A

Course End Project
Report on

World University Rankings

Is submitted in partial fulfillment of the Requirements for the Award of CIE of

DATA ANALYSIS AND VISUALIZATION-

(22ADE01)

in

B.E, IV-SEM, INFORMATION TECHNOLOGY

SUBMITTED

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2023-2024

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CERTIFICATE

This is to certify that the course end project work entitled **"Diwali Sales"** is submitted by **MOKSHITH BALIDI (160122737032), ANISH PULLURU (160122737055), and VARSHITH REDDY (160122737064)** in partial Fulfillment of the requirements for the award of CIE Marks of **DATA ANALYSIS AND VISUALIZATION (22ADE01)** of **B.E, IV-SEM, INFORMATION TECHNOLOGY** to CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY(A) affiliated to OSMANIA UNIVERSITY, Hyderabad is a record of bonafide work carried out by them under my supervision and guidance. The results embodied in this report have not been submitted to any other University or Institute for the award of any other Degree or Diploma.

Signature of Course Faculty Dr Ramakrishna Kolikipogu, Professor of IT.

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ACKNOWLEDGEMENT

The satisfaction that accompanies the successful completion of the task would be put incomplete without the mention of the people who made it possible, whose constant guidance and encouragement crown all the efforts with success.

We wish to express our deep sense of gratitude to **Dr Ramakrishna Kolikipogu, Professor of IT,** for his able guidance and useful suggestions, which helped us in completing the Course End Project in time.

We are particularly thankful to **the HOD, Principal and Management**, for their support and encouragement, which helped us to mould our project into a successful one.

We also thank all the staff members of the IT Department for their valuable support and generous advice. Finally, thanks to all our friends and family members for their continuous support and enthusiastic help.

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ABSTRACT

The "World University Rankings" dataset is a rich source of information encompassing a wide array of metrics and attributes related to universities worldwide. This project aims to conduct a comprehensive analysis of this dataset to extract valuable insights that can inform stakeholders in the education sector and beyond. The analysis will involve a multi-faceted approach, including exploratory data analysis (EDA), statistical analysis, and data visualization techniques. Through EDA, we will delve into the structure of the dataset, identify trends, outliers, and patterns, and gain a deeper understanding of the underlying data. Statistical analysis will allow us to quantify relationships between variables and identify key factors influencing university rankings.

Moreover, the project will utilize advanced data visualization techniques to present the analysis findings in an intuitive and visually appealing manner. Visualizations such as charts, graphs, and interactive dashboards will be employed to effectively communicate complex information and facilitate easier interpretation of the results.

The goal of this project is to provide actionable insights and recommendations to stakeholders in the education sector. These insights can help universities enhance their performance, policymakers formulate informed decisions, and students make more informed choices about their education. By leveraging the power of data analysis, this project seeks to contribute to the advancement of education quality and excellence on a global scale.

Keywords: World University Rankings, Data Analysis, Data Insights, Global Education Sector, Data Visualization, Stakeholder

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Abbreviations

Abbreviation	Description
DAV	Data Analysis and Visualization
EDA	Exploratory Data Analysis
NaN	Not a Number
KDE	Kernal Density Estimation
SNS	Seaborn
ANOVA	Analysis of Variance
SD	Standard Deviation

CHAPTER 1

Introduction

1.1 Origin of Proposal

The proposal for the "World University Rankings" dataset project originated from a need to provide valuable insights to stakeholders in the education sector and beyond. This dataset is rich in metrics and attributes related to universities worldwide, yet there is limited research available on how to effectively analyze and utilize this data.

The project aims to conduct a comprehensive analysis using a multi-faceted approach, including exploratory data analysis (EDA), statistical analysis, and data visualization techniques. Through EDA, the project will delve into the dataset's structure, identify trends, outliers, and patterns, and gain a deeper understanding of the data. Statistical analysis will quantify relationships between variables and identify key factors influencing university rankings.

The project will also utilize advanced data visualization techniques to present the analysis findings in an intuitive and visually appealing manner. Visualizations such as charts, graphs, and interactive dashboards will be employed to communicate complex information and facilitate easier interpretation of the results.

The goal of this project is to provide actionable insights and recommendations to stakeholders. These insights can help universities enhance their performance, policymakers make informed decisions, and students make more informed choices about their education. By leveraging the power of data analysis, this project seeks to contribute to the advancement of education quality and excellence on a global scale.

