A Statistical Analysis of Ultramarathoning Records

by Peter Riegel

In a recent article I discussed the performance of world class athletes in various endurance sports, and proposed an "endurance equation" that described their time vs distance behavior. When I was deciding how best to treat the world record data, I noticed that in the mile-to-marathon range the data points fell along a line which could be described by a simple mathematical expression. The endurance equation that I formulated had the form:

$$t = ax^b$$

where t=time (minutes), x= distance (km) and a and b are constants, unique for each activity. See table 1. I thought that the races at distances below 1500 meters were predominantly sprintlike in nature and did not reflect true steady-state endurance activity. Moreover, I reasoned that the distances beyond the marathon were not heavily contested and were thus less competitive. Accordingly, I based the endurance equation only on world records from 1.5 to 42.2 kilometers.

Table 1

The Endurance Equation

$t = ax^b$, where t=time in minutes and x=distance in km

Endurance range 1.5 to 42.2 km	a	b
men	2.297	1.07731
women	2.564	1.08511

Ultradistance range 50 km to 24 hour	a	b
men	1.050	1.28533
women	.814	1.39552

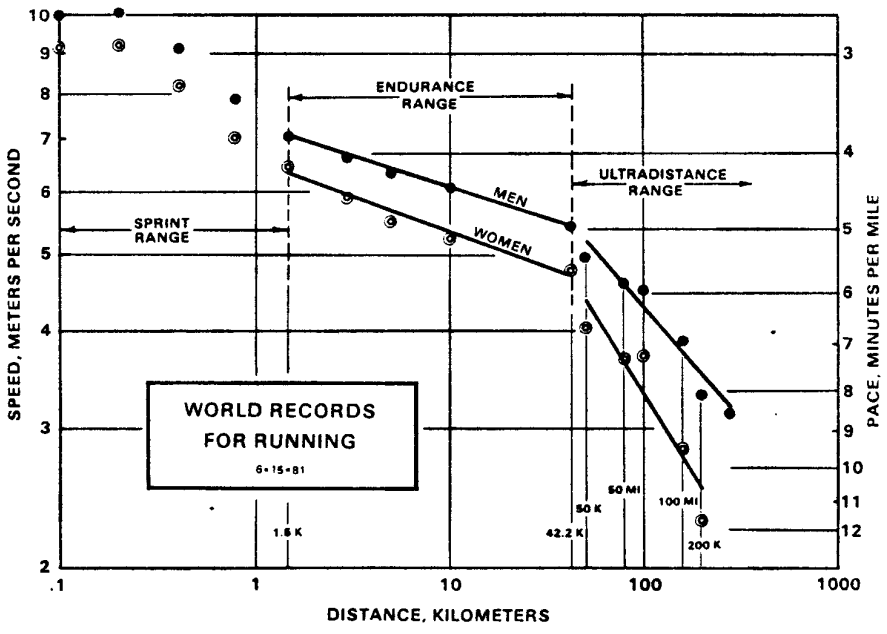
In the ultradistance range, which I take to include events from the marathon to the 24 hour run, there is tremendous potential for improvement. What can be expected when the competition really gets hot? For that matter what is the present level of performance? To find out some tentative answers I carried out the same sort of curve fitting that I did for the endurance range, but only for events from 50 km to 24 hour. I also decided to extrapolate the endurance range calculations to see what performances would result if champion ultrarunners followed the performance trends of the endurance athletes. Results of these calculations are shown in the figure and the tables. How good are the data? In the endurance range, the world records fall quite close to the line depicting the endurance equation. This indicates that that line does a good job of describing the activity in that range. In the ultradistance range, however, there is considerably more scatter, indicating that the power function I used may not be the best choice for a descriptive equation. Until the data points fall on a reasonably smooth curve, however, I feel that one curve is about as good as another to use, so I'm sticking with the power function until the world records tighten up a bit. How plausible are the projected values? Personally I find them somewhat unbelieveable, especially at the longer distances. Still, who in the 1960's would have expected to see the women's marathon where it is today? The figure shows all of the world records at standard distances from 100 meters to 24 hours. The heavy lines show the way that the endurance equation fits the data. I have made no effort to deal with the sprint range; it obviously does not fit the trend line from the endurance range.

