ISSN: 2473-4901
v12 n6800

Spatial Analysis Using ArcGIS Business Analyst for Market Evaluation: An Exploratory Case Study of a Local Car Wash Chain

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Abstract

Geographic Information Systems (GIS) and location analytics provide businesses with tools for integrating spatial, demographic, consumer, and operational data to support market evaluation and site-selection decisions. This case study examines how ArcGIS Business Analyst can be used in conjunction with internal sales data to evaluate the performance and expansion opportunities of Soapy Noble Express Car Wash, a regional car wash company operating in Connecticut and Massachusetts. Ten locations were mapped, including eight operating sites and two proposed expansion sites. Three-mile trade areas were used to capture demographic, economic, consumer spending, and traffic characteristics surrounding each location (n = 10). These data were combined with company sales and vehicle-volume information and analyzed using descriptive spatial analysis. The study demonstrates a practical approach through which regional and small businesses can combine commercially available spatial analytics with internal business data to evaluate existing markets and inform future location decisions. Exploratory correlations indicated that several trade-area characteristics were positively associated with February 2026 sales, although the small sample limits statistical inference. Feeding Hills represented an anomaly, recording the highest vehicle volume despite the lowest traffic exposure.

Keywords: Select four to six keywords that capture the essence of the paper. List the words in decreasing order of importance from left to right, with commas between the key word concepts. Also enter the Keywords into the papers system when submitting.

ISSN: 2473-4901
v12 n6800

Spatial Analysis Using ArcGIS Business Analyst for Market Evaluation and Sales Prediction: A Case Study of a Car Washing Company

James Geehan and Prajjwal Panday

1. INTRODUCTION

Location is a fundamental consideration in the performance of businesses whose customers must travel to a physical facility. Decisions regarding where to operate or expand require firms to evaluate not only the characteristics of a potential site, but also the population, economic conditions, consumer behavior, accessibility, and competitive environment surrounding it. Geographic Information Systems (GIS) and location analytics provide a means of integrating these factors into a common analytical framework, allowing organizations to identify spatial patterns and evaluate market characteristics that may be associated with business performance (Luo et al., 2025; Tudor et al., 2025; Zhao et al., 2025).

Location analytics have become increasingly relevant as businesses gain access to detailed geographic, demographic, traffic, and consumer expenditure data. Rather than evaluating prospective markets primarily through managerial judgment or individual indicators, GIS-based approaches enable organizations to examine multiple characteristics of a trade area simultaneously. Prior research has demonstrated the usefulness of geospatial analytics for applications including retail site selection, market segmentation, and evaluation of commercial activity (Chumakova et al., 2025; Tudor et al., 2025; Zhao et al., 2025). However, the practical value of these tools extends beyond large retailers with extensive location-planning capabilities. Regional and small businesses may similarly benefit by combining commercially available spatial data with their own operational data to identify the characteristics associated with successful locations.

This issue is particularly relevant for service businesses such as car washes, for which performance may depend upon a combination of local population characteristics, household purchasing power, vehicle traffic, accessibility, and consumer willingness to spend on vehicle-related services. Selecting an expansion location therefore presents a multidimensional decision problem. A location with substantial passing traffic, for example, may not necessarily outperform one located in a community with higher household income or greater spending on automotive services. Understanding how these characteristics interact with actual sales performance can provide managers with a more systematic basis for evaluating markets.

This study examines these relationships through a case study of Soapy Noble Express Car Wash, a locally owned New England company operating eight locations in Connecticut and southern Massachusetts and planning two additional locations. The company provides an appropriate setting for examining location analytics because its facilities operate across markets that differ considerably in demographic and economic characteristics despite their relative geographic proximity. By integrating market information obtained through ArcGIS Business Analyst with internal company sales and vehicle-volume data, the study evaluates how characteristics of the areas surrounding existing locations are associated with business performance.

Specifically, the study has two research questions. First, how do demographic, traffic, and consumer-spending characteristics vary across the trade areas surrounding the company's operating locations? Second, what relationships exist between selected trade-area characteristics and February 2026 sales performance across the eight operating locations? In doing so, the study illustrates a practical approach through which businesses can integrate spatial analytics with internal performance data to support market evaluation and location-related decision-making.

