Evaluation Model of Tea Industry Information Service Quality

Xiaohui Shi[1,2,3,4] and Tian'en Chen[1,2,3,4](✉)

[1] Beijing Research Center for Information Technology in Agriculture, Beijing 100097, China
[2] National Engineering Research Center of Information Technology in Agriculture, Beijing 100097, China
{shixh, chente}@nercita.org.cn
[3] Key Laboratory of Agri-Informatics, Ministry of Agriculture, Beijing 100097, China
[4] Beijing Engineering Research Center of Agricultural Internet of Things, Beijing 100097, China

Abstract. According to characteristics of tea industry information service, this paper have built service quality evaluation index system for tea industry information service quality, R-cluster analysis and multiple regression have been comprehensively used to contribute evaluation model with a high practice and credibility. Proved by the experiment, the evaluation model of information service quality has a good precision, which has guidance significance to a certain extent to enhance the information service quality of tea industry information website.

Keywords: Tea industry · Information service quality evaluation · Multiple regression · R-cluster

1 Introduction

According to characteristics of tea industry information service, and based on analysis of the evaluation goal for tea industry information service quality, the typicality of index system as the main direction, also takes the information requirements characteristic of users into account, the key factors influencing the quality of information service have been analyzed from platform function, platform information, platform design, platform framework and platform efficiency, then select 5 first grades and 30 s grades. 30 s grades are clustered by R-cluster analysis, finally forming an evaluation index system consists of 5 first grades and 17 s grades. Based on the influence factor of information service quality analyzed by information service quality evaluation model built with multiple regression, which will give a scientific guidance for tea industry information service.

D. Li and Z. Li (Eds.): CCTA 2015, Part II, IFIP AICT 479, pp. 320–329, 2016.
DOI: 10.1007/978-3-319-48354-2_33

2 Analysis Methods

2.1 R-cluster

R-cluster [1] is one kinds of the cluster analysis method, is adequate for lots of variable, and variable with a high correlation, its purpose is to cluster the variables in the same group, and find the representative variables to achieve the purpose of dimension reduction. In R-cluster theory, N objects are treated as N groups, the correlation coefficient around the groups is R, two groups having the biggest related coefficient are clustered in one groups, until all groups are clustered in one big group.

2.2 Multiple Linear Regression

2.2.1 Brief Introduction for Multiple Linear Regression Model

Multiple linear regression [2] model is one kinds of math model to consider the relationship around variable x_1, x_2,…, x_p and variable y. Assuming y is change along with the changes of x_1, x_2,…, x_p.

The mathematical expression of multiple linear regression is $Y = W^{(3)} * X + C$. $W^{(3)}$ is weight matrix, C is constant term.

2.2.2 Selection Criteria of Independent Variable for Multiple Linear Regression Model

Multiple linear regression model has advantages, such as simple method and high precision, when it simulate the data owning pure linear relationship, but having bad results in this situation of data is nonlinear relationship or data missing. In order to guarantee the excellent predictive results, the selection criteria of independent variable are summarized as follows: (1) independent variable has a outstanding influence with dependent variable, and there is a close linear relationship; (2) linear relationship between independent variable and dependent variable is true, not in form; (3) a certain mutual exclusion between the independent variables is necessary; (4) independent variable must have integrated data [3].

3 Index System

3.1 Preliminary Index System

Selecting platform function, platform information, platform design, platform framework and platform efficiency as the first grade indexes [4], and every index is further segmented, finally forming 30 s grade indexes, which forms the service quality index system for tea industry information platform, the specific indexes are listed as follows:

3.2 Index System Selection

Normally, the method of principal component analysis is used to solve a problem which contains lots of evaluation indexes, but the results from principal component

analysis depend on measured value of primitive index, so principal component analysis only solve simplification of quantitative index, not the descriptive index before quantitative [5].

In this paper, R-cluster is adopted. According to the correlation coefficient in indexes, all indexes are clustered by R-cluster, the demand of accuracy finally determines how many groups will be segmented, select the typical index in one group represent multiple indexes to achieve the purpose of simplified index [6].

Assuming there are P indexes u_1, u_2, u_3, …, u_p; N experts score for the relative coefficient among the indexes, the relative coefficient matrix after scoring is expressed in Table 2, and the cluster results are expressed in.

