

# HOW BIG IS THE LUCK FACTOR IN YACHT RACE SCORING?

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Ideally perhaps, the best sailor should always win. Maybe ideally in a hypothetical identical one design class, with all identically skilled crews, and either one-design or perfect handicaps, all yachts *should* finish in dead heat. But there are a number of unavoidable random factors that keep this from happening, including the natural variability of wind and waves, random interaction among boats, and the inevitable minimum variability of crew performance from race to race. As a group these may be called the “irreducible error” or “luck factor” in yacht race scoring. If we can estimate the magnitude of such irreducible errors, it can provide us with a useful benchmark for evaluating the meaningful accuracy of yacht handicap systems.

If we characterize the irreducible error in terms of its standard error, ( the RMS or root-mean-square of its values), I (sec/mi) and that of a handicap system as H (sec/mi) then under generally applicable conditions, the overall standard error of scoring, O (sec/mi), the sum of the two error types, will be given by

$$O = \sqrt{I^2 + H^2}$$

This means, among other things, that in order that overall scoring error, O, should be less than 10% worse than the irreducible error, I, the Handicap error, H, should not exceed roughly ½ of the irreducible error. Proof:

$$O = \sqrt{I^2 + (I/2)^2} \approx 1.1 \times I$$

## Evaluating the Irreducible Error

In order to estimate the luck factor, we picked a regatta including a class of essentially one design yachts that are well raced over a number of races. The Farr 40 class in the 2001 Key West race provided an excellent database with a class of 37 modern one-design yachts, very seriously raced with generally top class international crews and skippers in 8 races. The regatta results are posted at <http://www.premiere-racing.com/>. Essentially, we look at the *consistency* of performance of each boat from race to race.

Commonly, sec/mi differentials are figured relative to the time of the first boat. For the present purpose, however, that would have had the effect of including the variability of the first boat’s performance in with that of each other boat, thus overestimating the variance of each boat’s performance. For the present purposes therefore, the reference for each race was defined as the mean elapsed time of the first ten boats. This should reduce the variability of the reference to a negligible value.

The resulting elapsed time differentials, sec/mi relative to the reference, for each boat, for each race, are shown in Table 1. Finally in the next to last two columns we calculate the mean and standard deviation ( i.e. rms difference from its mean) for each boat over the 8 races. The variation (or std. dev.) numbers in the next to last column are a measure of the *inconsistency* of that boat, independent of its mean performance or skill level. The boats are sorted by place in the regatta (over the 8 races) in the last column. Interestingly, there is little or no correlation between inconsistency as indicated by the Std. Dev. column and regatta place. This contradicts the common intuition that the winners should be more consistent than the losers.

Finally, the figure in the lower right hand corner is the average over all boats, of the boat standard deviations from the race references, **19.7 sec/mi**. This is our best estimate of the standard deviation of the irreducible or inevitable variability of race results.

I take that to mean this: It is fruitless to strive for handicapping accuracy much better than about ½ this, or about, 9 sec/mi. This is not to say that race place positions may not be changed by differences this small, but rather that corrected time differences less than this are not actually significant of true difference in underlying boat and crew performance but are dominated by extraneous random influences having no consistent relation with inherent boat speed and crew skill, in other words, dumb luck.

Table 1 follows.

