Estimation And Prediction of Hospitalization and Medical Care Costs

Category: Data Analytics

From Aditya College Of Engineering.

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INTRODUCTION:

Abstract:

The "Estimation and Prediction of Hospitalization and Medical Care Costs" project aims to leverage data analytics techniques to address critical challenges in the healthcare domain. The primary objective is to develop predictive models that can accurately estimate and forecast hospitalization and medical care costs for individuals based on various demographic, medical, and socioeconomic factors.

Project Description:

Medical costs are one of the most common recurring expenses in a person's life. Based on different research studies, BMI, aging, smoking, and other factors are all related to greater personal medical care costs. The estimates of the expenditures of health care related to obesity are needed to help create cost-effective obesity prevention strategies. Obesity prevention at a young age is a top concern in global health, clinical practice, and public health.

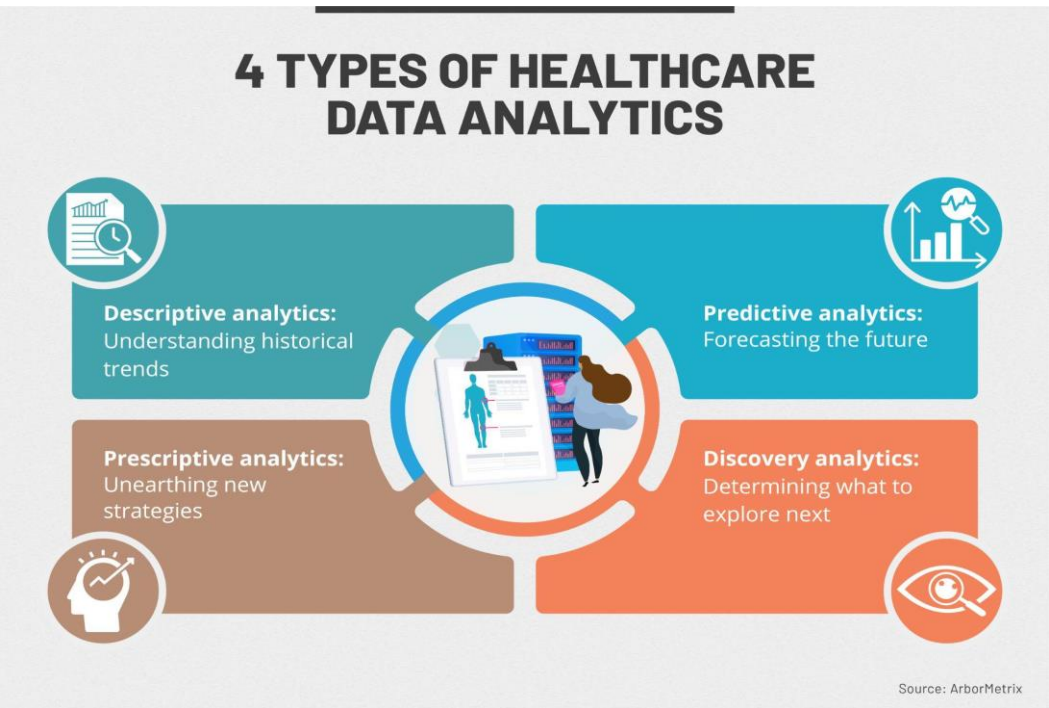

FIG:01

To avoid these restrictions, genetic variants are employed as instrumental variables in this research. Using statistics from public huge datasets, the impact of body mass index (BMI) on overall healthcare expenses is predicted.

PURPOSE OF THE PROJECT:

The project "Estimation and Prediction of Hospitalization and Medical Care Costs" through data analytics can have various valuable use cases and benefits in the healthcare domain. Here are some potential applications and achievements that can be realized:

1. **Cost Management and Resource Allocation**: Healthcare organizations and policymakers can use the predictive models to estimate future hospitalization and medical care costs. This information can aid in better budgeting, resource allocation, and financial planning to ensure efficient use of resources.
2. **Health Insurance Planning**: Insurance companies can leverage the predictive models to assess the potential risks and costs associated with different demographics, medical conditions, and geographic regions. This can help them design appropriate insurance plans and set premiums accordingly.
3. **Identifying High-Risk Groups**: By analyzing the data, data analytics can identify demographic groups or individuals with higher chances of hospitalization or significant medical care costs. Healthcare providers can then implement targeted preventive measures and interventions to manage these risks effectively.
4. **Healthcare Policy and Decision Making**: Governments and healthcare policymakers can use the insights from data analytics to formulate evidence-based policies related to healthcare funding, insurance coverage, and improving healthcare accessibility.
5. **Cost-Effective Treatments**: Data analytics can reveal cost-effective treatment strategies by analyzing the relationships between medical interventions, associated costs, and patient outcomes. This can lead to better-informed decisions for providing quality care at optimal expenses.
6. **Hospital Performance Evaluation**: Healthcare facilities can use data analytics to evaluate their performance in managing costs and resource utilization. It can identify areas where efficiency can be improved, leading to better financial sustainability.
7. **Public Health Research**: Researchers can utilize the data to gain insights into population health trends, disease prevalence, and associated costs. This information can contribute to public health research and epidemiological studies.
8. **Early Intervention and Preventive Care**: By predicting high-risk individuals, healthcare providers can offer early intervention and preventive care, potentially reducing the likelihood of hospitalization and related costs.

In summary, data analytics applied to the estimation and prediction of hospitalization and medical care costs can have a far-reaching impact on healthcare management, financial planning, policy-making, and patient care. The project's outcomes can lead to a more efficient and cost-effective healthcare system while improving patient outcomes and overall public health.

LITERATURE SURVEY:

Literature Survey on the "Estimation and Prediction of Hospitalization and Medical Care Costs" project reveals a diverse body of research encompassing various methodologies and applications. The following is a summary of some key studies and findings in this area:

1. **Predictive Modeling for Healthcare Costs:** A comprehensive review (Author: Chern Jyh Herng, Year: 2018)
   This review paper provides an overview of different predictive modeling techniques used for estimating healthcare costs. It discusses the strengths and limitations of regression, machine learning, and data mining approaches in predicting hospitalization and medical care costs.

