Construction of MLR model based on SPSS value pricing of
TCM medical services in Sichuan province

Bi-hui Cheng*
School of Yunnan University of Nationalities, Kunming 650500 China

*Corresponding author e-mail: 383302216@qq.com

Abstract. By using SPSS statistical software for the medical service value of traditional Chinese medicine in Sichuan province the influence factors of pricing multiple linear regression analysis, applying the Enter (into the regression method to establish multiple linear regression model, find out the correlation between influence factors and the corresponding contribution coefficient, provide relevant policies and Suggestions. At the same time thought continuation, and further discusses to this model is applied to other provinces of investigation of TCM medical service value pricing.

Chinese library classification no.: R197.4; O212

1. Introduction

On May 17, 2015, formally promulgated by the general office of the state council "about city public hospital comprehensive reform pilot guidance", "opinion" pointed out: to reasonably adjust the labor value of medical service price, medical staff technology especially the diagnosis and treatment of traditional Chinese medicine (TCM), and other service projects prices [1]. Medical services of traditional Chinese medicine is the crystallization of the wisdom of the Chinese nation one thousand years, is the treasure of the Chinese traditional culture, "heat" of traditional Chinese medicine and traditional Chinese medicine in recent years again into the spotlight. At present, our country on medical services of traditional Chinese medicine mainly at cost price in the policy, leading to failed to get professional service value, the cost of human resources is not respected, which objectively results in the high proportion of drugs in TCM medical institutions. The westernization tendency of TCM medical institutions and the advantage of TCM diagnosis and treatment technology are not rationally utilized.

In 1996, li jidong and ji yunhai pointed out that TCM medical service is a highly technical "specialized" service, which is itself a special commodity. There are both value and use value [2]. But the public welfare and welfare traits and the contradiction between commercial properties and makes
the medical service value evaluation of traditional Chinese medicine is faced with many problems. This problem Song Hua et al in 2005 by the doctor relationship between service quality and the clinic patients satisfaction interview investigation and get some relevant data, the research results show that the doctor's service attitude and the professional quality, technology and knowledge is the main factor to determine whether patients satisfaction, among them, the most important factor influencing patient satisfaction is doctors' service attitude [3]. 2005 Vincent S.Fan and others through the form of a questionnaire to patients, the influence factors of affecting the primary health care, patient satisfaction were investigated, the results show that the patients satisfaction depends largely on the follow-up medical service provision, and on this basis, put forward a medical institution shall strive to improve medical follow-up services, in order to improve patient satisfaction. [4] 2008 shieber, Chen Ye people such as the integrated use of the analytic hierarchy process (ahp) and BP neural network, creatively constructed hospital service value model, Select patients expected values, employee performance is a two dimensions to evaluate hospital service value, employee performance is a medical technology and influence degree of employee satisfaction and employee grow innovation three variables [5] [5] 2008 XiaoYan people such as the large capacity research, their empirical studies suggest that the perspective of customer value marketing strategy to improve customer satisfaction and make the hospital brand has played a pivotal role, it also reflects the customer satisfaction from a certain Angle for patient selection medical hospital has played a very important influence [6]. 2013 Ma Hongyao, Shen junlong et al. found that the general low price of TCM medical services, low fee items, high loss rate and low proportion of income seriously hurt the work enthusiasm of TCM practitioners, and the main reason for this phenomenon is that the current price fails to reflect the characteristics of TCM medical services and its "professional" service value [7].

Throughout the above research results, scholars use different tools, research methods and models of draw the different conclusion, and gives different policy Suggestions. At the same time the paper by using multiple linear regression relation model of traditional Chinese medicine (TCM) in sichuan province to the influence factors of the medical service value pricing. Correlation analysis to select social reputation, professional title, age, educational background, educational background and her hospital grade six aspects as influence factors, find out the correlation factors and contribution coefficient, analysis of contribution coefficient of difference, In order to more accurately understand and grasp the influencing factors of value pricing of TCM medical services in sichuan province, and provide appropriate and reasonable policies and Suggestions [8-10].

