2025 Handicapping Synopsis
Monday-Night Racing at SPSC

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1 A Historical Overview of Rolling Handicapping at SPSC

a long rambling digression — you can safely skip forward to section 2, section 3 *or* section 4

We have been running Monday-night races with rolling handicaps since 2010. There has been quite a lot of development along the way

In 2010 and 2011 we used time-on-distance handicapping. The rolling handicaps were derived from a moving window of six races with simultaneous regression of boat handicaps and race normalization factors. This technique had some weaknesses, the greatest of which was working in the realm of time-on-distance handicapping with its implied *error model*; a presumption that the time spread between boats is only dependent on course length and is independent of windspeed. We corrected this mistake starting 2012 and now live in the world of logarithmic time handicapping (i.e. time-on-time) where the expected spread between boats increases with elapsed time.

Our use of selective scoring which averages a boat's race scores over only those races in which it participated (i.e. not penalizing those without a perfect attendance record) didn't mesh well with a moving window handicapping analysis which chopped off all history; the table of results from boats verses races was only sparsely populated and a six race moving window was too small. Our remedy, starting in 2012, wasn't the obvious one to stretch the moving window further back in time; it was instead to split the regression into two stages.

The first stage would be to regress race normalization factors per race — with this factor each boat that participated in the race would receive an *imputed handicap*, a scaled version of their own elapsed time — *n.b. with this imputed handicap all boats would have tied on corrected time*. This is a very simple calculation.

For the second stage, each boat would compute a personal moving window average over its own history of imputed handicaps as ordered by time but skipping missed races. Again, very simple. This two stage *remedy* was not an innovation but, rather, the club catching up with accepted practice circa 2012.

Sailboat handicapping is not a hot-bed of innovation.

Using the two-stage regression gave us the opportunity to tweak the moving window average to make it more *robust* in the face of *outliers (results far from the norm)*. We stretched the window to extend over seven races where we exclude the fastest and slowest imputed handicap and average over the middle five (by geometric mean to be consistent with the log s/mi. error model). This has been the technique used from 2012 through 2024. Note that, despite being computerized and automated, a hand calculator would be sufficient to compute these rolling handicaps. Our 2010 and 2011 method of simultaneous regression required more computation than a hand calculator can provide which made it less approachable.

Our rolling handicaps have been considered *magic* by the sailors whether they own a hand calculator or not.

Starting this year we will be using an even simpler calculation. Stage one will be as before. For our rolling handicap we will not be using a moving window but shall walk the rolling handicap forward one race at a time. To compute the rolling handicap of the next race we shall take 4/5 of the log of current rolling handicap plus 1/5 of the log of imputed handicap of the current race to get the log of rolling handicap for the next race; if this step of the walk would exceed 10 s/mi. we cap it to exactly 10 s/mi. Note that a four-to-one weighted arithmetic mean of the logarithm of handicaps is identical to a four-to-one weighted geometric mean of handicaps — using the logarithmic form is traditional for time-on-time computations.

This technique is not truly new — just newly popular. And we are catching up with accepted 2025 practice. That the resulting rolling handicaps show less variation week-to-week while being less surprising in effect should make the handicapping method popular with sailors. I am hoping that, with this change, rolling handicapping should transition from *magical* to *mundane*.

2 An Aside on Pace and Corrected Time

this aside is not restricted to Monday-nights — you can skip to section 3 or section 4 if you are not interested

2.1 On Pace and Speed

Pace is a measure of how many seconds (abbreviated s) it takes to complete a nautical mile (abbreviated mi.) and varies inversely to speed measured in knots. So, for example, an average speed of 6 knots corresponds to a pace of 600 s/mi. and an average speed of 4 knots corresponds to a pace of 900 s/mi. Pace and speed multiplied together always results in 3600 s/hour

$$600\,\text{s}/\cancel{\text{mi.}} \times 6\,\cancel{\text{mi.}}/\text{hour} \quad = \quad 3600\,\text{s}/\text{hour} \quad = \quad 900\,\text{s}/\cancel{\text{mi.}} \times 4\,\cancel{\text{mi.}}/\text{hour}$$

Note that a slower pace is represented by a greater number of seconds per mile.

