

SCORING METHODS FOR HANDICAPPING RACING

Jim Teeters
Offshore Racing Association

Time on Distance

Performance Curve Scoring

Time on Time

Performance Line Scoring

Pursuit Racing

Effect of Current

“It seems very pretty (said Alice) but it’s rather hard to understand! Somehow it seems to fill my head with ideas – only I don’t exactly know what they are!”

Lewis Carrol, Through the Looking Glass

Length

- William Froude: $F_n = Vel \div \sqrt{(Gravity \times Length)}$
- Two models that are identical in shape/form, but different in size/scale will create identical wave patterns if operating at the same F_n . (extend to wave drag coefficient.)
- Speed Length Ratio:
- $SLR = V_k \div \sqrt{Length}$
- “Hull speed” when $SLR = 1.34$
- All other things being equal, length determines potential speed.

Length Time Allowance

- Assume boats sail at some fraction f of SLR:
- $V = f \times 1.34 \times \sqrt{L}$
- Elapsed time: $ET = \frac{Dist}{V}$
- ET diff. two boats: $ET_2 - ET_1 = D \left(\frac{1}{v_2} - \frac{1}{v_1} \right)$
- $\delta ET_{spm} = \frac{3600}{f \times 1.34} \times \left(\frac{1}{\sqrt{L_2}} - \frac{1}{\sqrt{L_1}} \right)$
- Handbook on American Yacht Racing Rules (Parsons et al 1934)
- $SPM\ owed = 2160 \times \left(\frac{1}{\sqrt{R_2}} - \frac{1}{\sqrt{R_1}} \right)$
- L has been replaced with a rated length R

