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An Analysis of the Dynamic Role of Huizhou Women in Historical and Cultural Development Based on Differential Equation Modeling

Jing Zhao[1] and Tao Wu[2,*]
[1] Basic Department, Luan Vocational Technical College, Lu'an, Anhui, 237158, China
[2] Information and Electronic Engineering College, Luan Vocational Technical College, Lu'an, Anhui, 237158, China
Corresponding authors: (e-mail: zhaojing3284@163.com).

Abstract In this paper, we choose the time series data of the number of women in Huizhou and the Huizhou region from 2013-2024, which are sourced from the official website of the National Bureau of Statistics (NBS). First-order difference equation and first-order difference equation methods are utilized to forecast the time series data from 2025-2030. For these data, a double difference model is established to analyze the long- and short-term relationship between the two through cointegration test, error correction model, placebo test, and regression analysis, so as to study the role of Huizhou women in the development of history and culture. The results show that the cointegration test reveals that for every 1% increase in the number of Huizhou women, the value of historical and cultural industry increases by 3.85%, which indicates that Huizhou women promote cultural development. The regression results yield a linear correlation between the two, with a correlation coefficient of 0.984 and a companion probability of P<0.01. Huizhou women have a long-term and stable effect on the development of history and culture, and do not have a short-term equilibrium relationship.

Index Terms difference equation, double difference model, time series, cointegration test, regression analysis

I. Introduction

In Huizhou region of China since the Ming and Qing Dynasties, with the improvement of the economic level, people's ideological and cultural level gradually open up, and women's images of subject consciousness manifested in Huizhou regional culture with diversified carriers are typical representatives [1]-[3]. As one of the typical cultures in ancient Chinese regional culture, Huizhou culture records the economic, political and cultural development of Huizhou in the Ming and Qing Dynasties of China, and contains extremely rich historical information and outstanding artistic, cultural and scientific achievements of Chinese feudal society [4]. The study of Huizhou culture can be found, Huizhou poetry, Huizhou merchants and education, etc. There are women's independence, active and enterprising consciousness and the pursuit of development, etc., which drove the development of the society of Huizhou region at that time [5]-[7].

In the course of the development of Chinese history and culture, women's subjective consciousness has undergone a long process of metamorphosis, and the intrinsic motivation of women's pursuit of independence and autonomy has the value of promoting the development of productive forces and maintaining social harmony [8]-[10]. As an important part of the social development process, women themselves have the incomparable superiority of men, and play a significantly higher role than men in specific areas [11], [12]. If the roles of both sexes in promoting social development are well coordinated, the development state of the whole society will be more stable [13]. Therefore, in-depth excavation of the content of Huizhou culture in which women manifest the pursuit of independence, initiative and self-development consciousness is of great significance to the objective evaluation of the historical status of women, and to fully excavate and give full play to the role of women in the contemporary society of economic globalization and cultural diversity.

In this paper, the value added of cultural industry in Huizhou region is used to measure the development of its history and culture, firstly, by collecting the research literature or data related to the study of the development of history and culture in Huizhou region from 2013-2024, and then, based on the first-order difference equations and first-order difference equations difference methods, we set up the difference equation time series prediction model to predict the number of women in Huizhou from 2025 to 2030 and the value of history and culture industry. Based on this, double difference statistics reflecting the effect of variables are constructed by establishing a double difference model and utilizing the differences between the experimental and control groups before and after the implementation. The cointegration test, error correction model, placebo test, and regression analysis were also used together to study the effect of Huizhou women on the development of history and culture.

II. Time series forecasting model based on differential equations

In real life, discrete phenomena are widely existed, and the difference equation based on the theory of recurrence relationship has many applications in describing probability, statistics and sociology. In recent years, with the rapid development of computer technology, differential equations have attracted people's attention, and more researchers have begun to predict and study the relevant practical problems in the economic field based on differential equations. The establishment method of time series forecasting model based on differential equations will be explored based on the relevant theory of differential equations [14].