2. LITERATURE REVIEW

2.1 Geographic Information Systems and Location Intelligence in Business Decision-Making

Geographic Information Systems (GIS) provide a framework for integrating traditional business data with information about geographic location, proximity, distance, accessibility, and spatial relationships. Although GIS is often associated with mapping and visualization, its business value extends to the analysis of how customers, competitors, infrastructure, demographic characteristics, and economic activity are distributed across geographic space (Ismael & Bashir, 2014). The resulting combination of spatial and nonspatial information allows organizations to evaluate business questions that conventional tabular analysis may not fully capture.

The use of formal location-analysis methods has developed substantially as geographic data and computing tools have become more accessible. Hernández and Bennison (2000) observed that retail location decisions had historically depended heavily on managerial experience and intuition despite the availability of formal location-analysis techniques. They argued that improvements in computing capability and access to retail-related data created opportunities for retailers to adopt more systematic decision-support approaches, with GIS serving as an important platform for such analysis. More broadly, Ramadani et al. (2018) found that the use of geomarketing information and consideration of location determinants can positively contribute to business development and managerial decision-making.

The concept of geomarketing extends this logic by explicitly integrating geographic information with marketing and market-analysis activities. Rather than treating customers and markets as spatially uniform, geomarketing recognizes that demographic characteristics, purchasing power, transportation patterns, competitive conditions, and consumer behaviors vary geographically. Tudor et al. (2025), in a bibliometric analysis of geomarketing research, describes the field as an intersection of spatial analysis and marketing that can support customer targeting, market segmentation, catchment-area analysis, and retail location strategy. Their review also concludes that GIS remains less integrated into mainstream strategic retail research than its practical potential might suggest.

These capabilities are particularly relevant to small and regional firms. Location decisions often involve substantial financial commitments, but smaller businesses may lack the specialized real estate and analytics departments available to national chains. Research involving small retail firms has nevertheless demonstrated that physical location remains an important contributor to business performance. Litz and Rajaguru (2008), for example, tested several classic location theories using more than 300 small U.S. hardware stores and found support for both central-place considerations and manager-identified factors related to customer convenience. GIS-based platforms therefore offer smaller firms an opportunity to incorporate data-driven location analysis into decisions that might otherwise depend primarily upon managerial judgment.

2.2 Trade Areas and Retail Site Selection

A central concept within location analysis is the **trade area**, the geographic region from which a business is expected to attract customers. Early spatial-interaction research established that customer patronage is affected not simply by geographic boundaries but by the relative attractiveness and accessibility of competing locations. Huff's (1963) probabilistic model of shopping-center trade areas represented a foundational development in this area by estimating the probability that consumers would patronize a location as a function of distance and store attractiveness. This perspective established an important principle that continues to influence location analytics: a market cannot be evaluated adequately based on population alone because customer behavior also depends on spatial accessibility and the attractiveness of alternative locations.

Subsequent research has increasingly integrated these traditional location models with GIS. Suárez-Vega et al. (2012) demonstrated how location models and GIS tools can be combined to support retail site-location analysis, while Roig-Tierno et al. (2013) combined GIS with the Analytic Hierarchy Process to evaluate potential supermarket locations. Their approach considered both market demand and competition and emphasized that site selection involves multiple criteria rather than a single measure of market potential.

Baviera-Puig et al. (2016) similarly developed a geomarketing model for supermarket location strategy that incorporated both objective data and managerial assessments of store and trade-area characteristics. Their analysis included sociodemographic conditions as well as factors such as accessibility, visibility, competition, and growth potential, demonstrating that the performance of a location depends upon the broader configuration of its market environment. More recent research continues to reinforce this multidimensional perspective. Demirel et al. (2026), for example, integrate demographic information with GIS-based spatial statistics to identify potential retail investment areas, emphasizing population density, accessibility, and the spatial distribution of existing markets. Reigadinha et al. (2026) go further by combining GIS with configurational analysis, arguing that successful retail locations may reflect multiple combinations of spatial conditions rather than a single universally optimal set of characteristics.

