# 1. Sampling sample analysis

Sampling analysis of questionnaire data is an important process that can help you understand the quality and representativeness of the data; it helps to gain a deeper understanding of the background characteristics of the sample and ensure the accuracy and validity of the results.

## 1.1 Sample size analysis

Sample size analysis for questionnaire surveys is a statistical problem that involves determining a sample size large enough to ensure representativeness and reliability of the survey results. The sample size calculation formula is:

Z is the Z value corresponding to the confidence level (for example, the Z value corresponding to the 95% confidence level is about 1.96).

p is the expected proportion (if you don't know it, you can use 0.5, because this will give the maximum sample size).

E is the margin of error (expressed as a decimal, for example, 0.05 corresponds to a 5% margin of error).

Using the previous test questionnaire for data prediction, a total of 70 questionnaires were sent out and 67 were collected (including 3 invalid questionnaires). Among them, 64 valid questionnaires were collected, and the p value of the expected proportion was 91.5%. We combined the results of the test questionnaire to estimate the required sample size for the formal questionnaire. Assuming the confidence level is 95%, the margin of error is ±5%, the expected response rate is 90%, and the overall proportion is 0.5, calculate the required sample size. Finally, the sample size of the formal questionnaire is 427 (384 / 0.9≈427), so we set the final number of questionnaires required to be distributed to 450 and the number of valid questionnaires to 400.

## **1.2 Demographic Characteristics Analysis**

Demographic characteristics analysis is an important step in questionnaire surveys. It can help you understand the composition of your sample and evaluate its representativeness. Demographic characteristics usually include age, gender, education level, income, occupation, geographic location, race and ethnicity, etc.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Demographic variables | Area | | | | School | |
| Nanning | Other Cities in Guangxi | Other provinces and cities | total | Guilin University of Electronic Technology Beihai Campus | Guilin institute of Information Science and Technology |
| Male | 8(12.5%) | 19(29.7%) | 11(17.2%) | 38(59.4%) | default | default |
| Female | 2（3.1%） | 14(21.9%) | 10(15.6%) | 26(40.6%) | default | default |
| <25 years old | 10(15.6%) | 32(50%) | 18(28.1%) | 60(93.4%) | default | default |
| 25<<45 | 0 | 1(1.6%) | 0 | 4(6.6%) | default | default |
| >45 years old | 0 | 0 | 3(4.7%) | 0 | default | default |
| Undergraduate | 10(15.6%) | 33(51.6%) | 20(31.3%) | 63(98.4%) | default | default |
| College | 0 | 0 | 1(1.6%) | 1(1.6%) | default | default |

Interpret the analysis results, identify the main group characteristics, and summarize their impact on the research topic. These steps help to gain a deeper understanding of the background characteristics of the sample and ensure the accuracy and validity of the results. Demographic analysis results of the test version of the questionnaire. Since college students account for the majority of the participants in the questionnaire survey, most of the education items are undergraduates. In the formal questionnaire, the education questionnaire item will be changed to the questionnaire item of the school to which they belong. In fact, the age is also quite concentrated, all concentrated under 25 years old, and the age questionnaire option can also be considered to be deleted.

# 2. Reliability analysis of questionnaire questions

Cronbach's Alpha is a reliability test method for evaluating the internal consistency of questionnaires or tests. This coefficient reflects the average correlation between the questions in the questionnaire and is used to measure whether different questions measure the same concept in a collaborative manner. The value of Cronbach's Alpha coefficient is between 0 and 1. The higher the value, the better the internal consistency of the questionnaire, that is, the stronger the correlation between the questions.

The calculation formula of Cronbach's Alpha coefficient is:

Where: K is the total number of questions; is the variance of the ith question; is the variance of the sum of all question scores.

Evaluation criteria:

<0.7: It is generally believed that the internal consistency of the questionnaire is low, and the design of the questionnaire may need to be reviewed.

0.7≤<0.8: Indicates that the questionnaire has acceptable internal consistency.

0.8≤<0.9: Indicates that the questionnaire has good internal consistency.

≥0.9: Indicates that the questionnaire has high internal consistency, but it may also indicate that the questions are too similar.