The numerical series in the practical problem is set as the original time series, which will be expressed as the following form:

$$x(t)=\left\{x(1),x(2),\cdots,x(n)\right\} \tag{1}$$

First order constant coefficient constant non chi-squared difference equation type time series forecasting model, model 1 form:

$$\hat{x}(k+1)=a\hat{x}(k)+c \tag{2}$$

where the value of parameter a,c is estimated by the least squares method, i.e., it is determined by the following equation:

$$\begin{pmatrix} a \\ c \end{pmatrix}=(B'B)^{-1}B'Y \tag{3}$$

Among them:

$$B=\begin{pmatrix} x(1) & 1 \\ x(2) & 1 \\ \vdots & \vdots \\ x(n-1) & 1 \end{pmatrix},Y=\begin{pmatrix} x(2) \\ x(3) \\ \vdots \\ x(n) \end{pmatrix} \tag{4}$$

The first order constant coefficient non-chiral (non-constant) difference equation type time series forecasting model is expressed in the form:

$$\hat{x}(k+1)=a\hat{x}(k)+c(k) \tag{5}$$

When $c(k)=b_0+b_1k$, there is model 2:

$$\hat{x}(k+1)=a\hat{x}(k)+b_0+b_1k \tag{6}$$

where parameter a,b_0,b_1 is determined by the following equation:

$$\begin{pmatrix} a \\ b_0 \\ b_1 \end{pmatrix}=(B'B)^{-1}B'Y \tag{7}$$

Among them:

$$B=\begin{pmatrix} x(1) & 1 & 1 \\ x(2) & 1 & 2 \\ \vdots & \vdots & \vdots \\ x(n-1) & 1 & n-1 \end{pmatrix},Y=\begin{pmatrix} x(2) \\ x(3) \\ \vdots \\ x(n) \end{pmatrix} \tag{8}$$

When $c(k)=b_0+b_1k+b_2k^2$, there is model 3:

$$\hat{x}(k+1)=a\hat{x}(k)+b_0+b_1k+b_2k^2 \tag{9}$$

where parameter a,b_0,b_1,b_2 is determined by the following equation:

$$\begin{pmatrix} a \\ b_0 \\ b_1 \\ b_2 \end{pmatrix}=(B'B)^{-1}B'Y \tag{10}$$

Among them:

$$B=\begin{pmatrix} x(1) & 1 & 1 & 1 \\ x(2) & 1 & 2 & 2^2 \\ \vdots & \vdots & \vdots & \vdots \\ x(n-1) & 1 & n-1 & (n-1)^2 \end{pmatrix}, Y=\begin{pmatrix} x(2) \\ x(3) \\ \vdots \\ x(n) \end{pmatrix} \tag{11}$$

The first order variable coefficient non chi-squared difference equation type time series forecasting model is expressed in the form:

$$\hat{x}(k+1)=a(k)\hat{x}(k)+c(k) \tag{12}$$

When $a(k)=b_0+b_1k$, $c(k)=c_0+c_1k$, there is model 4:

$$\hat{x}(k+1)=(b_0+b_1k)\hat{x}(k)+c_0+c_1k \tag{13}$$

where parameter b_0,b_1,c_0,c_1 is determined by the following equation:

$$\begin{pmatrix} b_0 \\ b_1 \\ c_0 \\ c_1 \end{pmatrix}=(B'B)^{-1}B'Y \tag{14}$$

where $B=\begin{pmatrix} x(1) & x(1) & 1 & 1 \\ x(2) & 2x(2) & 1 & 2 \\ \vdots & \vdots & \vdots & \vdots \\ x(n-1) & (n-1)x(n-1) & 1 & (n-1) \end{pmatrix}$, $Y=\begin{pmatrix} x(2) \\ x(3) \\ \vdots \\ x(n) \end{pmatrix}$.

When $a(k)=b_0+b_1k+b_2k^2$, $c(k)=c_0+c_1k+c_2k^2$, there is model 5:

$$\hat{x}(k+1)=(b_0+b_1k+b_2k^2)\hat{x}(k)+c_0+c_1k+c_2k^2 \tag{15}$$

where parameter b_0,b_1,b_2,c_0,c_1,c_2 is determined by the following equation:

$$\begin{pmatrix} b_0 \\ b_1 \\ b_2 \\ c_0 \\ c_1 \\ c_2 \end{pmatrix}=(B'B)^{-1}B'Y \tag{16}$$

where $B=\begin{pmatrix} x(1) & x(1) & x(1) & 1 & 1 & 1 \\ x(2) & 2x(1) & 2^2x(1) & 1 & 2 & 2^2 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ x(n-1) & (n-1)x(n-1) & (n-1)^2x(n-1) & 1 & n-1 & (n-1)^2 \end{pmatrix}$, $Y=\begin{pmatrix} x(2) \\ x(3) \\ \vdots \\ x(n) \end{pmatrix}$.

