

# The fire data research —based on binary regression analysis

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**Abstract** –In this paper, With 2003 to 2007 national statistical fire data as the research object, analysis the relationship of the number of injured in the fire, the burned construction area and direct economic losses by using binary regression analysis methods. Statistical analysis results show that the fire of casualty and direct economic loss into obvious positive correlation, but burned building area and direct economic losses are photograph sex is not obvious. Finally, targeted fire prevention measures such as strengthening public places of entertainment guard, establish and perfect the fire safety organization, implementation of rules and regulations ,pay special attention to daily fire management and so on, so as to achieve the purpose of reducing the economic losses.

**Keywords** –binary regression; fire injury number; burned building; direct loss;

## 1. Introduction

Fire belongs to burst the injury accident, is a disaster that occurred in high frequency and large harm in the current social. Especially in recent years, the fire accident accounted for a significant proportion of happened several group die group of injury burst damage accident, every year will cause casualties and huge economic loss, so the research of fire has become one of the focus of academic circles.

It is commonly believed that fire is a kind of random, accidental event. But random events have their statistical regularity, occasionally contain inevitable. Through the investigation of a large number of acquired about fire data, it is just a kind of quantitative form to show to fire the record, commonly known as the fire statistics, after analysis can be used as fire prevention design basis, but also play an important role of supporting for management and decision making. Therefore, it is important meaning to gradually achieve fire statistics qualitative description to quantitative description of great significance by using the fire statistics and establishing relevant model.

this article mainly aims at state 2003-2007 fire related statistical data, analysis the relationship of through the establishment of binary linear regression model for fire losses caused as a result of cost and the fire and burned the number of wounding building area of analyses the relation between the

In this paper, for the 2003-2007 national fire statistics, analysis the relationship of the loss costs, the

fire casualties and the burned building area as a result of fire accident through the establishment of a binary linear regression model.

## 2. Domestic related research were reviewed

All along, the evaluation of the fire situation in China are only limited to the comparison and analysis of fire since the number of casualties or economic losses in a single index value of each prize period statistics. Trends on the fire situation will only be predicted from the qualitative point of view, the development and utilization of the deep-seated far from the statistics contained information, the use of regression analysis method is still in the primary stage of exploration.

"Discussion on the issue of fire statistics"(2005), donghai Liu, tao Ji, discuss the importance of using statistical to understand and solve the fire problem.

"On the fire statistics and fire supervision"(2002) chongmin Zhou, the author uses statistical principles to establish a mathematical model of a linear regression. That is, if there is a linear relationship between two variables, one of which is the independent variable, and the other is the dependent variable, the number of sample data from the 1993-1997 Year with fire, and expressed them in a regression model mathematical relationships between various statistical tests on the model, and use this model to predict and control. Proposed several measures as follows: First, the densely populated old city staff all aging electrical wiring will be ordered to make

corrections within a time limit; second, public gathering places require all lines to wear flame retardant pipe laying; third, consider the line layout lighting and power cables separately laid down and strictly control the electricity load; fourth, develop electricity management system, so that people go out the lamp.

"Statistical model fire statistics"(2006), wenjuan Cao , Through the analysis of the existing fire statistics, the establishment of a simple binary linear regression model, and test the significance of this model . The analysis showed that illegal operations and electrical failures are the main factors of fires accident. People can use this model to the analysis of fire statistics in the different forms of data, and further statistical model fire statistics "The fire data research based on binary regression analysis "(2011) songmin Wang, yuexin Lan, according to the country's 2003-2007 fire statistics, applied regression analysis, the number of the economic losses caused by the fire with fire, wounding and burning the relationship between the construction area, the establishment of a binary linear regression model, artificial computing the least squares method for solving the accuracy of the correlation coefficient and the equation of the correlation test.

### 3. The linear regression model

For a correlation between the variables in real life, we often do not like the functional relationship did find the exact expression between them, but through a lot of trial (observational) data can be found between them there is a certain statistical regularity Mathematical Statistics is an effective method in the study of a random variable (the dependent variable) changes in the relationship with the other one or several common variables (independent variables) between regression analysis. The relational formula obtained by regression analysis, called the regression equation. The linear regression equation is called linear regression, or nonlinear regression. Linear regression is a regression analysis of the basic model, and a lot of the complexity of the situation can be transformed into linear regression for processing

#### 3.1. Collecting data

This article directly with the data in the Statistical Yearbook, Table 1 is the number of 2003-2007 fire wounding the burned building area with direct economic losses of Statistics data.

