Optimization of Tourism Industry

Project Summary

Our project aimed to develop a comprehensive solution for optimizing the tourism industry through advanced data analysis and AI prediction models. We began by conducting an extensive literature review to gather relevant research papers, which proved challenging. With this foundational knowledge, we created a preliminary mathematical model to address strategic decision-making for tourism businesses. This model underwent several refinements, including the addition of new parameters, modification of decision variables, and enhancement of constraints, ultimately resulting in a robust Mixed Integer Linear Programming (MILP) model.

Data collection was carried out using an online website for a tourism company, Egypt Tours Portal. We preprocessed this data, ensuring it was clean and in a normal form suitable for analysis. Using Excel dashboards, we performed thorough data analysis to identify key patterns and trends. To solve our mathematical model, we compared exact solutions with metaheuristic approaches. Implementing both in Python, we found that metaheuristic solutions, particularly the Genetic Algorithm, were more suitable for complex and larger problems due to better convergence times and optimal fitness values.

To facilitate tourism industry management, we developed a user-friendly Windows Form application using C# and the .NET Framework. This involved creating an entity-relationship schema, converting it into an entity-relationship diagram, and implementing it as a SQL database in SQL Server Management Studio 2019. The user interface, developed in Microsoft Visual Studio 2022, allows administrators to easily manage tourism packages, resources, and budgets.

Finally, we developed an AI prediction model using Python and Tkinter to forecast demand for tour packages from 2025 to 2028, based on historical data from 2019 to 2023. We compared seven algorithms (Decision Tree, Neural Network, Linear Regression, Gradient Boosting Regressor, Support Vector Regressor, K-Nearest Neighbors (KNN)), and Random Forest. The Gradient Boosting Regressor achieved the highest accuracy of 93.46%, making it the chosen model for our predictions. This comprehensive approach has resulted in a robust system that enhances the efficiency and effectiveness of tourism management.