When $a(k)=b_0+b_1k+b_2k^2+b_3k^3$, $c(k)=c_0+c_1k+c_2k^2+c_3k^3$, there is model 6:

$$\hat{x}(k+1)=(b_0+b_1k+b_2k^2+b_3k^3)\hat{x}(k)+c_0+c_1k+c_2k^2+c_3k^3 \tag{17}$$

where parameter $b_0,b_1,b_2,b_3,c_0,c_1,c_2,c_3$ is determined by the following equation:

$$\begin{pmatrix} b_0 \\ b_1 \\ b_2 \\ b_3 \\ c_0 \\ c_1 \\ c_2 \\ c_3 \end{pmatrix}=(B'B)^{-1}B'Y \tag{18}$$

Among them,

$$B=\begin{pmatrix} x(1) & x(1) & x(1) & x(1) & 1 & 1 & 1 & 1 \\ x(2) & 2x(1) & 2^2x(1) & 2^3x(1) & 1 & 2 & 2^2 & 2^3 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ x(n-1) & (n-1)x(n-1) & (n-1)^2x(n-1) & (n-1)^3x(n-1) & 1 & n-1 & (n-1)^2 & (n-1)^3 \end{pmatrix} \tag{19}$$

$$Y=\begin{pmatrix} x(2) \\ x(3) \\ \vdots \\ x(n) \end{pmatrix} \tag{20}$$

The model of the pole shift can be expressed as:

$$Y_t = Y_t' + \alpha t + \beta \tag{21}$$

where Y_t' is a time model without linear and constant terms, mainly composed of periodic and irregular change terms; α and β are the coefficients of linear and constant terms, respectively. In order to study the irregular variation of the polar shift, it is necessary to remove the effects of the trend term, the constant term and the periodic term. This can be obtained by first-order differencing the polar shift series:

$$\nabla Y_t = (Y_t' - Y_{t-1}') + \alpha[t-(t-1)] = \nabla Y_t' + \alpha \tag{22}$$

where $\nabla t = 1\,d$ is the time interval between the two differentials; $\nabla Y_t'$ contains the irregularly varying first-order differential component. The physical significance of the result obtained from the first-order difference of the pole shift is the velocity of the pole shift motion. The long-term trend of the pole shift is removed by differencing, but the effect of the change in the periodic term remains [15]. Differencing the first order difference result again gives the second order difference result as follows:

$$\nabla^2 Y_t = \nabla Y_t - \nabla Y_{t-1} = \nabla Y_t' - \nabla Y_{t-1}' \tag{23}$$

After the second-order differencing, the effect of the linear term has been removed, and the smooth variation of the periodic term has been further eliminated, and the obtained results reflect the irregular variation of the pole shift in the short term. According to the fact that the irregular variation of the pole shift is related to the short-term dynamics, the second-order difference of the pole shift time series can better reflect the irregular variation characteristics of the pole shift because the second-order difference results both eliminate the influence of the smooth variation of the pole shift and have the physical significance of the acceleration [16].

III. Double Difference Modeling

Double difference modeling is a measurement method used to assess the utility of policy implementation by dividing the research sample into experimental and control groups according to whether or not the policy is implemented, and assessing the impact of policy implementation by measuring the difference between the before and after changes in the two groups. The double-difference model mainly applies mixed cross-sectional data to evaluate the extent of the impact of an event or policy, and in some special contexts, the clever construction of cross-sectional data can also be applied to assess the method. This chapter is introduced from the model introduction, model principle, model construction and variable description, applicability test, and regression result analysis analysis respectively [17].

The double-difference model is divided into two groups of two-period double-difference models and two groups of multi-period double-difference models according to the number of times a certain policy has been implemented in the time period under study. Its baseline model is set as follows:

$$Y_{it} = \beta_o + \beta_1 treat_i + \beta_2 P_t + \beta_3 treat_i P_t + \varepsilon_{it} \tag{24}$$

In Eq.

Y_{it} - represents the explanatory variables for evaluating the impact of policy implementation.

$treat_i$ - represents the policy dummy variable, usually adopting the time node as the basis for judging the policy implementation, taking the value of 0 before the policy implementation and the value of 1 after the policy implementation.