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		Race 1	Race 2	Race 3	Race 4	Race 5	Race 6	Race 7	Race 8	Average	Variation	
	Distance	7.6	9.4	8.5	7.2	9.61	6.1	6.06	10.41		Std Dev	
Sail	Boat	sec/mi	sec/mi	sec/mi	sec/mi	sec/mi	sec/mi	sec/mi	sec/mi	sec/mi	sec/mi	PI
42F	Atalanti	-3.3	-0.6	3.0	43.1	-0.6	31.2	-15.0	-6.7	6.4	20.0	1
50010	Pegasus	-3.1	2.6	23.7	18.1	-5.2	16.6	-20.3	3.8	4.5	14.5	2
51408	Revolution	-2.4	-4.4	26.3	-24.3	3.3	1.8	36.8	1.2	4.8	18.9	3
25F	GBR 25R	7.9	-6.4	13.6	24.6	9.9	3.5	28.2	5.8	10.9	11.3	4
46999	Crocodile Rock	2.2	11.5	-1.8	1.4	41.5	21.5	29.2	-0.8	13.1	16.1	5
1	Mascalzone Latin	14.8	7.9	-1.2	13.5	22.2	52.8	0.6	-4.8	13.2	18.4	6
40038	Predator	0.0	2.8	7.0	7.4	-7.3	33.8	36.5	10.3	11.3	15.7	7
40A	Voodoo	22.9	13.1	-4.8	8.8	15.9	20.3	-7.8	7.4	9.5	11.1	8
28269	Wahoo	-2.7	17.2	16.4	29.9	80.9	-5.1	3.4	2.5	17.8	28.1	9
50955	Barking Mad	-1.4	10.4	0.6	-3.5		24.9	22.9	5.7	8.5	11.5	10
40036	Diana	30.2	16.0	-7.6	40.8	11.0	19.5	-5.3	-2.7	12.8	17.4	11
51581	Bambakou	16.0	3.7	25.2	-9.0	6.5	54.1	6.9	12.1	14.4	18.8	12
2272	Nerone	-1.6	10.1	2.1	46.0	38.2	-3.4	42.6	15.5	18.7	20.6	13
43770	Nitemare	14.0	14.6	6.4	26.8	-10.2	42.3	8.2	20.9	15.4	15.5	14
4040	Solution	16.3	-3.0	8.2	77.0	31.5	-4.2	52.8	4.1	22.8	29.1	15
68	Cavallino	20.8	8.8	25.4	52.5	15.0	-7.0	24.1	9.3	18.6	17.3	16
50051	Phoenix	6.9	7.7	7.3	62.2	6.1	127.6	43.9	3.2	33.1	43.9	17
40026	Raging Bull	6.8		13.2	3.6	43.9	10.8	38.9	14.3	18.8	15.9	18
51990	App/Conspiracy	10.1	-3.1	26.2	54.3	31.4	61.7	26.4	8.8	27.0	22.3	19
51573	Titan	16.8	8.2	29.5	83.3	37.0	7.7	37.6	0.2	27.6	26.6	20
615	EmotionalHooliga	27.5	0.8	24.7	-11.2	22.7	26.6	53.3	16.6	20.1	19.2	21
40G	Dawn Raid	25.2	19.6	4.2	79.5	-9.1	12.6	54.1	10.5	24.6	28.8	22
51123	Passage	5.5	18.5	28.8	29.9	36.9	0.2	52.1	21.8	24.2	16.7	23
40032	Iskra	20.5	22.7	24.3	13.3	51.6	36.2	11.5	17.9	24.8	13.2	24
46957	Groovederci	24.2	15.5	1.6	16.0	41.8		31.7	15.0	20.8	13.1	25
40070	Morning Glory	14.6	24.6	29.9	20.6	35.3	43.1	17.6	13.4	24.9	10.5	26
999F	A Bit of a Coup	21.9	24.7	13.7	40.2	6.6	25.8	62.5	10.8	25.8	18.2	27
54770	Dynamo	26.5	28.7	33.0	45.7	61.7	-0.8	50.3	6.0	31.4	21.4	28
141	Honour	12.9	26.1	27.6	44.7	58.3	7.4	58.9		33.7	20.8	29
4038	Madina	21.8	20.3	28.1	76.3	51.9	16.7	51.1	19.6	35.7	21.6	30
40076	@ccelerator		24.5	27.5	55.2	17.8	43.0	52.3	11.7	33.1	17.1	31
5095	Sled	16.9	27.0	24.6	33.1	71.2	22.1	70.4	20.7	35.8	22.2	32
40063	Gone Too Farr	23.8	23.5	18.1	61.5	64.3	38.2	56.3	12.8	37.3	20.8	33
50073	Twisted	26.7	16.8	3.9	85.0	68.8	32.0	66.7	15.6	39.4	29.9	34
50001	Flash Gordon 4	25.9	21.1	31.0	71.5	27.8	14.6	57.4		35.6	20.8	35
95	Gold Digger	21.7	17.3	25.7	29.6	81.8	50.3	68.3	21.0	39.5	24.4	36
40N	Peregrine	19.8	26.0	31.2	49.3		47.4	55.6	9.2	34.1	17.2	37

Mean Of Standard Deviations 19.7

### Consistency Analysis

This analysis addresses the question, how consistently do well sailed boats perform.

Based on results of the 37 boat Farr 40 class at the 2001 Key West race

The quantity tabulated in the 8 race columns is the difference, sec/mi, of the elapsed time for each boat, relative to the average elapsed time of the first 10 boats as a reference.

The last two columns are the mean and standard deviation of the boat,race difference.

The standard deviation is a measure of the inescapable inconsistency of boat performance resulting from random influences of skipper, crew, wind, and waves, and other boat influences..

A perfectly consistent performance over all 8 races would show a zero standard deviation.

The overall mean standard deviatgion in the lower right hand corner, 19.7 is the best single measure of inherent inconsistency in a very well sailed class.