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Assessment of the Impact of Transportation on the Hospitality Industry in Akure city using Machine Learning Algorithms

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Abstract: *This study aims at assessing the impact of transportation on Akure City's hospitality sector using machine learning algorithms. A total of 270 structured questionnaires were applied across nine hospitality and tourism hubs in Akure. Different performance indices were used to assess the impact of transportation on the hospitality industry in Akure which uncovered distinct gender and age distribution patterns across the locations. The different modes of transportation, the respondent's perception of convenience, accessibility of respondents, safety and security, affordability, transportation hub proximity, transportation reservation and transportation availability further underscore the urgency for infrastructure enhancements, in line with the Random forest model's prediction of hospitality ratings in Akure. Random Forest's higher accuracy (89%) compared to Kernel Nearest Neighbour (77%) signifies its superior predictive prowess, as indicated by the evaluation metrics of Mean Square Error (MSE), Mean Absolute Error (MAE), Root Mean Square Error (RMSE), and R-squared (R^2). Overall, the study significantly enriches the understanding of transportation's intricate role in shaping Akure's hospitality landscape, providing actionable insights for industry enhancement and sustainability.*

Keywords:

Transportation, Hospitality Industry, Machine Learning Algorithms, Performance indices

1. INTRODUCTION

The hospitality industry is undeniably a pivotal pillar of economic growth and social development in numerous regions across the globe. It encompasses a vast spectrum of businesses, including hotels, restaurants, event venues, tourism services and more, each contributing substantially to employment, revenue generation, and the overall well-being of communities (Palhares, 2003; Zaei and Zaei, 2013). At the heart of this industry lies a fundamental dependence on efficient and accessible transportation systems. The intricate interplay between transportation and the hospitality sector has, in recent years, undergone profound changes, with the dynamics of one significantly influencing the other. As urbanization and globalization continue to reshape the urban landscape, the significance of the hospitality industry within the broader economic context cannot be overstated. It not only serves as a source of employment for millions but also acts as a magnet for tourists, business travellers and event attendees (Bakare, 2020; Getachew, 2019; Jackson, 2017). In turn, these visitors stimulate local economies by spending on accommodation, dining, entertainment, and various other services. The relationship between transportation and hospitality is a dynamic one, continuously evolving in response to various factors (Bakare, 2020; Jackson, 2017; Ouariti and Jebrane, 2020). Technological advancements have revolutionized the way individuals travel and make bookings, impacting the strategies employed by hospitality businesses. Moreover, shifting consumer preferences, environmental concerns and changes in travel patterns have compelled both industries to adapt and innovate. As the global population becomes increasingly urbanized, cities are expanding and diversifying, leading to alterations in transportation infrastructure and services that have direct consequences for the hospitality sector (Asgary *et al*., 2011; Papatheodorou, 2021).

Akure, the capital city of Ondo State in Nigeria, presents an exceptional case study for our exploration due to its intriguing amalgamation of traditional and modern influences, as well as its dynamic process of urbanization. This unique blend of factors makes Akure an ideal microcosm to study the intricate relationship between transportation and the hospitality sector. Two striking features of Akure are its historical and cultural significance (Aderinlewo, 2020; Owolabi, 2009; Oyedepo, 2014). The city has a rich heritage rooted in Yoruba traditions and history, which have been seamlessly integrated into its contemporary identity. This blend of the old and the new is reflected not only in the city's architecture, but also in its social fabric, cuisine, and overall ambiance. This distinctive cultural identity can have a profound impact on the way transportation services are utilized within the city (Busari, *et al*., 2015a). For instance, tourists may seek authentic cultural experiences, requiring transportation services to provide access to traditional festivals, historical sites and local markets. Furthermore, Akure has experienced noticeable shifts in its demographic landscape over recent years. To meet these growing needs, Akure's hospitality sector has expanded, with new hotels, restaurants, and event venues emerging. The transportation network, in response, has had to adapt and expand to efficiently connect these growing clusters of hospitality establishments with the broader city and its transportation hubs. Similar demographic shifts can be observed in many urban areas worldwide, making the Akure case an insightful model for understanding the interplay between transportation and hospitality in rapidly growing cities (Busari, *et al*., 2015b).