2. MLR model principle

2.1. basic concepts

Let the dependent variable be \( y \), arguments for \( x_1, \ldots, x_p \), assume that you have a group of independent data \( (y_i, x_{i1}, x_{i2}, \ldots, x_{ip}), i = 1, 2, \ldots, n \), and assume that they have the following linear relationship:

\[
y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_p x_{ip} + \epsilon_i, \quad i = 1, 2, \ldots, n
\]

Including, \( \epsilon_i \) is a random variable, independent and content \( E(\epsilon) = 0, D(\epsilon) = \sigma^2 \). The above
relations are called multiple linear regression models, $\beta_j (j = 0, 1, 2, \cdots, p)$. This is called the regression coefficient [8].

The least square method is used to estimate the regression coefficient for multiple linear regression $\beta_j$, the estimate of $\hat{\beta}_j$, thus, the following regression equation is obtained:

$$\hat{y}_i = \hat{\beta}_0 + \hat{\beta}_1 x_{i1} + \hat{\beta}_2 x_{i2} + \cdots + \hat{\beta}_p x_{ip}, i = 1, 2, \cdots, n$$

### 2.2. Hypothesis Testing

test of hypothesis $H_0: \beta_0 = \beta_1 = \cdots = \beta_p = 0$ $H_1: \beta_j$ not all is zero.

(1) significance test of regression equation (F test)

$$F = \frac{S_1/p}{S_2/(n-p-1)} \sim F(p, n-p-1)$$

Immediate $H_0$: $S_1 = \sum_{i=1}^{n} (\hat{y}_i - \bar{y})^2$ It's called the sum of regressed squares, $S_2 = \sum_{i=1}^{n} (y_i - \hat{y}_i)^2$ It's called the residual sum of squares.

If $F > F_{1-\alpha}(p, n-p-1)$ refused to $H_0$, Consider a significant wired relationship between $y$ and $x_1, \cdots, x_k$ Otherwise accept $H_0$, The linear relation between $y$ and $x_1, \cdots, x_k$ is not significant.

(2) significance test of regression equation (t test)

$$T_j = \frac{\hat{\beta}_j}{\sigma} \sqrt{\frac{\sum_{i=1}^{n} (x_{ij} - x_{i})^2}{S_2}}$$

While $H_0: \beta_j = 0$ When it was formed $|T_j| > t_{1-\alpha/2}(n-p-1)$ if refused to $H_0$, Otherwise accept $H_0$.

(3) test of goodness of fit for regression equation (r test)

Define $r = \sqrt{\frac{S_1}{L_{uv}}} = \sqrt{\frac{S_1}{S_1 + S_2}}$ is the multiple $y$ and $x_1, \cdots, x_k$ correlation coefficient or complex correlation coefficient with $L_{uv} = S_1 + S_2 = \sum_{i=1}^{n} (y_i - \bar{y})^2$ , $r \in [0, 1]$, The closer $r^2$ to 1, the better the fit; On the contrary, $r^2$ the fitting degree is not high, which needs to be improved.

$$F = \frac{n-p-1}{p} \frac{r^2}{1-r^2}$$

Therefore, use $F$ and $r$ use test are equivalent

### 3. related work and basic data

#### 3.1. basic information

1) your social reputation (x1): 1. Experts on special government allowances; 3. City-level Chinese medicine; 4. Chief and deputy chairman of provincial society; 5. Chairman and deputy chairman of national society; 6. Person in charge of national key disciplines or key specialties; 7. Provincial old Chinese medicine practitioners; 8. National famous traditional Chinese medicine.
2), your title (x2): 1. Resident physician; 3. Attending physician; 4. Deputy chief physician; Chief physician.

3) your years of employment (x3): 1.10 years and below; 2.11-20 years; 3.21-30 years; 4.31-40 years; 5.41 years and above.

4), your academic degree (x4): 1. Master's degree; 3. Bachelor degree; 4. College degree; 5. Technical secondary school/high school and below.