These findings are relevant to traditional retail stores. Service businesses requiring customers to visit a physical location face similar questions concerning accessibility, population characteristics, traffic exposure, and surrounding land uses. Car washes provide a particularly location-dependent example because their potential customer base is geographically constrained and automobile access is intrinsic to the service. Ibrahim (2022) used GIS-based suitability modeling to evaluate potential car wash locations in Khartoum, Sudan, integrating factors including road access, surrounding land uses, slope, and proximity to public facilities. The study demonstrates the applicability of GIS specifically to car wash location decisions, although its emphasis was primarily on physical and environmental site suitability rather than observed business revenue or customer demand.

2.3 Integrating Spatial Market Data with Business Performance

An important development in location analytics is the movement from identifying attractive geographic areas toward testing spatial characteristics against observed customer behavior and business performance. Such integration allows organizations to move beyond describing a trade area to ask whether characteristics of that trade area are actually associated with stronger business outcomes.

De Beule et al. (2014), for example, extended the Huff model to benchmark retail network performance and predict turnover while accounting for spatial competition, brand attraction, and substitution among stores. Importantly, their analysis incorporated actual firm-level performance information and demonstrated how spatial models can be evaluated against observed outcomes rather than relying solely on theoretical measures of market attractiveness. Baviera-Puig et al. (2016) similarly incorporated trade-area characteristics into a model designed not merely to identify appropriate locations but also to estimate supermarket sales. These studies illustrate the benefit of connecting external market characteristics with internal measures of firm performance.

The increasing availability of behavioral and transactional data has expanded this approach further. Liang et al. (2020) calibrated a dynamic version of the Huff model using large-scale mobile location data and demonstrated that incorporating temporal patterns of actual store visits can improve estimates of market share. Their analysis also examined socioeconomic and demographic characteristics, including household income, as potential influences on store visitation. Suhara et al. (2021) subsequently validated gravity-based market-share models using large-scale transactional data across multiple retail and service categories, including grocery stores, restaurants, and gasoline stations. Their findings demonstrate the value of connecting spatial models to observed customer transactions when evaluating market behavior and competitive location decisions.

Recent location research also illustrates the growing range of data and analytical methods available to organizations. GIS studies have incorporated point-of-interest data, transportation networks, population density, socioeconomic indicators, spatial clustering measures, consumer behavior, and competitive characteristics to explain the distribution and performance of commercial activity (Luo et al., 2025; Tudor et al., 2025; Zhao et al., 2025). More sophisticated approaches increasingly combine GIS with statistical, econometric, machine-learning, or configurational methods rather than using maps solely as descriptive tools. For example, Demirel et al. (2026) employ spatial statistical methods to identify retail clusters and underserved areas, while Reigadinha et al. (2026) use GIS and fuzzy-set Qualitative Comparative Analysis to identify alternative configurations associated with existing retail locations.

Taken together, this literature suggests that effective location analysis should integrate multiple

dimensions of the market environment and, where possible, evaluate those characteristics against observed business outcomes. Much of the research reviewed above, however, examines large retail networks, supermarkets, or urban commercial systems. Research specifically addressing car wash location has focused more heavily on physical suitability and land-use considerations than on the relationship between trade-area characteristics and actual firm performance. The present study addresses this practical opportunity by examining a regional service business and integrating GIS-derived demographic, consumer expenditure, and traffic information with internal sales and customer-volume data. Rather than using GIS only to identify geographically attractive areas, the study evaluates whether characteristics surrounding existing locations are associated with observed business performance and then considers how those relationships may inform evaluation of prospective locations.

3. METHODOLOGY

This study employs a spatial analytics approach using ArcGIS Business Analyst (ESRI, 2026) to evaluate the relationship between geographic, demographic, and traffic variables and sales performance across Soapy Noble car wash locations. A total of ten sites were mapped, including eight existing locations and two proposed expansion sites. Each location was geocoded using its street address and mapped within ArcGIS to establish a consistent spatial framework for analysis. To define the relevant market area for each site, concentric trade area rings of 1-, 3-, and 5-mile radii were generated. A 3-mile radius was selected for the final analysis as it provided an optimal balance between capturing local market characteristics and minimizing spatial overlap across sites. This trade area was used as the basis for extracting demographic and economic variables associated with each location.