This research seeks to investigate the impact of transportation on the hospitality industry in Akure, with a particular focus on its implications for businesses, consumers and the broader community. By delving into this complex relationship, the aim is to uncover the challenges and opportunities that arise from the synergy between transportation and hospitality in the city. The performance indices to assess transportation efficiency and its influence on the hospitality industry were analysed by utilizing machine learning algorithms such as Random Forest and k-Nearest Neighbours (KNN).

2. METHODOLOGY

2.1 The Study Area

Akure is a city in south-western geopolitical zone of Nigeria. It is the capital and largest city of Ondo state. The city had a population of 403,000 as of the 2006 population consensus. Its current population is 774000 (Wikipedia, 2014)

2.2 The Research Design

The research design for this study is characterized as mixed-methods, combining both qualitative and quantitative research approaches. This mixed-methods design allows for a comprehensive exploration of the research objectives, capturing a wide range of perspectives, experiences and data related to the impact of transportation on the hospitality industry in Akure.

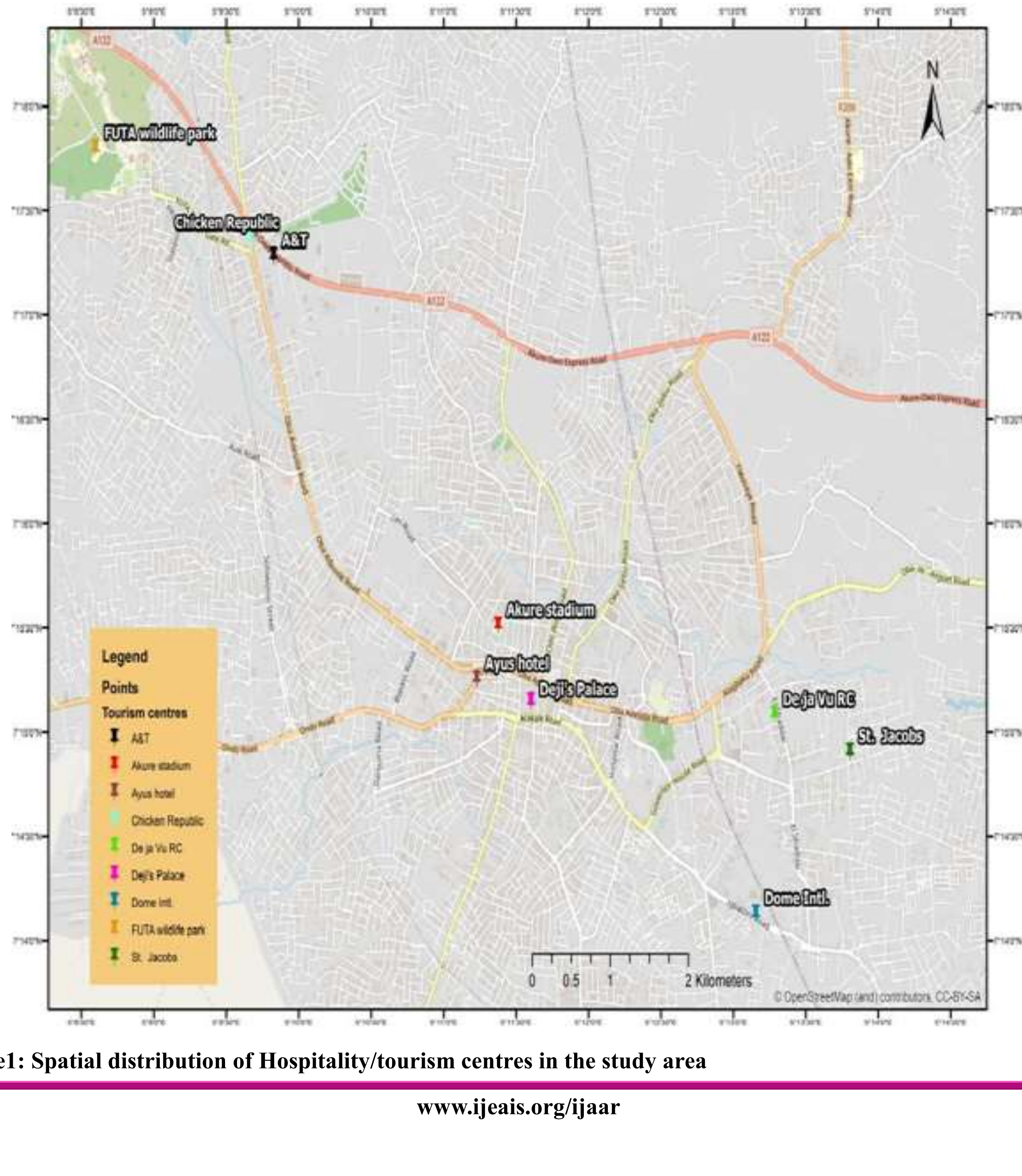

Figure1: Spatial distribution of Hospitality/tourism centres in the study area

2.2 Data Collection

Data were collected using a well-structured questionnaire administered at the different specified locations with the performance indices measured among the respondents in the study area. Careful selection included various hotels, restaurants, and event venues to ensure adequate representation from different parts of Akure.

This encompassed three hotels (Ayus Hotel located at Km 4, Ondo Road, Akure; At&T Hotel located along Ilesha-Owo Expressway before NNPC Mega Station, Akure and St. Jacobs Hotel located at Leonac junction Alagbaka GRA, Akure), three tourist destinations (FUTA Wildlife, Akure Township Stadium, Deji's Palace) and three entertainment centres (The Dome International Event Centre located along Igbatoro Road, Alagbaka area of Akure, Dejavu Restaurant and Lounge