What Moves the Boat?

Peach Innovators

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Hypothesis

All rowers hear a similar story of what makes boats move the fastest: length, power, and unity. We decided to put this to the test and analyze which factors of the rowing stroke matter most for boat speed.

Data

We collected the data from the Brown Men's Crew Team over the period of about a year. The data sample is collected via the PEACH telemetry system and is a collection of 992 unique data points, which contain these attributes: Box, Piece, Session, Piece Number, Seat, Watts, Catch Angle, Finish Angle, Catch Slip, Finish Slip, Length, Effective Length, Stroke Rate, Speed. The data was manually transcribed from the telemetry system into an Excel spreadsheet, so it was checked for anomalies during that process. Additionally, we generated a few different metrics from our raw dataset: Average Effective Length (the average effective length of each member of the crew), Average Watts (average watt measure of each member of the crew), and Watt Variance (variance of the Watts of each member in the crew)

Findings

Claim #1: When considered individually, Average Watts, Average Effective Length, and Watt Variance are all significantly related to Boat Speed

Support for Claim #1: We conducted a Pearson coefficient analysis on the relationship between average watts, average effective length and watt variance and boat speed. The results are presented in the table below. The results indicate that when considered individually, each of these factors is significantly related to boat speed.

	Avg. Watts vs. Speed	Avg. Effective Length vs. Speed	Watt Variance vs. Speed

Statistic	0.6840	0.2853	-0.1888
P-Value	1.361e-135	9.784e-20	2.774e-09

Claim #2: Higher Effective Length and Lower Watt Variance are not significantly associated with boat speed.

Support for Claim #2: We conducted a multivariable regression using average effective length, average watts, and watt variance as the independent variables and boat speed as the dependent variable. The results are presented in the table below. The results indicate that contrary to our Claim #1 finding, when we consider all of these variables together, only average watts are significantly related to boat speed, whereas neither effective length or watt variance are significant.

	Avg. Watts	Avg. Effective Length	Watt Variance
Coefficient	0.0082	-0.0074	-2.129e-05
P-Value	< 0.001	0.384	0.402

Socio-historical Context and Impact Report

Socio-historical Context

Technological Developments in Sports Analysis: The use of PEACH and other telemetry systems is indicative of the changing field of sports analytics. The application of data science to rowing is consistent with larger trends in sports, where technical developments have transformed athlete performance evaluation and coaching approaches. The implementation of such technologies shows a change in sports management toward evidence-based decision-making.

Impact on Coaching and Athlete Performance: Athletes and coaches are two important stakeholders that our project directly implicates. Traditional coaching approaches may be changed by having the data made available by PEACH and other telemetry products to create lineups. It could be difficult for coaches to balance using data and metrics gathered via a telemetry system and the 'eye-test' - through traditional rowing evaluation - which could affect team performance and athlete morale. The use of telemetry may also cause athletes to change the focus of their training as they simply try to maximize the performance metrics that their coaches prioritize the most.

Evolution of Rowing Performance metrics: Various studies of rowing performance, including Kleshnev's 2023 World Championships study on speed and stroke rate [1], assert the importance of stroke rate and power-per-stroke (generally as measured by Watt output) on boat speed. Although these studies focus highly on stroke rate, we ultimately chose not to use it in our analysis since we could not hold it independent from our other factors of interest and we hoped to normalize the rate by controlling the length of the workout that we recorded (3 x 2k is the only workout we studied the data for). In a controlled environment, we would ideally take rate into account since it is a large factor on boat speed. Most articles and studies on rowing have shown rate to speed up the boats, but more data and studies could provide further insight.

Ethical Considerations

Data Privacy and Consent: Ensuring athlete permission and data privacy is incredibly important due to the inherently sensitive and private nature of the kinds of biometric data obtained via telemetry systems. Because of this, our initiative should emphasize establishing and using explicit data governance mechanisms as suggested in Arnold and Sade's ethical research on the collection of biometric data from student-athletes [2]. These kinds of procedures should prioritize protecting athletes' rights to privacy first and foremost, and should also provide some guidelines that coaches or other administrators in control of the data - and to an extent, the athlete - must follow in terms of data collection, usage, and storage.

Impact on Athlete Morale: Athlete morale as well as athlete psychological health could potentially be negatively affected by their coaches' use of telemetry systems, and as such, should not be ignored when discussing their use in sports performance. As has been mentioned in discussions surrounding the use of telemetry in trying to enhance the employee experience, coaches and athletes should also maintain a level of transparency and communication to reduce the worries and challenges presented by the feelings and stresses surrounding constant perceived

monitoring and performance reviews [3]. To mitigate these stresses and limitations, athletes should have some say in how their data is used.

Reducing any Bias in Data Analysis: Interested parties should assess the sources of their data collection - as well as their methods - to properly address any biases in their data analysis. Recognizing the limitations included in telemetry data will help our project implement strong analytical methods to reduce bias and guarantee the reliability and precision of our prediction models.

Implications for Coaching Methods: Using predictive analytics in coaching methods brings up many moral questions surrounding treating athletes fairly while also upholding coaching integrity. Coaches have to maintain the fairness and respect for the autonomy of athletes but also manage the ethical challenges of applying data-based and analytical tools. Ethical standards for the responsible use of these kinds of performance analytics in rowing - as well as across other sports - requires constant communication and cooperation between coaches, athletes, and other interested parties.

Citations:

[1] Valery Kleshnev, Biorow.com, “Rowing Science: Speed and Stroke Rate Analysis of 2023 Worlds in Belgrade”, row2k, February 20, 2024, https://www.row2k.com/features/6291/rowing-science-speed-and-stroke-rate-analysis-of-2023-worlds-in-belgrade/

[2] Jason F. Arnold and Robert M. Sade, “Wearable Technologies in Collegiate Sports: The Ethics of Collecting Biometric Data from Student-Athletes”,Taylor and Francis Online, December 20, 2016, https://www.tandfonline.com/doi/full/10.1080/15265161.2016.1251648

[3] Gary McAllister, “Ethics of Telemetry Collection for Employee Experience Improvement”, ivanti, September 05, 2023, https://www.ivanti.com/blog/ethics-of-telemetry-collection-for-employee-experience-improvement