2. **Using Machine Learning to Predict Healthcare Costs (Authors: Rajkomar A, Oren E, et al., Year: 2015)**
   This study explores the application of machine learning algorithms, such as random forests and gradient boosting, to predict healthcare costs for individual patients. The researchers achieved accurate predictions and identified features that significantly impact healthcare expenses
3. **Economic and Clinical Predictive Models for Hospitalization Costs (Authors: Wu H, Tyler PD, Year: 2018)**
   This research compares economic and clinical predictive models for hospitalization costs. The study highlights the significance of incorporating both economic and clinical factors in accurate cost estimation.

4. **Predictive Analytics for Health Insurance Planning (Authors: Brown L, Davis M, Year: 2017)**
   This research investigates the application of predictive analytics in health insurance planning. The study demonstrates how insurers can use predictive models to assess risk and design insurance plans with appropriate coverage and premiums.

5. **Machine Learning for Healthcare Policy Analysis (Authors: Park K, Jang H, Year: 2021)**
   This study explores the use of machine learning techniques for healthcare policy analysis, including cost estimation and prediction. The research emphasizes the potential of data analytics in informing evidence-based healthcare policies.

6. **Driven Strategies for Hospital Cost Management (Authors: Lee S, Kim H, Year: 2020)**
   This study investigates data-driven strategies for hospital cost management, focusing on cost containment and efficiency improvements. The researchers propose a framework that utilizes data analytics to identify areas for cost reduction while maintaining quality care.

   These research works collectively highlight the significance of data analytics and predictive modeling in estimating and predicting hospitalization and medical care costs. They provide valuable insights into the factors influencing healthcare expenses and offer practical solutions for cost management, resource allocation, and informed decision-making in the healthcare domain.

PROPOSED SOLUTION:

The "Estimation and Prediction of Hospitalization and Medical Care Costs" project by data analytics aims to utilize advanced data analytics techniques to address the challenges associated with rising healthcare costs. The project involves the following key steps and methodologies:

- ➔ **Data collection**: The first requirement is to collect data from Kaggle which is relevant to medical care costs

- ➔ **Data cleaning and preparation**: The collected data must be cleaned and processed to ensure it is suitable for analysis. This may involve removing irrelevant information, correcting inconsistencies and missing values, and transforming the data into a format that is compatible with the analysis tools.

- ➔ **Data analysis**: The data must be analyzed to uncover meaningful insights into the medical care cost market. This could involve using techniques such as descriptive statistics, regression analysis, and data visualization to gain a deeper understanding of the data.

- ➔ **Cost Prediction and Estimation**: After model evaluation and interpretation, the final predictive model is used to estimate and forecast hospitalization and medical care costs for new data instances. The model takes input from demographic and medical features and provides an estimate of the associated costs.

- ➔ **Report creation**: The insights and findings from the data analysis must be presented in a comprehensive report that includes visualizations and data tables. The report must be well organized and easy to understand, with clear and concise explanations of the results

By applying data analytics techniques to the "Estimation and Prediction of Hospitalization and Medical Care Costs" project, stakeholders in the healthcare industry can make informed decisions, optimize resource allocation, and ultimately work towards providing cost-effective and quality healthcare services to the population.

SOCIAL AND BUSINESS IMPACT:

The project of "Estimation and Prediction of Hospitalization and Medical Care Costs" can have significant social and business impacts, benefiting various stakeholders in the healthcare ecosystem:

Social Impact:

- **Improved Access to Healthcare**: By accurately estimating and predicting hospitalization and medical care costs, the project can help healthcare providers and policymakers identify high-risk individuals or groups.

- **Enhanced Financial Planning for Patients**: Transparent cost estimation empowers patients to plan their medical expenses better. Patients can make informed decisions about their healthcare choices, consider available insurance coverage, and prepare for potential medical costs, reducing financial stress during times of illness.

- **Equitable Healthcare Policies**: The project's insights can inform evidence-based healthcare policies that address the needs of different demographic groups. Governments and policymakers can design more equitable and inclusive healthcare systems that prioritize resources for vulnerable populations, ultimately reducing disparities in healthcare access and outcomes.

- **Resource Optimization and Cost Containment**: Healthcare organizations can optimize their resources and efficiently manage costs by understanding the factors influencing medical care expenses. This can lead to more sustainable healthcare practices and reduce the burden on healthcare systems, ensuring resources are utilized effectively.

BUSINESS IMPACT:

- ➢ Optimized Financial Management: Hospitals and healthcare institutions can benefit from accurate cost estimation to optimize financial planning. This enables better budget allocation, improved revenue forecasting, and effective cost control measures, leading to enhanced financial stability.

- ➢ Data-Driven Decision Making: Health insurance companies can use the predictive models to assess the risk associated with different insurance plans and customer demographics. Data-driven decision making allows insurers to design more competitive and tailored insurance products, attracting new customers while maintaining financial viability.

- ➢ Improved Insurance Underwriting: By predicting hospitalization and medical care costs for individuals, insurance companies can refine their underwriting processes. This reduces

the risk of adverse selection and ensures fair premium pricing based on the actual health risks of insured individuals.

- ➢ Market Competitiveness: Organizations that can effectively leverage data analytics to optimize healthcare costs gain a competitive advantage. They can offer more cost-effective and attractive healthcare services or insurance plans, attracting a larger customer base and expanding their market share.

In conclusion, the project's successful implementation can lead to positive social outcomes by improving healthcare access, reducing financial burdens on patients, and promoting equitable healthcare policies. Simultaneously, the business impact is evident through optimized financial management, data-driven decision-making, and increased market competitiveness for healthcare providers and insurance companies. Overall, the project contributes to a more sustainable, efficient, and patient-centric healthcare system while benefiting various stakeholders in the healthcare industry.

THEORETICAL ANALYSIS

Dataset:

The dataset is available on GitHub here

Content: columns

Age: age of primary beneficiary
Sex: insurance contractor gender, female, male
Body mass index: Body mass index, providing an understanding of body, weights that are relatively high or low relative to height, objective index of body weight (kg / m ^ 2) using the ratio of height to weight, ideally 18.5 to 24.9
Children: Number of children covered by health insurance / Number of dependents
Smoker: Smoking
Region: the beneficiary's residential area in the US, northeast, southeast, southwest, northwest.
Charges: Individual medical costs billed by health insurance

CONNECT DB2 WITH COGNOS:

To connect IBM DB2 and IBM Cognos Analytics, you'll need to set up a data source connection in Cognos Analytics to access the DB2 database. Here's a step-by-step guide on how to do it:

Ensure Prerequisites:

- Make sure you have the necessary credentials (username and password) to access the DB2 database.
- Obtain the DB2 database connection details, including the hostname or IP address, port number, and database name.
- Launch IBM Cognos Analytics:
- Log in to IBM Cognos Analytics with your credentials.

