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BASED ON NEURAL NETWORK APPROACH PREDICTING MOBILE PAYMENT ADOPTION INCLINATION DETERMINANTS IN SOUTHEST ASIA

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ABSTRACT

The adoption of mobile payments is crucial for the development of mobile commerce. Based on the revised availability of technology readiness, we build the mobile payment adoption inclination model by integrating technology Acceptance 297samples Model. With data, neural network model is used to predict adoption of mobile payment determinants tilt and model compared with the multiple regression analysis. The results show that the neural network model exceed the multiple regression model, perceived usefulness and perceived ease of use are followed. Finally, the results of the most important indicators are discussed mobile tilt payment adoption, discomfort, enjoyment, innovativeness and insecurity, suggestions for the development of mobile payments are proposed.

Keywords: *Neural Network; Mobile Payment; Adoption Inclination; Multiple Regression; Availability of Technology*

1. INTRODUCTION

Mobile payment gets help from mobile communications networks, drawing support from mobile phones and other mobile terminals bank transfer, payment, shopping and other business activities. Different from traditional online payment, mobile payment can be implemented at any time, any place. Mobile payment is a key factor to drive the development of mobile commerce market. Since the banking industry in Southeast Asia is lagging behind, lack of outlets, only a handful of people can get bank services, while the mobile phone penetration rate is far ahead of bank penetration, therefore,on this situation, many Telecom operators have begun joint bank institutions launched their own wallet services (Mobile Money). Telecom operators wish to cover more people whom could not enjoy banking services. Telecom operators provide financial services to them. Southeast Asia have many wallet service operators, Philippines (Globe Gcash, Smart Money), Thailand (True Money, AIS mPay), Indonesia (Telkomsel T-cash, Indosat Dmopetku,

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XL Tunai). They are more advanced countries in wallet business in the region, the rest countries and regions are later or slower development. Compared with the huge number of mobile phone users, the current usage of mobile payment is still relatively low, but User involvement is critical to the success of mobile payments. Therefore, Users understand how to accept mobile payments as a new thing has been widespread concern in academia and industry. But a lot of information technology adoption studies, due to the complexity of the decision-making and uncertainty, it predict user adoption is often more difficult.

In related research has been to explore the adoption of mobile payments, the Technology Acceptance Model (TAM) is more popular theory, Moreover, most of the studies are usually based on structural equation modeling to validate (SEM) and other statistical methods between the relevant factors and technology adoption relationship.TAM plays a very important role in the adoption of information systems research.TAM has been widely used for a variety of information technology acceptance problems.The model is the main theoretical basis of this study. Since the initial TAM only considered the perceived ease of use and perceived usefulness. Its structure is too simple and has been criticized by some scholars[1].Therefore, we need to expand the adoption of TAM to better explore the issue of mobile payment. In research methods, the existing literature is often limited to the use of interpretative statistical analysis methods(such as regression analysis, structural equation) to examine the causal relationship between technology adoption and related factors of. Study of this causal relationship is a parametric regression. It assumes that the users adoption decisions are linear compensation. A lack of adoption decisions factors (such as perceived usefulness) of the other factors by improving (such as perceived ease of use) compensation [2]. However, we believe that the users make the decision to adopt the evaluation process is not necessarily compensatory. If consumers take into account safety factors may abandon the use of mobile payments, this may not be as mobile payment and usefulness compensated.Chiang pointed out that the study of linear statistical methods are not reliable, because it was unable to crawl to non-compensatory decision rules[2]. Models often oversimplify the complexity of the decision-making behavior of users [3].

In order to further deepen the existing studies, the present study included three objectives:Firstly, the theoretical basis through technical preparations,we expand TAM. We use neural network analysis discussion in the mobile network environment,we predict the key factor user adoption of mobile payment tendencies.This study is also response of Shmueli and other advocacy. That is, we should be combined with predictive analysis to deepen the study in the current field of information systems[4]. Secondly, this paper will examine whether it has a better fit and predictive ability than the linear compensation model in non-linear, non-compensatory decision model in predicting the adoption of mobile payments tendencies.To do this, compare the neural network analysis and multiple regression analysis of the results. In order to determine which method is better in forecasting the adoption of mobile payments. Finally, based on the results of the analysis in this paper, it Provide policy recommendations for mobile payment service providers (such as banks, third-party payment), in order to promote mobile payment market's rapid development.