Advantages of Cronbach's Alpha: (1) Wide applicability: Applicable to questionnaires containing multiple questions, especially when the questionnaire questions are intended to measure the same psychological construct. (2) Easy to calculate: It can be easily calculated using a variety of statistical software. (3) Widely used, with good comparability, and can evaluate the reliability of the overall measurement. Cronbach's Alpha has many advantages, but it also has some disadvantages. These include: the alpha coefficient is affected by the number of questions. The more questions there are, the higher the alpha coefficient may be. If all questions measure the same concept, the alpha coefficient may overestimate the internal consistency. If the questions are poorly designed or irrelevant, even if the alpha coefficient is high, the validity of the questionnaire cannot be guaranteed.

Cronbach's Alpha is widely used in fields such as psychology, education, and market research to verify the reliability of questionnaires, tests, or other evaluation tools. By calculating the alpha coefficient, researchers can determine whether the questionnaire is suitable for further research or practical application. In short, Cronbach's Alpha is an important statistical tool that helps researchers evaluate the internal consistency of questionnaires or tests, thereby ensuring the reliability and validity of research data.

(1) The following table shows the reliability of the EFFECT OF PRECISE PUSH SERVISE question type in this questionnaire:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **EFFECT OF PRECISE PUSH SERVISE** | | | | |
| Options | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted | Cronbach's Alpha |
| a）The precise mobile push message service affects my daily life by improving the efficiency of information acquisition ? | 0.297 | 0.325 | 0.859 | 0.836 |
| b）The mobile push message service affects my daily life through its impact on shopping decisions? | 0.533 | 0.468 | 0.822 |
| c）Mobile precision push messaging service improves user experience by making it easier and faster for me to access the information I need?? | 0.803 | 0.763 | 0.781 |
| d）Does the mobile precise push message service improve my user experience by helping me discover new products or services?? | 0.754 | 0.622 | 0.783 |
| e）To what extent can accurate information push through my phone meet my personalized needs and interests?? | 0.692 | 0.716 | 0.796 |
| f）What is my evaluation of the personalization level of precise information pushed by my phone for the product or service I am currently using? | 0.56 | 0.351 | 0.817 |
| g）I will actively interact with the precise messages pushed by my phone(such as clicking, buying, sharing, etc.)? | 0.52 | 0.39 | 0.823 |

(2) The following table shows the reliability of the MESSAGE VALIDITY AND QUALITY questions in this questionnaire:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **MESSAGE VALIDITY AND QUALITY** | | | | |
| Options | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted | Cronbach's Alpha |
| a）How much do you think the push messages you receive relate to your interests and needs? | 0.591 | 0.427 | 0.858 | 0.868 |
| b）What do you think of the timeliness of push messages? | 0.507 | 0.367 | 0.871 |
| c）Do you think the personalization of push messages meets your needs? | 0.748 | 0.635 | 0.83 |
| d）How How much value do you think push messages bring to you? | 0.697 | 0.613 | 0.84 |
| e）Do you think the content of mobile push messages is attractive? | 0.797 | 0.707 | 0.821 |
| f）Do you think the content of the mobile push message is readable? | 0.654 | 0.599 | 0.847 |

(3) The following table shows the reliability of the NON INTERFERENCE WITH USER EXCELLENCE questions in this questionnaire:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **NON INTERFERENCE WITH USER EXCELLENCE** | | | | |
| Options | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted | Cronbach's Alpha |
| a）When do you think is the best time to push messages? | 0.297 | 0.28 | 0.523 | 0.441 |
| b）For the frequency of pushing messages, what do you think (push frequency): | 0.533 | 0.386 | 0.356 |
| c）How do you evaluate the relevance of the content of the push message you received? | 0.803 | 0.375 | 0.369 |
| d）Do you want to be able to more finely control the type and frequency of receiving push messages? | 0.754 | 0.197 | 0.285 |
| e）Have you ever felt disturbed by pushing messages? | 0.692 | 0.64 | 0.336 |
| f ）Do you think you should add "do not disturb mode" or similar functions to avoid the interference of push messages? | 0.56 | 0.56 | 0.463 |
| g）How much do you think personalization of push messages can help reduce interference? | 0.52 | 0.141 | 0.436 |

From the test results, it can be seen that the test reliability of all questions in the NON INTERFERENCE WITH USER EXCELLENCE question type is relatively low, and the overall reliability is poor. Therefore, this question type needs to be modified or deleted in the formal questionnaire, or the question type needs to be changed to obtain better questionnaire test results.