There is a remarkable change in slope from the endurance range to the ultradistance range. The ultrarunners are slowing down at a higher rate. For example, in the endurance range, if the distance is doubled, men's speed decreases by 5% and women's by 6%. In the ultradistance range, doubling distance reduces men's speed by 18% and women's by 24%. Although I am sure that lack of competition is one good reason, I am equally sure that there is a physiological explanation as well - ultrarunning is different from ordinary endurance range running. (There is a physiological explanation. A runner can store only so much glycogen in his or her body. Since glycogen is the fuel of first choice, it is used up after 2-3 hours of world class running. Then the body must rely on free fatty acids, which cannot be utilized at the same running speed as in the first 2 or 3 hours of a run without producing an oxygen debt, i.e., lactate buildup. Eds.)

The strongest records in the ultra range are those set at 100 km, with the men's 100 miler a fine one as well. Both men's and women's 50 km records hang like ripe fruits, just waiting for some top marathoners to come along and gobble them up.

The women's record at 100 km was actually run at a faster pace than at 50 miles. Should the 50 mile time be considered a record at all? I have done so in the analysis, although a case can be made against it. I'm sure that increased competition will change this condition. We will probably never know how good the best of us can be until the ultradistance sport grows more competitive, and this will only come about through public awareness of the events and incentives to top runners. This incentive will likely not come until ultramarathons are contested on an Olympic level. Whether we really want the sport to grow is a philosophical question each of us must answer individually. Distance running has become overcrowded in many areas, and has lost much of its original attraction for many runners. Still, as a result of the growth we now have better clothing and shoes, and more races in which to compete.

Several articles have appeared over the last few years advancing the idea that women



A log-log plot of world record pace vs distance yields points that appear to follow straight line patterns.

should be better at the really long distances than men, because of their ability to burn their body fat. Although at least one ultramarathon has been won outright by a women, this hardly confirms the theory. Far more races of all distances are won by men. A look at the records in both the endurance and ultradistance ranges shows that, at least on the world-class level, men do relatively better than women as distance increases.

Women's extra fat appears to benefit them chiefly in long-distance cold water swimming, providing buoyancy and insulation, and women are undisputed masters of the English Channel. This is the only area where women hold the endurance advantage.

The value of competition in the setting of records is incalculable, but definitely great. At the world class level any race can result in a record if the conditions are right. This leaves the frontrunners with a dilemma - should they go for a record, risking a blowup, or just hang in for a victory? In a race of little importance the record may be sought, but when the stakes are high, conservatism is often the best strategy - run no faster than required for the win.

In the ultras so much is invested in each race that it may be imprudent to do more than is required to win or place well. In my personal experience, which has been limited to 5000 m to marathon races, I have sometimes held off a maximum effort when I knew that I had secured a good place in my age group. My best efforts have sometimes come when I was hopelessly out of contention and felt that I could afford to blow up.

Frequency of competition is known to keep runners sharp. Most top endurance athletes spend the year traveling the 10 k circuit, coming in to thump the locals, and rarely being challenged except in the bigger races where they encounter each other. By doing this they keep their racing instincts honed, and when they decide to peak and go for an important win, they are mentally ready and competitively experienced. The ultrarunner, however, cannot compete as frequently and still keep his edge. Although some will compete often, few can really go for a near maximum effort more than once or twice each year, because of the tremendous stores of body reserves that are used up in a really competitive long race. A top ultrarunner may have only ten opportunities in his lifetime to put a peak-condition body into an all-out effort under favorable conditions. Record-setting opportunities are thus much rarer for the ultrarunner than for the shorter distance competitor.

Another reason why the ultra records will probably lag behind those set at shorter distances is time. The longest endurance event, the marathon, takes only about two hours to complete. Records are set when the athlete has achieved peak fitness, has some close competition to press him, and has good running weather. This year Boston had temperatures in the fifties and a nice tailwind. Seko, Virgin and Rodgers hammered away at each other for most of the latter half of the race, and a course record was the result. How many 100 mile events can count on optimal weather for 10 or 20 hours straight? Not many, and the record runs in ultras will probably always be done in worse average conditions than those at shorter distances.