Pace is the natural measure of performance prediction and handicapping. A *general purpose handicap* (GPH) is a boat's pace on average and can be used for either time-on-distance or time-on-time handicapping. All existing systems of handicapping for club racing could easily be restated in terms of a general purpose handicap without changing their effective handicapping. For the benefit of competitors, we always express the rolling handicaps used on Mondays as a general purpose handicap.

2.2 The Universal Corrected Time Formulas

In order to calculate *corrected time* from *elapsed time* we need to single out a *scratch boat* ★ which acts as a reference for other finishers

For Time-on-Distance

$$\frac{\text{Corrected time}}{\text{Course length}} = \frac{\text{Elapsed time}}{\text{Course length}} + {}^{\star}\text{GPH} - \text{GPH}$$

For Time-on-Time

$$\frac{\text{Corrected time}}{\cancel{\text{Course length}}} = \frac{\text{Elapsed time}}{\cancel{\text{Course length}}} \times \frac{{}^{\star}\text{GPH}}{\text{GPH}}$$

Here *course length* and the scratch boat's general purpose handicap (★GPH) are common to all — each boat has its own elapsed time and general purpose handicap (GPH) yielding its own corrected time. Note that while these equations relate corrected time with elapsed time via a general purpose handicap they are better understood as formulas specifying *corrected pace* in terms of *observed pace*. Thinking in terms of pace always gives the most natural form for both the computation of handicaps and the application of handicaps to a race; however these are usually rewritten as time formulas when applied

For Time-on-Distance

$$\text{Corrected time} = \text{Elapsed time} + ({}^{\star}\text{GPH} - \text{GPH}) \times \text{Course length}$$

For Time-on-Time

$$\text{Corrected time} = \text{Elapsed time} \times \frac{{}^{\star}\text{GPH}}{\text{GPH}}$$

We can be assured that these formulas are universal and apply to all systems of handicapping — with the caveat that *performance curve scoring* (inapplicable to club racing) is neither time-on-distance nor time-on-time.

Corrected time is best interpreted as a handicapper's prediction, given its elapsed time, of how a boat should have finished were it the same as the scratch boat. This provides the basis for ordering boats on corrected time. Note that, for the scratch boat itself, its corrected time and elapsed time are always identical. Also note that the particular choice of boat chosen as scratch ★ doesn't effect how boats are ordered, making it possible to chose your own boat as scratch *post facto* and referencing other finishers to yourself. Our online results pages makes it easy to do this.

2.3 Differences Between Time-on-Distance and Time-on-Time

PHRF races occasionally use time-on-time handicapping, especially when each division covers a large spread in ratings. This handicapping is accomplished by an implicit transformation from a PHRF rating to a GPH handicap and, for the informed competitor, is just as easy to use as time-on-distance.

We still use, and will forever use, time-on-time handicapping on Monday-nights. The time-on-distance model predicts the time interval between boats should stay the exactly same in a light air race as it would in a medium or heavy air race; this is unrealistic and causes egregious errors in the running computation of handicaps.

While racing it is advantageous to know *time allowances* between yourself and your competitors — a time allowance being the gap in time between two boats that shall correct out the same. Note this is exactly same technique as is used to calculate a pursuit specific start time where slower boats start earlier than the faster boats.

With time-on-distance handicapping time allowances are proportional to course length which does not change throughout the race; whereas, with time-on-time, time allowances are proportional to elapsed time which does advance. Note that this explains the naming convention for time-on-distance versus time-on-time. Provided the course is not shortened, time-on-distance can be easier to use. Were you to complete a course where your average pace (i.e. your elapsed time divided by the nominal course length) works out to be the same as your GPH then time allowances with either system will be identical. If you finish faster that your GPH then time allowances will be proportionally lesser using time-on-time but if you finish slower that your GPH then time allowances will be proportionally greater.

With a GPH handicap it is very easy to precompute a table of time allowances usable for either time-on-distance or time-on-time handicapping. With such a table the difference in complexity between time-on-distance and time-on-time pretty much disappears. Even easier for a competitor is when your race committee makes such a table for you. We are, of course, pampered in this way — see the online scratch sheet pages (recomputed every week for Monday racers) and select your boat for your own table of time-allowances. There is linked documentation from these scratch sheet pages. On Mondays your standard handicap will be a GPH derived from your PHRF JOG rating by adding 750 s/mi. — with average winds time allowances will be exactly as time-on-distance PHRF would predict.

