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One dynamic linear-based relevant electronic commercial information model

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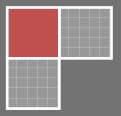
ABSTRACT

Electronic commerce development has been changing rapidly, and amount of information has been increasingly expanding, network electronic trade mode has also been widely developed and advanced, under the platform of researching on electronic commercial information, its dynamic study theory plays an important role in data analysis, project analysis and else, the paper bases on linear regression model, establishes multivariable linear relevant electronic commercial model to make analysis of electronic commercial ability and information processing.

KEYWORDS

Linear correlation; Electronic commerce; Linear regression.



INTRODUCTION

As far as current development status is concerned, Chinese network commerce has been unprecedented developed. And meanwhile, some Chinese commerce and trade have gradually started to develop towards network field, and been rapidly developed. Until 2011, Chinese network electronic commerce application and development in all kinds of aspects has basically become stable. However, nowadays, enterprises still need to go into deeper analyzing about how electronic commerce investment affects respective enterprises performances.

How an enterprise investment in electronic commerce affects its performance is a complicated process. But only fully understand electronic commerce ability connotation and structure, grasp essence of electronic commerce, and further targeted develop enterprise electronic commercial ability, then it can get good investment performance. Thereupon, measurement on enterprise electronic commerce ability is particular important. However, current study on enterprise electronic commerce ability measurement has not yet had quite efficient methods to reveal electronic commerce influences on an enterprise's strategy of enterprise, organizational structure, business flow and else, as well as its own constraints. Therefore, relevant study ways base on dynamic linear is of great significance in analyzing enterprise commerce ability connotation and structure.

MOLD ESTABLISHMENTS

TABLE 1 : Definition of electronic commerce

Author	Concept	Dimension
Zhu Kraemer	Enterprise ability of handling with business in internet with customers and enterprises	Information, trade, customization dimension
Chu Jan Tow Lawrence	Combination of Electronic commercial technological resources, business network, and electronic commercial management technology	Electronic commercial technological resources, business network, electronic business management technology, information cooperation, customer network
Zhao Jing	Not available	Shared information ability, cooperation flow ability
Soto-Acosta and Merono-Cerdan	Idea of combining with other resources to allocate and integrate	Internal and external electronic commerce ability

Linear regression model

Propose that random variable Y and variable X have some correlations, X is a variable that can be controlled and precisely observed, as age, testing moment temperature, time and pressure so on. It can randomly take X 's n pieces of values $x_1, x_2, \cdots, x_n$, X is regarded as non-random variable and common independent variable. Because Y is random, to X every defined value, Y has its distribution, if Y exists some numerical features, then their values are defined with X extracting determined value, it can use a group of samples (x_1, y_1), (x_2, y_2), …, (x_n, y_n) to estimate numerical features: $y = a + bx + \varepsilon$.

Among them, a is called constant, b is called regression coefficient, ε is called random error.

For economic and social research orientation existing relevant variables, the paper through processing data, utilizing regression model theorem, establishes relevant model and then carries out linear estimation.

Two variables linear correlation model

The paper firstly assumes that it has linear correlated random variable x and y, gets sample data as (x_i, y_i), from which $i = 1, 2, 3, \cdots, n$, according to probabilistic study, two random variables have same importance, therefore it gets implicit function relationship : $ax + by + c = 0$

By analyzing above formula, linear equation can be expressed as slop intercept form and general form as well as other ways, but to easier indicating the linear equation parameters changes, the paper transforms formula into normal form: $(ax + by + c) / \pm\sqrt{a^2 + b^2} = 0$

Or $x\cos\theta + y\sin\theta - p = 0$, Among them, $A = \cos\theta = a / \pm\sqrt{a^2 + b^2}$, B=sinθ=b/ $\pm\sqrt{a^2 + b^2}$, $C = -p = c / \pm\sqrt{a^2 + b^2}$, then transform its form into $Ax + By + C = 0$

It gets that random variable x and y coefficients meet : $A^2 + B^2 = 1$

Because two random variables x and y are linear correlation distributed, obtained experimental values are in the nearby of $ax + by + c = 0$ such straight line, carry out linear fitting with data. Due to provided linear correlation line

horizontal coordinate value that is also independent variable is defined, analyze by corresponding dependent variable actual observation value.

