JOURNAL OF CRITICAL REVIEWS

ISSN- 2394-5125 VOL 7, ISSUE 05, 2020

USAGE OF MOBILE PHONES BY THE ELDERLY PEOPLE IN CHINA: ANALYTICS THROUGH THE SPATIAL STATISTICAL MODEL

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Received: 28 February 2020 Revised and Accepted: 06 March 2020

Abstract

This paper discusses about usage behaviors and preference of mobile phone of the elderly people and researches on the big data, reflects the conducts of the elderly who use media, then analyses consumption features and preferences, and proposes strategy on database market. It will help to lay out future marketing strategy, to fill market demands more effectively, to improve the operator's efficiency and economic benefits, which is of dramatic significance. In addition to this, it could inspire development and innovative design of APP, phone package and give references for related government, enterprises and research institutions. This research paper is conducted from a total innovative perspective. In the existing literature research, the main research objective mostly focuses on the young generations while the elderly, as the main focus on the research of affecting factors of mobile phone usage, the function and application of design strategy for the elderly lacks the attention to their behaviors of mobile phone. Due to this, this research paper may fill the gap in the research field by using the innovative data source for analysis. The previous studies are overwhelmingly focused on the small amount of research on the younger generation and too dependent on the questionnaire as the only adopted common survey method and data source is mainly limited to a certain area. As a result, two drawbacks may show as the limited amount of data and systematic error in investigation. The findings is derived mainly based on the triangulation of quantitative analysis, literature research and specialist interviews. The analytics is based on the figure which is extracted from the operator's database and recorded in the real operation process which could eliminate the error to a maximum caused by the subjectivity of the users and reflect the real behaviors objectively with a high credibility.

Keywords: Usage of Mobile Phones; Elderly People; Spatial Statistics Model

1. Introduction

United Nations once predicted the global aging population would keep increasing at an annual average speed of 2.5% while this figure in China at the same period was 3.3%. As for the proportion of aging people of the total population, it has risen up from 6.6% in 1995 to 9.3% in 2020 while it nearly

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doubled during 25 years. Until 2020, the total amount of aging people over 65 will reach one hundred and sixty-seven million, which would occupy 24% of the overall global population of six hundred and ninety-eight million people. It means that among four elderly people exists a Chinese one. The national statistics department revealed that the scale of Chinese population over 60 would exceed two hundred and thirty million, taking up 16.7% of overall national population and deepening the aging progress. This is mainly due to the mixed influence composing of traditional values and data accessibility and there is still huge research gap/s to be filled conceptually and empirically (Law et al. 2019a; Law et al. 2020a; Law et al. 2020d; Calvopalomino et al., 2009; Macarro & Villafaina, 2011; Dong et al., 2012; Hynes et al., 2010; Jiang, 2011; Jun, 2015).

1.1 Research background

Until 2016, national population over 60 has surpassed two hundred and thirty million, taking up 16.7% of overall population, furthermore, this figure is still growing. This tendency indicates that the elderly-oriented market is a vast potential market as known as Grey Market (Deng, 1982; Chirwa et al., 2006; Haken, 2011; Wu & Liu, 2013; Tanveer et al., 2020; Valliappan Raju et al., 2019). However, media usage of the elderly especially the new media has not been paid attention even if the elderly market not only has increasing demands but also has the realistic consumption ability and sufficient time (Hashizume et al., 2008; Olsson et al., 2019). Except for some fields as tourism and healthy products, there are not many products designed for the elderly (Schewe, 1985; Conci et al., 2009; Jiang, 2011; Melda, 2011; Law et al., 2019a; Lin et al, 2011).

1.2 Research Significance

As for the main content and structure, this study can be divided into five parts and the following is the writing ideas and contents of each part. The first part is the introduction, mainly describing the background, motivation, content and significance of the research, introducing the basic framework and research objectives of the study, and the research methods to be adopted. The second part is the literature review, summarizing domestic and foreign literature on the elderly and mobile phones and television. It mainly elaborates on the status quo of aging issue and the research of the elderly, the interactive research of the elderly and TV media, and the interactive research of the elderly and mobile media. The third part describes the behavioral statistics of elder cell phone usage, which is divided into three main parts, the description of statistics, users' attribute exploration based on mobile App installation list and user group discovery based on mobile App usage record. Data interpretation refers to explaining its data source, collecting ways and its cleaning process and each variable. The analysis of mobile phone usage behaviors of the elderly can be separated into the following parts, consisting of the statistical analysis of their mobile phone models, aiming at obtaining the distribution of their preferences and price levels of branded terminals, the analysis of the monthly mobile bills of the elderly are shown as proof of their consumption distribution and are to reflect its changes with the timing (Biljon et al., 2008; Law et al., 2019b; Liu et al., 2011; Hosaka et al., 1996).