P_t - represents the time dummy variable, which takes the value of 1 before the policy implementation and 2 after the policy implementation, in the research time period, the individuals who implemented the policy are set as the experimental group, and the individuals who did not implement the policy are set as the control group.

β_o - represents the net effect of the sample before policy implementation.

β_1 - represents the net effect of individuals in the experimental group.

β_2 - represents the net effect of individuals in the control group.

β_3 - represents the policy implementation net effect.

$treat_i P_t$ - is the policy dummy and time dummy interaction term.

According to the baseline model the effects can be expressed for the experimental and control groups of the two two-period double-difference model, with the control group effect expressed as:

$$Y_{it}=\begin{cases}\beta_o & P_t=1 \text{ Before policy implementation}\\ \beta_o+\beta_2 & P_t=2 \text{ After policy implementation}\end{cases} \tag{25}$$

The experimental group effect is expressed as:

$$Y_{it}=\begin{cases}\beta_o+\beta_1 & P_t=1 \text{ Before policy implementation}\\ \beta_o+\beta_1+\beta_2+\beta_3 & P_t=2 \text{ After policy implementation}\end{cases} \tag{26}$$

From the computational reasoning of the double-difference model, the specific effect of policy implementation is obtained as β_3 after doing the difference twice. Considering the two-period panel data on this basis, the following equation is obtained:

$$y_{it}=\alpha+\beta P_t+\chi treat_{it}+\mu_i+\varepsilon_{it}\left(i=1,\cdots,n;t=1,2\right) \tag{27}$$

where P_t is a dummy variable for the experimental period and μ_i is an individual autocorrelation variable:

$$P_t=\begin{cases}1 & \text{If } t=2\text{, post-test}\\ 2 & \text{If } t=1\text{, pre-test}\end{cases} \tag{28}$$

The policy dummy variable is denoted as:

$$treat_{it}=\begin{cases}1 & \text{If } i\in \text{ experimental group and}\\ 0 & \text{Other cases}\end{cases} \tag{29}$$

In the above equation, when $t=1$, i.e., the experimental and control groups are not treated differently and $treat_{it}$ are both equal to 0. When $t=2$, the experimental group $treat_{it}=1$ and the control group $treat_{it}=0$.

Since it is panel data, $treat_{it}$ may be correlated with μ_i if the experiment fails to be completely randomized, resulting in inconsistent OLS. The original equation can be first-order differenced to eliminate μ_i to obtain the following equation:

$$\Delta y_i=\beta+\chi treat_{i2}+\Delta\varepsilon_i \tag{30}$$

Then using ordinary least squares estimation, a more consistent result can be obtained [18]. In the process of using the double difference model, in order to exclude the "difference" between the experimental group and the control group before the experiment, the double difference estimator can be expressed as:

$$\begin{aligned}\hat{\beta}_{DID}&=\Delta y_{treat}-\Delta y_{control}\\ &=\left(y_{treat,2}-y_{treat,1}\right)-\left(y_{control,2}-y_{control,1}\right)\end{aligned} \tag{31}$$

IV. Analysis of empirical studies

IV. A. Study area and study population

Huizhou is the abbreviation of the ancient Huizhou, also known as the ancient Shezhou, Xin'an. Song Xuanhe three years set up "a government six counties (state)" administrative division, through the Song, Yuan, Ming and Qing dynasties have not changed, this more than 1,300 years, and gradually formed a solid integration of regional cultural circle. At the time of the Ming and Qing Dynasties, Huizhou also ushered in its most prosperous period with the rise of the Huizhou merchants and their power in the business world. Currently, the concept of Huizhou as an administrative division has been diluted and consists of three cities in two provinces: Wuyuan and Jixi counties have been divided into Shangrao City in Jiangxi Province and Xuancheng City in Anhui Province, while the main body of ancient Huizhou (Shexian, Yixian, Xiuning, and Qimen) has been assigned to Huangshan City. Although the research object of this dissertation is limited to the typical traditional villages within the current Huangshan City, it still follows the concept of Huizhou, in order to highlight the connotation of Huizhou culture.

There are more research results on women's history in Huizhou, mainly focusing on the study of women's status, marital status, rituals and customs, women's indoctrination, women's image, and women's daily life, which are summarized in this thesis respectively. At the same time, it is noted that the existing research results pay different attention to and focus on different female groups in Huizhou, and the living conditions, psychological activities and behaviors of different female groups in the society at that time are indeed quite different.