Considering two independent variables fitting deviation, utilize minimum fitting principle, every test point (x_i, y_i) to correlated line's $Ax + By + C = 0$ distance, it gets distance relationship : $d_i = |Ax_i + By_i + C|$, $i = 1, 2, 3, \cdots, n$

Formula of sum of squares of distance: $Q = \sum_{i=1}^{n} d_i^2 = \sum_{i=1}^{n} (Ax + By + C)^2$

Above formula is correlation linear fitting objective function, due to formula $Ax + By + C = 0$ has $A^2 + B^2 = 1$, it is used as constraints to calculate. Therefore, obtained quadratic constraint planning issue : $\min Q = \sum_{i=1}^{n} (Ax + By + C)^2$

Subject to: $A^2 + B^2 = 1$

It gets

$$A = Sxr / \sqrt{\lambda + Sx^2 + Sxr^2}$$

$$B = -SxrA / \sqrt{\lambda + Sr^2}$$

$$C = -(A\overline{x} + B\overline{y})$$

$$\lambda = \left[-(Sx^2 + Sy^2) + \sqrt{(Sx^2 - Sy^2)^2 + 4Sxr^2} \right] / 2$$

Among them,

$$Sx^2 = \sum (x - \overline{x})^2 = \sum x^2 - (\sum x)^2 / n^2$$

$$Sr^2 = \sum (y - \overline{y})^2 = \sum y^2 - (\sum y)^2 / n^2$$

$$Sxr = \sum (x - \overline{x})(y - \overline{y}) = \sum xy - \left(\sum x \sum y\right) / n$$

By calculating above values, it then arrives at linear correlation equation.

Multivariable correlation calculation and solution

Generalize it to multivariable correlation calculation, the paper firstly assumes that it has linear correlated random variable x and y, gets sample data as (x_i, y_i), from which $i = 1, 2, 3, \cdots, n$, according to probabilistic study, two random variables have same importance, therefore it gets implicit function relationship: $ax + by + cz + d = 0$

By analyzing above formula, linear equation can be expressed as slop intercept form and general form as well as other ways, but to easier indicating the linear equation parameters changes, the paper transforms formula into normal form: $(ax + by + cz + d) / \pm\sqrt{a^2 + b^2 + c^2} = 0$

Or $x\cos\alpha + y\sin\beta + z\cos\gamma - p = 0$

Among them, $A = \cos\alpha = a / \pm\sqrt{a^2 + b^2 + c^2}$, $B = \sin\beta = b / \pm\sqrt{a^2 + b^2 + c^2}$, $C = \sin\gamma = c / \pm\sqrt{a^2 + b^2 + c^2}$, $D = -p = d / \pm\sqrt{a^2 + b^2 + c^2}$, then transform its form into $Ax + By + Cz + D = 0$

it gets that random variable x and y coefficients meet : $A^2 + B^2 + C^2 = 1$

Every test point (x_i, y_i) to correlated line's $Ax + By + Cz + D = 0$ distance, it gets distance relationship : $d_i = |Ax_i + By_i + Cz_i + D|$, $i = 1, 2, 3, \cdots, n$

Formula of sum of squares of distance: $Q = \sum_{i=1}^{n} d_i^2 = \sum_{i=1}^{n} (Ax + By + Cz_i + D)^2$

Above formula is correlation linear fitting objective function, due to formula $Ax + By + Cz + D = 0$ has $A^2 + B^2 + C^2 = 1$, it is used as constraints to calculate.