1.3 Research Method

This research paper mainly involves and adopts quantitative analysis. The data is obtained from the mobile phone user data of an operator in Qingyang District, in the meanwhile, the research paper also uses the data of TV user as a comparison analysis. In the early research stage, the required data types were determined through literature research, and matched with the actual data in the operation database

of an operator. After matching, the relevant raw data was extracted from an operator database using SQL, the range of which were from October 2017 to December 2018. These five quarters of data are proved to meet the requirements of Grey System. Then Excel was utilized to filter and clean the data, then combining with SPSS 20.0 to analyze the data. Since the figure in this paper is extracted from the operator's data system, it could discard systematic error brought by the questionnaire and validate the obtained data with a high credibility and objectivity.

2. Literature Review

The aging tendency of population has given multi-dimensional impacts on economic and social development in various countries thus attracted their focus ever since 1990s (Jia, 2016; Law et al., 2020b; Valliappan et al., 2020; Li et al., 2019). Different cultural circles have diverse definitions of the aged. According to WHO and some developed western countries, the elderly refer to people whose ages are over 65, while it is expressly stipulated by the government of PRC: "The elderly referred to in this Law are citizens at or above the age of 60". The data of the fifth Chinese National Population Census in 2000 showed that the percentage of aged population at or above the age of 60 makes up a proportion of 10.33%, which indicated that China had entered the era of aging society at the beginning of 21 century. there is no direct relevant research to be used as the reference, a large number of literature research from different perspectives has been adopted in this chapter, thus constantly approaching our research content and research method. Starting with the research on related problems of the elderly (Deng, 1982; Greco, 1986; Law et al., 2019c). At the same time, taken the research method as the starting point, this section demonstrated the relevant literature research on mobile phone user, presented the relevant research and their conclusions regarding the influential factors and demands for design of mobile phone and analyzed the current situation and behavior of college students' mobile phone usage. Finally, authors conducted in-depth literature research on the gray model and spatial statistical model, fully explaining their target objects and research conclusions, and explored their potential feasibility to this study.

Based on the literature review at home and abroad, authors can find that, first of all, the existing literature on the behavior of mobile phone users took mostly young people as the main body of research (Hashizume et al., 2008; Xiao et al., 2019; Chen et al., 2019; Francis et al., 2020). Referring to the studies on the use of new media by the elderly, it mainly focuses on the factors affecting the use of mobile phones by the elderly, the design strategies of mobile phones for the elderly, and the functions and applications of age-friendly mobile phones, but there is a lack of attention to the mobile phone user behavior of the elderly (Jun, 2015; Lin et al., 2010; Oviedo-Trespalacios et al., 2019; Yang et al., 2019). Secondly, among a small amount of research on the elderly, the data source is usually the elder participants in a certain region. On the one hand, only a limited number of data could be obtained. This study not only tried to analyze behavioral data to restore real consumption behavior, but also opened up a precedent for product development for mobile phone consumption market of the elderly. Although the scholars began to focus on elder consumers, in general, still lacks sufficient attention to develop new products for the elderly (Deatrick, 1997; Czaja et al., 2019; Yee et al., 2010). Referring to current research and development on elder consumers' market, it mainly focuses on tourism, health care products, clothing and relevant traditional fields but neglected the younger marketing tendency (Liu, 2020; Yazeed Alkatheeri et al., 2020; Law et al., 2020c; Law et al., 2019d). In addition, among the existing research, the relevant research failed in exploring the market in a deeper and more specific way. And the obtained figure may

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tolerate some errors owing to the data source lacking in subjectivity. On the basis of the literature research, the data in this paper is derived from the operator's database with high reliability, which can objectively reflect the real users' behaviors.

3. Research Framework

The data in this study comes from the mobile phone users provided by an operator in Qingyang district of Chengdu city. In the early stage, the required data type was determined through literature research and matched with the actual data in the operation database of a certain operator. After matching, SQL was used to extract the related original data from the database of a certain operator. A total data of five quarters were extracted from October 2017 to December 2018, which demonstrates the amount of data was enough for the Grey Prediction Model. Authors used Excel for data screening and cleaning together with SPSS 20.0 software for data analysis.

Following table 2.1 illustrates the variables involved here are the basic variables of the study. In the original data sources of the operator, they belong to different databases. In this study, various aspects of user information are connected by user ID.