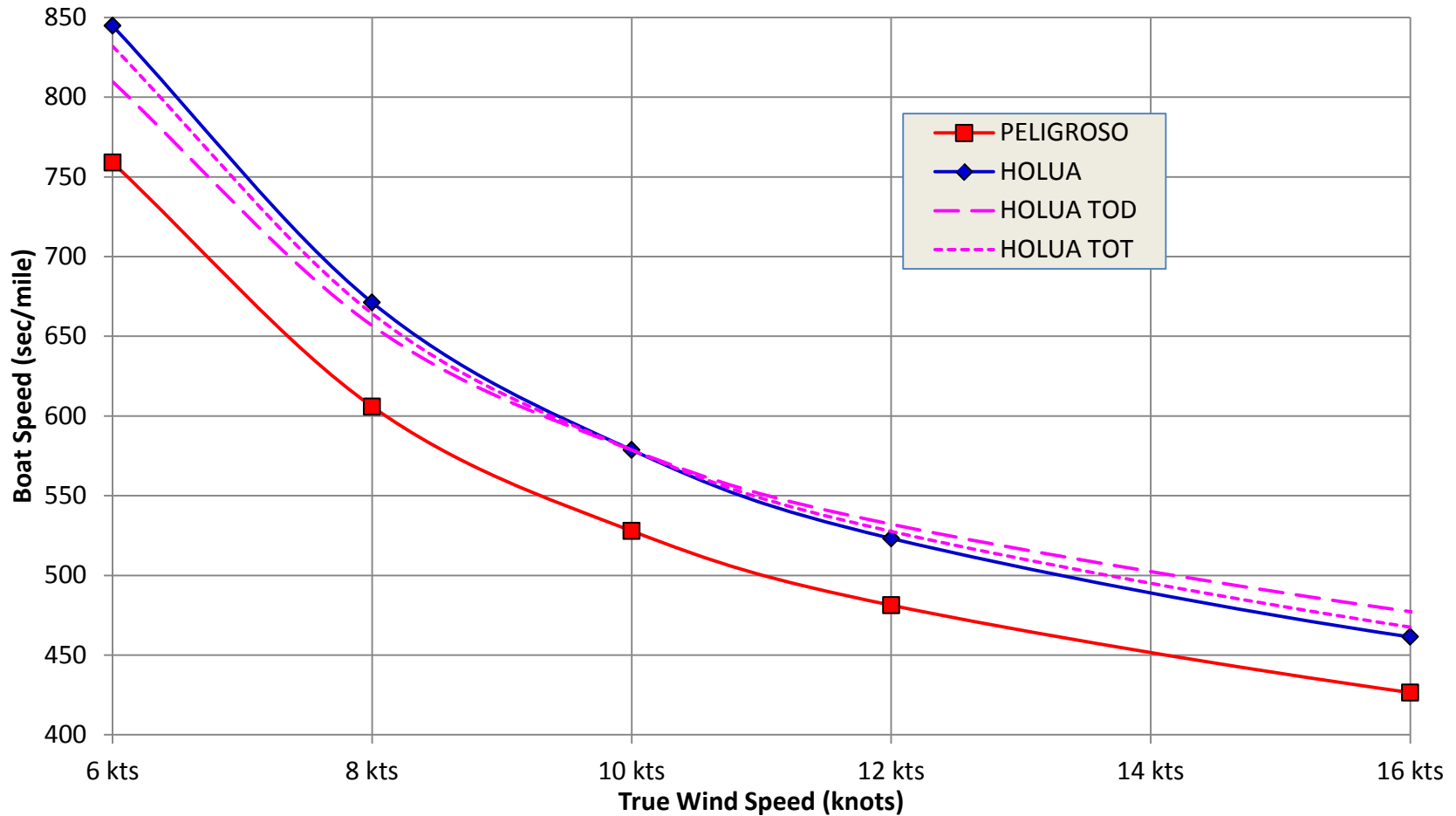
Time on Distance

- IOR “length” scoring was actual time on distance (TOD). The rating was an effective length.
- The time allowance was expressed as sec/mile (SPM).
- To compute corrected time from elapsed time, you first select a scratch boat.
- $CT = ET - (SPM_{yourboat} - SPM_{scratch}) \times Distance$
- TOD requires knowledge of:
 - Elapsed time of your boat
 - Rated SPM of your boat
 - Rated SPM of the scratch boat (real or theoretical)
 - Distance of the race course

Time on Time

- TOD scoring assumes that boat A always owes boat B a set time allowance per mile, say 10 sec/mile, **for all races**.
- An alternative concept is to assume that boat A is a certain percentage of speed faster than boat B. If say 3%, it always owes boat B 3%. Ratings are then ratios of boat speeds.
- A scratch boat, with some rated speed V_s is chosen. Any other boat, with speed V_b , has a rating of V_b/V_s . If boat B above is the scratch boat, then A has a rating of 1.03, often termed a Time Correction Factor (TCF). (TCF_{scratch} is 1.00.)
- Time on Time (TOT) scoring is then: $CT = ET * TCF$
- TOT requires knowledge of:
 - Elapsed time of your boat, Your boat's TOT rating

The Guts of TOD and TOT



TOD vs TOT: Which is Better?

- Two assumptions:
 1. TOD: constant difference in sec/mile
 2. TOT: fixed ratio of boat speeds
 3. Wind/course content for which those ratings should work
- If wind speed during a race is the same as those assumed in the ratings, both systems are virtually identical.
- If wind is lighter, TOT generally works better. TOD does not give enough time to slower boats. The same is generally true if the wind is heavier. The assumption of constant ratio of boat speeds is more accurate than constant differences.
- If a parking lot, TOD is better. TOT: allowances keep growing.

