The Chipstead High Point Scoring method in practice

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Abstract

This paper examines the Chips scoring method, noting its origin and evolution. It discusses the elements of the formula and points out that for a given fleet size the scores can be expressed in a greatly simplified form which could aid computation (and comprehensibility). Small anomalies or 'features' of the method are noted, together with some minor problems in incorporating it into Sailwave, the popular and powerful sailing scoring software. Two examples of scoring using Chips and a more commonly encountered method are compared.

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1 Introduction

The CHIPS High Point Scoring method (Burrell, 2006) is applicable for "club racing" as permitted by Rule 89.3(a) of the RYA Racing Rules of Sailing (RYA, 2004). It is used at a number of sailing clubs, notably Chipstead Sailing Club. At Banbury Sailing Club I have scored the Personal Pursuit Series by this method for the past 2 years.

CHIPS aims to produce scores based on each helm's performance while taking into account the degree of competitiveness in each race. It is a 'high point' system: the winning helm receives a higher score than his competitors. A key component of the system is that the winning helm's score will be higher the more competitors there are in a given race. As implemented at Chipstead Sailing Club those who do not start, compete or are disqualified (DNS, DNC or DSQ in RYA jargon) score zero. Those who do not finish (DNF, and presumably RAF, '*retired after finishing*', which is not specifically mentioned) are scored as 'last plus one'. We interpet the number of *starters* to mean the number who cross the start line; i. e. by definition, a DNS or DNC boat is not a starter, while DSQ is.

I started this examination of the scoring method after I had implemented it in an Excel spreadsheet. Later I realised that it could be implemented into Sailwave, which we had been using for Club results in general. Sailwave (Jenkins, 2006) is the *de facto* standard for sailing scoring software, used widely by sailing clubs and other bodies. It is well maintained by its author, Colin Jenkins, who responds quickly and positively to support issues, both in the immediate fault fixing sense, but also in planning future enhancements. However, it does not yet support CHIPS 'out of the box' as one of its standard scoring methods.

2 Scoring Method

The points scored, $\mathcal{S}_{p,n}$, for *finishing* in position p in a race for which there are n starters is determined using the following formula:

$$\mathcal{S}_{p,n} = (100 - d) \times \left(\underbrace{\frac{n-p}{n-1}}_{t_4} \times \underbrace{(1 - e^{-c(n-1)})}_{t_3} + \underbrace{e^{-cn}}_{t_2} \times \underbrace{(e^{c} - e^{-b})}_{t_1} \right) + d \quad (1)$$

The components of Equation 1 are given as $t_1 \ldots t_4$, to ease discussion later. While the constants in the formula are said to be capable of adjustment '*to meet specific needs*', they have been set to the values in Table 1. Note that earlier formulations of the scoring method (as discussed briefly in Section 3) used different values of these parameters.

Table 1: CHIPS parameter values

parameter	value
b	1.713
c	0.163
d	10.0

2.1 Adjacent ranking

The difference in score for adjacent rankings, $\mathcal{S}_{p,n} - \mathcal{S}_{p+1,n}$, for a fleet size n is dependent only on n and c. Let the difference be written δ:

$$\begin{aligned}\delta \;=\; & (100-d) \times \left(\frac{n-p}{n-1} \times \left(1 - e^{-c(n-1)}\right) + \; e^{-cn} \times \left(e^{c} - e^{-b}\right)\right) + d \\ & - (100-d) \times \left(\frac{n-p-1}{n-1} \times \left(1 - e^{-c(n-1)}\right) + \; e^{-cn} \times \left(e^{c} - e^{-b}\right)\right) - d\end{aligned}$$

Writing δ' for $\frac{\delta}{100-d}$, the expression becomes

$$\begin{aligned}\delta' &= \left(1 - e^{-c(n-1)}\right)\left(\frac{n-p}{n-1} - \frac{n-p-1}{n-1}\right) \\ \delta' &= \frac{1 - e^{-c(n-1)}}{n-1} \\ \text{or } \delta &= \frac{90\left(1 - e^{-c(n-1)}\right)}{n-1} \qquad (2)\end{aligned}$$

For verification, from the tables (Burrell, 2006), when $n = 3$, $\delta = 12.5$. Thus, allowing for some intrinsic rounding both of the δ and the value of c,

$$12.5 \approx \frac{90\left(1 - e^{-0.326}\right)}{2}$$

or

$$e^{-0.326} \approx 0.722$$

which evaluates nicely within expected bounds and provides some reassurance that we have not misinterpreted much so far.

