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Consistent Set of Running Times

In earlier papers (*1, 2*) it has been shown that a logarithmic relationship exists between various types of racing events. It was pointed out that a consequence of the linear log-log relationship between distance and time was a linear correspondence between the log of the average rate for a given distance and the log of the distance. This phenomenon applies not only to running events but to all types of racing—for example, walking, swimming, bicycle racing, and horse racing. The slope of the latter plot was defined as an "exhaustion constant" since it is a measure of how the average rates decrease with distance. The present communication shows how the log rate-log distance plot can be used to derive a consistent set of running times based on the best efforts to date.

When $\bar{r}$ (the average rate for a given distance) is plotted against the distance d, as has been done previously (*1, 2*), it is very difficult to decide which records are actually "best efforts," for the exact shape of the curve through the points has not been determined. However, this difficulty is removed when log $\bar{r}$ is plotted against log d. Since this plot must be linear (*2*) it is easy to determine which records are not consistent with the "best efforts," for all "best efforts" must fall in a straight line, and all other records below. To determine the times in which all records below the line should be performed to put them on the line it is necesary merely to divide the distance by the rate on the line.

In order to prepare a table of consistent times for running events, a plot of log $\bar{r}$ versus log d was made for all the world records. The plot was divided into two parts for convenience, one plot for the records for distances up to 1 mile and another for the records from 1 mile to the 2-hour run.

Table 1 presents a set of times for running events that has been derived from the linear log $\bar{r}$ versus log d plots. The 100-yard and 100-meter events have not been considered because of the strong effect of the start on these events which causes a considerable deviation from the straight-line function. It is obvious that the 220-yard, 1-mile, and 1-hour records are all equivalent performances and "best efforts," and that all other records need improvement to make them consistent.

Table 1. Consistent times for running events.

Distance	Time (hr: min: sec)	Consistent time (hr: min: sec)	Δt (sec)	Δt for present Olympic records (sec)
220 yd	0:0:20.1	0:0:20.1	0	
440 yd	0:0:46.0	0:0:45.8	0.2	
880 yd	0:1:48.6	0:1:44.5	4.1	
1 mi	0:3:58.0	0:3:58.0	0	
2 mi	0:8:40.4	0:8:22.1	18.3	
3 mi	0:13:14.2	0:12:57.6	16.6	
6 mi	0:27:59.2	0:27:19.8	39.4	
10 mi	0:48:12.0	0:47:23.3	48.7	
15 mi	1:16:26.4	1:13:22.4	184.0	
200 m	0:0:20.2	0:0:20.0	0.2	0.7
400 m	0:0:45.8	0:0:45.5	0.3	0.4
800 m	0:1:46.6	0:1:43.7	2.9	5.5
1,000 m	0:2:19.5	0:2:15.3	4.2	
1,500 m	0:3:41.8	0:3:39.1	2.7	6.1
2,000 m	0:5:07.0	0:5:01.0	6.0	
3,000 m	0:7:58.8	0:7:45.8	13.0	
5,000 m	0:13:40.6	0:13:27.3	13.3	38.7
10,000 m	0:28:54.2	0:28:24.3	29.9	52.7
15,000 m	0:44:54.6	0:43:43.2	71.4	
20,000 m	0:59:51.7	0:59:51.5	0.2	
25,000 m	1:16:34.6	1:16:11.9	22.7	
30,000 m	1:35:23.8	1:32:40.7	163.1	
12 mi, 809 yd	1 hr	1 hr	12 mi, 809 yd*	
22 mi, 418 yd	2 hr	2 hr	23 mi, 1373 yd*	

* Consistent distance.

The amount of improvement necessary (Δt) is indicated in column 4 of Table 1. The last column of Table 1 shows the amounts (Δt) by which the present Olympic records can be bettered to bring them into line with the best efforts to date.

It should be strongly emphasized that the rates which fall on the straight-line plots are in no sense "ultimates." The rates will be increased by better training methods, better nutrition, and improved tracks and equipment. However, the underlying logarithmic relationships will be maintained so that at any time it will be possible to show which records are out of line when compared with the best efforts.

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Comparison of Pinch-Caliper and X-ray Measurements of Skin plus Subcutaneous Fat

Although numerous studies of subcutaneous fat have appeared, only one previous report has dealt with the relationship between its roentgenogrammetric measurement and its measurement by spring-loaded pinch calipers in males (*1*).

In the present study (*2*) the thickness of the fat-plus-skin layer, at the level of the lowest rib at the midaxillary line, was measured by both techniques. Pinch-calipers exerting a force of 300 g over a 30 mm^2 area (*3*) were used to measure a double "fatfold," while measurements of the single-thickness shadow were made on standardized teleoroentgenograms (*4*).

Agreement between the two methods was high ($r = 0.88$) for 65 young men aged 21 to 22 years, thus confirming Baker's findings for thigh and arm fat (*1*). The median pinch-caliper value was 12.0 mm, while the median roentgenogrammetric measurement was 9.3 mm. On this basis, the actual pinch-caliper values were 65 percent of the true double-fold thickness (18.6 mm).

The possibility that the skinfolds were reduced 35 percent throughout the entire range was tested by comparing the distribution of pinch-caliper values to the roentgenogrammetrically determined values multiplied by 1.3. Using the Kolmogorov-Smirnov test (*5*), the two distributions were not significantly different at the 5-percent level (Fig. 1).

The two methods of measuring skin