Two primary datasets were utilized within ArcGIS Business Analyst: (1) traffic count data and (2) demographic market profiles derived from U.S. Census and consumer expenditure data. Traffic count data provided estimates of average daily vehicle flow on roads surrounding each site, serving as a proxy for visibility and accessibility. The demographic dataset included variables such as median age, gender distribution, total population, median household income, employment rate (population aged 16 and older), proportion of service industry employment, and average consumer spending on vehicle maintenance and repairs. These variables were selected based on their relevance to consumer purchasing behavior and service demand in automotive-related industries. In addition to external data, internal company data from Soapy Noble were incorporated into the analysis. This included total monthly sales and total number of vehicles serviced for February 2025 and February 2026. The dependent variable for the cross-sectional analysis was total sales for February 2026. February 2025 sales were used only for year-over-year comparison. These data were compiled and integrated with the spatial dataset in a structured format for statistical analysis.

4. RESULTS

Using ArcGIS Business Analyst's traffic count data, we calculated the average traffic volumes within the 1-mile and 3-mile radius trade areas for each Soapy Noble location (Figure 1). These averages were then compiled to compare the daily traffic exposure across all sites. This analysis allowed us to evaluate the relationship between traffic volume and the number of vehicles serviced at each location, helping determine whether higher traffic counts corresponded to greater customer activity.

ISSN: 2473-4901
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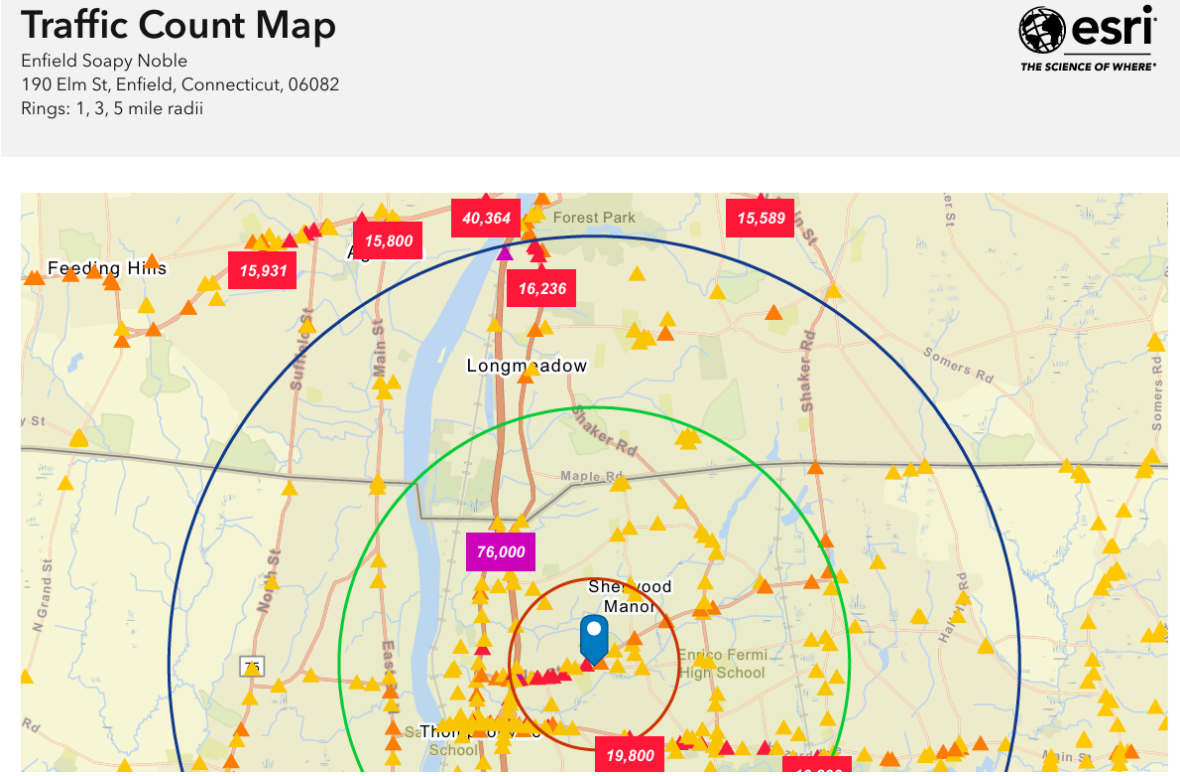
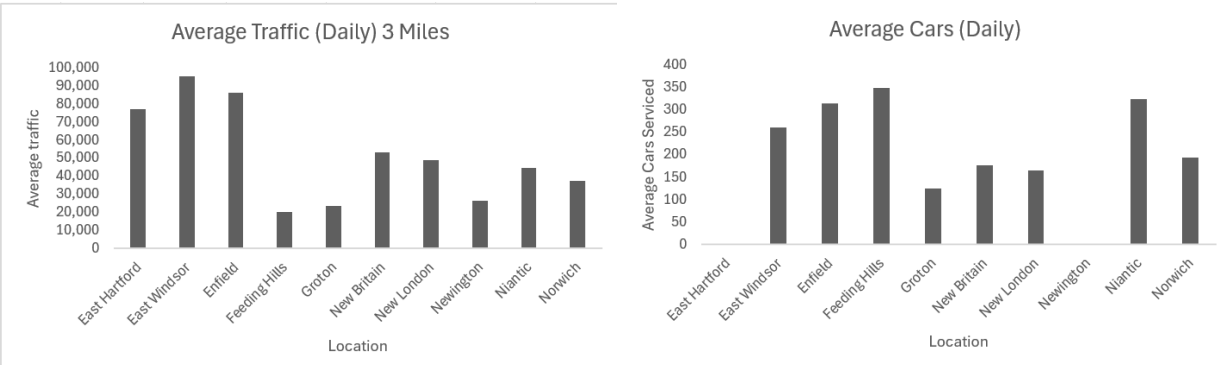


