The Effect on Athletes' Performance of Selecting Lanes in the 200m Dash

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AUTHOR BIO

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ABSTRACT

During the 200 meter dash in the sport of track and field, the first 100 meters of the race are run on a curve and the second half in a straight line. Since each athlete has to stay in their own lane throughout the race, athletes in higher lanes will start ahead in a staggered pattern, so each athlete runs the same distance. A common myth in the world of track and field is that the middle lanes are the best because biomechanics tells us that there is a physical disadvantage to an inside lane because the curve is run at a tighter angle and many believe there is a disadvantage to the outside lane because you are unable able to see the other competitors race and gauge yourself. However, this study found that contrary to common belief, the outside lanes are the best and provide a notable advantage when compared to other lanes in the 200 meters. Future studies should examine why the outside lanes provide an advantage compared to other lanes, including both mental and physical factors.

Keywords: Athletics, data, race angle, advantage.

INTRODUCTION

In the sport of track and field, during sprinting events, the 100 meter dash, the 200 meter dash, and the 400 meter dash, and even the 800 meter race for the first 100 meters, an athlete is assigned a lane at the start of the race. Other than the 100 meter dash, all the other races start on a curve. In order to make sure all the athletes are running the same distance, athletes on the outer lanes will start a little bit in front in a staggered formation.

However, because the athletes are running the curve at different degrees, the question of whether the angle of the curve impacts an athlete's performance in the 200 meter dash rises. In this paper, an athlete's best time during the season (SB) will be compared to how fast they ran at the World Championships and what lane they ran in.

Background

In track and field, the 100 meters is run in a straight line for the entire race, where each athlete remains in their own lane. However, in the 200 meters, the first 100 meters of the race are run on a curve. Then, the second 100 meters of the race are run on a straightaway. In order to guarantee athletes actually runs the same distance, as an athlete in lane 8 would be running more than an athlete in lane 1, the athletes in the outside lanes would start further up ahead of the inside lanes in a staggered pattern. Thus, athletes in higher lanes would run the curve at a less sharp angle than other athletes, but would not be able to see any athletes unless they are getting passed. (Chadwick, 2009)

In the world of track and field, it is a common held belief that the middle lanes are the best lanes to race in. This is because researchers studying biomechanics found that running on an inside lane can slow the athlete down because the curve is much tighter compared to an outside lane. (Churchill et al, 2019). Many believe the outside lanes are a disadvantage to athletes because the athlete won't be able to see anyone throughout the entire race to gauge their own speed unless the athlete is getting passed.

The sport of track and field is competed by countries around the world. When the athletes compete in the World Championships each year, and the Olympics every four years, the athletes are representing not only themselves, but also the people who are supporting them, and the country they are running and representing for. If lane numbers or other factors provide an unfair advantage to certain athletes, then the rules, regulations, and standards need to be changed in the spirit of fair competition for all athletes.

Methods

The data being used are the results of the World Championships from 2000 to 2019 and collected by David Munro, "Are there lane advantages in track and field?". The data being used is only from the first round of the 100 meter and 200 meter dash because athletes in later rounds will be assigned lanes based on their time instead of at random. Thus, to eliminate the possibility of an athlete running faster because the athlete is more talented, the study will only be using the data from the first round when lane assignments are assigned at random.

Once the data is opened, an excel file was created to store the lane number the athlete ran in, the athlete's SB in that season, what the athlete's racetime was, and what the difference was between the athlete's SB and what the athlete ran (DIFF). In order to delete any outliers, athletes that were in the dataset, but disqualified from the actual race were removed as their difference would be around 20 seconds and skew the data. This procedure was done for both the 200 meter dash and the 100 meter dash.

Using the R programming language and RStudio, Analysis of Variance (ANOVA) models were generated to compare the DIFF with the lanes in the 200 meter dash. Then, the same ANOVA model was used on the 100 meter dash. The lane numbers will be represented using letters instead of numbers because of the way the ANOVA model takes in numbers as the independent variable. Hence, A will be lane 1, B will be lane 2, and so on.

