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Analysis and Forecast of Contemporary Chinese Population

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Abstract: The analysis and projection of current Chinese population dynamics is the main emphasis of this study. This topic is extremely important in terms of demography, economics, sociology, and international relations. With approximately 1.43 billion people, China is the most populous country in the world and a worldwide giant in both economic and geopolitical terms. This study looks at historical, cultural, economic, and policy-related issues in an effort to understand the intricacies that have led China to this demographic prominence. China's population increase may be traced back to its ancient civilization, which cultivated cultural customs and conventions that still have an impact on demographic patterns now. The "demographic dividend," a population surge in the middle of the 20th century, signaled a turning point, and the one-child policy that followed, implemented in 1979, produced distinctive demographic contours and long-term repercussions. Fertility rates and generational dynamics have been influenced by the government's evolution of family planning programs, which have ranged from strict measures to more relaxed methods. Understanding and predicting China's population changes is urgent because of the societal and worldwide repercussions of this country's changing demographics. This study sets out on an exploratory trip to understand the complex causes and possible future trends in light of previous studies. This paper wants to contribute to a thorough knowledge of China's demographic evolution and its effects on global society by shedding light on these factors.

Keywords: China, population, trend, analysis, forecast

1. Introduction

China is an unmatched giant in the complex web of states that make up the world, not just because of its importance to the economy and to geopolitics, but also because of its enormous population. The world's most populated nation is China, which proudly claims to have "more than 1.43 billion people" right now [1]. Scholars, decision-makers, and onlookers alike have been intrigued by this astonishing demographic divergence, leading to an investigation of the complex processes that have catapulted China to the forefront of the world's demography. China's remarkable ascent as the world's most populous country is a subject of profound interest and study within the realms of demography, economics, sociology, and international relations. Over the past several decades, China's population growth has captivated the attention of researchers, policymakers, and observers, prompting a comprehensive exploration of the factors that have contributed to its demographic trajectory.

China's growth trajectory has been defined by a combination of historical, cultural, economic, and social variables that have accompanied its road to becoming the world's most populous country. While

DOI: 10.54254/2754-1169/55/20231012

other countries' populations are stabilizing or even declining, China's continued population growth brings opportunities and problems that need to be carefully examined. China's ancient civilization, which produced a rich tapestry of cultural norms, beliefs, and practices that continue to affect demographic trends now, is the historical setting of the country's population rise. China's rapid population growth in the middle of the 20th century, known as the "demographic dividend," was a key turning point that thrust the country to the center of demographic discussions around the world. The one-child policy was subsequently put into place in 1979, emphasizing China's distinctive demographic profile and igniting discussions about both its immediate and long-term ramifications.

China's transformation from a largely agrarian economy to a worldwide economic powerhouse has had a significant impact on its population dynamics, according to an economic perspective. Researchers are examining how industrialization, urban migration, and employment possibilities have contributed to both the expansion and aging of China's population as a result of the interwoven relationship between economic development, urbanization, and demographic transitions.

China's demographic trajectory has been significantly shaped by government policy. From the strict one-child policy to the more modern two-child policy and its subsequent relaxation, the evolution of family planning regulations has produced a complicated interplay between demographic aims, societal expectations, and personal preferences. Researchers have been exploring the impact of these policies on generational dynamics, gender imbalances, and fertility rates as a result of this dynamic environment.

Besides, China's distinctive cultural practices and customs have had a complex impact on the country's population expansion. Changes in reproductive behavior and family structures have been brought about by the conflict between traditional values, which place an emphasis on big families, and the reality of modern living, which prioritizes urbanization and career goals. Inquiries into how cultural variables affect demographic trends in a world that is rapidly changing have been sparked by this junction of cultural legacy and societal upheaval.

China's population is still expanding and changing, and its demographic trajectory is important beyond its borders. China's population dynamics have an impact on social welfare, geopolitics, environmental sustainability, and global economics. In order to develop policies that handle the difficulties and opportunities given by China's demographic landscape, it is necessary to comprehend the complex aspects of China's population rise.

The investigation of the complex dynamics influencing China's demographic landscape is the basis for the analysis and forecast of the modern Chinese population. Numerous studies have examined various facets of this complicated topic, illuminating the difficulties, opportunities, and complexities involved in comprehending China's demographic patterns.

Scholars such as Feng Wang and Junsen Zhang have extensively examined the historical context and implications of China's one-child policy. Their work, including papers like "China's Population Destiny: The Looming Crisis", delves into the policy's impact on fertility rates, gender imbalances, and generational dynamics [2]. Similarly, publications like "The Evolution of China's One-Child Policy and Its Effects on Family Outcomes" provide comprehensive insights into the policy's socio-economic effects and its legacy on contemporary Chinese demographics [3].

Research exploring the economic dimensions of China's population dynamics has also thrived. Studies like "The Demographic Future: What Population Growth and Composition Tells Us," offer analyses of the wider global implications of China's demographic shifts on trade, migration, and geopolitics [4].