(Figure 1. Traffic count map generated from Arc GIS Business Analyst of the Enfield Soapy Noble location)

It is important to note that the Newington and East Hartford locations should be excluded from this comparison because they have not yet been constructed and therefore have no serviced vehicles to report. Among the remaining eight locations, Feeding Hills recorded the highest number of vehicles serviced despite having the lowest average daily traffic volume (Figure 2). One explanation is that Feeding Hills is the only location outside Connecticut. According to U.S. Census data, Feeding Hills has a population comparable to East Windsor, with both communities having approximately 25,000 residents (Figure 2). While population alone does not adequately explain this anomaly, other factors including competition density, customer loyalty, membership participation, and operational characteristics may provide plausible explanations for the location's unusually strong performance.



(Figure 2 & 3, comparing average daily traffic count within 3-mile radius from each location to average cars serviced each day per location.)

After establishing the traffic-to-customer ratios, the next step was to evaluate how each location was performing financially. The primary performance measure used in the cross-sectional analysis was total sales for February 2026. February 2025 sales were used only to provide a year-over-year comparison

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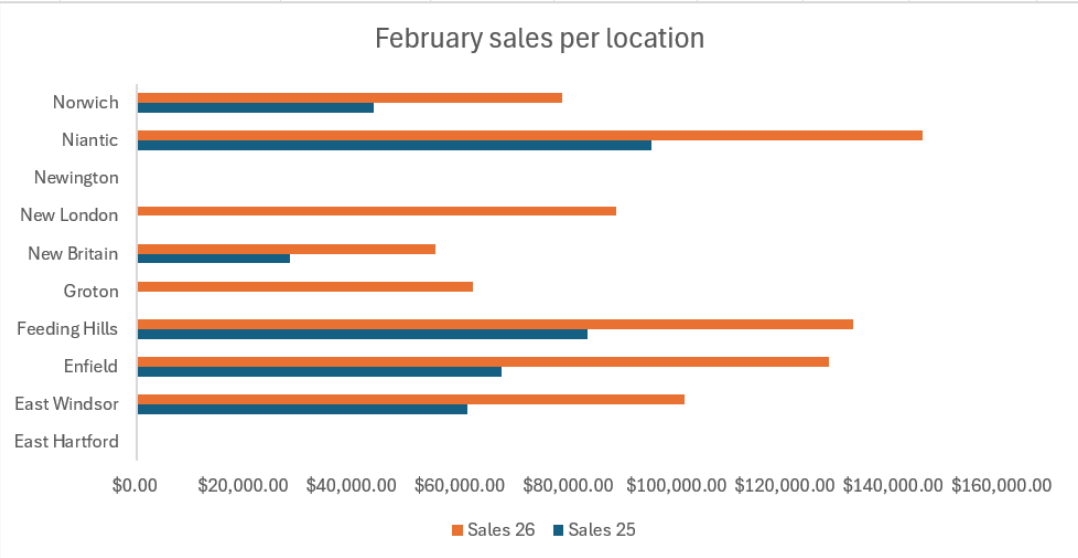
for locations operating during both periods. Although several locations were not yet operational in February 2025 and therefore could not be included in a year-over-year comparison, the operating locations all demonstrated substantial sales growth over the period. February was selected for analysis because it is typically one of the most challenging months for vehicle cleanliness in New England (Figure 4). During the winter season, municipalities apply sand and road salt to combat snow and ice, causing vehicles to accumulate dirt, salt residue, and grime at a much faster rate. At the same time, cold temperatures, snowfall, and unfavorable weather conditions discourage many residents from washing their vehicles themselves. As a result, demand for car wash services tends to increase during this period, making February an ideal month for assessing the performance of Soapy Noble locations.