2.2 The parameters

The term t_1 can be simplified from $e^c - e^{-b}$ since it is a constant and not influenced by n or p. With the suggested constants it evaluates to 0.9967. Its influence on the term t_2 is very small at 0.33%. Altering the b term to 1.731 would result in t_1 evaluating to exactly unity, with little appreciable

Table 2: Scores for $p = 1, 2, 3$ and DNF, when $n = 3$ for given and adjusted parameter values

c	b	$\mathcal{S}_{1,3}$	$\mathcal{S}_{2,3}$	$\mathcal{S}_{3,3}$	$\mathcal{S}_{\mathrm{DNF},3}$	
0.163	1.713	90	77.5	65	52.5	published parameter values
0.163	1.731	90.2	77.7	65.2	52.7	modified to make $t_1 = 1$
0.155	1.731	90	78	66	54	adjusting c when $t_1 = 1$

difference to the eventual scores, which are in any case rounded to the nearest 0.1. Initially it seems reasonable that the author may have intended the t_1 to be unity and merely made a transposition error with b.

Attractive as this might be in simplifying the expression and its evaluation, it would lead to slightly different values at small values of n, although when n is large its influence is insignificant. When $n = 3$, the present parameters conveniently give scores of 65, 77.5 and 90, which are intuitively pleasing, providing an apparently non-arbitrary progression.[1] Clearly, as published, b is 'correct'.

If we modify the parameters as shown in Table 2, the progression is still even (as we have shown earlier in Equation 2), but the actual values 'feel' less round. For acceptance of a system like Chips the scores have to seem rational and reasonable. This table examines both the the changes in $\mathcal{S}_{p,3}$ if b is altered to change the t_1 term to be unity, and also experiments with t_1 at unity, but c changing so that first place ($\mathcal{S}_{1,3}$) is 90, which may be felt to be more intuitively pleasing. Working with the minimum fleet size exaggerates the steps.

Changing the parameter t_1 so that it is unity makes only marginal changes to the scores as n increases. The increments are in any case sensitive to rounding so that the step is generally the same, but occasionally 0.1 greater. It is unlikely that this offends, and even less likely that it leads to different overall totals when scores over a series are evaluated.[2] Examining the published tables for $n = 25$, the observed value of δ oscillates from 3.6 or 3.7, which is what we would anticipate from a 'true' δ of 3.75.

Following from Equation 2, for a given n, the terms t_1, t_2 and t_3 are fixed. This offers the potential of simplified calculation (*cf.* Section 4), although the direct approach in both Excel and Sailwave would not take advantage of the invariance. For example, for a fleet size of 3, the Chips formula reduces

[1] In reality (also known as "to 4 decimal places") the scores are 65.0101, 77.5289 and 90.0476, which is less attractive to the human eye, though of no real significance numerically. Rounding was clearly a good move.

[2] If the individual scores are rounded to the 0.1 then I would treat cumulative scores over m races which were $\pm 0.05m$ as equal. In other words give the helms the benefit of a rounding 'envelope', but I have a contrarian view that ties are not intrinsically evil and that acknowledging them is better than the current arbitrary methods for breaking them.

