5-2023

Discovering Data-Driven Solutions: A Practical Guide for Small Businesses Implementing Data Analytics

Katherine Richoux

Discovering Data-Driven Solutions: A Practical Guide for Small Businesses Implementing Data Analytics

By

Katherine Armande Richoux

Advisor: Dr. Elizabeth Keiffer

An Honors Thesis in partial fulfillment of the requirements for the degree Bachelor of Science in Business Administration in Information Systems and Finance.

Sam M. Walton College of Business

University of Arkansas

Fayetteville, Arkansas

May 13, 2023

Discovering Data-Driven Solutions: A Practical Guide for Small Businesses Implementing Data Analytics

Introduction

In today's highly competitive business environment, small businesses are under growing pressure to fight for market share. To do this, a competitive advantage must be established to outperform other business competitors both big and small. One way that small businesses can create a competitive advantage is by utilizing their data and applying basic data analytics. Data analytics is the process of collecting and analyzing large sets of raw data using statistical tests to identify patterns and insights to make conclusions that inform business decisions (Frankenfield, 2023). The use of data analytics is not exclusive to large corporations and can be greatly beneficial to small businesses. Small businesses can gain valuable insights into market trends, customer demographics and purchasing behaviors, internal operations, performance monitoring, and more. Data analytics allows small businesses to harness the capability to create solutions for a variety of business needs at all levels ranging from high level management decisions down to daily in store operations. In this paper, I will explore the benefits of implementing data analytics for small businesses and examples of how and where it can be used.

This paper is meant to be a persuasive and informative introduction for small business owners or managers to become familiar with data analytics, its benefits, and how to successfully utilize it within their unique business scenarios. The structure of this paper will take on a conversational tone between author and reader to convey the information on a personal level through the Literature Review and Practical Guide.

The Literature Review will provide a detailed introduction into the world of data analytics. It is meant to answer common questions that one might have regarding the building blocks of implementing data analytics and covers general statistical knowledge that will be beneficial going forward. It will present common barriers to entry, why they exist, and how to overcome them. Components of data analytics such as data collection, storage, quality control, and types of testing will be discussed. Data analysis types including statistical analysis, diagnostic analysis, text analysis, and predictive analysis will be explored along with the statistical methods behind them such regressions, correlations, means testing, and cluster analysis. All this information will be beneficial to understand before applying it in the practical use cases that are described more in depth in the Practical Guide.

The Practical Guide will provide four case studies that consist of common questions or problems that data analysis can help resolve. These case studies range from solving internal financial issues to using consumer demographics and behaviors to create and market a new product line. These cases are meant to display how exactly data can be used to find valuable insights that can be interpreted to inform strategic decisions. The methods described in this section are generalizable and can be applied to other scenarios outside of the ones presented in this paper to be used for whatever business need best suits a company.

By the end of this paper, you will see the benefits that implementing data analytics can have on a small business. You will understand the differences in the types of data analytics procedures presented and how they are beneficial when applied in different situations. Overall, a general knowledge of data analytics, how analytics procedures work, and how data analytics can be used effectively will be achieved.

Literature Review

In the modern business world, a company's access and use of their data can be a key component of their success. Today, small businesses fight for market share in an environment dominated by retail giants such as Amazon, Walmart, and Target. These companies have an unprecedented grasp on evolving data and information systems technology which allows them to collect, track, and analyze their customers' data to gain a competitive advantage. Small businesses, by definition, are independently owned companies whose workforce is smaller than 1500 or whose revenue is under $40 million (Hait, 2021). Small businesses are integral to the U.S. economy and are present in every industry from fashion retail and restaurants to construction companies or financial service providers. How can these businesses begin to use their far more limited resources to remain competitive in this marketplace?

Utilizing your small businesses data is one of the most effective pathways to understanding customer trends, lowering operating costs, identifying risks, and creating competitive products or services. Harnessing this data can help to remove informational gaps that hold answers to key questions and can give guidance on future business decisions. It can be beneficial on two main fronts: providing improved external customer experience and making internal operations more efficient. These processes both positively affect net income in different ways. By having a heightened knowledge of your customers' wants and satisfaction, you can provide a better product or service and overall experience. This preserves existing customers relationships and attracts new customers, thus creating more revenue. By creating a more efficient internal process, you can simplify and streamline your day-to-day operations. Creating more accurate and in-depth reports and processes in far less time helps to lower company costs. The less time and resources allocated to daily operations – the more they can be utilized in other areas that need improvement. With these improvements combined, a company can see an increase in performance and key metrics such as sales revenue, net profit margin, and customer engagement.

In the text that follows, there will be a few words that are very similar to each other, however, their definitions are different. These words are data analytics, data analysis, and big data analytics. To avoid confusion, allow me to create a distinction between the different words by providing definitions and pointing out the differences. Data analytics refers to the general and broad field that covers the use of data and the many tools and analysis types therein (Kidd and Hornay, 2021; Bay Atlantic University, 2021). Data analysis is an individual process within the field of data analytics that is more specific to cleaning, transforming, modeling, and testing data to find information (Kidd and Hornay, 2021). Essentially, data analytics would describe the full process beyond the testing and modeling process, including activities such as storage and collection. Additionally, you may hear the phrase big data analytics. Big data analytics is still data analytics, but it is performed on such a large amount of data and data types that traditional tools cannot process its complexity and scale (Amadebai, 2022). Because of this, more advanced tools and techniques are needed, thus the use of big data analytics.

Today, upwards of 90% of US based companies are considered small businesses. Since the late 1990s the GDP share of these businesses has fallen from 48% to 43% (Chang, 2023). Small businesses are and have always been a crucial part of the American economy and have been drivers of innovation and providers of opportunity since their inception. Despite this, 50% of small businesses will fail within their first 5 years of business (Stasha, 2023). Factors such as

available funds and economies of scale leave small businesses far more vulnerable to economic shocks and low performance periods than their larger counterparts. How can these companies begin to offset this? While it is not a catch all solution, the implementation of data analytics within these companies can help greatly.

