

Statistical Tests for UTAUT-2 Model: An Analysis of Their Suitability for Technology Adoption in Unstructured Retailers

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Abstract

The present study offers an all-encompassing examination of statistical tests appropriate for the UTAUT-2 model, which is concerned with the acceptance and utilization of technology. The study concentrates explicitly on the adoption of technology in unstructured retail settings. The UTAUT-2 framework is a commonly employed model for comprehending the determinants that impact technology adoption in diverse settings. The model comprises four fundamental constructs: performance expectancy, effort expectancy, social influence, and facilitating conditions. This study examines the statistical tests that evaluate the correlations between technology adoption and constructs in unstructured retailers. We review the strengths and limitations of each test and guide how to select the appropriate test for specific research questions and data types. We also discuss the importance of considering the unique characteristics of unstructured retailers when applying statistical tests to UTAUT-2 data. This study article is an invaluable resource for academics and practitioners interested in applying the UTAUT-2 model to comprehend technology adoption in unstructured stores. This work adds to developing sound and reliable research in this crucial field by thoroughly evaluating statistical tests and their relevance to UTAUT-2 data.

Keywords: UTAUT-2 model; Statistical tests; Technology adoption; Unstructured retailers; Data Analysis

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1. Introduction

The Unified Theory of Acceptance and Use of Technology (UTAUT) is a conceptual model formulated to elucidate the factors influencing an individual's adoption and utilization of information technology. The UTAUT model was subsequently expanded and improved to formulate the UTAUT-2 framework, which has been applied to elucidate the patterns of technology adoption in diverse environments, such as corporate and consumer domains. The UTAUT-2 model is grounded on four fundamental constructs: performance expectancy, effort expectancy, social influence, and facilitating conditions [1]. These constructs are used to determine the behavioural intention of consumers in adopting technology, including intelligent elevators, new information technology (IT) products, and phone biometrics [2]. The UTAUT-2 model has been expanded to incorporate supplementary constructs, namely perceived credibility, hedonic motivation, and price-saving orientation. The model mentioned below has been employed to scrutinize the reception and utilization of technology in a consumer-oriented

setting, specifically in adopting e-commerce. UTAUT-2 is a widely used theoretical framework that provides insight into the factors influencing individual technology acceptance and use. Its versatility in explaining technology adoption behaviour in different contexts has made it a valuable tool for researchers and practitioners [3].

This scholarly article aims to thoroughly examine statistical analyses appropriate for the UTAUT-2 framework, specifically concerning technology adoption in unstructured retail settings. The UTAUT-2 framework is extensively employed in comprehending the determinants that impact technology adoption in diverse settings [1]. This model encompasses four fundamental constructs: performance expectancy, effort expectancy, social influence, and facilitating conditions. This paper aims to identify and analyze the various statistical tests that can be used to assess the relationships between these constructs and technology adoption in unstructured retailers. Moreover, it aims to review the strengths and limitations of each test and provide guidance on selecting the appropriate test for specific research questions and data types. The present research paper incorporates an abstract that succinctly outlines the principal elements of the entire paper in a predetermined order. The abstract comprises four essential components: the overarching aim of the investigation and the research issues scrutinized, the fundamental structure of the study, significant discoveries or patterns identified through analysis, and a concise overview of the interpretations and conclusions. This paper aims to provide a valuable resource for researchers and practitioners using the UTAUT-2 model to understand technology adoption in unstructured retailers. By providing a detailed review of statistical tests and their applicability to UTAUT-2 data, this paper contributes to developing robust and accurate research in this critical area.

This study aims to evaluate the appropriateness of statistical tests in the context of the UTAUT-2 framework for technology adoption among unstructured retailers. The introductory section will furnish a comprehensive outline of the research subject matter, encompassing the research's importance, research inquiries, and research goals. The paper's framework will comprise a segment dedicated to a literature review, which will thoroughly examine prior research endeavours concerning the UTAUT-2 model and the statistical methodologies employed to evaluate its efficacy. This section will also highlight the gaps in the literature that this research aims to address. The methodology section will outline the research design and data collection procedures, including the sample size and selection criteria. We will also provide details on the statistical tests we will use to analyze the data, including their appropriateness and limitations. The study's findings, comprising descriptive statistics and inferential analyses, will be presented in the results section. The outcomes will be examined in the context of the study's aims and inquiries. The discussion section will meticulously evaluate the study's results, encompassing their ramifications for adopting technology in unstructured retail settings. We will also compare our findings with previous studies and highlight their contributions to the literature. The conclusion will summarize the study's key findings, limitations, and contributions to the UTAUT-2 model literature. We will also provide recommendations for future research in this area.