(Figure 4, sales data from February 2025 compared to February 2026 per location.)

After evaluating sales performance across the existing locations, the next step was to examine the economic characteristics of the communities in which these sites operate. Comparing sales figures alone can be misleading, as performance expectations may differ between higher and lower income markets. Using demographic data from ArcGIS Business Analyst, we compared each location's 2026 median household income with its 2026 sales performance (Figure 5).

There is a general trend indicating that locations situated in higher-income areas tend to generate greater sales (Figure 5). Markets such as Niantic, Feeding Hills, Enfield, and East Windsor demonstrate both high median household incomes and strong sales figures. However, the relationship is not consistent. For example, New London produced strong sales despite having a lower median household income than several other locations, while New Britain and Groton, which have a similar household income to New London, were the only two cities to have less sales than median income. These findings suggest that although household income is an important indicator of market potential, factors such as traffic exposure, population characteristics, competition, and operational maturity also contribute significantly to a location's overall performance.

ISSN: 2473-4901
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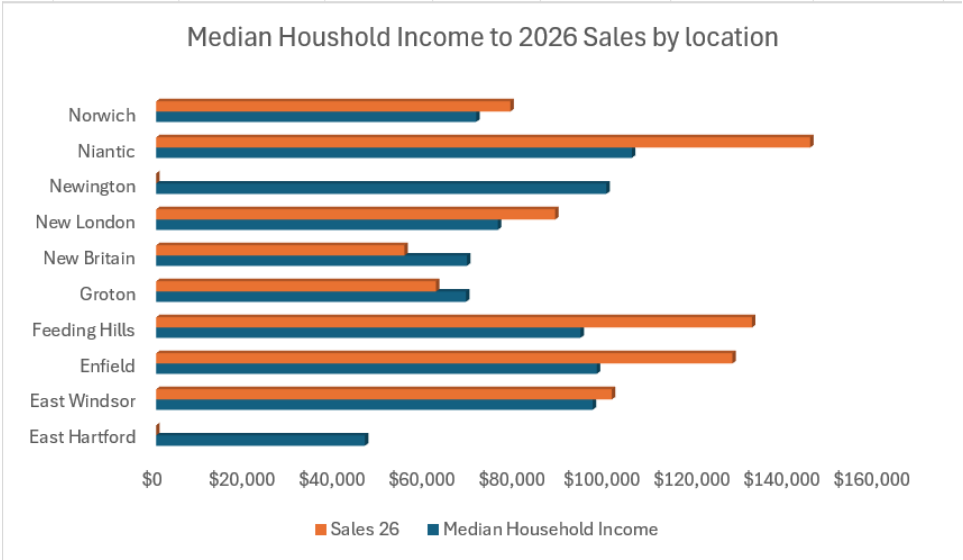
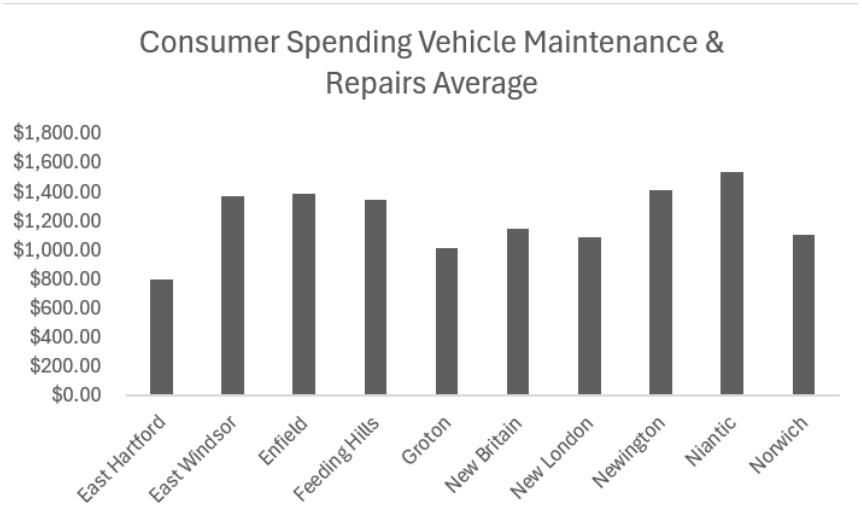