To combine the results of cluster, comprehensively considering the simplicity, representation and feasibility of indexes, analysis results are carried out as follows: when the minimum distance of correlation coefficients is under 0.03, the jumping points are obvious, indexes are clustered 17 groups. So, the results represented as follows: R_1: 4, 11, 15, 7, 13, 20, 8, 18, 21; R_2: 3, 23; R_3: 5, 17; R_4: 6, 10, 14, 30; R_5: 1; R_6: 2: R_7: 9; R_8: 12; R_9: 24; R_{10}: 28; R_{11}: 19; R_{12}: 27; R_{13}: 16; R_{14}: 21; R_{15}: 22; R_{16}: 26; R_{17}: 29 (Fig. 1).

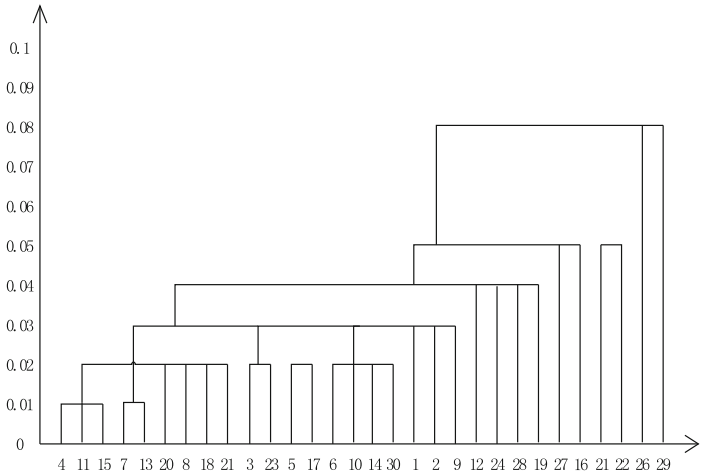

Fig. 1. Result of R-mode clustering

4 Data Acquisition

4.1 Experts Estimation

After the establishment of indexes system, expert estimation has two parts:

(1) General part indexes existing in traditional information service website or system. After the establishment of indexes system, select the typical tea information website, then let the experts who is good at agricultural informationization

estimate the quality of information service websites and the indexes that influencing the quality of information service.

(2) The indexes part reflecting the characteristics of cloud service platform. Because of tea industry information cloud service platform in domestic is still blank, there is no quantitative index to be verified, only the experts' view as the reference, that is means, when tea industry information cloud service platform is built, the 7 indexes, such as X23: Platform stabilization, X24: Platform compatibility, X25: Platform safety, X26: Platform adaptability, X27: Platform expansibility, X28: Software deployment simplicity and X29: Software operation shortcut will be fully considered.

4.2 Data Processing

First step: website selection. Tea information websites are divided into two groups: one group is comprehensive agriculture websites but covering content of tea industry information, another group is the professional tea information websites. The objects of this experiment are 40 websites in two groups, 18 comprehensive websites, such as agriculture information websites belong to province and municipal district, and 22 professional tea information websites, specific situation is listed in Table 3.

Second step: data acquisition. Experts estimate the 10 s indexes belong to Platform function, Platform information and Platform design in Table 1, information service quality and indexes estimated by quantitative evaluation, the scores are during 0–1, adopt the method of integrating multiple scores, the data is listed as Table 4 after data processing.

Table 1. Service quality evaluation index system of information platform for tea industry

	First index	Second index	After R-cluster
X_1 Service quality index system for tea industry information platform	Platform function	Function comprehensiveness	X_1
		Service interactivity	X_2
		Operation convenience	
		Service individuation	X_4
		Service professionalism	X_5
		Platform popularity	
	Platform information	Information accuracy	

(*continued*)

Table 1. (*continued*)

	First index	Second index	After R-cluster
		Information authority	
		Information vividness	X_9
		Information comprehensiveness	X_{10}
		Content uniqueness	
		Organization orderliness	
		Information timeliness	
		Retrieval convenience	
		Retrieval effectiveness	
	Platform design	Interface friendly	X_{16}
		Design standardization	
		Creativity uniqueness	
		Column novelty	X_{19}
		Structure clarity	
		Style unity	
		Color coordination	X_{22}
	Platform framework	Platform stabilization	X_{23}
		Platform compatibility	X_{24}
		Platform safety	X_{25}
		Platform adaptability	X_{26}
		Platform expansibility	X_{27}
	Platform efficiency	Software deployment simplicity	X_{28}
		Software operation shortcut	X_{29}
		Demand response timeliness	