Table 2.1 Variables used in Research

Variable Names	Variable Types	Other Remarks
Gender	Dummy Variable	Female = 0, Male = 1
Age	Continuous Variable	80 and above = 0, 75-79 = 1, 70-74 = 2, 65-69 = 3, 60-64 = 4
Region	Dummy Variable	Rural = 0, Urban = 1
Phone Number	Continuous Variable	
Phone Model	Dummy Variable	IPhone = 0, Samsung = 1, Huawei = 2, Xiaomi = 3, OPPO = 4, vivo = 5, other Chinese brands = 6, other non-Chinese brands = 7
Phone Type	Dummy Variable	Non-smart phone = 0, Smartphone = 1
Level of Phone Charge	Dummy Variable	0-20 CNY = 0, 20-40 CNY = 1,40-60 CNY = 2, 60 CNY and above = 3
Call Duration	Dummy Variable	0-1 hour = 0, 1-10 hours = 1, 10-20 hour = 2, 20 hours and above = 3
Call Frequency	Dummy Variable	0 time = 0,1-10 times = 1,10-20 times = 2,20 times and above = 3
App List	Dummy Variable	Social Networking = 0, Life and consumption = 1, online payment = 2, query tools = 3, map and navigation =

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		4,beautifying and photo-taking = 5,video players = 6, news information = 7, book reading = 8, enterprise customization = 9, others = 10
App-using Duration	Dummy Variable	0-1 hour = 0,1-10 hours = 1,10-20 hours = 2,20 hours and above = 3
App-using Data Traffic	Continuous Variable	
App-using Frequency	Dummy Variable	0 time = 0,1-10 times = 1,10-20 times = 2, 20times and above = 3

4. Data Analysis

The statistical analysis software SPSS was used to conduct statistical analysis on the database constructed above of the elderly in Qingyang district. Among the influences of demographic factors on the use of mobile Apps by the elderly, it can be seen that the proportion of women using mobile Apps was 8% lower than that of men, and there was a certain gender difference in the use of mobile Apps. Considering of historical reasons, the education level of elderly women is lower than that of elderly men, which result in a weaker learning ability of women in mobile App using than that of men. As the age grew older, the proportion of people who used mobile apps declines. 37% of people in the 60-64 age group use mobile Apps, while 7.6% of mobile App users were at the age group of 80 and above. With the growth of age, the learning ability of the elderly declined, as did their ability to learn and use APP.

Variable Name	B	S.E,	Wals	df	Sig.	Exp(B)
Gender	0.269	0.203	1.752	1	0.186	1.308
Age	0.183	0.091	4.005	1	0.045*	1.201
Region	0.390	0.173	5.072	1	0.024*	1.477
Phone Number	0.368	0.219	2.820	1	0.093	1.445
Phone Model	0.198	0.099	4.016	1	0.045*	1.219
Phone Type	2.613	0.481	29.514	1	0.000*	13.643
Level of Charge	0.032	0.187	0.029	1	0.866	1.032
Call Duration	-0.595	0.389	2.338	1	0.126	0.551
Call Frequency	0.258	0.127	4.118	1	0.042*	1.294
App List	-0.438	0.300	2.126	1	0.145	0.645
App- using Duration	0.220	0.491	0.201	1	0.654	1.246
App-using Traffic	0.144	0.254	0.321	1	0.571	1.155
App-using Frequency	-0.345	0.217	2.531	1	0.112	0.708
Constant	-4.819	0.863	31.192	1	0.000*	0.008

* indicates that the change is significant when the confidence is 0.95

Multiple linear regression model summary

Logarithm	-2Log Likelihood Value	Cox & Snell R-squared	Nagelkerke R-squared
1	614076a	.239	.355

Note: a. since the change of parameter estimation is less than.001, the estimation stops at 6 iterations.

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4.1 Analysis of Experimental Results

