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# Applying Information Integration Theory on the Modeling of Price Forecasting – An Example of Online Trading on Ebay

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**Abstract:** Because of the booming of internet technology and the great promotion internet portal, on-line exchange is more popular in the recent years. This study attempts to integrate concepts of Information Integrate Theory; Anchoring and Adjustment Method to explore the buyer's trade behavior between two different cultures. After observing the historical data on Yahoo's Taiwan and Yahoo's America, the anchoring effect and order effect during the process of a C2C auction is proposed in this study. Chinese buyers seem willing to pay much their attention on pricing during the whole process of an auction than American people do. But, the same phenomenon does exist for American doing a bid on a higher-priced luxury commodity. It sounds for a luxury product, there is a common pricing strategy existed between people of two different cultures. The results provide a very promised direction for knowledge capture and decision analysis for trading, and more works for data mining on pricing for different commodities, cultures, or other kinds of variables related to products and members of market might be a possible future approach for building a knowledge management system for a pricing mechanism for the market.

**Keywords:** E-service Trading Mechanisms and Market Places; Anchoring and Adjustment Method; Order Effect.

## I. Introduction

Questionnaire survey is mostly used to analyze for the studies of physical trading logistic, the on-line trading becomes more popular, which is very different from the physical trading logistic approach in the past and new analysis methods, such as market analyzing, are currently required. Because of the booming internet trade, every country is emphasizing on the development of international internet; however, the differences of cultures do affect the possibility of successful international business. According to the process of trading behavior on the internet, while buyers or sellers offer their negotiated prices, they have often had an initial price in their mind already. The initial price in their mind does refer to the past experience a trader setting up it, and continually presenting some complicated decisions in his brain. Anchoring and Adjustment process in the previous

study is used in this study to model the process of a C2C internet trade and to construct the relationship of a price function and a time sequence functions via a mapping of regressive fitness. So, this study attempts to integrate concepts of Information Integrate Theory; Anchoring and Adjustment Method to explore the buyer's trade behavior between two different cultures. And the historical data of trade on two websites of Yahoo's Taiwan and Yahoo's America is used and analyzed by numerical method.

## II. Literature Review

Ackerman [1] reveals the different pricing behavior between Chinese culture and American culture in his physical Logistic study. Graham [6] analyzed the influence of the different cultures on the strategy of negotiation. Clark [5] denoted every country's culture has her unique characteristic. Even many researches have this theory proved, it has no doubt that some scholars also consider the cultural factor is no influence at pricing. Thus, Ackerman explained the reason of no influence at pricing as the culture factor includes too many factors that can't be measured during a complicated pricing negotiation. Comparing Chinese culture with American culture, Jacob [8] pointed out the cultural difference not only has a leading effect on product; but it is actually developed as more influence on the process of trading. Roo's study [10] shows Taiwanese are sensitive to price of personal shopping and tendency of Pragmatism does exist. According to the saving difference in the different countries, the pricing process of trade is very different among the countries they had studied.

Four kinds of pricing were proposed by Wyld [13], they are fixed price, sale price, promoted price, and dynamic price. The dynamic pricing is the one interested in this study. Online pricing is emphasized by incrementing the ability of information swap, electronic commerce is classified four types as auction, haggle, exchange and bidding process. A virtual market as an online auction must have the ability to integrate the demand between buyer and seller, protect the member's right for both side of market, decrease the trading cost and reach the asynchronous of trading target [3]. Based on the difference of degree of involvement for a consumer, the process of his buying decision are very different. A consumer with a higher involvement makes his decision is based on his cognition on a product he wants to buy at first, then changes his attitude gradually before he decides to by it.

But, a consumer with a lower involvement will have his cognition of product firstly, then sooner decides to buy the product, and then changes his attitude of product after buying it.

