A Theoretical Explanation of the Causes of Popular Elements and Income Power Law Distribution Based on Data Analysis

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Abstract. The known statistical data show that the distribution of popular elements and people's income presents the characteristics of power law distribution. At present, the explanation for this phenomenon is mostly through the "rich get richer" theory, but the author believes that this theory has major flaws and fails to provide a reasonable explanation for many phenomena. Therefore, the author expands some empirical and recognized theories in a similar direction in logic, and derives a logical mathematical model through the derivation of mathematical formulas, so as to explain the phenomenon that the distribution of popular elements and people's income presents a power-law distribution. Then, by analyzing various characteristics of social networks and comparing them with some phenomena in nature, the conclusion can be extended to all self-organizing groups in nature.

1. Introduction

As we know, statistics show that the distribution of popular elements presents the characteristics of a power-law distribution. Nowadays, most explanations of this phenomenon are based on the rich get richer theory or the prioritized connection theory, that is, the first popular elements have a certain degree of randomness, but later people will preferentially join or connect to the first popular Among the elements. However, if it is for this reason that the popular elements show a power-law distribution, the first popular elements should not be out of date. However, in fact, popular elements have a lot of exclusivity between different groups in different periods, such as Tang poetry and Song poetry, such as the huge differences in popular elements in different countries. Therefore, the author believes that it is necessary to give a reasonable theoretical explanation for the power-law distribution of popular elements.

2. Theoretical Explanation of the Causes of Power Law Distribution of Popular Elements

To give such an explanation, we should first explain the causes of the popular elements. As a universal social psychological phenomenon, epidemic exists on the basis of people's demand for communication. In other words, communication among people is the basis for the emergence of epidemic.

We know that social network theory has a theory called community closure, which refers to the tendency of two individuals to form a connection because of their participation in the same community. The principles of ternary closure, community closure, and member closure can be considered to be the most important reasons for the formation of social networks. If we replace the community linking two individuals with a popular element, that is, a popular element that two individuals have a common preference for, it is clear that this is also in line with the community closure that forms the social network. In other words, you can think of a social network in which members share a common preference for a popular element. Let's discuss some of the characteristics of this type of social network.

This kind of social network is built around a popular element, but because the popularity of a popular element is quite random, it generally doesn't matter much what the popular element is. It is also because of the randomness of popular elements. We can think that the existence of such a

social network has a strong randomness. The reason for its existence is that people notice and are attracted to some popular elements.

First, there is the possibility that people will notice a certain popular element. We use a mathematical formula to express, where n is the number of people noticed by this popular element.

First, it is the possibility that people notice some popular element. We use mathematical expressions, y=n, where n is the number of people noticed by this popular element.

According to the Watts-Strogatz-Kleinberg model [1], we know that: 1. Homogeneous local connections are the same: each node has a direct edge with the node in r grid steps, 2. The random remote weak connection is controlled to some extent, so that the probability of connection between two nodes is inversely proportional to the power of their grid distance (the farther away the probability is, the smaller the probability is). Let d (v, w) be the distance from v to w (the number of grid steps), then the probability of generating a random edge from v to w is proportional to d (v, w)-q. The general value of q is 2. For simplicity, the value of q in the following is defaulted to 2.

We can assume that after the emergence of a popular element, due to its own attributes and location in the social network and other factors, there is a natural r value, and the node (here refers to the popular element) and the node in the r grid step (here refers to the individual) have a direct edge, that is, the node in the r grid step (here refers to the individual) has noticed the node (here refers to the popular element). Also, control of random remote weak connections based on the second point above. That is, the number of connections between nodes in r grid steps and nodes in 2r grid steps is equal to that in r grid steps.

$$\mathrm{y} = \mathrm{n} = 4 \times r^2 \times \frac{\sqrt{N}}{2 \times r} = \sqrt{N} \times 2 \times r \tag{1}$$

Among them, N is the number of nodes in the entire social network (here refers to individuals). This natural r value refers to the fact that due to factors such as the attribute and position of the popular element itself in the social network, it will naturally be paid attention to within a certain group. This group can be conceptually, such as those born after 1980s and 1990s; groups defined by human beings, or geographically, such as Taiyuan, Shanxi Province. Geographical groups, according to the Watts-Strogatz-Kleinberg model and scholars ' research, have been well proved. Although conceptual groups are more difficult in empirical terms, I believe that, logically, they speak of the distance between people and geographical groups, so they should be seen as having the same nature.

Δx is the difference of x when y=n, and its significance is the number of expectations of this social network with scale n in the whole social network.

We just assumed that there is a natural r value. In principle, we can see that there are many social networks of similar size ($4r^2$), and they are mutually exclusive, non-overlapping and full of social networks. Such as the provinces of administrative divisions, Shanxi, Shandong, Hebei, they are similar size, mutual exclusion, no overlap, and full of the country.