(4)The following table shows the reliability of the OPERABILITY question type in this questionnaire:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **OPERABILITY** | | | | |
| Options | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted | Cronbach's Alpha |
| a）Do you often perform relevant operations (such as clicking, replying, etc.) immediately after receiving accurate push messages? | 0.533 | 0.338 | 0.846 | 0.852 |
| b）For the precise push message you received, do you think the operation buttons or links contained in it are clear and understandable? | 0.741 | 0.621 | 0.807 |
| c）After receiving the precise push message, can you easily find the relevant operation buttons or links? | 0.789 | 0.674 | 0.799 |
| d）Do you think the operation options provided by the received precise push message meet your needs? | 0.798 | 0.706 | 0.8 |
| e）What operation options are usually included in the precise push message you receive? | 0.517 | 0.294 | 0.863 |
| f）Which operation option in the push message do you like least? | 0.533 | 0.353 | 0.846 |

(5)The following table shows the reliability of the USER CHOICE question type in this questionnaire:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **USER CHOICE** | | | | |
| Options | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted | Cronbach's Alpha |
| a）Do you like to receive precise push messages on your mobile phone with promotional and discount information? | 0.674 | 0.538 | 0.822 | 0.849 |
| b）Do you like to receive precise push messages on your mobile phone with product news and updates? | 0.643 | 0.502 | 0.827 |
| c）Do you like to receive precise push messages on your mobile phone with event invitations and reminders ? | 0.736 | 0.647 | 0.816 |
| d）Do you like to receive precise push messages on your mobile phone with personalized recommendation ? | 0.835 | 0.78 | 0.807 |
| e）Do you like to receive precise push messages on your mobile phone with social interaction notification ? | 0.585 | 0.421 | 0.832 |
| f）Do you like to receive precise push messages on your mobile phone with industry information and trends ? | 0.735 | 0.691 | 0.815 |
| g）Do you like to receive precise push messages on your mobile phone with Personalized recommendation ? | 0.329 | 0.194 | 0.86 |
| h）How often do you want to receive accurate push messages from your mobile phone? | 0.56 | 0.402 | 0.842 |
| l）For the precise push message you receive from your mobile phone, what is your most common operation? | 0.12 | 0.169 | 0.867 |

(5)The following table shows the reliability of the INFORMATION TRANSPARENCY question type in this questionnaire:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| I**NFORMATION TRANSPARENCY** | | | | |
| Options | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted | Cronbach's Alpha |
| a）Do you know your personal information or data behind the personalized push message? | 0.577 | 0.415 | 0.83 | 0.845 |
| b）Before receiving the personalized push message, will you receive the relevant privacy policy description or information use statement? | 0.635 | 0.468 | 0.819 |
| c）Do you want to have a more detailed understanding and control over the use of personal information and data involved in personalized push messages? | 0.307 | 0.179 | 0.88 |
| d）Do you know the information source of the mobile push message? | 0.772 | 0.703 | 0.789 |
| e）Do you know how to collect the information of mobile push messages? | 0.767 | 0.798 | 0.791 |
| f）Do you know how your personal data (such as interests, browsing history, etc.) is used to push messages? | 0.742 | 0.731 | 0.796 |

(6)The following table shows the reliability of the PERCEIVE EVALUATION question type in this questionnaire:

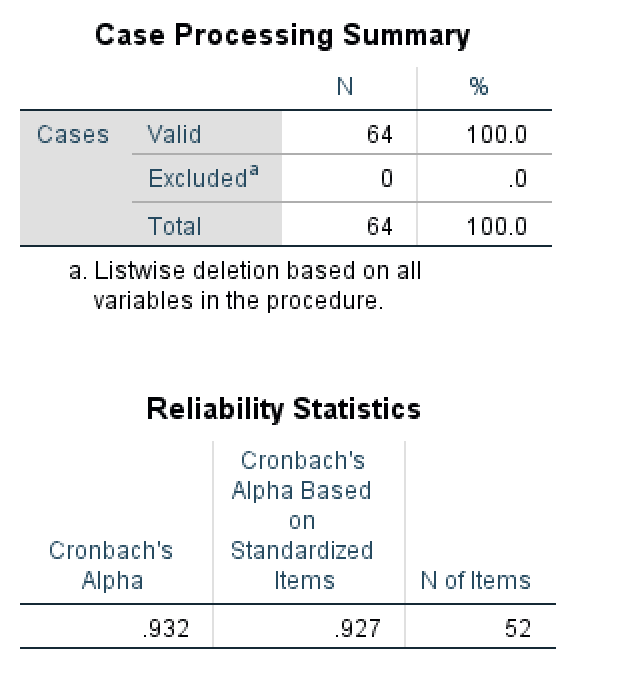
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PERCEIVE EVALUATION** | | | | |
| Options | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted | Cronbach's Alpha |
| a）How satisfied are you with the overall accuracy of mobile push messages? | 0.778 | 0.655 | 0.857 | 0.893 |
| b）What do you think of the information quality of push messages? | 0.813 | 0.674 | 0.844 |
| c）How do you evaluate the matching degree of the received push message with your personal interests and needs? | 0.784 | 0.686 | 0.854 |
| d）How do you evaluate the timeliness of push messages? | 0.682 | 0.525 | 0.892 |