In a report by the U.S Small Business Administration's SCORE Association, it was found that while 51% of small business owners believe that big data analytics is beneficial, only 45% utilize these practices. Statistical evidence would show that companies that use data analytics techniques have 15% higher revenue than those who do not (Change, 2023). A similar report also showed that 73% of small businesses said that finding new customers was their top priority, followed by retaining repeat customers, and improving customer satisfaction (Weston, 2022). Once again, data analytics has been shown to provide many avenues for customer relations solutions. Here we can see that many small businesses' immediate goals can be achieved using data analytics.

A similar study interviewed 40 companies that use data analytics, 74% were small businesses and the remaining were third parties that work directly with small businesses. It was found that within the companies interviewed, 49% analyzed their company performance once a week, and around 39% analyzed performance once a month (Ugbaja, 2023). Performance checks are a necessary part of ensuring that your company is maintaining a sustainable level of business. Data analytics makes running these performance checks more efficient and interpretable. Based on the research provided, companies can see improved sales performance, increased efficiency, and better customer relations by implementing data analytics.

Common Barriers to Entry

As with any change project, struggles and complications can arise. Due to a lack of resources such as adequate work force, funding, or experience, it is reasonable to understand why many small businesses are wary of creating a data analytics system. Here I will address some of these complications and how to overcome them.

One of the biggest barriers to implementing data analytics is the assumption that high costs must be involved in the process (Haney, 2017). Many small business owners may believe that the implementation of data analytics and the tools it requires can be costly and while this can be true it is not always the case (Haney, 2017). The evolution of analytics technology has allowed it to become much more attainable at lower price points. Technologies exist at all levels of complexity, ability, scale and thus price. It is important to choose a method that aligns with your company's funding capabilities and overall goals. For a small business, allocating a total of 2%-6% of its budget to data analytics ranging anywhere from less than $10,000 to $100,000 per year depending on company size is a healthy amount of investment (Lastiri, 2023). If you feel that you have none or very few funds to allocate for this area, there are still solutions available. Even the most common tools can be expanded upon with increased knowledge and time investment. If you have the financial resources available to invest more cash into your data analytics system this will open some additional avenues such as third-party providers or more advanced/automated software and hardware options.

Once we have overcome the initial barrier of available financial resources, complications can arise during the implementation and integration of data analytics into a company's business model. Most commonly companies run into complications with getting employees to adapt to the

change, being overwhelmed by the sudden influx of data, and by becoming discouraged by early missteps in the process.

When organizational and cultural changes occur within companies it is normal for employees to be weary of the restructuring that the changes bring to their role and the company overall. Thus, when implementing data analytics into a company it is normal to experience some resistance from employees (Bean & Davenport, 2019). Overcoming any pushback or hesitancy from employees will be vital to the success of your data analytics implementation process. For this, having an effective change management plan will be important. Change management is the process a company uses to facilitate smooth transitions both internally and externally, especially regarding employees (Miranda & Bottorff, 2022).

Shortly after the initial launch of a data analytics system and shift to a data driven culture in a company, it can become overwhelming for employees to manage the sudden increased intake of so much information (Haney, 2017). Beyond the intake of new data is learning how to use and apply it. This can cause confusion and a sense of defeat early in the process. It is important that you have delegated the data analytics tasks appropriately and proportionally so that the workload can be handled in a reasonable and achievable way. You may not understand everything there is to know at the beginning of this endeavor. You and your staff should be encouraged to spend time getting familiar with your data and be open to creating a testing environment where you can make mistakes and learn.

Creating a data analytics system for your company is not always easy. Like with any new project there will always be setbacks and complications. Working out issues in the initial stages is a part of the process that may take time. Although this can be frustrating it is important to remember that once data analytics is successfully integrated into a business it is always a net positive. As technology evolves, all companies regardless of size will have some handling of analytics. It is important now to create a competitive advantage in the present that you can build upon going into the future. Overall, staying ahead of the data analytics curve will be vital in keeping your company successful in the future, do not allow for initial barriers to dissuade you from beginning this process. A quality analytics system includes efficient data collection, storage, quality control, and analysis.

Data Collection

The first step in using your data is having an avenue or avenues for data collection. If you already collect and store your company data, then you have completed the first part of the process. If you are not routinely collecting and storing your data, it is important to understand that effective data collection is the first step in creating a quality analytics system (Peck, 2022). The data assembled can inform you of your customers' decision-making process, local business and customer trends, and your company's internal processes. This helps you be able to make educated decisions for your company's business strategy, so it is important to get this first step right. Not having a quality system of data collection in place can lead to the use of data that does not accurately represent the population or may return incorrect information. Naturally, the decisions made with these faulty results could lead to decreased customer satisfaction and decreased efficiency. There are many methods of data collection. Most commonly, companies can use web analytics, customer store data, customer surveys, and questionnaires, and existing company data (Cote, December 2021).

A popular data collection method is to collect data directly from your online storefront using features from web analytics services. Web analytics is a powerful tool and highly accessible through third parties such as Google Analytics, and Open Web Analytics, Adobe Analytics, and many more. In 2019, 30% of small businesses use web analytics to track website activity and performance (Blue Corona, 2019). While these tools can collect raw data that you can access and analyze however you would like, many have pre-existing capabilities of analyzing and creating detailed reports of their own. Web analytics typically tracks customer behavior through clicks to finds trends and patterns which can be beneficial in learning what your most popular items/services are. It can track which items/services are typically bought together to create suggestions, how customers navigate through your interface (how customer friendly it is), and your conversion rate (how many people that put items in their cart actually buy them). It can track your websites traffic volume and show you times of day/week/year your website gets the most traffic. It is also capable of collecting demographic information such as age and location, helping to better understand your audience. Overall, if you are looking for a user-friendly experience for your online storefront, using a third-party web analytics provider is a great starting point.

