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Preliminary Research on Aging Population and Flexible Retirement Policy of Shanghai

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Abstract

This paper predicts the trend for the population aged 60 and over the next years by using gray prediction model, using the gray GM (1,1) metabolism model predict the 60 years of age and older population will be increasing at least in the number of 150,000 per year from 2010 to 2015 in Shanghai. Introduce the policy of flexible retirement to measure the number of the elderly population who Reach retirement age but continued employment. Prove the policy’ implementation has enormous favorable foundation.

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Keywords: Metabolic GM(1,1)model; forecast elderly population; ageing population;Flexible Delay Retirement;

1. Preface

At present, population aging has become a common challenge faced by Countries around the world, with the fifth Population Census, China began to enter the ranks of countries with an aging population. Shanghai as the aging of the population above the national average large city, in response to population aging road faces more severe challenges. Shanghai aging of the population show the following three characteristics: First, the degree of population aging is much higher than the national average, has reached 21.6 percent in 2008.

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Second, because Shanghai has a better economic, health conditions, the average life expectancy greatly improve, making the average life expectancy of the aging population surpass the national average level. Third, in Shanghai there is a large-scale continuation of employment of the elderly group. Shanghai outstanding aging characteristics make great demand for health resources, the pension fund demand, therefore face enormous difficulties and distress in the process of coping with the population aging. At the same time, the average life expectancy raising level and the existence of retirement continue employment groups put forward new ideas in response to population aging. By introducing a flexible retirement age policy to ease the social pension insurance fund payment pressure, meet the practical needs of the population aging.

2. Forecast about the elderly population number of Shanghai

2.1. Build elderly population forecasting model

This article take the 60 years old and over population as the raw data to do Simulated prediction, the data which come from Shanghai Statistical Yearbook 2004-2010, as shown in Table 1.

Table 1. Shanghai aged 60 and over population number (unit: million)

<table>
<thead>
<tr>
<th>years</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>number</td>
<td>260.78</td>
<td>266.37</td>
<td>275.62</td>
<td>286.83</td>
<td>300.57</td>
<td>315.7</td>
<td>331.02</td>
</tr>
</tbody>
</table>

(1) 1-the AGO sequence of $X^{(0)}$

Set $X^{(0)}$ represent the total population of the original data sequence, its component represents the end of each year of the total population; population is increased by the original data sequence $X^{(0)} = (X^{(0)}(1), X^{(0)}(2), \ldots, X^{(0)}(n))$, An additive to generate $X^{(0)}$, get the generated sequence: $X^{(1)} = (X^{(1)}(1), X^{(1)}(2), \ldots, X^{(1)}(n))$, which $x^{(1)}(k) = \sum x^{(0)}(i), k = 1, 2, 3, 4, 5$

2004-2008 the original data sequence $X^{(0)} = (X^{(0)}(1), X^{(0)}(2), \ldots, X^{(0)}(n))$, once accumulated generating operation. Get 1-AGO sequence as shown in Table 2.

Table 2.1-the AGO sequence

<table>
<thead>
<tr>
<th>years</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gray</td>
<td>2.6078</td>
<td>5.2715</td>
<td>8.0277</td>
<td>10.896</td>
<td>13.9017</td>
</tr>
</tbody>
</table>

(2) Do authentic smooth test for $X^{(0)}$, from

$$\rho(k) = \frac{x^{(0)}(k)}{x^{(1)}(k-1)}$$  \hspace{1cm} (1)

get: $\rho(2) = 1.02$ $\rho(3) = 0.52$ $\rho(4) = 0.36$ $\rho(5) = 0.275$

(3) Inspect $X^{(1)}$ whether conform the Exponential law, from

$$\delta^{(1)}(k) = \frac{x^{(1)}(k)}{x^{(1)}(k-1)}$$  \hspace{1cm} (2)

get: $\delta(1)(3) \approx 1.52$ $\delta(1)(4) \approx 1.36$ $\delta(1)(5) \approx 1.28$

When $k > 5$, $\delta^{(1)}(K) \subseteq [1, 1.5]$, $\xi = 0.5$, meeting the Quasi-exponentially, Therefore, can construct GM (1, 1) model for $X^{(1)}$.  

(4) Form the mean generation for X\(^{(1)}\), let
\[
Z^{(1)}(k) = 0.5x^{(1)}(k) + 0.5x^{(1)}(k+1)
\]
\[
Z^{(1)} = (Z^{(1)}(2), Z^{(1)}(3), Z^{(1)}(4), Z^{(1)}(5)) = (3.95, 6.65, 9.646, 12.4)
\]
Thus:
\[
B = \begin{bmatrix}
-3.95 & 1 \\
-6.65 & 1 \\
-9.46 & 1 \\
-12.4 & 1 \\
\end{bmatrix}
\quad y = \begin{bmatrix}
2.6637 \\
2.7562 \\
2.8683 \\
3.0057 \\
\end{bmatrix}
\]

(5) Do Least squares estimation for Parameter Sequence that is \( a = [a, b]^T \)
\[
a = (B^T B)^{-1} B^T y = \begin{bmatrix}
-0.034 \\
2.60 \\
\end{bmatrix}
\]

(6) Determine the model
\[
\frac{d^{(1)}}{d_t} = -0.034 X^{(1)} = 2.60
\]
Settling accordingly time formula
\[
x^{(1)}(k) = (x^{(0)}(1) - \frac{b}{a}) e^{-\frac{a}{a}(k-1)} + \frac{b}{a} = 79.1343 e^{0.034(k-1)} - 76.4706
\]