Our approach is validated on large-scale data sets. Authors simply think of every smartphone in the dataset as a mobile user. To validate our proposed method, authors predefined 12 user properties. Filtering Preinstall Apps. According to our observation, there are a few pre-installed apps on some mobile phones, which are not eligible in reflecting users' interests and preferences. Authors manually filtered out some pre-installed applications from the original dataset. We've seen a lot of pre-installed apps related to mobile brands, mobile-phone operators and mobile-phone operating systems. In the end, authors filtered out 665 pre-installed applications, leaving 59,967 applications for the experiment. For the purpose of verifying our method, authors require the de facto information about the user's attributes. However, it is difficult to obtain real user information on a large scale. To solve this problem, authors adopted two strategies to build the real information of users: The first strategy is predefining user attributes based on the mobile phone model. In addition to the list of apps on each phone, there is also its model information in our data set. For each phone, authors grasped online for data related to smartphone models. Then, authors designed two user attributes: smartphone price and smartphone size. According to relevant researches, price is the first factor taken into consideration when users are about to buy mobile phones, accounting for 69.6% of all factors. The price of smart phones can reflect users' income and consumption level to some extent. Besides, the size of the mobile phone is another important factor which makes up to 20.2% among them all. The size of the phone reveals the user's preference for it to a certain context. Authors experimented with 12 predefined attributes to verify our approach. The remaining 8,566 users' data were used for the experiment after filtering out pre-installed applications and models when designing the price and size attributes. Optimization of user representation vector dimension: in user representation based on specific attributes, each mobile App is regarded as one dimension. In order to improve the calculating efficiency, authors need to optimize the dimensions of user representation vectors. In the experiment, authors tried 10, 50, 100, 200, 500 and 1000 dimensions to represent users. In our approach, for each given user attribute, authors use the method of information gain to rank applications according to their relevance, and sort out the most important mobile apps to represent users. Experimenting with four predefined user attributes: authors conducted the experiment exemplifying with price, size, beauty Shopping and Student Syllabus. Studied through the classification methods of AUC and EER in different dimensions. It can be known that when the dimension increased, the classification results of the four user attributes gradually improved and tended to be stable when the dimension was 500. For a more efficient calculation, the dimension of user representation is set to 500 in the following experiments. Below table 4.1 illustrates in the tariff card of mobile usage.

Table 4.1 Tariff for Mobile Utility

Monthly basic charge	Voice call within package	Traffic within package	Free incoming call	Rules of subsidiary cards	Voice call out of package	Traffic out of package	Return of red packets
19CNY	390 min (Domestic)	50M (Domestic)	Domestic	With a maximization of 1 subsidiary cards, the functional charge will be 10CNY/month/card	Long-distance roam within the city 0.15CNY/min	30CNY /500M	null
39CNY	390 min (Domestic)	50M (Domestic)	Domestic		Long-distance roam within the city 0.15CNY/min	0.3CNY/M	20CNY

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4.2 Spatial Statistical model

Spatial analysis refers to a series of theories and techniques for analyzing, simulating, predicting and regulating spatial processes (Gunnink et al., 2019; Sinclair et al., 2019; Liang et al., 2020). Under the circumstance of enriched spatial information and improved data management capacity, new born demands on the basis of spatial information services, exploration of knowledge and mechanism inversion are formed to promote the research of spatial information analysis theory, technology and method and the establishment of discipline system. Spatial statistical analysis serves as a branch of spatial analysis theory, which refers to integrating spatial information (area, length, proximity relationship, orientation and spatial relationship) into classical statistical analysis to research on the spatial correlation and spatial relationship of things and phenomena related to spatial position so as to reveal the spatial distribution law of the elements. Spatial statistical analysis is suitable for processing discrete data of geographical regions or zones rather than all spatial data (Gunnink et al., 2019; Sinclair et al., 2019). In this case, the core of spatial statistical analysis is to recognize the spatial dependence, spatial correlation or spatial auto correlation between geographically related data, involving the construction of spatial weight matrix, spatial auto correlation, measurement and test of spatial correlation, identification of spatial correlation, etc. From the perspective of spatial statistics, this section elaborates on the economic and social problems based on geographical space, that is, relevant studies on the spatial statistics of elderly people's mobile phone usage. Suppose there are n sampling points, each sample point is m variables. The relation between variables can be expressed by correlation coefficient, that is $r_{ij}(i,\ j = 1{\sim}m)$, where r_{ij} $(0 \le r_{ij} \le 1)$ is the included angle cosine of data standardization of standard deviation between the variables, x_i and x_j:

$$r_{ij} = \frac{\sum_{k=1}^{n}(x_{ki} - \bar{x}_i)\left(x_{kj} - \bar{x}_j\right)}{\sum_{k=1}^{n}(x_{ki} - \bar{x}_i)^2\left(x_{kj} - \bar{x}_j\right)^2}$$

4.3 Spatial linear regression

Both CLRM Model and CNLRM Model can hardly meet the needs of Spatial distribution data. For this, the Spatial Linear Regression Model (SLRM) has gradually developed for the further spatial research. The general form of SLRM is :

$$y = \rho W_1 y + X\beta + e$$
$$e = \lambda W_2 e + \mu{\sim}N(1,\ W),\ W_{ii} = h_i(za),\ h_i > 0$$

Where, β is the matrix of $K \times 1$, and K is the number of variables. X is the matrix of $N \times K$, N is numeral records of variable values, shown as $(x_1,\ x_2,\ \cdots x_n)$, and e is the residual. And ρ is a coefficient of spatial delay dependent variable, λ is the coefficient in the self-correlation structure of residual. μ means normal distribution with W ; F is the diagonal covariance matrix; G is the space weight matrix.