located along Elshadai Road, Alagbaka GRA, Akure and Chicken Republic located at FUTA Junction Area, Akure). A total of 360 questionnaires were distributed, with 40 questionnaires per location. However, 326 questionnaires were returned. Upon review, 270 questionnaires were deemed correctly filled out and suitable for analysis, averaging 30 questionnaires per location.

2.3 Techniques of Data Analysis

Data collected from the surveys were analysed using a statistical software called Statistical Package for the Social Sciences (SPSS). Descriptive statistics, such as means, frequencies and percentages were used to summarize the survey responses. Inferential statistical techniques such as regression analysis and correlation analysis, were employed to identify relationships, trends and patterns in the data. The data were subjected to analysis techniques, supported by the application of machine learning algorithms, specifically Random Forest and K-Nearest Neighbours (KNN). This process involved coding and categorizing data to identify recurring themes, patterns, and narratives relevant to transportation and hospitality in Akure. The purpose for incorporating machine learning models into the analysis was to enhance the efficiency and depth of the qualitative insights, allowing for a more comprehensive understanding of the research findings.

3. Results and Discussion

3.1 Gender Distribution

Figure 2 provides insights into the gender distribution of visitors accessing the transportation services at various locations in Akure. St. Jacobs Hotel and Deji's Palace showed a significant amount of male visitors with 73.33% respectively, indicating a preference for these locations among males.

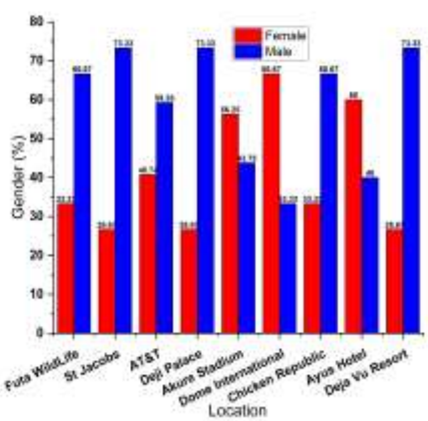

Figure 2: Gender distribution

3.2 Age Distribution

Figure 3 presents a comprehensive view of age distributions among visitors accessing the transportation services at various locations in Akure, depicted in percentages. The transportation services to FUTA Wildlife notably attracts a significant portion of visitors between 18 and 24 years, comprising 53% of its demographic profile, indicating a youthful or family-oriented appeal.