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2. A LITERATERE REVIEW

2.1 TAM And Mobile Payment Adoption Research

Existing technology adoption literature mainly based on technology acceptance model (TAM), innovation diffusion theory (IDT) and the theory of planned behavior (TPB) as the basis of a study,Wherein TAM theory put forward by the Davis is one of the technologies adopted in the field of research is currently the most widely used model [5].The theory will be perceived ease of use and perceived usefulness as a key factor in the tendency of users to technology adoption,perceived ease of use also affect the perceived usefulness.Given the lack of initial TAM, many scholars introduced new variables based on which user adoption of new technologies were discussed.Studies have shown that the expansion of TAM and appropriate correction can find a good explanation and user adoption of new technology process. In recent studies of mobile payment, TAM has been the concern of scholars and effectively applied. Kim analyzed that the users tended to use mobile payment system from two dimensions based TAM system characteristics and individual differences[6]. Schierz constructed the impact of users adoption of mobile payment services and verify the theoretical model basis on TAM.The results showed that: perceived usefulness, perceived ease of use, perceived safety and mobility and other users by influencing attitudes,thereby affecting the tendency to adopt mobile payments[7]. In the study of existing mobile payment adoption of factors,scholars pay more attention to the trust, risk factors and mobile payment systems and other technical characteristics,the relative neglect of the role of the users own factors [8-9].We believe that because of their quality and service of mobile technology, the users personal qualities have a major impact on the evaluation and adoption of new technologies.

2.2 Technical Preparation

Technology readiness reflects a state of mind, it demonstrated the features that the individual use new technologies[10]. Parasuraman the technical preparations defined as people in life and work, in order to complete a task or propensity to accept new technologies, and grouped into four dimensions: optimism, innovation, discomfort and insecurity.Optimistic person who believe that technology enables people to increase control over daily life, flexibility and efficiency; Innovative refers to the tendency to become a technology pioneer or a thought leader; Discomfort means to be aware of the lack of control technology, and produce the feeling of being overwhelmed by technology;Insecurity technical means do not believe, and if it works correctly is skeptical [11].Related literature that features users technical preparation is an important factor in the adoption of its technology[12].Lin will be included in the technical preparation TAM model and found the technical preparations have a major impact on the users tend to use electronic services[13]. Often technical preparations in the existing literature as a whole construct to study the relationship among technology adoption[14-15]. And this study has some limitations, because the technical preparations are four dimensions have clear meaning, and closely related to the psychological process technology adoption. So we need to examine the relationship among these four dimensions alone and technology adoption[12].Currently affecting the technology ready in user adoption of mobile payment environment is still very little literature tends to focus on. Therefore, it is significant that User adoption of mobile payment makes sense to examine tendencies from the perspective of technical preparation.

2.3 Neural Network

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Neural network is a large number of simple processing elements (called neurons) made extensive complex interconnected networks.It is similar to the human brain, it can acquire new knowledge from the environment through learning, the knowledge gained by the synaptic weights are stored. Using of sample data, learning algorithm can adjust the synaptic weights of the neural network in an orderly manner to achieve the desired design goals [16].

In related research in technology adoption, the neural network can make traditional statistical methods in a linear model caused oversimplified the complexity of the user's lack of decision-making behavior. Neural networks can not only learn complex linear and non-linear relationship between the input and output variables, and have a very good memory skills, self-learning ability and robustness. It can better test the real world of non-compensatory decision-making process.And non-parametric analysis of neural networks. It differs that regression and discriminant analysis required data or error term normally distributed. In front of analyzing on Neural Network Model, we need to know the overall error distribution [16].

Although neural networks have been applied in economics, consumers choice, and customers satisfaction, and many other fields.There is little research in information systems of neural networks[4,17].We learn from Chong and other research, the key factor in this paper is to examine the neural network to predict the tendency of users to adopt mobile payments. And with the results of multiple regression analysis was to determine which method is better predictive power.