Furthermore, the examination of China's urbanization and its effects on population distribution has been a focus of academic inquiry. Works like "Trends in Educational Gender Inequality in China: 1949-1985", contribute to the nuanced understanding of the links between societal norms, gender roles, and fertility decisions [5].

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Understanding the social implications of China's demographic transformation from a rapidly growing to an aging society is crucial. The need to foresee problems with healthcare and pension systems, appreciate the economic ramifications of changing consumer and labor dynamics, and navigate the worldwide repercussions of China's demographic changes are the driving forces behind this research. It also adds complexity to broader conversations on social change, individual rights, and human behavior to examine how historical legacies, governmental changes, economic transitions, and cultural factors interact to shape demographic patterns. In addressing these published researches, this research not only enriches our comprehension of a society in flux but also offers vital insights for policymakers, economists, and global stakeholders seeking to engage proactively with the multifaceted dimensions of China's evolving population dynamics.

In order to analyze the current population data and forecast the future amount of population, the data selected from the national statistics website were imported into R Studio and then analyzed and subtracted by the fpp2 and forecast library. After analyzing the characteristics, this data is forecast by the Arima model. And then, is the conclusion analysis of these results.

This essay sets out on an exploratory voyage in an effort to solve the mystery surrounding China's extraordinary population rise and then give a forecast for the future population. The rest of the paper is divided into data description, forecasting models, results analysis, and conclusions. Through these sections, this paper aim to shed light on the complex interplay of factors that have contributed to China's status as the world's most populous nation.

2. Literature Review

Due to its profound consequences for society, economics, and global dynamics, the analysis and forecast of the current Chinese population have attracted significant attention from academics, policymakers, and researchers across a variety of sectors. An overview of the important issues, research, regulatory changes, economic transitions, cultural influences, and projections that have helped us better comprehend China's demographic environment is given in this survey of the literature.

China's fertility dynamics have implications beyond its borders, influencing global labor markets, migration flows, and trade dynamics. Comparative studies, such as “Changing Kinship Structure and its Implications for Old-Age Support in Urban and Rural China”, situate China's fertility trends within the broader context of global demographic transitions [6]. These studies provide a holistic view of the factors driving fertility decline and their global repercussions. In general, researchers who study aging in China come to the conclusion that the country has become an old society. Besides, the author of this paper mentioned that during the next 40 years, urban residents would carry a greater “burden of support for elderly parents” [6].

How will China’s population grow in the following years? “Ageing of a giant: a stochastic population forecast for China, 2006-2060” points out that China’s population will increase to its maximum level in 2024 and start to “decline to 1,114 million people in 2060” [7]. This result is analyzed by China’s fertility rate and mortality rate and also the population increase differences between males and females. Because females have “lower mortality at working ages and lower ages”, the female population will reach its maximum level in 2026 while the male population in 2021[7].

Similarly, the CNN report that “China’s population is shrinking” [8]. This report analyzes why China’s population started to decline, and the status after China announced the one-child policy. And then, after 35 years of limitation to one child, China finally “scrapped the rule” [8]. China allowed couples to have two children in 2005 and then raised this to three in 2021. All this information points out a falling population will “exacerbate China’s problems with an aging workforce and drag on growth, adding to its woes as it struggles to recover from the pandemic” [8].

Another report then lists the factors that will impact the population, such as housing prices, education, healthcare, welfare, etc. This report also analyzes China’s first population decline, which

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was in 1961. The author mentioned this change as an "era of negative population growth" [9]. The author then used the plot to compare the forecast of population between China and India after 2023. It is clear to see that China's population starts to drop after 2023 and will have 0.77 billion people in 2100. However, compared to China's population, India's population will continue increasing till 2064, at its peak of about 1.7 billion people, and then after this peak, the population starts to decline and will have 1.53 billion people in 2100.

"China's Demographic History and Future Challenges" indicates that in comparison to most other nations, China is finishing its demographic transition in a shorter amount of time [10]. Although the country has benefited from the rapid and continuous drop in mortality and fertility as well as the increasing urbanization, particularly in terms of economic growth, China also faces tremendous problems in adapting to these changes.