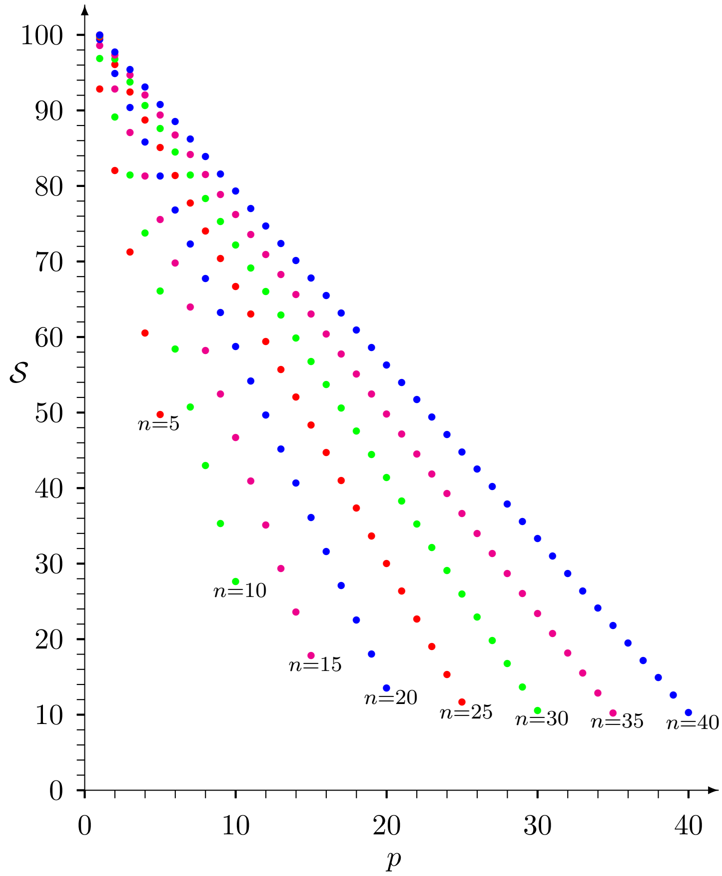

Figure 1: Scores for place p in selected fleet sizes

to

$$S_{p,3} = 102.57 - 12.51p \tag{3}$$

while for a fleet of 100

$$S_{p,100} = 100.91 - 0.91p \tag{4}$$

We have a very simple linear equation with an origin and offset (or step) to allow us to find any score $\mathcal{S}_{p,n}$ for a given fleet size. Figure 1 shows the scores for the values of p in various fleet sizes. The origin term can be regarded as the score $\mathcal{S}_{0,n}$ for the 'zero-th' position.

With $n = 3$, the t_2 term is 0.613, becoming vanishingly small with large n. The t_3 term is 0.278 when $n = 3$, rising asymptotically to 1 with larger values.

The remaining term, t_4 varies between 0 and 1 by definition. Defining

$$\text{range}_{p=3,n}\, t = x_3 \rightarrow x_n$$

to mean the range of possible values of a parameter t in a fleet of n boats, given that the smallest value of n may be 3 (by the normal implementation of Chips), the ranges of these parameters are summarised in Table 3.

Table 3: Parameter space

	$\text{range}_{p=3,\infty}$	
t_1	0.9967	a constant
t_2	$0.613 \rightarrow 0$	
t_3	$0.278 \rightarrow 1$	
t_4	$0 \rightarrow 1$	

Note that the contribution of $t_1 \times t_2$ cannot be greater than about 0.611, and that it is additive, with its greatest weight when n is small, and therefore when the effect of the t_3 term is least.

For example, when $n = 3$, the score for $p = 1$ becomes

$$\mathcal{S}_{1,3} = 90 \times \underbrace{(1 \times 0.278 + (0.613 \times 0.9967))}_{0.891} + 10 \approx 90$$

while for $p = 3$,

$$\mathcal{S}_{3,3} = 90 \times \underbrace{(0 \times 0.278 + (0.613 \times 0.9967))}_{0.611} + 10 \approx 65$$

If we now look at large values for n, say $n = 100$ with $p = 1$

$$\mathcal{S}_{1,100} = 90 \times \underbrace{(1 \times 1 + (0 \times 0.9967))}_{1} + 10 \approx 100$$

While for $p = n$

$$\mathcal{S}_{100,100} = 90 \times \underbrace{(0 \times 1 + (0 \times 0.9967))}_{0} + 10 \approx 10$$

The whole of the term $t_4 \times t_3 + t_2 \times t_1$ is designed to scale between 0 and 1, so that the eventual score must itself scale between 10 and 100; therefore a finishing boat in a large fleet cannot score more than 100 (for first place), or 10 (for last place). In practice 'not finishing' boats are scored as $\mathcal{S}_{n+1,n}$ which will mean that values lower than 10 could be met when $n > 17$.

