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Probability Distribution of Arithmetic Average of China Aviation Network Edge Vertices Nearest Neighbor Average Degree Value and Its Evolutionary Trace Based on Complex Network

Cheng Xiangjun, Yang Fang and Xiong Zhihua
School of Traffic and Transportation, Beijing Jiaotong University, Beijing 100044, China

Abstract: In order to reveal the complex network characteristics and evolution principle of China aviation network, the probability distribution and evolution trace of arithmetic average of edge vertices nearest neighbor average degree values of China aviation network were studied based on the statistics data of China civil aviation network in 1988, 1994, 2001, 2008 and 2015. According to the theory and method of complex network, the network system was constructed with the city where the airport was located as the network node and the route between cities as the edge of the network. Based on the statistical data, the arithmetic averages of edge vertices nearest neighbor average degree values of China aviation network in 1988, 1994, 2001, 2008 and 2015 were calculated. Using the probability statistical analysis method, it was found that the arithmetic average of edge vertices nearest neighbor average degree values had the probability distribution of normal function and the position parameters and scale parameters of the probability distribution had linear evolution trace.

Key words: Complex network, China aviation network, arithmetic average of edge vertices nearest neighbor average degree value, linear evolution trace.

1. Introduction

Aviation network is typical complex network with small world characters [1, 2]. About certain nation's aviation network, there are some unknown features in the field of complex network. This paper faces the aviation network of China through analyzing the passenger data [3] of civil aviation airlines in year 1988, 1994, 2001, 2008 and 2015 to reveal the complex network feature. According to complex network theory, network system of airports and airlines of China was constructed with airports regarded as nodes and airline regarded as edges to study the probability distribution of arithmetic average of edge vertices nearest neighbor average degree and its evolution trace of aviation network of China. Based on the statistical data, the arithmetic averages of edge vertices nearest neighbor average degree values in China aviation network in 1988, 1994, 2001, 2008 and 2015 were calculated. Using the probability statistical analysis method, it was found that the arithmetic average of edge vertices nearest neighbor average degree values had the probability distribution of normal function and the position parameters and scale parameters of the probability distribution had linear evolution trace.

2. Probability Distribution of Arithmetic Average of China Aviation Network Edge Vertices Nearest Neighbor Average Degree Value

For network $G = (V, E)$, where $v_i \in V$ is the node

Corresponding author: Yang Fang, Ph.D., lecturer, research fields: transportation management, traffic and transportation engineering.

of G, V is the set of nodes. E is the set of edges [4], $(v_i, v_j) \in E$. Matrix $A = (a_{i,j})_{n\times n}$ was constructed, where:

$$a_{i,j} = \begin{cases} 1, (v_i, v_j) \in E \\ 0, otherwise \end{cases} \quad (1)$$

Matrix A was called adjacent matrix of network G. The degree of node v_i was defined as the number of edges connected to v_i. The nearest neighbor average degree $k_{nn,i}$ of node v_i was defined as following [4]:

$$k_{nn,i} = \frac{\left[\sum_j (a_{i,j} \cdot k_j)\right]}{k_i} \quad (2)$$

In Eq. (2): k_i—the degree of node v_j; k_j—the degree of other node v_j in the network; $a_{i,j}$—the element of adjacent matrix.

The arithmetic average of edge vertices nearest neighbor average degree $K_{nn,i,j}^{EVA}$ was defined as following:

$$K_{nn,i,j}^{EVA} = \frac{1}{2}(k_{nn,i} + k_{nn,j}) \quad (3)$$

In Eq. (3): $k_{nn,i}$—the nearest neighbor average degree of edge vertex v_i; $k_{nn,j}$—the nearest neighbor average degree of edge vertex v_j; $(v_i, v_j) \in E$.

2.1 Probability Distribution of Arithmetic Average of Edge Vertices Nearest Neighbor Average Degree Value in China Aviation Network in 1988

The adjacent matrix A_{1988} was gotten from statistic data [3]. The arithmetic averages of edge vertices nearest neighbor average degree value K_n^{EVA} ($n = 1, 2, 3, ..., 265$) of 265 edges in 1988 were gotten from A_{1988} and Eqs. (2) and (3). Statistics was done to the data in Table 1 according to the interval in Table 1. The scattered points in Fig. 1 were drawn by the data in Table 1. Let the interval median be the horizontal axis *x* and the probability be the vertical axis *y*. Let the quantity of edges be N, the quantity of interval be m, the spacing of interval i be δ, the times of appearance in interval i be k_i, the frequency of appearance in interval i be q_i, the probability of appearance in interval i be p_i. Here $N_{1988}^E = 265$, $m_{1988} = 5$, $\delta_{1988} = 4.46$. It could be known from the probability theory [5]:

$$q_i = \frac{k_i}{N_{1988}^E}, \quad \sum_{i=1}^{m_{1988}} q_i = 1 \quad (4)$$

$$q_i = p_i \delta_{1988} \Rightarrow p_i = \frac{q_i}{\delta_{1988}}, \sum_{i=1}^{m_{1988}} p_i = \frac{1}{\delta_{1988}} \quad (5)$$

The normal distribution function is $N(\mu, \sigma)$, μ is the location parameter, σ is the scale parameter, its probability density function is $f(x)$.

$$f(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{\frac{-(x-\mu)^2}{2\sigma^2}} \quad (6)$$

It could be gotten from the statistical properties of normal distribution [5]:

$$\hat{\mu}_{1988} = \frac{1}{N_{1988}^E} \sum_{i=1}^{N_{1988}^E} x_i = 17.2 \quad (7)$$

$$\hat{\sigma}_{1988} = \sqrt{\frac{1}{N_{1988}^E - 1} \sum_{i=1}^{N_{1988}^E} (x_i - \bar{x})^2} = 4.07 \quad (8)$$

Let $\hat{\mu}_{1988}$ and $\hat{\sigma}_{1988}$ be location parameter and scale parameter to substitute in Eq. (6), the equation of fitting curve could be gotten:

$$\hat{y}_{1988} = 0.098 e^{-0.03(x-17.2)^2} \quad (9)$$

The fitting curve in Eq. (9) and sample points $p_{i,1988}$ were drawn in Fig. 2 with good fitting effect.

Take $\varepsilon_{i,1988}$ ($i = 1, 2, 3, 4, 5$) as residual to investigate the degree of approximation of fitting through the residual distribution [6].

$$\varepsilon_{i,1988} = p_{i,1988} - \hat{y}_{i,1988} \quad (10)$$

The residual $\varepsilon_{i,1988}$ was drawn in Fig. 3. All points in Fig. 3 were random fluctuation around $\varepsilon = 0$ and the range of fluctuation was very small.

$$|\varepsilon_{i,1988}| < 0.01 < \hat{\sigma}_{1988} = 4.07$$

This illustrated that the fitting effect was very good.

Table 1 Probability distribution of arithmetic average of edge vertices nearest neighbor average degree value in 1988.