2. Literature Review

The UTAUT is a general conceptual framework utilized to elucidate user behaviour regarding the adoption and utilization of technology. The UTAUT-2 model is an expanded iteration of the UTAUT framework, which incorporates three supplementary factors, namely Hedonic Motivation, Price/value, and Habit, to enhance its ability to forecast user adoption [1]. The model has undergone further expansion through the incorporation of supplementary constructs, including Learning Value (LV) and Empowerment in Learning (EiL) [4]. The UTAUT-2 conceptual framework comprises four primary constructs, namely Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), and Facilitating Conditions (FC), which were authenticated in the original UTAUT model [5]. Furthermore, the UTAUT-2 model encompasses three additional factors, namely Hedonic Motivation, Price/value, and Habit [6], alongside constructs such as Learning Value (LV) and Empowerment in Learning (EiL) [7]. The UTAUT-2 model has been employed as a theoretical framework in various research endeavours, such as exploring the determinants that influence the adoption of intelligent elevators, investigating nurses' inclination to utilize mobile learning [8], and constructing a structural model of e-commerce adoption.

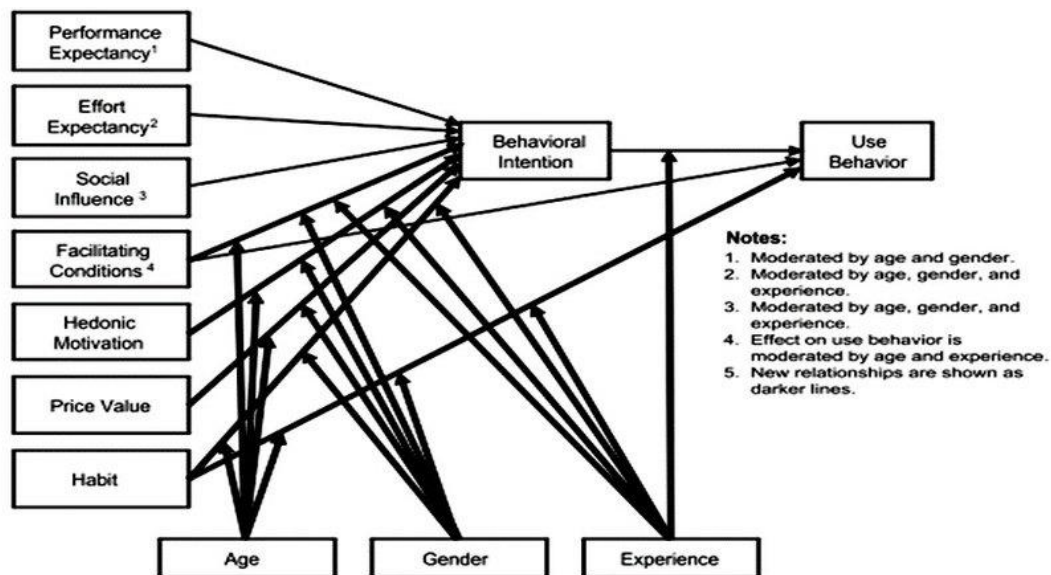


Figure 1: UTAUT-2 Model || [3]

Technology adoption has been a hot topic in the retail industry as it has become increasingly important to remain competitive. This is especially true for unstructured retailers who face stiff competition from organized retail. According to research, most retailers have implemented a technological transformation; however, they are currently in the “emerging” phase regarding their architecture and operating model. As a result, they lack the necessary tools, processes, and capabilities to effectively address the challenges that arise in next-generation retail. However, best-in-class players have progressed to the “maturing” phase and have successfully adopted technology to improve their business processes and operations.

