Crescendo Relay Handicap Analysis, Version 2
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The **Crescendo Relay** is a planned event at the GISC Winter Solstice meet with the following features:

- Four swimmers each swimming one leg of SCM freestyle at the following distances: 200m in the first leg, 150m in the second leg, 100m in the third leg, 50m in the fourth (final) leg.
- All relays are mixed relays and are composed of four swimmers, of any age or gender.
- Winners are determined by total elapsed time reduced by age- and gender-related handicaps.

The goal of an age-weighted, gender-neutral **Crescendo Relay Handicap** is to encourage level-playing field competition among relays in any combination of men and women with both older and younger swimmers. Without a handicap, relays with younger swimmers are likely to dominate the event, and potentially reduce the number of relays entered. Gender neutrality is introduced to encourage the largest field of entrants possible, without specifying a rigid 2 men, 2 women rule for the relay.

My proposed **CRH calculation procedure** is as follows:

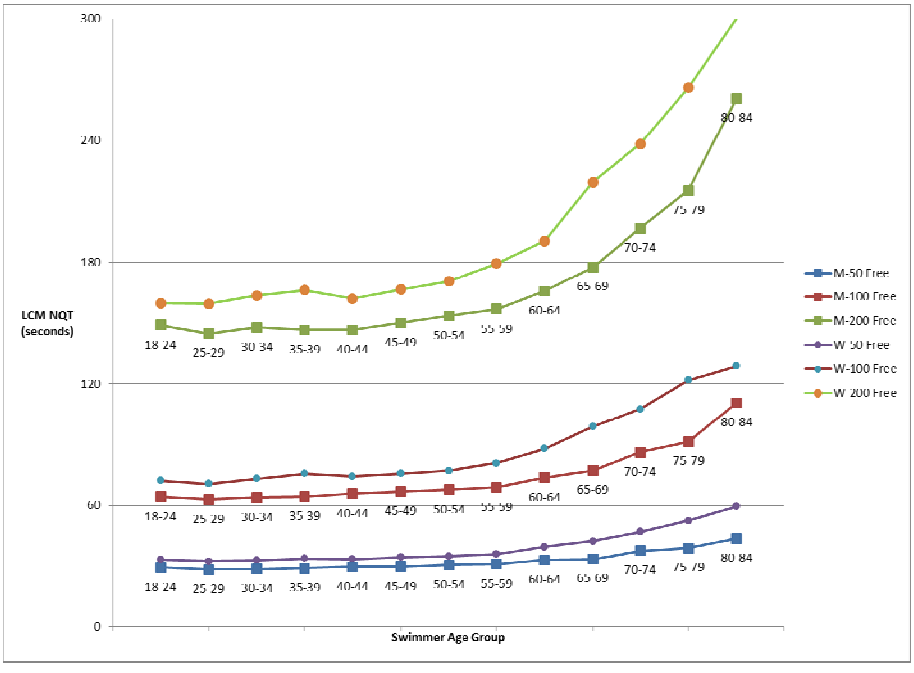
- Each relay team shall receive a one-second handicap for each year that the aggregate relay team age exceeds 180 years.
- Relay teams with aggregate team age equal to or less than 180 years receive no handicap.
- Each relay team shall receive a ten-second handicap for each female swimmer in the relay.

Example CRH calculations:

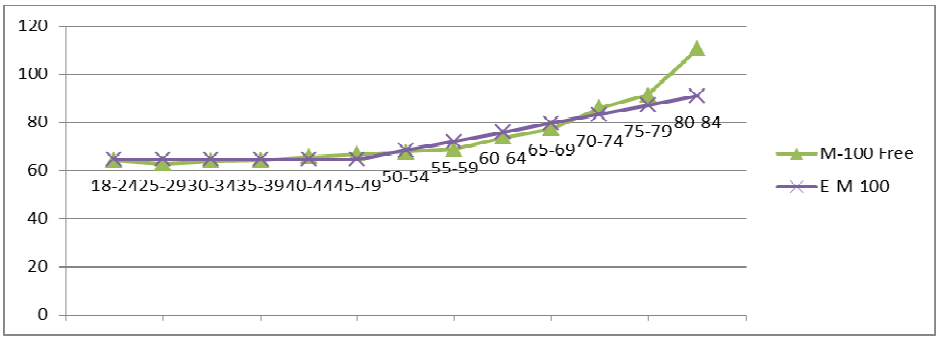
- A relay team is composed of four swimmers (M50, M62, W40, W56) with a total age of 208 years, and two women. This relay receives an age handicap of (208-180)=28 seconds and a gender handicap of 20 seconds for a total handicap of 48 seconds.
- A relay team is composed of four swimmers (W30, M32, W40, W65) with a total age of 168 years and three women. This relay receives no age handicap because the total aggregate relay age is less than 180 but receives a gender handicap of 30 seconds. Total handicap: 30 seconds.