Interval	[4.5, 8.96]	(8.96, 13.42]	(13.42, 17.88]	(17.88, 22.34]	(22.34, 26.8]
Median	6.73	11.19	15.65	20.11	24.57
Times	4	34	119	81	27
Frequency	0.015	0.128	0.449	0.306	0.102
Probability	0.0034	0.0287	0.1007	0.0686	0.0229

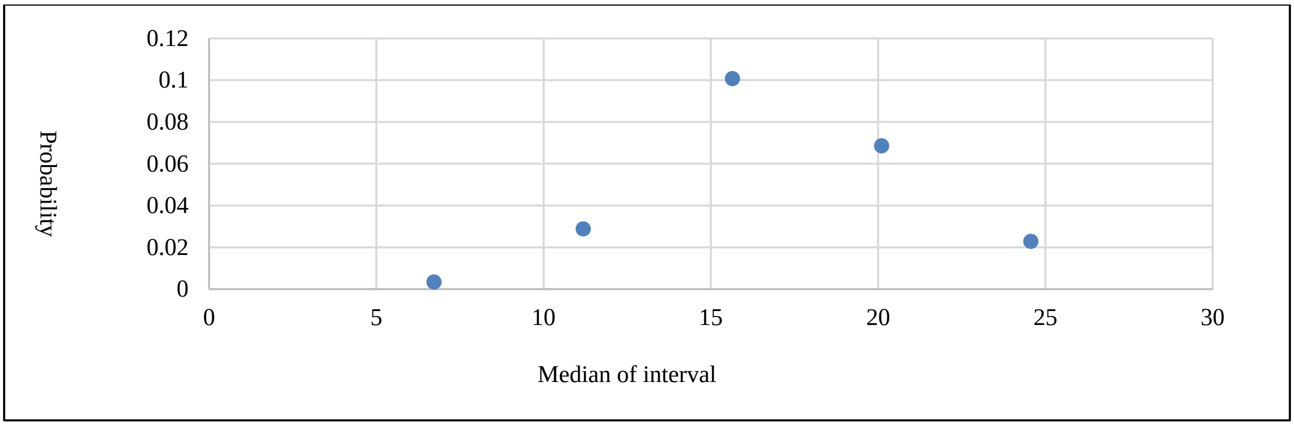

Fig. 1 Probability distribution diagram of arithmetic average of edge vertices nearest neighbor average degree value in 1988.

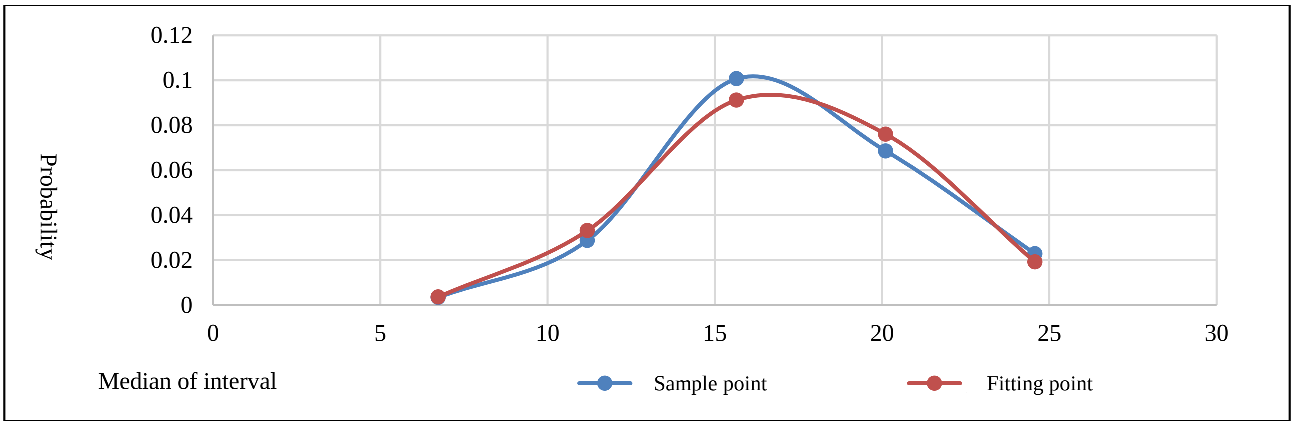

Fig. 2 Fitting effect diagram of probability distribution of arithmetic average of edge vertices nearest neighbor average degree value in 1988.

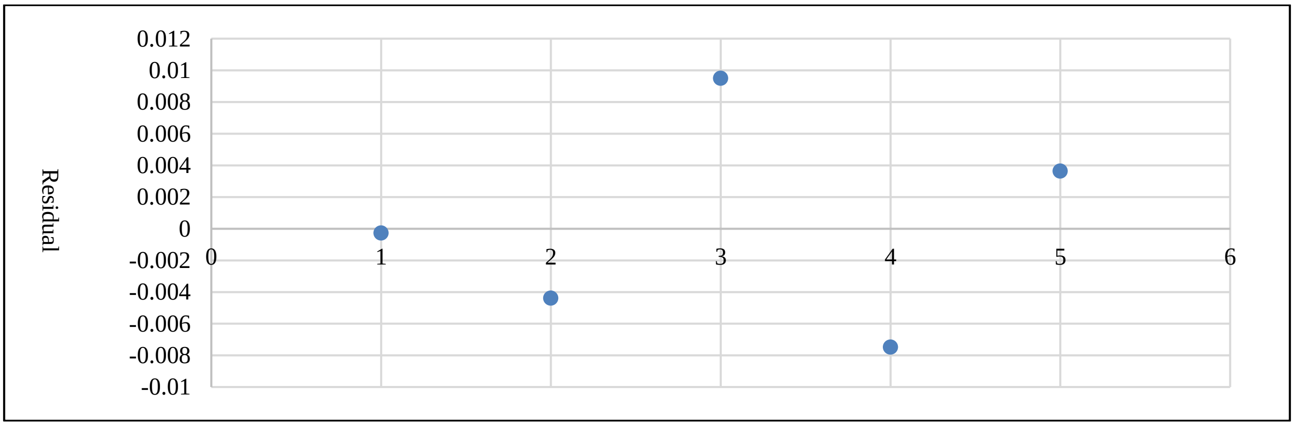

Fig. 3 Residual diagram of fitting curve of probability distribution of arithmetic average of edge vertices nearest neighbor average degree value in 1988.

2.2 Probability Distribution of Arithmetic Average of Edge Vertices Nearest Neighbor Average Degree Value in China Aviation Network in 1994

The adjacent matrix A_{1994} was gotten from statistic data. The arithmetic averages of edge vertices nearest neighbor average degree value K_n^{EVA} ($n = 1, 2, 3, \ldots\ldots, 589$) of 589 edges in 1994 were gotten from A_{1994} and Eqs. (2) and (3). Statistics was done to the data in Table 2 according to the interval in Table 2. The curve in Fig. 4 was drawn by the data in Table 2. It was similar to normal distribution function by observation. The definition of parameters and relationship of parameters were similar to Eqs. (4) and (5) in Section (2.1). Here, $N_{1994}^E = 589$, $m_{1994} = 5$, $\delta_{1994} = 6.2$. It could be gotten from the statistical properties of normal distribution:

$$\hat{\mu}_{1994} = \frac{1}{N_{1994}^E} \sum_{i=1}^{N_{1994}^E} x_i = 27.63 \qquad (11)$$

$$\hat{\sigma}_{1994} = \sqrt{\frac{1}{N_{1994}^E - 1} \sum_{i=1}^{N_{1994}^E} (x_i - \overline{x})^2} = 5.07 \qquad (12)$$

Let $\hat{\mu}_{1994}$ and $\hat{\sigma}_{1994}$ be location parameter and scale parameter to substitute in Eq. (6), the equation of fitting curve could be gotten:

$$\hat{y}_{1994} = 0.079 e^{-0.019(x-27.63)^2} \qquad (13)$$

The fitting curve in Eq. (13) and sample points $p_{i,1994}$ were drawn in Fig. 5 with good fitting effect.