All the data related to the study on the development of history and culture in Huizhou from 2013 to 2024 come from the official website of the National Bureau of Statistics. The data used in this study are all from the official publication, which can ensure the authenticity, authority and reliability of the research data to a certain extent.

IV. B. Modeling

Based on the above principle, the two two-period double difference model is generalized to a two multi-period double difference model with the following model setup:

$$\begin{aligned} Y_{it} &= \beta_o + \beta_1 treat_{it} + \beta_2 D_t + \omega_1 P1_t + \omega_2 P2_t \\ &+ \omega_3 P3_t + \cdots + \omega_m Pm_t + \varepsilon_{it} \end{aligned} \tag{32}$$

In order to eliminate the endogeneity caused by the correlation between independent variables (the number of women in Huizhou) and error terms, and avoid the unobservable heterogeneity affecting the explanatory variable (added value of cultural industry), the control variables (living conditions, psychological activities, marital status and behavior patterns, etc.) were added to the time fixed effect control variables and individual fixed effect variables, that is, more control variables were added to eliminate the influence of individual differences and time effects on the explanatory variables, and the benchmark model was obtained as follows:

$$Y_{it} = \beta_o + \beta_1 treat_{it} + \beta_2 X_{it} + \mu_i + \gamma_t + \varepsilon_{it} \tag{33}$$

where Y_{it} - represents the explanatory variables. $treat_{it}$ - is the dummy variable. X_{it} - represents the control variable. μ_i - represents individual fixed effects. γ_t - for time fixed effects. ε_{it} - for the error term.

IV. C. Empirical analysis process and results

IV. C. 1) Smoothness test

The data of the number of Huizhou women and the value of Huizhou history and culture industry from 2013 to 2024 in Huizhou area are selected as samples, and the time series model of discrete difference equation is established to forecast the number of Huizhou women and the value of Huizhou history and culture industry from 2025 to 2030. The number of women in Huizhou and the value added of Huizhou historical and cultural industry from 2013 to 2030 are obtained as shown in Table 1.

Table 1: A list of the added values of huizhou women and wenhua industries

Year	Number(Ten thousand)	Value-added of cultural industry	Year	Number (Ten thousand)	Value-added of cultural industry
2013	3415.85	109512	2022	4482.14	213684
2014	3326.41	121285	2023	5694.82	294572
2015	3130.84	98532	2024	6092.22	352278
2016	3241.12	95011	2025	6674.85	526749
2017	3080.42	57564	2026	7182.16	551895
2018	3047.72	103345	2027	7585.66	732541
2019	2911.32	88226	2028	7662.89	1386284
2020	3018.84	155178	2029	7884.55	1548920
2021	3017.32	167874	2030	7723.98	1766841

The parallel trend test is a prerequisite that must be available to carry out the assessment of the double difference model, and the test results are shown in Figure 1.

From the figure, it can be seen that the level of historical development in Huizhou fluctuates around the level of 0, none of which is significant, indicating that the model satisfies the parallel trend assumption. In addition, it can be seen from the latter part of the figure that the regression coefficient shows a significant upward trend, indicating that the increase in the number of women in Huizhou has a certain long-term and stable effect on the growth of the historical development level in Huizhou.

The placebo test is also an important step in the smoothness test of the double-difference model, which can further verify the robustness of the model. The basic idea is to generate "dummy variables" for estimation, and if the coefficients of the fictitious dummy variables are still significant, it indicates that the estimation results of the previous model are less reliable, and there may be a bias due to the influence of other factors outside the model. The empirical practice of the placebo test is usually to randomly select individuals as the treatment group, and repeat the iteration for a sufficient number of times, which can usually be set to one thousand times, to observe whether the coefficient change of the "dummy variable" is still significant. The distribution of the coefficients of the randomly selected "dummy variables" and the corresponding p-values are shown in Figure 2, in which the horizontal axis shows the number of coefficients, the vertical axis shows the density value and p-value, the curve is the distribution of the kernel density of the estimated coefficients, and the black dots are the p-values of the estimated coefficients. It can be noticed that the coefficients are mostly clustered around 0 and the vast majority of the estimated values have p-values significantly greater than 0.1, indicating that they are non-significant at the 10% level, which suggests that the model passes the placebo test.