(7)The following table shows the reliability of the IMPACT OF PRECISE PUSH SERVICE question type in this questionnaire:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **IMPACT OF PRECISE PUSH SERVICE** | | | | |
| Options | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted | Cronbach's Alpha |
| a）Does the push message help you make better purchase decisions or daily decisions? | -0.371 | 0.168 | 0.6 | 0.035 |
| b）Did the push information prompt you to take some actions (such as downloading apps, purchasing goods, etc.)? | 0.354 | 0.374 | -.705a |
| c）Does the push information help you find new interests or products? | 0.263 | 0.421 | -.389a |
| d）Does the push affect your perception of the brand or product? | 0.053 | 0.091 | -.033a |

From the test results, it can be seen that the test reliability of all questions in the IMPACT OF PRECISE PUSH SERVICE question type is relatively low, and the overall reliability is poor. Therefore, this question type needs to be modified or deleted in the formal questionnaire, or the question type needs to be changed to obtain better questionnaire test results.

In this test questionnaire, Cronbach's Alpha was used to calculate and analyze the reliability of the questionnaire questions. The overall reliability analysis results of all questions are as follows:



From the analysis results, the Cronbach's Alpha of this test questionnaire is 0.932. The reliability value is in line with the test expectations, but it also highlights that the reliability value is too high. First of all, there are too many questions in the questionnaire, 52, which raises the reliability test value. Secondly, the design of the questionnaire questions is too focused, and the questions measure the same concept, which also raises the reliability measurement coefficient. Therefore, during the formal measurement, the test questions should be streamlined. At the same time, questionnaire questions about internal push of the APP are added to expand the scope of research and increase research ideas. For the two types of questionnaire questions with low reliability in the pilot test, the method of adjusting and changing the questions or deleting the questions is adopted to deal with them. Thereby ensuring that the reliability of the formal questionnaire meets the test expectations.

# 3. Questionnaire question validity analysis

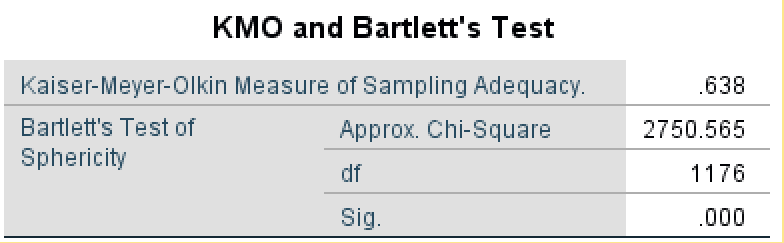
KMO (Kaiser-Meyer-Olkin) test and Bartlett's Test are statistical methods used to evaluate whether data is suitable for factor analysis. These two tests are usually used when conducting questionnaire validity analysis to determine whether the data structure is suitable for further construct validity analysis. The KMO test measures the proportion of partial correlation and complete correlation between variables. It is an index between 0 and 1, which is used to evaluate the degree of sharing between variables in the data. The closer the KMO value is to 1, the higher the commonality between variables and the stronger the applicability of factor analysis. Evaluation criteria: KMO=0.9 or above: excellent; 0.8-0.9: excellent; 0.7-0.8: good; 0.6-0.7: average; 0.5-0.6: barely; below 0.5: unsuitable. It is generally believed that the KMO value should be greater than 0.6 to be suitable for factor analysis. The specific calculation formula is as follows:

where:  is the simple correlation coefficient between variable (i) and variable (j); is the partial correlation coefficient between variable (i) and variable (j). The KMO value measures the overall size of the correlations among all variables relative to the overall size of the partial correlations. If the partial correlations are small, which means that the common variation between variables is mainly driven by their common correlation to other variables, in this case the KMO value will be close to 1, indicating that the data is very suitable for factor analysis. On the contrary, if the partial correlation is large, the KMO value will be close to 0, indicating that factor analysis may not be the best choice.