3. Data And Methodology

3.1. Statistics Analysis: Data Description

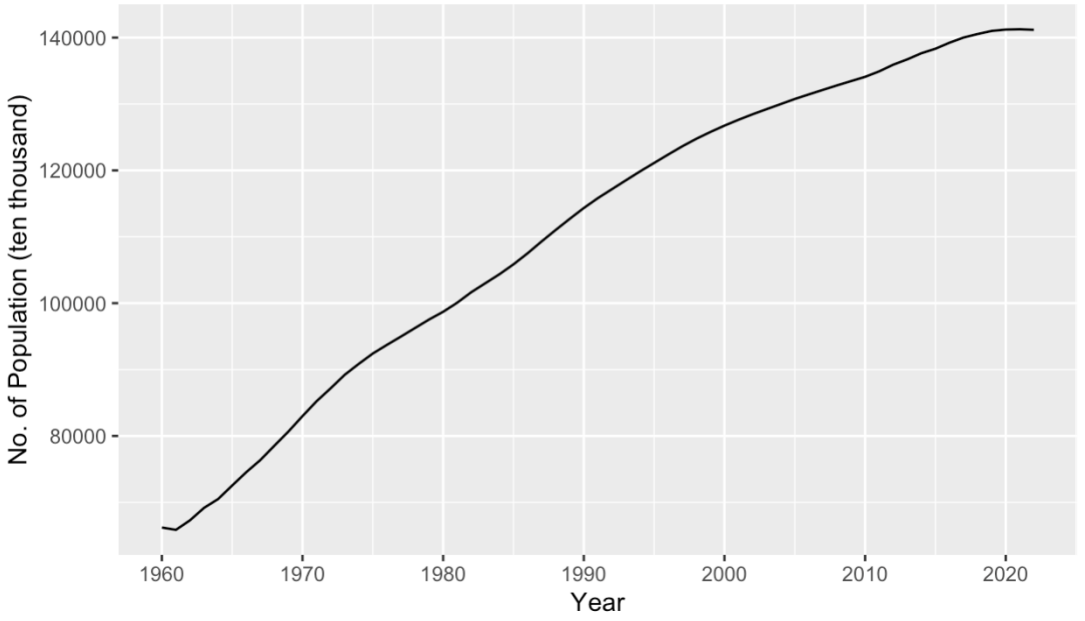

Figure 1: The total population at the end of the year.

In Figure 1, the data from the National Bureau of Statistics shows only two declines in the Chinese Population, one in 1961 and another in 2021. The decline in population in 1961 is because of the "Great Famine" and also the Economic Difficulties. China experienced an unprecedented Natural Disaster and does not have enough ability to address this problem. Therefore, the decline of the population is unavoidable at that time. Then, the population will be at its highest overall point in 2021 and start to decline after this year. Also because this data is annual data, there is no seasonality or cyclicity. However, Figure 1 has an upward positive trend since the very beginning and starts to drop a little bit after 2021. However because the National Bureau of Statistics only has one data collected after 2021, which is 2022, this paper will make a prediction for the following years' population.

3.2. Statistics Analysis: Forecasting Models

The P-value provided by the Augmented Dickey-Fuller Test is 0.984, which is a very large value and larger than any significant level, such as 0.05 and 0.01. Because the alternative hypothesis is

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stationary, therefore, people do not have enough evidence to reject the null hypothesis. That is this data is non-stationary. Therefore, this paper need to consider the forecasting models that are suitable for non-stationary time series data, such as Arima, ETS, etc.

The two methods that are used are ARIMA and ETS. These two powerful techniques could boost the process of analyzing different levels: ARIMA excels at modeling data with trends and seasonality, can handle non-stationary data, and offers flexibility in its structure for capturing different patterns. The ETS model, on the other hand, is simple yet robust, effectively managing irregularities in the data. Together, they provide easily interpretable smoothing parameters to understand underlying patterns and offer automated procedures for model selection. Both methods serve as efficient tools for forecasting with different emphasis and focus. Besides that, the random walk function, drift method, and naive model are also used to perform further forecasting procedures to check which one is the best forecasting model.

4. Results

4.1. Using ARIMA Method to Forecast

The auto Arima function gives Arima(3,2,0). In other words, there are no autoregressive as well as moving average terms in the model. But a second-order differencing on the series is needed to make this time series stationary. So this auto Arima model with order (3,2,0) is suggesting that this population data is like a random walk. Meanwhile, the forecast predicted by Arima(3,2,0) is shown in Figure 2.