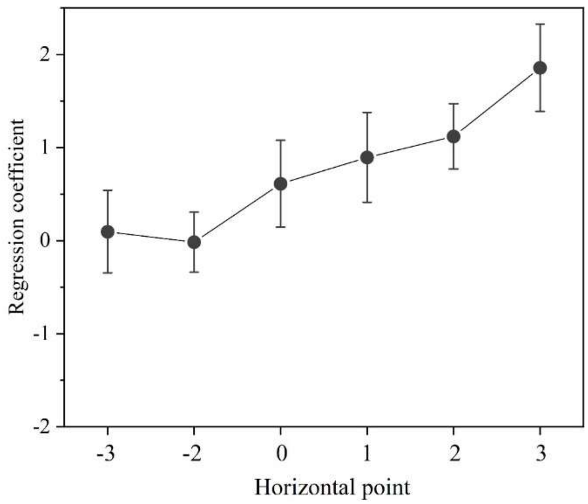

Figure 1: Parallel trend test results

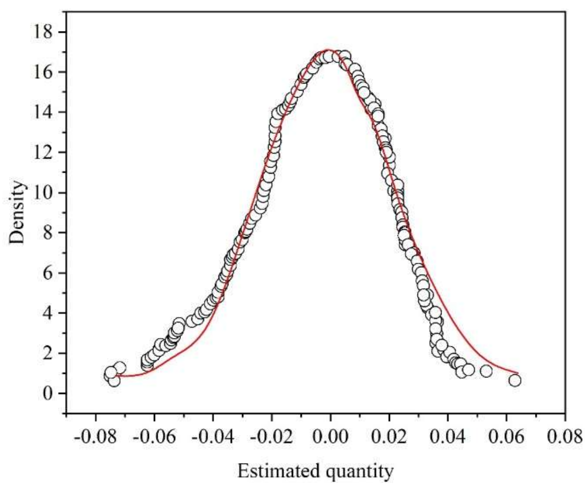

Figure 2: Placebo test results

IV. C. 2) Cointegration tests

Since the time series data of the number of women in Huizhou and the historical and cultural industry in Huizhou region are the same as the second-order monotonic, then the two variables are cointegrated with each other. According to the Engle-Granger test, if the two time series are cointegrated, it indicates that there is a long-term equilibrium relationship between the two time series.

The results of Johansen statistical test are shown in Table 2, which shows that there is a unique cointegration relationship between variables LNC and LNCI at 5% significance level, i.e., there is a long-term stable dynamic equilibrium relationship between the development of Huizhou history and culture industry and the number of Huizhou women. For every 1% rise in the total number of Huizhou women, the value added of Huizhou historical and cultural industry rises by 3.85%, which is more elastic, indicating that Huizhou women promote cultural development, which is in line with the expectation of economic theory. The test of whether the residuals of the model are autocorrelated shows that there is no autocorrelation: the test of stability of the cointegration equation shows that the eigenvalues of the concomitant matrices fall within the unit circle, indicating that the cointegration equation is smooth.

Table 2: List of the results of the johansen cointegral test of the variable

Cointegral variable	Null hypothesis: the number of cointeger vectors	Eigenvalue	Trace statistics	5% significant level threshold
LNC,LNCI	r=0	11.9524	8.0214**	15.52
	r=1	15.2384	1.325	3.85
	r=2	15.9472		

The regression scatter plot is a scatter plot with a fitted regression curve through a binary regression equation with one of the sequences in the sequence group as the horizontal axis and the other sequences as the vertical axis, and with the option to transform these sequences. This study uses econometric software to do a regression scatter on the value added of historical and cultural industries and the number of Huizhou women as shown in Figure 3. Most of the scatter points are located near the fitted regression straight line, indicating that there is a strong linear relationship between the value added of historical and cultural industries and the number of women in Huizhou. This study uses Pearson correlation analysis on the added value of history and culture industry and the number of women in Huizhou, which yields a correlation coefficient of r=0.984 between the added value of history and culture industry and the number of women in Huizhou, with a probability of companionship of P<0.01, which further supports the existence of a linear correlation between the history and culture industry in Huizhou and the number of women in Huizhou.

