



Prediction of "Specialized, Fined, Peculiar and New" Enterprise Patents in Zhejiang Province Based on GM (1,1) Model

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ABSTRACT

Objective: To predict the total number of patents of "specialized and Specialized, Fined, Peculiar and new" enterprises in Zhejiang province in the next five years, and to provide a reference for the Zhejiang Provincial government to implement scientific and modern management of "specialized and Specialized, Fined, Peculiar and new" enterprises. **Method:** from the ministry of three batches of "new" enterprise list using Python for enterprise location, understand the "new" distribution, and further analyze the "new" enterprises in Zhejiang province, mining 64 listed companies nearly ten years patent applications, using MATLAB software, using GM (1,1) model, predict the next five years "new" enterprises in the total number of listed enterprises. **Conclusion:** The prediction results show that in the next five years, the patent number of "Specialized, Fined, Peculiar and new" enterprises in Zhejiang Province will show an exponential growth, reflecting the strong scientific and technological innovation ability of "Specialized, Fined, Peculiar and new" enterprises.

Keywords: "Specialized, Fined, Peculiar and new" enterprises; grey forecast; modern management; Zhejiang Province

1. INTRODUCTION

On August 26, 2019, the fifth meeting of the central financial and Economic Commission proposed to "cultivate a number of small and medium-sized enterprises that are" Specialized, Fined, Peculiar and new ". "Specialized, Fined, Peculiar and new" enterprises are excellent representatives of small and medium-sized enterprises and important forces of scientific and technological innovation. They are characterized by "specialization, refinement, characteristics and novelty".

In recent years, China has continuously strengthened the cultivation of "Specialized, Fined, Peculiar and new" enterprises, injecting new impetus into innovation driven development. Based on the space-time pattern of 4922 "Specialized, Fined, Peculiar and new" enterprises, this paper understands the distribution of "Specialized, Fined, Peculiar and new" enterprises, and further analyzes the "Specialized, Fined, Peculiar and new" enterprises in Zhejiang Province. Using MATLAB software and grey prediction, it predicts the total number of patents of Listed Enterprises in the "Specialized, Fined, Peculiar and new" enterprises in Zhejiang Province in the next five years.

2. DISTRIBUTION ANALYSIS OF SPECIALIZED AND SPECIALIZED NEW ENTERPRISES

On August 26, 2019, the fifth meeting of the Financial and Economic Commission of the CPC Central Committee proposed to "cultivate a number of 'Specialized, Fined, Peculiar and new' small and medium-sized enterprises". With the deepening of the cultivation of "Specialized, Fined, Peculiar and new" enterprises, a number of "specialized and Specialized, Fined, Peculiar and new" enterprises have emerged.

By 2021, the Ministry of Industry and Information Technology has published three batches of special "little giant" enterprises list, 248 in 2019, 1,744 in 2020, 2,930 in 2021, a total of 4,922 "Specialized, Fined, Peculiar and new" in the three years. Vigorously develop "Specialized, Fined, Peculiar and new" enterprises can provide a steady stream of power for scientific and technological innovation, and understanding the characteristics of "Specialized, Fined, Peculiar and new" enterprises can be a reference for the country to introduce a series of policies.

Table 1. Distribution of "Specialized, Fined, Peculiar and new" enterprises (Table credit: original)

Province	Quantity	Province	Quantity
Zhejiang Province	475	Fujian Province	227
Guangdong Province	433	Henan Province	212
a folk art form popular in Shandong	369	Liaoning Province	212
Jiangsu Province	289	Sichuan Province	212
Beijing Municipality	264	Hebei Province	210
Shanghai Municipality	262	Hubei province	177
Hunan Province	241	Jiangxi Province	151
Anhui Province	235	Tianjin Municipality	133
Chongqing City	124	Heilongjiang Province	42
Shaanxi Province	114	Jilin Province	38
Shanxi International Gong and Drum Festival	113	the Ningxia Hui Autonomous Region	37
the Guangxi Zhuang Autonomous Region	84	the Nei Monggol Autonomous Region	27
Yunnan Province	61	Hainan Province	17
Guizhou Province	53	Qinghai Province	11
Gansu Province	49	Xizang Autonomous Region	2
Xinjiang Uygur Autonomous Region	48		