Payne's research [9] of the structure of human information process addressed that making decision is presented as a function. The effect of decision comes from the characteristic of task itself, such as number of cases, attribute, time pressure and reaction model. A human will refer his belief as an anchoring point, and then try to adjust it with some new information segment. It may be a positive or a negative adjustment. Every new information segment will be combined with an older one to become a new one. It might make the later occurred information having a more weight, thus order effect is happened. More strong points have more effect in the negative information. More weak points have more effect in the positive information [12]. There have two kinds of Anchoring points. The internal point does exist in a decision maker's belief or thought originally. The external point is expressed as common tasks, trade advertisement titles, numbers or texts. Chapman and Johnson [4] denoted a decision maker tends to search some evidences as his decision basis supporting his anchoring point. According to the selective accessibility model, when a human starts to ask and compare, he often is making his selective hypothesis. He assumes that the value of problem is equal to his anchoring point. For example, a bidding participant often applies the market value as his reference point for a target product he is searching for. The hypothesis in his mind is "the initial price is very possible closed to the market price" [2]. The stage of integration and adjustment includes the process from integrating the target and the anchoring point, and then adjusting the anchoring value up to his final decision is made. Information integration theory supporting the reaction of a decision maker can be presented as a function as follows [11]:

$$r_i = w_1s_1 + w_2s_2 + \dots + w_i s_i = (1-w_i)r_{i-1} + w_i s_i$$

$r$ : the decision maker's choice.

$w$ : the weight

$s$ : the estimation of information segment

$i$ : the location of each information.

If a decision maker makes a different weight on each information segment, the order effect will be happened. According to his intuitional rule, a decision maker will start at the first point then adjust to a second information direction in order to precede serial information integration. The lack of adjusting anchoring point is found in the past study [7]. Because a human makes his decision via a psychological process and his behavior does interact with environment. Adjustment of human belief is a serial process of anchoring and adjustment. The original function can be fixed into this situation.

$$r_i = r_{i-1} + w_i (s_i - R)$$

$r_i$ : the belief after receiving information segment  $i$

$r_{i-1}$ : the anchoring point

$s_i$ : the value of information segment

$w_i$ : the weight of information segment  $i$

$R$ : the reference point, it may zero or  $r_{i-1}$

When  $R = r_{i-1}$ , the function is equal to the last one, but it is different in the symbol  $w$ .

### III. Research Method

This study attempts to integrate concepts of Information Integrate Theory; Anchoring and Adjustment Method to explore the buyer's trade behavior between two different cultures. So, the historical data of trade on two websites of Yahoo's Taiwan and Yahoo's America is used and analyzed by numerical method. A method with the initial bidding price starting from one dollar is set up to for studying the bidding behavior in an auction for this study. After observing the historical data of trade on two websites of Yahoo's Taiwan and Yahoo's America, the anchoring effect and order effect during the process of a C2C auction is proposed in this study as shown on Figure 1. While a buyer entering the auction website with his own expect price for the bidding product called as a buyer's initial anchoring point. A buyer's initial anchoring point is a reference price point based on his past buying or bidding experience on a related product or process. It is the anchoring point defined in this study. After observing the phenomenon of frequency of offering price on two online trades, Order Effect model is applied to express the process of adjustment between buyers and sellers. In other words, while the bidding desire is increased by a positive effect, then they will try to show up online to offer a higher price frequently and to communicate more often in the bidding product information searching or pricing strategy suggestions on the discussion panel. On the other hand, while a negative effect does occur on a buyer, he might despair or post some negative on the broad. And each bidding price shown on the broad is a market price to a new entering buyer, and it will be an anchoring point to a new entering buyer. So, these bidding reference are dependent and related to each other, the order effect of positive or negative is continuously demonstrated during the whole bidding process for an online auction. It is more quickly and transparent than that for a traditional action. Due to the difference of degree of involvement on a bidding product, a process of anchoring for the pricing sensitivity would distinct into a buyer as a general buyer or an expert. A bidding product can be classified into general, specialty and luxury based on the degree of involvement. Using Information Integration Theory proposed by Anderson to integrate the on-line continuous segments of time series with the segment of entering the process of an auction. And the initial and current effects were shown on a graph and an equation using the statistic method to test its curve.