Bartlett's sphericity test is used to test whether the correlation between variables is significant, that is, to test whether the correlation coefficient matrix of the observed variables is significantly different from the unit matrix. The null hypothesis of this test is that there is no correlation between the observed variables (i.e., the correlation matrix is ​​an identity matrix). If the value of Bartlett's test is less than the usual significance level (for example, 0.05), the null hypothesis is rejected, indicating that there is a correlation between variables and that factor analysis is suitable. Bartlett's test is a statistical test used to test whether there is a significant difference in the overall correlation coefficient between variables. It is mainly used to test whether the data is suitable for factor analysis. The calculation formula for Bartlett's Test is as follows:

Where:is the chi-square statistic;is the sample size;is the number of variables; is the determinant of the correlation matrix.

The validity measurement values of this test questionnaire are shown in the figure below:



It can be seen from the test results that the result of Bartlett's sphericity test is infinitely close to 0, which is less than the usual significance level (for example, 0.05). The null hypothesis is rejected, indicating that there is a correlation between variables and is suitable for factor analysis. The value of KMO is 0.638, which is a situation where the validity results are very average but factor analysis can be performed. It proves that the questionnaire survey is generally usable, but it still needs to be optimized. The main problem is that there is still correlation between the questions. The solution is to refine and delete some questions in the formal questionnaire to reduce the correlation between questions, thereby improving the validity of the questionnaire questions.

# 4. Difference test

First, do a difference test on gender and corresponding question type results. Difference test analysis was performed using independent samples t test. Independent samples t-test, also known as two-sample t-test or Student's t-test, is a statistical method used to compare whether there is a significant difference in the means of two independent groups. This test is suitable for comparing the means of two sets of data, where each set of data comes from a different subject. The basic assumption of the independent sample t test is that both sets of data come from normally distributed populations, and the variances of the two populations are equal (homogeneity of variances). The purpose of the test is to determine whether the population means from two independent samples are equal. The two different assumptions are:

Null hypothesis (H0): There is no difference between the population means of the two groups, that is, μ1=μ2.

Alternative hypothesis (H1): There is a difference between the population means of the two groups, that is, μ1≠μ2.

Independent sample t-test calculation formula:

where、is the sample mean of the two samples;、is the variance of the two samples;、is the sample size of the two samples.

If the calculated t-value is greater than the critical t-value (or the p-value is less than the significance level, usually 0.05), then the null hypothesis is rejected and there is a significant difference between the two groups. The independent samples t-test is a powerful yet simple tool for comparing differences between two groups. However, it is necessary to pay attention to its assumptions when using it, and interpret the results in conjunction with actual conditions. The independent sample t test is widely used in medicine, psychology, social science and other fields to compare the difference between two independent groups on a certain quantitative index, such as the comparison of the effects of two different treatment methods, the impact of different education methods on academic performance. Impact etc. In this project, this method was used to test whether there are differences in the answers of men and women to different question types.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Analysis of gender differences in each dimension** | | | | | | |
| Different dimensions | gender | N | Mean | Std.Deviation | t-test for Equality of Means | Sig.(2-tailed) |
| EFFECT OF PRECISE PUSH SERVISE | Male | 38 | 16.42 | 4.272 | -0.108 | 0.914 |
| Female | 26 | 16.54 | 4.254 |
| MESSAGE VALIDITY AND QUALITY | Male | 38 | 15.63 | 4.377 | -0.503 | 0.616 |
| Female | 26 | 16.15 | 3.585 |
| NON INTERFERENCE WITH USER EXCELLENCE | Male | 38 | 13.74 | 2.533 | -1.559 | 0.124 |
| Female | 26 | 14.77 | 2.703 |
| OPERABILITY | Male | 38 | 15.47 | 4.215 | -2.048 | 0.045 |
| Female | 26 | 17.69 | 4.315 |
| USER CHOICE | Male | 38 | 26.89 | 7.457 | -0.707 | 0.482 |
| Female | 26 | 28.19 | 6.818 |
| INFORMATION TRANSPARENCY | Male | 38 | 15.61 | 5 | -0.796 | 0.429 |
| Female | 26 | 16.46 | 3.603 |
| PERCEIVE EVALUATION | Male | 38 | 12.21 | 3.24 | 0.166 | 0.869 |
| Female | 26 | 12.08 | 3.058 |
| IMPACT OF PRECISE PUSH SERVICE | Male | 38 | 10.58 | 1.795 | -1.047 | 0.299 |
| Female | 26 | 11.04 | 1.612 |