2.3 Anomalies

In fact, the score $\mathcal{S}_{n+1,n}$ is anomalous with regard to all other scores. It is not a monotonically decreasing value. Counter-intuitively, its lowest value, 7.6 is found when the fleet size is 31. As the fleet size increases from 31 it slowly rises, of course never exceeding the score for $p = n$. In practice this should not be an issue, but it might be awkward to tell a non-finisher in a

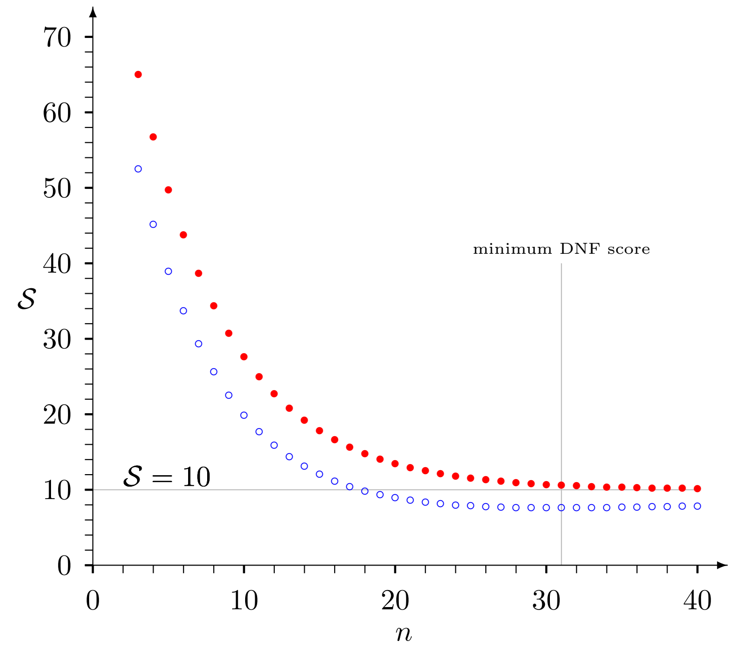

Figure 2: Scores for 'last' finisher • and DNF ∘ for fleet size n

fleet of 30 that he scored less than a non-finisher in a fleet of 50. The amount is not great at 0.6, but sailing sometimes brings out the competitiveness in even the normally placid. Figure 2 shows the curve of the scores for last place and for a DNF as the fleet size increases.

This behaviour is echoed with the values of 'origin' rising from 102.57 at $\mathcal{S}_{0,3}$ to a maximum of 104.54 at $\mathcal{S}_{0,11}$ before declining slowly towards $\mathcal{S}_{0,\infty}$. Figure 3 shows the change in values with fleet size.

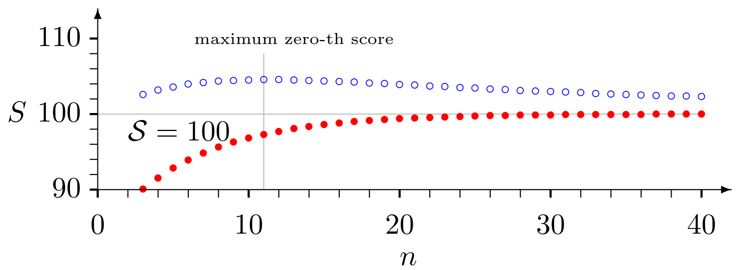

Figure 3: Value of step 'origin' ∘ and first place • for fleet size n

Table 4: "Old" Chips (and Rinderle B) parameter values

parameter	value
b	0.81
c	0.23
d	10.5
f	1.478
k	1

3 Chips' history

An earlier Chips (Burrell, 2004?) scoring formula was:

$$\mathcal{S}_{p,n} = (100 - d) \times \left(\left[\frac{n-p}{n-1} \right]^k \times \left(1 - (1+f)e^{-b-cn}\right) + fe^{-b-cn} \right) + d \quad (5)$$

While this appears slightly more formidable, chiefly by the introduction of two more parameters, k and f, the basic exponential structure is still evident. The exponent k on the $\frac{n-p}{n-1}$ term was 1 and the other parameters take different values from the present formulation as shown in Table 4.