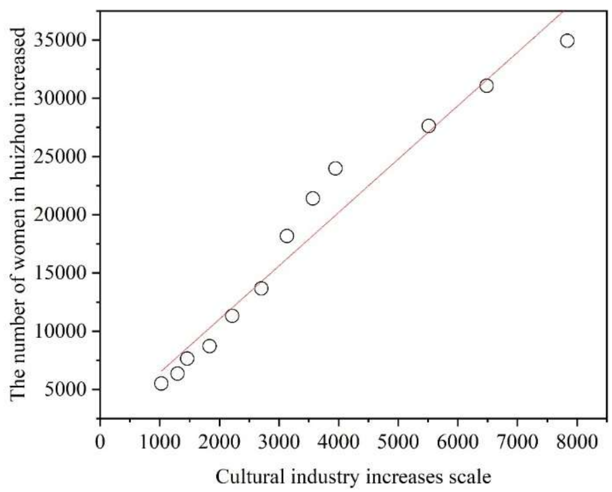

Figure 3: Regression scatter diagram

IV. C. 3) ADF test

In order to analyze the relationship between Huizhou women and the development of history and culture, it is first necessary to test the smoothness of the time series data to avoid the pseudo-regression phenomenon. In order to eliminate the phenomenon of heteroskedasticity in the time series, it is necessary to carry out the natural logarithmic transformation of the two variables, which are recorded as LNC and LNCI, respectively, and use the measurement software STATA12.0 to carry out the unit root test on LNC and LNCI respectively, and the results can be obtained as shown in Table 3, which is shown in Table 3.In this paper, we use the AIC and SC minimum criterion to determine the number of lagged orders, and we adopt the ADF to analyze the relationship between women of Huizhou and the historical and cultural development of the The time series data of the two variables are smooth. It is shown as a non-stationary time series. Perform first-order differencing and then unit root test, showing the existence of unit root. Second-order differencing is performed again. The t-statistics of the original sequence of the number of Huizhou women and the original sequence of the value added of historical and cultural industries (LNCI) correspond to the probability of concomitance of 0.9999 and 1.0000, respectively, which is much larger than the significance level of 1%, i.e., the original sequences LNC and LNCI are non-smooth. The t-statistics of the first-order difference series of the number of Huizhou women (ΔLNC) and the first-order difference series of the added value of history and culture industry (ΔLNCI) correspond to the probability of companionship of 0.4205 and 0.2426, respectively, which is greater than 1% significance level, i.e., the first-order difference series of ΔLNC and ΔLNCI are non-smooth. The t-statistics of the second-order difference series of the number of Huizhou women (ΔLNC) and the second-order difference series of the value added of the historical and cultural industry (ΔLNCI) correspond to the probability of companionship of 0.0005 and 0.0014, respectively, which is much smaller than the significance level of 1%.

Table 3: Adf test

Test sequence	Sequence type	Test type	T statistic	Associated probability p	Whether it's stationary	Single integer
LNC	Primitive sequence	(0,0,1)	10.7425	0.9999	Nonstationary	2
Δ,LNC	First difference	(0,0,1)	-0.6251	0.4205	Nonstationary	
Δ,LNC	Second difference	(0,0,1)	-4.7625	0.0005	stationary	
LNCI	Primitive sequence	(0,0,1)	8.8422	1.0000	Nonstationary	2
Δ,LNCI	First difference	(0,0,1)	-1.0596	0.2426	Nonstationary	
Δ,LNCI	Second difference	(0,0,1)	-4.0882	0.0014	stationary	

Error correction As shown in Table 4, in the error correction model of explanatory variables (LNC) to explanatory variables (LNCI), the t-statistic of the constant term corresponds to the probability of concomitance greater than 1% significance level, and the t-statistic of the explanatory variables and error correction term corresponds to the probability of concomitance greater than 5% significance level, which can indicate that the model as a whole is insignificant, and that the original sequence of the number of women in Huizhou and the history and culture industry have no short-term equilibrium relationship.

Table 4: Error correction model of time series

Explained variable	Interpretation variable	coefficient	Standard error	T statistic	Associated probability p
LNCI	Constant term (c)	0.174	0.0711	2.4521	0.0425
	LNC	0.0382	0.3562	0.1124	0.9225
	ecm(-1)	-0.2526	0.2294	-1.1385	0.2954

V. Conclusion

The research data of this paper comes from the official website of the National Bureau of Statistics for the study of historical and cultural development in Huizhou from 2013 to 2024. The selected samples are counted, the corresponding time series prediction model and double difference model are established, and a complete empirical analysis of Huizhou women's influence on the development of history and culture is carried out, and the specific conclusions are shown as follows:

(1) Based on the prediction model, the number of women in Huizhou and the added value of Huizhou historical and cultural industry in 2030 are obtained as 77,239,800 people and 1,766,841,000 yuan, respectively.

