Analytical Model to Predict Osteopathic Medical Students Risk of Failing NBME Clinical Shelf Exams

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Problem:

- Students are required to take multiple standardized exams while in medical school.

- Prior research demonstrates a significant correlation between quantitative pre-matriculation predictors such as undergraduate grade point averages (GPAs) and Medical College Admission Test (MCAT) scores with both clinical and professional performance.[1–5]

- Little research has been done to evaluate if medical school GPA during the first and second year of medical school and COMLEX Level 1 score predict a student's success on the NBME clinical discipline shelf exams.

- The purpose of our pilot study is to identify third year Osteopathic Medical students that may benefit from enhanced preparation for clinical shelf exams in order to achieve a passing score.

- A predictive analysis model was developed for Lake Erie College of Osteopathic Medicine (LECOM) students to predict NBME SHELF exam failures based on students' first and second year GPAs and COMLEX Level 1 scores

Approach:

- An Extreme Gradient Boosting Model (XGB) was used to predict the likelihood of an individual failing a certain number of Shelf medical exams.

- 433 students' academic records who graduated in 2018 and 2019 at LECOM which included medical school preclinical GPA during years 1 and 2, Clinical science NBME Shelf exams, and COMLEX L 1 scores was used to create the model.

- Raw data disclosed that the number of failed exams was not proportionate, therefore, up-sampling was used to make the proportion of all classes (fail counts) equal.

- This changed the total number of records to 1,204 with 1084 records being used to train the model, while 120 records were used to retrospectively validate its accuracy.

- Table 1 shows the distribution of COMLEX L 1, GPA 1 and GPA 2 among 433 students used to train our algorithm.
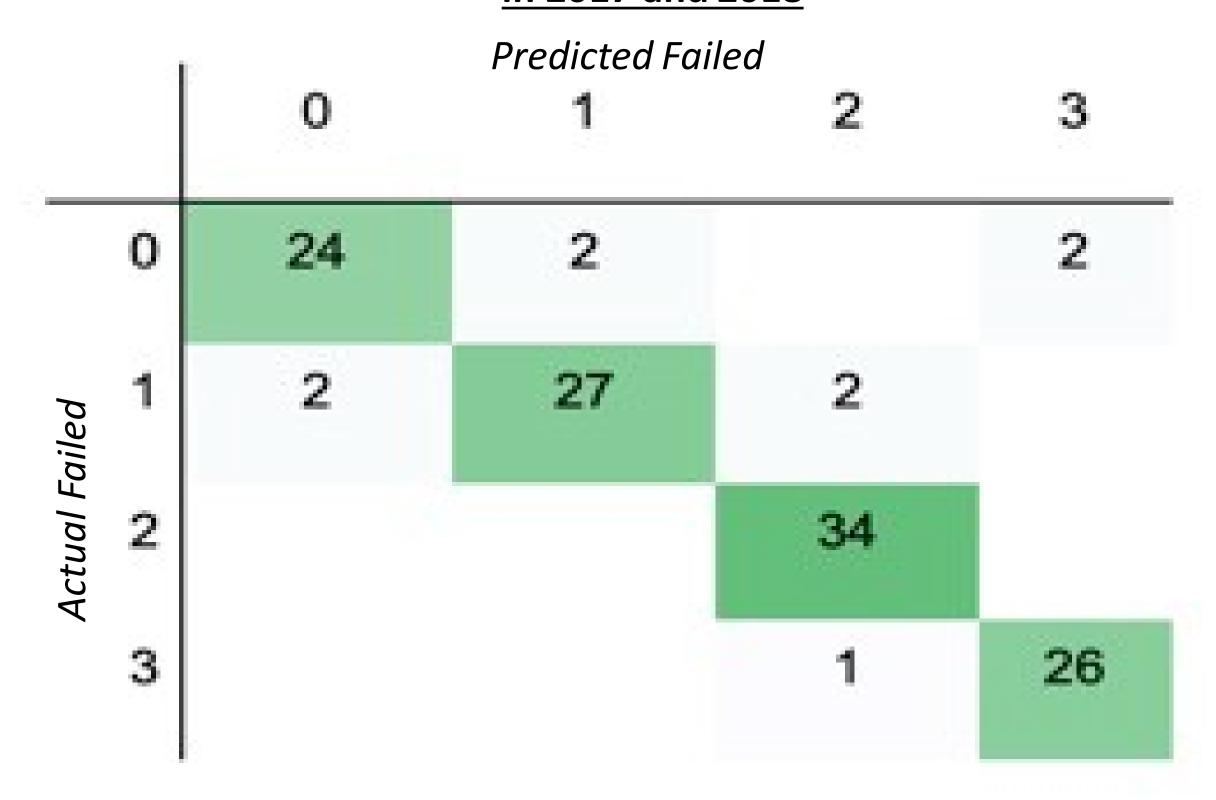
Table 1: Dataset of 433 students at LECOM