By analyzing the results, only the significance test of operability is 0.045, which is less than 0.05 and there is a gender difference. There is no difference in the dimensions of other questionnaire results between men and women.

Since the regional variable has three options, namely: Nanning City, other cities in Guangxi, and cities in other provinces, one-way analysis of variance is used to test the differences between the dimensions. One-way analysis of variance (One-Way ANOVA) is a statistical method used to compare whether there are significant differences in the mean values ​​of three or more independent sample groups. This method is suitable for studying the impact of a categorical independent variable (factor) on a continuous dependent variable, where the categorical independent variable has three or more levels (i.e., groups). The purpose of one-way analysis of variance is to explore whether there are statistically significant differences in the means between different groups. Its basic assumption is that each group of data comes from a normally distributed population and the variances of each group are equal (homogeneity of variance).

The two different assumptions are:

Null hypothesis (H₀): μ₁=μ₂=μ₃=...=μₖ (mean values ​​of all groups are equal);

Alternative hypothesis (H₁): Mean values ​​of at least two groups are not equal.

ANOVA determines whether the difference between groups is significant by comparing the variance between groups with the variance within groups. If the variance between groups is significantly greater than the variance within groups, it is considered that there is a difference between groups.

Find or calculate the p-value based on the F statistic and the corresponding degrees of freedom. If the p-value is less than the pre-set significance level (usually 0.05), the null hypothesis is rejected, and it is believed that there is a significant difference in the means of at least two groups. If the p-value is greater than the significance level, the null hypothesis cannot be rejected, and it is believed that there is insufficient evidence to show that there is a significant difference in the means between the groups.

One-way ANOVA is a powerful statistical tool that can compare the differences between multiple groups at the same time. However, when using it, it is necessary to pay attention to its assumptions and interpret the results in combination with actual conditions. One-way ANOVA is widely used in scientific research, especially when it is necessary to evaluate the impact of a factor (such as treatment methods, educational technology, work environment, etc.) on the outcome variable (such as treatment effect, academic performance, work efficiency, etc.) at different levels. One-way ANOVA is one of the commonly used statistical methods in social science, biology, engineering, and psychology research. It is used to test whether there are significant differences between three or more groups on a certain variable. Through this analysis, researchers can determine whether the effects under different conditions are significantly different, thereby providing a basis for further research and practice.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Analysis of differences in regional factors in various dimensions** | | | | | | |
| Different dimensions | Different regions | N | Mean | Std. Deviation | F | Sig. |
| EFFECT OF PRECISE PUSH SERVISE | Nanning | 7 | 14.71 | 1.604 | 0.785 | 0.461 |
| Other cities in Guangxi | 36 | 16.89 | 4.111 |
| Other cities in other provinces | 21 | 16.33 | 4.963 |
| MESSAGE VALIDITY AND QUALITY | Nanning | 7 | 14.29 | 2.215 | 0.573 | 0.567 |
| Other cities in Guangxi | 36 | 16.03 | 3.715 |
| Other cities in other provinces | 21 | 16.05 | 5.015 |
| NON INTERFERENCE WITH USER EXCELLENCE | Nanning | 7 | 12.14 | 1.574 | 2.441 | 0.096 |
| Other cities in Guangxi | 36 | 14.33 | 2.586 |
| Other cities in other provinces | 21 | 14.52 | 2.786 |
| OPERABILITY | Nanning | 7 | 13.86 | 2.61 | 1.607 | 0.209 |
| Other cities in Guangxi | 36 | 16.36 | 4.079 |
| Other cities in other provinces | 21 | 17.24 | 5.078 |
| USER CHOICE | Nanning | 7 | 25.29 | 6.473 | 0.345 | 0.71 |
| Other cities in Guangxi | 36 | 27.75 | 7.173 |
| Other cities in other provinces | 21 | 27.57 | 7.606 |
| INFORMATION TRANSPARENCY | Nanning | 7 | 14.14 | 3.532 | 1.314 | 0.276 |
| Other cities in Guangxi | 36 | 16.69 | 4.118 |
| Other cities in other provinces | 21 | 15.29 | 5.198 |
| PERCEIVE EVALUATION | Nanning | 7 | 11.14 | 2.268 | 0.401 | 0.672 |
| Other cities in Guangxi | 36 | 12.28 | 3.132 |
| Other cities in other provinces | 21 | 12.29 | 3.466 |
| IMPACT OF PRECISE PUSH SERVICE | Nanning | 7 | 9.86 | 1.574 | 1.248 | 0.294 |
| Other cities in Guangxi | 36 | 10.97 | 1.874 |
| Other cities in other provinces | 21 | 10.71 | 1.454 |