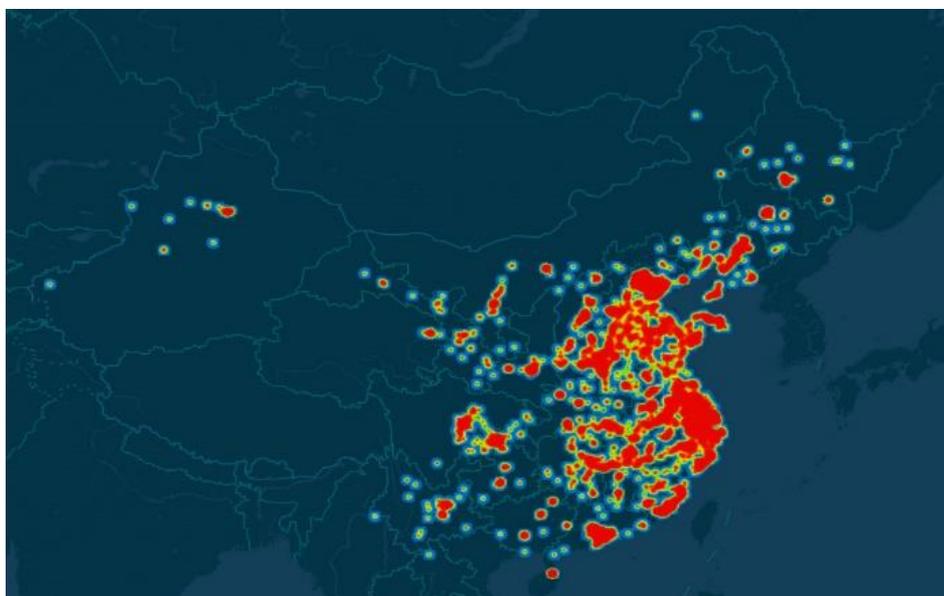


Figure 1 Distribution of "specialized, specialized and new" enterprises(photo credit: original)

"Specialized, specialized and new" enterprises are the leader in the SME group,^[5] but also the main force of SME technological innovation ^[6]. As can be seen from Table 1 that Zhejiang Province has the largest number of "specialized and new" enterprises. Therefore, this paper starts from Zhejiang province "Specialized, Fined, Peculiar and new" enterprises for further analysis.^[3]

3. LOCATION DISTRIBUTION OF "SPECIALIZED, FINED, PECULIAR AND NEW" ENTERPRISES IN ZHEJIANG PROVINCE

Table 2 Distribution of "Specialized, Fined, Peculiar and new" in Zhejiang Province (Table credit: original)

Prefecture-level city	In 2019,	In 2020,	In 2021,	Amount to
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Hangzhou City	2	20	32	54
Huzhou city	1	11	17	29
Jiaxing city	2	9	23	34
Jinhua City	1	11	22	34
Lishui city	0	6	6	12
Ningbo City	5	50	127	182
Quzhou City	1	1	6	8
Shaoxing city	1	9	18	28
Taizhou	3	9	19	31
Wenzhou City	2	19	31	52
Zhoushan city	1	3	7	11

Table 3 Distribution of "Specialized, Fined, Peculiar and new" listed companies in Zhejiang Province (Table credit: original)

Prefecture-level city	In 2019,	In 2020,	In 2021,	Amount to
Hangzhou City	1	10	2	13
Huzhou city	0	4	2	6
Jiaxing city	1	3	3	7
Jinhua City	0	3	1	4
Lishui city	0	1	2	3
Ningbo City	0	3	9	12
Quzhou City	0	0	1	1
Shaoxing city	0	2	2	4
Taizhou	2	2	5	9
Wenzhou City	0	0	2	2
Zhoushan city	0	1	2	3

As can be seen from Table 2 that the number of "specialized, specialized and new" enterprises in Ningbo, Zhejiang Province is far ahead. There are 182 "specialized, specialized and new" enterprises in three years, followed by Hangzhou. Table 3 analyzes the location of listed companies among 475 "specialized, special and very new" enterprises in Zhejiang Province. It can be seen from Table 3 that the number of "specialized, special and very new" enterprises in Hangzhou ranks first, followed by Ningbo.

4. ZHEJIANG PROVINCE LISTED "SPECIALIZED, FINED, PECULIAR AND NEW," ENTERPRISE PATENT NUMBER GRAY FORECAST

Patent is an important embodiment of the innovation ability of enterprises. As of May 1,2022, Zhejiang province "special and special new" enterprises have obtained a total of 12,626 invention patents, 22,397 utility model patents and 6,598 appearance patents. Among them, there are 35,786 total valid patents as of May 1,2022. In this paper, GM (1,1) model is used to predict

the total number of patents of 64 listed companies in Zhejiang province in the past decade.^{[1][4]}

The GM (1,1) model can predict the data with little data, incomplete sequence and low reliability. It does not consider the distribution law or the change trend, and is suitable for the short and medium term prediction of exponential growth.