Take $\varepsilon_{i,1994}$ ($i = 1, 2, 3, 4, 5$) as residual to investigate the degree of approximation of fitting through the residual distribution.

$$\varepsilon_{i,1994} = p_{i,1994} - \hat{y}_{i,1994} \qquad (14)$$

The residual $\varepsilon_{i,1994}$ was drawn in Fig. 6. All points in Fig. 6 were random fluctuation around $\varepsilon = 0$ and the range of fluctuation was very small.

$$\left|\varepsilon_{i,1994}\right| < 0.005 < \hat{\sigma}_{1994} = 5.07$$

This illustrated that the fitting effect was very good.

Table 2 Probability distribution of arithmetic average of edge vertices nearest neighbor average degree value in 1994.

Interval	[13.3, 19.5]	(19.5, 25.7]	(25.7, 31.9]	(31.9, 38.1]	(38.1, 44.3]
Median	16.4	22.6	28.8	35	41.2
Times	32	171	283	86	17
Frequency	0.054	0.290	0.481	0.146	0.029
Probability	0.0087	0.0468	0.0776	0.0235	0.0047

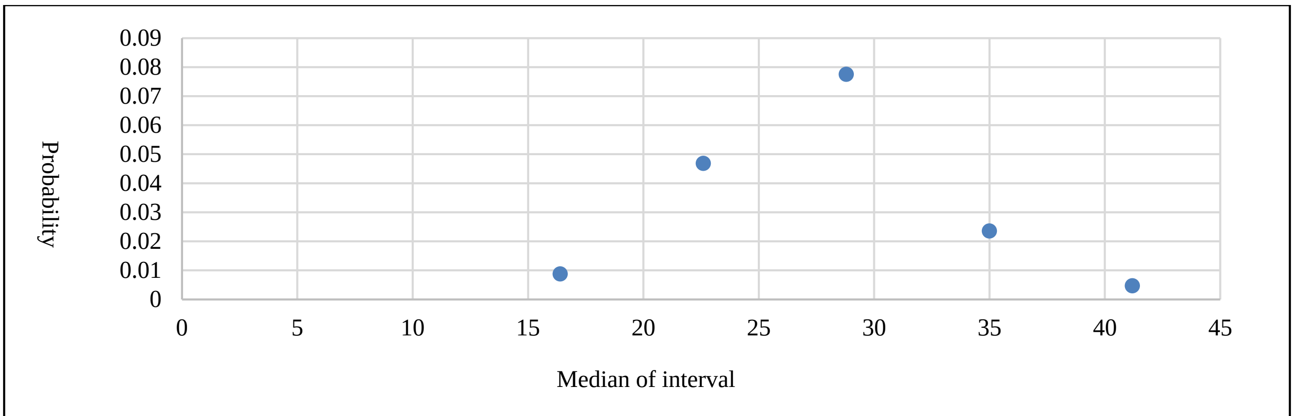

Fig. 4 Probability distribution diagram of arithmetic average of edge vertices nearest neighbor average degree value in 1994.

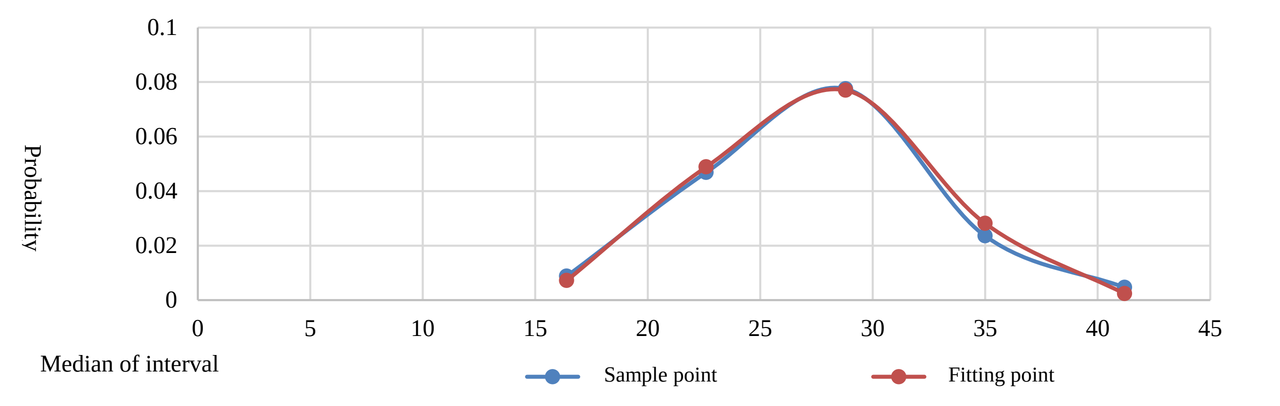

Fig. 5 Fitting effect diagram of probability distribution of arithmetic average of edge vertices nearest neighbor average degree value in 1994.

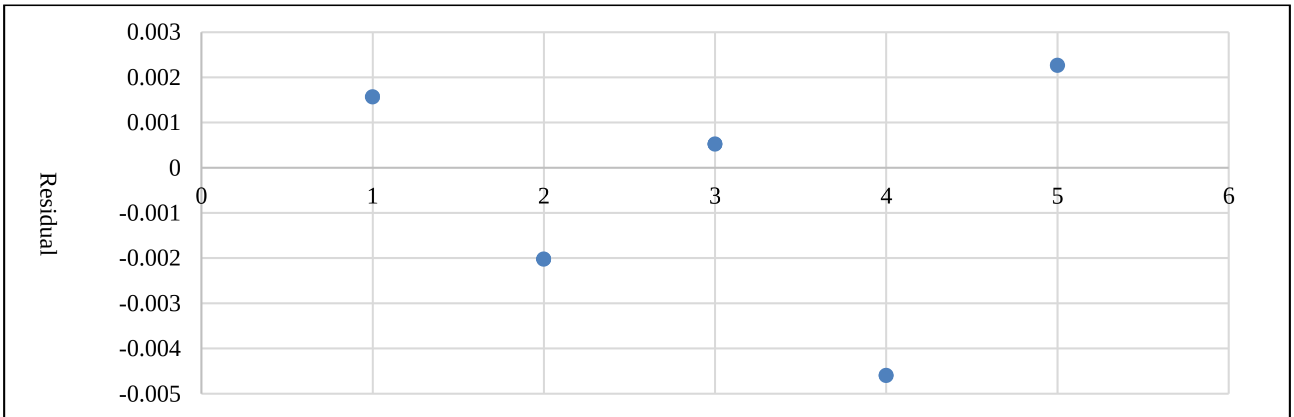

Fig. 6 Residual diagram of fitting curve of probability distribution of arithmetic average of edge vertices nearest neighbor average degree value in 1994.