(1) If $\rho = 0,\ \lambda = 0,\ a = 0,$

$$y = X\beta + e$$

it is called the classical linear regression model without spatial effect.

(2) If $\lambda = 0,\ a = 0,$

$$y = \rho W_1 y + X\beta + e$$

it belongs to the mixed regression space autoregressive model.

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(3) If $\rho = 0$， $a = 0$,

$$y = X\beta + (I - \rho W_2)^{-1}\mu$$

It is a linear autoregression model with space self-regression disturbance.

(4) If $a = 0$

$$y = \rho W_1 y + X\beta + (I - \rho W_2)^{-1}\mu$$

It is the mixed spatial autoregressive model with spatial autoregressive perturbation term. The general model of spatial linear regression after simplifying its process was obtained as

$$B(Y - \mu) = Ce$$

In the above formula, the matrix C is determined by the specific model and the matrix B is calculated from the identity matrix *i.* μ is true values while B is an estimated value of the vector. Theorem From the traditional GM (1, 1) model, the least-square solution of model $\rho^{(0)}(k) + a_1 z_\rho^{(1)}(k) = b_1$ can be calculated. Finally, the corresponding time response function can be obtained according to the equation above.

There are some deficiencies. In the foregoing chapter of this dissertation, grey system and grey correlation theory are described. Moreover, several kinds of common models are summarized through a large number of references and found out that existing grey correlation models have some disadvantages amidst them all, and the ways to solve these shortcomings is to make appropriate modifications and perfections to the model for what you want to study as well as the content of the data in order to get more precise conclusion. The formed data sequences are:

$$\Delta x_0 = \left(\Delta x_0(1), \Delta x_0(2), \cdots, \Delta x_0(n-1)\right) = \left(x_0(2) - x_0(1), x_0(3) - x_0(2), \cdots, x_0(n) - x_0(n-1)\right)$$

$$\Delta x_i = \left(\Delta x_i(1), \Delta x_i(2), \cdots, \Delta x_i(n-1)\right) = \left(x_i(2) - x_i(1), x_i(3) - x_i(2), \cdots, x_i(n) - x_i(n-1)\right)$$

Use

$$\frac{\Delta x_0}{\Delta x_i} = \left(\frac{\Delta x_0(1)}{\Delta x_i(1)}, \frac{\Delta x_0(2)}{\Delta x_i(2)}, \cdots, \frac{\Delta x_0(n-1)}{\Delta x_i(n-1)}\right)$$

$$\overline{\left(\frac{\Delta x_0}{\Delta x_\iota}\right)} = \frac{1}{n-1}\sum_{k=1}^{n-1}\frac{\Delta x_0(k)}{\Delta x_i(k)}$$

To respective represent the sequence and its mean of the ratio of slopes of $X_0$and X_i in each corresponding period of time. Then the improved grey slope correlation degree is:

$$\gamma(X_0, X_i) = \frac{1+\overline{|\Delta x_0(k)|}}{1+\overline{|\Delta x_0(k)|}+1+\overline{|\Delta x_0(k)-\Delta x_\iota(k)|}}\ ,\ \overline{\left(\frac{\Delta x_0(k)}{\Delta x_\iota(k)}\right)} \geq 0$$

$$\gamma(\mathrm{X_0}, \mathrm{X_i}) = -\frac{1+\overline{|\Delta x_0(\mathrm{k})|}}{1+\overline{|\Delta x_0(\mathrm{k})|}+1+\overline{|\Delta x_0(\mathrm{k})-\Delta x_1(\mathrm{k})|}}\ ,\ \overline{\left(\frac{\Delta x_0(k)}{\Delta x_\iota(k)}\right)} < 0$$

Wherein,

$$\overline{|\Delta x_0(k)|} = \frac{1}{n-1}\sum_{k=1}^{n-1}|\Delta x_0(k)|$$

$$\overline{|\Delta x_0(k) - \Delta x_\iota(k)|} = \frac{1}{n-1}\sum_{k=1}^{n-1}|\Delta x_0(k) - \Delta x_i(k)|$$

$$\overline{\left(\frac{\Delta x_0(k)}{\Delta x_\iota(k)}\right)} = \frac{1}{n-1}\sum_{k=1}^{n-1}\frac{\Delta x_0(k)}{\Delta x_i(k)}$$