SMART Scratchsheet



Offshore Racing Association SMART Scratchsheet TM

WARNING

Trophy Division - Section 4

TABLE OF TIME ALLOWANCES

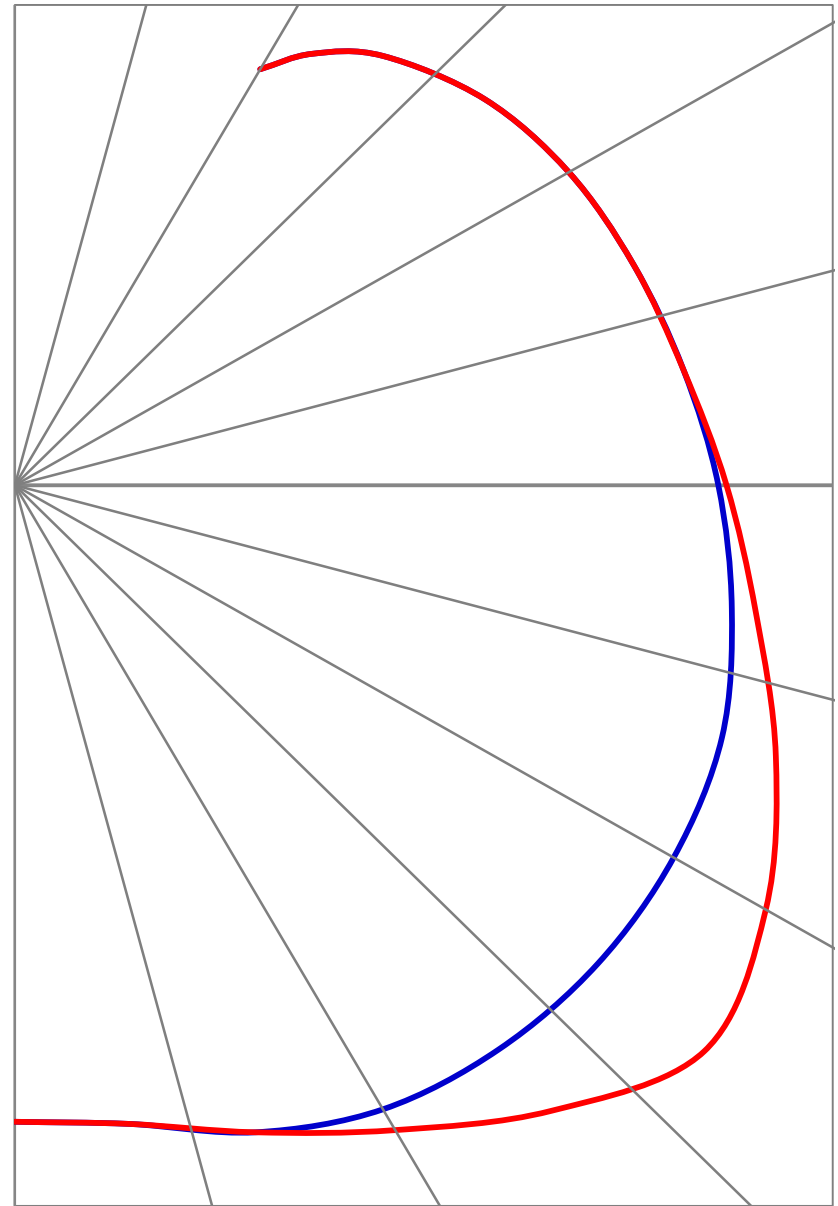
Your Boat:		1	Sufficient Reason					
Rating Selection:		1	Offshore All Purpose			Positive: Total Hours Owe		
TOT:		0.963	(for Sufficient Reason)			Negative: Total Hours You		
Key In Your Elapsed Time (h/m/s):		1 Hrs	0 Min	0 Sec	Elapsed Time for You			
Corrected Time:		0.963	(for Sufficient Reason)			1.000 Hrs	10 Hrs	20 Hrs
ID	Sail No.	Yacht Name	Design	TOT	ET Allow.	ET Allow.	ET Allow.	
1	USA 52901	Sufficient Reason	J122	0.963	0h 00m 00s	0h 00m 00s	0h 00m 00s	
2	USA 84	Gotta Wanta	J122	0.962	-0h 00m 04s	-0h 00m 37s	-0h 01m 15s	
3	USA 50659	Mazal Tov	J120	0.962	-0h 00m 04s	-0h 00m 37s	-0h 01m 15s	
4	USA 53581	Ewai	J122	0.961	-0h 00m 07s	-0h 01m 15s	-0h 02m 30s	
5	USA 25900	Perversion	J120	0.959	-0h 00m 15s	-0h 02m 30s	-0h 05m 00s	
6	USA 38005	Painkiller 4	Sydney 38	0.953	-0h 00m 38s	-0h 06m 18s	-0h 12m 36s	