Another way to collect customer data is through customer surveys or questionnaires (Cote, December 2021). This is a great way to collect qualitative customer feedback and demographic information. Surveys are commonly sent out via email, text, receipts, or through pop ups on websites. It is important to note however that the success of this collection is fully reliant on the willingness of your customers to participate and thus could lead to biased results. It is common to see stores offering promotions to customers who participate in these surveys. This method is not as automated as web analytics, many times it will produce unstructured data that will require more cleaning. However, it is a great way to collect direct customer feedback.

It should also be noted that a lot of company data can be found internally through routine business operations (Sammy, n.d;Treehouse Technology Group, n.d). This existing data requires no extra collection process and is created continually within the business as it operates. These metrics include sales, inventory, employee feedback, and more. These metrics simply need to be gathered and organized so that they can be used and interpreted effectively for data analytics.

Data Storage and Quality

Once you have collected your data two things to keep in mind are how you will store your data and how you will maintain the quality of your data. These are both crucial building blocks of preserving high quality, usable data.

Data can be stored in a variety of ways, ranging from entry level technology such as Excel, or up to non-local servers such as Cloud based servers. The size of your company and how much data you collect will be good indicators of where and how you should store your data (Vellila, 2022). If you have less variables and less inputs overall Excel would be a great option. If you have more variables or need to be able to view data relationships easier, a more advanced system such as SQL or a Cloud based option might be a better fit. Regardless of which you choose, customer privacy and overall security of your business information should be prioritized in this final decision (Fuggle, 2021).

The second thing to keep in mind would be maintaining your data quality. The tests you run on your data can only provide as good results as the data that you input into them. For this

reason, it is important to make sure that your data quality is always well maintained. You should have guidelines in place for each variable to keep consistency so that bad data will not be kept or admitted into the database. Having a standardized data quality reference is a good way to initiate good data quality practices within your company. With data coming from a variety of sources quality data is essential for good data driven decision making (Ehrlinger et al., 2019).

Types of Data Analysis

When it comes to analyzing data, there are a wide variety of techniques that can be used. A good starting place for selecting a technique is deciding what type of data analytics will best suit your needs. Four major categories include statistical analysis, diagnostic analysis, text analysis, and predictive analysis (Islam, 2020). Many companies use multiple or even all these methods. These techniques can be used in straightforward ways but can be expanded upon through the right technology to become much more advanced.

Statistical Analysis

Statistical analysis is a method of analysis used to find patterns and trends that uncover valuable insights in datasets (Simplilearn, 2023). Statistical analysis is primarily quantitative, meaning it is number based. Statistical analysis is an overarching term that includes multiple types of quantitative analytics, most notably: descriptive statistics and inferential statistics (Bender, 2023). Descriptive statistics is a powerful tool to make large amounts of company data easily interpretable by providing a summary of a company's numerical data. It is typically presented visually through graphs, charts, and tables for easier consumption. This type of analysis does not create any new information or conclusions, it simply summarizes and describes. If you are looking to expand upon your descriptive analysis results, this is when inferential analysis comes in. Inferential analysis uses the analyzed data to draw conclusions by recognizing relationships and patterns. These relationships allow you to expand past the dataset by inferring these results onto a larger population. This now allows you to make decisions based on what you can assume of a larger population. (See Types of Testing in Data Analysis for more details.)

Diagnostic Analysis

Diagnostic analysis is used to answer the "why" of an event. It drills down into your data to discover the root causes of the relationships and patterns in your data. It primarily uses statistical analysis to examine assumptions on the cause of an event or change in trend. It is a great tool for finding out why changes in performance occur and can help inform decisions on how to solve them. The linking of cause-and-effect relationships is unique to diagnostic analysis and should be applied in situations where this is your established goal (Cote, November 2021).

Text Analysis

Text analysis, also known as text mining, is used to create value out of large sets of unstructured text data. The disorganization of unstructured text data makes it hard to find specific information, customer sentiment, patterns, and trends efficiently. Implementing text analysis allows machine learning tools to sort and extract valuable information and insights from vast amount of raw qualitative data (Medelyan, 2021). If you need to find certain information more effectively, text analysis can be used on all company documents, survey/questionnaire responses, and reports. To take text analysis one step further, text analytics can be used to find

quantitative results from the qualitative data. Text analysis and text analytics are different as text analysis provides qualitative results and text analytics provides quantitative results (*What Is Text Analysis? A Beginner's Guide*, n.d.). This means text analysis reveals important information within the text and returns that data without any further exploration or manipulation. While text analytics uses the quantitative data mined from the text to find patterns and trends within a company's text data using statistical methods. Its results can closely resemble those of statistical analysis and can return these findings in the form of graphical representations or reports.

Predictive Analysis

Predictive analysis is utilized to make predictions on the future. It uses current and historical data to predict future results or events (Bush, 2021). It is an effective tool to use when making long-term decisions and future planning. Predictive analysis has become extremely popular in the business information sector for its ability to help management make informed decisions on long term business plans. It can be quite complex as it can be its most powerful with the addition of supplemental data that may originate from outside of your personal database. However, if you are capable of it, predictive analysis is an invaluable tool for being able to predict future performance.

Because of the nature of predictive analysis, it is often performed using machine learning techniques. The algorithms used in machine learning are capable of learning and adjusting based on these changing factors far more efficiently than other methods (Bush, 2021). While machine learning can sound intimidating, setting up a machine learning model using a software with that option, can be relatively simple. Machine learning uses algorithms that utilize many of the statistical tests that have been previously mentioned such as measures of central tendency (mean/median/mode/etc), regressions, correlations, etc. Simply put, machine learning can be like any other tests but with more automated help by using software or creating code.

Types of Testing Used in Data Analysis

Having a general knowledge of types of testing used in data analysis is essential in learning how and why they are used. It is important to have a basic understanding of the statistical methods behind these analyses so you can have an informed insight into what the test results are telling you. There are many types of analytical tests, too many for me to mention in this paper's constraints. Given this, I have picked several tests that are widely applicable, intuitive, and easy to apply for introductory analytics users: regressions, correlations, comparison of means, and cluster analysis.

