The University Of Sheffield.

School Of Health And Related Research

Optimizing route choice in Mini-mountain marathons

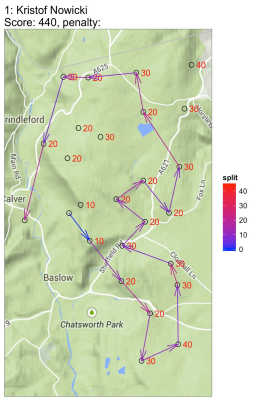
Peter J. Dodd (Sheffield)
September, 2015

Background

- Mini-mountain marathons are long-course score orienteering races over hilly terrain.
- Checkpoints carry scores reflecting their remoteness
- Any number can be navigated in any order
- Not possible to visit all checkpoints
- Late return is penalized via an escalating points deduction

Finding the best route is an NP-hard combinatorial optimization problem known as the Orienteering Problem

Winner's route choice



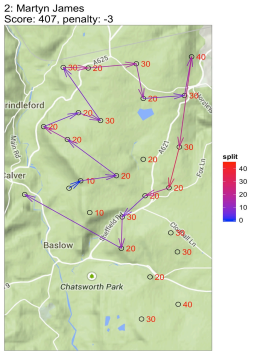
Questions

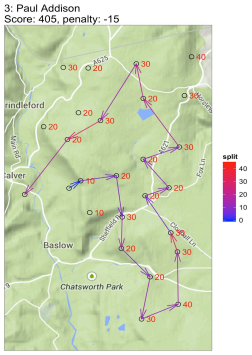
We considered split data from the 1st round of the Rab 2015 event series.

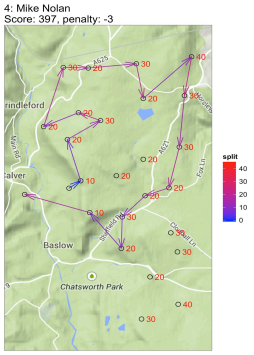
We wondered:

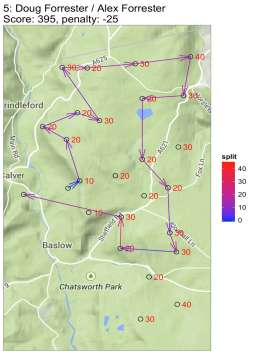
- Did top finishers take similar routes?
- Was speed or route-planning acumen more important?
- How close to optimal is route choice by experienced competitors?

Route choices: position 2-5







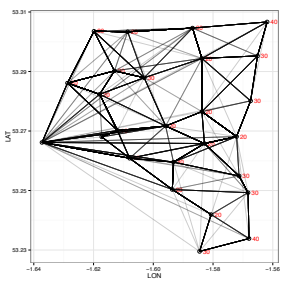


Analysis

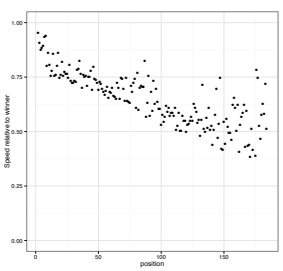
- We modelled the split, T_{ij}, over leg i over competitor j as

$$T_{ij} = d_i / s_j$$

where d_i is a notion of distance for the leg, and s_j is a notion of speed for the competitor.
- We used linear regression on the log-splits to infer the relative speed of competitors and leg lengths.
- We encoded possible route choices as the sequence appearing between 1 and N in permutations of 1, ..., N.
- We wrote a score function based on the points accrued minus the penalty associated with the total route duration.
- We used a genetic algorithm to search through the space of permutations to optimize the score for the winner's speed.

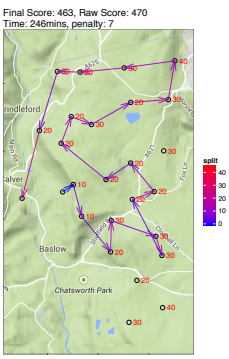


Above: all legs run
Below: rank vs speed



Discussion

- Top routes are surprisingly varied (see **above**)
- Rank and speed related but with increasing scatter due to mishap (see **left**)
- Genetic algorithm did improve winnier's score; but only by ~7% (see **below**)



But...

- Some legs missing, arguably irrelevant ones
- Within-leg navigation and speed confounded
- Relatively flat course

Contact us:
p.j.dodd@sheffield.ac.uk

www.sheffield.ac.uk/heds
www.scharrheds.blogspot.co.uk

@scharrheds
www.facebook.com/scharrsheffield