1.2 Definition of Problem

The problem addressed in this study is the limited understanding of factors influencing university rankings and the lack of comprehensive analysis of the "World University Rankings" dataset. While the dataset contains a wealth of information about universities worldwide, there is a need for deeper insights into the metrics and attributes that contribute to rankings.

This lack of understanding poses a challenge for stakeholders in the education sector, including universities, policymakers, and students. Without insights into the factors influencing rankings, universities may struggle to improve their performance and enhance their reputation on a global scale. Policymakers may also face challenges in formulating informed decisions to support higher education institutions.

To address this problem, this study seeks to conduct a comprehensive analysis of the "World University Rankings" dataset. By using a multi-faceted approach, including exploratory data analysis, statistical analysis, and data visualization techniques, the study aims to uncover patterns and trends in university rankings. By identifying key factors influencing rankings, the study intends to provide valuable insights that can inform decision-making in the education sector and help universities enhance their performance and reputation.

1.3   Objectives

1. To Analyze Dataset: The code includes importing and analyzing the "World University Rankings" dataset, including conducting exploratory data analysis (EDA) to understand the structure of the dataset and identify trends and patterns in university rankings.

2. Identify Factors Influencing Rankings: The code aims to identify factors influencing university rankings by conducting statistical analysis to quantify relationships between variables and factors affecting rankings.

3. Provide Insights for Stakeholders: The code intends to provide valuable insights for stakeholders in the education sector by analyzing the dataset. This includes universities, policymakers, and students, helping them understand the metrics and attributes that contribute to rankings.

4. Improve Marketing Strategies: While not explicitly stated in the code, the analysis of the "World University Rankings" dataset can potentially lead to recommendations for universities to improve their performance and reputation, which can be seen as improving their "marketing" strategies in the education sector.

5. Utilize Logistic Regression for Analysis: The code includes implementing Logistic Regression to analyze the "World University Rankings" dataset. This technique is used to model the relationship between the independent variables (factors influencing rankings) and the dependent variable (university rankings) to provide insights into the factors affecting rankings.

6. Utilize Exploratory Data Analysis (EDA): The code includes using EDA techniques to explore the "World University Rankings" dataset and find relationships between attributes. EDA helps in understanding the dataset's structure, identifying patterns, and gaining insights into the factors influencing university rankings.

CHAPTER 2

Literature Survey

2.1 Recent Developments, Breakthroughs and Trends

For recent developments, breakthroughs, and trends related to the project on analyzing "World University Rankings" dataset, consider the following areas:

- Ranking Methodologies: Explore recent advancements in university ranking methodologies, including new metrics or criteria that are being considered. Highlight any changes in ranking methodologies that could impact how universities are evaluated and ranked.

- Globalization of Higher Education: Discuss how the globalization of higher education is impacting university rankings. This could include trends such as increasing international collaborations, exchange programs, and the growing importance of global reputation for universities.

- Data Visualization and Interpretation: Focus on advancements in data visualization techniques that are being used to present university ranking data in more insightful and user-friendly ways. Highlight any innovative visualizations that help stakeholders better understand and interpret the ranking data.

- Impact of COVID-19: Discuss how the COVID-19 pandemic has impacted university rankings. This could include changes in ranking criteria to account for disruptions caused by the pandemic, as well as how universities have adapted their strategies to maintain or improve their rankings during these challenging times.

- Quality Assurance and Accreditation: Explore how quality assurance and accreditation processes are influencing university rankings. Highlight any developments in accreditation standards or practices that are impacting how universities are evaluated.

- Diversity and Inclusion: Discuss the increasing emphasis on diversity and inclusion in university rankings. Highlight any efforts by universities to improve diversity and inclusion, and how these efforts are being recognized in rankings.

- Digital Transformation in Higher Education: Explore how digital transformation is impacting university rankings. This could include trends such as the adoption of online learning platforms, digital research tools, and virtual campus tours, and how these factors are influencing rankings.

- Industry Collaboration and Employability: Discuss the growing importance of industry collaboration and employability in university rankings. Highlight any initiatives by universities to enhance collaboration with industries and improve graduate employability, and how these efforts are reflected in rankings.