The form of the Chips' equations owe much to another scoring system, developed by Jim Rinderle (Downing, 2005): Rinderle B. Using the same notation as Chips this is:

$$\mathcal{S}_{p,n} = (100 - d) \left(\frac{n-p}{n-1} \times \left(1 - e^{-b-cn}\right) \right) + d$$

with the same[3] parameter values as Table 4. This is remarkably like a simplified version of Equation 1.

4 Computational efficiency

Computational efficiency is not the issue it once was. When I started computing over 25 years ago, there were real advantages to writing 'tight' (compact and efficient) code, but the ever-increasing speed of processors has removed this necessity. However, it still offends me to see redundant code. Spreadsheet applications like Excel do encourage the repetition of invariant operations. For example, rather than setting t_1 to its constant value and referencing this value, the expression could be evaluated directly in calculating each score in a fleet.

[3]Perhaps not exactly true. Downing (2005) gave $b = 0.8$ rather than $b = 0.81$. I suspect this is simply a difference in reporting.

As we have discussed earlier, the basic Chips formula breaks down into four components, and for a given fleet size three of these components are constants. For a given fleet size it is sufficient to calculate the origin and offset as we did in Equations 3 and 4 and then any score is given by a multiplication and a subtraction. If we calculate each score simplistically in turn from the formula, we would require 8 additions or subtractions, 5 multiplications, 1 division and 4 (horrendously expensive!) calls to the exp function. Setting up the initial origin and offset has an overhead for each value of n, and is almost the same cost as calculating one value of $\mathcal{S}$ naïvely.

While this practice could benefit Excel (or any other spreadsheet) code, it is inapplicable to Sailwave (Jenkins, 2006). At present Sailwave can only use the Chips formula as a Custom high point defined by a formula in the Scoring system option by entering the following expression in a single line:

```
10+90*(((s-p)/(s-1))*(1-2.7183^(-0.163*(s-1)))
    +(2.7183^(-0.163*s))*0.996712681)
```

The term `s` is a native Sailwave variable for n, while `p` corresponds to p. In a sense this is the point at which I came into examining Chips closely, when it was not possible to enter the 'raw' formula because there is a Sailwave restriction on the number of characters which may be entered into the expression. Instead of the final constant, `0.996...`, I wanted to enter `2.7183^(-1.713)`, but ran out of characters.

5 Comparing Chips and ISAF Appendix A

The scoring system most often encountered is the Low Point System found in the RYA handbook as the ISAF (International Sailing Federation) Appendix A. It is a scoring system where a first place is awarded 1 point, a second place 2 points and so on. Apart from the obvious differences between a high point and a low point scoring system, it may be less obvious that Chips, probably in common with other high point schemes, handles DNC in a way which is significantly different. With Appendix A, a DNC is usually scored as 'number of boats in a series+k', where $k \geq 1$, while Chips scores DNC as zero, i. e. you get no benefit whatsoever from not racing.

The results for Banbury Sailing Club's 2005 and 2006 Personal Pursuit Series are shown as Tables 5 and 6. The 2005 series was originally scored with Equation 5, but has been rescored to the latest version. Note that only the qualifiers are shown to make the results a little more mangeable. There are a variable number of competitors from race to race, (between 16 and 26 in 2005, ,and between 8 and 19 in 2006) making Chips scoring rather attractive. The 'standard' Low Point System is shown first for comparison. At Banbury, the discard rule for the Pursuit series is that 2 results may

Table 5: Personal Pursuit Series 2005. In the Low Point scoring DNF is scored as ‘number of starters in race+1’, while DNC is ‘number of starters in series+1’. In Chipstead scoring, DNC is scored zero. n is the number of starters in a given race; in the ‘nett’ column, n is the total number of starters in the series. The ‘change’ column may be read as ‘CHIPS rank = Low Point rank+change’.