2.3 Probability Distribution of Arithmetic Average of Edge Vertices Nearest Neighbor Average Degree Value in China Aviation Network in 2001

The adjacent matrix A_{2001} was gotten from statistic data. The arithmetic averages of edge vertices nearest neighbor average degree value K_n^{EVA} ($n=1,2,3,......,730$) of 730 edges in 2001 were gotten from A_{2001}, Eqs. (2) and (3). Statistics was done to the data in Table 3 according to the interval in Table 3. The curve in Fig. 7 was drawn by the data in Table 3. It was similar to normal distribution function by observation. The definition of parameters and relationship of parameters were similar to Eqs. (4) and (5) in Section (2.1). Here, $N_{2001}^E=730$, $m_{2001}=5$, δ_{2001}=8.88. It could be gotten from the statistical properties of normal distribution:

$$\hat{\mu}_{2001}=\frac{1}{N_{2001}^E}\sum_{i=1}^{N_{2001}^E}x_i=30.66 \tag{15}$$

$$\hat{\sigma}_{2001}=\sqrt{\frac{1}{N_{2001}^E-1}\sum_{i=1}^{N_{2001}^E}(x_i-\overline{x})^2}=5.62 \tag{16}$$

Let $\hat{\mu}_{2001}$ and $\hat{\sigma}_{2001}$ be location parameter and scale parameter to substitute in Eq. (6), the equation of fitting curve could be gotten:

$$\hat{y}_{2001}=0.071e^{-0.0158(x-30.66)^2} \tag{17}$$

The fitting curve in Eq. (17) and sample points $p_{i,2001}$ were drawn in Fig. 8 with good fitting effect.

Take $\varepsilon_{i,2001}$ ($i=1,2,3,4,5$) as residual to investigate the degree of approximation of fitting through the residual distribution.

Table 3 Probability distribution of arithmetic average of edge vertices nearest neighbor average degree value in 2001.

Interval	[6, 14.88]	(14.88, 23.76]	(23.76, 32.64]	(32.64, 41.52]	(41.52, 50.4]
Median	10.44	19.32	28.2	37.08	45.96
Times	1	70	416	211	32
Frequency	0.0014	0.0959	0.5699	0.289	0.0438
Probability	0.0002	0.0108	0.0642	0.0325	0.0049

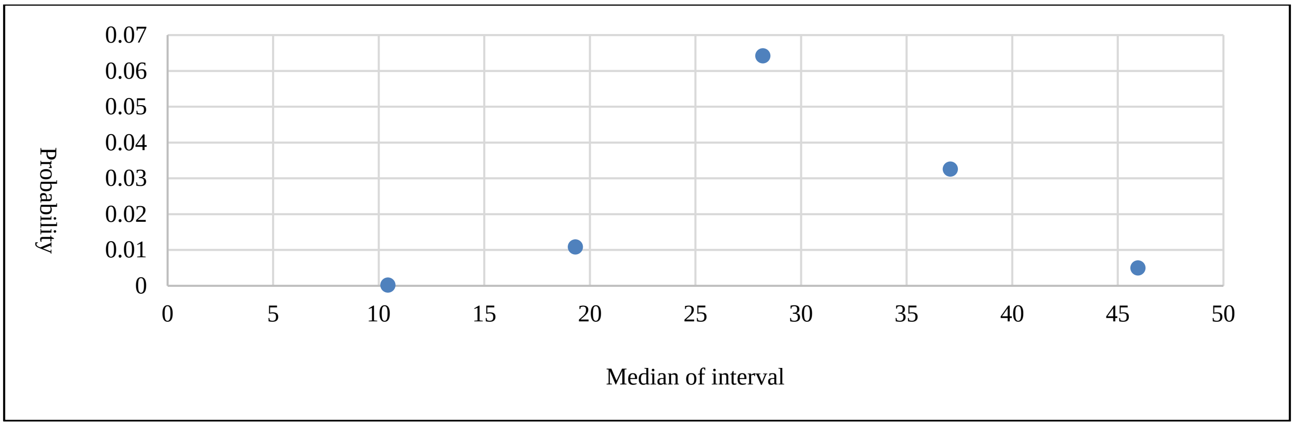

Fig. 7 Probability distribution diagram of arithmetic average of edge vertices nearest neighbor average degree value in 2001.

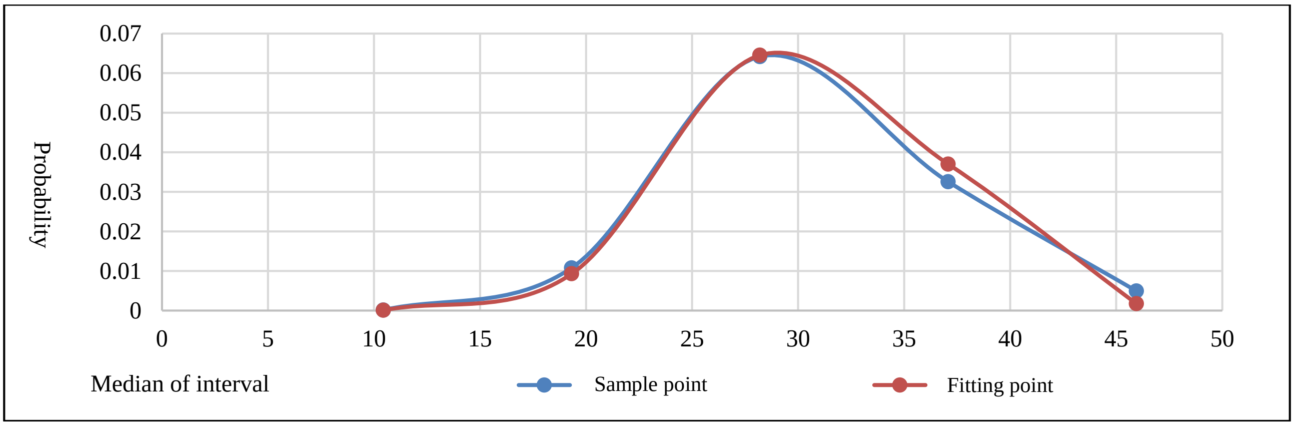

Fig. 8 Fitting effect diagram of probability distribution of arithmetic average of edge vertices nearest neighbor average degree value in 2001.

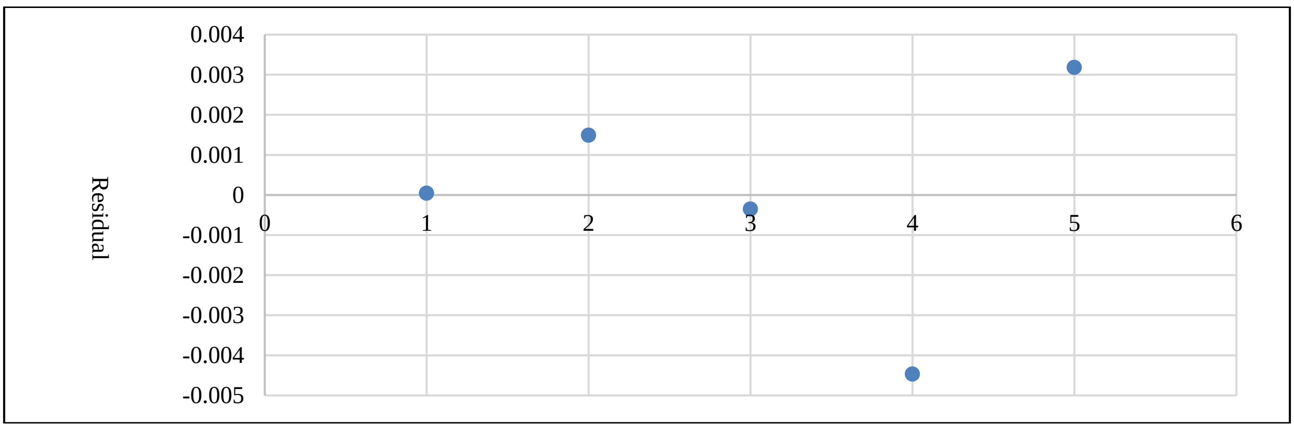

Fig. 9 Residual diagram of fitting curve of probability distribution of arithmetic average of edge vertices nearest neighbor average degree value in 2001.

$$\varepsilon_{i,2001} = p_{i,2001} - \hat{y}_{i,2001} \quad (18)$$

The residual $\varepsilon_{i,2001}$ was drawn in Fig. 9. All points in Fig. 9 were random fluctuation around $\varepsilon = 0$ and the range of fluctuation was very small. $|\varepsilon_{i,2001}| < 0.005 < \hat{\sigma}_{2001} = 5.62$. This illustrated that the fitting effect was very good.