Table 2. Related coefficient matrix

	X1	X2	X3	X4	X5	…	X30
X1: Function comprehensiveness	1						
X2: Service interactivity	0.15	1					
X3: Operation convenience	0.12	0.14	1				
X4: Service individuation	0.11	0.32	0.18	1			
X5: Service professionalism	0.47	0.41	0.56	0.24	1		
X6: Platform popularity	0.12	0.13	0.68	0.05	0.87	…	
X7: Information accuracy	0.21	0.89	0.12	0.98	0.94	…	
X8: Information authority	0.45	0.86	0.11	0.84	0.92	…	
X9: Information vividness	0.13	0.97	0.13	0.86	0.94	…	
X10:Information comprehensiveness	0.97	0.75	0.08	0.88	0.96	…	
X11: Content uniqueness	0.12	0.85	0.14	0.99	0.92	…	
X12: Organization orderliness	0.65	0.82	0.84	0.15	0.87	…	
X13: Information timeliness	0.78	0.94	0.89	0.98	0.82	…	
X14: Retrieval convenience	0.56	0.93	0.97	0.97	0.84	…	
X15: Retrieval effectiveness	0.42	0.84	0.85	0.99	0.86	…	
X16: Interface friendly	0.01	0.95	0.89	0.85	0.12	…	
X17: Design standardization	0.75	0.12	0.84	0.12	0.98	…	
X18: Creativity uniqueness	0.15	0.78	0.12	0.86	0.12	…	
X19: Column novelty	0.12	0.86	0.11	0.87	0.15	…	
X20: Structure clarity	0.32	0.81	0.84	0.98	0.56	…	
X21: Style unity	0.15	0.14	0.91	0.15	0.86	…	
X22: Color coordination	0.11	0.23	0.56	0.12	0.14	…	
X23: Platform stabilization	0.12	0.45	0.98	0.11	0.86	…	
X24: Platform compatibility	0.11	0.21	0.94	0.15	0.14	…	
X25: Platform safety	0.11	0.12	0.12	0.12	0.86	…	
X26: Platform adaptability	0.92	0.15	0.84	0.87	0.84	…	
X27: Platform expansibility	0.95	0.34	0.23	0.56	0.85	…	
X28: Software deployment simplicity	0.87	0.87	0.86	0.87	0.85	…	
X29: Software operation shortcut	0.12	0.15	0.92	0.86	0.92	…	
X30: Demand response timeliness	0.23	0.97	0.76	0.82	0.85	…	1

5 Evaluation Model

5.1 Experiment Data Processing

In experiment, 30 data before in Table 4 as the training sample, 11 data after in Table 4 as the test sample.

Table 3. Objects of experimental evaluation for tea information sites

Groups	Website	Website
Professional(22)	http://www.ymt360.com	http://tea.fjsen.com
	http://www.teauo.com	http://www.zgchawang.com
	http://www.i-tea.cn	http://tea.ahnw.gov.cn
	http://cy.zgny.com.cn	http://www.t0001.com
	http://www.teatea.co	http://www.fjteaw.cn
	http://www.tea160.com	http://www.chawh.net
	http://www.b-tea.com	http://www.puercn.com
	http://www.hbteainfo.com	http://www.qspg.cn
	http://www.cyppw.com	http://www.bjhjcha.com
	http://www.cs12396.cn	http://www.ctma.com.cn
	http://www.cluyu.cn	http://www.paicw.com
Comprehensive(18)	http://bb.ahnw.gov.cn	http://www.xinnong.com
	http://www.ynagri.gov.cn	http://www.sbny.cn
	http://www.cnsp.org.cn	http://www.tech-food.com
	http://www.cnluye.com	http://www.farmers.org.cn
	http://www.yuanlin365.com	http://www.8658.cn
	http://nc.mofcom.gov.cn	http://video.1kejian.com
	http://www.scnjw.gov.cn	http://www.xxsagri.gov.cn
	http://www.agronet.com.cn	http://www.qzny.gov.cn
	http://www.eagric.com	http://www.foodmate.net

Indexes' corresponding relation are: X_1: Function comprehensiveness, X_2: Service interactivity, X_4: Service individuation, X_5: Service professionalism, X_9: Information vividness, X_{10}: Information comprehensiveness; X_{12}: Organization orderliness, X_{16}: Interface friendly; X_{19}: Column novelty, X_{22}: Color coordination, Y: information service quality.

5.2 Selection of Influencing Factors

Before the influencing factors are finally selected, the correlation between information service quality and influencing factors needed to be analyzed respectively. The purpose of correlation analysis is to represent the correlation situation and its change rule between variables, and find the correlation model with each other, which can provide references for making the next decision.