2.3.1 Pursuit Handicapping with Boat Specific Start Times

In a pursuit race, the organizers work out time allowances between boats using the same tables as remarked upon above to determine boat specific start times; with all the handicapping applied at the start boats will place in the order they finish without recourse to corrected times.

Most organizers of pursuit races choose to honour the time-on-distance model and work out time allowances between boats suitable for the *nominal* course length (the straight line distances of all the legs summed up); shortening course is impossible; and all the inaccuracies endemic to time-on-distance handicapping applies. But, as we have noted, it is possible to honour the time-on-time model and work out time allowances based on elapsed time. This allows organizers target the finish time and work out suitable start times; an RC should shorten course to meet that target as best as possible; and racing across both slow and fast races should still be competitive. This is the technique we shall use for the Monday Pursuit Series.

2.3.2 An Aside on an Aside: On Logarithms

Multiplications and divisions in the time-on-time corrected time formula correspond to addition and subtractions in the time-on-distance corrected time formula. When time-on-time calculations were still done by hand, log tables were used to transform one to the other. The same is true for computations used to determine handicaps. With computerization log transforms are no longer needed but it can elucidate why we use a geometric mean when calculating rolling handicaps.

3 The Confusion of PHRF Ratings and the Derived Standard Handicaps

this section is mostly of historical interest — you can safely skip forward to section 4

3.1 Transforming the Gauge

When doing time-on-time handicapping it is possible to transform all the standard and rolling-average handicaps by a common scaling factor without effecting corrected times in any way; in the corrected time formula handicaps only appear in the ratio $^{\star}\mathrm{GPH}/\mathrm{GPH}$ so a common scaling factor cancels out completely. Such a scaling operation is desirable so that handicaps really are a GPH and truly reflect a boat's pace on average; but, on the other hand, changing handicaps in bulk is disruptive for only a minor gain.

Gauge transformations are implicitly involved when converting between competing handicapping schemes.

3.2 A Short Recap of Standard Handicaps and the Different Gauges

We did things all wrong in the years 2010 and 2011.

In the years 2012 – 2017 we equated a ECPHRF JOG rating of $200\,\mathrm{s/mi.}$ to a *Std* handicap (nominally a GPH) of $700\,\mathrm{s/mi.}$ and then equated each additional of $5\,\mathrm{s/mi.}$ in ECPHRF rating to an additional $7\,\mathrm{s/mi.}$ in the *Std* handicap. The $\Delta 5\,\mathrm{s/mi.}$ECPHRF $\rightarrow$ $\Delta 7\,\mathrm{s/mi.}$*Std* magnification was based on an analysis of 2010 – 2011 data which suggested the ECPHRF ratings were too stingy for the higher-rated boats in the club. The equating of $200\,\mathrm{s/mi.}$ECPHRF to $700\,\mathrm{s/mi.}$*Std* was based on US Sailing's time-on-time recommendations and turned out to be ridiculously optimistic for a GPH on Lake St. Clair. Nevertheless we maintained this overly fast gauge for six years despite knowing of its shortcomings. Handicapped racing is (for the most part, provided you don't switch between time-on-time and time-on-distance) independent of gauge.

Starting in 2018, with eight years of data to draw from, we transformed our *Std* handicaps in the older gauge to the a newer gauge by multiplying our supposed GPH handicaps by $10/7$. The resulting gauge was used through to 2022. The assignment of *Std* handicaps wasn't modified except as to honour the new gauge with $200\,\mathrm{s/mi.}$ECPHRF equating to $1000\,\mathrm{s/mi.}$*Std* and $\Delta 5\,\mathrm{s/mi.}$ECPHRF $\rightarrow$ $\Delta 10\,\mathrm{s/mi.}$*Std*.