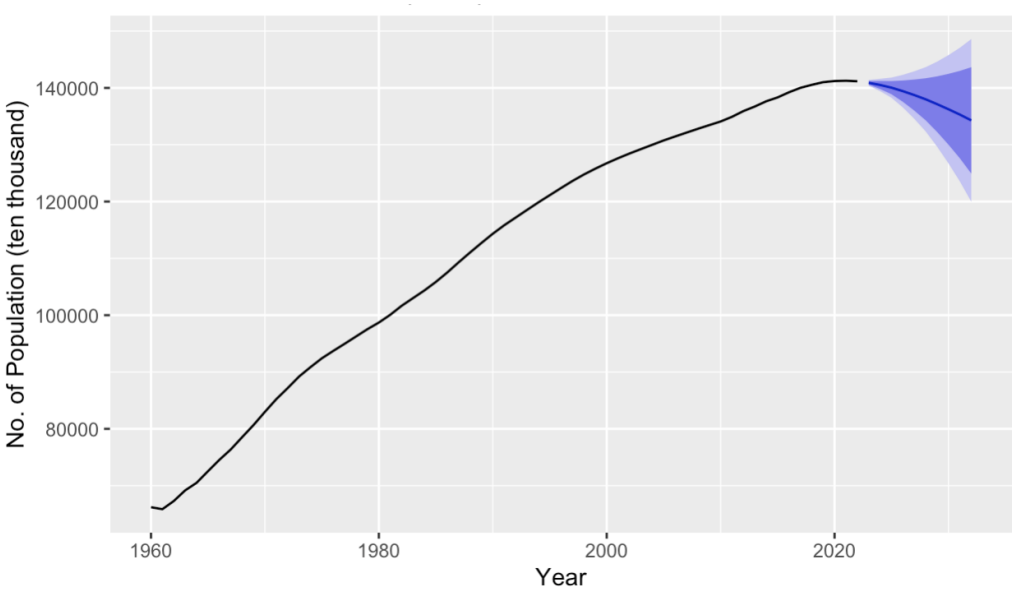

Figure 2: Forecasts plot from Arima(3,2,0).

Notice that AIC here is 856.53 and Root Mean Squared Error RMSE is roughly equal to 243.731. The p-value in the Ljung-Box test is larger than the significant level, which also suggests that residuals from ARIMA(3,2,0) are consistent with white noise.

Now, take a look at the ACF plot and the PACF plot (Figure 3):

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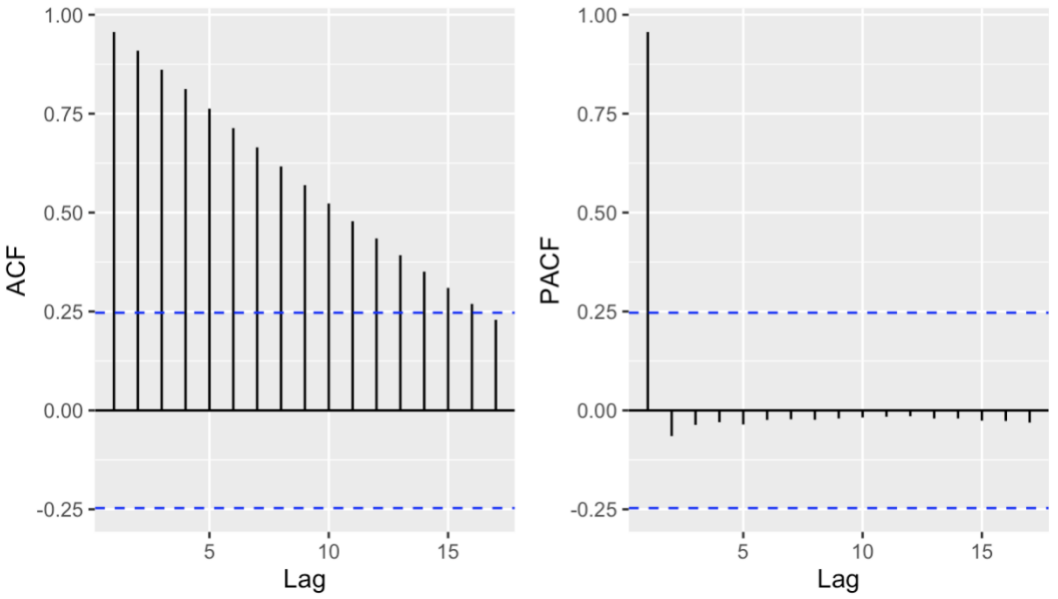

Figure 3: The ACF plot and the PACF plot of population.

The data are clearly non-stationary, as the series wanders up and down for long periods. Consequently, take a look at the differences of the data (Figure 4&5&6).

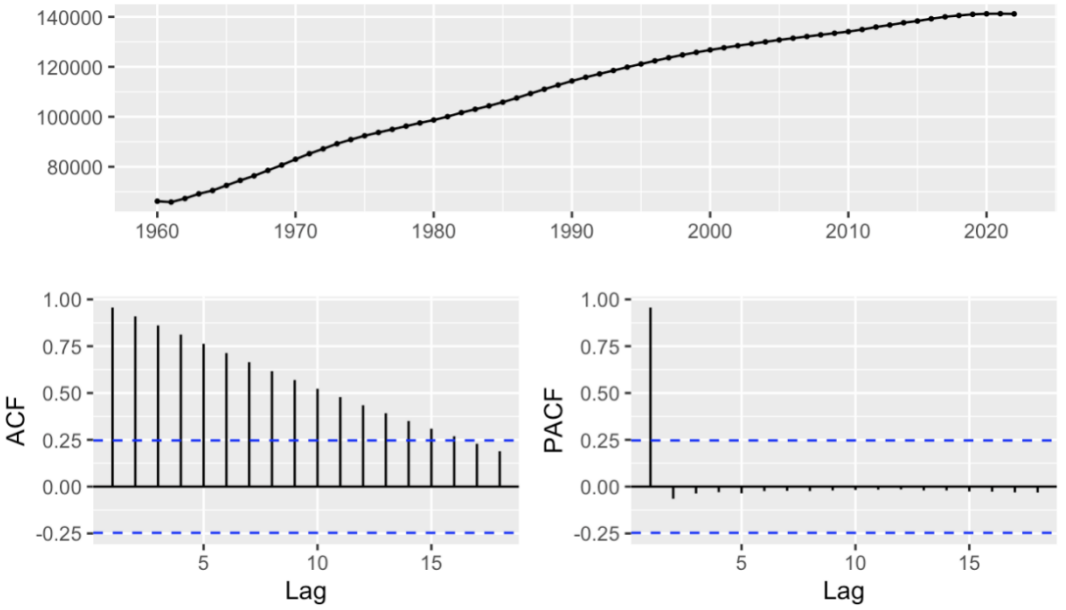

Figure 4: The original version of population data.