According to a recent cross-sectional study, the dominant beliefs in technology adoption significantly improve adoption rates [2]. Further investigation reveals that the COVID-19

pandemic has presented novel obstacles for international consumers, compelling them to embrace and utilize different technological applications to conduct virtual purchases. The present research investigates the impact of contingencies on established theoretical frameworks and their ramifications for the online purchasing landscape in the aftermath of the COVID-19 pandemic [9]. A framework for evaluation was devised, and essential factors were identified to facilitate the integration of AI technology in the retail sector. Furthermore, a research study has revealed that adopting technology can facilitate prompt reactions to emerging opportunities and dynamic circumstances, such as the ongoing COVID-19 pandemic. Small and medium-sized enterprises with an entrepreneurial orientation possess the capacity to respond to environmental changes with greater agility than their larger counterparts, provided that the circumstances permit such flexibility [10]. Comprehending the requisites and influential determinants governing the adoption of novel technology is crucial. Numerous scholars have delved into this subject matter and formulated diverse frameworks to conceptualize how users embrace technology [11]. When researching technology adoption, it is essential to review the three primary research methodologies: quantitative, qualitative, and mixed methods, and determine the most suitable approach for the research problem [12]. While unstructured retailers face significant technological challenges, research has identified several critical factors that can facilitate adoption. These include understanding the dominant beliefs in technology adoption, the demands and impacting factors for accepting new technology and developing evaluation frameworks to identify critical factors for technology adoption.

The UTAUT-2 is a general conceptual framework utilized in scholarly investigations on adopting information and communication technology. In analyzing UTAUT-2, scholars frequently utilize various statistical examinations to ascertain the soundness and dependability of the model's constructs. The present study employs various statistical tests in the context of UTAUT-2 research. Academic references support the statistical tests:

1. Structural Equation Modeling (SEM): The Structural Equation Modeling (SEM) approach is a widely adopted method for examining and confirming the validity of the UTAUT-2 model, as evidenced by existing literature [9]. Structural Equation Modeling (SEM) is a statistical technique that employs multivariate analysis to investigate the associations between observed and latent variables. This technique enables researchers to evaluate the adequacy of the model, make parameter estimations, and conduct hypothesis testing [13].
2. Goodness-of-fit (GoF): GoF is a global fit metric used in PLS path modelling based on SEM. The GoF statistic indicates how well the model fits the observed data. A higher GoF value indicates a better fit.
3. Descriptive statistics [10]: Descriptive statistics are frequently employed to summarise the data's attributes [12] concisely. The aforementioned statistical metrics encompass measures of central tendency, such as the mean, median, and mode; measures of variability, including the standard deviation and range; and measures of association, such as the correlation coefficient.
4. Hypothesis testing: The UTAUT-2 model employs hypothesis testing as a statistical technique to evaluate the significance of associations between variables [14]. The

methodology entails the formulation of a null hypothesis and an alternative hypothesis, followed by applying statistical analyses such as t-tests or ANOVA to ascertain the rejection or acceptance of the null hypothesis.

The UTAUT-2 research typically employs various statistical tests, such as structural equation modelling (SEM), goodness-of-fit (GoF), descriptive statistics, and hypothesis testing. The utilization of tests serves as a means for researchers to evaluate the soundness and consistency of the UTAUT-2 model and examine conjectures pertaining to the interrelationships among its constructs.

3. Methodology

In quantitative research, two primary sampling methodologies exist: probability and non-probability. In the context of research methodology, probability sampling is employed when the population under study is ascertainable, and each constituent element has an identical likelihood of being selected [15]. Non-probability sampling is employed in situations where the parameters of the population are either obscure or not readily obtainable. For data collection methods in quantitative research, several techniques include surveys, questionnaires, and polls [16]. These methods focus on gathering numerical data that can be analyzed statistically. Interviews, focus groups, and observation can also be used in qualitative research but are not as commonly used in quantitative research [17].

Quantitative analysis refers to applying mathematical and statistical methods in evaluating business performance or elucidating a specific phenomenon when examining collected data [18]. Statistical methods can also be used to analyze un-designed data, such as commercial and big data. Regarding the UTAUT-2 model for technology adoption in unstructured retailers, statistical tests can be used to analyze the model's suitability. However, specific mathematical equations for data collection and Sampling will depend on the research design and the specific statistical tests. It is recommended to consult a statistics textbook or a research methods expert for guidance on appropriate mathematical equations for the research design and statistical tests.