**Table 1:**2003-2007 years, the number of fire wounding, burned buildings (square meters), with direct losses (million)

years	the number of fire wounding	burned buildings (square meters)	with direct losses (million)
2003	3087	4418764	159088
2004	2969	3683852	167357
2005	2508	3971887	136603
2006	1565	3973089	82650
2007	969	19518413	112515

(Note: data from the national statistics database: <http://219.235.129.58/welcome.do>)

It can be seen from the above table; the economic direct losses with the injury growing number burned increase the loss of the building area more, and therefore make the following two assumptions.

The null hypothesis  $H_1$  : number of casualty and economic losses directly into the positive correlation;  $H_{11}$  : both non-positive Correlations

The null hypothesis  $H_2$  : burned building area and economic positive correlation between direct loss;  $H_{22}$  : both non-positive Correlations

#### 3.2. Set the regression equation

Combining these two assumptions and qualitative analysis, and it is assumed that no one burns, the house is not burned in the fire do not think the economic losses. Therefore, the binary linear regression equation can be set as follows:

$$Y = b_1 X_1 + b_2 X_2$$

Y: the dependent variable (direct loss costs);

$X_1$  : the independent variable (injury Number);

$X_2$  : the independent variable (burned building area);

$b_1, b_2$  : regression coefficients.

#### 3.3. Data analysis

Excel software for data regression analysis leads to the following results in Table 2.

**Table 2** :data analysis results(reserved to two decimal places)

Analysis of Variance	df	SS	MS	F	Significance F
Regression analysis	2	4661952615	2330976308	29.59	0.033
Residuals	2	157561237.9	78780618.93		
Total	4	4819513853			

  

	Coefficients	Standard error	t Stat	P-value	Lower 95%
Intercept	-14734.6	22349.81	0.66	0.6	110898.04
injury Number	53.65939	7.34	7.31	0.02	22.07
burned building area	0.003834	0.001	3.94	0.069	0.00034

Be seen from the above table, the correlation coefficient  $b_1$ ,  $b_2$ , respectively, equal to 53.65939, 0.003834 rounding rule regression equation  $Y = 53.66X_1 + 0.0038 X_2$ , correlation test means to test the reliability of the regression equation identified to be able to represent the relationship between the independent variables and the dependent variables. Only through the correlation test then use it to analysis and forecast. Next, author will test the correlation coefficient and model significant of the above equation through T-test and F test. Under the condition that significant level  $\alpha = 0.05$ , the test statistic  $b_1$ ,  $b_2$  are respectively equal to 7.30, 3.94, and the look-up table shows that the threshold value  $T_{0.05} 2 / (5-2-1) = 4.30$ , therefore there 7.30 greater than 4.3, so refused Assuming  $H_{11}$ , accept the null hypothesis  $H_1$ : Means that the number of casualties in the direct loss is significant, because 3.93 is less than 4.3, it can not refuse burned building area of direct loss is not significant, that burned the building of direct loss The impact was not significant. Similarly, the significance level  $\alpha = 0.05$ , the test statistic  $F = 29.59$ , while the critical value of  $F_{0.05} (2,2) = 19$ , because 29.59 is greater than 19, so reject the hypothesis  $H_{22}$ , accept the null hypothesis  $H_2$ . Shows that the model is significantly, indeed able to represent the mathematical relationship of the number of injury burned building areas and direct economic losses.

#### 4. Fire prevention and coping strategies

Based on the above analysis results, since a strong relationship exists of the three, then in order to reduce the occurrence of fires and to minimize economic losses, it is necessary to take practical measures to cope with, reduce casualties and buildings burned.

##### 4.1. To strengthen public entertainment precautions

Places of public entertainment is the fire-prone places, is often the source of the fire, so curb the fire of public places of entertainment, especially major fire accidents occurred in the establishment of long-term

mechanism for regulation of fire hazards, and firmly establish "ensure fire safety eliminate fire hazards" philosophy. As the starting point to the owners and employees, and enhance awareness of fire prevention, and the implementation of preventive measures, and fully mobilize and play to the initiative and creativity of the people. Actively take legal, administrative, economic, and propaganda measures to resolutely fire hazard remediation before the fire broke out, to ensure that the fire safety of the public places.