Results

Table 1. Summary of the 100 Meter Dash Generated by *ggplot2()*

	Df	Sum Sq	Mean Sq	F value
Lanes	8	0.34	0.04216	0.801
Residuals	1608	84.61	0.05262	

Table 2. Multiple Comparisons of Means with 95% Family-wise Confidence Level Generated by *TukeyHSD()* of the 100 Meter Dash

	DIFF	Lwr	Upr	
B-A	0.0046431322	-0.07859722	0.08788348	
C-A	0.0236750458	-0.05986078	0.10721087	
D-A	0.0318952429	-0.05113031	0.11492079	
E-A	0.0158129479	-0.06686688	0.09849278	0.9996384
F-A	-0.0007058534	-0.08331831	0.08190660	1.0000000
G-A	-0.0034688995	-0.08642410	0.07948630	1.0000000
H-A	0.0299176788	-0.05408196	0.11391732	0.9734023
I-A	-0.0173139746	-0.13222607	0.09759812	0.9999403
C-B	0.0190319136	-0.05169032	0.08975415	0.9957729
D-B	0.0272521107	-0.04286667	0.09737089	0.9550843
E-B	0.0111698156	-0.05853926	0.08087889	0.9999045
F-B	-0.0053489856	-0.07497814	0.06428017	0.9999997
G-B	-0.0081120317	-0.07814750	0.06192343	0.9999922
H-B	0.0252745466	-0.04599495	0.09654404	0.9740992
I-B	-0.0219571068	-0.12792026	0.08400605	0.9993462
D-C	0.0082201971	-0.06224909	0.07868949	0.9999917
E-C	-0.0078620980	-0.07792373	0.06219954	0.9999939
F-C	-0.0243808992	-0.09436301	0.04560122	0.9768011
G-C	-0.0271439453	-0.09753033	0.04324244	0.9570860
H-C	0.0062426330	-0.06537174	0.07785700	0.9999992

I-C	-0.0409890204	-0.14718444	0.06520640
E-D	-0.0160822951	-0.08553473	0.05337014
F-D	-0.0326010963	-0.10197332	0.03677112
G-D	-0.0353641424	-0.10514417	0.03441589
H-D	-0.0019775641	-0.07299606	0.06904093
I-D	-0.0492092175	-0.15500371	0.05658528
F-E	-0.0165188013	-0.08547688	0.05243928
G-E	-0.0192818474	-0.08865017	0.05008648
H-E	0.0141047309	-0.05650928	0.08471875
I-E	-0.0331269225	-0.13865032	0.07239648
G-F	-0.0027630461	-0.07205105	0.06652496
H-F	0.0306235322	-0.03991158	0.10115865
I-F	-0.0166081212	-0.12207874	0.08886250
H-G	0.0333865783	-0.03754966	0.10432282
I-G	-0.0138450751	-0.11958437	0.09189422
I-H	-0.0472316534	-0.15379231	0.05932900

Table 3. Summary of the 200 Meter Dash Generated by *ggplot2()*

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Lanes	8	3.25	0.4067	2.138	0.0296 *
Residuals	1635	310.97	0.1902		

Table 4. Multiple Comparisons of Means with 95% Family-wise Confidence Level Generated by *TukeyHSD()* of the 200 Meter Dash

	DIFF	Lwr	Upr	p adj
B-A	0.027909408	-0.1531386	0.208957419	0.9999289
C-A	-0.009005340	-0.1890108	0.171000147	1.0000000
D-A	-0.019973788	-0.1995418	0.159594192	0.9999943
E-A	-0.024058442	-0.2034132	0.155296365	0.9999755
F-A	-0.058843854	-0.2387385	0.121050831	0.9844364
G-A	-0.066441678	-0.2460097	0.113126303	0.9664552
H-A	-0.108818425	-0.2888239	0.071187063	0.6294199
I-A	-0.137142857	-0.3672552	0.092969467	0.6477208
C-B	-0.036914748	-0.1692924	0.095462910	0.9946031
D-B	-0.047883195	-0.1796653	0.083898929	0.9699479
E-B	-0.051967849	-0.1834594	0.079523655	0.9505066