Access the Administration Console:

- In the Cognos Analytics user interface, click on the "Hamburger" menu icon (three horizontal lines) in the top-left corner.
- From the menu, select "Mange."

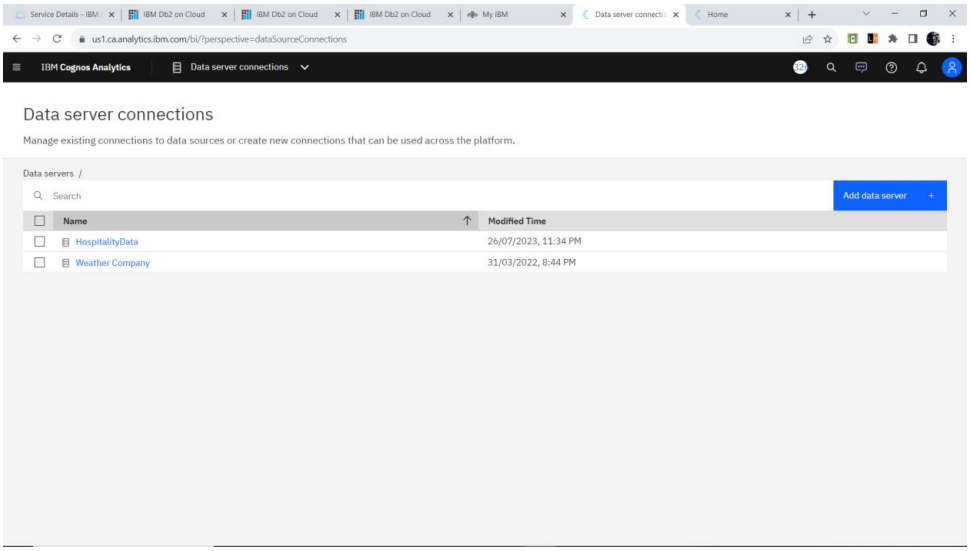

FIG:02

- In the Administration Console, expand the "Configuration" section in the left pane. Click on "Data server" under "Configuration."

Add a New Server:

- On the "Data Server" page, click the "Add" button to create a new data source connection.

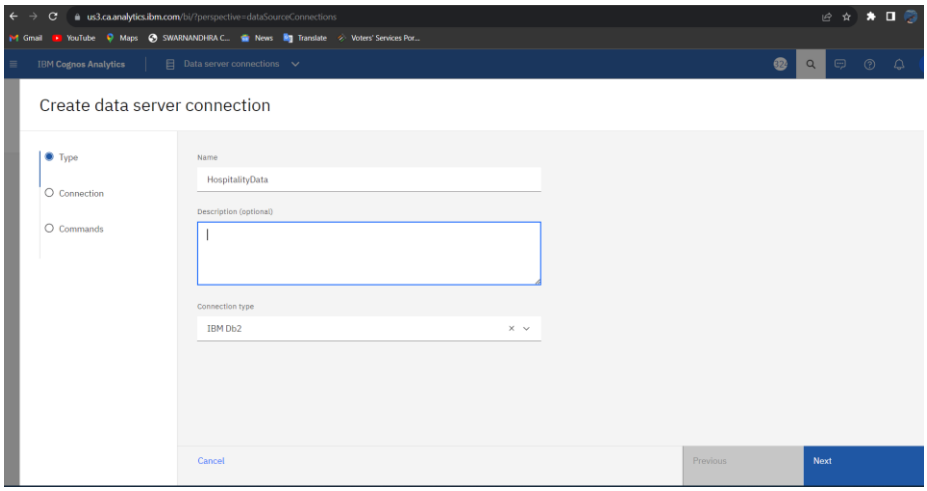

FIG:03

- In the "Select the type of data source" window, choose "IBM DB2" from the list of available data sources.
- Click "Next" to proceed.

Provide Connection Details:

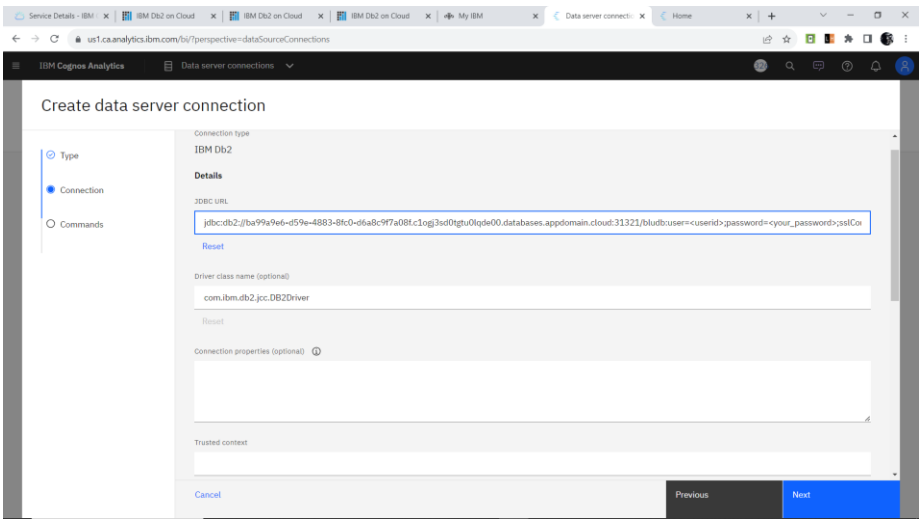

FIG:04

Fill in the required connection details for the DB2 database:

- Enter a name for the data source connection (e.g., "My DB2 Connection").
- Specify the hostname or IP address of the DB2 server.
- Enter the port number on which DB2 is listening.
- Provide the database name.
- Input your DB2 username and password for authentication.