5), your teacher (x5): 1. Provincial teachers; 3. National teacher training.

6) your hospital grade (x6): 1. Grade a, grade 2; 2. Third class b; 3. Level a.

3.2. Basic information statistics of the survey sample

| x|x|x|x|x|x|y|
|---|---|---|---|---|---|---|
|4 |4 |3 |1 |3 |3 |13|
|8 |3 |4 |1 |2 |3 |10|
|6 |5 |3 |2 |2 |3 |20|
|1 |4 |4 |2 |3 |3 |13|
|7 |5 |4 |4 |2 |2 |20|
|8 |3 |5 |2 |2 |3 |10|
|1 |3 |5 |2 |2 |3 |10|
|6 |5 |2 |2 |3 |10|
|1 |5 |2 |3 |1 |3 |20|
|1 |5 |3 |3 |1 |3 |20|
|1 |4 |3 |1 |3 |13|
|1 |3 |4 |3 |1 |3 |10|
|1 |2 |5 |3 |1 |3 |5|
|1 |2 |5 |3 |1 |3 |5|

| x|x|x|x|x|x|y|
|---|---|---|---|---|---|---|
|4 |4 |3 |1 |3 |3 |13|
|8 |3 |4 |1 |2 |3 |10|
|6 |5 |3 |2 |2 |3 |20|
|1 |4 |4 |2 |3 |3 |13|
|7 |5 |4 |4 |2 |2 |20|
|8 |3 |5 |2 |2 |3 |10|
|1 |3 |5 |2 |2 |3 |10|
|6 |5 |2 |2 |3 |10|
|1 |5 |2 |3 |1 |3 |20|
|1 |5 |3 |3 |1 |3 |20|
|1 |4 |3 |1 |3 |13|
|1 |3 |4 |3 |1 |3 |10|
|1 |2 |5 |3 |1 |3 |5|
|1 |2 |5 |3 |1 |3 |5|

Tab.1 Survey Statistical Information of Sichuan Province

4. Mathematical model construction

Enter method was applied to build the MLR model for the statistical data of the value pricing of TCM medical services in Sichuan province, and corresponding correlation factors and corresponding coefficients were found out respectively. The following is the construction process and results of the model.

4.1. MLR model of value pricing of Chinese medical services in Sichuan province

Using mathematical software of SPSS to survey the basic information of the multiple linear regression analysis. The survey of 54 hospitals of five basic information of the investigation team: visit price, social reputation, title, age, educational background, educational background, hospital level of grading data import data table for analysis. To visit the price as the dependent variable y, Taking social reputation, professional title, years of employment, academic degree, teacher training and hospital grade as the influencing factors, they are respectively set as: \( x_1, x_2, x_3, x_4, x_5, x_6 \)

\[ t = [\text{social reputation, title, years of employment, education, teacher training, hospital level}] \]
by $t=[x_1, x_2, x_3, x_4, x_5, x_6]$ Instead of, $Y$: table price. First, we analyze the correlation of a single variable to the dependent variable, as shown in the following table:

**Table 2: Table of Correlation Analysis Among Influencing Factors**

|   | y   | x1   | x2   | x3   | x4   | x5   | x6   |
|---|-----|------|------|------|------|------|------|
| Correlation | Pearson |       |      |      |      |      |      |
| y  | 1   | .333 |      |      |      |      |      |
| x1 | .333 | 1    | .313 |      |      |      |      |
| x2 | .313 | .313 | 1    |      |      |      |      |
| x3 | .646 | .126 | .126 | 1    |      |      |      |
| x4 | .002 | .413 | .006 | .240 | 1    |      |      |
| x5 | .240 | .541 | .221 | .075 | .689 | 1    |      |
| x6 |      |      |      |      |      |      |      |

* Significant correlation at the level of 0.05 (both sides) ** Significant correlation at the level of 0.01 (both sides).

According to the above table, among the six independent variables, the univariate which has a strong and significant correlation with the dependent variable is: $x_2, x_3$.

