**Amelito’s Sizzling House Sales Analytics with Time Series Forecasting**

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A Capstone Project Presented to

College of Computer Studies

Our Lady of Fatima University – Quezon City

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In Partial Fulfillment

Of The Requirements for the Degree of

BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY

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December 2022

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**CHAPTER I**

1. **Introduction**

The project, entitled Amelito’s sizzling house sales Analytics forecasting website, is a modern style marketing strategy to help Amelito's San Jose del Monte Branch. Big or small restaurants often have trouble forecasting sales due to a lack of data or funds for data analysis. In this chapter, we will look at ways to help the owner restaurant to become more proficient in forecasting both sales and expenses. Using the history of past sales foodservice operations is critical when attempting to accurately forecast future sales. But, as the famous investing quote states, "Past Performance does not guarantee future results”. It is not enough to only look at the past to predict the future. There are just too many variables that can positively or negatively affect our operation. In this unit, we will look at several ways food service operations can attempt to accurately forecast.

The motivation for forecasting sales is that every restaurant case restaurant business faces the following difficulties in inventory management at this when the product demand is unstable, the inventory cannot meet the existing demand orders, which can easily lead to overstock or out-of-stock raw materials. When the order fluctuates so much that it is impossible to grasp the delivery time and the scheduled delivery quantity fully, the delivery time is shortened, and the production efficiency is reduced.

Customer orders have shifted to a small number of diversified products, causing significant market volatility, and the increase or decrease in the number of product orders changes over time. Therefore, the restaurant cannot respond to the number of goods based on the prior order information and expects to be delivered within the delivery date. However, market fluctuations have caused unstable demand orders. By preparing more inventory, the owner of the restaurant can avoid shortages and increase the order completion rate, but it is easy to generate high holding costs.

**1.1 Project Context**

forecasting is when you estimate how many orders your business will receive over the next few weeks or months. This should take into account any promotions or sales, any new product launches, and any product discontinuations. Being prepared for any variations in your average orders helps you save money, helps maintain a positive customer experience, and helps your fulfillment services be prepared for the changes in order volume. For example, suppose that your fulfillment service usually fulfills 100 orders a week for your business. If you run a marketing campaign that results in 500 orders without notifying your provider, then your fulfillment service might not be prepared to handle the additional orders, which can result in processing and shipping delays for your customers. Further, you might not have sent enough inventory to the fulfillment service. By forecasting your demand and informing your fulfillment service, you can make sure that both you and your fulfillment service are prepared for anticipated spikes in orders.

**1.2 Purpose and Description**

This project will benefit both the owner and the customers who want to facilitate their orders. By using the project, we made for this owner, sales forecasting can help the owner make informed decisions about everything from staffing and inventory to new product lines and potential marketing efforts. Sales can be seen within a year, and if there are still ingredients on hand, this site can be viewed to determine if there are any left. The site can also be used to determine how many people have bought the product and what their reviews are. Not only will this project help the owner to increase their sales, but also to create a better customer experience. It will also provide customers with a better way of ordering goods and tracking their orders. This project will help the owner create a better business and create a strong customer base

**1.3 Objectives of the Study**

**1.3.1** To plan a web-based ordering system that will forecast sales using the Arima algorithm

**1.3.2** To develop a system that analyzes sales data and forecasts future sales. And to create a system for tracking restaurant sales performance.

**1.3.3** To evaluate the proposed system to the IT experts for evaluation using an international standardization measurement

**1.3.3.1** Functional Suitability

**1.3.3.2** Performance Efficiency

**1.3.3.3** Usability

**1.3.3.4** Reliability

**1.3.4** To present the system to the user and allows them to evaluate it using international standardization

**1.3.4.1** Usability

**1.3.4.2** Performance Efficiency

**1.3.4.3** Functional Suitability

**1.3.4.4** Reliability

**1.4 Statement of the Problem**

A research project has been undertaken to develop an online ordering system. This will make it easier for the owner and customer to place an order as well as monitor the restaurant's performance. All the menus and supplies can be viewed here, as well as the price per pound of ingredients. This research also aims to answer the following questions:

**1.4.1** How did the researchers plan to create a system that analyzes and estimates the cost and revenue of Amelito’s Sizzling house?