	rank	competitor	scores					nett	change
Low Point	1	Solo 3784	9	4	DNF	1	14	14	
	2	GP 13860	DNF	1	6	DNC	7	14	
	3	M Rocket 3085	2	6	12	7	DNC	15	
	4	M Rocket 3229	1	11	13	DNC	5	17	
	5	Solo 3566	8	7	DNF	DNC	4	19	
	6	Lark 2301	DNC	2	8	DNC	10	20	
	7	Firefly 3005	5	DNC	4	11	DNC	20	
	8	GP 13743	4	DNC	19	14	3	21	
	9	Solo 3832	DNC	DNC	3	10	8	21	
	10	Solo 4353	DNF	3	DNC	9	DNF	30	
	11	Comet 218	DNF	12	DNC	2	DNC	32	
	12	GP 12805	DNC	DNC	17	15	6	38	
	13	Solo 1581	DNC	DNC	1	DNF	DNF	40	
	14	GP 13410	DNC	15	15	DNC	11	41	
	15	Laser 153500	DNC	9	DNF	DNC	2	42	
	16	M Rocket 3389	DNF	DNC	DNC	6	DNF	45	
Chipstead	1	GP 13860	11.1	99.0	84.5	0	72.2	255.7	+1
	2	M Rocket 3229	98.8	41.7	63.0	0	81.3	243.1	+2
	3	Solo 3784	55.0	83.4	7.6	99.1	40.6	237.5	−2
	4	M Rocket 3085	93.3	72.9	66.0	69.4	0	235.6	−1
	5	Lark 2301	0	93.8	78.3	0	58.7	230.8	+1
	6	GP 13743	82.4	0	44.5	34.6	90.3	217.2	+2
	7	Firefly 3005	76.9	0	90.7	49.5	0	217.0	+4
	8	Solo 3832	0	0	93.7	54.5	67.72	215.9	+1
	9	Solo 3566	60.4	62.5	7.6	0	85.8	208.8	−4
	10	GP 12805	0	0	50.7	29.7	76.8	157.1	+2
	11	Solo 4353	11.1	88.6	0	59.4	8.9	159.1	−1
	12	Laser 153500	0	52.1	7.6	0	94.9	154.5	+3
	13	Comet 218	11.1	36.5	0	94.2	0	141.8	−2
	14	GP 13410	0	20.8	56.8	0	54.1	131.8	
	15	Solo 1581	0	0	99.9	9.8	8.9	118.6	−2
	16	M Rocket 3389	11.1	0	0	74.3	8.9	94.3	
		n	16	17	26	18	20	50	

be discarded and that overall scores are therefore based on the three ‘best’ results. There is also a category ‘DNSO’ (Did Not Sign Off) which is scored as DNF.

As noted earlier, CHIPS scoring (almost always) avoids ties (but note the near tie between ranks 6 and 7 in Table 5). In Table 6 there are no less than 3 ties to be resolved, out of only 11 qualifiers. As I have implied earlier, no method of tie resolution is satisfactory.

The differences in ranking in the 2006 series between Low Point and CHIPS are small, which perhaps suggests that the tie resolution is reasonably fair! However, the differences in ranking in the 2005 series, Table 5, is considerable, with changes of up to four places. In general terms the analysis shows that it is better to do well in larger fleets (which is what CHIPS set out to reflect!).

The two scoring methods give broadly similar results. If they were identical there would be no point in pursuing the apparently more complex CHIPS method. The differences do begin to draw attention to how the different

Table 6: Personal Pursuit Series 2006. In the Low Point scoring DNF is scored as ‘number of starters in race+1’, while DNC is ‘number of starters in series+1’; RAF and DNSO are scored as DNF. In Chipstead scoring, DNC is scored zero. n is the number of starters in a given race; in the ‘nett’ column, n is the total number of starters in the series. The ‘change’ column may be read as ‘CHIPS rank = Low Point rank+change’.