Null hypothesis of test is correlation coefficient of two variables expressing 0 in totality. The process of correlation analysis in SPSS shows the probability of hypothesis formation [7].

On the SPSS 18 platform, data correlation analysis respectively is produced between Y and X_1, X_2, X_4, X_5, X_9, X_{10}, X_{12}, X_{16}, X_{19}, X_{22}. Correlation between Y and X_2, X_4, X_5, X_9, X_{10}, X_{16}, X_{19}, respectively is obvious, and shows linear relationship, and these indexes can be selected as the influencing factors for Y, so multiple regression model is established.

Table 4. Experimental data

Y	X_1	X_2	X_4	X_5	X_9	X_{10}	X_{12}	X_{16}	X_{19}	X_{22}
0.84	0.77	0.81	0.80	0.81	0.68	0.74	0.88	0.44	0.55	0.88
0.39	0.77	0.36	0.35	0.37	0.25	0.29	0.88	0.04	0.16	0.88
0.38	0.75	0.35	0.34	0.35	0.25	0.28	0.86	0.04	0.14	0.86
0.60	0.74	0.61	0.56	0.56	0.52	0.50	0.88	0.21	0.32	0.88
0.73	0.72	0.69	0.69	0.69	0.61	0.63	0.86	0.32	0.43	0.86
0.35	0.71	0.31	0.31	0.31	0.22	0.25	0.82	0.03	0.13	0.82
0.31	0.71	0.27	0.26	0.27	0.15	0.22	0.80	0.01	0.09	0.80
0.74	0.71	0.71	0.70	0.71	0.62	0.65	0.84	0.34	0.44	0.84
0.52	0.71	0.50	0.47	0.49	0.40	0.42	0.84	0.12	0.23	0.84
0.85	0.70	0.82	0.82	0.82	0.68	0.75	0.80	0.45	0.56	0.80
0.54	0.70	0.52	0.50	0.51	0.43	0.44	0.80	0.14	0.26	0.80
0.48	0.70	0.47	0.44	0.45	0.35	0.37	0.80	0.09	0.19	0.80
0.35	0.70	0.34	0.32	0.32	0.23	0.25	0.80	0.03	0.13	0.80
0.31	0.69	0.27	0.27	0.27	0.14	0.21	0.78	0.01	0.08	0.78
0.50	0.69	0.47	0.43	0.46	0.38	0.39	0.82	0.10	0.20	0.82
0.63	0.68	0.62	0.59	0.60	0.52	0.53	0.78	0.24	0.34	0.78
0.41	0.68	0.37	0.37	0.38	0.28	0.31	0.78	0.04	0.17	0.78
0.30	0.68	0.26	0.25	0.26	0.14	0.20	0.76	0.01	0.07	0.76
0.50	0.67	0.48	0.44	0.46	0.39	0.40	0.80	0.11	0.22	0.80
0.74	0.66	0.70	0.70	0.69	0.61	0.64	0.78	0.33	0.43	0.78
0.51	0.66	0.49	0.46	0.47	0.40	0.41	0.78	0.11	0.22	0.78
0.79	0.64	0.76	0.75	0.76	0.63	0.69	0.74	0.40	0.50	0.74
0.62	0.64	0.62	0.58	0.58	0.52	0.51	0.74	0.22	0.32	0.74
0.53	0.64	0.51	0.49	0.50	0.41	0.43	0.76	0.13	0.23	0.76
0.82	0.63	0.78	0.78	0.78	0.66	0.72	0.72	0.43	0.53	0.72
0.31	0.62	0.27	0.28	0.28	0.18	0.22	0.70	0.02	0.09	0.70
0.88	0.61	0.84	0.84	0.85	0.70	0.79	0.70	0.49	0.58	0.70
0.33	0.52	0.29	0.30	0.29	0.20	0.25	0.58	0.02	0.11	0.58
0.33	0.51	0.29	0.29	0.29	0.19	0.24	0.58	0.02	0.11	0.58
0.32	0.51	0.29	0.27	0.28	0.19	0.23	0.58	0.02	0.10	0.58
0.69	0.50	0.67	0.65	0.65	0.57	0.60	0.58	0.30	0.39	0.58
0.47	0.50	0.46	0.43	0.44	0.34	0.36	0.58	0.07	0.19	0.58
0.64	0.50	0.62	0.61	0.60	0.55	0.54	0.58	0.25	0.35	0.58
0.34	0.49	0.30	0.30	0.30	0.21	0.24	0.56	0.02	0.12	0.56
0.64	0.49	0.62	0.60	0.60	0.54	0.54	0.56	0.24	0.34	0.56
0.55	0.49	0.58	0.51	0.51	0.42	0.45	0.58	0.19	0.29	0.58
0.34	0.49	0.30	0.31	0.30	0.22	0.24	0.56	0.02	0.12	0.56
0.83	0.48	0.79	0.79	0.80	0.67	0.73	0.55	0.43	0.54	0.55
0.58	0.47	0.60	0.54	0.55	0.46	0.48	0.56	0.19	0.30	0.56
0.56	0.47	0.59	0.53	0.53	0.44	0.46	0.56	0.16	0.29	0.56