3. THE RESEARCH MODEL

Referring Parasuraman did the division of technical preparations dimension.Considering optimism as one dimension, the concept is very close with perceived usefulness in TAM, it refers to the perception of new technologies or services bring value,In this study, leaving only the perceived usefulness, while fun is introduced into the dimension of technical preparations.Fun as a cognitive factors,it refers to the users believe that the use of this technology is interesting[18]. Numerous studies show that having fun on the adoption of technology and services is a significant effect[18-19].Jin in his study also considered fun dimension, the technical preparation and Acceptance Model (TRAM) has been amended[20].Therefore,we make some fun into the technical preparation is rational. The correction of the technical preparations should promote the integration of mobile payments TAM after the adoption tendency Model,Where innovative and fun new technology is the users experience positive, driving force as a technical preparation;Discomfort and insecurity are the user of new technology negative feelings as a restraining force technical preparations.

Innovative as personal traits are important factors affecting users adoption of new products or services.Users typically are strong innovative new things show a positive attitude and the courage to try. The innovative low individual relatively conservative, for innovation relatively conflict.Mort and other studies indicated that the users personal innovation of advanced mobile commerce technology adoption and used have a great impact[21].Mobile payment as a new payment method, most of their lack of understanding, innovative user adoption tends to be an important role.When the user selects the mobile service,fun is an important intrinsic motivation.Mobile services is the pleasure, the more users adopt, the stronger tendency[22].More and more scholars put fun into

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mobile commerce adoption model. Lu and other studies have found that the fun has a positive impact on the mobile shopping adoption [19].Different from traditional online payment, mobile payment transactions to meet user demand or consumption anytime, anywhere through mobile phones, users will tend to enjoy the fun of the process, rather than blindly pursue the task is completed.

There is little attention to literature discomfort this measure.This study was to verify the discomfort and mobile payment adoption whether there is a correlation with the dumping. Generally, technology-based product or service, People always worry about learning costs and the difficulties they bring in the understanding and application. Discomfort indicates the extent of this fear. High user discomfort often find new technology or service is more complex. Resulting in frustration and frustration, it affect their adoption of new technologies or services. Sona studies have shown discomfort significant negative impact on the utilization of the innovative features of the product [12].

This differs from the discomfort emphasis on the lack of control technology. Due to insecure is focus on security and privacy issues lead to mistrust technology.Instinctively, people tend to avoid the insecurity caused by the behavior, especially, in the face when mobile payment services, the uncertainty of the mobile network and a variety of potential risks. It will cause the user to the personal account security and privacy concerns,thereby reducing the tendency for mobile payments adoption.Shin Research indicates that confidence, perceived risk is an important factor affecting user behavior intention [23].

Perceived usefulness reflect the individual extent that the use of mobile payment work performance improved.Some existing empirical literature shows that the perceived usefulness of mobile technology adoption has a positive and significant effectiveness [16].Flexibility is the biggest advantage of mobile payment.When users find it very convenient on the transactions and payments, the willingness to use will be greatly enhanced.Perceived ease of use means that the user learn to use mobile payments to be paid for effort.Although many users may use the phone very skilled.However, payments to mobile unfamiliar, plus the phone itself, the physical properties of limitations may hinder its adoption of mobile payment services.

4. RESEARCH METHODS

Neural networks is the main research methods,results of its analysis and the results of multiple regression analysis to compare.And confirm the forecast of mobile payment adoption tendencies whether there are differences on the key factors.

4.1 Variable Measurements And Questionnaire Design

Through the questionnaire to the key factors mobile payment adoption tendencies investigate the effects.Questionnaire each factor using a multi-measure indicators, each of which indicators are measured using seven scale,1 to 7 points respectively, meaning "strongly disagree, disagree, somewhat disagree, neutral, somewhat agree, agree, strongly agree."In order to ensure the effectiveness of variables.The questionnaire asked all items are derived from the literature, including innovation, discomfort, insecurity, fun, adoption tendencies, perceived usefulness, perceived ease of use[11,18,24-25].Combining mobile payment scenarios were appropriately corrected.In order to ensure clarity and accuracy of the contents of the questionnaire, respondents avoid misunderstanding

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the meaning of problems.In this paper, the questionnaire measured way before checking the content.Object is a pre-test 12 graduate students in the field of information systems.Modify the questionnaire based on their feedback.Definitive questionnaire included seven questions of variable 20.