2.4 Probability Distribution of Arithmetic Average of Edge Vertices Nearest Neighbor Average Degree Value in China Aviation Network in 2008

The adjacent matrix A_{2008} was gotten from statistic data. The arithmetic averages of edge vertices nearest neighbor average degree value K_n^{EVA} ($n = 1, 2, 3, ..., 940$) of 940 edges in 2008 were gotten from A_{2008}, Eqs. (2) and (3). Statistics was done to the data in Table 4 according to the interval in Table 4. The curve in Fig. 10 was drawn by the data in Table 4. It was similar to normal distribution function by observation. The definition of parameters and relationship of parameters were similar to Eqs. (4) and (5) in Section (2.1). Here, $N_{2008}^E = 940$, $m_{2008} = 5$, δ_{2008}=9.44. It could be gotten from the statistical properties of normal distribution:

$$\hat{\mu}_{2008} = \frac{1}{N_{2008}^E} \sum_{i=1}^{N_{2008}^E} x_i = 35.9 \quad (19)$$

$$\hat{\sigma}_{2008} = \sqrt{\frac{1}{N_{2008}^E - 1} \sum_{i=1}^{N_{2008}^E} (x_i - \overline{x})^2} = 6.53 \quad (20)$$

Let $\hat{\mu}_{2008}$ and $\hat{\sigma}_{2008}$ be location parameter and scale parameter to substitute in Eq. (6), the equation of fitting curve could be gotten:

$$\hat{y}_{2008} = 0.061 e^{-0.0117(x-35.9)^2} \quad (21)$$

The fitting curve in Eq. (21) and sample points $p_{i,2008}$ were drawn in Fig. 11 with good fitting effect. Take $\varepsilon_{i,2008}$ ($i = 1, 2, 3, 4, 5$) as residual to investigate the degree of approximation of fitting through the residual distribution.

$$\varepsilon_{i,2008} = p_{i,2008} - \hat{y}_{i,2008} \quad (22)$$

The residual $\varepsilon_{i,2008}$ was drawn in Fig. 12. All points in Fig. 12 were random fluctuation around $\varepsilon = 0$ and the range of fluctuation was very small. $|\varepsilon_{i,2008}| < 0.003 < \hat{\sigma}_{2008} = 6.53$ This illustrated that the fitting effect was very good.

Table 4 Probability distribution of arithmetic average of edge vertices nearest neighbor average degree value in 2008.

Interval	[8.5, 17.94]	(17.94, 27.38]	(27.38, 36.82]	(36.82, 46.26]	(46.26, 55.7]
Median	13.22	22.66	32.1	41.54	50.98
Times	2	89	434	355	60
Frequency	0.0021	0.0947	0.4617	0.3777	0.0638
Probability	0.0002	0.0100	0.0489	0.0400	0.0068

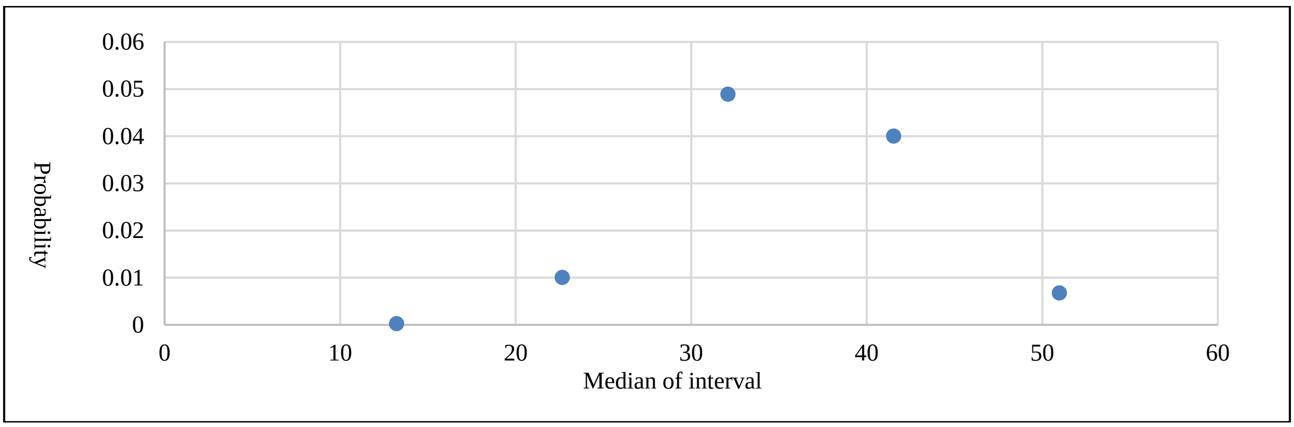

Fig. 10 Probability distribution diagram of arithmetic average of edge vertices nearest neighbor average degree value in 2008.

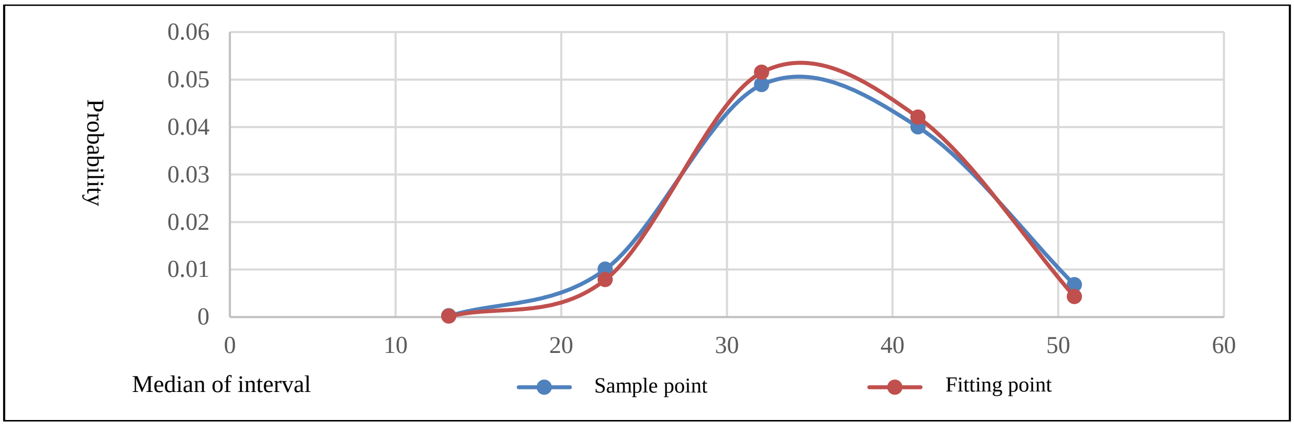

Fig. 11 Fitting effect diagram of probability distribution of arithmetic average of edge vertices nearest neighbor average degree value in 2008.

