Formula 1 accident calculations via Monte Carlo on first straight + turn

Kevin Wilbrink (6310621) and Jordi Wippert ()

October 18, 2017

Abstract

Non eram nescius, Brute, cum, quae summis ingeniis exquisitaque doctrina philosophi Graeco sermone tractavissent, ea Latinis litteris mandaremus, fore ut hic noster labor in varias reprehensiones incurreret. nam quibusdam, et iis quidem non admodum indoctis, totum hoc displicet philosophari.

1 Introduction

- What is the problem addressed?
–
- Are there existing solutions?
– There are no existing solutions, however, our model is based on MC traffic simulation. So it is comparable
- What has been done before by others?
– Others have made MC traffic simulation model, we modified that model, instead of avoiding collision.
- What do you hope to achieve?
– Nice graphs/tables that shows perfect clear situations

2 Methods

3 Results

The results are based on simulations which are ran 10,000 times for each track. The total sum of crashes is 121,747.

country	turn	mtr	brake	speed	crashes
Australia	R-L	381	100	150	7837
China	R-L	324.7	50	170	7664
Bahrain	R-L	476.4	100	70	7792
Russia	R-R	205.2	-	300	2103
Spain	R-L	690.5	100	130	7211
Monaco	R-R	111	75	103	7477
Canada	R-L	258	125	154	6334
Azerbaijan	L-R	206	50	116	7926
Austria	R-L	318	200	122	673
GB	R-L	270	-	281	991
Hungary	R-L	576	100	85	7550
Belgium	R-L	251	150	77	2887
Italy	R-L	615	125	80	7393
Singapore	L-L	274	50	126	8724
Malaysia	R-L	620	100	74	8849
Japan	R-L	373	10	152	1262
USA	L-R	364	100	86	8217
Mexico	R-L	890	200	107	6279
Brazil	L-R	334	50	109	5129
UAE	L-R	305	50	150	9449

Table 1: Overview of grand prix, with circuit data. All the circuits are listed in table 1, with all the necessary data. In the last column we can see the numbers of crashes based om our simulation model. The number of crashes seems divided equally for most of the circuits. Some of them have significant lower crashes, e.g. Austria, with only 673 crashes.

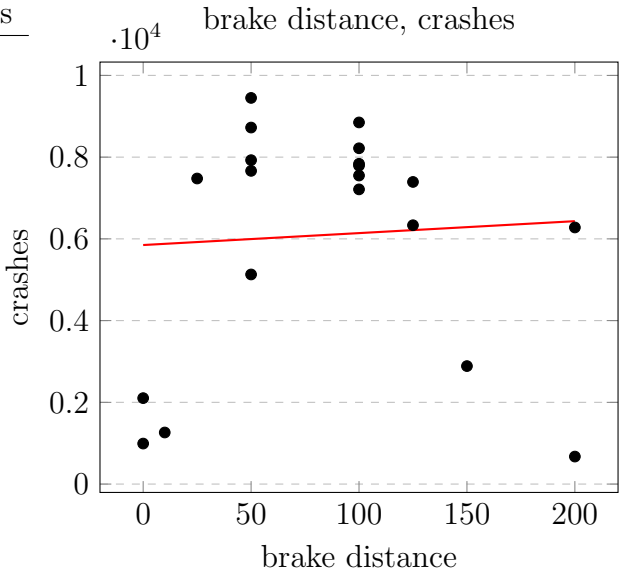

Figure 1: Crashes on scale of brake distance

In figure 1 every single dot means the numbers of crashes based on the brake distance. In this figure we see a stable trend. It seems that the brake distance doesn't affect the number of crashes.