4.2 Data Sources

Survey include college students, MBA students and some of the social employment.Final questionnaires were distributed and 355 copies, of which 297 valid questionnaires for the empirical analysis in this paper.Sample statistics as described in Table 1.Table 1 shows that the majority of respondents with higher education, partial younger, lower income.This is consistent with the present stage of the main features of mobile payment users, indicating that the sample has a representative.

category	Options	Frequency ratio（%）	
gender	male	124	41.8
	female	173	58.2
age	Under the age of 18	3	1.0
	18 ~ 24 years old	177	59.6
	25 ~ 30 years old	54	18.2
	31 ~ 35 years old	36	12.1
	36 ~ 40 years old	19	6.4
	Over the age of 40	8	2.7
education level	Following College	22	7.4
	University degree	247	83.2
	Graduate and above	28	9.4
monthly income	below 1000 yuan	157	52.9
	1001 ~ 3000 yuan	42	14.1
	3001 ~ 5000 yuan	35	11.8
	5001 ~ 8000 yuan	29	9.8
	above 8000 yuan	34	11.4

Table 1: Describes Sample Statistics Table

4.3 Reliability and Validity of The Scales Test

Confirmatory factor analysis of reliability and validity study of the scale.Table 2 lists the load of each index, the average variance (AVE) of each factor extracted and Cronbach's & value.As can be seen, & value of each factor greater than 0.8,Standard load values of all indicators are above 0.7, AVE values were greater than 0.5.Description scale has good reliability and convergent validity.

Table2: Test Reliability, Convergent Validity Analysis Table

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

factor	Index	Standard load	Cronbach's α	AVE
Innovation	INN1	0.832		
	INN2	0.878	0.896	0.742
	INN3	0.874		
pleasure	ENJ1	0.808		
	ENJ2	0.923	0.905	0.766
	ENJ3	0.890		
Discomfort	DIS1	0.929		
	DIS2	0.936	0.930	0.870
No sense of security	US1	0.849	0.867	
	US2	0.851	0.688	
	US3	0.786	0.688	
Perceived usefulness	PE1	0.900		
	PE2	0.912	0.935	0.828
	PE3	0.917		
Perceived Ease of Use	PEOU1	0.937		
	PEOU2	0.935	0.955	0.876
	PEOU3	0.936		
Adoption tendency	MPAP1	0.874		
	MPAP2	0.888	0.942	0.794
	MPAP3	0.911		

Discriminant validity analysis are shown in Table 3.AVE square root values of the respective factor (Table diagonal digital) are greater than the correlation factor and other factors, it showed good discriminant validity.

Table 3: Discriminant Validity Analysis Table

Index	INN	ENJ	DIS	US	PE	PEOU	MPAP
INN	0.861						
ENJ	0.510	0.875					
DIS	-0.141	-0.395	0.932				
US	-0.143	-0.214	0.604	0.829			
PE	0.479	0.749	-0.370	-0.247	0.910		
PEOU	0.537	0.698	-0.303	-0.233	0.785	0.936	
MPAP	0.504	0.749	-0.442	-0.304	0.842	0.794	0.891

4.4 Multiple Regression Analysis

Multiple regression to determine the impact of the adoption of mobile payments tends significant variable. The results are shown in Table 4. VIF value of all of the factors were less than 5 and a tolerance greater than 0.1,research data indicates that there is no multicollinearity problem. Model square(R)=0.781, root mean square error (RMSE) of 0.103.The results show that in the six predictors. Innovative and insecurity did not pass the test of significance, perceived usefulness is a tendency to adopt mobile payments the most important predictors,The rest were perceived ease of use, fun Table 4 The Results of Multiple Regression Analysis Table and discomfort.

Table4:The Results of Multiple Regression Analysis Table

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factor	B	Significant	tolcrance	V I F
INN	0.049	0.143	0.670	1.492
ENJ	0.152	0.001	0.370	2.701
DIS	-0.112	0.002	0.573	1.744
US	-0.026	0.438	0.661	1.512
PE	0.439	<0.001	0.300	3.330
PEOU	0.278	<0.001	0.333	3.005

$R^2 = 0.781$, RMSE = 0.103

4.5 Neural Network Analysis

Critical to the performance of the input variables to enhance the low correlation and prediction of neural networks related to the selected target.According to the results of factor analysis of the foregoing, innovation, fun, discomfort, insecurity, perceived usefulness, perceived ease of use have good reliability and validity.Therefore, as a tendency to adopt mobile payments antecedent variable input neural network model.