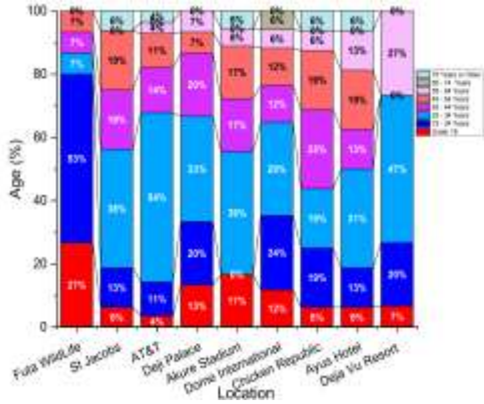

Figure 3: Age distribution

3.3 Percentages of Residents and Visitors

Figure 4 shows the transportation services to FUTA Wildlife, for instance, stands out as a hotspot for visitors, with 66.67% of its presence comprised of non-residents. This suggests that FUTA Wildlife is likely a tourist destination or a location frequently visited by individuals from outside the area.

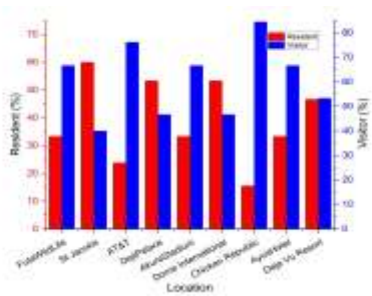

Fig 4: Percentage of visitors and residents

3.4 Purpose of Visit

Figure 5 provides an insightful overview of the types of visits each location in Akure attracts, offering valuable insights into their diverse purposes and strengths. FUTA Wildlife stood out with 57% of its visits attributed to tourism, showcasing its strong appeal as a tourist destination

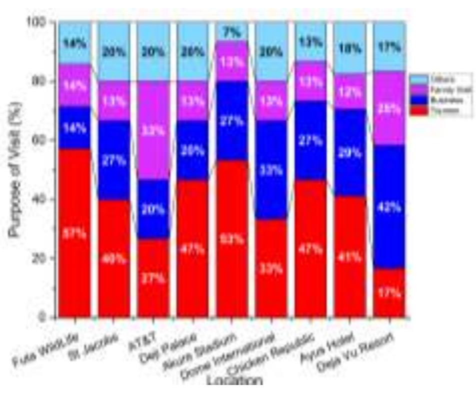

Fig 5: purpose of visit

3.5 Mode choice preference across respondents

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Table 1 presents data on travellers' mode preferences across different hospitality and tourism centres, offering insights into their transportation needs and preferences. At&T sees a strong reliance on personal vehicles at 63.64%, possibly due to limited public transport options.

3.6 Visitor Convenience/Perception

Table 2 shows an in-depth analysis of respondents' perceptions regarding the convenience levels of various locations, utilizing a Likert scale for quantification. Dome International follows

closely with a mean score of 4.86, reflecting a generally high convenience perception among respondents. Dome International's convenience, likely due to well-equipped facilities and services

Table 1: Preference for Modes of Transportation

Destination	Bus (%)	Personal Vehicle (%)	Taxi (%)	Keke Napep (%)	Other (%)
FUTA Wildlife	20.83	25.00	20.83	16.67	16.67
St Jacobs	15.79	15.79	10.53	10.53	15.79
At&T	27.27	63.64	27.27	9.09	9.09
Deji's Palace	4.76	19.05	28.57	9.52	23.81
Akure Stadium	15.63	18.75	25.00	6.25	12.50
Dome International	17.86	35.71	17.86	0.00	17.86
Chicken Republic	2.94	26.47	38.24	0.00	11.76
Ayus Hotel	3.23	48.39	16.13	3.23	9.68
Deja Vu Resort	2.86	34.29	25.71	5.71	14.29

Table 2: Visitor Experience/ Perception

Location	Numerical Mean	Standard Deviation	Ranking
FUTA Wildlife	3.67	2.05	6
St Jacobs	3.86	1.70	4
At&T	4.53	2.20	3
Deji's Palace	2.67	2.16	9
Akure Stadium	3.43	1.35	8
Dome International	4.86	2.06	1
Chicken Republic	3.86	2.20	4
Ayus Hotel	4.80	2.40	2
Deja Vu Resort	3.50	2.05	7

3.7 Accessibility

Table 3 provides valuable insights into how respondents view the ease of access to these locations. Chicken Republic emerges as the most accessible destination, according to the mean score of 4.10, indicating that respondents overwhelmingly find it very easy to access. This strong perception is further supported by a relatively low standard deviation of 2.02, implying a general consensus among respondents regarding Chicken Republic's high accessibility.