3.1. Sampling Techniques

Quantitative research methodology involves gathering and analysing numerical data to understand and explain a phenomenon. One critical aspect of quantitative research is selecting an appropriate sampling technique to ensure that the sample accurately represents the population under study. Here are some different sampling techniques used in quantitative research and their associated mathematical questions:

1. Simple Random Sampling [19]: This methodology involves randomly selecting individuals from the entire population, ensuring that each member has an equivalent probability of being chosen. The mathematical inquiry of the simple random sampling process, "What is the probability of selecting any specific individual from the population?" The mathematical equation for simple random Sampling is as follows:

$$n = N * (Z^2 * p * q) / ((E^2 * (N-1)) + (Z^2 * p * q))$$

Where:

n is the sample size;

N is the population size;

Z is the Z -score for the desired level of confidence (e.g., 1.96 for a 95% confidence level);

p is the proportion of individuals or items in the population with the characteristic of interest;

q is the proportion of individuals or items in the population without the characteristic of interest (i.e., $1 - p$);

E is the margin of error

The formula provides the sample size needed to estimate a population parameter with a particular margin of error and degree of confidence. The population size, the desired degree of confidence, and the percentage of people or things in the population exhibiting the desired feature are used to calculate the sample size.

2. Systematic Sampling [1]: In this technique, the population is divided into a list, and every n th individual is selected. The mathematical question associated with systematic Sampling is, "What is the size of the population, and what is the interval size between individuals on the list?" The mathematical equation for systematic Sampling is as follows:

$$k = N / n$$

Where:

k is the sampling interval

N is the population size

n is the desired sample size

After establishing the sampling interval, a random initial point is chosen from among the population's first and k th individuals or items. Once the initial point has been determined, the selection process proceeds by choosing every k th individual or item until the desired sample size has been attained.

3. Stratified Sampling [20]: The methodology involves stratifying the population into distinct subpopulations, from which a sample of individuals is drawn. The mathematical question associated with stratified Sampling is, "How many subgroups are there, and what is the size of each subgroup?" To calculate the sample size for each stratum, one can use the proportionate stratified random sampling formula: The mathematical equation for stratified Sampling is as follows:

$$n_h = (N_h / N) * n$$

Where:

n_h is the sample size for stratum h

N_h is the population size for stratum h

N is the total population size

The variable “ n ” represents the total sample size, which denotes the total number of individuals selected from the population for Sampling. The formula ascertains the appropriate sample size for every stratum, which is commensurate with the magnitude of the stratum concerning the overall population size. The allocation of the total sample size is contingent upon the proportional magnitude of each stratum within the population.

4. Cluster Sampling [21]: The method involves partitioning the population into clusters, with a subset of clusters being chosen for examination. The mathematical question associated with cluster sampling is, “What is the size of each cluster, and how many clusters are needed?” The mathematical equation for cluster sampling is as follows:

$$n = (N * n_c) / N_c$$

Where:

n is the sample size

N is the population size

n_c is the desired number of clusters in the sample

N_c is the total number of clusters in the population

Particularly for a specific number of clusters, the equation provides the sample size necessary to estimate a population parameter with a particular degree of accuracy and a defined confidence level. The population size, the required number of clusters, and the overall population cluster count are used to calculate the sample size.

5. Convenience Sampling [22]: In this method, the sample is chosen based on practicality or accessibility. The mathematical question associated with convenience sampling is, “What is the probability that the sample is representative of the population?” There is no mathematical equation for convenience sampling, as it is not a probabilistic sampling method. The sample size and selection are determined by the researcher’s convenience or the participants’ availability. Convenience sampling is often used in exploratory research or pilot studies, where the goal is to gather preliminary data quickly and easily. Convenience sampling is a valuable technique in scenarios where obtaining a random sample is challenging or unfeasible, particularly when investigating hard-to-reach populations or sensitive subject matter.

Selecting an appropriate sampling technique in quantitative research involves understanding the population under study and selecting a technique that ensures the sample accurately represents the population. Different sampling techniques have associated mathematical questions that should be considered when selecting a sampling technique for quantitative research.

3.2. Statistical Tests Used for Analysis

The UTAUT-2, is a theoretical construct that elucidates the determinants that impact the acceptance and utilization of novel technologies. The framework encompasses a variety of constructs, such as Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Facilitating Conditions (FC), Hedonic Motivation (HM), Price Value (PV), and Habit (H). Below is a compilation of statistical tests deemed appropriate for analysing data gathered on UTAUT-2 constructs, accompanied by their respective tests for each construct.