5.3 Experiment Analysis

On the platform SPSS 18, multiple regression model has been established, X_2, X_4, X_5, X_9, X_{10}, X_{16} and X_{19} as independent variables, Y as dependent variable. Results of multiple linear regression show that X_2, X_4, X_5, X_9, X_{10}, X_{16}, with Y shows the positive correlation respectively, but the estimated value of regression coefficient for X_{19} shows negative correlation, which is not fact, so estimated value of X_{19} is not believable [8], then eliminate variable X_{19}. Second regression is carried out.

R^2 of model is 0.999, adjusted R^2 also is 0.999. Value of F tends to rationality. To a certain extent, model reflect the relationship for information service quality and influencing factors, finally the influencing factors model of information service quality is carried out as follows:

$$Y = 0.075 + 0.100 * X_2 + 0.005 * X_4 + 0.368 * X_5 + 0.025 * X_9 + 0.481 * X_{10} + 0.020 * X_{16}.$$

5.4 Model Test

The established multiple regression model is tested by test data.

Table 5 shows that results of 10 test data present ideal results, relative errors between predictive value and real value all are less than 3 %, and average error is only 1.01 %. Experiment demonstrates that the established model is multiple fitted equation having a good reliability [9].

Table 5. Relative errors between predicted and actual values

Sequence number	True value	Predictive number	Relative error
1	0.69	0.694392	0.64
2	0.47	0.466296	1.63
3	0.64	0.640351	0.05
4	0.34	0.336517	1.60
5	0.64	0.639849	0.02
6	0.55	0.555037	0.44
7	0.34	0.336832	2.31
8	0.83	0.829506	0.54
9	0.58	0.586938	1.90
10	0.56	0.567998	0.96

6 Conclusions

All study above shows that two aspects will be paid more attention to during the building of cloud service platform:

(1) In the process of construction for information service system, these indexes such as service interactivity, service individuation, service professionalism, information vividness, information comprehensiveness and interface friendly, are important to influence information service quality.
(2) During the process of building for cloud service platform, these 7 indexes such as platform stabilization, platform compatibility, platform safety, platform adaptability, platform expansibility, software deployment simplicity and software operation shortcut should be fully considered.

Acknowledgment. Financial supports from the National Science and Technology Support Project of China (Grant No. 2013BAD15B05) and the Natural Science Foundation of Beijing, China (Grant No. 4151001) are sincerely acknowledged.

References

1. Chen, M., Deng, J.: Website quality evaluation optimization based R-cluster. Inf. Sci. **9**, 40–42 (2006)
2. Sun, H., Fang, J., Li, J.: Temperature errors modeling for micro inertial measurement unit using multiple regression method. In: Proceedings of the International Symposium on Intelligent Information Systems and Applications, pp. 411–415 (2009)
3. Sadhuram, Y., Ramana Murthy, T.V.: Simple multiple regression model for long range forecasting of Indian summer monsoon rainfall. Meteorol. Atmos. Phys. **99**, 17–24 (2009)
4. Wang, W.: Analysis and comment on study and application of EC websites evaluation. Inf. Sci. **21**(6), 640–642 (2006)
5. Zhao, Y.: Information service quality evaluation for industry information center website. Inf. Resour. Study **6**, 32–37 (2009)
6. Pei, L., Wang, J.: Research on user-oriented appraisal framework of website information service quality. Inf. Sci. **28**(5), 60–64 (2009)
7. Zhi, F., Zhou, J.: Multidimensional Statistic Analysis, pp. 188–230. Science Publisher, Beijing (2002)
8. Chen, C., Wu, H.: Agricultural information service quality evaluation model based on factor analysis and multiple regression. J. Agric. Mech. Res. **09**, 11–17 (2014)
9. Zhou, W.: Research on the quality evaluation model of mobile information service based on the consumer satisfaction. J. Acad. Libr. Inf. Sci. **02**, 74–78 (2015)