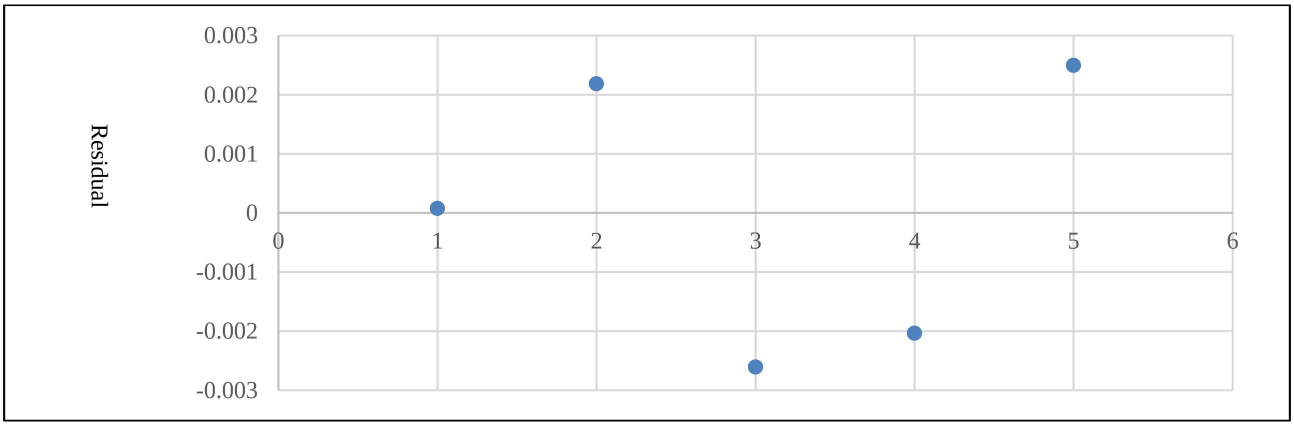

Fig. 12 Residual diagram of fitting curve of probability distribution of arithmetic average of edge vertices nearest neighbor average degree value in 2008.

2.5 Probability Distribution of Arithmetic Average of Edge Vertices Nearest Neighbor Average Degree Value in China Aviation Network in 2015

The adjacent matrix A_{2015} was gotten from statistic data. The arithmetic averages of edge vertices nearest neighbor average degree value K_n^{EVA} ($n=1,2,3,......,1924$) of 1,924 edges in 2015 were gotten from A_{2015}, Eqs. (2) and (3). Statistics was done to the data in Table 5 according to the interval in Table 5. The curve in Fig. 13 was drawn by the data in Table 5. It was similar to normal distribution function by observation. The definition of parameters and relationship of parameters were similar to Eqs. (4) and (5) in Section (2.1). Here, $N_{2015}^E=1924$, $m_{2015}=5$, δ_{2015}=15.74. It could be gotten from the statistical properties of normal distribution:

$$\hat{\mu}_{2015}=\frac{1}{N_{2015}^E}\sum_{i=1}^{N_{2015}^E}x_i=51.74 \tag{23}$$

$$\hat{\sigma}_{2015}=\sqrt{\frac{1}{N_{2015}^E-1}\sum_{i=1}^{N_{2015}^E}(x_i-\overline{x})^2}=9.83 \tag{24}$$

Let $\hat{\mu}_{2015}$ and $\hat{\sigma}_{2015}$ be location parameter and scale parameter to substitute in Eq. (6), the equation of fitting curve could be gotten:

$$\hat{y}_{2015}=0.041e^{-0.0052(x-51.74)^2} \tag{25}$$

The fitting curve Eq. (25) and sample points $p_{i,2015}$ were drawn in Fig. 14 with good fitting effect. Take $\varepsilon_{i,2015}$ ($i=1,2,3,4,5$) as residual to investigate the degree of approximation of fitting through the residual distribution.

Table 5 Probability distribution of arithmetic average of edge vertices nearest neighbor average degree value in 2015.

Interval	[4.08, 19.82]	(19.82, 35.56]	(35.56, 51.3]	(51.3, 67.04]	(67.04, 82.78]
Median	11.95	27.69	43.43	59.17	74.91
Times	1	111	779	931	102
Frequency	0.0005	0.0577	0.4049	0.4839	0.0530
Probability	0.00003	0.00367	0.02572	0.03074	0.00337

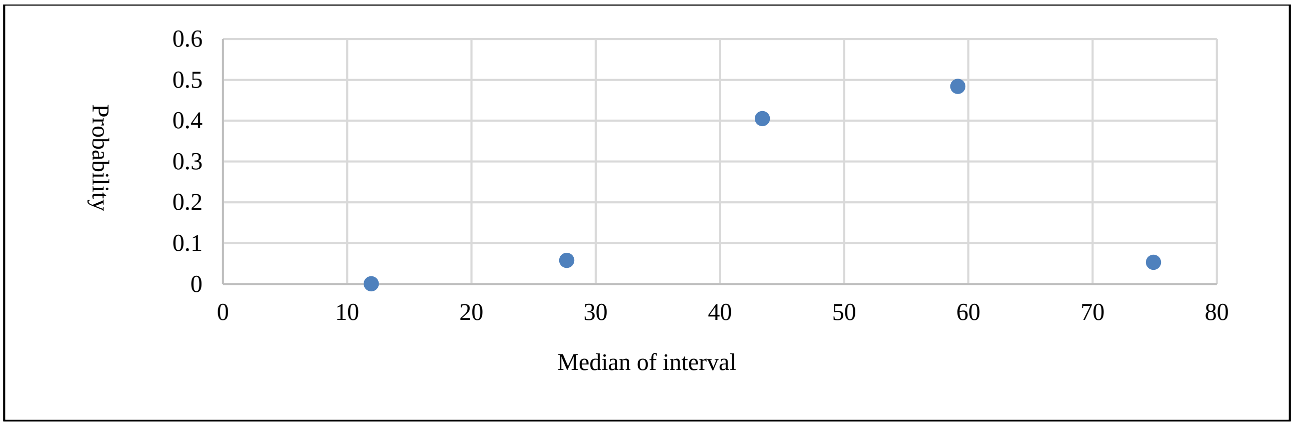

Fig. 13 Probability distribution diagram of arithmetic average of edge vertices nearest neighbor average degree value in 2015.

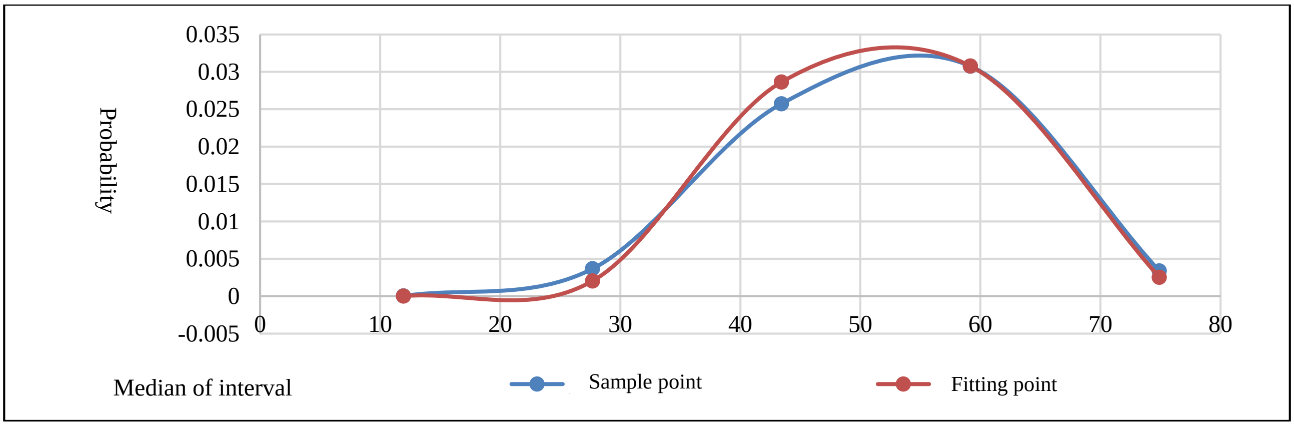

Fig. 14 Fitting effect diagram of probability distribution of arithmetic average of edge vertices nearest neighbor average degree value in 2015.