(Figure 5, comparison of February 2026 sales per location to median household income.)

After examining the relationship between median household income and sales performance, ArcGIS Business Analyst provided an additional variable that may further explain differences between locations: consumer spending on vehicle maintenance and repairs. Using consumer expenditure data compiled by ESRI from U.S. Census sources, we created a comparison of average spending across each trade area. Car wash services are categorized within vehicle maintenance and repair expenditures, so these metric services as a useful indicator of local demand for automotive services.

Niantic recorded the highest average annual spending on vehicle maintenance and repairs, followed closely by Newington, Enfield, East Windsor, and Feeding Hills (Figure 6). In contrast, East Hartford exhibited the lowest spending level of all locations. These results suggest that residents in higher-spending markets may be more willing to invest in vehicle upkeep, creating additional opportunities for car wash businesses.



(Figure 6, consumer spending average on car washes, classified as vehicle maintenance and repairs, gathered from Arc GIS Business Analyst.)

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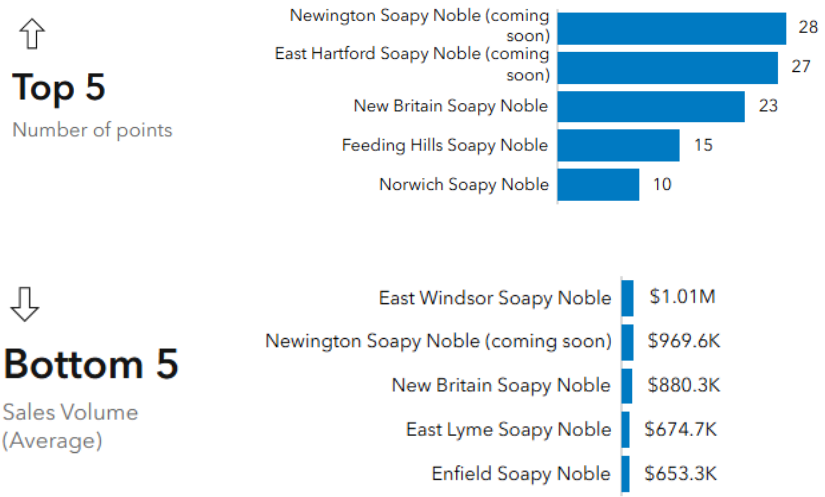
5. DISCUSSION

The results demonstrate the importance of integrating spatial and demographic analytics into business decision-making. High-income regions with strong traffic flow tended to show higher February 2026 sales, although the exploration nature of the analysis and small sample size limit inference. Anomalies such as high daytime populations indicate that additional variables, such as commuter patterns and business density, should be incorporated in future models. Expanding the analysis to include competitive positioning and retail demand metrics would further improve predictive accuracy.

While what the results show are promising, there are many pathways that ArcGIS Pro Business Analyst allows for. Choosing high traffic volume is just one potential route that the program allows for. Using the 100 plus different infographic options that the program has allow for endless amounts of critical data that are essential to improving any business. The next step to this research is to use the surrounding businesses and create a competition model that can analyze Soapy Noble's competition in the area. Using an infographic set titled "Business Key Facts," further analysis could be constructed around what businesses are successful in each location and what the daytime population is compared to the total population.