Therefore, $$\Delta x = \frac{\mathrm{N}}{4 \times r^2} \tag{2}$$

Next, we discuss the possibility that people will be attracted to some popular element after they notice it. We can assume that the probability is k. Let m be the actual scale of popularity, and its expected value is $k \times n$. We can use its expected value to approximate its value and obtain:

$$\mathrm{y} = m = k \times n = k \times \sqrt{N} \times 2 \times r \tag{3}$$

Attainable:

$$y = k^2 \times N^2 \times \frac{1}{x} \tag{4}$$

where, the value of k is related to N. Due to the limited energy of individual, the total number of all such social networks can be expressed as $L \times N$. L represents the average number of social networks that a single person can focus on, and it is a constant related to communication technology. This value can also be expressed as $y = 1$, x value is $L \times N$, also is $k^2 \times N^2$.

That is, $k = \sqrt{\frac{L}{N}}$. That is, the greater the value of N, the smaller the value of k.

This is the approximate value of the distribution function of popular elements, that is, popular elements show power-law distribution characteristics.

3. Theoretical Explanation of the Causes of Power-law Distribution of Income

In the above, we have introduced the social network formed by popular elements as the core. Now, we extend the concept of ' popular elements ' to elements within all eyes. In fact, this concept we analyze should have been an element within all people s sights. Popular elements are only a part of this concept and should be randomly distributed in this overall concept. Therefore, their distribution functions are actually part of the overall function, and the overall distribution function is also a power function, which is very similar to the original function. Now, for further analysis, we must first restore the concept of ' popular elements ' above to elements within all human sights. In this way, everything that people notice should be put into this function.

We know that the distribution of people's income is also in line with the power law, in this part we discuss its causes. To discuss this issue, we must first clarify what the essence of income is. Money income is a general equivalent in a market economy, which is a medium for commodity exchange. The higher an individual's income, the higher the ability of the individual to exchange goods with other individuals in the same market. In other words, money income is the power to distribute social resources. Of course, money income is only a part of the power to allocate social resources, and there are other forms of power to allocate social resources, such as housework, help among friends, and political power. However, in the market economy, money income is the main part of this power. The concepts of these two are similar to the relationship between' popular elements' mentioned above and elements within all line of sight, and their distribution functions should be very similar. In order to discuss the causes of the power-law distribution of income, we first discuss the distribution of social resource allocation power.

3.1. Ideally the Distribution of Income People Want to See

We all know that Marx's indiscriminate human labor [2] means that all human labor is equivalent in abstract philosophy, so some people put forward the idea of equal distribution that is called fairness. But I think what people pursue is fairness within the horizon, not the average for all. We mentioned above that people will be attracted by several social networks, and L represents the average number of social networks that a single individual concerns. I believe that the line of sight within the scope of fairness, that is, people require fairness refers to the fairness in these social networks are concerned about.

From the perspective of indiscriminate human labor, the total wealth on this social network is determined by its scale, namely, the number of individuals in the social network. Since human beings are creatures that rely on the power of groups to compete, I believe that the equitable distribution required by people is divided into two parts. One is the participation income of everyone, and the other is the action required by the whole group. For the benefit of each person's participation, because each person's energy is similar, it can be considered that the number of social networks of concern is similar, so in this part, each individual's power to allocate social resources is similar. For another part of the entire group's action needs, because ' family has thousands of people, a director ', generally through competition, in the entire social network to produce a leader, and give them the power to dominate these social resources. Obviously, the number of these social resources is proportional to the total wealth of the social network, that is, proportional to the scale of the

social network. The scale of this social network is its attention, that is, the distribution function of social resource allocation power is the distribution function of popular elements obtained in the previous section, which is reduced to the distribution function of elements within all the line of sight of people, and then it is reduced in a certain proportion and then moved upward for a period of time. It also shows the characteristics of power-law distribution.

The function is:

$$y = L \times N \times \frac{1}{x} \times d + C \tag{5}$$

Where C is the constant about L, which is the basic social welfare of each individual in the whole society as a participant in social activities, and d is the reduced proportion, which can ensure the total area unchanged. As mentioned above, L is a constant related to communication technology. The more developed the communication technology is, the more things people can pay attention to, and the value of C, that is, the higher the basic social welfare people require. That is, the minimum living security required is positively related to communication technology. Moreover, the ideal number of disposable resources of individuals in the whole society is represented by wealth. The offline depends on communication technology, and the online depends on the scale of the whole society, namely the number of individuals.

3.2. Non-ideal Circumstances

What we discussed above is the income distribution that people want to see under ideal circumstances. However, in the real world, for various reasons, people's income distribution is often different from the theoretical value in the ideal situation. The most important reason is people's selfishness. After people obtain the leadership of a social network through competition, they obtain the right to control the resources in the social network. After that, they often do not use all the resources above the goal of the social network, but use some resources for their own selfish desires, including consolidating their status in the social network, which is called "power is not used, expired and abolished". Moreover, once he loses the right to control the resources in the social network for competitive reasons, often for some inertia reasons, he will retain a lot of resources in his hands. Although due to competition, if it uses too much resources for purposes other than the goals of the social network, this person will often lose his leadership over the social network quickly, but people will always use some resources more or less for their own selfish desires.