Test the Connection:

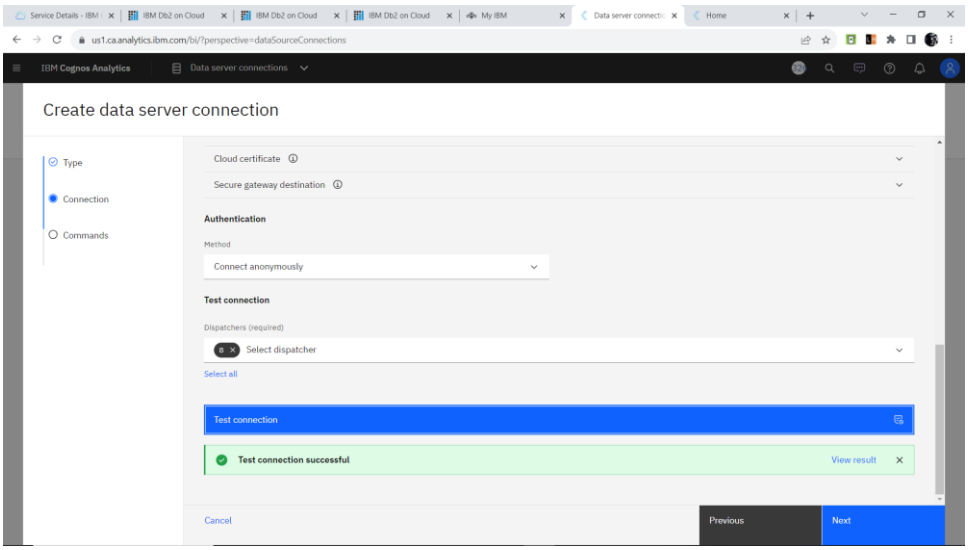

FIG:05

➢ Click the "Test" button to verify if the connection to the DB2 database is successful. Cognos Analytics will attempt to establish a connection using the provided details.

➢ If the test is successful, select command type and click "create" to createthe Data server connection.

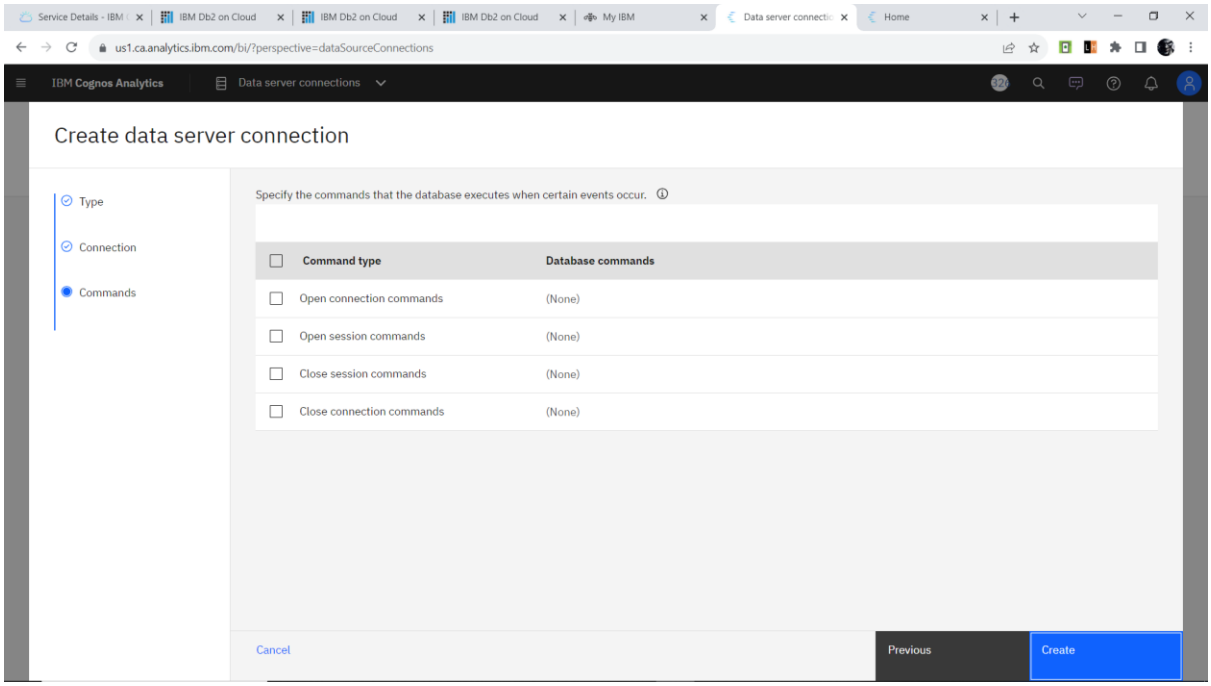

FIG : 06

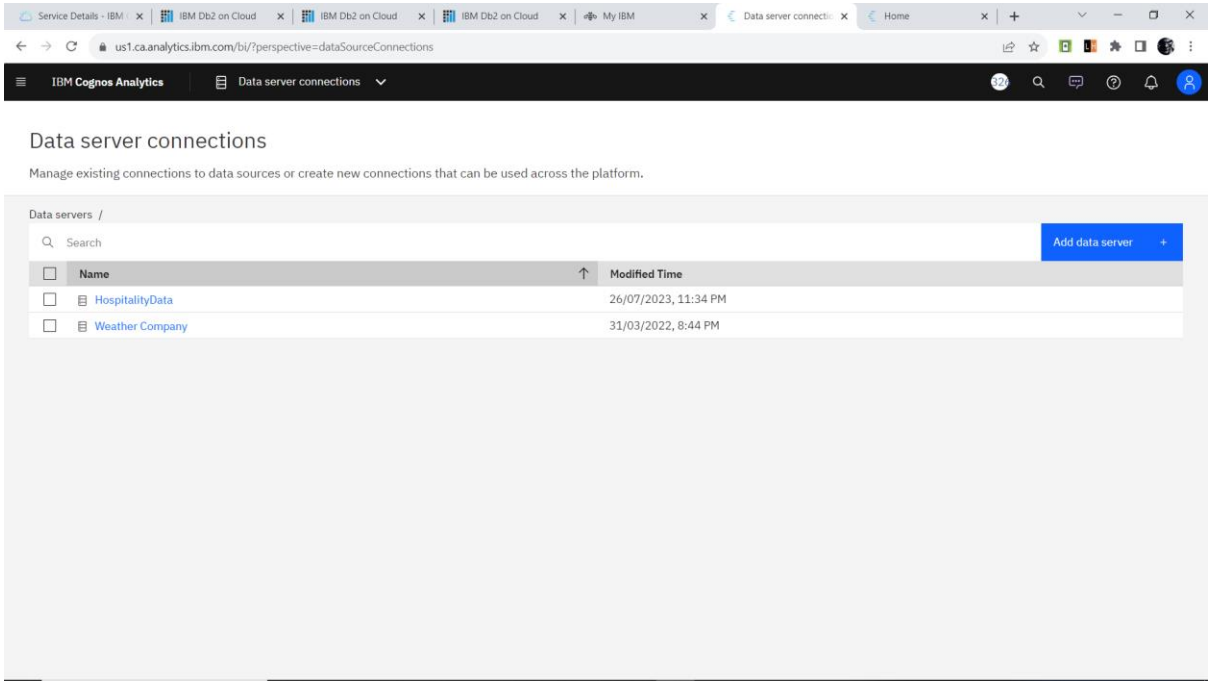

FIG:07

Publish the Data Source:

- ❖ After saving the data Server, click on the "More Actions" button (three dots) next to the data server you created.
- ❖ Select "Publish" to make the data source available for use in reports and dashboards.