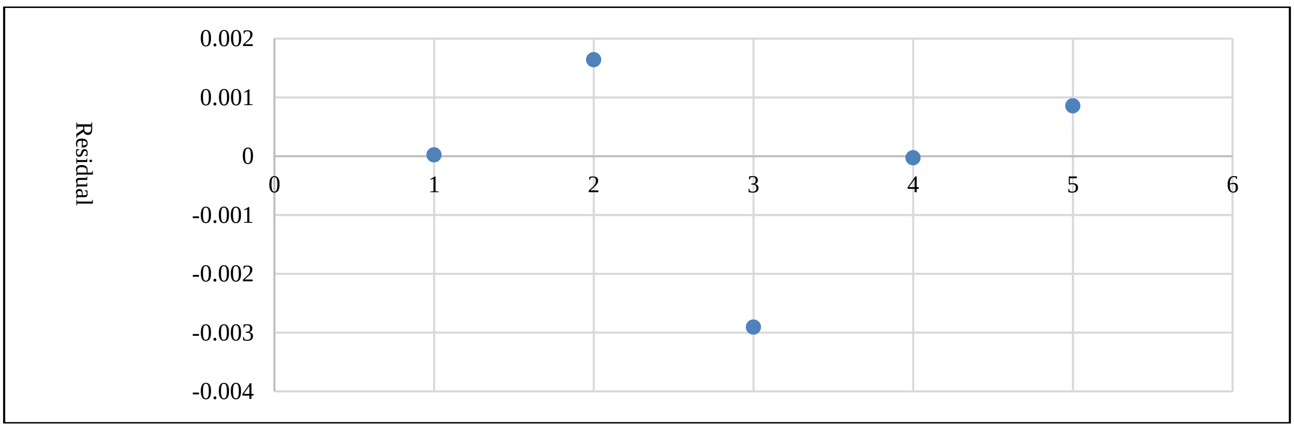

Fig. 15 Residual diagram of fitting curve of probability distribution of arithmetic average of edge vertices nearest neighbor average degree value in 2015.

Table 6 The evolution of probability distribution parameter of arithmetic average of edge vertices nearest neighbor average degree value.

Year	1988	1994	2001	2008	2015
Location parameter	17.2	27.63	30.66	35.9	51.74
Scale parameter	4.07	5.07	5.62	6.53	9.83

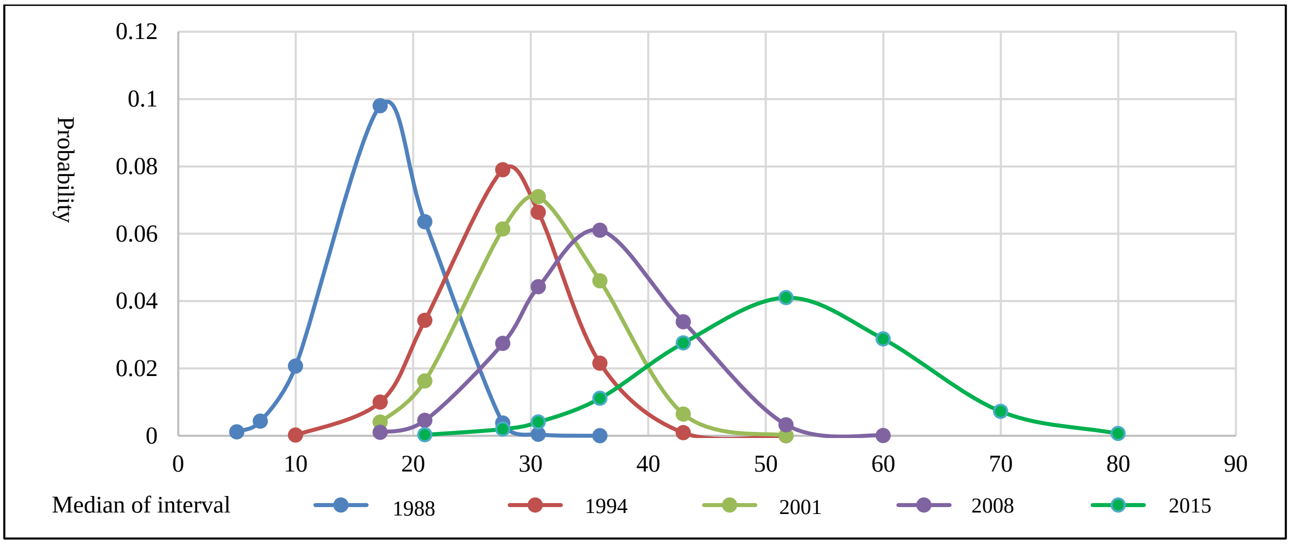

Fig. 16 The evolution diagram of probability distribution curve of arithmetic average of edge vertices nearest neighbor average degree value.

$$\varepsilon_{i,2015} = p_{i,2015} - \hat{y}_{i,2015} \qquad (26)$$

The residual $\varepsilon_{i,2015}$ was drawn in Fig. 15. All points in Fig. 15 were random fluctuation around $\varepsilon = 0$ and the range of fluctuation was very small. $|\varepsilon_{i,2015}| < 0.003 < \hat{\sigma}_{2015} = 9.83$. This illustrated that the fitting effect was very good.

2.6 Evolution of the Probability Distribution of Arithmetic Average of Edge Vertices Nearest Neighbor Average Degree Value in China Aviation Network

The probability distribution parameters of the arithmetic average of edge vertices nearest neighbor average degree values in China aviation network were listed in Table 6. In order to more intuitively observe the evolution trend of the probability distribution of the arithmetic average of edge vertices nearest neighbor average degree values, the probability distribution function curves of these five years were plotted in Fig. 16. It could be found that in Fig. 16, the five normal distribution curves from left to right were the probability distributions in 1988, 1994, 2001, 2008 and 2015 respectively. The width of the curve changed from narrow to wide and the peak value of the curve changed from high to low. The change of the position parameter reflected the same situation, that was, the median point of the curve moved to the right and became larger year by year. The change of scale parameters was also the same, that was, the scale parameters increase year by year, and the curve gradually becomes wider. Because the area under the curve was unchanged and all were 1, the peak value became lower.

