Helium Health

Predictive Analytics for Healthcare Resource Allocation

This case study provides an opportunity for an experienced Data Scientist to showcase their expertise in working with healthcare data, developing complex predictive models, and delivering impactful solutions to enhance operational efficiency and resource management in the healthcare industry.

Background:

The Health EMR company provides a comprehensive electronic medical records system used by healthcare providers. The company has access to a vast amount of anonymized patient health data, including medical histories, diagnoses, treatments, and resource utilization patterns. The data science team aims to leverage this data to develop predictive models that can forecast future resource demands and enable proactive planning and allocation. The goal is to improve patient outcomes, enhance operational efficiency, and optimize resource utilization across healthcare facilities.

Description:

The dataset includes the following information: Dataset Link

- **Patient Health Records:** Anonymized patient data containing medical histories, diagnoses, treatments, medications, lab results, and other relevant clinical information.
- **Resource Utilization Data:** Historical records of resource utilization, such as hospital admissions and emergency hospital visits
- **Demographic Data**: Additional demographic information about patients, including age, gender and location

Your Tasks:

1. **Data Preprocessing and Integration**: Preprocess and integrate the patient health records, resource utilization data, and demographic information. Handle missing values, standardize data formats, and ensure data privacy and security.
2. **Feature Engineering**: Extract relevant features from the patient health records and demographic data to enable accurate resource demand predictions. This may involve transforming raw clinical data, aggregating time-series information, incorporating temporal factors, and considering patient-specific characteristics.

3. **Resource Demand Prediction**: Develop predictive models that can forecast resource demands at different healthcare facilities. Utilize machine learning techniques such as regression, time series analysis, or deep learning to predict future resource utilization based on historical patterns and patient attributes. Evaluate the models using appropriate metrics and fine-tune them for optimal performance.
4. **Resource Allocation Optimization**: Optimize the allocation of healthcare resources based on the predictions from the resource demand models. Develop algorithms or decision support tools that consider available resources, service levels, geographical factors, and patient needs to allocate resources efficiently and minimize bottlenecks. Incorporate constraints and objectives from healthcare providers and stakeholders.
5. **Model Interpretability and Explainability:** Ensure the developed models are interpretable and explainable to healthcare professionals and stakeholders. Provide insights into the key factors driving resource demands and highlight any actionable recommendations for resource optimization.
6. **Deployment and Monitoring**: Implement the predictive analytics model into the Health EMR system to provide real-time resource demand predictions. Establish monitoring mechanisms to track model performance, detect anomalies, and update the models periodically as new data becomes available.

Deliverables:

- Preprocessed and integrated dataset with documentation on data preprocessing steps.
- Predictive resource demand models with documented code, including feature engineering techniques, model selection, and evaluation.
- Resource allocation optimization algorithms or decision support tools, along with guidelines for implementation.
- Model interpretation and explanation documentation, highlighting key insights and actionable recommendations.
- Deployment plan, including integration steps, monitoring procedures, and strategies for scalability.

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Data dictionary

Patient Demography

patient_id	Unique ID for all Patients
Institution_id	Patient Institution Id
dob	Patients date of birth
sex	Patients gender
State	Patients Location

Hospital Visits

visit_id	Unique hospital encounter ID
patient_id	Unique ID for all Patients
Institution_id	Patient Institution Id
admitted_at	Date patient was admitted (in-patients)
discharged_at	Date patient was discharged (in-patients)
inserted_at	Date hospital visit occurred
visit_type	Type of hospital visit
facility_type	Institution type

We would expect this to take a few days of wall-clock time **(ideally no more than a week**), and a few hours of CPU time. As we are also very busy there will no doubt be delays on both sides as we work on this together. Please set expectations as you would in your job!

Finally, once you have finished this, you'll present the project to us in a group call.

All the best!

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