Regression

Regression models analyze the relationship between a dependent variable and independent or explanatory variable(s). Essentially, we are looking to see how changes in one variable (independent) affect another variable (dependent) (Zach, 2021). Linear regressions can tell you if the direction of the relationship is positive or negative sloping and provides an equation to show how the change of one variable affects the other (Zach, 2021). A simple linear regression tests the strength of the relationship between two variables. For example, when the number of customers visiting the store or changes do the sales change? A multiple linear regression looks for two or more explanatory variables that have a relationship with a dependent variable. For example, when the number of customers in the store changes and how many

discounts there are currently running how do the sales change? You can use any combination of variables to find the strength and the direction of the relationship between them.

Correlation

Correlations analyze if there is a significant linear relationship between one or more variables. It is similar to a regression test in that it shows both the directions and strength of the relationship between variables, except that a correlation will not provide an equation to show how the independent variable(s) affects the dependent variable (Zach, 2021). The most popular correlation test is known as the Pearson r which is used to find a linear correlation coefficient between two continuous variables. There are other types of correlations tests that are suited for nonlinear relationships and for the addition of extra variables that also provide these relationships correlation coefficients. This coefficient tells you how strong the relationship is. It is important to note that correlation does not necessarily lead to causation. Simply, correlation is meant to identify a relationship in general. Once a relationship has been identified or not, you will know if it is productive to continue with other tests that can be used to find out more about the relationship beyond its strength and direction.

Comparison of Means

Comparison of means tests identify the differences of means based on different variables of test groups. More specifically, "(Means) comparison tests look for differences among group means. They can be used to test the effect of a categorical variable on the mean value of some other characteristic" (Bevans, 2022). This is a broad category and overarches more types of tests than the others. It includes paired t-tests, independent t-tests, Analysis of Variance (ANOVA), and Multivariate Analysis of Variance (MANOVA). Paired t-tests measure one determining/predictor variable against a mean outcome. Independent t-tests measure the difference of means between two independent groups. ANOVA is used to extend the independent t-test and find the difference of means between more than two groups. MANOVA adds another dimension to ANOVA by allowing for more dependent variables. Overall, these tests are used to study the differences among groups and help to point out the different characteristics of the groups that may explain the difference of means.

Cluster Analysis

Cluster analysis is used to identify groups (clusters) by finding repeated associations between variables (Hassan, 2023). It works to find these clusters but provides no insight into why these might exist. It is an algorithm that mostly points out these relationships that would otherwise be hidden to most analytics models. Finding these clusters can lead you to find commonalities within them that can help you to understand their behavior or performance and can help form categories.

Conclusion

The research provided shows the realistic benefits of data analytics for small businesses. Small businesses are essential to the economy as we know it. To remain competitive with growing corporations they will need to work towards advancing their technological and data capabilities. A business is only as strong as the information it derives its decisions from, and the best information is derived from good data. With a solid understanding of data and the application of it, businesses are given a guide to improved performance.

Time is valuable, by delaying the onset of data analytics in your company you risk losing profits, customers, and resources to competitors. With the wealth of resources available there is no better time to begin exploring the analytics options that best suit you and your company. Utilizing this paper, you can walk away with a basic overview of statistics, understanding the types of data analytics, common uses for them, and how you can move forward in applying this knowledge.

Practical Guide

In this section we will convert the knowledge from the Literature Review into real world application. By introducing four common issues that small businesses encounter we will explore options for implementing data analytics that best suit your needs. Identifying your problems is an appropriate first step in knowing what will work best for you. It all depends on what you want to do: what questions you need answered or problems that need to be solved.

To start, what does a company that uses data analytics look like? A company with a firmly established analytics process will be able to efficiently structure and organize its data for easy analysis. The company will be able to use this data to sort through and locate important qualitative/text information, to analyze quantitative data and create figures to find trends and patterns in both qualitative and quantitative data, to find the reasoning behind recurring problems, and be able to predict future performance based on different decisions. Ultimately, data analysis is used to both provide existing information in a more digestible format, but it is also used to analyze this existing information to create new information. Both capabilities are key in making business decisions.

In this section I will present four cases of a small business. Each case will represent a different issue. After introducing these cases I will explore possible solutions and different paths to reach these solutions. The same business will be used to represent all four cases.

As the focus of this paper is to help you identify and pick the data analysis type that is best suited for your business's needs and to provide a general overview of how analytics can help you achieve your goals. I will avoid giving technical details of how to conduct the specific data analysis but will instead focus on their application to the business. These case studies are presented in a way that shows the decision-making process behind using data analysis and how you can interpret your findings to make decisions and the possible long-term benefits thereof.

Setting the Stage

For the purpose of this paper, assume you are a small business owner with both a brick-and-mortar location and an online storefront. Your company specializes in clothing retail with relatively equal amounts of in-store and online business. This business model has created many avenues for data collection. Assume that the company is already capable of data collection and storage, so we will be focusing specifically on the methods of data analysis.

Case Studies

Case 1 looks to answer to answer the question of finding the descriptive statistics needed to identify a problem. This case will focus on using available quantitative/numeric company data. Assume the company has not made use of summarizing financial and sales reports, thus leaving a lot of data unused and unapplicable. Leaving the company's quantitative data in raw

form is inefficient when trying to identify issues or find useful information. For this case we are finding a way to create visualizations and descriptive statistics for a company to better summarize and visualize their metrics and performance. Specifically, Case 1 will observe the company's sales performance over periods of time to understand at what points in time sales are the best and worst.

Case 2 looks to answer the "why" behind the descriptive statistics results discovered in Case 1. Assume it was found that the company shows a lag in sales around the same time every month. Without being able to discern the reason for this drop in sales it cannot be fixed. This case will focus on using the company's data to find the reasons for a cyclical change in performance. Finding the root cause of these periodic dips in sales becomes essential to solving the issue.