**1.4.2** How did the researchers develop Amelito’s sizzling house sales analytics with forecasting. with the use of Arima Algorithm

**1.4.3** How did the IT experts evaluate the proposed project using an international standardization measurement.

**1.4.3.1** Functional Suitability

**1.4.3.2** Performance Efficiency

**1.4.3.3** Usability

**1.4.3.4** Reliability

**1.4.4** How did the owner of the restaurant evaluate the Information of Sales Forecasting System

**1.4.4.1** Usability

**1.4.4.2** Performance Suitability

**1.5 Scope and Limitation**

The following are some of the scopes of the proposed system:[1] Real-time forecasting of daily sales involves using data from previous sales and other relevant information to predict how much a business will sell on a particular day. This can be done using a variety of techniques, including time series analysis, machine learning algorithms, and econometric models. [2] ordering system is a software or online platform that enables customers to place orders for goods or services. This can include a wide variety of systems, such as online marketplaces, e-commerce platforms, and point-of-sale systems used in physical retail stores. [3] Inventory system is a software or set of tools used to track and manage the stock of goods and materials used in a business or organization. These systems can help businesses and organizations keep track of inventory levels, monitor stock movements, and generate reports and alerts to help manage inventory and prevent stockouts or overstocking. [4] The system can operate everywhere with an internet connection with a responsive user interface. This allows for the system to be accessed and used by users from various locations, as long as they have a device with internet access and a suitable browser or application to interact with the system's user interface.

The following are some of the limitations of the proposed system: [1] it is internet independent. Any signs of disconnection, the system will shut down or not operate properly [2] unstable or limited data that can affect the accuracy of the forecasting feature, [3] the size of the input can affect the training time.

**CHAPTER II**

**2.0 Related Literature and Studies**

As with conjoint analysis, one can develop a model of the expert. This approach, judgmental bootstrapping, converts subjective judgments into objective procedures. Experts are asked to make a series of predictions. For example, they could make forecasts for the next year’s sales in geographical regions. This process is then converted to a set of rules by regressing the forecasts against the information used by the forecaster. Once developed, judgmental bootstrapping models offer a low-cost procedure for making forecasts. They almost always provide an improvement in accuracy in comparison to judgmental forecasts, although these improvements are typically modest (Armstrong 1999).

Extrapolation methods use only historical data on the series of interest. The most popular and cost effective of these methods are based on exponential smoothing, which implements the useful principle that the more recent data are weighted more heavily. Another principle for extrapolation is to use long time-series when developing a forecasting model. Yet, Focus Forecasting, one of the most widely used time-series methods in business firms, does not do this. As a result, its forecasts are inaccurate (Gardner and Anderson 1997).

In some industries, forecasting acts as an input to many operations and business decisions that affect the profitability of the firm; in production planning, long-term forecasting is employed to determine an adequate level of manpower and acts as an input for business planning, such as planning for expansion or contraction of production units ([Sa-ngasoongsong et al., 2012](https://www.sciencedirect.com/science/article/pii/S0040162520313068" \l "bib0063)).

Moreover, [Ca'Zorzi and Schnatz (2010)](https://www.sciencedirect.com/science/article/pii/S0040162520313068" \l "bib0014) forecasted extra Euro-area exports using various price and cost competitiveness measures and found that for a recursive estimation approach, the effective exchange rate based on the export price index outperforms the other measures. [Wang et al. (2011)](https://www.sciencedirect.com/science/article/pii/S0040162520313068" \l "bib0075) found that standard autoregressive integrated moving average (ARIMA) models are capable of improving export forecasts in comparison to heuristic methods for Taiwan.

The choice of forecasting method depends on various factors, such as the time period, the cost of preparing forecasting and benefit resulting from its use, desired level of accuracy, forecasting period, data quality, availability, and the level of complexity of the relationships ([Bintang et al., 2019](https://www.sciencedirect.com/science/article/pii/S0040162520313068" \l "bib0010)).