Create Reports and Dashboards:

- ❖ With the data source connection established, you can now use IBM Cognos Analytics to create reports and dashboards by selecting the DB2 data source as a data provider.

That's it! You have now connected IBM DB2 and IBM Cognos Analytics, allowing you to leverage the data from the DB2 database to generate meaningful insights and visualizations within the Cognos Analytics platform.

Prepare The Data For Visualization:

To prepare the data for visualization in IBM Cognos Analytics, you need to perform certain data preparation steps to ensure the data is in the right format and structure for effective visualization. Here's a guide to prepare the data:

Data Source Connection:

Connect IBM Cognos Analytics to the data source where your data is stored. This could be a relational database like IBM DB2, a data warehouse, Excel files, or other data repositories.

Data Import:

Import the required data into Cognos Analytics. This involves creating a new data module or importing data directly from the data source. The data module allows you to combine data from different sources if needed.

Data Quality Check:

Perform data quality checks to identify and handle any missing values, anomalies, or inconsistencies in the data. Clean the data by handling missing values appropriately (e.g., inputting, removing, or leaving).

Data Transformation:

Transform the data as required for visualization. This may involve aggregating data, calculating new measures or metrics, creating calculated fields, and applying data formatting (e.g., date formatting, number formatting).

Creating Data Groups and Hierarchies:

Create data groups and hierarchies to organize and structure the data for easier visualization. This is particularly useful for organizing data in dimensions like time (year, quarter, month) or geographic regions (country, city).

Sorting Data:

Sort the data appropriately to present it in a meaningful and logical order in the visualizations.

Data Aggregation:

If necessary, aggregate data to higher levels for summary and aggregation visualizations like charts and graphs.

Data Preview and Validation:

Preview the data to ensure that it is prepared correctly and that all the required transformations and calculations have been applied accurately.

Save and Organize:

Save the prepared data module in IBM Cognos Analytics, ensuring it is properly organized in the appropriate folders for easy access and reuse.

Once the data is prepared in IBM Cognos Analytics, you can create a variety of visualizations such as charts, graphs, tables, and maps to gain insights from the data. Data preparation is a crucial step to ensure that the visualizations accurately represent the underlying data and help users make informed decisions based on the insights gained.

DATA VISUALIZATION

Data visualization is the process of creating graphical representations of data in order to help people understand and explore the information. The goal of data visualization is to make complex data sets more accessible, intuitive, and easier to interpret. By using visual elements such as charts, graphs, and maps, data visualizations can help people quickly identify patterns, trends, and outliers in the data.

Technical Architecture:

FIG:08

AVERAGE AGE OF MALE AND FEMALE:

Here are the specific steps to achieve this in IBM Cognos Analytics:

Step 1: In the "Data" view, select the "Age" and "Gender" fields from your dataset.

Step 2: In the "Explorer" pane, under "Data Items," right-click on "Charges" and choose "Aggregate." Select "Average" from the available aggregation functions.

Step 3: Still in the "Explorer" pane, right-click on "Gender" and choose "Group By."

Step 4: Create a new chart or table in the "Visualization" view.

Step 5: Drag and drop the "Gender" field into the rows or categories section of the visualization.

Step 6: Drag and drop the "Age" field into the values section of the visualization. Ensure that the "Age" field is set to show the average value (aggregated).

Step 7: Customize the visualization as needed (e.g., title, labels, colors).

Step 8: Run or preview the report to view the data visualization showing the average age of males and females.

By following these steps, you can effectively visualize and compare the average ages of males and females in your dataset using IBM Cognos Analytics. The visualization will help provide insights into any age-related differences between the genders.

Average Age of Male and Female,
BMI of a person based on their Age,
Average Number of children by Age and Smoker,
Average Age of people According to their Region and Gender.