Case 3 looks to identify customer sentiment using a company's qualitative text data. This is the data that comes in from the company's social media, emails, customer feedback forms, and website. This looks at what is going on within company textual data during the time periods of sale decrease from the previous cases. For this, the company's qualitative text data will have to be structured and analyzed. Not having efficient access to this data leaves a void of information when data needs to be recalled either for customer support or for making decisions. Here you want to know what customer sentiment towards your business is to resolve common customer complaints and concerns to solve recurring issues.

Case 4 looks to help make future business decisions based on performance outcomes of different strategic options. In this case the company would like to launch a new product line and determine the ideal targeted marketing campaign to promote it. To do this a company will need to have an idea of current demands in the market, the target demographic and through what marketing platforms the majority of their audience can be reached.

Now that you know each of these cases it will be easy to navigate to the ones that closest resemble the questions that you are looking to solve. It should be noted that the solutions given for each of these cases are not answers for only these specific cases. They can be translated and used for a wide variety of problems, and they are simply a teaching tool to explain how they can be applied in the real world.

Change Management

Getting your company's workforce on board with data analytics is essential in having a successful introduction of new processes. When a company is already structured in a way that people are comfortable and familiar with it can be difficult to convince employees to change existing systems. This is true for any change project and here is where effective change management becomes important. Luckily for small businesses, a smaller workforce means it is easier to reach all employees and integrate them individually into the new system. It is important at the forefront of the implementation of data analytics in a company to keep your system from becoming fragmented. This can be accomplished by creating a company culture that centers and prides itself on the use of data analytics. Data culture is an important part of creating and maintaining a company that uses data in its everyday process. If your company is yet to have this, this should not be a reason to avoid creating it. This can be done by focusing on integrating key people such as managers and supervisors and allowing them to influence and integrate their teams. Overall, providing employees with the necessary resources to adapt to these changes and

by creating a data-focused company culture will be an important practical first step in onboarding your workforce to a new data analytics system.

Case 1: Statistical Analysis Case Study

The first case will focus on using existing numerical/quantitative data. The company has the data already collected and available from daily sales, financial reports, etc. You are likely already able to view this and make some interpretations of it, but it can possibly be done more efficiently. In this case, the specific question you would like to answer is on sales performance based on time. By performing statistical analysis, you can break this down in a way that will show you the performance over years, months, weeks, days, and even times of day. From this analysis you will find out at which points in the year, months, weeks, or day your company has the best and worst sales performance. Knowing your sales performance in relation to time is important for many decisions especially for marketing purposes such as advertising and sales promotions. For this you will use statistical analysis.

Statistical analysis is easily accessible through multiple platforms and methods. Most of these platforms can perform the basic statistical analysis functions such as finding basic metrics such as means, medians, and other measures of central tendency that can be useful for your company. They can also be expanded to show patterns and trends through correlations, comparative statistics, regressions, and cluster analyses. Another very important function of these is that they can create visualizations and data dashboards which are not necessary to view the results of these analyses but can make it much easier to interpret. For this case study you will be using descriptive statistics to summarize and visualize the data and inferential statistics to show sales trends in relation to time.

First, we will use descriptive statistics to identify sales performance at different time variables such as month, week, day, and hourly intervals. The goal is to simply gather all of the numbers in one area for easy analysis. You can see this easily on your own when all the data has been cleaned and summarized to appropriately show the breakdown of sales over time. From here it may also be beneficial to create a visualization such as a line graph that shows the highs and lows of sales over different periods of time. This makes it simple to interpret and understand the sales performance of your store at different times. Overall, the use of descriptive statistics here is meant to provide a summary of the businesses' sales and financial performance.

Descriptive statistics can be applied to any company data you wish to summarize. Any analytics platform will be able to perform the entry level statistics functions that are meant to provide a snapshot of a company's performance at a given time such as averages, net/gross profits, and losses, or monitoring cash flow. You can choose what performance points you would like to monitor and implement those calculations into your dashboard creation. At the end you should be able to create a visualization that provides a comprehensive summary of the company's metrics that can be easily interpreted at any time.

Inferential statistics will use statistical tests to find trends to show that there is a relationship between the time period and sales performance. For this case specifically, it is best suited to run a regression analysis. Recall that regression analyses are meant to find relationships between variables. Here we are trying to identify time periods that correlate with major changes in sales performance. Using a regression model will explain how strong of a relationship that

sales performance and time have. This allows us to know that time is an important factor in sales performance and if it should be used in decision making.

Assume that we visualize the data and find that sales dip recurringly around the same time each month. Now we know that there is something occuring around this time each month that is causing sales to decrease. Knowing this, we can move forward looking for the exact problem by digging further into company data around these periods of time.

Case 2: Diagnostic Analysis Case Study

In Case 2 we will explore the idea of analysis being able to find the underlying causes of ongoing issues in a company. After performing an analysis of your sales as you did in the previous case study you notice that sales dip noticeably around the same time each month despite customer traffic remaining consistent. You will want to know what the root problem behind this decline in sales might be. For this you can use diagnostic analysis, also known as root cause analysis.

Once you are to this point in your data analytics journey things begin to add more elements and can seem to be more complicated. The answering of the "why?" seems to add another dimension. But in reality, you are running a lot of the same tests that we talked about previously such as correlations, regressions, and clustering analysis.

As was shown previously, the use of descriptive statistics and visualizations can be powerful tools in identifying relationships in your data. Creating an overlay of your previously created summaries and other company metrics can show how changes in different variables affect others. For this case, we should analyze all company metrics that have a direct influence on sales.

Let us say that you find the strongest relationship between the inventory levels and the sales performance on a monthly time frame. From here you can look back at your data and deduce that as inventory levels drop towards the end of a stock period, sales begin to decline as well. Naturally, you are able to understand that with less products in stock and with the most in demand products already sold out that your conversion of shoppers to buyers would be lower thus dropping sales performance. Now you can correct this stocking issue to keep inventory levels at a sustainable level throughout the month, helping you to correct this loss of sales.