The actual inflation rate is generally decreasing from the first to the third quarter of the year 2015 due to slower price increase of food items, as well as the cheaper price of electricity and domestic petroleum products (Bangko Sentral ng Pilipinas, 2015). However, from October 2015, the actual Inflation Rate started to increase for about 0.7%. This is due to higher prices of food items because of the seasonal demand nearing Christmas Season, the adverse impact of typhoons Lando, Nona and Onyok that visited the country and non-food inflation increases as prices of service-related CPI components accelerate (Bangko Sentral ng Pilipinas, 2015).

One of the forecasting challenges faced by sales managers is seller subjectivity. As proven in psychology, sellers tend to be overly optimistic of their forecasts, only to under-deliver at the end. This is why more than 40 percent of sales operations leaders identified this as their biggest challenge to forecast accuracy, according to a study by Korn Ferry.

[Winklhofer and Diamantopoulos (2003)](https://www.sciencedirect.com/science/article/pii/S0040162520313068" \l "bib0079) also tested a path model of ESF behavior and performance to find the key determinants of export sales forecasting performance.

Theresa Hoang Diem Ngo in his work used the time series which is a collection of observations for a certain variable that appear in a positive pattern over time. The most typical patterns are rising or declining trends, cycles, seasonality, and uneven oscillations. Analysts notice the outline and assume that it will repeat itself in the future to recreate a time sequence event as an occupation of its historical qualities. Using the Box-Jenkins technique, this research focuses on how to identify a suitable time series replica by comparing the aggregate autocorrelation purpose (ACF) and fractional autocorrelation purpose (PACF) to academic autocorrelation functions [1]. Eliete Nascimento Pereira employed wavelet decomposition to detect time series forecasts. A combination of forecasting methodologies, including the Autoregressive incorporated Moving Average (ARIMA) and artificial Neural Networks, was employed to obtain superior merit time series forecasting. Wavelet decomposition, ARIMA, and a hybrid neural network Multilayer Perception model were introduced in this study. Time sequence forecasting is the outcome of these models being mutually linear. Wahyudi, using the ARIMA model sought to prognosticate the stock price volatility of equities listed on the Indonesia Stock Exchange. The stylish ARIMA model was set up using the Indonesia Composite Stock Price Index, according to the empirical disquisition (0, 0, 1). The AIC criterion was used to determine this model. In a food company, the time series technique is used to predict and forecast demand. The study demonstrates how historical demand data may be utilized to forecast future demand and how these estimates affect the supply chain. Historical demand data was used to develop several autoregressive integrated moving average (ARIMA) models using the Box–Jenkins time series procedure, and the best model was chosen based on four performance criteria: the Akaike criterion, the Schwarz Bayesian criterion, maximum likelihood, and standard error. These related helps to build the forecasting using the ARIMA model to predict the future sales.

**CHAPTER III**

**3.0 Methodology**

In this chapter, the researchers will explain the methods used and how the researcher will develop the *“Amelito's sizzling house sales analytics with time series forecasting”* using autoregressive integrated moving average, or ARIMA for algorithm and Quantitative sales forecasting method.

**3.1 Algorithm**

**Arima** - An autoregressive integrated moving average, or ARIMA, is a statistical analysis model that uses [time series data](https://www.investopedia.com/terms/t/timeseries.asp) to either better understand the data set or to predict future trends. A statistical model is autoregressive if it predicts future values based on past values. For example, an ARIMA model might seek to predict a stock's future prices based on its past performance or forecast a company's earnings based on past periods.

Time Series Forecasting - the process of analyzing time series data using statistics and modeling to make predictions and inform strategic decision-making. It’s not always an exact prediction, and likelihood of forecasts can vary wildly especially when dealing with the commonly fluctuating variables in time series data as well as factors outside our control. However, forecasting insight about which outcomes are more likely or less likely to occur than other potential outcomes.

**3.2 System Design**



*Figure 1: Visual Representation of Agile Methodology*

The Figure shown above is the Agile Methodology, the diagram will be used by the researchers for The Development of the system. Before the real system is built conducting and analyzing is being implemented. With the use of each small prototype, the guarantee of concluding issues will resolve in an immediate time, as well as small unresolved issues. The project will proceed to design and implementation once the unresolved issue is fixed. and will be tested until system requirements are validated based on the requirements and scope of the system. The researchers are allowed to go back to the analysis phase if this development approach is not being met.