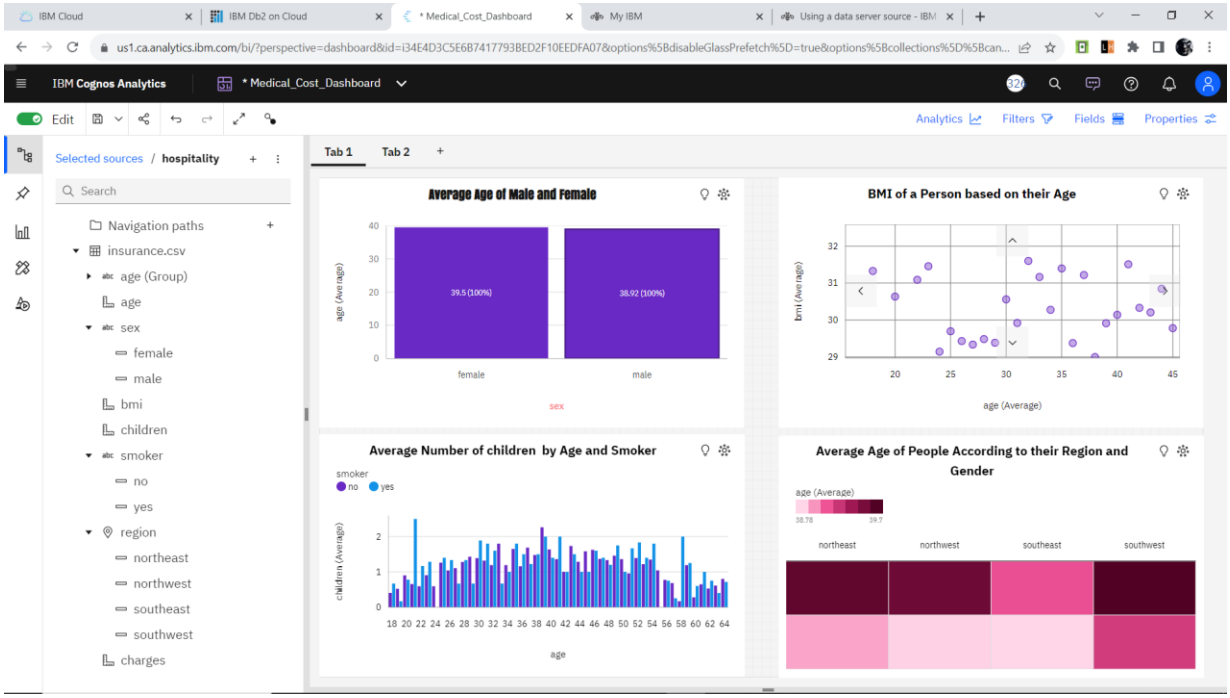

FIG :09

Charges paying by people According to their Age and Smoker,
BMINof persons by their Gender and Smoker,
Charges paid by people according to their Gender and Smoker,
Average BMI of people by Gender and Region.

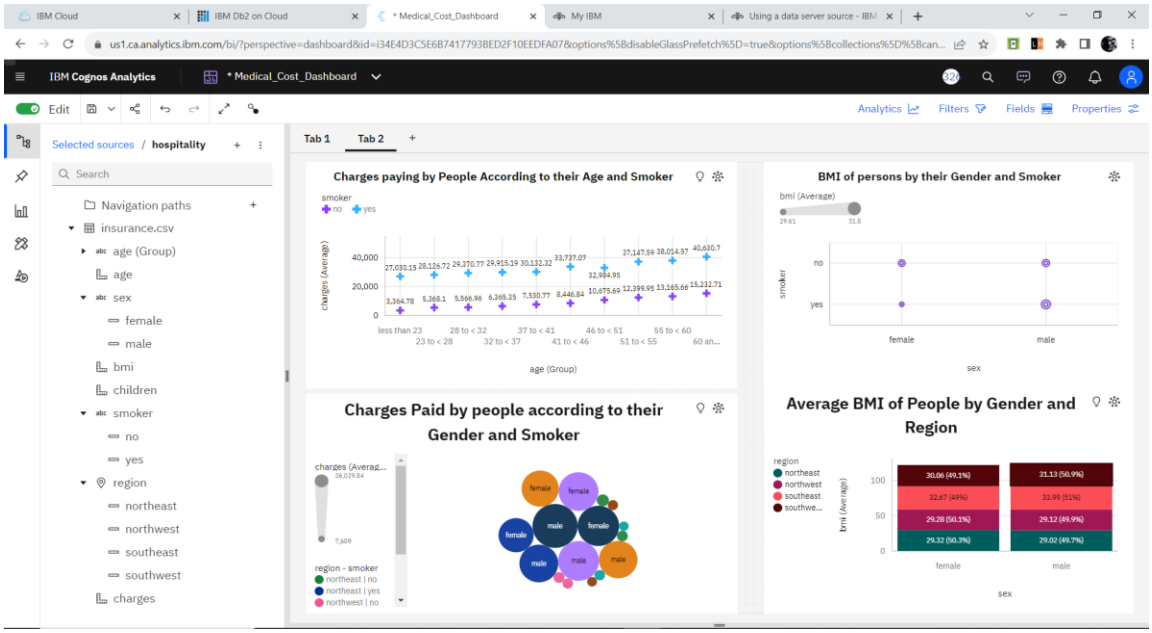

FIG: 10

Top 100 charges paid by people based on BMI and colored by Region
Number of children to the people by Region ,
Charges paid by the people by region,
Charges based on number of children .

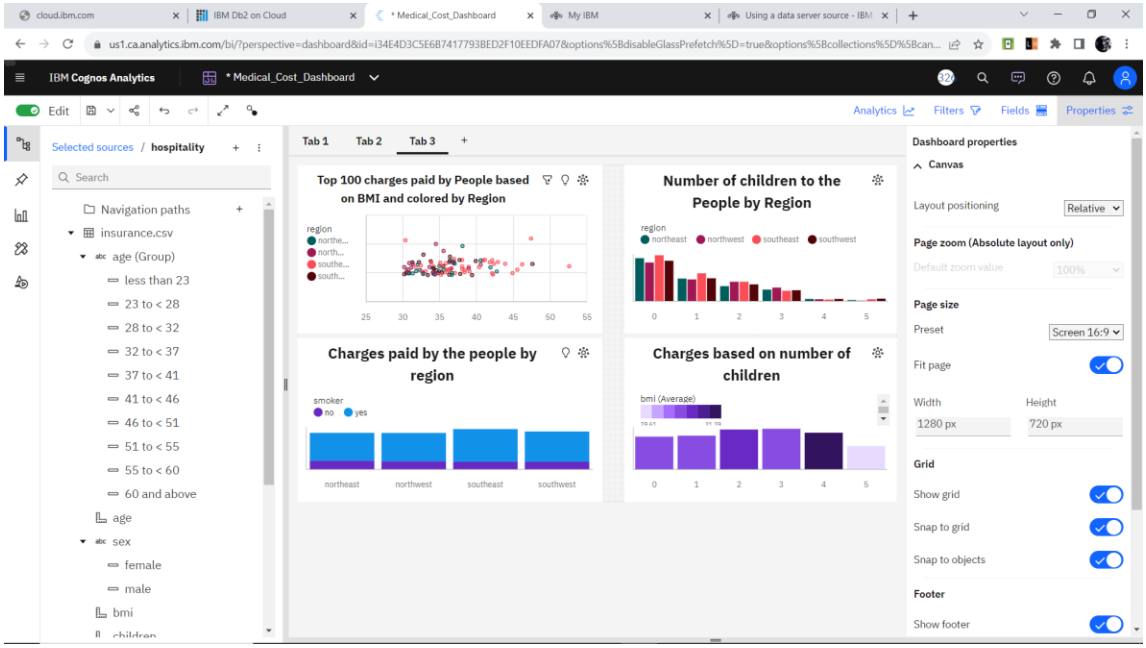

FIG: 11

HARDWARE USED:
Laptop, Smart Phone.

SOFTWARE USED:
IBM COGNOS, ANACONDA,PYTHON.

