BOOK OF ABSTRACTS Open Access

Optimisation of cycling training

P Scarf [1]✉, M Shrahili [1], SA Jobson [2] and L Passfield [3]

Abstract

Introduction: Training is fundamental to improving athletic performance, and progressive training schedules are commonly adopted. However, the quantification and optimisation of a progressive training schedule in order to "peak" at a particular competition is an open problem. This paper explores this problem through the use of a mathematical model of training that is well known, but that has proved difficult to implement in practice.

Purpose: To investigate a methodology to quantify the effect of training on potential performance for an individual rider based on data collected in the field and to describe how the quantification of training can be used to determine an optimal training schedule.

Methods: The methodology uses power output, collected using a power meter, and heart-rate, collected using a heart-rate monitor, of all sessions (training or racing) in a rider's history. The power output developed in a session at time t is related to the heart-rate and power output in sessions up to time t using a statistical model in which performance output depends on training input. The training input measure: relates to all sessions conducted to date; is called the accumulated training effect (ATE); and is based on the Banister model (Banister et al., 1975: Australian Journal of Sports Medicine 7, 57-61). The measure has a number of unknown parameters that require estimation for a particular rider. The performance output measure: relates to a particular session; and is notionally that heart-rate required during a session to maintain a high percentile of power output. The resulting statistical model of training and performance is fitted to the power output/heart-rate histories of 11 competitive cyclists.

Results: Estimates of model parameters are obtained for the eleven riders. The extent to which performance is statistically, significantly related to training depends on the rider and the exact specification of the performance and training measures. Figure 1 shows for example the performance (hp75: the heart-rate required by a rider during a session to maintain his/her long-term upper quartile power output) and training measures over the training period for a particular rider.

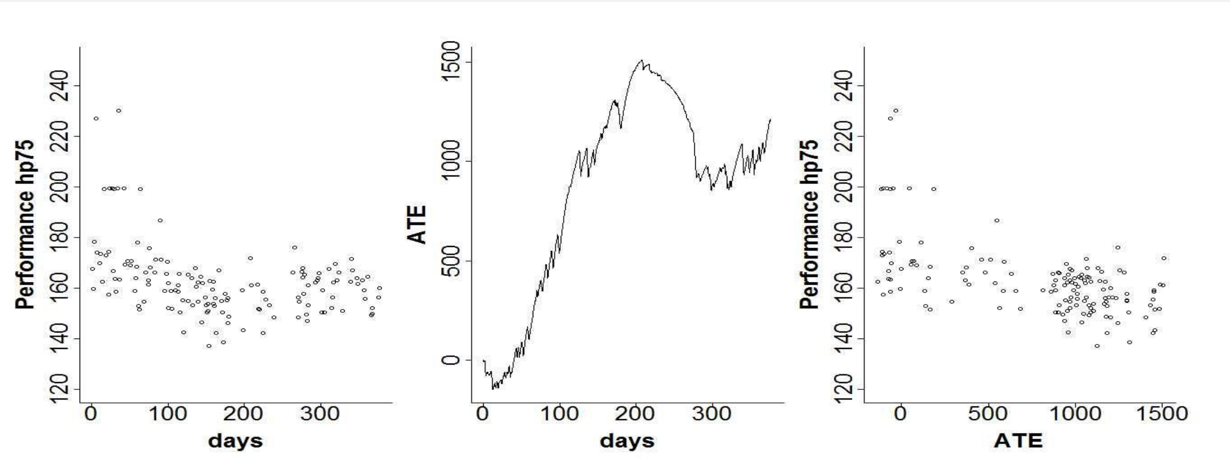

Figure 1. (a) Performance over time; (b) training over time; (c) performance vs training.

Discussion: If performance is statistically, significantly related to training and thus the training measure parameters are known, then in principle training can be optimised (with respect to the model). However, many issues remain: considerable noise in the heart-rate, power output relationship means that model parameters are not well estimated; refinement of the model is required in relation to cardio-vascular drift; training data must be complete (no missing sessions) and this is not always the case or even known; the appropriate value for the power output percentile of the performance measure is not obvious.

Conclusion: Preliminary results indicate some success in quantifying the Banister model of training and performance for individual riders using power output and heart-rate data collected in the field.

✉ **Contact email:** *l.passfield@kent.ac.uk* (L. Passfield)

[1] Centre for Sports Business, Salford Business School, University of Salford, UK.

[2] Department of Sports Studies, University of Winchester, UK.

[3] School of Sport and Exercise Sciences, University of Kent, UK.

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