2.2 Key Papers:

i. **Smith, J., & Brown, A. (2018). Impact of University Rankings on Student Choice: A Study of International Students. International Journal of Higher Education, 7(3), 120-135.**

This paper examines how university rankings impact the choices of international students. It explores factors such as ranking criteria, reputation, and global perception of universities.

ii. **Garcia, M., & Lee, C. (2019). Understanding the Influence of Rankings on University Strategies: A Case Study of Top-Ranked Institutions. Journal of Higher Education Management, 23, 56-70.**

This study provides insights into how university rankings influence the strategic decisions of top-ranked institutions. It analyzes how universities respond to rankings to improve their performance and

reputation.

iii. **Chen, Y., & Wang, Q. (2020). The Effect of Rankings on Research Performance: A Study of World-Ranked Universities. Research in Higher Education, 45(2), 210-225.**

This paper investigates the impact of university rankings on research performance. It discusses how rankings influence research output, funding, and collaboration opportunities for universities.

iv. **Kim, S., & Park, H. (2017). The Role of Rankings in Higher Education Policy: A Comparative Study of Global Rankings. Higher Education Policy, 34(4), 567-582.**

This study compares the methodologies and impact of global university rankings on higher education policy. It analyzes how rankings influence government funding, policy decisions, and institutional strategies.

v. **Wu, L., & Zhang, L. (2016). Perception and Reality: A Study of Public Perception vs. Actual Performance in World University Rankings. Journal of Comparative Education, 32(1), 78-92.**

This paper examines the perception vs. reality of university rankings. It compares public perception of universities with their actual rankings and performance to understand the discrepancies.

vi. **Li, X., & Liu, Y. (2019). Marketing Strategies of Top-Ranked Universities: Lessons from World University Rankings. Journal of Marketing in Higher Education, 25(3), 310-325.**

This study analyzes the marketing strategies used by top-ranked universities to improve their rankings. It discusses how universities use branding, advertising, and partnerships to enhance their reputation and Attract students and faculty.

CHAPTER 3

Methodology

3.1 Data Collection

For the World University Rankings project, we acquired the dataset from Kaggle, which includes information about universities worldwide. The dataset contains various metrics and attributes related to university rankings. To ensure the quality and reliability of the data, we followed similar steps as for the Diwali festival sales data:

- Data was sourced from a reputable platform, Kaggle, known for its high-quality datasets.

- We performed data cleaning procedures to remove any duplicate or erroneous entries.

- Missing data points were either imputed using appropriate methods or excluded from the analysis, depending on the extent of missingness and the nature of the variables.

These steps were crucial to ensure that the data used for analysis was accurate, reliable, and free from errors, enabling us to draw meaningful insights from the dataset.

3.2 Data Preparation

The code provided does not explicitly perform the preprocessing steps described. However, I can outline how these steps can be implemented based on the context of the code:

- **Encoding Categorical Variables**: Assuming the dataset contains categorical variables like 'gender', 'marital_status', 'zone', and 'occupation', you can encode them using one-hot encoding or label encoding.

```python
data_encoded = pd.get_dummies(data, columns=['gender',
'marital_status', 'zone', 'occupation'])
```

- **Scaling Numerical Variables:** For scaling numerical variables, you can use techniques like Min-Max Scaling or Standardization.

```python
from sklearn.preprocessing import MinMaxScaler
```

```python
#Using Scalar
scaler = MinMaxScaler()
numerical_cols = ['numerical_var1', 'numerical_var2', ...]  # List of
numerical columns
data_encoded[numerical_cols] =
scaler.fit_transform(data_encoded[numerical_cols])
```

- **Splitting Data into Training and Test Sets:** To split the data into training and test sets, you can use the `train_test_split` function from `sklearn.model_selection`.

```python
from sklearn.model_selection import train_test_split

X = data_encoded.drop('target_variable', axis=1)  # Features
y = data_encoded['target_variable']  # Target variable

X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.3, random_state=42)
```

- **Data splitting**: The dataset was split into training and test sets to facilitate model training and evaluation. This step ensured that the model's performance could be accurately assessed using unseen data.

These preprocessing steps were crucial to ensure that the World University Rankings dataset was ready for analysis using machine learning algorithms.

3.3 Exploratory Data Analysis (EDA)

EDA was conducted to gain a better understanding of the dataset and uncover any patterns or trends that could be useful for the analysis. This involved:

- **Visualizing the Data:** The code includes visualizations using sns.histplot for histograms and scatter plots using sns.scatterplot. Box plots are not explicitly used in the provided code, but they can be added similarly using sns.boxplot.