Table 3: Accessibility

Destination	Mean	Standard Deviation	Ranking
FUTA Wildlife	3.29	1.23	9
St Jacobs	3.82	1.55	3
At&T	3.94	1.93	2

Deji Palace	3.41	1.63	8
Akure Stadium	3.47	1.75	7
Dome International	3.65	2.12	6
Chicken Republic	4.10	2.02	1
Ayus Hotel	3.76	1.89	4
Deja vu Resort	3.71	1.96	5

3.8 Transportation Availability

Table 4 delves into respondents' perceptions regarding the availability of transportation options to various destinations, offering insights into the consistency or diversity of opinions across different locations. Deja Vu Resort centre tops the list with the highest mean score of 5.00, indicating a strong consensus among respondents that transportation options to this destination are consistently available. However, the relatively high standard deviation of 2.94 suggests some variability in opinions despite the high mean score, hinting at potential fluctuations in perceived availability.

Table 4: Transportation Availability

Destination	Mean	Standard Deviation	Ranking
FUTA Wildlife	3.71	1.81	5
St Jacobs	4.12	1.44	2
At&T	3.76	2.86	4
Deji Palace	3.65	2.40	6
Akure Stadium	3.59	2.43	7
Dome International	3.12	2.31	8
Chicken Republic	3.94	2.40	3
Ayus Hotel	2.53	1.51	9
Deja Vu Resort	5.00	2.94	1

3.9 Cost/ Affordability

Table 5 provides a comprehensive overview of how various locations are perceived in terms of cost affordability, measured on a Likert scale ranging from Very Reasonable to very Unreasonable. FUTA Wildlife emerges as the most positively perceived location in terms of cost of transportation services, ranking first with a high mean score of 4.56. This signifies a strong consensus among respondents that FUTA Wildlife route offers very reasonable pricing, making it an attractive option for budget-conscious travellers. in contrast,

Table 5: Cost/ Affordability

Location	Mean	Standard Deviation	Rank
FUTA Wildlife	4.56	1.03	1
St Jacobs	3.68	2.19	4
At&T	3.68	1.68	4
Deji’s Palace	3.76	2.48	3
Akure Stadium	3.44	1.85	6
Dome International	3.56	1.85	5
Chicken Republic	3.76	2.10	3
Ayus Hotel	3.92	2.08	2
Deja vu Resort	3.68	2.08	4

3.10 Average Hub Proximity

Figure 6 provides valuable insights into respondents' perceptions regarding travel times to different destinations in Akure. Analyzing the percentages reveals distinct patterns and trends in how people perceive accessibility and convenience across various locations. This high percentage indicates a widespread perception of St Jacobs being easily accessible within a short timeframe. Smaller percentages mentioned travel times of 15 to 30 minutes (7.14%), 31 to 45 minutes (20.14%), and 46 to 60 minutes (7.14%), reflecting a slightly varied perception of accessibility among respondents.

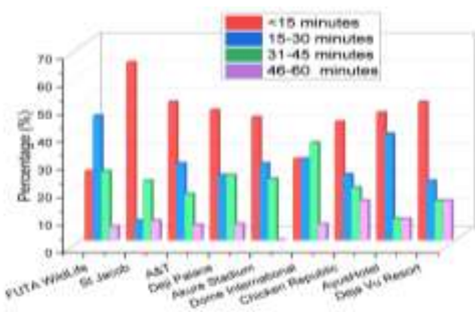

Fig 6: Average Hub proximity time

3.11 Availability of Transportation options

Table 6 presents perceptions regarding the availability of transportation options. Using a Likert scale, respondents rated locations based on how well they felt these destinations catered to accessibility needs. At&T emerges as the most available location, where transportation services can be easily accessed with a mean score of 2.77. This high rating suggests that respondents generally believe the transportation options around

At&T meet availability requirements quite effectively.