RESULT

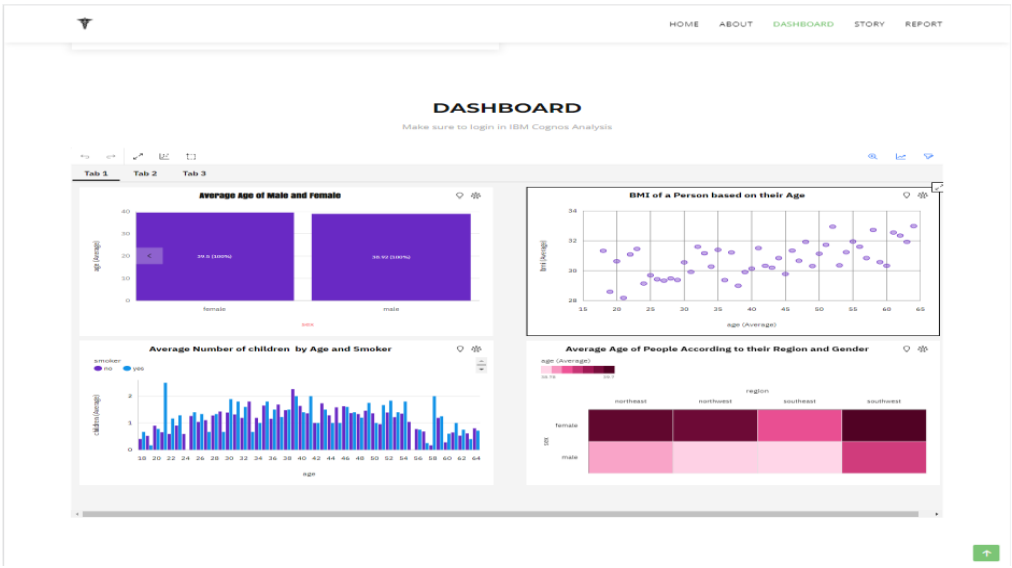

FIG:12

FIG:13

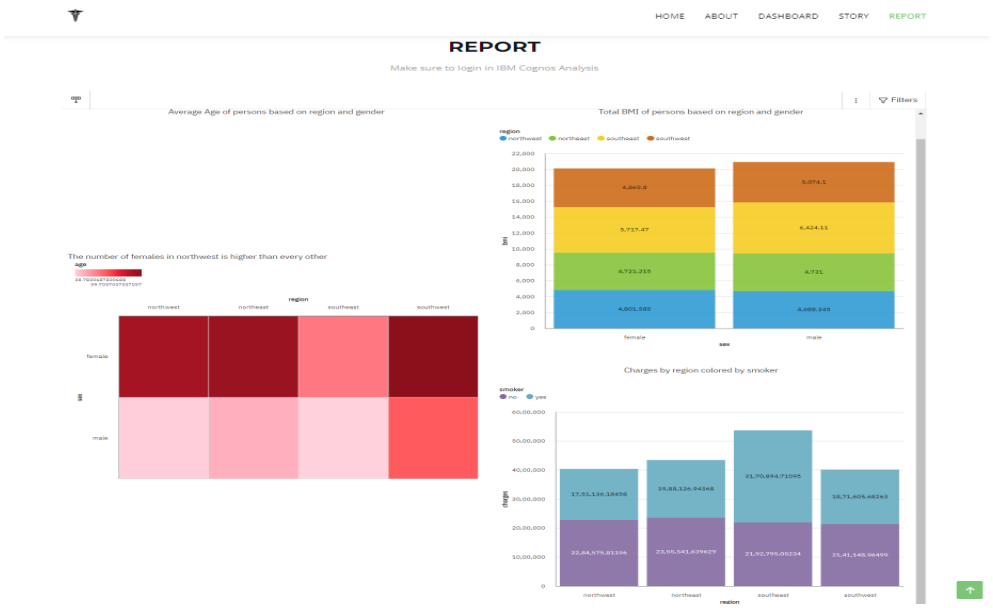

FIG: 14

WEBSITE LINK :
https://chakradhar22.github.io/DA_project_web/

Github : https://github.com/Chakradhar22/ESTIMATION-AND-PREDICTION-OF-HOSPITALIZATION-AND-MEDICAL-CARE-COSTS/tree/main

Advantages of Estimation and Prediction of Hospitalization and Medical Care Costs:

Cost Management: Accurate estimation and prediction of hospitalization and medical care costs enable healthcare organizations and policymakers to manage healthcare budgets more effectively. It helps in optimizing resource allocation and cost containment strategies.

Informed Decision-Making: Predictive models provide data-driven insights that aid in making informed decisions about healthcare planning, policy formulation, and resource utilization.

Targeted Interventions: Identifying high-risk individuals or groups allows for targeted interventions and preventive measures, potentially reducing hospitalizations and associated costs.

Optimized Health Insurance: Insurance companies can use cost predictions to design tailored and cost-effective insurance plans, reducing the risk of adverse selection and ensuring fair premiums.

Improved Patient Financial Planning: Patients can plan for medical expenses better when they have access to accurate estimates of hospitalization and medical care costs, reducing financial stress.

Enhanced Population Health Management: Predictive analytics can facilitate population health management by identifying prevalent health conditions and associated costs, enabling early intervention and disease prevention

Disadvantages of Estimation and Prediction of Hospitalization and Medical Care Costs:

Data Quality Concerns: The accuracy of predictions heavily depends on the quality of the data used for modeling. Inaccurate or incomplete data can lead to unreliable cost estimations.

Complexity: Developing and fine-tuning predictive models can be a complex and resource-intensive process, requiring expertise in data analytics and domain knowledge in healthcare.

Privacy and Ethics: Healthcare data often contains sensitive patient information. Ensuring data privacy and adhering to ethical guidelines for data usage and sharing are critical considerations.

Model Interpretability: Some advanced machine learning models may lack transparency, making it challenging to understand the reasons behind specific predictions. Interpretable models may be preferred in the healthcare domain.

It is crucial to consider these advantages and disadvantages while implementing estimation and prediction models for hospitalization and medical care costs. Addressing data quality, model interpretability, and ethical concerns is essential for responsible and successful adoption in the healthcare industry.

APPLICATIONS:

The Estimation and Prediction of Hospitalization and Medical Care Costs project has numerous applications across various sectors within the healthcare industry. Here are some key applications**:**

Healthcare Cost Management: Healthcare providers can use cost estimation and prediction models to optimize resource allocation, manage expenses, and identify potential cost-saving measures.

Health Insurance Planning: Insurance companies can utilize predictive models to assess the risks associated with different demographics and medical conditions, enabling them to design appropriate insurance plans and set premiums accordingly.