The improved model solves the problem of positive and negative attributes on the basis of grey

ISSN- 2394-5125 VOL 7, ISSUE 05, 2020

slope correlation. Next, the improved model is used for empirical analysis of data to obtain relevant quantitative analysis conclusions. Set the reference sequence composed of the mobile phone charge data of the elderly is denoted as

$$X_0^{(1)}, X_0^{(2)}, \cdots, X_0^{(n)}$$

And the reference sequence composed of corresponding mobile phone call duration data is denoted as

$$X_1^{(1)}, X_1^{(2)}, \cdots, X_1^{(n)}$$

The comparison sequence of corresponding App categories is represented as

$$X_2^{(1)}, X_2^{(2)}, \cdots, X_2^{(n)}$$

The corresponding comparison sequence of App-using duration is taken as

$$X_3^{(1)}, X_3^{(2)}, \cdots, X_3^{(n)}$$

The comparison sequence composed of the corresponding App-using traffic is denoted as $X_4^{(1)}, X_4^{(2)}, \cdots, X_4^{(n)}$

A row of data obtained after data preprocessing is taken as an example for empirical analysis and description, and set as sequence $X_0^{(1)}, X_1^{(1)}, X_2^{(1)}, X_3^{(1)}, X_4^{(1)}$,

Processing the above sequences with averaged dimensionless method, and thus obtained $\Delta X_0^{(1)}, \Delta X_1^{(1)}, \Delta X_2^{(1)}, \Delta X_3^{(1)}, \Delta X_4^{(1)}$ and $\overline{\left|\Delta x_0^{(1)}(k)\right|}$, $\overline{\left|\Delta x_0^{(1)}(k) - \Delta x_1^{(1)}(k)\right|}$, $\overline{\left|\Delta x_0^{(1)}(k) - \Delta x_2^{(1)}(k)\right|}$, $\overline{\left|\Delta x_0^{(1)}(k) - \Delta x_3^{(1)}(k)\right|}$, $\overline{\left|\Delta x_0^{(1)}(k) - \Delta x_4^{(1)}(k)\right|}$

To get

$$\gamma\left(X_0^{(1)}, X_1^{(1)}\right) = \frac{1 + \overline{\left|\Delta x_0^{(1)}(k)\right|}}{1 + \overline{\left|\Delta x_0^{(1)}(k)\right|} + \overline{\left|\Delta x_0^{(1)}(k) - \Delta x_1^{(1)}(k)\right|}} = 0.806$$

$$\gamma\left(X_0^{(1)}, X_2^{(1)}\right) = \frac{1 + \overline{\left|\Delta x_0^{(1)}(k)\right|}}{1 + \overline{\left|\Delta x_0^{(1)}(k)\right|} + \overline{\left|\Delta x_0^{(1)}(k) - \Delta x_2^{(1)}(k)\right|}} = 0.9394$$

$$\gamma\left(X_0^{(1)}, X_3^{(1)}\right) = \frac{1 + \overline{\left|\Delta x_0^{(1)}(k)\right|}}{1 + \overline{\left|\Delta x_0^{(1)}(k)\right|} + \overline{\left|\Delta x_0^{(1)}(k) - \Delta x_3^{(1)}(k)\right|}} = 0.9794$$

$$\gamma\left(X_0^{(1)}, X_4^{(1)}\right) = \frac{1 + \overline{\left|\Delta x_0^{(1)}(k)\right|}}{1 + \overline{\left|\Delta x_0^{(1)}(k)\right|} + \overline{\left|\Delta x_0^{(1)}(k) - \Delta x_4^{(1)}(k)\right|}} = 0.8583$$

By analogy with the above calculation method, grey relational degree is calculated for all the data collected and preprocessed.