Single vs. Multiple Ratings

- Single: ratings apply to all races no matter what the wind speed or course layout.
 - Simple, although less accurate
 - More winners (every dog...) Good for long season?
- Multiple: pick rating from a menu selection: windward leeward, (even/odd legs), random, offwind, customized to specific events.
 - “Should” be fairer racing
 - Burden of selection process

Diverse Polars

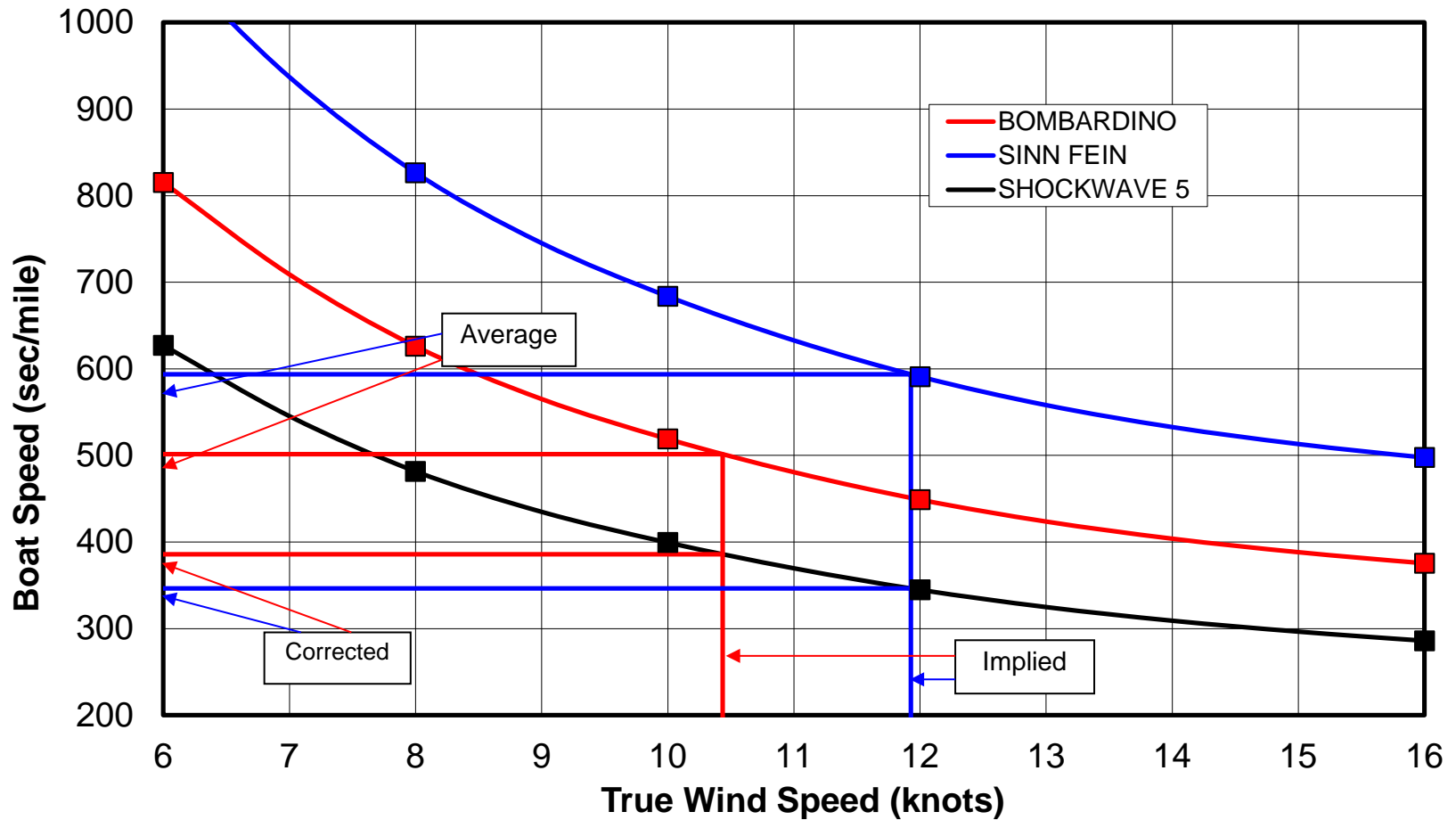
- Boats with **blue** and **red** curves have identical upwind and downwind VMGs.
- With identical ratings they would have fair W/L racing.
- **Red** curve is superior broad reaching, typical of sport boats
- What happens if the race has broad reaching?