##### 4.1.1. Strengthen the inspection work, off to a good source

strengthen the construction of the trial, acceptance and pre-opening inspection, improve public gathering places architectural layout to strengthen the construction of the trial to the public places of entertainment, acceptance, opened fire safety checks before, eliminate congenital fire hazards, to ensure that the public places of entertainment standardized an important means of fire safety management track. Safe evacuation of the public places of entertainment, has detailed provisions in the architectural interior decoration design code for fire protection design of tall buildings for fire protection "," architectural design code for fire protection, electrical wiring, internal training, fire-fighting facilities on public entertainment design, review, acceptance must be strictly in accordance with the regulatory requirements, the source of the good relations, do not stay hidden.

##### 4.1.2. Rational distribution of fire-fighting facilities, wide spread of security knowledge

To ensure the evacuation of channel security exit the unimpeded and fire facilities intact and prevent the occurrence of the casualty evacuation channel blockage, lack of safe exit adverse phenomenon. Places of public entertainment in the business during the evacuation routes, safety exits always kept clear of the most basic requirements to prevent casualties and property losses. In the evacuation doors and evacuation Walking crossing should be installed the necessary emergency lighting facilities, in order to facilitate the safe evacuation along evacuation signs to guide staff the event of a fire. Business must ensure unobstructed escape doors, escape doors must not be allowed to closure, lock, or any impact

on the evacuation of items placed in the aisles. Employees to strengthen the maintenance of fire control facilities and equipment, emergency lighting, security and evacuation signs, ensure its integrity, effectively, to ensure that effective fighting after a fire.

## **4.2. Establish and improve fire safety organizations, the implementation of rules and regulations, strengthen the dairy fire safety management.**

### **4.2.1. Improve the safety awareness of the legal representative**

Decree 61 of the Ministry of Public Security stipulates that the main person in charge of the legal representative of the corporate units or illegal units is the unit responsible for fire safety, fire safety work of the unit has overall responsibility. Fire Management to implement the guiding philosophy of "grasping corporate, legal grasp", the first responsibility of the legal representative of the Fire Safety and earnestly, carry out fire safety work.

### **4.2.2. Enhance fire team building**

Establish a sound and part-time, volunteer fire brigades building a good grasp of the day-to-day management of fire prevention. Enhance fire safety education and training of employees; improve self-help self-defense capability of public entertainment. Owners of places of public entertainment in the application for pre-opening inspection organization for fire safety training for practitioners, and strictly implement the use of fire, electricity, gas, oil management system, the number of hours shall not exceed the number of rated managers should stick to their posts, strengthen the duty to check the implementation of fire safety responsibility system, and designate a person to carry out safety inspections after business hours and business check. In addition, it is need to strengthen socialization fire safety publicity propaganda education. Guide social units, especially the various economic organizations to establish a "security is effective, security is the concept of life", and comprehensively improve the universal awareness of fire safety, fire safety knowledge and skills: To give full play to the role of the media of newspapers, radio, television, Internet and other publicity, strengthen social supervision by public opinion, through a variety of passing and means to fully mobilize the enthusiasm of the

masses of the people involved in fire safety work; should further improve the reporting system of fire hazards and timely summary of the verification report. Report fire hazards and fire violations have made outstanding contributions to give the appropriate material and spiritual rewards, incentives the violations do struggle of the whole society with the Fire, and the formation of the social atmosphere for everyone concerned about fire hazards, everyone remediation fire hazards

## **5. Conclusion**

In summary, during fire statistics, people can analysis and forecast the cause of the fire, the casualties, and burned the building area by statistical correlation and regression knowledge base on the collected sample data, References, it has very far-reaching significance in the fire supervision. On one hand, it is possible to make the fire supervision pinpoint target, clear task highlights the focus be targeted to avoid blindness, play a multiplier effect. On the other hand, through the establishment of a model of the fire situation scientific and quantitative evaluation can provide a reliable basis for the next fire cycle focus on methods of fire prevention work arrangements as well as the fire brigade training program. Provide favorable support for the study of the fire broke the law, characteristics, and promote the further development of performance-based fire design in our guidance realistic fire supervision. But this article there is some deficiencies due to the source of this data is a single year longer, insufficient data and so on.

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