(7) Calculate the Analog value of \( x^{(1)} \)
\[
x^{(1)} = (x^{(0)}(1), x^{(0)}(2), x^{(0)}(3), x^{(0)}(4), x^{(0)}(5))
\]
\[
= (2.6638, 5.3542, 8.2031, 11.1311, 14.2173)
\]

(8) Deoxygenize the Analog value of \( x^{(0)} \)
\[
x^{(0)}(k) = a^{(1)} x^{(1)}(k) = x^{(1)}(k) - x^{(1)}(k-1)
\]
\[
x^{(0)} = (x^{(0)}(1), x^{(0)}(2), x^{(0)}(3), x^{(0)}(4), x^{(0)}(5))
\]
So \( X^{(0)} = (2.6638, 2.6904, 2.8491, 2.9279, 3.086) \)

(1) Checking deviation

<table>
<thead>
<tr>
<th>Serial number</th>
<th>The original data</th>
<th>Simulation data</th>
<th>residual error</th>
<th>Relative deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>2.6637</td>
<td>2.6638</td>
<td>-0.0001</td>
<td>0.01%</td>
</tr>
<tr>
<td>3</td>
<td>2.7562</td>
<td>2.6904</td>
<td>0.0576</td>
<td>2.0%</td>
</tr>
<tr>
<td>4</td>
<td>2.8683</td>
<td>2.8491</td>
<td>0.0192</td>
<td>0.067%</td>
</tr>
<tr>
<td>5</td>
<td>3.0057</td>
<td>3.086</td>
<td>-0.0803</td>
<td>2.6%</td>
</tr>
</tbody>
</table>

Using the calculation data of model and the Statistical Yearbook data from 2005 to 2008 do deviation checking, you can find the model has high accuracy, so we can use this model to forecast the number of elderly population in Shanghai. According to the model and the time response function has been established,
using the gray system model software doing short-term forecasts, further analyze the prediction accuracy of the model.

Table 4. Prediction table of the number of elderly population from 2009 and 2010

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>The original data</td>
<td>315.7</td>
<td>331.02</td>
</tr>
<tr>
<td>Simulation data</td>
<td>312.27</td>
<td>325.14</td>
</tr>
<tr>
<td>Relative deviation</td>
<td>0.01</td>
<td>0.018</td>
</tr>
</tbody>
</table>

Using gray system model software predicts the number of elderly population about the year 2009 and 2010. According to data in the table can be found a small deviation between the simulated data and actual observations, the model in short-term forecast has a high credibility.

2.2. Predict the number of flexible delay retirements

(1) Forecast number of aged 60 and over population from 2011 to 2015 in Shanghai using metabolic model, the results are shown in Table 5.

Table 5. Number of the elderly population, 2011-2015 (unit: 0.01 million)

<table>
<thead>
<tr>
<th>Years number</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>340.42</td>
<td>355.10</td>
<td>371.22</td>
<td>387.46</td>
<td>404.74</td>
</tr>
</tbody>
</table>

According to forecast data provided by the Shanghai Scientific Research Center on Aging and other departments, the total number of Shanghai for the elderly in 2015 will exceed 4 million. Through the gray GM (1, 1) model to predict the number of the next five years, getting the data of 2015 is 4.0474 million. These predicted results close to the data released by Shanghai Municipal Scientific Research Center on Aging, prove that the model has the higher accuracy in prediction.

(2) Forecast number of flexible retirements

In the process of the flexibility to delay retirement wishes in Shanghai survey, author found that there are 37 investigators being in the state of continued employment in 106 respondents reached the retirement age, the ratio is 34.9%. Therefore, we assume that the next five years reach retirement age continued employment proportion is 34.9%, the number to who reach retirement age to continue in employment from 2004 to 2015 is shown in Table 6.

Table 6. 2004—2015, Number of flexible delay retirement (unit: 0.01 million)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>260.78</td>
<td>266.37</td>
<td>275.62</td>
<td>286.83</td>
<td>300.57</td>
<td>315.7</td>
<td>331.02</td>
<td>340.42</td>
<td>355.10</td>
<td>371.22</td>
<td>387.46</td>
<td>404.74</td>
</tr>
<tr>
<td>2</td>
<td>91.012</td>
<td>92.963</td>
<td>96.191</td>
<td>100.103</td>
<td>104.899</td>
<td>110.179</td>
<td>115.526</td>
<td>118.807</td>
<td>123.930</td>
<td>129.556</td>
<td>135.224</td>
<td>141.254</td>
</tr>
</tbody>
</table>

Note: “1” represents the number of elderly population; “2” represents the number of flexible retirements.
3. Conclusions

Shanghai and even nationwide are facing the serious problem of aging population, doing pension insurance reform, it is Imminent in exploring multiple channels to effectively alleviate the pressure on the payment of social pension insurance, to promote sustainable development of Social pension insurance policies. Shanghai, there are a lot of Employees continue employment who reach the retirement age, and this article take Flexible Delay Retirement Survey as a starting point, reasoning to get three following conclusions: Firstly, Shanghai, a huge reach retirement age to continue employment groups in the real socio-economic makes flexible retirement age policy’ implementation has a good foundation. Secondly, the elderly population has a strong desire for employment, make the implementation of flexible retirement policy can get the broad support of the workers. It plays an important role, and the flexible delay retirement policies implementation can conducive to sustainable development of social endowment insurance system.

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References