

# Predicting a Power-Duration Curve in Elite Endurance Track Cyclists.

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## Purpose:

A power-duration curve provides coaches and athletes with a snapshot of the workload achievable for any given duration at a single point in time which can then be used to inform training and race strategy depending on the demands of the event. The accuracy of a power-duration curve is important to ensure it can be used to accurately predict performance. This preliminary research aims to determine whether a multi-trial protocol can be used to accurately predict the power duration curve up to the length of 20 minutes (to reflect the longest trial that is usually used) whilst incorporating an accurate prediction of the athlete's capabilities within the severe exercise domain (typically durations shorter than 60 seconds). Furthermore, this research seeks to explore which trials can be used to most accurately predict the curve with the least amount of trials so that coaches and athletes can use the protocol without impacting heavily on their training schedule. This research has been conducted using elite track cycling endurance athletes who are typically able to achieve greater power outputs within the severe exercise domain than an elite road racing cyclist however they must still demonstrate strong aerobic capabilities to race for longer durations than a track sprint cyclist therefore this research also demonstrates the challenges in predicting a power-duration curve in a novel subject group.

## Methods:

A total of 20 (11 male, 9 female) elite track cyclists (defined as having competed for a National Cycling Federation at a major international competition within the last 2 years) aged 22±4 years completed 6 maximal time trials of differing durations (6 seconds(s), 30s, 60s, 360s, 720s, 1200s) over 2 days (3 on each) on a static cycle ergometer (Wattbike, Nottingham UK). The combination of the trials was randomized for each day but the participants always completed the trials in reverse time order. Each trial was completed seated and from a static start using the participants same individual riding positions. Participants were asked to refrain from strenuous activity for 24 hours before the trials and had 30 minutes of off the bike recovery between the 3 trials on each day and 24 hours of recovery between the two testing days to ensure they could perform their best in each trial.

The average power output was recorded for each of the 6 trials completed and plotted on a power duration curve (Figure 1). Individual data points were then systematically taken out of the power duration curve to determine whether an accurate prediction could still be achieved with less trials (Figure 2). For each combination of trials, all the known power outputs (6s, 30s, 60s, 360s, 720s, 1200s) were compared to the predicted power output.

## Results:

Statistical analysis showed there to be only one known duration that could be accurately predicted by the 6 and 3 point protocols and two and three for each of the two point protocols (table 1) although each of these predicted the known points included in them due to an R value of 1.0. Based on this analysis, none of the protocols tested could be used to accurately predict most the known power-duration values.

## Limitations:

The results presented were calculated using an exponential line of best fit with an R value greater than .98 however this meant that the line often under-predicted power values known to be achievable even when that duration was included in the protocol. Further analysis will amend the line of best fit to go through the highest known values.

So far, Paired T-tests were used to compare known power values for each duration tested against the predicted value from each protocol however this doesn't provide a full representation of the power-duration curve, further statistical analysis is needed to determine whether any of the protocols demonstrate no significant difference across the whole line.

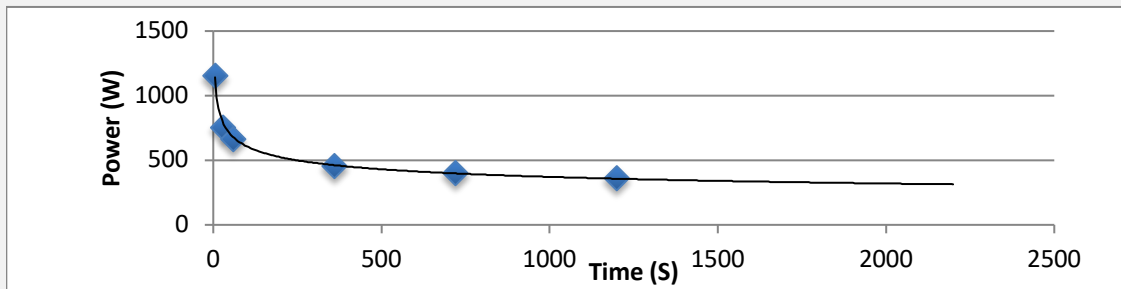


Figure 1. Power-duration curve predicted using 6 maximal time trials over a 2-day period.

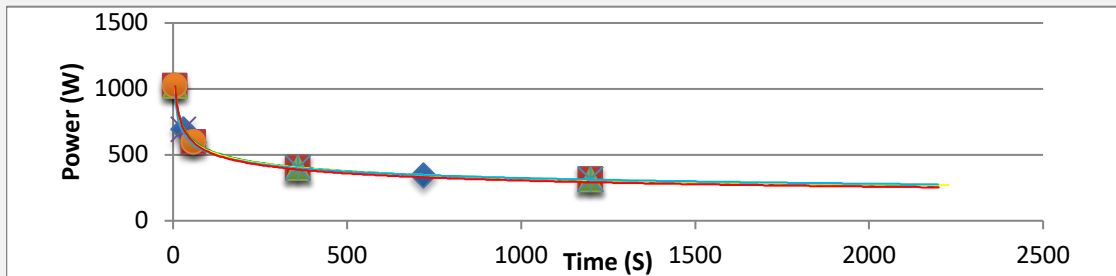


Figure 2. Power-duration curves predicted from the same data set using 2,3,4 and 6 data points.

		Protocol				
		Black	Green	Yellow	Red	Blue
Time (s)	6	0.0005	0.0005	0.0005	0.0005	0.0005
	30	0.0005	0.0005	0.0005	0.0005	0.0005
	60	0.0005	0.002	0.0005	0.333	0.0005
	360	0.0005	0.0005	0.0005	0.583	0.139
	720	0.317	0.544	0.811	0.0005	0.817
	1200	0.0005	0.0005	0.0005	0.0005	0.355

Protocol Key	
Black	All 6
Green	6 360 1200
Yellow	30 360 1200
Red	6 60
Blue	360 1200

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**Key words:** Power-duration, performance modelling, track cycling

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