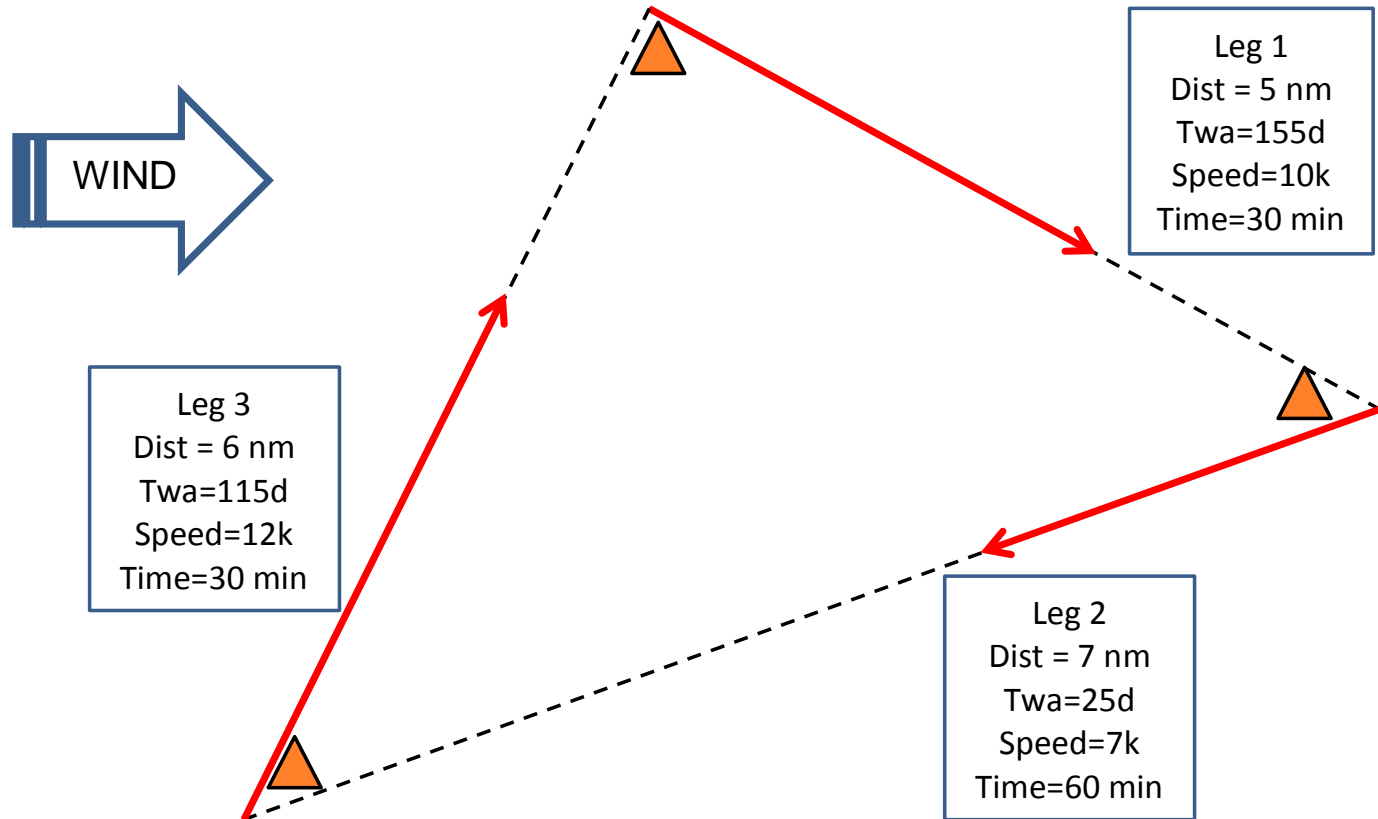
More Issues

- Pre, During or Post Race choice
 - NOR or SI's
 - Fly flag at 5 minute gun
 - Post race rating choice (Really, REALLY, bad idea)
 - Competitors don't know handicaps, accusations hurled at RC
- Pre, During or Post Race calculation
 - Permits customization, potentially closer racing,
 - Know your constituents, choose what meets their needs, communicate.
- Tidal effects: slows down a buoy racing. TOT will do a better job for scoring.

Performance Curve Scoring



Constructed Courses



Customized Handicap

Point of Sail (%)	6 Knots	8 Knots	10 Knots	12 Knots	14 Knots	16 Knots	20 Knots	24 Knots
Beat	3	0.5	0.5	0.5	0.5	0.5	0.5	
52	2	0.5	0.5	0.5	0.5	0.5	0.5	
60		2	2	2	2	2	2	
75		4	4	4	4	4	4	
90		8	8	8	8	8	8	
110		12	12	12	12	12	12	
135		26	20	18	14	10	10	
150	45	15	21	23	25	29	29	20
165	25	16	16	16	17	17	17	40
Optimum Run								
Wind Weighting	25	16	16	16	17	17	17	40
Wind Weighting	1	4	10	13	24	31	14	3

Common Scoring Solutions

- Transpac – custom, single number TOT (was TOD)
- Pacific Cup, Cabo, Puerto Vallarta – custom,
- Acapulco – custom, multiple for course layouts, TOT
- Chicago Mac – custom, TOT, two choices, decision
- Bayview Mac – single number TOT
- Marblehead Halifax -- single number TOT
- Newport Bermuda – performance curve scoring

Dealing with Complexity

- TOD perhaps the easiest to calculate in ones' head.
- TOT probably requires calculator: customized tables
 - Chicago Mac uses custom Smart Scratchsheet with tables
- Performance Curve Scoring
 - Newport Bermuda has Smart Scratchsheet with full code for computing ratings: available to all
