A Data-Centric Approach to Increasing Crew Lethality: Proposing 'Moneyball for Gunnery'

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When Billy Beane, general manager of the Oakland Athletics from 1997-2015, started using data analytics to build a winning baseball team on a budget, many in the baseball community were skeptical. However, the team's performance demonstrated that leveraging in-game data to identify undervalued players could provide an edge. During the 2002 season, the team won 20 games in a row on a budget less than a third of the league's most expensive teams. He accomplished this by applying a "sabermetrics" approach of collecting and analyzing in-game activity to build a cost-effective team, as described in the 2003 book *Moneyball: The Art of Winning an Unfair Game*.¹

Inspired by Beane's approach, our data analytics team in the Ivy Raider Brigade (1st Stryker Brigade Combat Team, 4th Infantry Division) asked a similar question: Can data analytics help us improve crew performance during mounted machine gun (MMG) lethality? Similar to the Oakland A's, combat units are constrained in terms of time and ammunition. Producing better Table VI results more efficiently builds lethality.

We found that similar to baseball, in-game statistics during gunnery can identify factors that correlate with better crew performance. Our results, which suggest that Table III is an undervalued player, stem from only a single brigade's Stryker gunnery, but the project underscores the general approach's potential. Of note, we do not argue that analytics should replace leader experience or "gut instinct;" rather, the insights data provides can elevate intuition while reducing cognitive bias.

Applying Data Analytics to Mounted Machine Gunnery

For those unfamiliar with Stryker gunnery, it is designed to train and qualify Stryker crews by progressing them through



Figure 1 — Gunnery Analytics Framework

PROFESSIONAL FORUM

six tables. Tables I and II are designed to train vehicle identification, ammunition identification, and simulation training in garrison. Table III is a range that uses blank-fire iterations and Multiple Integrated Laser Engagement System (MILES) gear, giving crews a repetition to focus on calling swift and correct commands. Table IV is a static live-fire range that focuses on trigger time, and Tables V and VI are maneuver live-fire ranges. As Table VI is the qualifying table, it is our outcome variable and best indicator of a crew's lethality.

Applying a "Moneyball" approach to gunnery first required an open mind about what produces better performance on Table VI. Beane bucked conventional wisdom when he began measuring players using **on-base percentage** and **slugging percentage** rather than traditional metrics such as **stolen bases**, **runs batted in**, and **batting average**.² Using these new metrics, he was able to identify players whose contribution to winning was undervalued. This analysis identified opportunities for hiring high potential players at a discount.

Having posed our research question regarding what in-game statistics are predictive of performance, four steps remained: developing a framework, collecting data, modeling the data, and interpreting the results. Our framework is below. We proposed that unit, crew, and environmental factors are linked with Table VI performance.

We next collected data, measuring the factors that we could, which included prior table scores and weather data.

Unfortunately, since we began the project after the conclusion of the brigade's gunnery, we were not able to gather data on all crews. We were, however, able to obtain information for approximately half of the brigade's Stryker crews; this data set was large enough to be valid since it included 126 crews from one infantry battalion, the cavalry squadron, and the engineer battalion.

Having compiled the data, we then built models to help explain relationships between factors of interest. These consisted of linear and nonlinear models relating prior table scores and Table VI, controlling for weapon system (M2 or MK-19), battalion/squadron, and Table VI weather conditions (wind, temperature, barometric pressure, and weather conditions). We conducted the analysis on government computers using the Army Resource Cloud.

The type of model that worked best was a logistic regression, a nonlinear model that estimates the probability of a binary outcome, which in this case was a Stryker crew achieving a first-time qualification on Table VI ("Q1").

Unexpected Results: Table III and Unit Culture Are "Undervalued Players"

Using the logistic regression model, we found a surprising result: Table III scores were correlated with a higher probability of achieving a Q1 on Table VI. This was not what we expected, since Table III uses MILES lasers rather than live ammunition. Each additional point a crew earned on Table III



A Stryker crew in the 1st Stryker Brigade Combat Team, 4th Infantry Division prepares to conduct Stryker gunnery during individual weapons training at Fort Carson, CO. (Photo courtesy of the 4th Battalion, 9th Infantry Regiment's Facebook page)



Predicted probabilities of Q1_Binary TBL3_Overall | WPN | Predicted (95% CI) 720 M₂ 0.81 (0.35, 770 0.87 (0.52. 98) 810 0.91 (0.64, 98 860 910 0.94 (0.75, 0 99 (0.82, 0.96 0 99 (0.88, 1000 0.98 00 720 770 810 **MK19** (0.24, 0.80 (0.39, Ø 0.86 (0.51. 97 860 .91 (0.63. 910 94 1000 0 97 (0.81 Adjusted for: TBL4_Overall 795.48 TBL5 Overall 695.39 TEMP_D_TBL6 48.53 TEMP_N_TBL6 BAR0_D_TBL6 33.03 26.97 BARO N_TBL6 26.80 . WIND_N_TBL6 WIND_D_TBL6

Figure 2 — Predicted Probability of Q1 Using Table III Scores

was correlated with an approximate one percent additional probability of achieving a Q1.