Model's parameters calibration

In the following, we further define parameter a、b. In the problem, it totally has 21 groups of data $(x_1,y_1),(x_2,y_2),\cdots,(x_i,y_i)$, $i=1,2,\cdots n$, according to formula(1), it has $\begin{cases} y_i = a+bx_i+\varepsilon_i \\ E_{\varepsilon_i}=0, D_{\varepsilon_i}=\sigma^2 (i=1,2,\cdots,11) \\ \varepsilon_i \end{cases}$ Mutual independent

By formula(2), it has $\varepsilon_i = y_i - a - bx_i$, $i=1,2,\cdots,11$, record $Q(a,b)=\sum_{i=1}^{11}\varepsilon_i^2=\sum_{i=1}^{11}(y_i-a-bx_i)^2$

$a+bx_i(i=1,2,\cdots,11)$ is regression value, $Q(a,b)$ shows sample observation value y_i and regression value deviation status, $Q(a,b)$ gets smaller, then deviation will get smaller ; $Q(a,b)$ gets bigger, then deviation will be bigger. Regression model that to be solved should let deviation value to be taken the minimum. Because $Q(a,b)$ is function of a and b, a and b value should be able to let $Q(a,b)$ to arrive at the minimum value. Therefore, regarding a and b value solution problem has been transformed into problems of solving the extreme value of function of two variables $Q(a,b)$.

To solve $Q(a,b)$ minimum value, it needs to respectively solve partial derivatives of a,b, and partial derivative is 0, it gets partial derivative equation set : $\begin{cases} \frac{\partial Q}{\partial a}=-2\sum_{i=1}^{11}(y_i-a-bx_i)=0 \\ \frac{\partial Q}{\partial b}=-2\sum_{i=1}^{11}(y_i-a-bx_i)x_i=0 \end{cases}$

Organize and get $\begin{cases} na+b\sum_{i=1}^{11}x_i=\sum_{i=1}^{11}y_i \\ a\sum_{i=1}^{11}x_i+b\sum_{i=1}^{11}x_i^2=\sum_{i=1}^{11}x_iy_i \end{cases}$

TABLE 2 : Electronic commerce ability

Electronic commerce ability constitution system		Classification of problems
Strategic capacity		Electronic commerce ability and enterprise strategies adaptation
		Whether it has clear electronic commerce strategy planning system
		Whether it has clear electronic commerce strategic development objective
Management ability	Inner enterprise	Management layer's management concepts
		Enterprise electronic commercial functional distribution
		Adjust organizational structure and develop electronic commerce
		Electronic commerce standard formulating and optimizing capacity
		Integrate operational scale and ability
		Train electronic commercial talents
Technological resources	Outer enterprise	Investigation and research before electronic commerce competition starting
		Electronic commerce suppliers detection
		Electronic commerce customers establishments
		Electronic commerce customers upgrading and maintenance
		Electronic commercial products generalization
	Inner enterprise	Electronic commerce experience
		Electronic commerce platform construction
		Electronic commerce platform maintenance
		Electronic commerce platform new and old system integration
	Outer enterprise	Electronic commerce logistics system establishment
		Payment system establishment

Formula(5)is a normal equation set, solve the equation set and then it can solve a and b estimation:

$$\hat{b}=\frac{11\sum_{i=1}^{11}x_i y_i-\sum_{i=1}^{11}x_i\sum_{i=1}^{11}y_i}{11\sum_{i=1}^{11}x_i^2-\left(\sum_{i=1}^{11}x_i\right)^2}=\frac{\sum_{i=1}^{11}\left(x_i-\bar{x}\right)\left(y_i-\bar{y}\right)}{\sum_{i=1}^{11}\left(x_i-\bar{x}\right)^2}$$

$$\hat{a}=\frac{1}{11}\sum_{i=1}^{11}y_i-\frac{\hat{b}}{11}\sum_{i=1}^{11}x_i=\bar{y}-\hat{b}\bar{x}$$

Calculate and get $\hat{a}=-22062.52, \hat{b}=19.35$

Functional relationship after parameters calibration is: $y=-22062.52+19.35x$

It gets dynamic parameters estimation value and error value, as TABLE 3 shows.