5. Discussion of research suggestion

According to Urie Bronfenbrenner's ecological systems theory, in order to create a good media ecological environment for the elderly and cultivate the good habits of the elderly to use the new media, different subjects are required to work together, such as family members (the elderly, children, etc.), mobile program developers, mobile communication operators, society and government etc. (Koller et al., 2019; Hertler et al., 2018) The findings of this study suggested that each subject should communicate

with each other (Sheremeta, 2018) and cooperate well (Tan et al., 2017) in order to create a better living environment for more elderly people (Law et al. 2020e; Law et al. 2020f; Kemperman et al., 2019; Guo et al., 2019; Chaouali et al, 2019). Therefore, the following recommendations are made for the above-mentioned subjects:

6. Conclusion

Most of the elderly are retired people. Since they have already left the society, they have much more time than they did during the working period. Mobile App developers should aim at the consumer psychology of the elderly and launch service products that meet their psychological needs (Gindidis et al., 2019; Banskota et al., 2020; Karjaluoto et al., 2019). In this way can the mobile enrich the cultural life of the elderly, promote their health and help them enjoy their life optimistically (Wang, 2019; Bernardo et al., 2020; Kim et al., 2020). This not only achieves the purpose of physical training, but also eliminates the sense of loneliness, and enhances the group friendship of the elderly (Waycott et al., 2019; Hu et al., 2019; Frazer, 2020). The main purpose of marketing is to carry out volume marketing for low-end customers. The basic telephone charges are divided into two positions: 19 rmb and 39 rmb. They can add a sub-card, which sets voice time in the package as the main selling point. It provides a large number of voice minutes in the package, but the supply of mobile internet data is very small.

7. REFERENCES

1. Ak， Melda N. Predicting preferences of university students for prepaid vs post paid cell phone service plans[M]. Pergamon Press， Inc. 2011.
2. Banskota, S., Healy, M., & Goldberg, E. M. (2020). 15 Smartphone Apps for Older Adults to Use While in Isolation During the COVID-19 Pandemic. Western Journal of Emergency Medicine, 21(3), 514.
3. Hynes M， Wang H， Kilmartin L， et al. Monitoring of activity levels of the elderly in home and community environments using off the shelf cellular handsets[C]// International Conference on Consumer Electronics. IEEE， 2010:9-10.
4. International Journal of Control and Automation, Vo. 12, no.5. pp. 107-113
5. Jia B Kangbai.Social network analysis and modeling of cellphone-based syndromic surveillance data for ebola in Sierra Leone[J].Asian Pacific Journal of Tropical Medicine，2016，9(09):829-833.
6. Jiang L. An Analysis of Tourism Market for the Elderly in China[J]. Business Economy， 2011.
7. Jun YIN. Investigation and Analysis of Consumption Potential of Clothing Functional Market of Chinese Elderly[A]. International Informatization and Engineering Associations、Atlantis Press.Proceedings of 2015 International Conference on Economics，Social Science，Arts，Education and Management Engineering (ESSAEME 2015)[C].International Informatization and Engineering Associations、Atlantis Press:，2015:5.
8. Karjaluoto, H., Shaikh, A. A., Saarijärvi, H., & Saraniemi, S. (2019). How perceived value drives the use of mobile financial services apps. International Journal of Information Management, 47, 252-261.
9. Kemperman, A., van den Berg, P., Weijs-Perrée, M., & Uijtdewillegen, K. (2019). Loneliness of older adults: social network and the living environment. International journal of environmental

research and public health, 16(3), 406.