Additionally, we found that the type of weapon system matters. Stryker crews fire either an M2 machine gun or MK-19 grenade launcher, with the latter being more difficult due to the longer time of flight and curved trajectory of the rounds. The Table III results were far stronger for M2 crews, which was expected since MILES cannot simulate either MK-19 trajectory or flight time.

Controlling for weather conditions on Table VI improved the accuracy of the analysis. Including this factor was important since some crews faced more difficult conditions on Table VI. For example, higher barometric pressure on Table VI was correlated with a lower Q1 probability since denser air reduces accuracy.

We conducted numerous robustness checks to ensure that the statistical results did not occur due to chance. Modeling the data in multiple different ways produced relatively consistent results that increased confidence in the findings. During this process, we found that Table III had the strongest predictive power. Table IV was sometimes predictive, though Table V was generally not predictive. This result was valuable since it provided early indicators of crew success. Within Table III, we found that Table III Night had the strongest relationship with Table VI performance for both M2 and MK-19 crews.

We also found that unit culture was also positively correlated with higher probability of Q1. We used data from our February 2024 unit culture survey (administered the month prior to the brigade's gunnery window) to gauge seven "measurables" of unit culture, including perceptions of care for Soldiers, leader competence, and information flow. Adding up the seven 10-point Likert scale questions provided a "culture index," with a maximum score of 70. This index reflected the "strength" of company-troop culture. Our analysis suggested that unit culture was strongly related with a

Figure 3 — Example Data Table³

crew's chance of achieving a Q1 — companies/troops with stronger culture achieved more Q1s. In fact, the culture index was statistically more predictive than Table III results, which was a surprising finding.

So What? Using the Data to Increase Crew Lethality

Putting these results into practice required comparing them to our firsthand experiences, particularly those of seasoned NCOs, to conduct a common-sense check. Numerous discussions determined that Table III serves as a valuable indicator of crew preparation prior to deploying to the range. It assesses which crews are proficient in target acquisition and proper fire commands, among other skills. Skills such as rapid target acquisition and proper fire commands are apparent even when no rounds are going downrange. Unit culture likely reflects the level of Soldier commitment to excelling and the quality of their leadership.

The key implication of our results is that leaders can set a threshold on Table III before allowing them to advance to Table VI. Our analysis suggests that for crews to have a 90-percent chance of achieving a Q1, a score of approximately 800 should be the threshold for Table III for M2s. MK-19s require a higher threshold of approximately 850.

Way Ahead: Deliberate Data Collection and Machine Learning

Moving forward, we can improve this analysis by expanding data collection and refining the modeling. The data for this study was limited to about half of the brigade's Stryker crews. This gap highlights the need for more deliberate data collection in the future. There are also a range of additional variables we would like to measure, including crew experience, vehicle maintenance, Table I-II scores, and embedded trainer use, among many others.

It is important to note that the results could change with

PROFESSIONAL FORUM ·

more complete data, as well as by unit and with each gunnery. What is significant, however, is the approach. Taking the time to generate evidence about "what works," rather than leaving data sitting on the floor, has tremendous potential to increase readiness.

Collecting more qualitative and quantitative variables, as well as more data entries, will enable the opportunity to test additional machine learning models. These models utilize different methodologies compared to regression analysis. This may create stronger predictions in crew qualifications and become an on-hand tool commanders can use during gunnery to determine if crews are ready for Table VI.

With better data, we can both refine our base regression models and apply more sophisticated machine learning models to improve predictions that translate into greater lethality in pursuit of our goal of zero Q2s.

Notes

¹ Michael Lewis, *Moneyball: The Art of Winning an Unfair Game* (NY: W.W. Norton & Company, 2003).

² Explanations for on-base percentage, slugging percentage, stolen bases, runs batted in, and batting average terms can be found at https:// en.wikipedia.org/wiki/On-base_percentage, https://en.wikipedia.org/wiki/ Slugging_percentage, https://en.wikipedia.org/wiki/Stolen_base, https:// en.wikipedia.org/wiki/Run_batted_in, and https://en.wikipedia.org/wiki/ Batting_average_(baseball).

³ To view the authors' complete data appendix, send an email to usarmy. moore.tradoc.mbx.infantry-magazine@army.mil.

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Soldiers from the 1st Stryker Brigade Combat Team, 4th Infantry Division conduct operations during Joint Readiness Training Center Rotation 25-02 at Fort Johnson, LA. (Photo by SPC Isaiah Mount)