

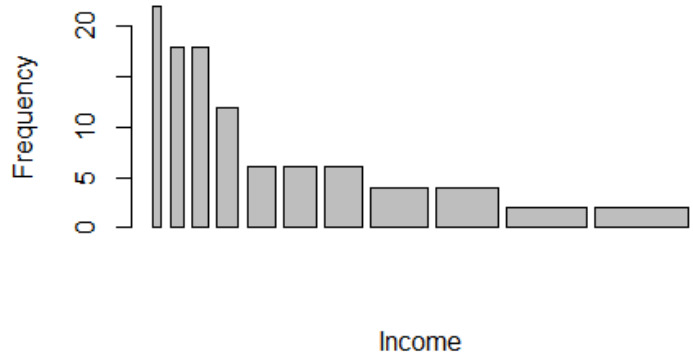

Figure 1: The distribution law of the tourism city income

The result indicates that people tend to choose well-known cities when choosing tourist destinations. In the long run, this can lead to the Matthew effect. In order to avoid this situation, local tourism management departments should provide distinctive tourism experience according to the different needs of different tourists and enhance the competitiveness of local scenic spots.

4 CONCLUSION

In this paper, we study the tourism city income distribution by the entropy. With the improvements of the living standards recently, the people's demand for travel is increasing, which forces us to study the tourist and get its internal law, so that, we can gain a reasonable solution to ensure the safety of people traveling and form a good state of the tourism operation.

5 ACKNOWLEDGEMENTS

We appreciate the financial support of this work that was provided by the National Natural Science Foundation of China (11801012) and Anyang Normal University Students innovation Fund project (X2020104790142).

REFERENCES

1. Shannon, C. E. (1948). A mathematical theory of communication. *The Bell system technical journal*, *27*(3), 379-423.
2. Wilson, A. G. (1967). A statistical theory of spatial distribution models. *Transportation research*, *1*(3), 253-269.
3. Wilson, A. G. (1970). Entropy in urban and Regional modelling. London, England: Pion Press.
4. Cai, M., Du, H. F., & Marcus, F. W. (2017). Caveman network and its application in analysis of complex network entropy, *Systems Engineering-Theory and Practice*, 37, 2403-2412.
5. Shen, Q., Huang, Y., Ma, N., & Liu, Y. J. (2015). Entropy reduction point in complex networks: Taking the evolution of micro-blog transmission network as an example, *Mathematics in Practice and Theory*, 45, 282-290.
6. LI, Y., Fang, J. Q., & Liu, Q. (2017). An entropy approach to complexity of networks generated with the unified hybrid network model: complexity of complex systems, *Science and technology review*, 35, 56-62.
7. Dong, Y., Shibin, Z., & Kang, Z. (2016). Identification of key nodes in a complex network based on AHP-entropy method. *J. Guangxi Univ.*, *41*(6), 1933-1939.
8. Meng, C., Du Hai-Feng, Yi-Ke, R., & Feldman, M. W. (2011). A new network structure entropy based node difference and edge difference. *Acta Physica Sinica*, *60*(11), 1105131-1105139.
9. Zhao, J. X. (2015). Evaluation method of network invulnerability based on nonoverlapping paths entropy, *Application Research of Computers*, 32, 825-826, 851.
10. Xu, Q., Yi, H. Y., & Zhu, J. (2015). Virtual network mapping algorithm based on entropy weight method, *Computer Engineering and Applications*, 51, 94-99.
11. Long, Y. H. (2015). Analysis of entropy into finite volume models scale-free network diffusion, *Journal of Hubei University of Arts and Science*, 36, 9-12.
12. LIU, Y., & WANG, N. (2015). Comparison of clause alignment based on maximum entropy model and Back Propagation neural network model. *Computer Engineering and Applications*, 51, 112-117.
13. He, X. J., Tan, Y. J., & Wu, Y. Y. (2016). Entropy-based Measurement of the Complexity of Network Organization and Its Empirical Analysis. *Systems Engineering*, 34, 154-158.
14. Li, Y. Z., Liu, Q., & Gao, B. (2016). Probe into evaluation method of switch network performance in smart grid based on AHP-entropy method, *ShanXi Electric Power*, 44, 29-33.

15. Yunxia, Z. (2017). The Measure Research of Cooperation Network Evolution Based on Entropy Theory. *Journal of Intelligence*, 36, 183-188.
16. Cheng, R., Lei, J., & Cheng, J. (2017). Evaluation method of network attack strategy based on conditional Shannon entropy and VPRS, Journal of WuT (Information and management engineering), 39, 162-167.
17. Qiu, L., Ye, Y., & Jiang, C. (2017). Fault diagnostic method for micro-grid based on wavelet singularity entropy and SOM neural network. *J. Shandong Univ.*, *47*(5), 118-122.
18. Hairong, S., Rui, W., & Junya, G. (2017). Thermal System Modeling Based on Entropy and BP Neural Network. *Journal of System Simulation*, *29*(1), 226-233.
19. Zheng, W. U., Hongtao, Y. U., Shuxin, L. I. U., & Yuhang, Z. H. U. (2017). User identification across multiple social networks based on information entropy. *Journal of Computer Applications*, *37*(8), 2374-2380.
20. Pan, W. B., Cheng, G., Guo, X. J., & Huang, S. X. (2017). An adaptive classification approach based on information entropy for network traffic in presence of concept drift. *Chinese Journal of Computers*, *40*(7), 1556-1571.
21. Wang, Z. L. (2019). Entropy theory of distributed energy for internet of things. *Nano Energy*, *58*, 669-672.