Figure 2 Patent number of 64 listed companiesin(photo credit: original)

Table 4 GM (1,1) model level ratio table (Table credit: original)

GM (1,1) model-level ratio table				
Order number	Original value	Tier ratio	Original value + translation conversion shift value (shift=899)	Converted value and the ratio
1	184.000	-	1083.000	-
2	295.000	0.624	1194.000	0.907
3	544.000	0.542	1443.000	0.827
4	481.000	1.131	1380.000	1.046
5	526.000	0.914	1425.000	0.968
6	671.000	0.784	1570.000	0.908
7	747.000	0.898	1646.000	0.954
8	899.000	0.831	1798.000	0.915
9	897.000	1.002	1796.000	1.001

First, the level ratio is calculated, is between the interval [0.982,1.0098], and the data is suitable for model construction; the table shows that part of the level ratio is not within the interval. Therefore, if the original value does not pass the level ratio test, then the "translation conversion value" can be passed, that is, the "translation conversion value" can be added to the original value, so that the new data meets the level ratio test and calculates based on the data, and then the "translation conversion value" is deducted when calculating the predicted value later.

That is, the translation conversion value of 899.00 is added to the original value, and the data-level ratio test values after the final translation conversion are within the standard range interval [0.819,1.221], which means that this data is suitable for GM (1,1) model construction.

Table 5 Model building results (Table credit: original)

Model building results			
Developmental quotient a	The amount of action in gray b	The posterior difference is compared to the C value	Small-error probability p-value
-0.0538	1166.7824	0.0528	1.000

When using the GM (1,1) model, it is necessary to calculate the development coefficient a, the gray action amount b, and calculate the posterior difference ratio C-value and the small error probability p-value;

The posterior difference ratio C value is used for model accuracy level test, the smaller the better, generally C value is less than 0.35, the model accuracy level is good. C value is less than 0.5, C value less than 0.65 means the model accuracy is basically qualified, if C value is greater than 0.65, the model accuracy level is unqualified, the model posterior difference ratio C value is 0.0528 \leq 0.35, means that the model accuracy level is very good.

The small error probability p-value is generally less than 0.7 means that the model is unqualified, less than 0.8 means that the model is barely qualified, less than 0.95 means that the model is qualified, and greater than 0.95 means that the model accuracy is very good. The model small error probability p-value is 1.000 $<$ 1.0, which means that the model accuracy is very good.

The GM (1,1) model is used to predict the patent number of listed companies in Zhejiang province in the next five years after 2021, as shown as follows.

Table 6 Model prediction value table (Table credit: original)

Model prediction value table		
Order number	Original value	Predicted value
2013	184.000	184.000
2014	295.000	359.648
2015	544.000	429.253
2016	481.000	502.708
2017	526.000	580.225
2018	671.000	662.029
2019	747.000	748.357
2020	899.000	839.459
2021	897.000	935.599
Back phase 1	-	1037.056
Back phase 2	-	1144.124
Back phase 3	-	1257.112
Back phase 4	-	1376.349
Back phase 5	-	1502.181

This paper establishes a prediction model of patent application quantity based on the theory of gray system. From the forecast results, the total number of patents in Zhejiang Province in the next five years. Based on GM (1,1) model, the patent number of 64 listed enterprises in Zhejiang Province from 2022 to 2027 will increase from 897 to 1502, increasing by 1.67 times, with an average annual increase of 121.

5. CONCLUSION

5.1 The distribution of "Specialized, Fined, Peculiar and new" enterprises presents a unique feature

"Specialized and new" enterprises are concentrated, and "enterprises are mainly concentrated in the eastern coastal areas and central and western provinces, such as Zhejiang Province, Guangdong Province, Jiangsu Province, etc. In segments and industries," specialized, specialized and new " enterprises are mainly concentrated in manufacturing and high-tech fields. Vigorously developing "specialized, specialized and new" enterprises is a major strategic measure to build China into a manufacturing power. In the growth of "specialized, specialized and new" enterprises, enterprises should give full play to their main role, fully play the guiding role of the government, and further improve the business environment.

5.2 "Specialized, Fined, Peculiar and new" enterprises have strong scientific and technological innovation ability

It has the characteristics of high profit, strong scientific and technological innovation ability, and from the perspective of Zhejiang Province, the patent number of "specialized and Specialized, Fined, Peculiar and new" enterprises currently shows exponential growth, and has extremely strong development potential. Under the background of implementing the strategy of strengthening the country with intellectual property rights, the "specialized and high-quality" enterprises need to further realize high-quality development, and it is necessary to further explore the financial resources of financial institutions, give full play to the guidance and

support of the whole society, and fully realize the transformation and upgrading of enterprises.

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