**3.2.1 Requirements**

The researcher analyzes and researches the formula that can be used to estimate the cost and revenue of Amelito’s Sizzling House accurately. Then the researcher will choose an algorithm that will best fit for analyzing the data, as well as an algorithm that can be used to predict and forecast their short-term performance.

**3.2.2 Design**

In this stage, the researcher created a visual representation of the application interfaces, system, database, flowchart, and the logical structure of the requirements being gathered from the previous phase. This will serve as the researcher's guide during the development of prototypes that will ensure that the requirements are being met.

**3.2.2.1 Program Flowchart**

The program flowchart shows the visual representation of the system with ARIMA algorithm.

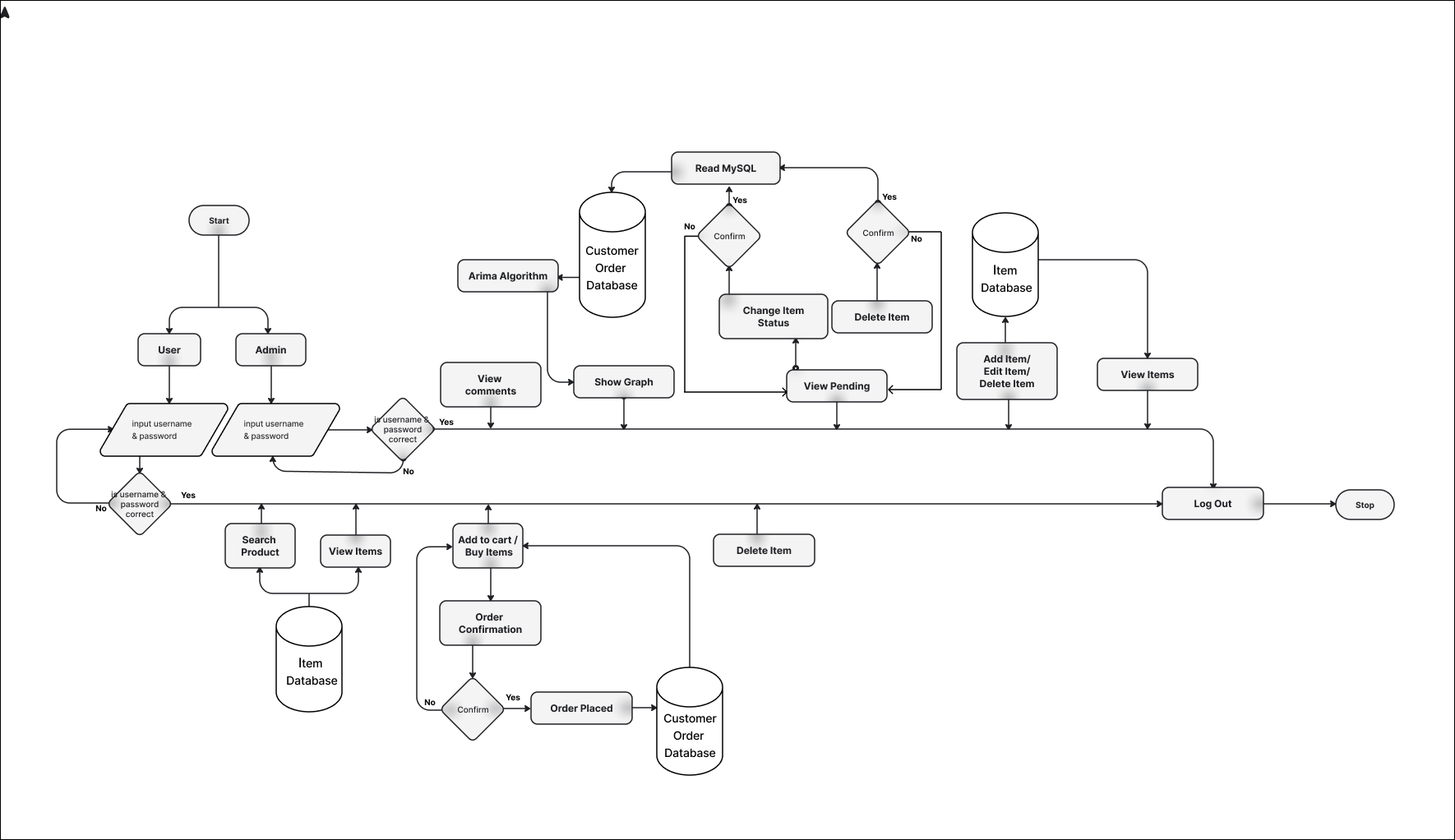
*Figure 2. Visual Representation of the Program Flowchart*

