

15597

# HiMCM Practice: Triathlon

Aarushi, Jasmin, Lauren, Sharvi

# Problem and Constraints

- We need to plan the logistics for an upcoming triathlon with ~ 2000 participants
- Logistics include:
  - timing of different waves
  - grouping of waves
  - overall structure
  - 1500m swim, 40K bike, & 10K run
- Participants include some pro & premier triathletes, but majority just participate for fun
- Determine divisions for awards
- Determine schedule of wave start times
- Consider congestion on the course
- Minimize time of road closure
- Max road closure time: 5.5 hrs

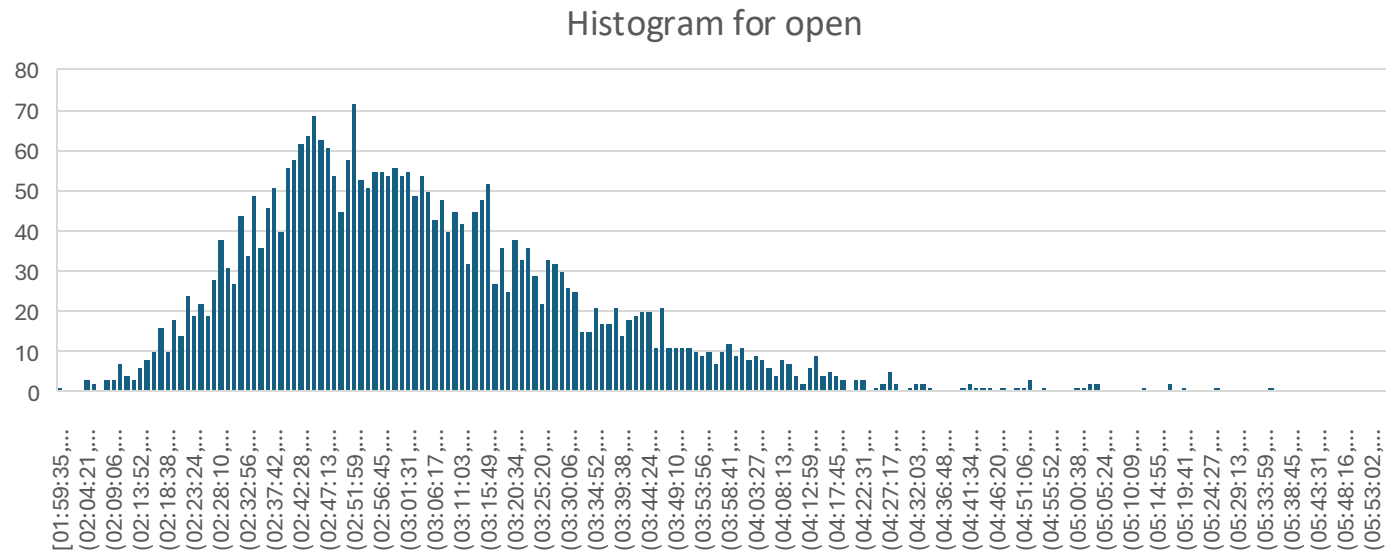
# Main Constraints

- Minimize congestion on the course
- Minimize time of road closure
- Max road closure time: 5.5 hrs
- How did we do this?

# Assumptions

- Road time only includes the bike and run phases
- Waves of 100 people at a time
- Slower people would disperse by the time a slightly faster wave catches up to them (with more time, we would prove this with math)
- Pros and premiers are the ones racing (prize money, place, etc.) and should have minimal interference from amateur racers

# Initial Approach



- Started with a histogram to see the distribution of times
- Originally thought of doing waves by time
- We considered that many people might not already have a recorded time, so hard to base off of that
- Wasn't effective

# Model Justification

Awards divisions:

- Split up by age
- Common for many triathlons and large races

Wave divisions:

- Split up by age because they cannot be split up by time (not everyone has ran a triathlon before)
- Started with pro/premier first because they are the fastest
- Did not strictly go fast to slow because slower people would have less time on the road (due to wave delays)

# Time Ranges Based on Category and Phase

Group	Lowest Time	Highest Time	Range (min)	Avg Time	Lowest Time	Highest Time	Range (min)	Avg Time
Male Pro	1:48	2:03	0:15	1:54	0:32	0:38	0:05	0:35
Female Pro	1:58	2:09	0:11	2:03	0:36	0:41	0:05	0:38
All Pros	1:48	2:09	0:21	1:59	0:32	0:41	0:09	0:36
Male Premier	1:56	2:30	0:34	2:10	0:33	0:48	0:15	0:39
Female Premier	2:06	2:43	0:37	2:23	0:36	0:49	0:12	0:44
All Premiers	1:56	2:43	0:47	2:17	0:33	0:49	0:16	0:41
M Open	1:59	5:02	3:02	2:58	0:35	2:09	1:33	0:59
F Open	2:18	5:57	3:39	3:16	0:41	2:07	1:26	1:02
All Open	1:59	5:57	3:58	3:07	0:35	2:09	1:34	1:00
CLY	2:16	4:15	1:59	3:16	0:47	1:41	0:53	1:11
ATH	2:36	5:19	2:42	3:45	0:50	1:44	0:53	1:17
	Final				Run			