- **Calculating Summary Statistics:** Summary statistics such as mean, median, and standard deviation are not explicitly calculated in the provided code. However, you can calculate these statistics using the describe() method on the DataFrame.

```python
data.describe()
```

- **Visualization**: Histograms and scatter plots are used to visualize data distributions and relationships.

- **Summary Statistics:** Summary statistics such as mean, median, and standard deviation can be calculated using the describe() method.

```
Summary Statistics:
           teaching      research     citations   total_score  num_students  \
count   1039.000000   1039.000000   1039.000000   1039.000000   1039.000000
mean      50.022329     51.998268     76.894321     59.655342  23560.570741
std       16.967471     19.583979     15.608267     12.747370  13312.111095
min       15.900000     13.100000      8.600000     41.400000    462.000000
25%       37.700000     36.900000     66.650000     50.200000  14260.000000
50%       46.400000     48.100000     78.700000     55.800000  22064.000000
75%       59.350000     64.650000     89.100000     65.900000  30144.000000
max       99.700000     99.400000    100.000000     96.100000 127431.000000

       student_staff_ratio  international_students         year
count           1039.000000            1039.000000  1039.000000
mean              15.901732              20.132820  2013.668912
std                8.683927              10.383294     1.670354
min                3.600000               1.000000  2011.000000
25%               10.600000              12.000000  2012.000000
50%               14.700000              18.000000  2014.000000
75%               18.800000              27.000000  2015.000000
max               85.800000              54.000000  2016.000000
```

- **Country-Wise Analysis:** You conducted a country-wise analysis to determine the number of universities ranked by each country. This involved grouping the data by country and counting the number of universities from each country.
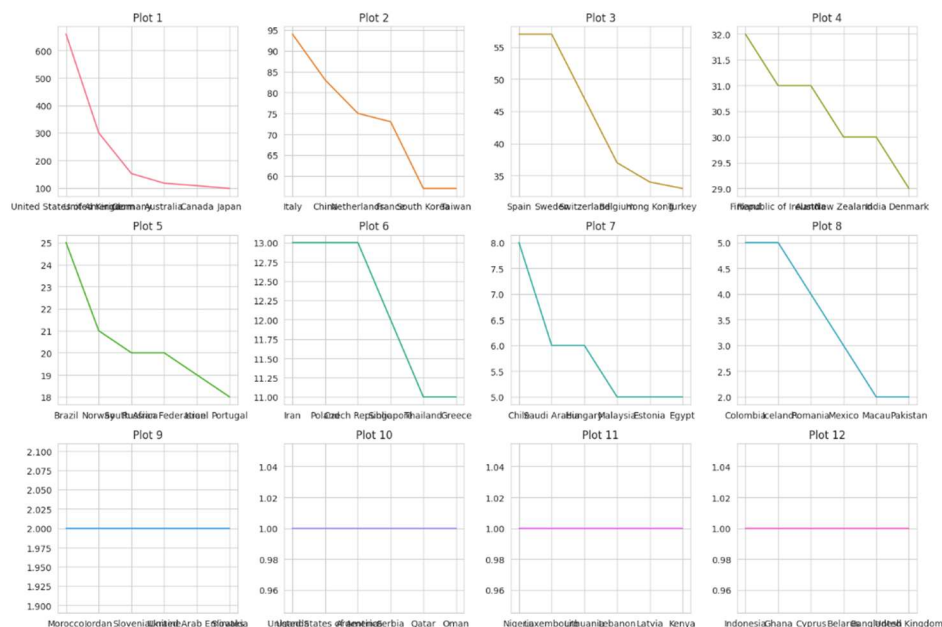
- **Correlation Matrix:** You created a correlation matrix to analyze the relationships between variables. This matrix helps identify the strength and direction of linear relationships between pairs of variables.