10. Kian Aun Law, Amiya Bhaumik, Jiemiao Fang, Valliappan Raju (2020e), Impact of Network Relationship Management Capability towards International Opportunity Recognition for Improving Efficiency and Effectiveness: Cross Organizational Knowledge Integration in China, Test Engineering and Management March-April 2020, pp. 12259 - 12270.
11. Kian Aun Law, Amiya Bhaumik, Jiemiao Fang, Valliappan Raju (2020f), Exploring Network Capability, International Opportunity Recognition and Development on the International Performance of Born Global firms in China, Test Engineering and Management March-April 2020, pp. 12306 - 12318.
12. Kian Aun Law, Amiya Bhaumik, Peng Sun, Valliappan R. (2020a) Factors determining the relationship between superiors and their subordinates: Evaluating the trust factor in Chinese organizations, International Journal of Psychosocial Rehabilitation 24 (4) ,pp.1075-1088.
13. Kian Aun Law, Amiya Bhaumik, Peng Sun, Valliappan R. (2020b), Interpersonal trust within an organization based on hierarchical context: Towards improving organizational efficiency in China, International Journal of Psychosocial Rehabilitation 24 (6) ,pp.54-72.
14. Kian Aun Law, Amiya Bhaumik, Peng Sun, Valliappan Raju (2019d) "Factors Determining the Relationship between Superiors and Their Subordinates: Evaluating the Trust Factor in Chinese Organizations" International Journal of Control and Automation, Vo. 12, no.5. pp. 63-76.
15. Kian Aun Law, Amiya Bhaumik, Valliappan R.(2020c), The structure of superior behavior and individual belonging behavior based on trust development direction in Chinese firms, International Journal of Psychosocial Rehabilitation 24 (6) ,pp.73-92.
16. Kian Aun Law, Amiya Bhaumik, Yin Hao, Valliappan R.(2020d), Effectiveness of mobile phone users based on aging issue: In the context of urban part of China, International Journal of Psychosocial Rehabilitation 24 (4) ,pp.1496-1503.
17. Kian Aun Law, Amiya Bhaumik, Hao Yin, Valliappan Raju (2019b) "Effectiveness of Mobile Phone Users Based on Aging Issue: In the Context of Urban Part of China" International Journal of Control and Automation, Vo. 12, no.5. pp. 107-113
18. Kim, H., Kim, J. Y., Lee, J., & Kang, Y. (2020). How to Enhance Social Relationships of Older Adults: Design and Development of a Mobile Application for Active Seniors. Archives of Design Research, 33(2), 105-121.
19. Koller, S. H., dos Santos Paludo, S., & de Morais, N. A. (Eds.). (2019). Ecological Engagement: Urie Bronfenbrenner's Method to Study Human Development. Springer Nature.
20. Li, X., Li, T., Li, H., Qi, J., & Hu, L. (2019). Research on the Online Consumption Effect of China's Urbanization under Population Aging Background. Sustainability, 11(16), 4349.
21. Lin Wang， Pei-Luen Patrick Rau， Gavriel Salvendy. Older Adults' Acceptance of Information Technology[J]. Educational Gerontology， 2011， 37(12):1081-1099.
22. Liu Y C， Ou Y K. Effects of Age and the Use of Hands-Free Cellular Phones on Driving Behavior and Task Performance[J]. Traffic Injury Prevention， 2011， 12(6):550-558.
23. Liu, M. T. (2020). Influence Factor of Chinese Elders' Wealth Management Behaviour: An Empirical Study. International Journal of Management Studies, 16(2), 97-121.
24. Macarro A， Villafaina E. Interaction Mechanism for Language Learning for Elderly People through Mobile Devices[J]. Advances in Intelligent & Soft Computing， 2011， 89:333-340.
25. Mobile Phone Users Based on Aging Issue: In the Context of Urban Part of China"
26. Muhammad Tanveer, Amiya Bhaumik, Shafiqul Hassan, Ikram Ul Haq A Scopus Based

Bibliometric Evaluation of Saudi Medical Journal from 1979 to 2019 International Research Association for Talent Development and Excellence 2020 Volume - 12, Issue - 2s 2328-2337

27. Valliappan R.,Phung, S.P., Economic dimensions of blockchain technology: In the context of extention of cryptocurrencies, 2020, International Journal of Psychosocial Rehabilitation 24 (2) ,pp.29
28. Valliappan Raju, Dr. Siew Poh Phung, Prof. Dr. Ramanathan Kalimuthu, Identifying Elements to Implement E-Governance: Role of Organizational Readiness, Authority Readiness, Customer Readiness, Competency Readiness and Technology Readiness, International Journal of Engineering and Technology, Vol 8, No 1.10 (2019), DOI: 10.14419/ijet.v8i1.10.28383
29. Wang, Q. (2019). The Influence of College Students' Mobile Phone Dependence on Their Self-Esteem and Loneliness.
30. Waycott, J., Vetere, F., & Ozanne, E. (2019). Building Social Connections: A Framework for Enriching Older Adults' Social Connectedness Through Information and Communication Technologies. In Ageing and Digital Technology (pp. 65-82). Springer, Singapore.
31. Wu， L， F， Liu， S， F. Grey system model with the fractional order accumulation[J]. Communications in Nonlinear Science and Numerical Simulation， 2013， 18(7): 1775-1785
32. Xiao, Y., Wang, D., & Fang, J. (2019). Exploring the disparities in park access through mobile phone data: Evidence from Shanghai, China. Landscape and urban planning, 181, 80-91.
33. Yang, H. L., & Lin, S. L. (2019). The reasons why elderly mobile users adopt ubiquitous mobile social service. Computers in Human Behavior, 93, 62-75.
34. Yazeed Alkatheeri , Ali Ameen , Osama Isaac , Ibrahim Alrajawy , Amiya Bhaumik The Effect of Knowledge Management Quality and Management Information Systems on Decision Making Quality Test Engineering & Management 2020 Volume – 82, Issue - Jan/Feb 12075 - 12085
35. Yee S L C Y， Duh B L， Quek F. Investigating narrative in mobile games for seniors[C]// International Conference on Human Factors in Computing Systems， CHI 2010， Atlanta， Georgia， Usa， April. DBLP， 2010:669-672.