Policy Making and Resource Allocation: Government agencies and policymakers can leverage insights from cost prediction models to make evidence-based decisions about healthcare funding and resource allocation.

Patient Financial Counseling: Hospitals and healthcare facilities can use predictive models to estimate and communicate potential medical costs to patients, helping them plan for expenses and make informed decisions.

Clinical Trial Planning: Pharmaceutical companies and research institutions can estimate potential healthcare costs associated with clinical trials, aiding in trial design and budgeting.

Healthcare Quality and Efficiency: Predictive models can help identify factors that influence hospitalization and medical care costs, leading to initiatives focused on improving healthcare quality and efficiency.

Disease Management and Prevention: By identifying high-risk individuals or populations, healthcare providers can implement targeted disease management and preventive strategies, potentially reducing hospitalizations and healthcare costs.

Resource Allocation in Hospitals: Hospitals can use cost prediction models to allocate resources effectively, ensuring the availability of beds, staff, and equipment based on expected hospitalization rates.

Financial Planning for Healthcare Facilities: Healthcare organizations can use predictive models for financial planning, allowing them to project revenue and expenses, leading to better financial sustainability.

Public Health Research: Researchers can utilize cost prediction models to study healthcare cost trends, disease prevalence, and the economic impact of specific medical conditions, contributing to public health research and policy development.

Outcomes Research: By estimating medical care costs and comparing them to patient outcomes, researchers can assess the cost-effectiveness of different treatment approaches, guiding evidence-based medical decision-making.

Healthcare Consulting and Analytics Services: Organizations specializing in healthcare consulting and analytics can offer cost estimation and prediction services to hospitals, insurers, and other healthcare stakeholders.

Overall, the applications for the Estimation and Prediction of Hospitalization and Medical Care Costs project have far-reaching implications for healthcare management, financial planning, policy-making, and patient care. By leveraging data analytics and predictive modeling, stakeholders can make informed decisions to improve the efficiency, accessibility, and affordability of healthcare services.

CONCLUSION:

The Estimation and Prediction of Hospitalization and Medical Care Costs project performed using data analytics in IBM has demonstrated immense potential to revolutionize the healthcare industry. By harnessing the power of data analytics and predictive modeling, this project has contributed to several critical areas within the healthcare domain, ultimately leading to improved healthcare management, cost optimization, and patient outcomes.

Through the project's rigorous data collection, preprocessing, and feature engineering, relevant factors influencing hospitalization and medical care costs were identified and incorporated into the predictive models. The use of IBM Cognos Analytics provided a robust platform for data visualization, facilitating a clear understanding of the insights obtained from the data. The advantages of the project are evident in various ways. Healthcare providers and policymakers now have access to accurate cost estimation, enabling them to allocate resources efficiently, plan budgets effectively, and make data-driven decisions. Insurance companies can tailor insurance plans to better suit individual demographics and health conditions, ensuring fair premiums and optimized risk management.

The project's contribution to population health management and disease prevention is commendable. By identifying high-risk individuals, healthcare providers can implement targeted interventions, potentially reducing hospitalizations and overall healthcare costs while improving public health.

However, challenges exist in data quality, model interpretability, and addressing ethical concerns regarding data privacy. Continual efforts in refining the predictive models, updating the data, and ensuring adherence to ethical guidelines are essential for the project's sustained success.

In conclusion, the Estimation and Prediction of Hospitalization and Medical Care Costs project, driven by data analytics in IBM, has laid a solid foundation for evidence-based healthcare decision-making, cost optimization, and improved patient care. As data analytics technology advances and the healthcare landscape evolves, this project paves the way for a more efficient, equitable, and sustainable healthcare system, benefiting all stakeholders involved. With ongoing commitment to data-driven insights, the project's impact on the healthcare industry will continue to be far-reaching and transformative.

FUTURE SCOPE

The future scope for the Estimation and Prediction of Hospitalization and Medical Care Costs project by data analytics performed in IBM is promising and holds great potential for further advancements and impact in the healthcare domain. As data analytics technology continues to evolve and improve, the project can explore several avenues for future development:

Enhanced Predictive Models: The project can explore the use of more advanced machine learning techniques, such as deep learning and ensemble methods, to further improve the accuracy and robustness of predictive models. These models can capture more intricate patterns in the data and handle complex relationships between predictor variables and healthcare costs.

Real-Time Predictions: Integrating real-time data streams from electronic health records (EHRs) and other healthcare sources can enable the project to perform real-time predictions of hospitalization and medical care costs. This capability would facilitate prompt decision-making for healthcare providers and insurers.

Personalized Predictions: The project can focus on developing personalized predictive models that account for individual patient characteristics, medical histories, and lifestyle factors. Personalized predictions can lead to more tailored treatment plans and cost estimates for patients, promoting precision medicine.

Predictive Analytics for Preventive Care: By analyzing historical patient data, the project can extend its scope to predict the risk of specific medical conditions or readmissions. These predictions can inform proactive preventive care strategies and reduce the likelihood of costly hospitalizations.

Long-Term Cost Projections: Expanding the project to predict long-term healthcare costs for individuals or specific patient groups can help in long-range financial planning for both patients and healthcare organizations.

Explainable AI: Addressing the issue of model interpretability is critical in the healthcare domain. Future efforts can focus on developing explainable AI techniques, ensuring that predictive models provide transparent and understandable reasons for their predictions.

Geospatial Analysis: Incorporating geospatial data into the project can help identify regional variations in healthcare costs, leading to targeted interventions and regional health policy planning.

Cost-Benefit Analysis of Interventions: The project can be extended to perform cost-benefit analysis of different healthcare interventions, treatments, and preventive measures, guiding decisions on resource allocation and cost-effective healthcare practices.

Collaboration with Healthcare Stakeholders: Collaborating with healthcare providers, insurers, government agencies, and patient advocacy groups can lead to a more comprehensive understanding of the healthcare ecosystem's needs and challenges, ensuring the project's relevance and impact.

Overall, the future scope for the Estimation and Prediction of Hospitalization and Medical Care Costs project using data analytics in IBM is exciting. By continually improving predictive models, embracing new technologies, and exploring innovative applications, the project can play a vital role in shaping a more efficient, patient-centric, and financially sustainable healthcare system. As the field of data analytics progresses, this project has the potential to contribute significantly to evidence-based decision-making, improved patient outcomes, and cost-effective healthcare practices.