Table 6: Availability of Transportation Options

Location	Mean	Standard Deviation	Rank
FUTAWildlife	1.56	2.23	8
St Jacobs	2.44	2.69	4
At&T	2.77	2.79	1
Deji’s Palace	2.33	2.49	6
Akure Stadium	2.11	2.26	7
Dome International	2.44	2.63	5
Chicken Republic	2.69	2.80	3
Ayus Hotel	2.72	2.92	2
Déjà vu Resort	1.50	2.20	9

3.12 Security and Safety

Table 7 shed light on the influence of safety and security concerning the choice of route of visitors travelling to and within Akure. The transportation services provided to FUTA Wildlife makes it the most favoured destination, with respondents attributing a significant positive impact to the safety and security measures implemented there. This perception is supported by FUTA Wildlife’s high mean score of 3.407, indicating a strong consensus among respondents regarding the effectiveness of safety measures in influencing their decision to ply the route from place of origin in visiting this location.

Table 7: Security and Safety

Location	Mean	Standard Deviation	Ranking
FUTA WildLife	3.407	0.276	1
St Jacobs	3.370	2.104	2
AT&T	3.333	1.560	3
Dome International	3.259	0.978	4
Chicken Rep	3.370	1.560	2
Ayus Hotel	3.259	1.166	4
Akure Stadium	3.370	1.166	2
Deja vu Resort	3.333	1.366	3
Deji's Palace	2.778	1.908	5

3.13 Descriptive Analysis

The heat map displayed in Figure 8 shows the relationship between the performance metrics and hospitality rating. The colour scale indicates the degree of relationship of each feature with the target variable (hospitality rating). It is evident that performance metrics such as transportation hub proximity, access modes, accessibility for people with disabilities, transportation scheduling, cost, availability, purpose of visit, and competitive comparison are highly correlated with hospitality rating while other metrics namely guest feedback on accessibility, multimodal transportation show very weak relationship. For the modelling phase, variables or metrics that are positively related with the target variable (hospitality rating) were adopted as features for the random forest and KNN models.

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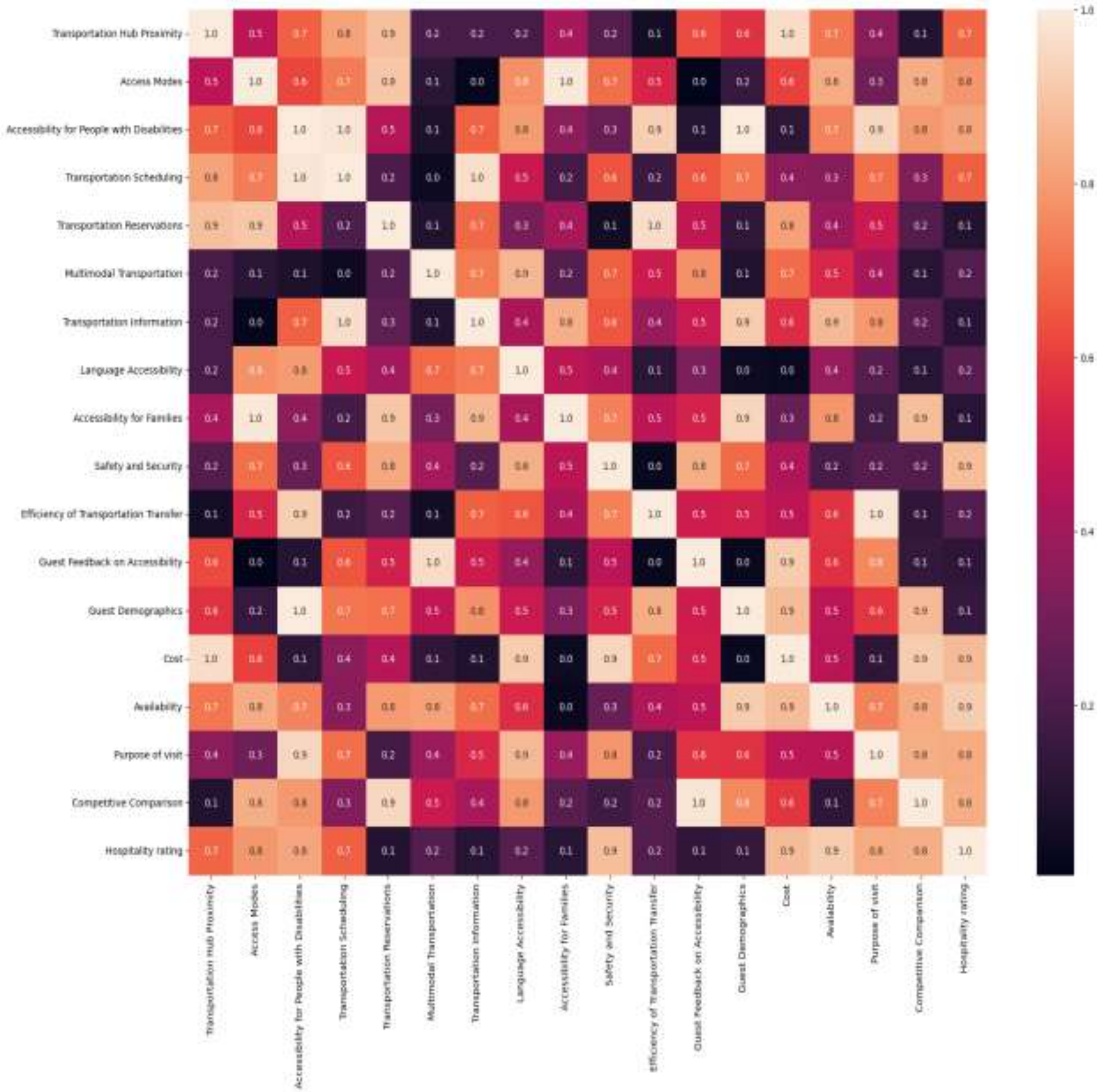