Case 3: Text Analysis Case Study

Now that you have identified a problem and the root cause of it, you want to see some additional data to help you see how this is impacting your company. Analyzing customer sentiment can help you understand what solutions are most desired by customers. You most likely already have massive amounts of textual qualitative data at your fingertips, but it is not very useful until text analysis is used to interpret it. Your company possesses multitudes of free form textual information that hold unrealized potential. Sourcing from a variety of avenues such as internal forms, contracts, reports, social media accounts, customer feedback forums, phone calls, and website interactions, the list goes on. These hold answers to many questions, for now we will focus on understanding the customer sentiment around inventory levels. You would like to find the commonalities amongst all this feedback so that common complaints can be resolved, and common approvals can be amplified. This can be done using text analysis.

Many companies do this by implementing some form of a Voice of Customer (VOC) application. These applications will scan through all forms of feedback that could come from customers such as email, transcribed calls, logged in-store customer complaints, social media messages or comments, website feedback, and surveys. This type of program is capable of mining the text for keywords and can perform a variety of different commands or analysis with the data.

Once you have access to a program with text analysis functions it is time to decide what you would like to know. Recall in this case study we are trying to understand customer sentiment regarding the recurring lack of inventory of high demand products. This is an opportunity to use Sentiment Analysis. Sentiment Analysis is a form of text analysis that identifies customer sentiment from feedback and can rank it categories such as positive/negative/neutral. It does this by finding commonalities in vocabulary, phrases, and tone within the text data. Text analysis can also be used to identify and categorize frequently mentioned topics within your data. To get these results all the qualitative data from the sources you provide will be searched and the frequency of certain words or phrases will be measured. The most mentioned topics will be returned. These results provide insights into what is receiving the most customer attention, allowing you to respond accordingly.

For this case, we specifically want to observe the reactions of customers around the time each month that sales drop. A combination of website and social media comments, emails, and customer inquiries show that customers are particularly upset about the lack of inventory for one specific product. This tells you to increase the amount of this product ordered each month in order to meet the demand and thus increase revenue. This is an example of using text analysis to pinpoint a specific issue to address it more effectively than if you were to have to guess what your customers wants.

Case 4: Predictive Analysis Case Study

For the fourth case study let's look at a more proactive use of data analytics. Thus far, the examples I have given have been used to solve pre-existing issues or questions. However, there is also a wide range of uses for analytics when it comes to making business decisions that can provide insight into the future of a company. For example, say you are preparing to update your inventory and bring new merchandise to your store. Along with this you would like to create a targeted marketing campaign to promote said merchandise. To do this you will want to ensure that the new product will perform well and will be in demand with your existing customers. Additionally, you will want to know what customer demographics you will be marketing towards for the campaign to be as effective as possible. In this case it is extremely important to know what your customers want. A good way to observe this is by looking at the historic performance of different products, observing their shopping habits, and the demographics who most frequently buy from your business. Using this data with a predictive analysis model will allow you to have an idea of the future performance of your company based on these variables and how you manipulate them.

In this specific instance, since it is more multifaceted, you should be aware of the variables that are applicable. First, analyzing your business historical data and the current industry market trends and the relationship between the two will be an important aspect of knowing what future products will perform well for the new line. For the marketing portion of

this case, you want to understand your customer's demographics and the avenues of marketing that are most successful.

Let's start with using predictive analysis to analyze historic and present data to understand which future trends to capitalize on that will be most profitable for your company. When it comes to trying to predict any kind of future performance or outcomes, predictive analysis is what you will use. Using a machine learning tool is an effective way for executing predictive analysis. A combination of regressions and cluster analysis can be used to test the performative relationship between the variables and how different decisions result in different outcomes and the probability of such. These analyses will take historic and current data to project future performance and the output can change based on included variables and the change in data values. Based on previous customer behavior towards your products and the analysis of the market a projected outcome based on differing decisions can be formed. This gives you insight into what products will be most sought-after and create demand for your company.

Knowing your customer demographic and behavior is important for the application of this information. Your customer demographic can be found by collecting customer information upon request and by using web analytics. Web analytics will allow you to track variables of customers demographics and analyze them easily. This type of analysis could use clustering analysis which can group together customers by different variables including demographic information. From these clusters you can analyze their behavior allowing you to understand which group of site visitors have the most activity and convert into the most sales. Now you can know what demographic is most likely to be most profitable to market towards. Knowing who to market towards also helps you choose the best avenue of marketing for you. Overall, this case is a multistep process that uses predictive analytics and clustering of your customer demographics to first select a new product to launch and then to decide the most effective way to market it.

In this case, you are deciding between three different options for a new product line. You can create predictive analysis models on all three products to determine which has the highest probability of being the most successful. To do this, you will set up three different models for each product; we will call them products A, B, and C. Each of these products could be grouped into different product groups that already exist in your company's inventory- we will call these products X, Y, and Z. This is where the historic data will come from. So, product A is related to product X, B to Y, and C to Z. Using three regression models, we will predict if a customer will choose to buy each product. Using the results from the regression model, we find that 50% of customers would buy product A while 25% would buy products B and C. Given these results you would choose to launch product A.

Following the same process with more models, it was reconfirmed that based on the time of the launch in late summer or early fall, the demographics of existing customers, historic sales performance, and customer loyalty that it would likely be most profitable if you launched product A - a line of football themed gameday attire.

Now that we know this, what audience is most likely to purchase these products? You can perform a cluster analysis using your web analytics data and see what products customers typically show the most interest in and purchase the most of. Assume you find that young adults from the ages of 18-28 that live near the school for which you are selling gameday attire for are historically the highest buyers from products in this category. Now that we know who the audience of this launch will be you can take extra data from questionnaires or other web

analytics data to determine how this group of customers most commonly find out about your business. From here the best avenue of marketing will be apparent, for this case it is found that social media marketing on Instagram and Facebook is how many of these customers are reached.

Combining all this information you now know that launching a football gameday inspired clothing line in the months prior to football season will perform well with young adults who live near college campuses and that the social media marketing is the most effective use of marketing for this demographic. These insights have helped to provide a distinct and strategic business plan that considers the future performance of your business.