Therefore, the bidding decision of a series of buyers, as the order entering points of segment were corresponding to function of time with a different weight, can be equated into a pricing curve as the following model. The definition of parameters in the model is described as follows:

$$Y_x = C + W_i Z_x^i$$

$$Z_x = C + V_j X_k^j$$

$A\{X_1, \dots, X_k, X_n\}$ : A set of sequence order for n persons in an auction process.

$B\{Y_1, \dots, Y_k, Y_n\}$ : A set of bid price from persons in the process.

$T\{Z_1, \dots, Z_k, Z_n\}$ : A set of the entering time point of a person for an auction process.

$W\{w_1, \dots, w_i, w_n\}$ : the weight of variant in a pricing function,  $i=1, 2, \dots, n$

$V\{v_1, \dots, v_j, \dots, v_o\}$ : the weight of variant in a time sequence function,  $j = 1, 2, \dots, o$ .

$X_k$ : the kth person in Set X,  $k=1, 2, \dots, p$ .

$Y_k$ : the bid price offered from the kth person.

$Y_0$ : the initial price offered from the seller.

$Z_k$ : the entering time pint of the kth order.

$Z_0$ : the ending time point set up by the seller.

$W_i$ : the ith weight of a pricing function

$V_j$ : the jth weight of a time sequence function

$C$ : Constant

Pricing Function  $Y=G(Z) =G[F(X)]$

Time Sequence Function  $Z=F(X)$

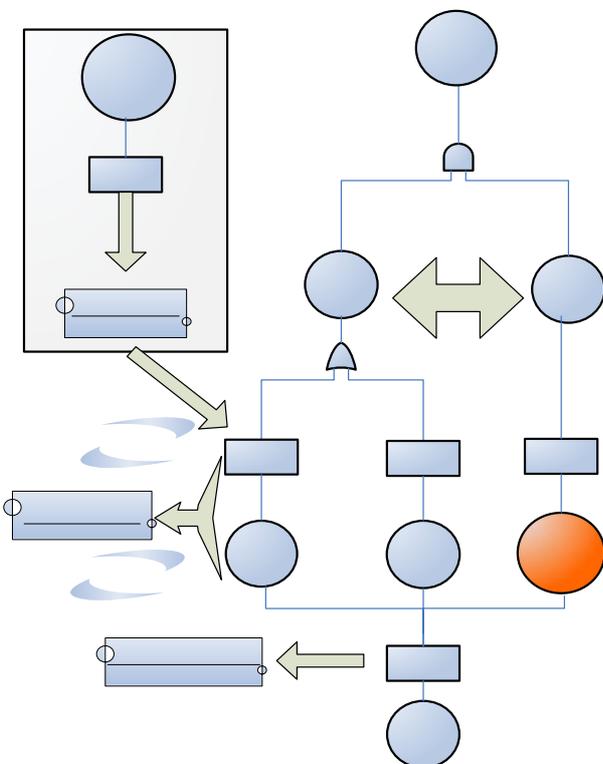


Figure 1 Anchoring Effect and Order Effect during a Process of a C2C Auction

### IV. Research Result and Discussion

Using the equations defined in the model, six sets of historical data classified as general, specialty-pro, and luxury-higher price within two counties are applied for running the fitness test, and fitting into linear distribution, exponential distribution, square function with one unknown variable, cubic function with one unknown variable and logarithmic function. Functions with R-square > 0.9 explanatory power were chosen as the results are shown as Table 1, Figure 2 and Figure 3. Based on Bayer's Rule and order effect, the reference point of an initial bidding was reflected on the pricing while a buyer entering into the process of trade as shown in Figure 3. Comparing on the difference of culture, the degree of pricing participation of a Chinese is higher. Chinese buyers seem willing to pay much their attention on pricing during the whole process of an auction than American people do. But, the same phenomenon does exist for American doing a bid on a higher-priced luxury commodity. It sounds for a luxury product, there is a common pricing strategy existed between people of two different cultures.

