2022 SSC Case Studies in Data Analysis Poster Competition

Case Study #	Developing a physician performance model in critical care
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Supervisor	TBD
Project Title	A model for evaluating physician performance

INTRODUCTION:

Since the last century, many efforts have been spent developing the ability of a health care system, focusing on patients in the intensive care unit (ICU). Traditionally physicians participate in 360 evaluations by answering questions scoring from 1 to 5, but this method fails to incorporate patient information and thus can be biased. Assessment of physicians' performance depends on various factors such as professional knowledge level and behavioral competence, therefore, we seek to develop a new model that includes patient information to evaluate physician performance.

OBJECTIVE:

The primary objective is to assign each physician an 'effective' 360 score that separately considers a physician's professional ability and behavioral competence. Further, we apply machine learning to predict whether a given ICU patient can survive under a specific physician. By assessing each physician's score and results in predicted death rates, we obtain a new model and summarize which of the factors may affect a physician's success more.

METHODS:

First we separate the 360 evaluation questions into two professional questions and behavioral questions, obtaining two separate scores for each doctor. We keep important categorical variables and replace missing values with average. A new data frame is thus obtained for all physicians. Next, we wrangle the patients' data, keeping the apache score, initial, max, end sofa score. Then, we include whether the patient is alive.

RESULTS:

We obtained the pca analysis, random forest plot as well as knn. First we constructed two data frames containing doctor and patient data respectively. In the doctor data, we combine characters of doctor and 360 evaluation, and select overall score, evaluation rank, position, and summarize score from 360 evaluation to technic, non technic and overall scores. In the patient data frame, max/initial/end score for each physician by each patient are included along with the alive outcome, apache II score and whether the patient is over 60. By EDA, whether the patient is over 60 may affect the death rate. We split the patient data (after data cleaning) and sample 80%

of it as training data with the rest of them as test data. Using KNN, the best k equals to 4 with accuracy 0.89. By applying a classification tree, we find the optimal size of the tree is 3 since it has the smallest error 0.7646 with 3 splits. Random forest model shows that the most important variable is max score, followed by apache II score. End score is also very important for Gini. The scores of patients who are finally dead are more concentrated while the scores from alive patients are unstable and have outliers by PCA. We take the first two components which explain about 89% data. From biplot, we could see that the apache II score is correlated to initial score, and max/end score do not have a correlation with them. By DMS we found that the scores of physicians have no overlap by separation of whether alive or not.

CONCLUSIONS:

We developed a machine learning model that predicts whether a given patient will survive, assigning to a particular physician. From our analysis, we can conclude whether a patient is alive after treatment can significantly affect the score of the physician. Future work will include analysis of categorical variables to refine our model.