Summary

Now that we have covered four cases in which data analytics was used to answer the what's, whys, and how's of this specific company, let's reflect on the effects of this. Given that all these analyses are successful what is the potential benefit for this company?

In Case 1, we used statistical analysis to find the relationship between time and sales performance. By using descriptive statistics, regressions, and creating visualizations we can breakdown and interpret the company's sales over time. We can find the patterns at every timeframe down to the day, helping to learn when shoppers are the most active and most willing to buy. Generally, this understanding of customer behavior helps you to know when to launch new merchandise, when to restock, when to run ads or launch marketing campaigns, and when to send out sales and promotional offers. In this case, we were able to identify at what time periods sales dropped the most, leading us to discover a monthly dip in sales. Knowing this we can move forward in correcting the issue. In this case study and in general application, we can assume that if interpreted correctly this would have a positive effect on revenue.

In Case 2, we used diagnostic analysis to figure out why sales dropped cyclically around the same time each month. By comparing sales performance data with possible cause variables by looking at the big picture of your data and overlaying different variables with the use of visuals. This analysis helped to conclude that sales were dropping towards the time of the month when inventory was low or out of stock due to shipments being completed on a monthly schedule. Because of this, products with a higher demand were selling out before new shipments could arrive causing sales to drop in the days between sell out and restock of inventory. This inventory led you to the decision to keep a shorter resupply period so that products would stay in stock more consistently. This diminishes the effect that inventory had on sales and sales performance begins to see a consistently stable sales level on a monthly basis.

In Case 3, we used text analysis to learn about customer sentiment around the monthly dip in sales performance to further ensure that the best solution for customers was chosen. We used a program that is able to 1. Find commonly used words; 2. Track attitude towards certain product; 3. Find information and extract it; 4. Categorize for easier reviewing. By finding commonly used words and phrases it helps to decipher the tone and thus common sentiments among customers. This analysis is meant to provide efficiency to you, your employees, and your customers. It enables you to have a general understanding of customer sentiment, to create solutions to recurring problems more quickly, and to respond to individual concerns more quickly. It was found that customers most frequently talked about one product being out of stock and showed the most negative reaction to this. Knowing this, you can decide to increase the amount of this product that your business stocks, allowing you to meet demand. Overall, by

using text analysis to understand the opinions of your customers, you can react to them promptly, increasing customer satisfaction and thus returning customers.

In Case 4, we used predictive analysis to decide what new merchandise to launch at the store and who to market it towards. We found that the most profitable product to launch would likely be a new line of football game-day attire in the summer months leading up to football season. Your demographic would be young adults, ranging from 18-28 including students and recently graduated alumni. Your primary marketing avenue would be through social media such as Instagram and Facebook where a large range of your primary audience can be reached. By using this information and applying it you launch a line of products that is in high demand around this time of year and in this location. Due to the product demand the probability of its success is much higher, and you can see an increase in revenue because of it. Overall, anticipating your customers' wants helped you to be ahead of competitors in providing products that would be highly sought after in the future, allowing you to capitalize on the opportunity and increase profitability.

Now that we have completed the case studies you should understand how these data analysis methods are applicable in real world situations. The solutions provided here are just one of the many ways that data can be used to influence your business strategy. The expansion of data analytics capabilities can provide invaluable insights for the continued success of your small business.

Choosing the Best Method for You

It is important to choose data analytics techniques that best suit your company's technological and business needs. The way that you perform data analytics should align with the resources you are able to allocate into developing the system and the upkeep that you think is feasible to maintain and update it. Some types of analytics will be too large scale and complicated for smaller businesses, while others will not be robust enough to cover all a company's needs.

You should choose a data analytics method based on what questions you want to answer or what problems need to be addressed. For example, do you want to be able to quickly recall information from existing documents, make large amounts of financial data easily interpretable, or to find patterns and relationships in customer behavior. All of these would require a different data analysis approach.

<div align="center">Conclusion</div>

In conclusion, this paper has presented the benefits and potential that implementing data analysis holds for small businesses. The research provided proves that small businesses that utilize data analysis observe an improved understanding of company operations, increased efficiency, and increased profitability. Overall, a company's ability to effectively leverage their data allows them the ability to make informed decisions at a much more detailed level, finding information that would have gone unnoticed otherwise.

Through the use of case studies, I provided ways to implement statistical analysis, diagnostic analysis, text analysis, and predictive analysis. All of these types of analysis methods are accessible and applicable in a small business environment. Using the process described in

these cases can help you to understand a realistic analytics process for your business. You can use these as an outline to apply data analysis to your specific business needs.

The implementation of data analytics requires careful planning and awareness of a company's goals. It is important that the proper resources are allocated to ensure the success of a data analysis project. Investment in a small business's workforce, engagement, time, software, and hardware are integral to reaching success. Attention to every step from collection to interpretation will help you create the solutions that will lead to success.

Overall, the benefits that data analysis can bring to a small business are significant, but it requires dedication and persistence. If small businesses want to stay competitive in their industries, using data analytics will become fundamental in doing so. By reading this paper you have already taken a step in the right direction, planning how to apply what was learned is the next step. There is no better time to begin your small businesses data analytics journey than the present.

References

Amadebai, E. (2022, February 26). This Is How Big Data Analytics Differ From Regular Analytics. *Analytics for Decisions*. https://www.analyticsfordecisions.com/big-data-analytics-differ-from-regular-analytics/

Bay Atlantic University. (2022, June 14). Data Analysis vs Data Analytics: What Is the Difference? - Bay Atlantic University - Washington, D.C. *Bay Atlantic University - Washington, D.C.* https://bau.edu/blog/data-analysis-vs-data-analytics/

Bean, R. and Davenport T.H. (2019, February 5). *Companies Are Failing in Their Efforts to Become Data-Driven*. Harvard Business Review. https://hbr.org/2019/02/companies-are-failing-in-their-efforts-to-become-data-driven

Bender, J. (2023). What Is Statistical Analysis? *Business News Daily*. https://www.businessnewsdaily.com/6000-statistical-analysis.html

Bevans, R. (2022, January 2020). Choosing the Right Statistical Test | Types & Examples. *Scribbr*. https://www.scribbr.com/statistics/statistical-tests/

Bush, T. (2021b, March 24). Predictive Analysis: Definition, Tools, and Examples. *PESTLE Analysis*. https://pestleanalysis.com/predictive-analysis/#:~:text=Predictive%20analysis%2C%20more%20commonly%20known%20as%20predictive%20analytics%2C,world%20as%20it%20is%20invaluable%20in%20effective%20decision-making.