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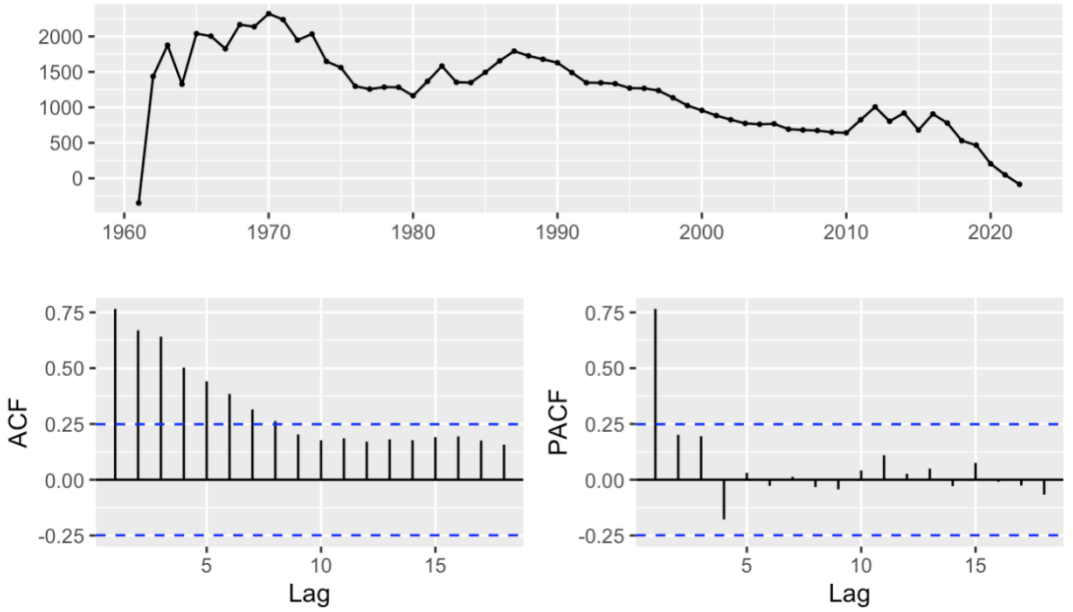

Figure 5: The first difference version of population data.

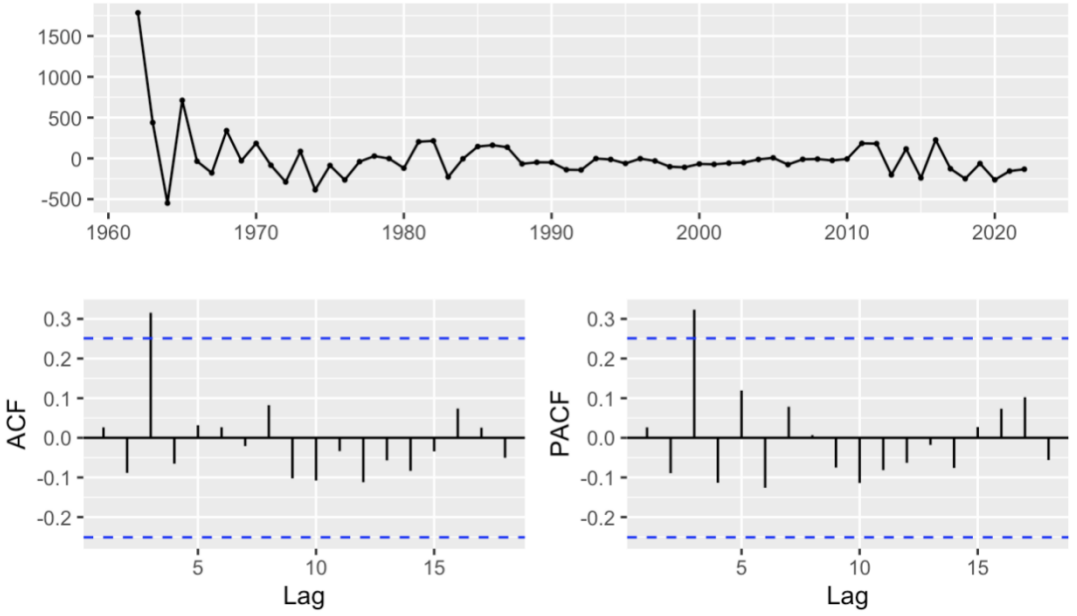

Figure 6: The second difference version of population data.