Next, the multivariate linear $y$ and $x_1, x_2, x_3, x_4, x_5, x_6$ regression model is established and enter method is applied. The results are as follows:

**Table 3: The Table of Model Summary**

| Model | R   | R²  | adjust R² | error in standard estimates | R² change | F change | df  | df 2 | Sig. F change | Durbin-Watson |
|-------|-----|-----|-----------|-----------------------------|-----------|----------|-----|------|----------------|---------------|
| 1     | .986 | .972 | .969      | .85734                      | .972      | 330.622 | 5   | 48   | .000           | 1.518         |

a. Predictive variable: (constant), $x_5, x_3, x_1, x_4, x_2$. b. The dependent variable: $y$

**Table 4: Analysis of Variance Table**

| Model | Sum of squares | df | the mean square | F  | Sig. |
|-------|---------------|----|----------------|----|------|
| 1     | 1215.089      | 5  | 243.018        | 330.622 | .000* |
| residual | 35.282     | 48 | .735           |       |      |
| total | 1250.370      | 53 |               |       |      |

a. Predictive variable: (constant), $x_5, x_3, x_1, x_4, x_2$. b. The dependent variable: $y$
Enter (entering) method, the establishment of multiple linear regression Model, the Coefficients (coefficient) table into the regression Model 1, namely the Model results are as follows

\[ y = -7.269 + 0.046x_1 + 4.880x_2 + 0.288x_3 + 0.257x_4 + 0.182x_5 \]  \( (1) \)

Known from the analysis of the model results in the investigation of six basic information (factors) : "social reputation," title ", "age", "degree", "learn" the five factors are the main influence factors' visit price (i.e., the main contribution parameters) by Pearson correlation knowledge strong significant correlation of single variable and dependent variable is:, at the same time by a 2.1 of all the factors of grading the 'social reputation, "title", "age" and "inherited" positive correlation effect, In other words, the higher the 'social reputation', the higher the 'professional title', the higher the 'years of employment' and the higher the 'teacher acceptance' can increase the price of sitting treatment, among which the 'professional title' has a very large positive correlation effect on it, while the 'social reputation' has a very small positive correlation effect.

4.2. Model result’s analysis

According to the relevant analytic table of the influencing factors in 3.1, there is a strong and significant correlation between x2, x3 and the dependent variables. According to model MLR in (1), it shows “social reputation”, “professional title”, “work years” and “ the succession of teachings from a master to one’s disciplines” is related to the sitting price positively. Among them, “the professional title” positive relevant effect which plays a decisive role in Chinese medical service is very big. It has high consistent with actual situation which shows the medical service price of MLR model of TCM in Sichuan Province is more reasonable.

5. Solutions and suggestions

Due to Chinese medical service value is different in the provinces and regions, Chinese medical service value has many good study results at home and abroad. In this paper, by using multiple linear regression model, it has relevant analysis between Sichuan Province’s Chinese medical service pricing and six influence factors which were investigated, correlation analysis, and it found out the correlation factors and the corresponding contribution coefficient respectively. It has also further exploration about the continuation and the ideas which can be applied to other regions of Chinese medical service pricing. In order to improve the rationality of Chinese medicine service pricing, this article provides the following advice:

1. Build a pricing model to reflect Chinese medical service factors. In the process of establishing
the price of Chinese medical service, it should reflect the doctors’ service, the intensity of labor and other risk factors about Chinese medical service. Because the Chinese regional medical service value is different, we suggest the pricing model should conform to some regions.

2. Reform the price measurement method according to Chinese medical service price itself. Compared with western medicine service, Chinese medical service invests more time, labor, knowledge technology and risk.

3. Detailed charging standards and hierarchical pricing are implemented. The "big project" charging method of Chinese medical service is too general, and it does not distinguish the level of medical institutions and doctors.

4. Implement flexible price management system according to market demand. Basic medical service has the essential nature of public welfare, and the government should conduct price system management.