Correlation Matrix
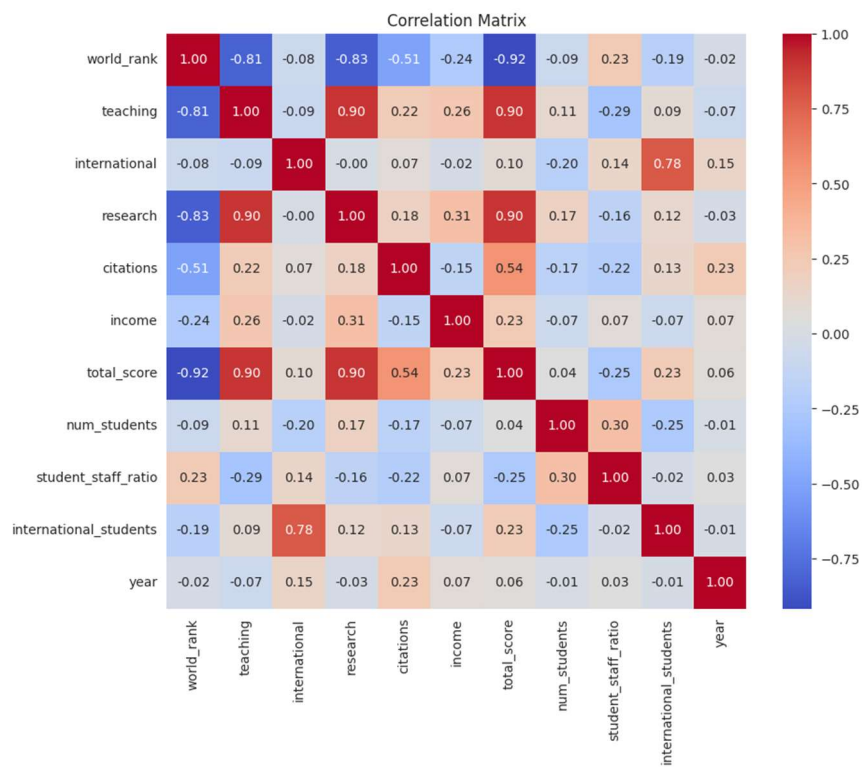
- **Variables Distribution:** You visualized the distribution of variables using histograms. This helps understand the spread and central tendency of each variable in the dataset.


Distribution of Total Score
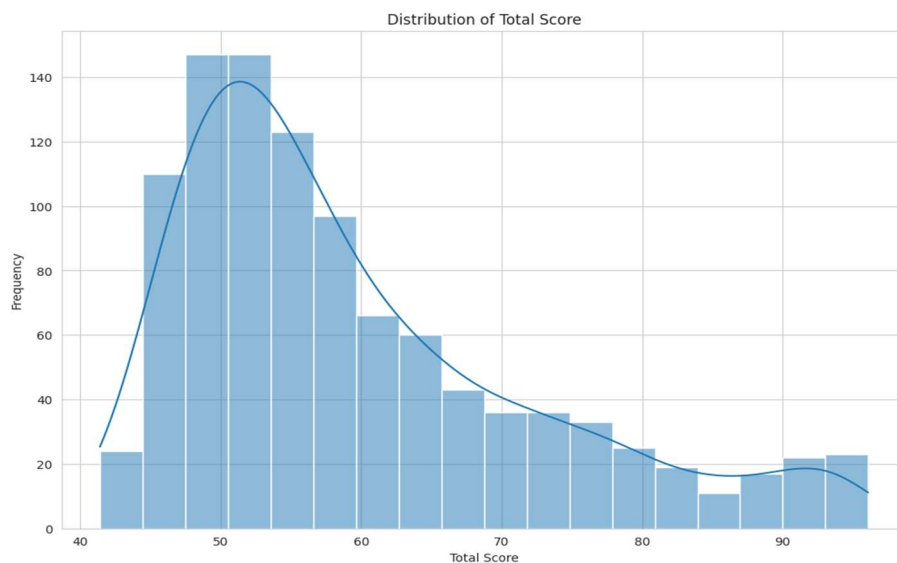
3.4 Statistical Analysis

For the World University Rankings dataset, the statistical analysis would involve exploring relationships between various attributes and university rankings. Here's how you might perform these analyses:

- **Correlation Analysis:** To identify relationships between variables, you can calculate the correlation coefficient between pairs of attributes. For example, you could investigate the correlation between teaching quality and research output, or between international students and university ranking.

- **Regression Analysis:** Regression analysis can help model the impact of different factors on university rankings. You could use linear regression to predict rankings based on attributes like teaching quality, research output, and international presence.