Figure 2 shows the program flowchart of Amelito’s sizzling house sales analytics with Time series forecasting. The Forecasting system uses laravel 7, php, jquery, javascript and html/css. First, you need to import raw data sets or the sales data of Amelito’s sizzling house. After that the system will utilize past and current data to predict future values over a period of time or a specific point in the future. ARIMA considers the past values (autoregressive, moving average) and predicts future values based on that. By analyzing data that we stored in the past, we can make informed decisions that can guide the business strategy and help the owner to understand future trends.

**3.2.2.2 System Flowchart**

The system flowchart shows the functionality of the entire system. The visual representation will help to understand how navigations and other operations are made through the system.

Diagram

Description automatically generated

*Figure 3. Visual Representation of the System Flowchart*

Figure 3 shows the system flowchart of the entire system of “*Amelito's sizzling house sales analytics with Time series forecasting*”.This shows the forecasting system website which sales can be seen within a year, and if there are still ingredients on hand, this site can be viewed to determine if there are any left.

**3.2.2.3 Theoretical Framework**

The researchers’ premise on the theory that, with the use of analyzed data. According to Armstrong and Collopy (1992) Traditional error measures, such as mean square error, do not provide a reliable basis for comparison of methods. The Median Absolute Percentage Error (MdAPE) is more appropriate because it is invariant to scale and is not overly influenced by outliers. For comparisons using a small set of series, it is desirable, also, to control for degree of difficulty in forecasting. One measure that does this is the Median Relative Absolute Error (MdRAE), which compares the error for a given model against errors for the naive, no change forecast.

One theoretical framework for sales forecasting is the "marketing mix" model, which includes the four key elements of product, price, promotion, and place. This model suggests that changes in any of these elements can affect sales. For example, if a company changes the price of its product, this may influence the demand for the product and, in turn, affect sales.

Overall, the goal of sales forecasting is to provide a realistic estimate of future sales that can be used to inform business planning and decision-making.

Graphical user interface, application, Teams

Description automatically generated**3.2.2.4 Conceptual Framework**

*Figure 4: Conceptual framework of the proposed system*

Figure 4 shows a conceptual framework of the system. It explains how the user accesses the website. When the user successfully login into the website, the website will display a system dashboard. The user can now choose from any of the provided option in the dashboard. A request will now be sent to the web server by the website. The web server contains the ARIMA algorithm where the input test data is stored as a session variable and is used to analyze raw datasets, process estimating future revenue by predicting the amount of product or services a sales unit (which can be an individual salesperson, a sales team, or a company) will sell in the next week, month, quarter, or year.

**3.2.3 Development**

In the development phase, the researchers must meet all the requirements and specifications of the system. If not, the researchers must seek out the issues and the missing functionalities should be addressed to be able to finish the system.The following functions that need to be addressed include but are not limited to the user Interface design of the website itself. The backend functions, including the raw datasets filtering to multi-dimensional arrays and ARIMA algorithm. Lastly, the hosting includes the XAMPP server (Linux, Apache, MySQL, PHP).

**3.2.4 Testing**

During this phase, the testing is conducted by the researchers to determine if the system really predicted the sales revenue and measure the accuracy using the MAPE (Mean Absolute Percentage Error) formula.

Graphical user interface, application

Description automatically generated

**3.2.5 Deployment**

In the deployment phase, the system has finally reached the end of its development cycle, with all the needs of the system are met and it is ready to be evaluated based on its given scope.