Understanding local consumer spending patterns is particularly important when evaluating the future potential of the proposed East Hartford and Newington locations. With help from ARC GIS Business Analyst, we were able to visualize the surrounding businesses for each area that are also car washes. Seeing the choice that Soapy Noble made to put in two new locations in Newington Connecticut and East Hartford Connecticut, we figured that there was a reason behind the untapped market. What Arc GIS Business Analyst has told us is that these two locations have the most business distinguished as "car wash." While the two areas have nearly 30 car wash locations, as demonstrated in figure 7, Newington Connecticut ranks in the bottom five sales volume average taking in an average of $969.6K yearly (figure 8).



(Figure 7 & 8, top 5 locations that have the most businesses labeled as "car wash" within the 3-mile radius of the location, compared to the bottom 5 sales volume for all businesses labeled as "car wash" in the 3-mile radius of each location.)

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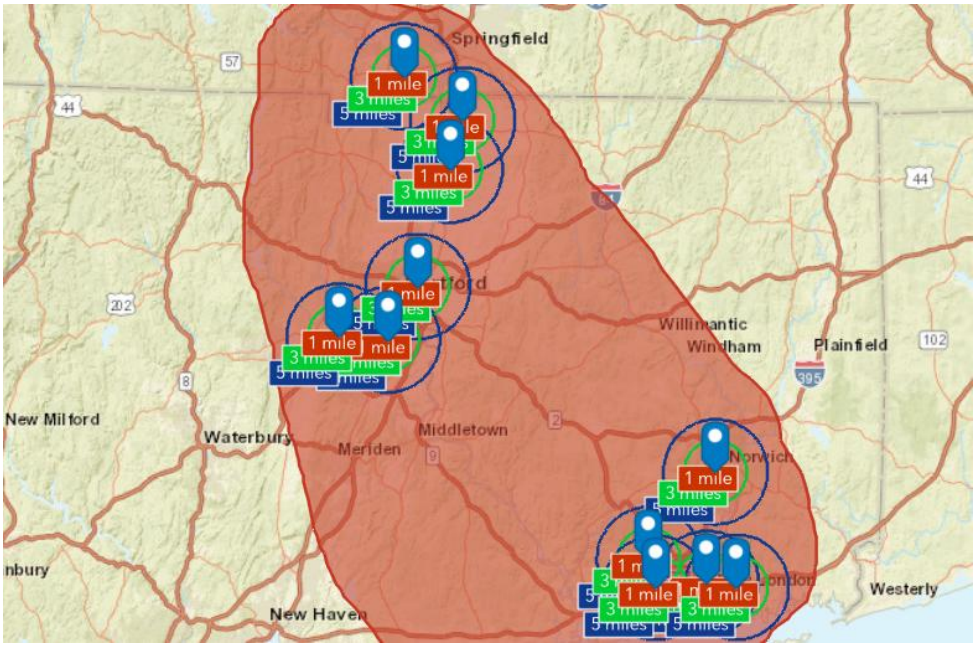

(Figure 9, the covered markets for Soapy Noble according to Arc GIS Business Analyst.)

The figure above shows the area covered by Soapy Noble. With a hold on north-central and southeastern Connecticut, Soapy Noble should look to expand further outside of this bubble (figure 9). This is the map that was created to gather information about each location in Arc GIS Business Analyst. A project for future analysis will be exploring more of what Arc GIS Business Analyst has to offer by digging for more information about competition sites and finding further untapped market opportunities for small businesses to grow and thrive.

6. CONCLUSION

This study confirms that spatial analytics is a valuable tool for evaluating and predicting business performance. By leveraging ArcGIS Business Analyst and statistical modeling techniques, organizations can better understand market dynamics and optimize site selection strategies. Future research should incorporate additional spatial datasets and refine predictive models to improve accuracy and scalability.

The useability of ArcGIS Business Analyst is something that anyone can truly learn. From step-by-step tutorials or through trial and error, the ArcGIS Business Analyst tool is an essential tool for any business looking for a better understanding of their geographical and demographic surroundings. The data that comes from ArcGIS Business Analyst is taken from the United States Government, i.e., the Census data from previous years as well as traffic center data and many other forms of information, proving that the information is real and necessary to operation and successful business. For a final takeaway, ArcGIS Business Analyst has everything you need to conduct a thorough location analysis. It gathers strong pieces of information that can blow your mind when going through all it has to offer. The information is presented in easy-to-understand ways, and you are given multitudes of choices on how you want the data to be presented. ArcGIS Business Analyst should always come at the forefront of any location analysis for any business.

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