

# Joseph Britton 2104278 Research methods presentation

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# Analytical methods for post-race analysis & pre-event prediction for endurance race strategy

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MSC RESEARCH PROPOSAL

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# Research objectives

1. Identify key performance indicator's (KPI's) that influence race outcomes
2. Develop a predictive model for endurance race strategy optimization
3. Validate the predictive model against real world data
4. Optimize decision-making for race strategy teams
5. Assess the practical applications and limitations of the proposed model

# Industrial relevance

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Provide access to pre and post race to smaller racing teams



Provide a **user-friendly data analysis tool** for private teams to optimize strategy without needing expensive software.



Improve **data-driven decision-making** for teams that lack real-time telemetry capabilities.

| Project timeline |                                                |            |            |
|------------------|------------------------------------------------|------------|------------|
| Position         | Activity                                       | Start date | End date   |
| 1                | Research KPI's for race strategy               | 01/06/2025 | 11/06/2025 |
| 2                | Begin model development                        | 12/06/2025 | 07/07/2025 |
| 3                | Validate the predictive model                  | 08/07/2025 | 18/07/2025 |
| 4                | Optimize decision making                       | 19/07/2025 | 13/08/2025 |
| 5                | Implement into a race weekend to test strategy | 14/08/2025 | 15/08/2025 |

## Project planning/ timescale

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## Literature review – Necessity for research

- ❑ Existing Methods Do Not Consider All Key Factors
- ❑ Need for Data-Driven Decision Making
- ❑ Lack of Endurance-Specific Strategy Models
- ❑ Industry Application & Real-World Relevance

# Literature review

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## Current predictive models in use within industry

Monte Carlo (Hatton, 2024)

1) Machine learning and AI based models (intrafocus, 2024)

2) Stochastic dynamic programming and game theory (Braghin, 2022)



## Model development

Select parameters for inclusion within model

Research implementation schemes (Kampen, 2024)

Analyse alternate predictive models



## Model validation

Cross-Validation Techniques

Simulation-Based Validation (Heilmeier, 2022)

Benchmarking Against Established Models (Kampen, 2024)

# Proposed methodologies for race optimization

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Machine learning-  
based predictive  
modelling

Model predictive  
control for  
dynamic strategy  
adjustment

Genetic algorithms  
for stint  
optimization

Reinforcement  
learning for  
adaptive decision-  
making

# Results collection, analysis and validation

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Comparing predicted data against a full endurance race

Investigation of results for anomalies in data

Sensitivity analysis

Driver fatigue analysis

Comparing suggested strategy to race data for validation

# Limitations of research



Lack of university data on the subject area



Real-World Validation Constraints



Complexity of External Factors



Computational Resources for Large-Scale Simulations



Time scaling

# References

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## Any questions?

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GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

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