**3.3 Statistical Tool**

The researchers will use the statistical technique that uses time series data to predict the future. The parameters used in the ARIMA are (P, d, q) which refers to the auto-regressive, integrated, and moving average parts of the data set, respectively. ARIMA modeling will take care of trends, seasonality, cycles, errors, and non-stationary aspects of a data set when making forecasts.

## **3.3.1 Research Ethics**

3.3.1.1 The study should prioritize the well-being of the research participants, and the researchers should aim to ensure that the benefits of the research outweigh any potential risks. No possible medical/ physical/ emotional/ psychological risks associated to the study.

3.3.1.2 All research participants should voluntarily agree to participate in research without pressure from any financial gain or other perks in return for their involvement.

3.3.1.3 In terms of privacy issues towards the participant of the research should be prioritized. The researchers must ensure that personal data is kept secure and are not disclosed to unauthorized persons. The researcher implements a data confidentiality policy to ensure that the respondent understands the organization’s requirements in relation to the disclosure of personal data and confidential information. The data will be stored online and will dispose of by deleting the old data and replacing the current. Any infringement of the Data Privacy Act of 2012 is the responsibility of the researchers.

3.3.1.4 The researchers intend to utilize Google Forms to ensure the security of their data because it enables them to control the accessibility of the form and the ability to modify and administer the data. The information received from the respondents will be kept totally confidential.

3.3.1.5 The researcher preferred to demonstrate the system by video recording in order to explain clearly what the system was all about and to give the respondent feedback. Sometimes, the researcher may have limited time to present their system, and a video demonstration can help to ensure that they are able to cover all the important points without running out of time. If the researcher is not in the same location as their participant, it may be more practical to record a video than to travel to the audience's location.

3.3.1.6 The research protocol underwent ethical review through the OLFU-IERC.

## **3.3.2 Research Instruments**

The researchers will conduct a survey questionnaire for the respondents. There were two questionnaires used in this study. The first part – consists of (8) eight items that measure the Performance Efficiency, Usability, Reliability, and Functional Stability of the system. It also aims to evaluate an appropriate response time when performing its function, as well as accessibility and efficacy through IT professionals. The second part consists of (8) eight items that measure the Performance Efficiency, Usability, Reliability, and Functional Stability of the system, and it includes the user assessing how a system works, how easy it is to use, and whether the system aims to estimate crop production and success rate.

## **3.3.4 Population and Sampling**

The target population for this research is defined to include, specifically, the owner of the restaurant business as the users and the I.T. professionals. The researchers will conduct an online survey which is composed of questions related to the specific characteristics of the system. The researchers will also conduct an online meeting based on availability and desire to participate for those respondents who require assistance to be able to understand the system and collect data more effectively. To conduct the survey, the researchers should follow the required qualifications for both groups of respondents. If both groups of respondents do not have those criteria, he/she will be ineligible for the research.

The inclusion criteria outlined in this scenario are specific and limited to a particular population of Filipino citizens, either male or female individuals between the ages of 25 to 50 years old and willing to participate. Additionally, the criteria are further limited to those who are working in the I.T. field, specifically in web development and data analytics, between the ages of 25 to 50 years old and willing to participate in the study. The sample population of this study stood at 10 individuals and 3 I.T. professionals, gave a total of 13 respondents.

## **3.3.4 Data Collection**

In the process of data collection, the researchers will prepare a formal letter, duly signed by the Thesis Adviser, to request permission to carry out their study and will be distributed to selected respondents with consent to undertake the research using an online survey within social media platforms.

In conducting an online survey questionnaire, the researchers will be established an appropriate setting for the online survey and will seek permission from the respondents, explain the system to them or held a discussion about it, and then organize an online meeting. In addition, the survey will be conducted using Google forms that contain guiding questions as a basis. This also allows us to create and analyze surveys right away, get findings as they come in, and summarize the results using the provided charts and graphs. The gathered information from the respondents will be kept strictly confidential.