F-B	-0.086753261	-0.2189802	0.045473689
G-B	-0.094351085	-0.2261332	0.037431039
H-B	-0.136727832	-0.2691055	-0.004350174
I-B	-0.165052265	-0.3601767	0.030072185
D-C	-0.010968447	-0.1413146	0.119377712
E-C	-0.015053101	-0.1451054	0.114999229
F-C	-0.049838513	-0.1806344	0.080957356
G-C	-0.057436337	-0.1877825	0.072909822
H-C	-0.099813084	-0.2307613	0.031135139
I-C	-0.128137517	-0.3222950	0.066020006
E-D	-0.004084654	-0.1335308	0.125361445
F-D	-0.038870066	-0.1690632	0.091323035
G-D	-0.046467890	-0.1762092	0.083273411
H-D	-0.088844637	-0.2191908	0.041501522
I-D	-0.117169069	-0.3109210	0.076582905
F-E	-0.034785412	-0.1646843	0.095113513
G-E	-0.042383236	-0.1718293	0.087062863

H-E	-0.084759983	-0.2148123	0.045292347	0.5264721
I-E	-0.113084416	-0.3066388	0.080470008	0.6724937
G-F	-0.007597824	-0.1377909	0.122595277	1.0000000
H-F	-0.049974571	-0.1807704	0.080821298	0.9593746
I-F	-0.078299003	-0.2723538	0.115755798	0.9442671
H-G	-0.042376747	-0.1727229	0.087969412	0.9850362
I-G	-0.070701180	-0.2644532	0.123050795	0.9691577
I-H	-0.028324433	-0.2224820	0.165833090	0.9999534

Figure 1. Boxplot of DIFF vs Lanes in the 100 Meter Dash

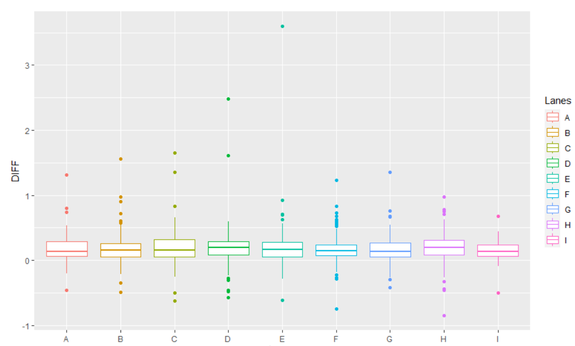


Figure 2. Mean Plot with 95% Confidence Interval in 100 Meter Dash

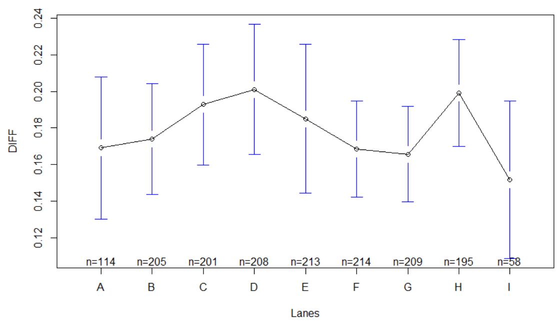


Figure 3. Boxplot of DIFF vs Lanes in the 200 Meter Dash

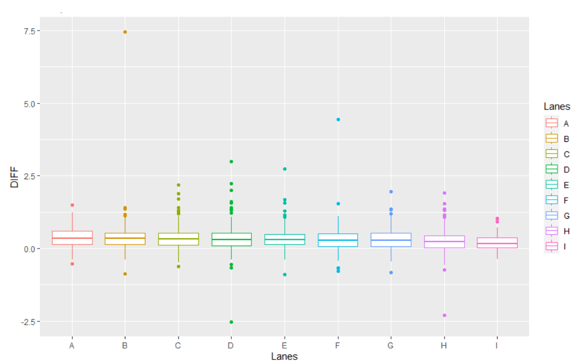
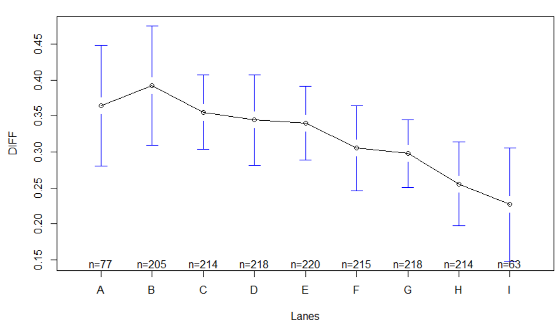