Since there is no way to determine heuristic hidden nodes in the neural network number, according to Wang, etc. with 1-10 hidden nodes to test recommendations neural networks[26].We have found that the neural network hidden nodes 10 has sufficient complexity map data set. And it will not cause neural network model to generate additional errors.

Thus, 10 hidden nodes used herein, a single hidden layer contains to build neural networks,output layer contains a variable, the mobile payment adoption tendencies.In this study, the neural network model shown in Figure 1.

Multi-layer perceptron training algorithm to train the neural network.Meanwhile, in order to prevent over-fitting model was used ten-fold cross-validation method,namely,90% of the sample data is used to train the neural network, the remaining 10% of the data used to verify the trained neural network prediction accuracy.RMSE neural network model (RMSE) as shown in Table 5.As can be seen from Table 5, the training module cross-validation RMSE mean is 0.098,Authentication module cross-validation RMSE mean is 0.099.Neural network model on display capture input and output variables numerical relationship is very reliable.

Compared with the multiple regression model,neural network model has a lower RMSE values,show fitting and data predictive ability of neural network model has better, user adoption of mobile payments in decisions to capture more complex nonlinear effects.

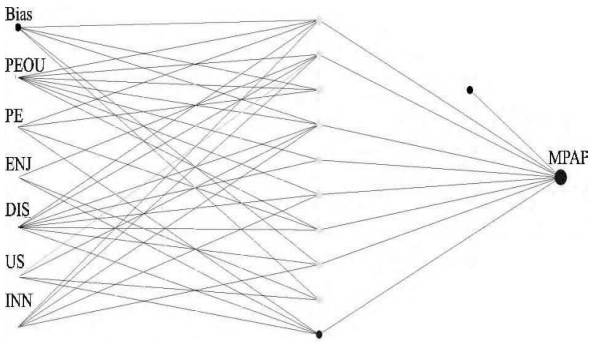

Figure1: Structure of Neural Network

Table5: The Neural Network Model of The RMS Error Results Table

Network	Training	Testing
1	0.095	0.131
2	0.099	0.086
3	0.098	0.107
4	0.102	0.081
5	0.086	0.099
6	0.101	0.093
7	0.101	0.097
8	0.100	0.094
9	0.100	0.104
10	0.099	0.093
The mean RMSE	0.098	0.099

Constituting the mobile payment adoption

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propensity three indicators are added as the output value of the neural network, since each of the indicators are based on seven Likert scale,users adoption of mobile payments in the range tendency of this article from 3-21, neural network model to predict the effect as shown in Table 6.Forecasting results show that the neural network model in this paper might pay a tendency on the validity of the adoption in predicting the user moves.

Table6: Mobile Payment Adoption Tendencies Neural Network Model to Predict The Effect of Table

category	Number of people	proportion
Accurate prediction of the value of MPAP	93	31.3%
The prediction error of the MPAP value is less than 1	209	70.4%
Error MPAP value is less than 2	260	87.5%

Sensitivity analysis is the calculation of the 10 network, input variables and output variables to predict the average relative importance.Neural networks have very good self-learning ability to determine the importance of input variables[17].Thus, according to the results shown in Table 7, in accordance with the relative order of importance were perceived usefulness, perceived ease of use, the discomfort, fun, innovative and insecurity.

Table7: Importance of Standardized Variables Table

Input variables	PE	PEOU	DIS	ENJ	INN	US
Relative importance	1	0.457	0.315	0.219	0.159	0.104

5. THE DISCUSSION AND INSPIRATION

Based on the above findings,we found that it can more accurately reveal the key factors predict user adoption of mobile payment and non-compensatory nonlinear neural network model.Despite the multiple regression analysis, it can also be used to explain the adoption of mobile payments tends to a higher proportion of the variance (R2 = 0.781), however, the neural network model has better fitting resistance,linear and nonlinear relationships between predictor variables and the adoption tendencies can be captured.The study also shows that the adoption of mobile payments are not part of the decision-making compensatory decisions.