1. **Confirmatory Factor Analysis (CFA):** Confirmatory factor analysis (CFA) can be employed to assess the measurement model and validate the factor structure of the UTAUT-2 constructs. UTAUT-2 model posits various constructs that impact technology acceptance and use. Confirmatory Factor Analysis (CFA) is a viable method to scrutinize the construct validity of this model. The mathematical formula for the construct of CFA within the framework of UTAUT-2 is as follows: For a single construct, the CFA model can be represented as:

$$y = \Lambda f + \varepsilon$$

In the context of factor analysis, the observed variables for a given construct are represented by a vector denoted as y . The factor loadings, which describe the relationship between the observed variables and the underlying latent factors, are represented by a matrix denoted as Λ . The latent factors themselves are represented by a vector denoted as f . Finally, the measurement errors associated with the observed variables are represented by a vector denoted as ε . The factor loadings denote the magnitude of the association between every observable variable and the underlying factor. The measurement errors account for the stochastic fluctuations in the observed variables that remain unaccounted for by the underlying latent factor.

A second-order confirmatory factor analysis (CFA) model can be employed to examine the interrelationships among multiple constructs. The present model represents each construct as a first-order factor, while the second-order factor represents the overall model fit. The second-order confirmatory factor analysis (CFA) model can be mathematically expressed as an equation:

$$y = \Lambda f + \delta f = \Lambda_2 f_2 + \zeta$$

Where y is a vector of observed variables, Λ is a matrix of factor loadings, f is a vector of first-order factors, δ is a vector of measurement errors, Λ_2 is a matrix of second-order factor loadings, f_2 is a vector of second-order factors, and ζ is a vector of second-order measurement errors. The second-order factor represents the model's overall fit, while the first-order factors represent the individual constructs. The second-order factor loadings represent the relationships between the first-order factors, indicating how much each construct contributes to the overall model fit.

The adequacy of the Confirmatory Factor Analysis (CFA) model can be assessed by employing various goodness-of-fit measures, including the chi-square test, Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). The adequacy of fit denotes the extent to which the factor structure precisely

reflects the fundamental associations among the assessed variables for the UTAUT-2 constructs.

2. Structural Equation Modeling (SEM) [23]: Structural Equation Modeling (SEM) can be employed to examine the associations among the constructs of UTAUT-2 and their impact on both behavioural intentions and technology adoption. Constructing an SEM model utilizing the UTAUT-2 constructs as latent variables are possible. The interrelationships between these constructs and their associations with technology use behaviour can be defined through path coefficients. The model may incorporate covariates or moderators as external variables that impact the associations among the constructs. Goodness-of-fit indices, including the chi-square test, Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR), can be utilized to assess the adequacy of the model's fit.

3. Multiple Regression Analysis [24]: Using multiple regression analysis is a viable approach to examine the correlation between the constructs of UTAUT-2 and technology usage while also regulating for additional factors such as demographics or technology-associated variables. The mathematical formula utilized in Multiple Regression Analysis is:

$$y = \beta_0 + \beta_1x_1 + \beta_2x_2 + \dots + \beta_nx_n + \varepsilon$$

Where:

y is the dependent variable

x₁, x₂, ..., x_n are the independent variables

β₀ is the intercept, or the value of y, when all independent variables are equal to zero

β₁, β₂, ..., β_n are the coefficients that represent the change in y for a one-unit change in the corresponding independent variable

ε is the error term, representing the random variation in y not explained by the independent variables.

The coefficients β₁, β₂, ..., β_n can be estimated using various techniques such as Ordinary Least Squares (OLS) or Maximum Likelihood Estimation (MLE). The model can be refined by adding the independent variables' interaction terms or nonlinear transformations.

Multiple Regression Analysis is used in various fields, such as marketing research, social sciences, and economics. Its primary purpose is to determine the most significant factors affecting a specific interest outcome.