Once the income distribution in the real world deviates from the ideal value, people will take some measures to correct it. Legal means such as policy, law, etc. The obvious ones are inflation and inheritance taxes. The famous American heritage tax can reach 50 %. These are obvious means to prevent the rich from getting richer. Inflation is detrimental to creditors, and inheritance tax is even shakier to prevent the accumulation of wealth across generations. From the perspective of preventing the rich from becoming richer, most of the policies and laws to prevent the widening gap between the rich and the poor can be attributed to them, such as the progressive tax system, which can be said to occupy an important part of all policies and laws and are often the most concerned part [3].

If these legal means are still unable to correct the income distribution that deviates from the ideal value in the real world, people will sometimes take some illegal means. For example, gangs, bribery, in fact, these means and tax policies are the same, are the means of redistribution of social resources, are used to correct the income distribution deviation. Often, the more imperfect the law is, the more rampant this means is. The imperfect law here refers to policies and laws that prevent the widening gap between the rich and the poor, namely those used to correct the income distribution. Furthermore, if these means are still unable to correct the distribution of income, they will often be accompanied by war and revolution. What's interesting is that history has proved that too average income distribution cannot be sustained for a long time.

Seems to want to deviate from this income distribution in reality and make it recognisable only if the social network is completely disconnected. There are also some examples in history to achieve

the effect of complete separation of social networks through race or religion. Through examples of apartheid social networks, such as the policy of apartheid between whites and blacks, racial differences between whites and blacks also led to the existence of early slavery in the United States ; Examples of religious secessionist social networks, such as Jews, who persisted in Judaism different from other religions and traditional lifestyles that were excluded from other European peoples, had long been ostracized by European countries, culminating in the Holocaust of Jews during the Second World War. India's caste system is also an interesting example. India's religion believes that even reincarnations cannot be connected among its castes. That is, such a thorough isolation, it is possible to completely separate the entire social network, so that people accept this deviation of income distribution.

4. Related Properties of Social Networks

4.1. Changes in Social Networks

The key point of the author's opposition to the theory of ' richer ' is that these social networks are changeable, including their own changes and their leaders ' changes [4]. In the above, we refer to a constant k, which refers to the probability that an individual is attracted by a certain social network after he or she is concerned about it. We also analyze that the value of this constant k is related to the overall scale N. The larger the value of N is, the smaller the value of k is. The larger the value of k, means that people can pay less attention to the reserve force, and the smaller the value of k, means that those who are concerned about the competition will be greater. This means that the larger the overall size of the social network, the faster people's attention focus changes. Although, after the change of this social network, it will have certain inheritance to the previous network, partly because the leader will use some of the public resources controlled by it for his own selfish desire, so that he has a certain congenital advantage in the next competition, but the overall change must be increased with the increase of N value.

4.2. The Importance of Niche Elements

Another interesting phenomenon is that people seem to pay more attention to the scale of their social network, rather than its core elements [5]. For example, there are always some people ' Qu Gao and Shao ' who disdain the public elements, and some people are addicted to conspiracy theory, aliens and other minority elements. I think this is because people are more sensitive to the scale of the social network where the elements they are concerned about. Like some genius, will find some new elements, these elements in the beginning are often small elements. After these elements are accepted by the public and become public elements, these geniuses sometimes abandon their leadership and turn to seek new directions.

This phenomenon is somewhat similar to the lazy ant effect [6]. The lazy ants effect refers to putting some food in one place and allowing ants to find it. Most ants are very industrious to carry food back and forth, but no matter how abundant the food here is, there are always a few ants who do not join this route. They seem to do nothing all day long and look around. People call this few ants lazy ants. Once people cut off the food source of the ant colony, those ' lazy ants ' ' stand out ' and lead the ants to the new food source they have already detected. This is just like those lovers of minority elements, although there is no use at ordinary times, but sometimes it is the discoverer of people's new direction. This seems to be an efficient survival law that nature evolved millions of years ago and group organisms must abide by. While simply following the simple model, it can help groups through the countless changes of nature.

5. Conclusion

Marx said that human nature is the sum of all social relations [7]. The basic view of the current social network theory [8] is that people in social situations will form similar ways of thinking and acting because of their relationship. Social network theory regards social network system as a whole to explain social behavior. This further expands Marx's exposition of human nature.

Observing various phenomena of society from the perspective of social network, many of them are in line with the characteristics of power-law distribution. This paper theoretically analyzes the causes of these phenomena obeying power law distribution, and holds that these phenomena are not unique to human society. Many groups in nature obey this law after self-organization.

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