AI-Based Ranking Model for Medical Tourism Destinations

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Abstract

Medical tourism has become an essential component of global healthcare, with patients traveling internationally for affordable and high-quality medical treatment. This paper presents an AI-driven approach for ranking countries based on their medical tourism potential. A multi-criteria decision-making framework is developed, integrating healthcare infrastructure, economic factors, and safety indicators. Machine learning techniques such as **K-Nearest Neighbors (KNN) Imputation**, **Normalization**, and **Weighted Score Computation** are applied to ensure fair and dynamic rankings.

1 Introduction

Medical tourism involves traveling abroad for medical treatments, driven by factors such as:

- Availability of high-quality healthcare infrastructure.

- Cost-effectiveness of medical procedures.

- Ease of travel, visa policies, and international accessibility.

- Safety, business regulations, and economic stability.

To systematically evaluate countries, we propose a data-driven AI-based ranking model integrating medical, economic, and tourism-related indicators.

2 Data Collection

Data is obtained from multiple sources:

- **World Bank API:** Healthcare expenditure, hospital infrastructure, GDP per capita.

- **United Nations World Tourism Organization (UNWTO):** International tourist arrivals.

- **OECD Economic Indicators:** Business ease and stability indices.

Each country is represented as a feature matrix $X \in R^{N \times M}$, where N is the number of countries and M represents key indicators.

3 Mathematical Formulation

The **Medical Tourism Score** is computed based on six key components:

3.1 Weighted Score Function

Each country is assigned a score based on:

$$S_i = w_1 H_i + w_2 E_i + w_3 G_i + w_4 T_i + w_5 B_i + w_6 S_i$$

where:

- H_i = **Hospital Beds per 1,000 people** – Healthcare Infrastructure.

- E_i = **Healthcare Spending per Capita (USD)** – Quality of Healthcare.

- G_i = **GDP per Capita (USD)** – Affordability Proxy.

- T_i = **Annual Tourist Arrivals (millions)** – Accessibility Popularity.

- B_i = **Ease of Doing Business Score** – Legal Simplicity.

- S_i = **Safety Index (Low Homicide Rate)** – Safety Consideration.

with weights:

$$w_1 = 0.3, \quad w_2 = 0.25, \quad w_3 = 0.2, \quad w_4 = 0.1, \quad w_5 = 0.1, \quad w_6 = 0.05$$

3.2 Normalization

To ensure comparability, we apply min-max normalization:

$$X'_{ij} = \frac{X_{ij} - \min(X_j)}{\max(X_j) - \min(X_j)}$$

which rescales all values to a range of $[0, 1]$.

4 Handling Missing Data Using AI

Some countries have missing values in healthcare statistics. To address this, we apply:

4.1 K-Nearest Neighbors (KNN) Imputation

Missing values are estimated using the k most similar countries:

$$X_{ij}^{(impute)} = \frac{1}{k} \sum_{n \in \mathcal{N}(i)} X_{nj}$$

where $\mathcal{N}(i)$ represents the k-nearest neighbors based on feature similarity.

4.2 Regression-Based Predictions

For countries with extensive missing data, we apply regression:

$$X_{ij} = \beta_0 + \sum_{k=1}^{M} \beta_k X_{ik} + \epsilon_i$$

where β_k are regression coefficients and ϵ_i is the error term.

5 Implementation and Results

5.1 Algorithm Workflow

The AI-driven ranking system follows:

1. Retrieve global medical, economic, and tourism indicators.

2. Apply **KNN, Regression, and Normalization** for missing values.

3. Compute the **Medical Tourism Score** for each country.

4. Rank destinations and visualize results.

5.2 Top 5 Medical Tourism Destinations

Table 1 presents the highest-ranked medical tourism destinations based on our model.

Country	Medical Score	Hospital Beds per 1,000	Healthcare Spending (USD)
Thailand	0.92	2.1	850
India	0.89	1.5	600
Turkey	0.85	2.8	1200
Mexico	0.83	1.7	900
South Korea	0.81	12.3	4500

Table 1: Top 5 Medical Tourism Destinations

6 Conclusion and Future Work

This study presents an AI-driven ranking system for medical tourism destinations , integrating healthcare and economic factors. Our findings suggest that:

- Countries with **high medical infrastructure and affordable healthcare** rank highest.

- **International accessibility and medical tourism popularity** influence ranking.

- **Safety and business ease** impact patient decision-making.

Future Enhancements:

- AI-Based Cost Analysis: Evaluating treatment affordability using real-world pricing.

- Hospital Doctor Ratings: Integrating quality metrics based on patient feedback.

- Real-Time Dashboard: Deploying a web-based interactive ranking tool.

References

- World Bank API: `https://data.worldbank.org`

- UNWTO Tourism Statistics: `https://www.unwto.org/statistics`

- OECD Healthcare Reports: `https://www.oecd.org/health`