Neural network model is to predict the tendency of different mobile payment adoption in order of importance and a key factor in the results of multiple regression analysis,this shows that the adoption of mobile payments predict user preferences and explain the difference between a causal relationship exists mobile payment adoption tendencies and influencing factors. It also verified the Shmueli other studies [4].

Perceived usefulness is the most important predictive factor of mobile payment adoption tendencies, followed by perceived ease of use.The results support the conclusions of other scholars before Kim,TAM also shows in the field of mobile payments is still of great value.Adopt decisions on pay mobile users are most concerned about mobile payments can bring their own efficiency and their ability to handle things.In addition, users of mobile payment to grasp the degree of difficulty of subjective feelings affect their propensity to adopt is also very important.

In TAM, based on the technical preparations based on four exogenous variables theory, the discomfort is one of the variables that affect the adoption of mobile payments tends to the most

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critical.After all, mobile payment significant differences in the terminal, operations, processes, and other aspects of the presence of traditional payment,the user is bound to cause discomfort, but the traditional online payment also can basically meet the needs of users daily transactions, so users often do not want to pay the extra time and effort to learn to use mobile payments, leading to discomfort tends to affect user adoption.

Prediction fun mobile payment adoption tendencies also play an important role,it also verified the article will be included in the research model of rationality.Compared with the traditional personal PC, mobile phone portability more in line with people's pursuit of freedom of nature.Users are often willing to enjoy the depth of interaction with the phone.For mobile Internet users,increase the use of mobile payments fun and cognitive inputs to complete the transaction by phone without time and space limitations, thereby increasing user adoption of mobile payments tendencies.

Despite the multiple regression analysis showed that innovative and insecurity on the adoption of mobile payments is not significant, however, the neural network model of innovation and insecurity are important predictors.This is because multiple regression assumes that the user's mobile payment adoption decisions are linear compensation,The neural network model can better test the uncompensated decision-making process,its analysis showed that the innovative and insecurity and mobile payment adoption relationship between the non-linear compensation,Predict whether the user is an important factor in the adoption of mobile payments.From the Big Five personality theory point of view, innovation and strong individuals tend to have a strong openness and extra-version,willing to take the initiative to learn and try new things and techniques.Insecurity is the smallest factor affecting in all predictors,some mobile terminals, especially smart phones malicious attacks often occur, will cause a lot of mobile payment users sidelines.

In this paper, payment service providers to better promote the mobile payment provides a useful inspiration.As a payment service provider, it can base its scale on the traditional Internet users, fully utilize the existing brand,strengthen the new features of mobile payment services (mobile, real-time, etc.) publicity and promotion,enhance the user using the mobile payment services and identity sense of fun, at the same time pay attention to the user experience and existing habits,minimize user in the mobile terminal using payment services discomfort.To continue to improve the relevant safeguards in the development and design of mobile payment applications or mobile banking site, the need of special attention to safety, and on this basis, streamline operations, optimize processes, and actively introduce innovative mobile payment, improve the user's perceived usefulness and perceived ease of use.Based neural network model constructed in this paper, payment service providers can adopt low tendency predicted value based on the user's mobile payment, it provide targeted services, to carry out precision marketing in order to effectively promote mobile payment services.

5.1 Conclusions And Future Research Directions

In this paper, the preparation and TAM theory, a user tends to adopt mobile payment model based on modified technical user, Neural network analysis to examine the key factors to predict the tendency of mobile payment adoption, results of multivariate regression analysis and comparison.The results show that: the neural network model is better than the multiple regression model, is able to better capture the nonlinear compensation relationship between

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predictor variables and the tendency to adopt,Mobile payment adoption in predicting the tendency, perceived usefulness and perceived ease of use is the most important factor.

We build models with good degree of interpretation and forecasting capabilities, but there are some limitations.First, this article only discusses the tendency of users to adopt, although the tendency is closely related to the adoption of real usage behavior, but they are not the same; Secondly, they are many factors personal qualities.This article is from the perspective of the technical preparations, the culture and character can be considered in the model in the future.

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