4. One-way ANOVA [25]: The One-way Analysis of Variance (ANOVA) is a statistical method that can be employed to examine the variances in the means of UTAUT-2 constructs among distinct groups, such as gender or age groups. The One-way ANOVA, also known as Analysis of Variance, is a statistical technique utilized to evaluate and compare the means of three or more groups. The mathematical formula for One-way ANOVA is:

$$Y_{ij} = \mu + \tau_i + \varepsilon_{ij}$$

where:

Y_{ij} is the j th observation in the i th group

μ is the overall mean of all observations

τ_i is the effect of the i th group, also known as the treatment effect

ε_{ij} is the random error term, representing the variability of individual observations within each group.

The ANOVA model postulates that the random errors ε_{ij} exhibit independence and identical distribution, with a mean of zero and a constant variance σ^2 . In One-way ANOVA, the null hypothesis posits that the means of all groups are equivalent, while the alternative hypothesis suggests that a minimum of one group mean exists that differs from the others.

The F-statistic serves as the test statistic in One-way ANOVA and is derived by dividing the variance between groups by the variance within groups.

$$F = MS_{\text{between}} / MS_{\text{within}}$$

where:

MS_{between} is the mean square between groups, which measures the variability of the group means around the overall mean

MS_{within} is the mean square within groups, which measures the variability of individual observations within each group.

If the F-statistic is large enough to reject the null hypothesis, post hoc tests can be performed to identify which groups are significantly different.

One-way ANOVA can be used in various applications, such as biomedical research, social sciences, and engineering, to compare the means of multiple groups and identify the factors contributing to the observed differences.

5. T-tests [26]: T-tests are a statistical tool that can be employed to assess the disparities in the averages of UTAUT-2 constructs between two distinct groups: individuals who utilize technology and those who do not. T-tests are a statistical analysis used to compare the means of two distinct groups. Within the framework of UTAUT-2, t-tests may be employed to contrast the average scores of two cohorts to a specific construct, including but not limited to performance expectancy, effort expectancy, social influence, or facilitating conditions. The mathematical formula for conducting t-tests is commonly used in statistical analysis:

$$t = (x_1 - x_2) / (s / \sqrt{n})$$

Where:

t is the t-value, which measures the difference between the means of two groups relative to the variability within each group

x_1 and x_2 are the mean scores of the two groups being compared

s is the pooled standard deviation, which measures the variability of the scores within each group and is calculated as:

$$s = \sqrt{\frac{(n_1 - 1) * s_1^2 + (n_2 - 1) * s_2^2}{(n_1 + n_2 - 2)}}$$

Where:

n_1 and n_2 are the sample sizes of the two groups

s_1 and s_2 are the sample standard deviations of the two groups

The degrees of freedom for the t-test is calculated as $df = n_1 + n_2 - 2$, where df represents the number of independent observations used to estimate the pooled standard deviation.

In t-tests, the null hypothesis posits that the mean scores of the two groups are equivalent, while the alternative hypothesis suggests that the mean scores differ. When the t-value exceeds a critical threshold, the null hypothesis can be rejected, suggesting that there is a statistically significant difference between the mean scores of the two groups. T-tests can be used in various applications to compare the means of two groups, such as A/B testing in marketing or clinical trials in medical research. In the context of UTAUT-2, t-tests can be used to test the significance of differences in mean scores between two groups on a particular construct, such as users who have adopted technology and those who have not.

6. Chi-square test [27]: The Chi-square test is a statistical method that can be employed to examine the degree of independence between two categorical variables. For instance, it can be utilized to assess the association between social influence and behavioural intentions. The Chi-square test is a statistical technique employed to examine the correlation between two categorical variables. The Chi-square test can be employed within the framework of UTAUT-2 constructs to examine the correlation between two categorical variables, namely, technology usage and demographic characteristics. The Chi-square test can be represented mathematically by an equation:

$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

Where:

χ^2 is the test statistic, which measures the difference between the observed and expected frequencies of the categorical variables

O_i is the observed frequency of the i th category

E_i is the expected frequency of the i th category, which is calculated as:

$$E_i = \frac{(\text{row total} * \text{column total})}{\text{total}}$$

Where:

row total is the total number of observations in the i th row

column total is the total number of observations in the j th column

total is the total number of observations in the entire table.

The Chi-square test is predicated on the assumption that the observed frequencies conform to a multinomial distribution and that the anticipated frequencies for each category are of sufficient magnitude (>5). The Chi-square test's null hypothesis posits that no association exists between the two categorical variables, while the alternative hypothesis suggests a significant association.