### V. Conclusions

The findings of this study reveal the equations of a function of pricing related to anchoring and adjustment and a function of time sequence of bidding related to order effect can be constructed via the historical data from the data base of trading on the Internet. The phenomenon of trading online does demonstrate the human's cognitive behavior. And the decision making on a bidding price online between Chinese and American are different, and there is a common decision behavior existed for some kinds of commodities too. The results provide a very promised direction for knowledge capture and decision analysis for trading, and more works for data mining on pricing for different commodities, cultures, or other kinds of variables related to products and members of market might be a possible future approach for building a knowledge management system for a pricing mechanism for the market.

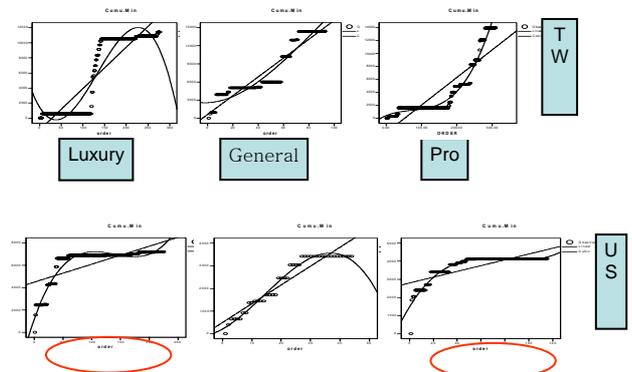


Figure 2 Relationship of Time Sequence Function

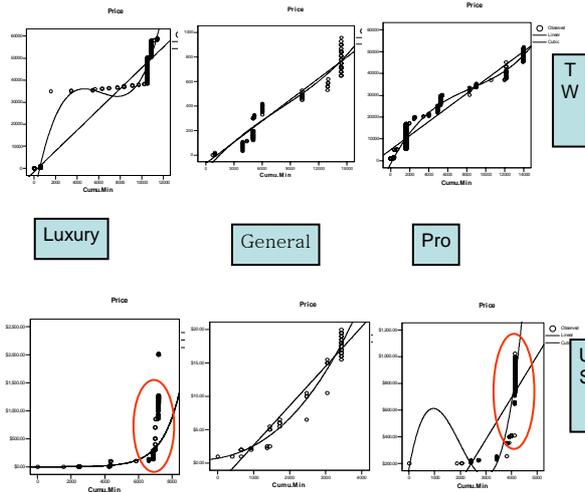


Figure 3 Relationship of Pricing Function

Table 1 Equations of Y and Z for Six Data Sets

Taiwanese Website: TW-Yahoo	
Luxury Commodity–Supper High Price	
$Y = -13052 + 26.2938Z - 0.0045Z^2 + (2.4E - 7)Z^3$	
$Z = 1481.56 - 94.358X + 1.444X^2 - 0.0036X^3$	
General Commodity - low Price	
$Y = -122.88 + 0.0899Z - (5E - 6)Z^2 + (2.1E - 7)Z^3$	
$Z = 2580.72 + 7.9633X + 2.3137X^2 - 0.0088X^3$	
Specialty-Pro	
$Y = -1456.5 + 8.4267Z - 0.0008Z^2 + (3E - 8)Z^3$	
$Z = 400.9 + 22.6372X - 0.2345X^2 - 0.0011X^3$	
American Website: US-Yahoo	
Luxury Commodity–Supper High Price	
$\ln(Y) = 0.4177 + 0.001Z$	
$Z = 1153.93 + 143.835X - 1.0958X^2 + 0.0026X^3$	
General Commodity - low Price	
$Y = 0.7037 + 0.0010Z + (8.2E - 7)Z^2 + (1E - 10)Z^3$	
$Z = 205.899 + 72.1357X + 3.5368X^2 - 0.0820X^3$	

Specialty-Pro
$Y = 166.98 + 1.0483Z - 0.0007Z^2 + (1.2E - 7)Z^3$
$Z = 1482.12 + 106.367X - 1.3698X^2 + 0.0057X^3$

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