(2) There is a long-term stable dynamic equilibrium relationship between the development of Huizhou history and culture industry and Huizhou women, and there is no short-term equilibrium relationship. As the total number of Huizhou women, the value added of Huizhou history and culture industry also rises. Pearson correlation analysis further supports the existence of linear correlation between Huizhou history and culture industry and the number of Huizhou women.

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References

[1] Yang, B. (2023). Yangzhou Revisited: Spatial Imaginaries and Women's Literature during the Qing. Journal of Chinese Literature and Culture, 10(1), 57-80.
[2] Li, G. (2017). Women's voices from'our homeland': Fujian women's local identity and identity politics. Journal of the Oriental Society of Australia, 49, 186-210.
[3] Binbin, Y. A. N. G. (2022). Anchoring Identities in Yangzhou: Xú Deyin (1681–after 1760) and the Re-Invention of the Huizhou Legacy. Chinese Literature, Essays, Articles, Reviews, 44, 141-173.
[4] Zhao, Z., & Zhan, H. (2022, September). Research on Effect of Huizhou Merchants' Cultural Image Communication. In Proceedings of the 5th International Conference on Big Data Technologies (pp. 403-408).
[5] Xiaoyan, D. (2025). Uncovering Female Voices in a Male - dominated Discourse: An Analysis of Gender Dynamics in Medical Case Records From the Qing Dynasty, China. Gender & History.
[6] Guo, Q. (2015). Huizhou Studies in China: Scholarship and Sources. Nan Nü, 17(1), 165-180.
[7] Wang, H. (2023). The Body and Soul of Chinese Genealogies: Taking the Genealogies of Huizhou as an Example. In The General Theory of China’s Genealogy (pp. 415-429). Singapore: Springer Nature Singapore.

[8] Pollock, S., & Brunet, M. H. (2018). " When It Became Equal": How Historical Consciousness and Theories of Agency Can Explain Female Students' Conceptions of Feminism. Canadian Social Studies, 50(1), 11-24.
[9] Hara, M. R. (2023). FEMALE SUBJECTIVITY AND CONSCIOUSNESS. China's May Fourth Movement: New Narratives and Perspectives.
[10] Feng, C., Kang, Y., Li, J., & Zhu, X. (2023). The early rise of female consciousness and long-term female labor force participation. Journal of Economic Issues, 57(1), 123-152.
[11] Chappell, S. G. (2023). Is consciousness gendered?. European Journal of Analytic Philosophy, 19(1), S8-13.
[12] Kim, A. Y., Sinatra, G. M., & Seyranian, V. (2018). Developing a STEM identity among young women: A social identity perspective. Review of Educational Research, 88(4), 589-625.
[13] Chatterjee, S., Dutta Gupta, S., & Upadhyay, P. (2018). Empowering women and stimulating development at bottom of pyramid through micro-entrepreneurship. Management Decision, 56(1), 160-174.
[14] Qipeng Wang& Min Han. (2023) .Dirichlet Graph Convolution Coupled Neural Differential Equation for Spatio-temporal Time Series Prediction. Neural Processing Letters,55(9),12347-12366.
[15] Hengyun Zhang,Jianyi Deng,Yiwen Xu,Yichuan Deng & Jia Rui Lin. (2025) .An Adaptive Pedestrian Flow Prediction Model Based on First-Order Differential Error Adjustment and Hidden Markov Model.Buildings,15(6),902-902.
[16] Huanfeng Yang,Hongbin Chen,Xiaoqiang Yue & Guangqing Long. (2025) .High-order fractional central difference method for multi-dimensional integral fractional Laplacian and its applications. Communications in Nonlinear Science and Numerical Simulation,145,108711-108711.
[17] Yiding Wu,Qing Liu & Qiming Guo. (2025) .Can Vertical Mergers and Acquisitions of Renewable Energy Enterprises Enhance Supply Chain Resilience?—Empirical Verification Based on Multi-Period Difference-in-Differences Model. Sustainability,17(7),3211-3211.
[18] Mohsen Barzegar & Francisco Alegria. (2025) .Experimental validation of the precision of sinusoidal amplitude estimation using a least squares procedure in the presence of additive noise. Scientific Reports,15(1),12789-12789.