These graphs show how the time series has become stationary. One thing that stands out in this situation is that the data has less noise in first-order differencing whereas the noise increases after the first order. Therefore, this paper considers choosing first-order differencing for the Arima model. By using an autocorrelation plot, the second-order differencing has caused the immediate lag to shift to the negative side, indicating that the series has surpassed the difference in the second order.

From the PACF graph, the first lag is significantly out of the limit and the second one is also out of the significant limit but it is not that far so select the order of the p as 1. By comparison, Arima with order (1,4,9) will be analyzed in the following procedures.

DOI: 10.54254/2754-1169/55/20231012

Notice that AIC this time is 850.19 and Root Mean Squared Error is roughly equal to 220.9357. With comparisons, the AIC in Arima(3,2,0) is larger than the AIC in Arima(1,4,9) about 6 and the RMSE value is larger in Arima(3,2,0) for almost 23. Therefore, this paper can conclude that Arima(1,4,9) is much better than another model because the RMSE value and AIC value for Arima(1,4,9) are both smaller than the Arima(3,2,0) for a large magnitude.

4.2. Using ETS Method to Forecast

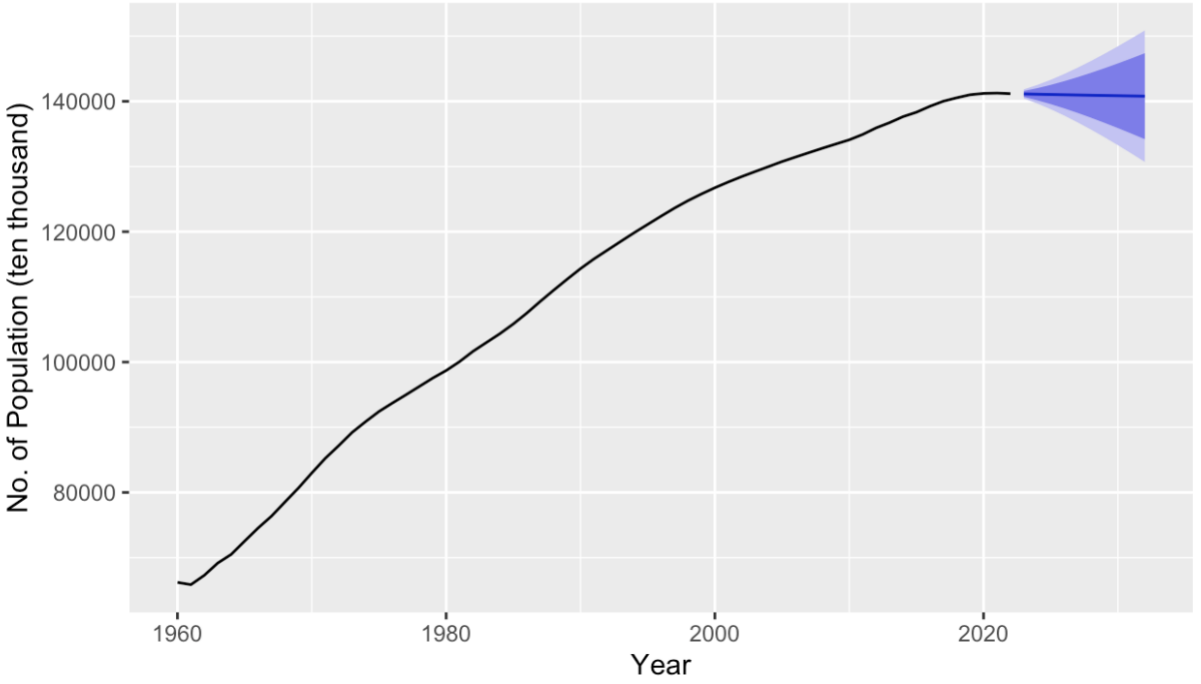

Figure 7: Forecasts plot from ETS(A,Ad,N).

The results from the ETS(A, Ad, N) mean this model underlies the damped trend method(Figure 7). In order to be more accurate, this paper tries to only care about the year after 1962, which has a continued increasing trend after this time period. After excluding the data before 1962, the values of AIC and RMSE dropped from 1009.136 to 892.0881 and from 344.5398 to 176.7601. And then, the new results from the ETS(A, A, N) demonstrate a trend that changes over time(Figure 8).