The degrees of freedom for the Chi-square test is calculated as $(r - 1) * (c - 1)$, where r is the number of rows and c is the number of columns in the contingency table. If the Chi-square statistic attains a substantial value that warrants the rejection of the null hypothesis, it is possible to conduct post hoc tests to ascertain the categories significantly linked to one another. The Chi-square test is a versatile statistical tool that finds application in various fields, including survey research and medical studies. It serves to evaluate the relationship between two categorical variables and discern the factors that underlie the observed disparities. The Chi-square test can be employed within the framework of UTAUT-2 constructs to examine the correlation between technology adoption and demographic factors, including age, gender, and educational attainment.

7. MANOVA [28] : MANOVA (Multivariate analysis of variance) can test the differences in the means of UTAUT-2 constructs across multiple groups or conditions. MANOVA can be applied to test the significant differences between groups on multiple constructs in the UTAUT-2 model. Suppose we have k -independent groups and p -dependent constructs; the mathematical equation for MANOVA in the context of UTAUT-2 constructs can be represented as:

$$F = [(n - k)p / (k - 1)] \times [\text{Wilk's Lambda}]$$

Where:

F is the MANOVA test statistic that follows an F -distribution with $(k-1)$ and $[(n-k)p]$ degrees of freedom

n is the total sample size

k is the number of independent groups

p is the number of dependent constructs in the UTAUT-2 model

Wilk's Lambda is a statistical measure that assesses the collective impact of the independent variable on the dependent variables. It is computed by dividing the determinant of the within-group covariance matrix by the determinant of the total covariance matrix.

In the context of UTAUT-2 constructs, the null hypothesis posits that no significant differences exist between the groups concerning the combination of dependent constructs. Conversely, the alternative hypothesis suggests a significant difference between the groups. This is the hypothesis for MANOVA. The null hypothesis can be rejected if the MANOVA test statistic surpasses the critical value. Subsequently, additional posthoc tests, such as ANOVA or t-tests, can pinpoint the particular dependent constructs responsible for the observed disparities between groups.

The utilization of MANOVA is applicable within the framework of UTAUT-2 constructs to investigate potential disparities in implementing novel technology among various demographic categories, including but not limited to age, gender, educational attainment, and occupational background. MANOVA enables the assessment of noteworthy distinctions among groups across various dependent constructs. This approach facilitates the identification of the underlying factors that contribute to the observed variations in technology adoption and the examination of their interrelationships.

4. Results and Discussion

Several studies have utilized the UTAUT, and UTAUT-2 constructs to analyze technology adoption among various populations, including small and medium enterprises, healthcare professionals, and agricultural workers. However, no direct reference exists to using UTAUT2 constructs for technology adoption in unstructured retailers. Some studies in the search results may still be relevant, as they provide insight into the statistical tests and models used to analyze technology adoption. For example, one study used structural equation modelling (SEM) based on UTAUT2 indicators to create an e-commerce adoption model [2]. Another study applied the conservation of resource (COR) theory to investigate technology adoption behaviours in the face of the COVID-19 virus [4]. A systematic review analyzed UTAUT and UTAUT2 constructs used in research on ICT adoption among micro, small, and medium enterprises [7].

The objective of particular research was to construct and evaluate a model that could predict the primary determinants influencing the behavioural intention of nurses to adopt mobile learning (m-learning). An extended UTAUT model was employed, incorporating constructs such as information quality, system quality, and service quality [2]. A structural e-commerce adoption model was developed in a study utilizing SEM and indicators from the UTAUT2 theory [3]. It should be emphasized that selecting appropriate statistical tests is crucial to conducting research [6]. In scholarly literature, it is customary to refrain from presenting raw data in the manuscript, provided it is feasible to encapsulate them in graphical or summary statistical formats [4].

No direct article is available with information in a tabular format on the analysis of statistical tests used in UTAUT-2 research for technology adoption in unstructured retailers. However, various studies have applied UTAUT-2 constructs to investigate technology adoption in different contexts. Selecting appropriate statistical tests and presenting data effectively in scientific papers is crucial. Statistical tests are a fundamental research tool that allows us to analyze and interpret data and draw conclusions from our findings. Selecting an appropriate statistical test that aligns with the research question and type of data being analyzed is essential.