Chang, J. (2023, February 20). 63 Crucial Small Business Statistics for 2023: Data Analysis & Projections. *Financesonline.com.* https://financesonline.com/crucial-small-business-statistics/#:~:text=Small%20Business%20Sector%20Statistics%201%20Small%20and%20medium,around%20the%20world.%20%28World%20Bank%2C%202019%29%20More%20items

Cote, C. (2021, December 2) *7 Data Collection Methods In Business Analytics* https://online.hbs.edu/blog/post/data-collection-methods

Cote, C. (2021, November 18) *What is Diagnostic Analytics? 4 Examples* https://online.hbs.edu/blog/post/diagnostic-analytics

Ehrlinger, L., Rusz, E., & Wöß, W. (2019). *A Survey of Data Quality Measurement and Monitoring Tools.* https://arxiv.org/abs/1907.08138

Frankenfield, J. (2023, March 14). Data Analytics: What It Is, How It's Used, and 4 Basic Techniques. *Investopedia*. https://www.investopedia.com/terms/d/data-analytics.asp

Fuggle, L. (2020, August 6). *How to Get Data Storage Right for Every Size Business*. https://blog.hubspot.com/website/data-storage

Haney, J. (2017, December 16). *Business Analytics Challenges Faced by Small Businesses* https://businesspartnermagazine.com/business-analytics-challenges-faced-by-small-businesses/#:~:text=Business%20Analytics%20Challenges%20Faced%20by%20Small%20Businesses%201,nightmare.%20...%204%20Measuring%20the%20Wrong%20Indicators%20

Hassan, A. (2023). What Is Cluster Analysis? *Built In*. https://builtin.com/data-science/cluster-analysis

Islam, M. M. (2020). Data Analysis: Types, Process, Methods, Techniques and Tools. *International Journal on Data Science and Technology*, *6*(1), 10. https://doi.org/10.11648/j.ijdst.20200601.12

Kidd, C. & Hornay, R. (2021, January 8). *Data Analytics vs Data Analysis: What's The Difference?* BMC Blogs. https://www.bmc.com/blogs/data-analytics-vs-data-analysis/

Lastiri, L. (2023). Data Analytics: How Much Does It Cost for a Small/Mid-Sized Company? *Octolis*. https://octolis.com/blog/data-analytics-costs

Medelyan, A., PhD. (2021). 5 Text Analytics Approaches: A Comprehensive Review. *Thematic*. https://getthematic.com/insights/5-text-analytics-approaches/

Miranda, D. & Bottorff, C. (2022, August 7). The Four Principles Of Change Management. *Forbes Advisor*. https://www.forbes.com/advisor/business/principles-of-change-management/

Peck, J. (2022). 5 Best Practices for Small Business Data Collection. *GoCanvas*. https://www.gocanvas.com/content/blog/post/5-best-practices-for-small-business-data-collection/

Sammy, R. (n.d.). *How to Use Internal Data for Brand Storytelling – Fractl*. Fractl. https://www.frac.tl/use-internal-data-brand-storytelling/

Stasha.S. (2023, March 23). *38 Essential Small Business Statistics For 2023*. https://policyadvice.net/insurance/insights/small-business-statistics/

Simplilearn. (2023). What is Statistical Analysis? Types, Methods and Examples. *Simplilearn.com*. https://www.simplilearn.com/what-is-statistical-analysis-article

U.S. Census Bureau, & Hait, A. W. (2021, January 19). The Majority of U.S. Businesses Have Fewer Than Five Employees. *Census.gov*. https://www.census.gov/library/stories/2021/01/what-is-a-small-business.html

Treehouse Tech Group. (2022). How to Make Your Company's Internal Data Work for You. *Treehouse Tech Group*. https://treehousetechgroup.com/how-to-make-your-companys-internal-data-work-for-you/#:~:text=Internal%20data%20is%20information%2C%20statistics%2C%20and%20trends%20that,user%20trends%2C%20operational%20lessons%2C%20and%20results%20from%20surveys.

Ugbaja, L. (2022, February 9). *Analytics For Small Businesses: Here's Why SMEs Must Adopt It*. https://databox.com/0small-business-analytics-benefits

Velilla, J (2022, December 3) How to Choose the Best Data Storage Solution for Business in 2023. *ServerMania Blog*. https://blog.servermania.com/data-storage-options-business/#:~:text=Direct%20attached%20storage%20is%20a%20file%20storage%20system,installing%20NAS%20devices%20onto%20the%20LAN%20through%20TCP%2FIP.

Weston. B. (2022, May 10). Weston, B. (n.d.). Infographic: Are You Taking Advantage of Marketing Data? *SCORE*. https://www.score.org/resource/blog-post/infographic-are-you-taking-advantage-marketing-data

What is Text Analysis? A Beginner's Guide. (n.d.). MonkeyLearn. https://monkeylearn.com/text-analysis/#:~:text=Companies%20use%20text%20analysis%20tools%20to%20quickly%20digest,or%20categorize%20survey%20responses%20by%20sentiment%20and%20topic.

Zach. (2021). Correlation vs. Regression: What's the Difference? *Statology*. https://www.statology.org/correlation-vs-regression/

75+ Small Business Statistics To Help Your Digital Marketing Strategy. (2019, November 26). Blue Corona. https://www.bluecorona.com/blog/29-small-business-digital-marketing-statistics/