"Fair racing between different types of boats on handicapping systems in sail racing"

Chapter 3

3 How empirical handicapping numbers are established

What do we mean with empirical? First of all it means information from actual performance. The best information is statistics from *many* races in different locations. The handling of statistical data is dealt with in the chapter "Statistics from Races" below. Here we will discuss the interpretation of statistical data.

What is the handicapping number supposed to tell?

What the boat *can* perform

Not necessarily equal to what the boat *has* performed

When statistics is scarce or lacking we have to go to other sources of information. One such source is formulas based on empirical handicapping numbers from many boats. One such formula is the NLYS formula, which you will find in Appendix 5. This formula was developed from a regression analysis of LYS numbers and dimensions of boats and sails.

Empirical?

- Statistics from *many* races
- Empirical formulas (NLYS)
- Comparisons with other empirical systems (PHRF, HN)
- Comparisons with other similar boats
- Comparisons with rules like IMS?
- Analysis of individual races??
- Subjective evaluations???
- Anecdotes????

Another important source of information when we lack statistics is other empirical handicapping numbers like PHRF or HN. Often a boat type has been raced a lot in the USA or France when the first boat is imported to Norway, and even if we have one or two boats in Norway, the statistical background may be much wider in other countries.

The information mentioned above may be regarded as strictly empirical. There is however the possibility to make temporary ratings from measurement rules when no other sources are available. In particular IMS, DH or IR2000 may be useful.

Conversions between a number of different systems are handled in the chapter "Conversions between some different handicapping systems" below.

Forget about anecdotes

80% of the sailors believe they are among the best 20%

Analyses of individual races may be regarded as empirical, but local conditions may make such information completely useless. The only reliable source of empirical information is statistics from *many* races, preferrably on different locations.

As a handicapping officer you will also hear a number of subjective evaluations. "I am sailing better than he is, and it is hopeless to win with my rating." On rare occations this may be true, but you should remember that there is a psychological factor involved. 80% of the sailors believe that they are among the

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best 20%. Therefore, by definition, if they loose races the handicapping is wrong, but if they win they sail well.

"I don't win, so my rating is wrong"

If the rating is right an average sailor will get an average result

Another typical misinterpretation is that some sailors believe that if the handicap is right you will win. The fact is that if the handicap is right an average sailor will get an average result on the racecource.

The least reliable source of empirical information is anecdotes and hearsays. "I remember when we were beating to windward…." This happened to me when I sailed faster than an other boat with a higher LYS, and afterwards the other boat complained about his LYS. The simple explanation was that I had 8 people on the rail in a fresh breeze, but he had none. So, don't listen to anecdotes. There are often facts missing.

What is behind a result?

- The boat? (this is what we aim for)
- The weather?
- The crew?
- The competitors?
- The geography?
- Data errors?

When we evaluate statistics from races we must be aware of the fact that there are many factors contributing to the results. We aim at the performance of the boat, but what about weather, crew, competitors, geography or even data errors?

The boat

- Age? (design + wear + owner + crew)
- Sails?
- Equipment?
- Trim?
- Is it "standard"?

The potential of the boat is very seldom obtained

Let us start with the boat. Is it up to date? Typically an IOR type boat is not as fast as a modern boat with the same dimensions. A well kept boat with a clean bottom is faster than one with a rough bottom. Are the sails and equipment all right? The trim is seldom perfect. And there is a possibility that a boat of standard type deviates from the specifications. When you include the crew in the evaluation you will find that very seldom the boat's potential is obtained on the racecourse. Most crews do not reach the optimum perform ance.

The weather

- Big - small boat?
- Beat - reach - run boat?
- Heavy - light weather boat?
- Waves?
- Varying conditions?

Varying conditions

- Increasing wind? (Bias)
- Decreasing wind? (Bias)
- Calm periods? (Bias)
- Permanent wind shifts? (may cause large spread of results)
- Oscillations?
- Puffs? (Acceleration)

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The weather is another important factor. Bigger boats usually need more wind to perform well. Some boats are performing well on a beat to windward, while others are better on a run or a reach. Heavy weather boats get better statistics in heavy weather. Light boats, in particular if they have a small longitudinal radius of gyration, perform better in waves than heavier ones. And as described in some detail in the chapter "Corrected time errors and IDEAL TIME calculation", varying wind conditions may seriously distort race results.

Increasing wind speed will usually favour the smallest boats, which sail in higher average wind speed. Decreasing wind speed is favouring the largest boats, which in extreme cases may even finish before the wind disappears and stops the smaller ones completely. A period of calm weather will favour the smallest boats when time-on-time scoring is used, but there is no such favouring when time-on-distance is used. Other types of wind variations like permanent wind shifts, oscillations, puffs etc also contribute to the distortion of results.

Competence
- Skipper?
- Crew?
- Training?
- Experience with the boat?
- Good day?

The skipper and the crew obviously affect the results, and a well trained crew with experience from the particular boat gets the best results. There is also a random element, which gives a medium crew a win on a good day.

Competitors
- Beginners?
- Experienced cruisers?
- Average racers?
- Good racers?
- Professionals?

The results are not only dependent on the own boat and crew. An average sailor wins over beginners, while he will loose against professionals, and the differences are bigger than generally understood.

Different types of boats
- Preferred by cruising people?
- Preferred by racing people?
- Preferred by professionals?
- Numerous/few?
- Sailed often/seldom?

When you interpret statistics you will also have to consider regional variations. Wind and wave conditions are different in the inner Oslo Fjord as compared to an open sea at Skagerak or outside La Rochelle.