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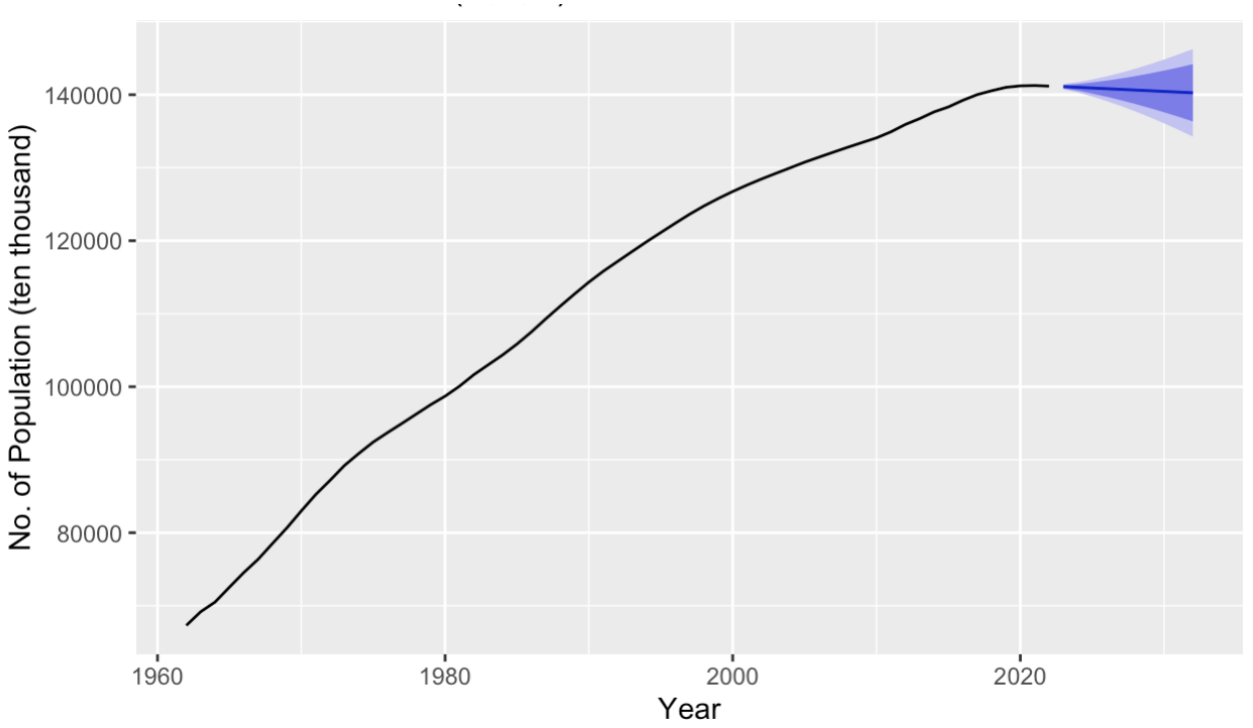

Figure 8: Forecasts plot from ETS(A,A,N).

4.3. Basic Analysis

Table 1: The results from above model.

	AIC	AICc	RMSE	MAPE
Arima(3,2,0)	856.53	857.25	243.731	0.1773001
Arima(1,4,9)	850.19	855.81	220.9357	0.1024297
ETS(A,Ad,N)	1009.136	1010.636	344.5398	0.2284568
ETS(A,A,N)	892.0881	893.1790	176.7601	0.1365558

There are three main changes in China's government policy, such as The 18th CPC Central Committee's Third Plenary Session made the decision to implement the "Single Second Child" plan in 2013. The "Comprehensive Two-Child" plan was introduced in 2015, according to the announcement made during the Fifth Plenary Session of the Eighteenth Central Committee. The Fifth Plenary Session of the Eighteenth Central Committee concluded in Beijing on October 29, 2015. The announcement of the "comprehensive implementation of the policy that a couple can have two children" was made in a communiqué that was released on the same day, signaling the end of the "one-child policy" era, which had been in place for 35 years on the basis of adhering to the fundamental national policy of family planning. It is important to note that the only population decline since the formation of the People's Republic of China took place in the years 1960 and 1961, which were also disaster-prone for our nation.

Although the population is growing overall, the growth rate is gradually decreasing. The Academy of Social Sciences forecasts that China's population will peak at 1.442 billion in 2029 and then progressively fall after that. However, China's population has started to grow negatively since the end of 2021. With the help of data, the birth population will struggle to stay at 12 million in 2020, and there will still be a net rise in births of 1.6 million. The net population increase will be less than

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500,000 by 2021, and it appears that the painting industry won't be able to rebound. Less than a tenth of a century has passed since this population rise began. 10 years ahead of the estimated demographic turning point, a negative population increase in 2022 is a given. The population born between January and July 2022 is anticipated to decline by 11–12% annually based on current private statistics, sample findings, and locally released data. The estimated number of births among them in 2022 is 9.5 million, the estimated number of deaths in 2022 is 10.3 million, and the estimated net population growth in 2022 is -800,000.

By comparing all the variables in Table 1, the Arima(1,4,9) model has the smallest AIC value and RMSE value at the same time. Therefore, the Arima(1,4,9) model illustrates a 95% confidence interval [1401.782, 1411.885] (in million) with a point forecast of 1406.833 million people in 2023(Figure 9). The median value continues to decrease in the following years in a quadratic relationship. By the way, the Arima(3,2,0) model illustrates a 95% confidence interval [1403.995, 1413.952] (in million) with a point forecast of 1408.973 million people in 2023. The point forecast value will also decrease in the following years. In conclusion, the total population in China will continue to decrease in the following ten years.