Considering world records is a convenient way to gauge the nature of a sport. But although the numbers are precise and accurate, their interpretation is far less so. It is a mistake to take too seriously the numbers game of record analysis. There are factors in racing that I hope will never be quantified. That's why it's such a great game.

Peter Riegel is a 46-year-old engineer living in Columbus, Ohio. He has run 23 marathons, but, as yet, no ultras. The attraction is growing though and he may run a 50 miler soon.

Table 2

Projected performance in the ultradistance range based on performances in the endurance range

Event	Projected record	Present record	Projected pace (min per mi)	Present record pace (min/mi)
Men:	Projected record			
50 km	2:35	2:48	5:00	5:25
50 mi	4:19	4:51	5:11	5:50
100 km	5:28	6:10	5:17	5:57
100 mi	9:07	11:31	5:28	6:55
24 hour	245 mi	169 mi	5:52	8:30
Women:				
50 km	2:59	3:27	5:45	6:39
50 mi	5:00	6:03	6:00	7:15
100 km	6:19	7:27	6:06	7:12
100 mi	10:36	15:44	6:22	9:26
24 hour	212 mi	123 mi	6:47	11:40

Lawder First in Broadway Debut

This race is the Northeast version (there's also a 2 bridges 36 miler along the Potomac River near Washington, D.C., each October) of the original Two Bridges 36 Mile race in Scotland each August. The scenic course crosses the Delaware River twice and has several difficult hills, especially between the 19 and 27 mile marks.

At the front of the field it was a battle between two ultra vets, Jack Bristol and Bill Lawder, with Lawder finally emerging victorious by 2 1/2 minutes.

Donna Hudson, 2nd woman finisher in the 1980 London to Brighton race, was the first woma: in 4:57:40.

Lawder was presented with the Guenter Erich Cup. The award was named as such due to the dedicated effort by Erich to create an ultra event in the North Poconо area. Erich himself placed a very impressive 5th and was the first master.

The race was the first event staged by the Broadway Ultamarathon Society. Many more are in the works.

Rich Innamorato

Two Bridges 36 Mile

Matamoras to Milford, Pennsylvania — August 9, 1981 — 36 mi

1.	Bill Lawder,34,NJ	4:06:06
2.	Jack Bristol,32,CT	4:08:36
3.	Dave Faherty,36,NJ	4:12:57
4.	Ken Grenbenstein,28, NY	4:18:00
5.	Guenter Erich,48,NJ	4:20:11
6.	Hal Stern,35,NY	4:26:02
7.	Rich Langsam,30,NY	4:28:10
8.	Jim Shapiro,34,NY	4:32:27
9.	Ralph Balsamo,34,NJ	4:32:52
10.	Rich Innamorato,32, NY	4:39:49
11.	Bud Courtney,32,NY	4:40:25
12.	James Smith,44,NY	4:40:45
13.	Joe Dugan,43,NY	4:41:51
14.	Frank Lorey,52,NJ	4:44:10
15.	Marc Landry,26,PA	4:49:00
16.	Donna Hudson,33,NY	4:57:40
17.	Al Byrnes,28,NJ	4:57:40
18.	Bob Rother,48,NY	5:02:40
19.	Bill Piper,35,PA	5:17:04
20.	Lewis Cullen,27,NY	5:20:21
21.	Martin Yecies,37,CT	5:27:16
22.	Don Schaller,38,NY	5:29:33
23.	Fred Robbins,54,MA	5:42:37
24.	Bill Peck,39,NY	5:43:40
25.	Charles Gadol,24,NJ	5:54:06
26.	Anita Mathieu,35,NY	5:55:05
27.	Michael Kandel,39,NY	6:26:38

28 starters

Run for the Border

Bernardston, MA to Suffield, CT — August 9, 1981 — 54.1 mi

1. Dick Golas, 44, MA 7:55:48

Three starters.