

# Mountain Bike Racing Simulator Project

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## 1 Introduction

Paul MacDermid lecturer of Human Performance at UCOL, believed from his research of 10 years, that the current rules and regulations governing the World Cup Cross Country Mountain Bike Racing (XCO-MTB) start order has inequalities for athletes taking part in the event. Paul wanted to simulate a fair mountain bike race to see if the results generated, match or differ from the existing results. Paul's research has indicated that a fair race would have a different result set, but there is no evidence to prove the theory.

A windows application was created to help **Hugh Morton** (Massey Lecturer) and Paul MacDermid (UCOL), with their theoretical calculations, so their hypotheses can be tested.

## 2 Objectives

The objectives of the project were to develop an application that would:

- Allow users to enter race start data and have the system perform a race simulation base on the data.
- Perform Normal Distribution.
- Generate graphs that would display start vs. finish positions and changes in position.
- Search and display previous records.
- Save individual/search records in a separate document (Excel Format).

## 3 Methods

During the analysis phase, it was identified that formulas were needed to achieve the objectives. As a result the following formulas have been adopted to calculate the outcome.

The formula to calculate the Theoretical Race Time and Forecast Race Time is:

$$z = \frac{x - \mu}{\sigma}$$

Based on a change in position, the Mean/Average was calculated for each cyclist using the formula:

$$\bar{x} = \frac{\sum_{i=1}^n (x_1 + x_2 + \dots + x_n)}{n}$$

Based on the Average, the Standard Deviation (Dispersion/Spread) was calculated using the formula:

$$\sigma = \sqrt{\frac{\sum_{i=1}^n (x_i + \bar{x})^2}{n - 1}}$$

Based on the Standard Deviation, the Standard Error of Mean (SEM) was calculated using the formula:

$$SEM = \frac{SD}{\sqrt{n}}$$

The project followed the Rapid Application Development (RAD) methodology.

## 4 Results

The application allows a user to enter values, and run a race simulation (Figure 1). The system performs the calculations and saves the results to an embedded SQL Server 2005 Express database.



Figure 1: Main Form

The application allows the user to view the results in a grid or a graph format (Figure 2.)

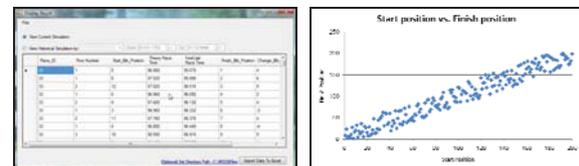


Figure 2: Result Formats

The user also has the options of viewing previous simulations and exporting the data to MS Excel.

## 5 Conclusion

Paul MacDermid and Hugh Morton can now test the hypothesis of a fair mountain bike race, with a click of a button. The simulated data can then be analysed alongside other researched data for comparison.

If the hypothesis is found to be true, they have evidence to present to Union Cyclist International in the hope of changing the rules and regulations to benefit all athletes that take part in XCO-MTB.