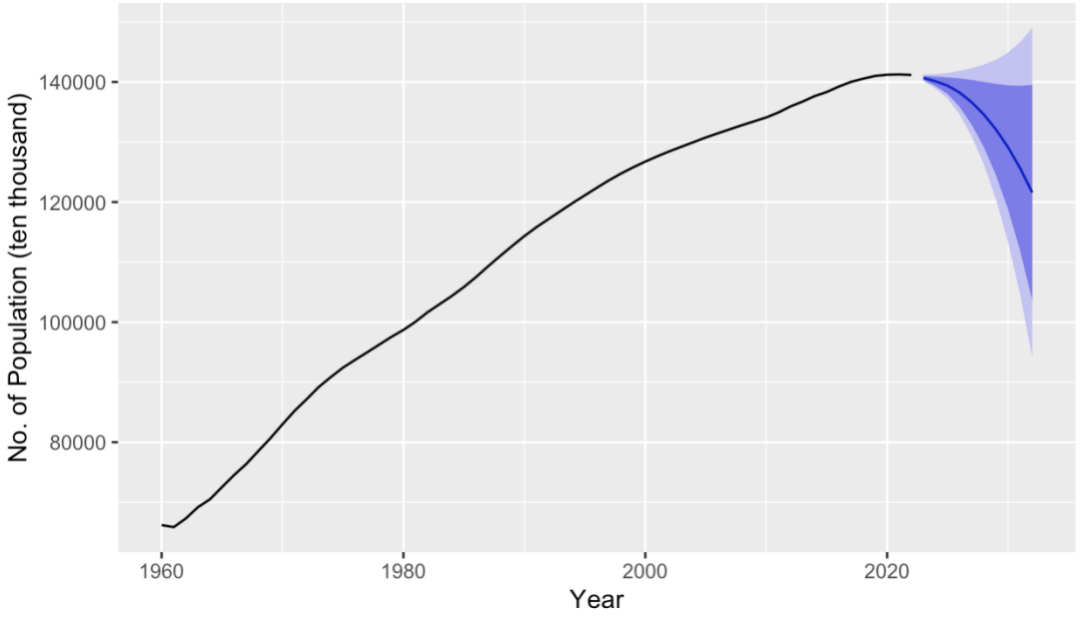

Figure 9: Forecasts plot from Arima(1,4,9).

5. Conclusion

The population development trend in China exhibits specific features along with the development of its economy and culture. Over time, China's population has been naturally growing at a slower rate. Prior to the 1970s, China's population growth rate was maintained at more than 20%. The family planning policy was implemented in China in the 1980s and the 1990s. Even though the birth rate exceeded 10% in the 1980s, the proportion of people born before the 1970s had drastically decreased. People born in the 1980s started to reach the jade age one after another in the 21st century. The population of China has grown naturally at a rate that is less than 10% since the 1990s. China started enforcing the two-child policy entirely in 2016, although the population's natural growth rate has not increased considerably. It is currently less than 6%, which is the same as the natural growth rate in 2004 and 2005. And for the following 10 years, the population will continue decreasing.

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The population growth rate is declining for two main reasons: the first is a decrease in the number of people who are fertile age, and the second is a decrease in women's willingness to have children. According to the 2010 Census, which reveals that the female population has fallen by about 41% and the birth population has shrunk by approximately 35%, the decline in the number of persons of childbearing age is mostly caused by the long-term trend of population decline and the decline in the female population. These numbers also directly affect China's projected population growth rate in the future.

Meanwhile, the population's age distribution reveals the signs of aging. China's population is aging, which is primarily seen in three ways: first, a reduced age structure overall; second, an increase in the number of senior people; and third, an aging working population.

As a result, the plan for China's future development is the first to create a reliable birthing system. The declining fertility rate is one of the major issues affecting our population economics. Despite the two-child policy's implementation, China's birth rate has remained largely steady, with one-child birth rates declining while the two-child contribution rate has increased to 50%. China must therefore promote fertility and continue to enhance the related system.

Second, improve the social security program. The development and stability of our economy and society, as well as the fair allocation of labor resources and the fair arrangement of pension fund revenue and expenditure in our nation, are all related to the creation and maintenance of the ideal social security system. China's social security system now has weak binding and poor sustainability.

Third, make labor resource allocation improvements. Government will specifically enhance the information infrastructure, education system, and household registration system. The supply and demand of labor resources in China are somewhat out of balance, which is precisely why. On the one hand, there is a shortage of labor resources with advanced technology, and on the other, there is an abundance of some low-quality labor resources.

Fourth, hasten the model for economic development's transition. This is due to China's population structure being unbalanced, which would result in an increase in the proportion of elderly people and the disappearance of the previous demographic dividend. This presents the economic development model's change with both an opportunity and a difficulty. Therefore, in order to appropriately manage the process of economic transformation, people must enhance the quality of the working population, correct the coordination of aging, and properly address the relationship between economic development and population resources.

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