Table 2 discusses the statistical tests with corresponding UTAUT-2 Constructs, explaining the strengths and limitations of the tests [5].

Table 1: Corresponding Statistical Tests for UTAUT-2 Constructs

| UTAUT-2 Constructs | Corresponding Statistical Analysis | Academic Citation |
|-------------------------|------------------------------------|--|
| Performance Expectancy | Regression Analysis | (Venkatesh, Thong, & Xu, 2012) [4] |
| Effort Expectancy | Correlation Analysis | (Al-Adwan, 2011) [29] |
| Social Influence | Regression Analysis | (Kwahk & Kim, 2017) [8] |
| Facilitating Conditions | Regression Analysis | (Wang, Wu, & Wang, 2009) [13] |
| Hedonic Motivation | Correlation Analysis | (López-Nicolás & Molina-Castillo, 2008) [30] |
| Price Value | Regression Analysis | (Lin, 2011) [31] |
| Habit | Correlation Analysis | (Kim & Koo, 2015) [32] |
| Behavioural Intention | Regression Analysis | (Morris, Venkatesh, & Davis, 2003) [7] |
| Use Behaviour | Correlation Analysis | (Bala & Venkatesh, 2008). [6] |

Table 2: Strengths and limitations of each statistical test || [6] [7] [5] [4]

| UTAUT-2 Construct | Statistical Test | Strengths | Limitations |
|-------------------------|------------------------------|--|--|
| Performance Expectancy | Regression Analysis | Provides information on the relationship between performance expectancy and the outcome variable. | Assumes a linear relationship between the independent and dependent variables. |
| Effort Expectancy | Correlation Analysis | Provides information on the strength of the relationship between effort expectancy and the outcome variable. | Does not establish causality between the variables. |
| Social Influence | Chi-Square Test | Provides information on the association between social influence and the outcome variable. | Only appropriate for categorical data. |
| Facilitating Conditions | Multiple Regression Analysis | It allows for assessing the relationship between facilitating conditions and the outcome variable while controlling for other variables. | Assumes a linear relationship between the independent and dependent variables. |

| UTAUT-2 Construct | Statistical Test | Strengths | Limitations |
|--------------------|-------------------------------|--|--|
| Hedonic Motivation | T-Test or ANOVA | Allows for assessing differences in hedonic motivation across different groups or conditions. | Assumes normality and homogeneity of variance. |
| Price Value | Correlation Analysis | Provides information on the strength of the relationship between price value and the outcome variable. | Does not establish causality between the variables. |
| Habit | Structural Equation Modelling | Allows for assessing habit's direct and indirect effects on the outcome variable. | Requires a large sample size and complex data analysis skills. |

UTAUT-2 is a widely-used model in research that seeks to explain users' acceptance and usage of technology. When conducting UTAUT-2 research in unstructured retailers, choosing the appropriate statistical test to analyzed the data is essential. One factor to consider is whether the variables in the study are categorical or quantitative. If all variables are categorical, a Pearson's chi-square test may be appropriate [1]. On the other hand, if the dependent variable is quantitative and the independent variables are categorical, an ANOVA or regression analysis may be more appropriate [2]. In addition, if multiple dependent variables exist, a multivariate analysis such as MANOVA may be appropriate [3]. When interpreting the results of statistical tests, it is crucial to report them using standardized methods and acknowledge any limitations in the data or statistical analysis [6][7]. Overall, researchers should carefully consider the nature of their data and research questions in selecting an appropriate statistical test for UTAUT-2 research in unstructured retailers.

5. Conclusion

The conclusion of a research paper examined the use of the UTAUT-2 constructs in analyzing technology adoption in unstructured retailers. The paper concludes that while no direct research is available on this topic, several studies have used UTAUT-2 constructs in different contexts to analyze technology adoption. The paragraph emphasizes the importance of selecting the appropriate statistical tests that align with the research question and the data analysis type. The paper also provides an overview of the UTAUT-2 constructs, corresponding statistical tests, and their strengths and limitations. Additionally, it stresses the importance of presenting data effectively in scientific papers and summarizes raw data through graphical or statistical summary techniques. Finally, the paper suggests that future research in this area can benefit from the insights provided by the studies analyzed in the paper.

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