## **3.3.5 Data Gathering Procedure**

The researchers provide the system with useful features for the owner which is to create a Sales Analytic’s with Time Series Forecasting of crop yield success rate in the Business. It uses a quantitative approach that is objective, and its questionnaires are used to collect information with close-ended questions that involve use of numbers, variables and as well as the formulas. The following questions will be evaluated by both IT Professionals, and it will be interpreted by the given statistical tool. Researchers are required to have minimal interference to avoid incidences of modified respondent behavior and enhance the collection of accurate information. The researchers will collect data using convenience sampling, a non-probability sampling technique in which participants are chosen based on their availability and desire to participate. There was no time constraint set for conducting the research. The respondents who will participate in the research are 10 users and 3 IT Professionals. The researchers will ask the respondents about their information to make sure they are qualified.

## **3.3.6 Likert’s Scale**

The researchers will use the Likert Scale as a statistical tool for the questionnaires. Likert scale is used to acquire more specific responses by avoiding uncertainty. The statements will be based on (4) four specific characteristics from ISO 25010:2011 Software Quality Requirements and Evaluation:

1. **Performance Efficiency** - represents performance in terms of resources used under specific situations.
2. **Usability** - the capability of users to determine whether a product or system is suitable for their needs.
3. **Reliability** - the extent to which a system is operational and accessible when required for use.
4. **Functional Suitability** - the extent to which the functions aid in the completion of specific purposes and objectives.

The results will be interpreted based on the following:

|  |  |  |  |
| --- | --- | --- | --- |
| **Strongly Agree** | **Agree** | **Disagree** | **Strongly Disagree** |
| (4) | (3) | (2) | (1) |

## **3.3.4 Weighted Mean**

This statistical method calculates the average by multiplying the weights gathered in the Likert scale and taking its sum. The weighted mean formula can be shown in the equation below:

*Weighted Mean = ∑ni=1 (xi\*wi)/∑ni=1wi*

*where: ∑ denotes the sum; w is the weights; and x is the value*

## **3.3.5 Percentage Error**

This statistical treatment method will calculate the percentage error between an experimental measured value and a theoretical actual value. Percent error is the difference between a measured or experiment value and an accepted or known value, divided by the known value, multiplied by 100%. The formula is shown below:

*Percentage Error = ((Estimated Number – Actual Number)/ Actual number) x 100*

# Appendix 1

**Survey Questionnaire**

Table 1.0 *Survey Questionnaire for IT Professionals*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Criteria* | 4  **Strongly Agree** | 3  **Agree** | 2  **Disagree** | 1  **Strongly**  **Disagree** |
| 1. **Functional Suitability** | |  |  | |
| The system function easier to execute specific tasks |  |  |  |  |
| The system information is accurate. |  |  |  |  |
| 2. **Performance Efficiency** | |  |  | |
| The system load in a second  when performing its function |  |  |  |  |
| The system has a reasonable response time when accessing the program. |  |  |  |  |
| 3. **Usability** | |  |  | |
| The system is easily accessible when the user.  needs it |  |  |  |  |
| 4. **Reliability** |  |  |  |  |
| The system is available and accessible to use by the users |  |  |  |  |
| The system information is accurate. |  |  |  |  |

*Table 1.0 shows the Survey Questionnaire for IT Professionals*.

The following set of questions in each criterion will be evaluated by the IT professionals and it will be interpreted by the given statistical tool.

Table 2.0 *Survey Questionnaire for Customer*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Criteria* | 4  **Strongly Agree** | 3 **Agree** | 2  **Disagree** | 1  **Strongly**  **Disagree** |
| 1. **Performance Efficiency** | |  |  |  |
| The web-based system responds quickly to user requests. |  |  |  |  |
| The web-based system has a reasonable response time when navigating. |  |  |  |  |
| 2. **Usability** | |  |  |  |
| The system is designed to be user-friendly and accessible, even for individuals with limited technical expertise. |  |  |  |  |
| The system's interface is crafted to minimize user confusion and errors. |  |  |  |  |
| 3 **Functional Suitability** | | | | |
| The system's features align with the user's specific requirements and expectations. |  |  |  |  |
| The system's information is consistently reliable and correct. |  |  |  |  |

*The Table 2.0 shows the Survey Questionnaire for Amelito’s Customer.*

The following set of questions in each criterion will be evaluated by the Amelito’s Customer and it will be interpreted by the given statistical tool.

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