Figure 9: Heat map Plot

3.14 Modelling

In this section, the Random forest regression and KNN model was used to estimate the traffic mode data. Each model was trained, validated and tested on the hospitality dataset. The dataset was randomly split into 70% for training, 15% for validation and 15% for testing. By random shuffling of the dataset, noise in the dataset was easily filtered out, and the average of the cross-validation method's results was adopted to also avoid evaluation deviation.

3.14.1 Random Forest Regression Model

A Random Forest regression model was used to analyze the performance indices for measuring the impact of transportation on the hospitality industry in Akure. The Random Forest regression model was trained using the prepared dataset, with the target variable being a measure of the rate or frequency of use of the transport mode. The trained model's performance was evaluated using validation techniques such as mean squared error (MSE) or root mean squared error (RMSE) to assess its ability to accurately predict mobility outcomes. The model evaluation report for the random forest model shows that the model achieved about 89% accuracy on the testing set. The model root mean square error as shown in Table 8 is 2.28 and the mean absolute error of 2.25. The frequency of mobility as shown in Figure 10 indicates that the impact of transportation on hospitality rating, increases in an upward trend.

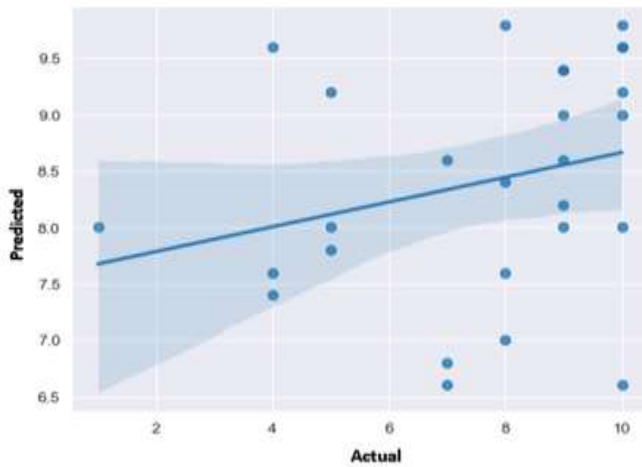

Figure 10: Random Forest Model

Table 9: Random Forest Model Evaluation Metrics

Metrics	Random Forest
Mean Square error	5.21
Mean absolute error	2.25
Root mean square	2.28
R^2	0.89

3.14.2 KNN Model

The model evaluation report for the KNN model shows that the model achieved about 77% accuracy on the testing set.