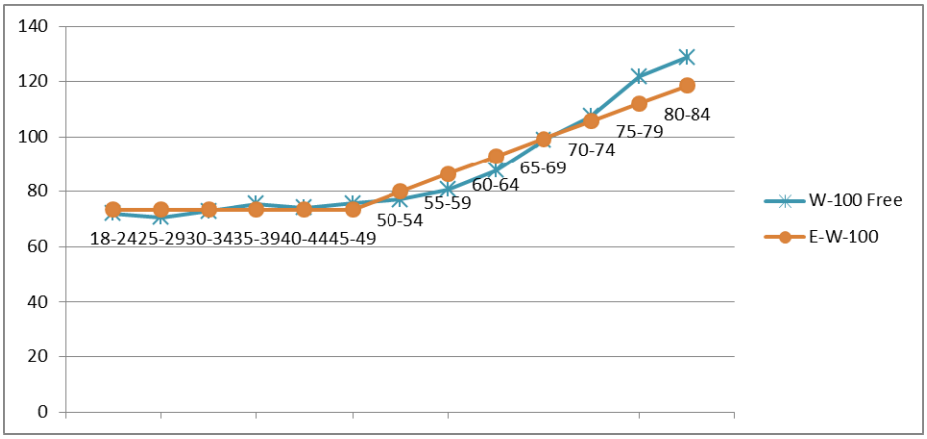
Background.

As master swimmers get older, they get a little slower in general. However, this rate of getting slower isn't uniform. Here's a chart of the National Qualifying Times (NQT) for the 2013 LCM Nationals meet, by age and gender for 50m, 100m and 200m free.



Age Analysis. What we can observe is that, in general, the times are pretty flat (that is, no slower) from the youngest age to ages in the 40s, then there is an increase. If we want a simple age handicap rule, we need a rule that recognizes both the age threshold when times begin to increase more significantly and a linear handicap (x seconds per year of age by distance). I used some simple statistical techniques to find the best threshold and the best linear relationship to fit the data. For Men's 100m Free, the best fit was a breakpoint at 45 years, with a handicap of 0.75 seconds per year (below). For Women's 100 Free the story was similar but not exactly the same: breakpoint at 45, with a handicap of 1.29 seconds per year. For relays consisting of two men and two women, an average handicap of 1 second per year is very close to the average of these two results.





Gender Analysis. Looking at gap between male and female times for the 100m free in the NQT data, this gap is around 8 seconds for swimmers up to 45 years of age and then increases to 20-30 seconds in the oldest age groups. Given that we want a simple gender handicap that is not complicated by age, an average of 10 seconds per female swimmer (regardless of distance swum) fits the data reasonably well.

Hypothetical Relay Analysis Results. I used the NQT data to simulate over 100 randomly generated relay teams, where each swimmer swam exactly the NQT on each leg. Times for the 150m leg were estimated using the average of the 200m and 100m NQTs. In these hypothetical relays I assessed the handicaps and measured how different the handicap adjusted times would be. The best combination for age was for the 45 years per swimmer threshold (180 total aggregate age threshold) and 1 second per year, combined with a 10 second per female swimmer. This resulted in an average absolute difference of about 6 seconds among all competing relays.

Recommendation. I recommend that we use the relatively simple handicapping formula for the Winter Solstice Meet. It can be implemented after the fact when the times are reported and calculated prior to the posting of the results.