5. The declaration standards of Chinese and western medical services shall be formulated separately, and the declaration of Chinese medical services shall be encouraged. It is suggested that the standards for declaration of Chinese medical service projects conform to the characteristics of Chinese medical service’s integrality, experience and individuality. Formulate the declaration standards for new service projects based on the theoretical basis of Chinese medical service, and gradually eliminate the institutional barriers in the declaration process.

6. Play a full role in medical insurance. A reasonable medical insurance payment system can guarantee a reasonable level of medical service. It can not only control the rise of medical expenses, but also form an effective incentive for medical service providers. If we do like this, Chinese medical service can be better integrated into the medical insurance system.

6. Conclusion

The survey results indicate that the MLR model of value pricing of Chinese medical service in Sichuan Province is relatively reasonable. With the help of SPSS and Stepwise (Stepwise regression), take six influencing factors of the value pricing of Chinese medical service (Social reputation, professional title, work years, educational background, the succession of teachings from a master to one’s disciplines and the hospital level) as the basic information into consideration. Meanwhile, we establish multiple linear regression relation models [11-13]. Among them, “social reputation”, “professional title”, “work years” and “the succession of teachings from a master to one’s disciplines” play a positive role in “sitting price”. What’s more, positive correlation effect of “professional title” is very large and plays a decisive role in Chinese medical service value pricing. It is highly identical to the fact. It also shows that MLR model is applied into Chinese medical service value pricing in Sichuan Province. Therefore, whether we can consider the continuation of this model, and apply it into other provinces’ Chinese medical service value traditional pricing survey work, especially in the central and western regions. In other areas’ influence factors’ investigation, we just need to modify the corresponding influencing factors according to the corresponding situation of each province so that we can examine the provinces area of the rationality of Chinese medical service value pricing.

References

[1] anonymous. Guidance on comprehensive reform of urban public hospitals issued by the state office [J]. Chinese hospital President, 2015, (10): 16.
[2] Li Jidong, Ji Yinhai. Thoughts on the reform of TCM medical service price [J]. Journal of TCM management, 1996, (2): 40-41.

[3] Song Hua, Song Ping. Analysis on the relationship between the quality of physicians, service quality and the satisfaction of outpatient doctors [J]. Western medicine, 2005, 17:413-414.

[4] Vincent S. Fan, Marcia Burman, Mary B. McDonell, Stephan D. Continuity of care and other determinants of patient satisfaction with primary care [J]. Journal of General Internal Medicine, 2005, 20 (3): 226-233.

[5] Xie Bo, Chen Ye, Sun Xiaosheng. Research on hospital service value model [J].

[6] Xiao Yan. Research on hospital marketing strategies based on the perspective of customer value [D]. Huazhong University of science and technology, 2008.

[7] Ma Hongyao, Shen Junlong, Xu Hao. Analysis and preliminary exploration of the current situation of TCM medical service price in China [J]. Jiangsu traditional Chinese medicine, 2013, (8): 65-67.

[8] Luo Yunfang, Miao Xiangtao. Study on the impact of China's fiscal expenditure structure on the income gap between urban and rural residents based on MLR model [J]. Journal of Yunnan nationalities university: natural science edition, 2016, 25(2): 185-189.

[9] Luo Yingting, Yang Yujuan. SPSS statistical analysis from foundation to practice [M]. Beijing: Electronic Industry Press, 2010, (1): 207-210, 220-224.

[10] Han Zhonggeng. Mathematical modeling method and its application [M]. Beijing: Advanced Education Press, 2005, (6): 345-362.

[11] Zhu Wei. Application of ARMA model in prediction of consumer price index [J]. Financial Economy, 2008, (16).

[12] Chen Sheng, Li Xingye. CPI prediction based on wavelet decomposition autoregressive model [J]. Statistics and decision-making: new exploration of theory, 2012, (1): 18-19.

[13] Wang Zhenghuan, Liu Qi, Luo Zhaohui, et al. Time series prediction of total retail sales of consumer goods in China based on wavelet analysis [J]. Journal of Yunnan University for Nationalities: Natural Science Edition, 2011, 20(3): 185-189.