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Employing Machine Learning to Predict Student Aviator Performance (Continuation)

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EMPLOYING MACHINE LEARNING TO PREDICT STUDENT AVIATOR PERFORMANCE - CONTINUATION

EXECUTIVE SUMMARY

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Project Summary
For decades, naval aviation training has used the Navy Standard Score (NSS) as the primary means of overall student performance evaluation. Machine learning analysis of student aviator training performance data offers novel and more accurate methodologies than current methods for performance assessment. These methodologies include identifying students for attrition or remediation, as well as identifying optimal pipeline assignments. In a previous effort, we identified important predictors and developed prediction models of performance in primary, intermediate, and advanced training based on data from Aviation Selection Test Battery (ASTB), Introductory Flight Screening (IFS), and Aviation Preflight Indoctrination (API) training. This research extends the effort to later stages of training by developing models to predict performance in advanced training based on earlier stages (Chief of Naval Air Training, n.d.). The goal of the analysis is to determine the set of metrics predictive of student performance for these stages of training and to reveal trends and patterns that may indicate where and when remedial action is needed. The data science methodology used for this research is based on the Cross-Industry Standard Process for Data Mining (CRISP-DM) (Vorhies, 2016). Research results indicate that primary NSS scores alone are not a strong predictor of advanced NSS scores for all pipelines, while intermediate NSS scores are a much better predictor of advanced NSS scores. Further, the research indicates that models for predicting NSS advanced scores based on both primary NSS scores and intermediate NSS scores for pipelines requiring intermediate training are reasonably good ones, with the best models developed for the Jet pipeline. Finally, the research indicates that the top four candidate predictors for both the average overall and flight advanced event scores are average familiarization, formation, basic, and radio instruments event scores. These results have important implications in reducing time-to-train, improving aviator quality, and reducing training costs related to student failure to complete training.

Keywords: *machine learning, data analytics, predictive models, aviation training*

Background
With the current shift within the Navy to new training management systems (i.e., Training Sierra Hotel Aviation Readiness Program [T-SHARP]), new methodologies for evaluating and predicting student performance should be examined. Specifically, machine learning provides an opportunity to better evaluate students by fully examining every indicator of performance throughout a student's training, from subtest scores on the aviation selection test battery and test scores during initial ground school to each graded item on every flight event. This full integration of performance criteria will identify trends and patterns currently lacking in traditional methods. Specifically, it will provide a better overall evaluation of student success in training, helping to determine which aviation pipeline will ensure the most student success, while highlighting those students needing remediation earlier, in order to provide additional resources.

This research applies advanced statistical and machine learning methodologies and techniques to analyze training data at a more granular level than ever before accomplished. The study also attempts to connect individual-level student data from selection through training to fleet aircraft assignment, providing the opportunity to identify performance indicators and trends across the continuum of aviation training. The data science methodology used for this research is based on the CRISP-DM methodology (Vorhies, 2016). The CRISP-DM process model includes six phases that address the main requirements for data mining. The six phases are undertaken in a cyclical and iterative manner and include: Business/Mission Understanding, Data Understanding, Data Preparation, Modeling, Evaluation, and Deployment.

Findings and Conclusions

The main purpose of this research is to provide a data-driven evaluation of student pilot performance to identify performance indicators of whether a student will be successful or not in training, with what type of aircraft and training the student will be most successful, and how early in training can likely success or failure be determined. This will greatly assist Naval Air Training Command sponsor leadership in assigning students the most appropriate training pipeline, as well as identifying individuals for attrition earlier on in training, thus reducing training costs.

Research results indicate that primary NSS scores alone are not a strong predictor of advanced NSS scores for all pipelines, while intermediate NSS scores are a much better predictor of advanced NSS scores. The research also indicates that primary NSS scores are a better predictor of advanced NSS scores for students in advanced Training Wings 4 and 5 for all pipelines, and both primary and intermediate NSS scores are better predictors of advanced NSS scores for students in advanced Training Wing 2 for intermediate training pipelines (i.e., E2/C2, Jet, Tilt-rotor). Further, the research indicates that models for predicting NSS advanced scores based on both primary NSS scores and intermediate NSS scores for pipelines requiring intermediate training are reasonably good ones, with the best models developed for the Jet pipeline. Finally, the research indicates that the top four candidate predictors for both the average overall and flight advanced event scores are average familiarization, formation, basic, and radio instruments event scores. These results have important implications in reducing time-to-train, improving aviator quality, and reducing training costs related to student failure to complete training.

Recommendations for Further Research

In this research effort, we identified important predictors and developed prediction models of performance in advanced naval aviation training based on data from primary and intermediate training. While our methodologies and results provide a good foundation for future research, we recommend extending this effort to later stages of training by developing models to predict performance in the Fleet Replacement Squadron (FRS) based on primary, intermediate, and advanced training. Analysis goals include: determining the set of variables predictive of student performance in FRS; revealing trends and patterns that may indicate where and when remedial action is needed; and identifying in which aviation pipeline a student will be most successful based on performance in preceding training.

References

Chief of Naval Air Training. (n.d.). *Naval aviator training*. https://www.cnatra.navy.mil/training-sna.asp

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Acronyms

API	Aviation Preflight Indoctrination
ASTB	Aviation Selection Test Battery
CRISP-DM	Cross-Industry Standard Process for Data Mining
FAA	Federal Aviation Association
FRS	Fleet Replacement Squadron
IFS	Introductory Flight Screening
NSS	Navy Standard Score
T-SHARP	Training Sierra Hotel Aviation Readiness Program