In 2023, a analysis of the previous ten years of data found that equating of $\Delta 1\,\mathrm{s/mi.}$ECPHRF with $\Delta 2\,\mathrm{s/mi.}$*Std* failed to be statistically significant. A previously obvious inference had apparently been illusory or, more likely, a reflection of the boats upon which it was based — for a wider population the effect disappeared. After matching $\Delta 1\,\mathrm{s/mi.}$ECPHRF to $\Delta 1\,\mathrm{s/mi.}$*Std*, we took the opportunity to refine the gauge just a little bit more by equating $200\,\mathrm{s/mi.}$ECPHRF with $950\,\mathrm{s/mi.}$*Std* (see subsection 4.1).

3.3 Transformations Across Year Boundaries

In 2010 and 2011 we used time-on-distance handicaps that increased with faster boats. This was a mistake which we avoided in later years. We did not use per-race imputed handicaps which could be carried forward to the next season so transforming handicaps across the 2010 $\mapsto$ 2011 $\mapsto$ 2012 wasn't a priority. We ignore it from now on.

From 2012 on we have used time-on-time handicaps that were, at least nominally, GPH's for which it makes sense to compare them across seasons. For the 2017 $\mapsto$ 2018 transition a gauge transformation of $\times 10/7$ needed to be well documented as, until 2023, we did carry imputed handicaps forward from the previous year.

$$\overbrace{200\,\mathrm{s/mi.}}^{\text{ECPHRF JOG Rating}} \quad \text{equated with} \quad \overbrace{700\,\mathrm{s/mi.}}^{2012\text{–}2017} \overset{\times 10/7}{\mapsto} \overbrace{1000\,\mathrm{s/mi.}}^{2018\text{–}2022} \overset{\times 19/20}{\mapsto} \overbrace{950\,\mathrm{s/mi.}}^{2023\text{–}2025}$$

Note that we have always pinned the gauge in terms of a boat with a JOG rating of $200\,\mathrm{s/mi.}$

4 On Ratings and Rolling Handicaps for the 2025 Monday-Night Series

this is the meat of the synopsis — do read this section

4.1 The *Standard Handicap* (the Initially Assigned Handicap) as a GPH

Assigned *standard handicaps* are derived from an PHRF JOG rating via a formula

$$\text{Standard handicap} = 750\,{}^{\text{s}}\!/\!_{\text{mi.}} + \text{PHRF JOG Rating}$$

This standard handicap is a GPH and can be used to estimate the performance of your own boat. For example, a 150 s/mi. rated boat (for a GPH of 900 s/mi.) should expect to average 4 kt. around the race course of on a typical Lake St. Clair day. A 3.8 kt. course average speed corresponds to a 197 s/mi. PHRF rating. Yeah GPH!

4.2 Determining *Imputed Handicaps* for Each Race

For each race we will compute a time-on-time handicap, named the *imputed handicap*, that would give every finisher the same corrected time (this imputed handicap being simply a scaled version of the boat's elapsed time). The geometric mean of the imputed handicaps of these finishers will equal the geometric mean of the standard handicaps for these same boats — this fact determines the scaling factor from elapsed times to imputed handicaps with each race determining its own scaling factor. Note that the imputed handicap recorded is then rounded to the closest whole s/mi.

Being *normalized* to form a GPH, an imputed handicap is itself a prediction of performance although not yet a prediction of good enough quality to be used for ongoing handicapping. Several per-race imputed handicaps are combined to compute the *rolling handicap* of each boat.

4.3 The *Rolling Handicap*: Rapid Convergence and the Continuing Formulation

After each Monday race, a boat's handicap for use on subsequent races will be computed from the intermediate imputed handicaps of its own preceding finishes. The technique used will depend on whether the boat has already completed five races, enough races to use the ongoing formulation, or whether the boat is still in the *rapid convergence* phase designed to rapidly diminish the influence of the initially assigned handicap with a optimistic (if temporarily volatile) performance handicap. Using abbreviations, handicaps are computed as such:

Std is *Standard*, *Bf* is rolling *Before* race, *Imp* is *Imputed* for the race, *Af* is rolling *After* race