Random errors
may be handled by statistical methods

Systematic errors
must be handled by professional knowledge

Regional variations
- Wind conditions?
- Wave conditions?
- Frequency of different boat types?
- Different boats preferred by the best sailors

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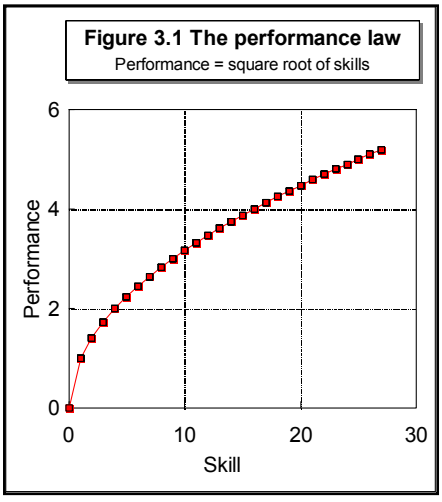
Some boats are very popular in one country, and less popular in other countries. Large fleets produce sailors who get the best out of the boat, while single boats seldom are sailed to their full potential. It is also a fact that the best sailors tend to prefer certain types of boats, which therefore get better than average statistics. On the other hand typical heavy cruisers are usually sailed by family sailors who sail few races and seldom sail up to the potential of the boat.

Table 3.1 Coefficient of variation of racing performance

	1996	1997	Average
IMX-38	0.037	0.019	0.028
Express	0.040	0.034	0.037
H-boat	0.046	0.031	0.038
Soling	0.044	0.036	0.040
IF	0.048	0.044	0.046
Folkboat	0.059	0.039	0.049
Comfortina 32	0.049	0.051	0.050
Maxi 77	0.067	0.040	0.054
Maxi 95	0.067	0.055	0.061

All the factors mentioned above will have to be evaluated when you use statistical data to set empirical handicapping numbers. Therefore it is important that rating officers are very experienced sailors, who can make qualified evaluations of these factors. The random errors are discussed in the chapter on statistical analysis of results, but the factors discussed here cause systematic errors, which cannot be reduced by statistical methods or more data. Systematic errors must be handled by means of professional knowledge.

I have tried to find objective measures of the competence of the sailors in different classes. As explained in the chapter on statistical analysis of race results, you may calculate an experienced rating for each boat in a regatta. If you collect all experienced ratings for a boat type in a number of regattas, you can calculate the standard deviation STD and the average m(Le) of these experienced ratings for the specified boat type. The coefficient of variation COV is the standard deviation divided by the average. From the Nordic LYS statistics I have calculated the coefficient of variation for some different types of boats, and it seems like boats where you would expect more skilled sailors have lower coefficient of variation than types of boats where you expect to find more family oriented sailors. The reason for this is what I call "the performance law". The better you get the sooner you hit the roof, and there are larger variations in performance between less experienced sailors, than between more experienced sailors. It is also interesting to note that the statistical distribution of the experienced LYS number, Le, in one year very closely follows the Normal distribution function.



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One interesting issue, which we have discussed at some length in the Nordic LYS committee, is whether we should look at the statistical performance of the average boat, or at the best boats. The best boats may de defined as the average of the best 1/3, the best 1/4 or even the best 1/5 of all boats. This means that we move up to a certain chosen level of the standardised normal variable, and make the comparisons at that level. I think this idea may have some merits, and it is included as an option in the statistical program, but it is too early to jump to conclusions. One difficulty is that such an estimate would have to be dependent on the standard deviation of Le, and for a boat type with a small number of results this parameter may vary a lot at random. The data we have indicate that LYS numbers are fairly close to the average performance, and I recommend that the average performance, m(L_e), is used.

Figure 3.3 Nordic LYS 1996. Maxi 95

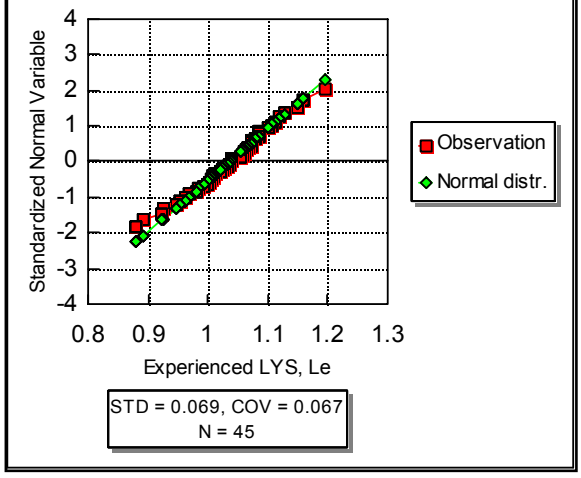
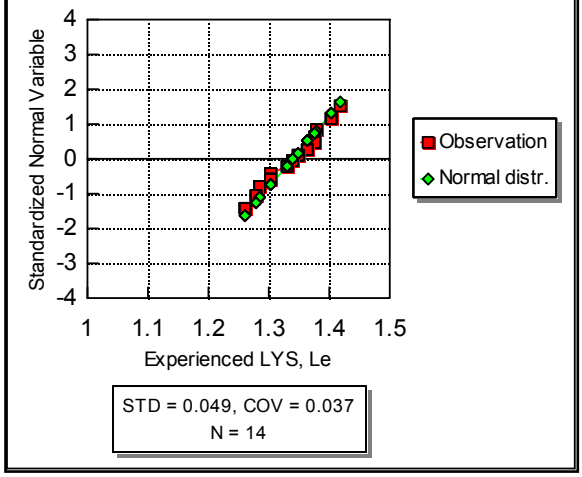


Figure 3.2 Nordic LYS 1996. IMX-38



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