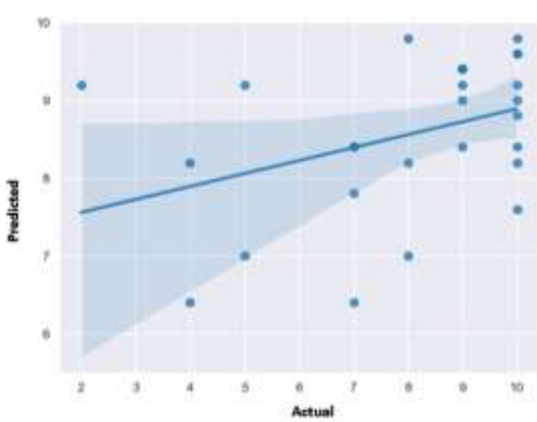

Figure 10: KNN Model

Table 10: KNN Model Evaluation Metrics

Metrics	KNN
Mean Square error	15.23
Mean absolute error	4.12
Root mean square	3.90
R^2	0.77

3.15 Model Performance Comparison

The model comparison as displayed in table 12 using evaluation metrics such as RMSE, MSE, MAE, R^2 shows that the random forest model performed better than the KNN model with accuracy level of 89% in predicting hospitality performance indices in Akure city.

Table 11: Model comparison

Metrics	KNN	Random Forest
Mean Square error	15.23	5.21
Mean absolute error	4.12	2.25
Root mean square	3.90	2.28
R^2	0.77	0.89

4 CONCLUSION AND RECOMMENDATION

4.1 Conclusion

The following conclusion were reached through this study:

i. The gender distribution analysis of transportation services across various locations in Akure indicates clear preferences among visitors. Locations like Futa Wildlife, St Jacobs, and Deji's Palace attract a majority of male visitors, with percentages ranging from 66.67% to 73.33%. The Dome International and Ayus Hotel, on the other hand, have a higher proportion of female visitors at 66.67% and 60% respectively. Akure Stadium attracts more female visitors than Chicken Republic with percentages of 56.25% and 33.33% respectively.

ii. Futa Wildlife is a tourist hotspot with 66.67% non-resident presence, contrasting with St Jacobs, a predominantly residential area with 60% residents. At&T stands out as a commercial hub with 76.19% visitors, while Deji's Palace and Akure Stadium cater equally to residents and visitors (53.33% residents, 46.67% visitors). Dome International also balances residents and visitors, while Chicken Republic primarily attracts more visitors (74.5%) than residents (25.5%). Ayus Hotel and Deja vu Resort centre focus on visitors, with 66.67% non-resident presence each which is typical for hospitality and leisure zones.

iii. Futa Wildlife and Deji's Palace focus significantly on tourism, representing 50% and 46.67% of visits respectively. St Jacobs attracts tourism (37.50%), business (25%), and family visits (12.50%). At &T emphasizes family visits (33.33%) alongside business activities, while Akure Stadium serves as an event venue with 53.33% tourism visits. Dome International and Chicken Republic offer versatile experiences, evenly distributing tourism, business, and family visits. Ayus Hotel caters to tourists (60%) and business travellers (20%), while Deja vu Resort centre prioritizes family visits (20%) alongside tourism (46.67%) and business visits (33.33%).

iv. Safety and security significantly influence transportation mode choices in Akure: motorcycles rank highest (mean 4.634). Other modes show notable impact (mean 3.870, SD 1.142), underscoring the importance of comprehensive safety measures across all transport sectors.

v. The model comparison between KNN and Random Forest algorithms in predicting hospitality performance indices in Akure shows that Random Forest achieved higher accuracy. The evaluation metrics, including MSE, MAE, RMSE, and R_2, indicate superior performance by Random Forest with lower errors and higher R_2 value compared to KNN.

4.2 Recommendations:

Overall, Random Forest demonstrates better predictive capability for assessing the impact of transportation on the hospitality industry in Akure. Utilizing machine learning models like Random Forest, which demonstrated superior accuracy (89%) in predicting hospitality performance indices and provided valuable insights. Continued use of such models can aid in forecasting trends, optimizing service delivery, and making data-driven decisions to enhance overall hospitality industry performance in Akure. The state government should invest in infrastructure upgrades and provide accessibility features to ensure seamless transportation experiences, particularly at locations perceived as less accessible, such as Akure Stadium

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