Within the Year			
5	before competing	*Bf* is assigned to be *Std* based on PHRF JOG rating	
Rapid Convergence		**Weighting for Geometric Mean of *Bf* and *Imp* → *Af***	**Step Clamped to**
4	after first finish	1:1 geometric mean of assigned *Std* and *Imp* → *Af*	18 s/mi.
3	after second finish	2:1 weighted geometric mean of *Bf* and *Imp* → *Af*	16 s/mi.
2	after third finish	3:1 weighted geometric mean of *Bf* and *Imp* → *Af*	14 s/mi.
1	after fourth finish	4:1 weighted geometric mean of *Bf* and *Imp* → *Af*	12 s/mi.
Thereafter			
0	⋮	4:1 weighted geometric mean of *Bf* and *Imp* → *Af*	10 s/mi.

these abbreviations for handicaps are the same as shown on the results and scratch sheet pages

The rolling handicap for after the race *Af* is a weighted geometric mean (rounded to the closest whole s/mi.) of the the rolling handicap going into the race *Bf* and the imputed handicap of the race *Imp*; however, the step from *Bf* to *Af* is not allowed to exceed the *clamped* limit. There are no formal *handicapping certificates*; rather, a boat's standard handicap *Std*, how far along it is in achieving five finishes, and its ongoing rolling handicap *Bf* (to be used for the subsequent race) serves the same purpose. See the scratch sheet for this information.

4.4 Reported Corrected Times

Using the abbreviated handicaps of the results page (as shown above), corrected times will be calculated from elapsed time and the rolling handicap *Bf* by the formula

$$\text{Corrected time} = \text{Elapsed time} \times \frac{{}^{\bigstar}Bf}{Bf}$$

and reported rounded to the closest second. Here ${}^{\bigstar}Bf$ is the handicap of a scratch boat used as a common reference for all boats. Note that the elapsed and corrected time are the same for the scratch boat. The choice of ${}^{\bigstar}Bf$ is arbitrary as it has no effect on how a boat will place — using the fastest boat is traditional — the SPSC racing page first loads with the winning boat as scratch but any competitor can be designated the scratch boat by clicking on the table row. The results page will report differences in corrected time for each boat from the scratch boat.

Boats are placed by ordering exact fractions so actual ties on corrected time are far rarer than the (still rare but occasional) apparent ties in the reported but rounded corrected time.

4.5 On a Comfortable Walk — Following the Rolling Handicap from Race to Race

The influence of a single race result wanes gradually over the season. We quantify how much the rolling handicap varies race-to-race according to how many races, on average, the results from a single race influences the handicapping of subsequent races. For 2025 that will be a leisurely five races for a nice gently-undulating walk.

4.6 Computing the Rolling Handicap After Five Finishes: An Elucidation

Each boat walks its own rolling handicap forward using its imputed handicap for the race via a 4:1 weighted rolling geometric mean clamping the step size to at most 10 s/mi.

Equivalent Formulations of $Bf \to Af$ before Rounding and Clamping

Weighted Arithmetic Mean of Log Pace	**Weighted Geometric Mean of Pace**
$\frac{4}{5}\log Bf + \frac{1}{5}\log Imp = \log Af$	$\sqrt[5]{Bf^4 \times Imp} = Af$

The logarithmic form is traditional. Also note that the handicaps are expressed in units of pace despite the application of time-on-time handicaps being independent of course length; units of distance in these calculations always cancel out.

4.7 The Preservation of Handicapping *Gauge* in Handicapping Computations

In the derivation of the imputed handicaps for a race we intentionally limit the data used to be the boats' standard handicaps and their elapsed times. Course length is also available but unneeded with a time-on-time model. The simple regression which determines the race *normalization factor* (which accounts for how the day's racing differ from a typical day's race) ensures that imputed handicaps have the same *gauge* as the standard handicaps; then the pace that is the imputed handicap becomes a simplistic prediction for performance on a typical day's racing. Likewise, the derivation of rolling handicaps from imputed handicaps preserves the gauge implicit in the imputed and the standard handicaps. This gauge in turn is specified by the derivation of the standard handicaps from PHRF JOG ratings (for the addition of 750 s/mi. see subsection 4.1 and then see section 3).

To determine whether this gauge actually leads to reasonable predictions of course-average speeds for a typical Monday race on a typical course requires off-season analysis of a large number of races to average over the many different wind conditions to be expected over a season. Different gauges make no difference in how handicapping is applied to a given race; across a season only gauge consistency is required to derive rolling handicaps from imputed handicaps and accommodate participants who come and go on their own schedule. Our methods manage that.