	rank	competitor	scores					nett	change
Low Point	1	GP13743	3	DNC	DNC	2	1	6	
	2	M Rocket 3229	1	5	14	3	DNC	9	
	3	Lark 2115	7	DNC	2	DNC	3	12	
	4	GP13860	DNF	11	1	4	DNC	16	
	5	British Moth 730	8	1	DNC	7	DNC	16	
	6	M Rocket 3085	5	10	7	DNF	DNC	22	
	7	Solo 3784	DNC	DNC	10	DNF	2	30	
	8	M Rocket 3489	DNC	8	12	DNC	DNS	31	
	9	Solo 3588	9	DNC	DNSO	DNC	DNF	39	
	10	GP 11302	DNC	DNF	11	DNSO	DNC	49	
	11	GP 12805	DNC	DNSO	DNSO	DNC	RAF	50	
Chipstead	1	GP13743	81.4	0	0	93.3	95.6	270.4	
	2	M Rocket 3229	96.8	80.3	34.6	87.8	0	265.0	
	3	GP13860	19.9	51.9	99.1	82.4	0	233.4	+1
	4	Lark 2115	50.7	0	94.2	0	78.1	222.9	−1
	5	British Moth 730	43.0	99.3	0	65.9	0	208.2	
	6	M Rocket 3085	66.0	56.7	69.4	11.1	0	192.1	
	7	Solo 3784	0	0	54.5	11.1	86.8	152.4	
	8	M Rocket 3489	0	66.1	44.5	0	0	110.7	
	9	Solo 3588	35.3	0	9.8	0	25.6	70.7	
	10	GP 11302	0	9.3	49.5	11.1	0	69.9	
	11	GP 12805	0	9.3	9.8	0	25.6	44.7	
		n	10	19	18	16	8	42	

scoring methods reward different aspects of the competition.

These results were calculated with both Excel and then with Sailwave.[4] There are a few small issues with Sailwave: rounding, DNS and heavy weather.

Rounding

Although Sailwave was set to “round off calculated points” to a single decimal place, it appears to retain more significant places in calculating the nett scores, and therefore there may be a difference of 0.1 in the score. This should not be significant, but Burrell (2006) declares that “For each individual race the points score, $\mathcal{S}$, determined by the formula is rounded to 0.1.”

DNS

Boats which “do not start” are awarded zero points. However, Sailwave appears to include such boats in calculating the fleet size n, and somehow, when m DNS boats are present, the scores for DNF are calculated as if their place was $n+m$. To allay any doubt, the *only* ticked box in Sailwave’s Scoring

[4] Version 1.94 build 27: at 16 November 2006 this is the latest version.

code Properties was *This code imples that the boat came to the starting area for the race.*

Heavy weather

Although of marginal importance to this analysis, it is difficult to see how to incorporate scoring for a "heavy weather event", where two "phantom" boats are introduced: i. e. the number of starters is increased artificially by 2. The phantoms are not to be included in the calculation of DNF and RAF scores.

6 Conclusion

The CHIPS scoring system has many attractive points. Its least attractive feature is its apparently complex formula. Examination shows that the formula is not particularly complex, and can easily be broken down into comprehensible elements. However the inclusion of a constant term (t_1 in this discussion), dressed as a variable does little to dispell the illusion of complexity.

Once it is appreciated that the scores are uniformly distributed for a given fleet size, much of the mystique disappears. To quote Downing (2005) describing the similar Rinderle B: "The system is linear with respect to place and non-linear with respect to the number of boats that started."

There are still some quirks: the anomalous behaviour of the DNF scores may unsettle many, if they realise it occurs. To be honest, such results are unlikely to influence those in the first handful of places, and below a certain level people are less worried about position (in my opinion). Likewise, the anomalous behaviour of the $\mathcal{S}_{0,n}$ score which can be used in a simplified calculation might worry some, but it is conveniently hidden away and few are ever likely to notice it.

The (almost guaranteed) absence of ties is surely a godsend. Frankly I find it easier to explain CHIPS scoring than the various methods of tie resolution: all of which require suspension of disbelief.

Implementation in a spreadsheet is cumbersome until it is appreciated that we can exploit the linearity of place. The more desirable implementation in Sailwave appears to have a few problems (unless, as is entirely plausible, I have misunderstood some of the Sailwave setup), and it would be convenient to have CHIPS implemented within Sailwave, just like Rinderle B.

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