- Tables for final time, run, bike, and total road time (run and bike)
- Looked at lowest, highest, and average time for each group
- Also looked at the range
- Showed us how long different stages would take
- Did not look at swim (no road constraint)

Group	Lowest Time	Highest Time	Range (min)	Avg Time	Min	Max	Avg
Male Pro	0:57	1:05	0:08	1:02	1:29	1:44	1:37
Female Pro	1:04	1:10	0:05	1:07	1:40	1:51	1:45
All Pros	0:57	1:10	0:13	1:04	1:29	1:51	1:41
Male Premier	1:02	1:22	0:19	1:08	1:35	2:10	1:48
Female Premier	1:05	1:25	0:19	1:16	1:42	2:15	2:00
All Premiers	1:02	1:25	0:23	1:12	1:35	2:14	1:54
M Open	1:01	2:59	1:58	1:24	1:36	5:08	2:24
F Open	1:09	3:12	2:02	1:38	1:51	5:19	2:40
All Open	1:01	3:12	2:11	1:31	1:36	5:21	2:32
CLY	1:04	1:59	0:54	1:28	1:51	3:40	2:39
ATH	1:20	2:47	1:27	1:48	2:10	4:31	3:06
	Bike				Total road time		

# Time Ranges Based on Age and Final Time

Group	Lowest Time	Highest Time	Range (min)	Avg Time	Rank (fast to slow)
M OPEN u29	2:04	4:44	2:40	2:57	1
F OPEN u29	2:18	4:17	1:59	3:12	2
M OPEN 30-39	2:05	4:32	2:27	2:56	3
F OPEN 30-39	2:22	5:57	3:35	3:15	4
M OPEN 40-49	2:05	4:32	2:27	2:54	5
F OPEN 40-49	2:18	5:17	2:59	3:16	6
M OPEN 50-59	2:10	4:50	2:39	3:04	7
F OPEN 50-59	2:24	4:54	2:30	3:20	8
M OPEN 60+	1:59	4:50	2:50	2:57	9
F OPEN 60+	2:05	5:57	3:52	3:16	10

Based on final time

- Times based on age using final time only
- Looked at lowest, highest, range, and average
- Ranked from fastest to slowest using average time



# Ordered Waves by Age and Category

Group	Rank (fast to slow)
M OPEN 40-49	1
M OPEN 30-39	2
M OPEN u29	3
M OPEN 60+	4
M OPEN 50-59	5
F OPEN u29	6
F OPEN 30-39	7
F OPEN 40-49	8
F OPEN 60+	9
F OPEN 50-59	10

Major categories	Subcategories	Total	Waves
ALL PRO and PREMIER	PROS AND PREMIER	80	1
M OPEN	M OPEN 40-49	657	7
F OPEN	F OPEN u29	160	2
	M OPEN 30-39	774	8
	F OPEN 30-39	370	4
	M OPEN u29	283	3
	F OPEN 40-49	259	3
	M OPEN 60+	106	1
	M OPEN 50-59	386	4
	F OPEN 50+	141	2

- Pros and premiers go together first
- Alternated men and women from fastest to slow (based on ranking)
- Looked at total based on groups
- Waves within each of these groups, approximately 100 people in each

# Conclusion

Awards divisions (male and female):

- Pro
- Premier
- Open 19 and under
- Open 20-29
- Open 30-39
- Open 40-49
- Open 50-59
- Open 60+

Order of groups for start:

- All pros and premier
- M Open 40-49
- F Open 29 and under
- M Open 30-39
- F Open 30-39
- M Open 29 and under
- F Open 40-49
- M Open 60+
- M Open 50-59
- F Open 50+

# Strengths and Weaknesses

## Strengths:

- Optimized for this specific problem
- Because we have past data, we were able to fairly distribute the waves & start times
- Less road congestion & sorted by speed

## Weaknesses:

- Doesn't account for outliers
- Would be challenging to apply to different scenarios
- Still some road congestion due to slower people needing to go first

# Future Additions:

- Determine how far apart the waves should go
- Determine where people will be on the course to understand course congestion
- Optimize wave start times to minimize congestion
- Optimize wave start times to give slower people the most time on the road so that they can finish

# Questions

Any questions?  
Thanks for listening!