

The heptathlon is an athletics competition consisting of 7 events: 200m sprint, 800m run, 100m hurdles, high jump, long jump, shot put, javelin.

The scoring system uses two types of equation:

$$y = a(b - x)^c \quad (1)$$

$$y = a(x - b)^c \quad (2)$$

where  $a$ ,  $b$  and  $c$  are constants,  $x$  is the competitor's time or distance and  $y$  is the number of points they are awarded.

Which events do you think use equations of type (1)? Why?

Which events do you think use equations of type (2)? Why?

The table below shows the values for  $a$ ,  $b$  and  $c$  in each event. It also shows the best times and distances of an Olympic hopeful in training, as well as the World Records for each heptathlon event (as of April 2011).

Event	$a$	$b$	$c$	$x$ measured in	Olympic hopeful	World records
200 meters	4.99087	42.5	1.81	seconds	25.34s	21.34s
800 meters	0.11193	254	1.88	seconds	2min 13.00s	1min 53.28s
100 m hurdles	9.23076	26.7	1.835	cm	13.65s	12.21s
High Jump	1.84523	75	1.348	cm	1.43m	2.09m
Long Jump	0.188807	210	1.41	cm	5.67m	7.52m
Shot Put	56.0211	1.5	1.05	metres	12.45m	22.63m
Javelin Throw	15.9803	3.8	1.04	metres	45.05m	72.28m

In order to work out a suitable training schedule for her, work out her score in each event.

Suppose she could close the gap between her current performance in each event and the world record by 10%. How would that affect her progress towards her target heptathlon score of 6000 points?

Instead, she could put together an alternative training schedule aiming to close the gap by 20% in some events. However, this extra training would have to be at the expense of her training for other events (so for every event she chooses to improve by 20%, she must choose another where she forfeits the 10% gain and instead maintains her current level).

Could this training strategy lead to a better score?

Can she reach the target of 6000 points?