- Focus: make it easy for the sailor to know how he is doing versus the competition throughout the race

Pursuit Races

- Time allowances built into the start sequence.
- First to finish wins. Finish order is score/rank.
- Easy to understand for all, including first time racers.
- Pass the boats in front.
- Stay ahead of the boats behind.
- No calculations.
- Time differences at finish very easy to record.
- FUN!
- Close finishes require knowing the wind speed, direction and course layout.

Rating Perfection: So What?

- If:
 - Ratings are perfect.
 - All boats are sailed exactly to their ratings.
 - Wind and Course conditions exactly match those assumed by rating.
 - Then you get great results.
- But:
 - Wind and Course never match the conditions assumed in the rating.
 - Sailors make mistakes.
 - “Mother Nature” is unfair: lifts/headers/puffs/lulls.
- Having “fair” ratings is only half the problem of close racing

General Recommendations

- Know your clients:
 - Why did they come, what are their expectations, do they understand sailboat racing, can they deal with complexity?
- Determine your priorities:
 - Should the best sailed/prepared boat win every race? – more accuracy
 - Should you have more winners? (Every dog...) – more luck
- Questions:
 - Build participation, or identify the best sailor, or blend of both?
 - How predictable is the wind/course content?
 - If predictable, model it, go for accuracy, if not KISS
- Design/choose what works best for the sailors.
- Good class breaks

“More sailboat races are lost by not reading the NOR than anything else.”

The “Wizard” 2015