3. The Evolution Trace of Probability Distribution Parameter of Arithmetic Average of China Aviation Network Edge Vertices Nearest Neighbor Average Degree Value

The evolution trace of probability distribution parameters of arithmetic average of edge vertices nearest neighbor average degree values in China aviation network was discussed here. Let the location parameter of normal distribution be *x*. Let the scale parameter of normal distribution be y. To take x as abscissa and y as ordinate, the location parameters and scale parameters in Table 6 were drawn in Fig. 17 as scattered points. The correlation coefficient r of scattered points in Fig. 17 was calculated.

$$r = \frac{L_{xy}}{\sqrt{L_{xx}L_{yy}}} = \frac{\sum_{i=1}^{n}(x_i - \overline{x})(y_i - \overline{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \overline{x})^2 \sum_{i=1}^{n}(y_i - \overline{y})^2}} \quad (27)$$

Here, n = 5. Using the data in Table 6, the value of correlation coefficient r was calculated, r = 0.985. The critical value of $r_{|\alpha=1\%, f=3}$ was 0.959 found in critical value table [6] at degree of freedom $f = n-2 = 3$ and level of significant α of 1%. Since $|r| = 0.985 > 0.959 = r_{|\alpha=0.01, f=3}$, the scattered points in Fig. 17 had significant linear correlation. Least square method [6] was used as an approach in Eq. (28) to fit the line with points in Fig. 17.

$$\begin{cases} \hat{\beta}_0 = \overline{y} - \hat{\beta}_1\overline{x} = 0.645 \\ \hat{\beta}_1 = \dfrac{L_{xy}}{L_{xx}} = 0.171 \end{cases} \quad (28)$$

The linear equation:

$$y = 0.171x + 0.645 \quad (29)$$

The fitting line of Eq. (29) was drawn with the sample points in one diagram of Fig. 18 with good fitting effect.

To take t test [6] of Eq. (29), test hypothesis is:

$$H_0 : \beta_1 = 0$$

When the hypothesis was true, there is:

$$\hat{\beta}_1 \sim N(0, \frac{\sigma^2}{L_{xx}}) \quad (30)$$

Here, $\hat{\beta}_1$ fluctuates near zero, statistic t is build.

$$t = \frac{\hat{\beta}_1}{\sqrt{\dfrac{\hat{\sigma}^2}{L_{xx}}}} = \frac{\hat{\beta}_1\sqrt{L_{xx}}}{\hat{\sigma}} \quad (31)$$

where:

$$\hat{\sigma}^2 = \frac{1}{n-2}\sum_{i=1}^{n}(y_i - \hat{y}_i)^2 \quad (32)$$

Statistic t was calculated by data in Table 6 and Eqs. (30)-(32): $t = 9.92$.

To check the t distribution table [6], at significant level α of 0.01 and degree of freedom $f = n-2 = 3$ the value of $t_{|\alpha=0.01, f=3}$ in table is 4.541. So, $|t| = 9.92 > 4.541 = t_{|\alpha=0.01, f=3}$, null hypotheses H_0 is refused. The linear correlation of Eq. (29) is significant. The linear relationship between location parameter and scale parameter in Fig. 18 illustrated that the evolution of probability distribution of arithmetic average of edge vertices nearest neighbor average degree value of China aviation network had linear trace.

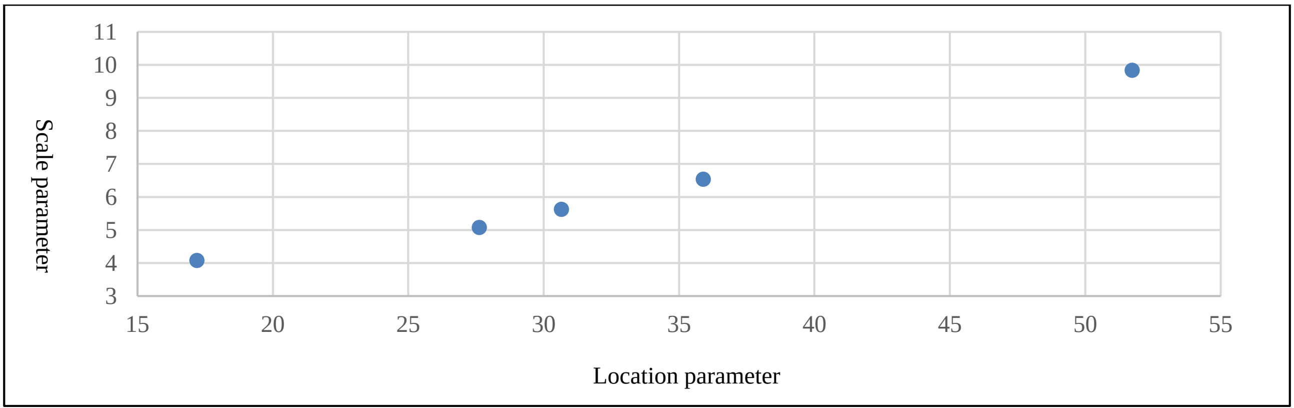

Fig. 17 The scattered points diagram of parameter relationship of probability distribution of arithmetic average of edge vertices nearest neighbor average degree value.

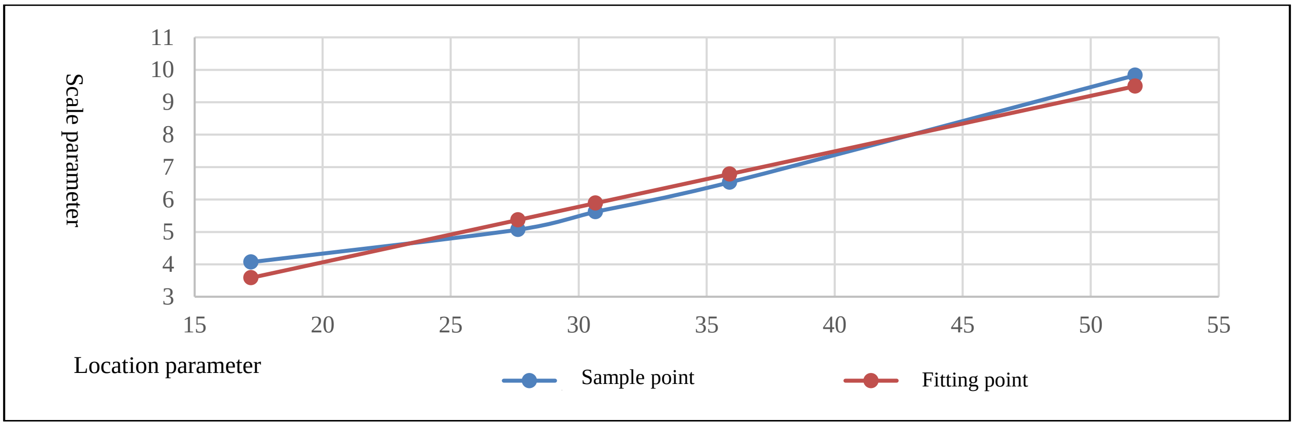

Fig. 18 The fitting effect diagram of linear relationship of probability distribution of arithmetic average of edge vertices nearest neighbor average degree value.

4. Conclusion

Based on the statistics of China civil aviation in 1988, 1994, 2001, 2008 and 2015, the probability distribution and evolution trace of the arithmetic average of edge vertices nearest neighbor average degree in China aviation network were studied. According to the theory and method of complex network, the network system was constructed with the city where the airport was located as the network node and the route between cities as the edge of the network. The arithmetic average of edge vertices nearest neighbor average degree of each edge was calculated, and it was found that it had the probability distribution of normal function, and the position parameters and scale parameters of the probability distribution had linear evolution trace.

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