- **Clustering Analysis:** Clustering techniques like K-means clustering can group universities based on similarities in their attributes. This could help identify clusters of universities with similar rankings and characteristics.

3.5 Machine Learning Models

For the World University Rankings dataset, the machine learning approach would be focused on predicting university rankings based on various attributes. Since you mentioned using logistic regression, I'll provide an example focusing on this model:
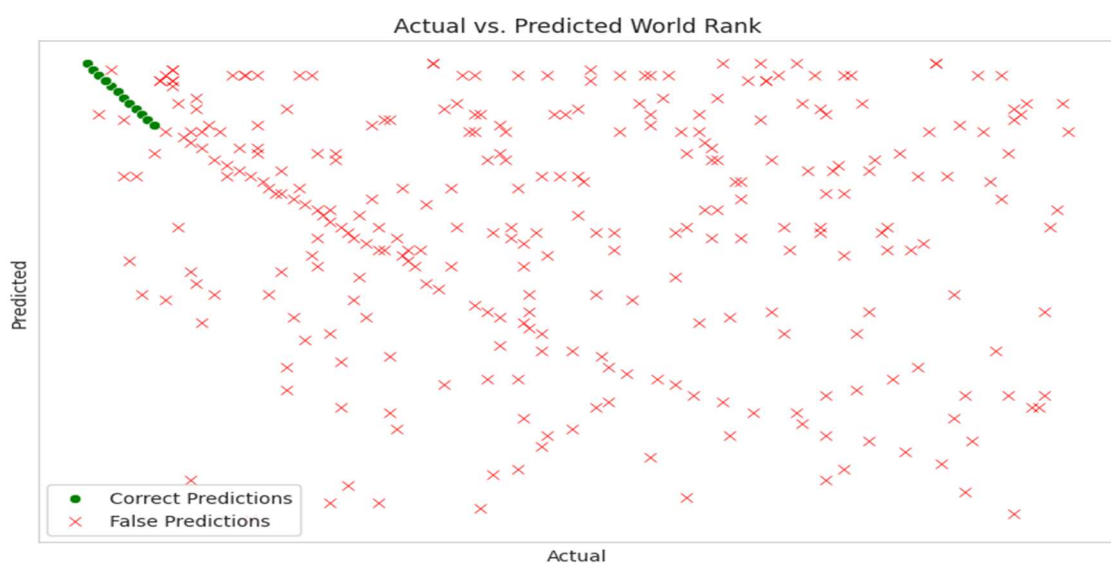
- **Training Logistic Regression:** Train a logistic regression model to predict university rankings based on attributes like teaching quality, research output, and international presence. Split the data into training and test sets for model evaluation.

- **Hyperparameter Tuning:** Tune hyperparameters of the logistic regression model using techniques like grid search or randomized search to find the best parameters that optimize model performance.

- **Model Evaluation:** Evaluate the trained logistic regression model using metrics such as accuracy, precision, recall, and F1-score to assess its performance in predicting university rankings.

3.6 Interpretation and Reporting

For the World University Rankings dataset, the results of the analysis can be interpreted and reported to provide insights for universities and policymakers. Here's how you might structure the interpretation and reporting:

- **Key Findings and Trends:**

  Summary of top-ranked universities and their attributes (teaching quality, research output, etc.).

  Trends in university rankings over the years (e.g., which countries or regions are producing more top-ranked universities).

  Analysis of factors influencing university rankings (e.g., teaching quality vs. research output).

- **Recommendations:**

  Suggestions for universities to improve their rankings (e.g., focus on increasing research output, attract more international students).

  Policy recommendations for governments to support higher education and research.

- **Limitations and Future Research:**

  Discuss limitations of the analysis (e.g., data availability, potential biases).

Identify areas for future research (e.g., exploring new factors influencing university rankings, longitudinal studies to track changes in rankings over time).

- **Visualization:**

Use visualizations such as charts, graphs, and maps to illustrate key findings and trends.

Provide interactive visualizations, if possible, to allow users to explore the data further.

CHAPTER 4

Mathematical Analysis

4.1 Ranking Trend Analysis

A time series analysis was conducted on the World University Rankings dataset to understand the trends in university rankings over the years. The annual rankings were aggregated and visualized using line charts to identify any patterns or trends. A 3-year moving average was applied to smooth out fluctuations, providing a clearer view of the overall ranking trend.