TABLE 3 : Dynamic linear parameters estimation result

Parameter	Estimated value	Parameter standard error
c	12.5315	0.0535
α_2	0.1467	0.0532
α_3	0.2101	0.0571
α_4	0.1801	0.0618
α_5	0.2764	0.0692
α_6	0.5298	0.0810
α_7	0.7264	0.1092
β_2	0.7001	0.0532
β_3	-0.9122	0.0569
β_4	-2.5948	0.0619
β_5	-3.8048	0.0689
β_6	-5.0879	0.0800
β_7	-6.8325	0.1086

CONCLUSION

It gets estimation and error analysis results as Figure 1, Figure 2 show.

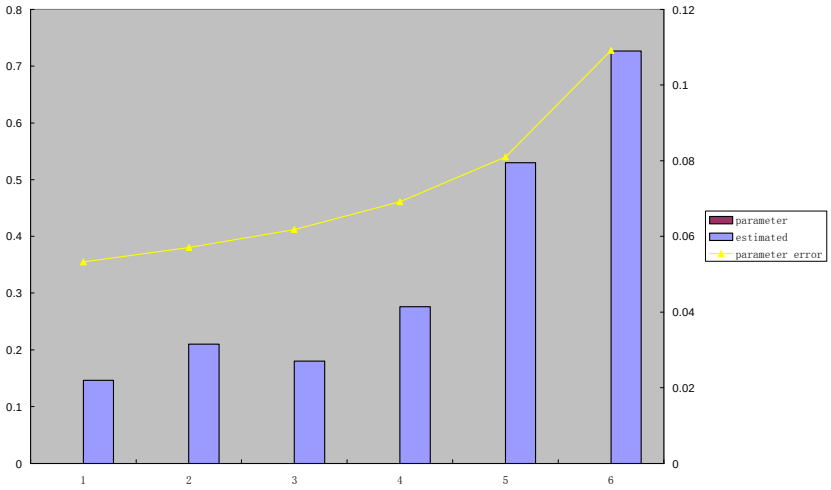


Figure 1 : Parameter α estimated value and error analysis

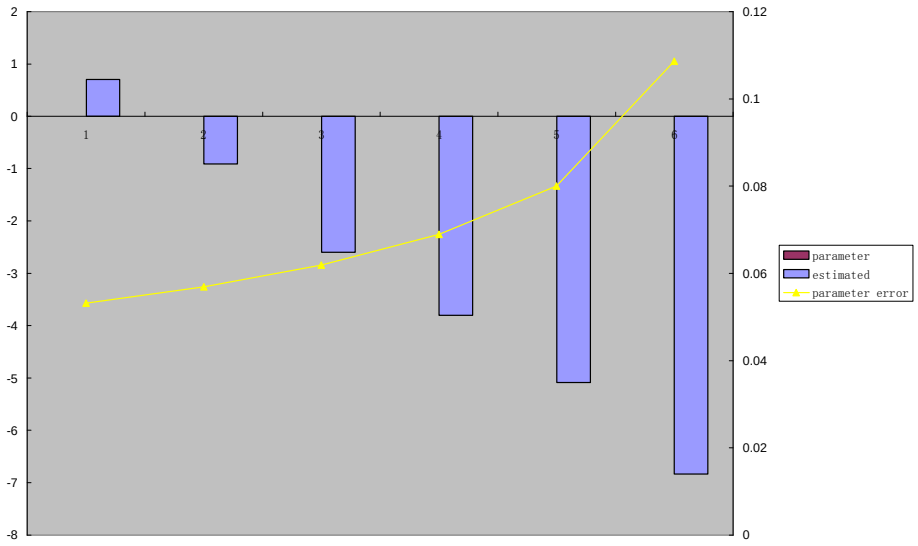


Figure 2 : Parameter β estimated value and error analysis

In figure, parameter α and β estimated value and error analysis, both errors values decrease with estimated values increasing.

Enterprise electronic commerce ability suffers inner enterprise and outer environment double influences, as electronic commerce ability and enterprise strategies adaptation, clear electronic commerce strategy planning system, electronic commerce standard formulating and optimizing ability, electronic commerce platform new and old system integration and else, all of which are important factors to promote electronic commerce ability. The paper studies electronic commerce according to two variables linear correlation model, and gets estimated value and error analysis results.

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