	COMLEX L-1	GPA1	GPA2
Mean	538.67	3.00	3.01
Median	531	3.05	3.04
Mode	518	2.39	2.77
Standard Deviation	89.83	0.54	0.47
Minimum	320	1.51	1.83
Maximum	843	4	4

Table 2: COMLEX averages/range and GPAs during year one and two correlated to NBME Shelf exam failures

# of Failed Shelfs	COMLEX L1 Average	COMLEX L1 Range	# of Failed Shelfs	GPA Y1 Average	GPA Y1 Range	# of Failed Shelfs	GPA Y2 Average	GPA Y2 Range
0	566.96	320-843	0	3.14	1.93-4.0	0	3.15	2.19-4.0
1	502.93	397-699	1	2.78	1.58-3.96	1	2.79	2.2-3.78
2	422.13	357-476	2	2.55	1.99-3.32	2	2.54	1.83-3.14
3	414.81	320-486	3	2.35	1.51-3.01	3	2.41	1.96-2.86

Table 3: Model Validity Results of 120 students graduated in 2017 and 2018

Predicted Failed / Actual Failed confusion matrix:

Actual Failed \ Predicted Failed	0	1	2	3
0	24	2		2
1	2	27	2	
2			34	
3			1	26

Outcomes:

- To test our algorithm for accuracy, we first evaluated 120 records of students with available Clinical NBME shelf scores.

- Our model showed that of 26 students who were predicted to fail zero exams 92 % did not, while 7.69 % did fail one exam

- When predicting the failure rate of one exam in 29 students, 93.1 % of those students did fail one exam

- In determining the failure rate of two exams among 37 students, our model predicted this with 91.8% accuracy.

- Lastly in predicting 28 students' chance of failing three exams, it demonstrated a 92.8% accuracy rate.

- Predicted and actual fail rates amongst 120 students are summarized in Table 3.

- The model was prospectively applied to 113 students who were currently in clinical rotations to determine the failure rate of a single exam

- After applying our algorithm on this data, the model was able to predict with 90 % accuracy the chances of a student failing at least one exam.

Next Steps:

- Our pilot study looked at COMLEX LEVEL 1 score along with GPAs during first and second year of osteopathic medical school to help predict with an overall 92.5% accuracy rate a student's chance of failing a NBME Shelf exam.

- Based on the accuracy of our model, we aim to evaluate 3rd third year osteopathic medical students and provide enhanced preparation to those who are predicted to fail NBME Shelf exams.

- *Limitations:*

  - Analysis was conducted in a single osteopathic medical school, therefore our findings may not apply to other medical schools.

  - Our study did not include USMLE scores as osteopathic graduates are not required to take this exam

  - Data set used to train the algorithm was small; a larger data set would have enabled a more robust cross-validation method as well as a reduced reliance on up-sampling of the raw data.

- Future studies should examine not only COMLEX scores but also USMLE scores to determine if any correlation exists in failure rates on the NBME SHELF exams.

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