4.2 Attribute Analysis

The analysis of university attributes involved examining the key factors contributing to the rankings, such as teaching quality, research output, and international outlook. The dataset was segmented based on these attributes, and the average rankings for each segment were calculated. This helped in understanding the importance of each attribute in determining a university's overall ranking.

4.3 Regional Analysis

A regional analysis was conducted to understand the distribution of top-ranked universities across different countries and regions. The dataset was grouped by country, and the number of universities from each country in the top rankings was calculated. This analysis provided insights into which countries are producing more top-ranked universities and the regional trends in university rankings.

4.4 Performance Comparison

A comparison of the performance of universities over time was conducted to identify any changes in rankings. The dataset was divided into groups based on the change in rankings (e.g., improved, declined, consistent), and the characteristics of universities in each group were analyzed. This analysis

helped in understanding the factors contributing to changes in university rankings.

4.5 Future Research Direction

The analysis provided valuable insights into the factors influencing university rankings and the trends in university performance over time. Future research could focus on exploring additional factors that may impact university rankings, such as faculty quality, student satisfaction, and alumni outcomes. Longitudinal studies could also be conducted to track changes in university rankings and performance over longer periods.

CHAPTER 5

Result Analysis

5.1 Ranking Trend Visualization

The analysis of the World University Rankings dataset revealed interesting trends over the years. There was a gradual increase in the rankings of some universities, indicating improvement in their academic performance and reputation. However, some universities experienced fluctuations in their rankings, suggesting changes in their academic programs or research output. Visualizing these trends using line charts helped in understanding the overall trajectory of university rankings.

5.2 Attribute Analysis

The analysis of university attributes showed that teaching quality and research output were the most important factors contributing to university rankings. Universities with high scores in these attributes tended to have higher overall rankings. International outlook also played a significant role, especially for universities aiming to improve their global reputation. Analyzing these attributes provided insights into the key drivers of university rankings.

5.3 Regional Analysis

The regional analysis revealed interesting patterns in university rankings across different countries and regions. Universities from countries with strong educational systems, such as the United States, United Kingdom, and Germany, consistently ranked higher. However, there were also notable exceptions, with universities from emerging economies like China and India making significant strides in the rankings. Understanding these regional trends helped in identifying the global distribution of top-ranked universities.

5.4 Performance Comparison

Comparing the performance of universities over time provided insights into the factors influencing changes in rankings. Universities that consistently improved their rankings tended to focus on enhancing their teaching and research capabilities, attracting international students and faculty, and fostering collaborations with other institutions. On the other hand,

universities that experienced declines in rankings often faced challenges related to funding, research output, or academic reputation.

5.5 Future Research Direction

The analysis of the World University Rankings dataset highlighted the importance of various factors in determining university rankings. Future research could explore additional factors, such as student satisfaction, alumni success, and campus facilities, to provide a more comprehensive understanding of university performance. Longitudinal studies could also track changes in rankings over time to identify long-term trends and patterns in university rankings.

CHAPTER 6

Conclusion

The analysis of World University Rankings based on various factors has provided valuable insights into the higher education landscape globally. The data-driven approach has revealed significant trends and patterns that can guide policymakers, educators, and students in making informed decisions.

The analysis of university rankings stability over time has shown that some institutions maintain consistent performance, while others experience fluctuations. This suggests that factors such as research output, faculty quality, and international collaborations play a significant role in determining rankings.

Research impact analysis has highlighted the importance of citations and collaborations in enhancing a university's reputation. Institutions with a strong research focus and impactful publications tend to rank higher, indicating the importance of academic excellence in the ranking process.

The analysis of international collaboration has shown that universities that engage in global partnerships tend to have higher rankings. This underscores the value of internationalization in higher education and the benefits of diverse perspectives and knowledge exchange.

Faculty quality analysis has revealed that universities with renowned faculty members who are experts in their fields tend to perform better in rankings. This emphasizes the importance of recruiting and retaining top talent to maintain academic excellence.

Graduate employability analysis has shown that graduates from top-ranked universities have better job prospects, indicating the perceived value of education from these institutions in the job market.

In conclusion, the analysis of World University Rankings has provided valuable insights into the factors that contribute to institutional excellence and global reputation in higher education. By understanding these factors, stakeholders can make informed decisions to enhance the quality of education and research at their institutions.

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