Figure 4. Mean Plot with 95% Confidence Interval in 100 Meter Dash



Definitions

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

DF: Degrees of freedom in the source.
Sum Sq: Sum of squares due to the source.
Mean Sq: Mean sum of squares due to the source.
F value: the *F* Statistic
Pr(>F): the *p* value.
SB: Athlete's fastest race time before World Championships meet.
DIFF: Athlete's SB subtracted from World Championships race time.
Lwr: Lower end point of the interval.
Upr: Upper end point of the interval.
p adj: *p* value after adjustment for multiple comparisons.
n: Number of datapoints.
Signif: Significant
ANOVA: Analysis of Variance

Discussion

Examining the results, there is no significant correlation between the lane number and the athlete's performance in the 100 meter dash. Looking at the summary generated by *ggplot2()* in Table 1, there is no significance in the 100 meter dash as the *p* value generated is 0.601, which is much greater than 0.05. Thus, there is no strong correlation between the lane number and the athlete's performance in the 100 meter dash. This can be further proven in Figure 1 and Figure 2 as there is no apparent correlation between the lane number and the DIFF.

Looking at the 200 meter dash, we can observe a correlation between the lane number and the athlete's performance. Using *ggplot2()*, Table 3 shows the *p* value is 0.0296, which is indeed less than 0.05 and is significant. Then, using *TukeyHSD()*, the *p* value is 0.0367078 at H-B in Table 4, which means there is a significant difference between lane 2 and lane 8 as the *p* value is less than 0.5. It is however interesting to note that H-B is the only significant difference out of all the possible comparisons. However, a clear negative correlation between lanes and DIFF is shown in

Figure 4, where lane 1 has the greatest DIFF and lane 9 has the smallest DIFF.

The results of this study supports the work done by Munro, Chadwick, Churchill et al. The data shows that the lane number does not affect the 100 meter dash because there is no significant correlation as the athletes are all running in a straight line. However, there is a significant correlation in the 200 meter dash as there is a strong correlation where the outer lanes give athletes an advantage compared to the inside lanes.

Conclusion

This study is the first time an ANOVA model has been used to compare the difference between an athlete's SB and their racetime against the lane number they ran in for that race. It is noteworthy to note that the athlete's lane number for their SB before the World Championships were not considered in this study.

Future studies should be done to examine how lane numbers affect athlete's performance whether there is an advantage for athletes physically or mentally in some lanes compared to others. If future studies continue to prove lane assignments give some athletes an unfair advantage compared to other athletes, then in the spirit of fair competition, the rules and standards of track and field need to be adjusted in order to give every athlete a fair opportunity.

REFERENCES

Munro, D. (2022). Are there lane advantages in track and field? *PLOS ONE*, *17*(8), e0271670. https://doi.org/10.1371/journal.pone.0271670

Sarah M. Churchill, Grant Trewartha & Aki I. T. Salo (2019) Bend sprinting performance: new insights into the effect of running lane, Sports Biomechanics, 18:4, 437-447, DOI: 10.1080/14763141.2018.1427279

Chadwick, S. (2009), "From outside lane to inside track: sport management research in the twenty‐first century", *Management Decision*, Vol. 47 No. 1, pp. 191-203. https://doi.org/10.1108/00251740910929786

Dmunro-Git. (n.d.). *GitHub - dmunro-git/Lane-Advantages: Replication Package for Lane Advantages Project*. GitHub. https://github.com/dmunro-git/Lane-Advantages