Judging from the test results, if the statistical p-value of each dimension is greater than the significance level (0.05), the null hypothesis cannot be rejected, and it is believed that there is insufficient evidence to show that there is a significant difference in the mean between groups. In other words, there is no significant difference in the region between the dimensions, which is in line with the expected statistical results.

# 5. Correlation analysis

Questionnaire correlation analysis is an important statistical method to study the strength and direction of the relationship between variables. Correlation analysis is a method used to evaluate whether there is a certain statistical association between two or more variables. Correlation analysis can help researchers understand the strength and direction of the relationship between variables, but it is different from the causal relationship. In this sample, the Pearson correlation coefficient is used to evaluate the correlation of the tested samples. Pearson correlation coefficient: used to quantify the strength of the linear relationship between two continuous variables. The data is required to be approximately normally distributed. The Pearson correlation coefficient (r) is used for the linear relationship between continuous variables, with a value range of -1 to +1, and an explanation: r = 1 is completely positively correlated; r = -1 is completely negatively correlated; r = 0 is no linear correlation. The calculation formula is as follows:

Where: n is the sample size, that is, the number of data points; is the i-th observation of variable X; is the sample mean of variable X; is the i-th observation of variable Y. is the sample mean of variable Y. Correlation strength judgment: |r| < 0.3: weak correlation; 0.3 ≤ |r| < 0.5: moderate correlation; |r| ≥ 0.5: strong correlation.

When conducting correlation analysis, researchers need to pay attention to the following points: (1) Correlation does not equal causation. Just because there is a correlation between two variables, it does not mean that one variable causes the change of the other variable. (2) The distribution characteristics and measurement level of the data will affect the selected correlation analysis method. (3) It is necessary to test whether the data meets the assumptions of correlation analysis, such as linear relationship, normality and homogeneity of variance. Correlation analysis is an important part of questionnaire survey data analysis, which provides valuable information for understanding the relationship between variables. The correlation analysis statistics of each dimension are as follows:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Correlation statistics of each dimension** | | | | | | | | |
| Different dimensions | Effect of precise push servise | Message validity and quality | Non interference with user excellence | Operability | User choice | Information transparency | Perceive evaluation | Impact of precise push service |
| Effect of precise push servise | 1 |  |  |  |  |  |  |  |
| Message validity and quality | .729\*\* | 1 |  |  |  |  |  |  |
| Non interference with user excellence | .432\*\* | .438\*\* | 1 |  |  |  |  |  |
| Operability | .451\*\* | .403\*\* | .537\*\* | 1 |  |  |  |  |
| User choice | .550\*\* | .349\*\* | .357\*\* | .733\*\* | 1 |  |  |  |
| Information transparency | 0.238 | 0.145 | .348\*\* | .533\*\* | .525\*\* | 1 |  |  |
| Perceive evaluation | .511\*\* | .414\*\* | .404\*\* | .728\*\* | .656\*\* | .659\*\* | 1 |  |
| Impact of precise push service | -0.187 | -0.153 | 0.022 | -0.098 | -0.133 | .287\* | -0.037 | 1 |

The result with two \* indicates that there is a significant correlation between the variables at the 99% significance level. The correlation result between service impact and information transparency is one \*, indicating that there is a significant correlation between service impact and information transparency at the 95% significance level. No \* indicates a weak correlation. In this test, service impact and other dimensions show weak correlation characteristics, and there are some negative correlations. It shows that the higher the efficiency of precision push, the smaller the service impact.