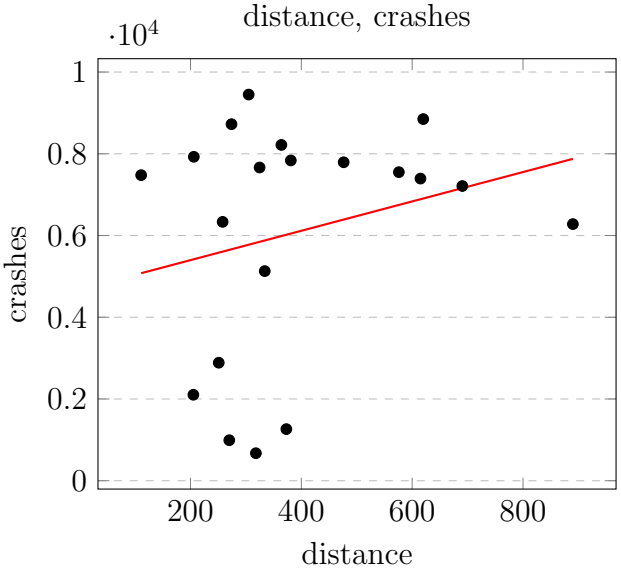

Figure 2: Crashes on scale of turn distance

According to figure 2, we see that the number of

crashes increase when the distance rises. There are numerous causes for this, high speed could be one.

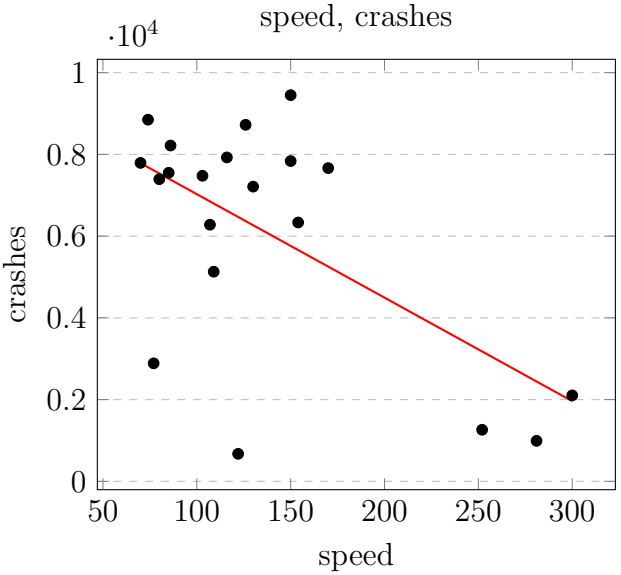

Figure 3: Crashes on scale of turn speed

When a driver can take a turn without braking much, the number of crashes will decrease. Figure 3 is a nice description of this behaviour and it seems logical. Imagine that you have a large turn coming ahead, then you and the drivers in front of you don't have to brake suddenly.

4 Discussion

(Meaning of your results w.r.t. others) Avoid vague subjective statements (like I find .., or .... highly significant...., etc.) Rather use "The figure shows ...."

MC traffic simulation, `https://link.springer.com/article/10.1007/s11709-009-0032-3`

Nagel Schrekenberg, traffic simulation? `https://people.sc.fsu.edu/~jburkardt/classes/isc_2009/monte_carlo_simulation.pdf`

Sort of something we do? Except we want to crash.. and these model try to avoid collision..

5 Conclusion

What did you learn, why did you do it, how does it advance science - done, what is left for future work? - done

Our goal of this paper is to predict the outcome of a Formula 1 race on a small part of a track. We want to find unsafe conditions, to improve the safety of the track and make it safer for the driver. However, during the eximination of our results, we figured that the crash of cars occur completely at random. We did not find a significant factor that show how or when a crash will hapen. By improving our model, with futher research, and try to mimic the real world F1 races with extra conditions like driver response or the width of the corner. Nobody can react as fast as a computer and the corners are most of the time smaller than the straight part. So you have to position yourself, react to other drivers, before entering the cornern. Also the acceleration is currently linear, which under normal circumstances is not linear. There are a lot of other factors that we have not take in account.

Appendix

The supplementary online material of our statistic hypothesis test and source code can be found on Jordi's Github page: `https://github.com/LiveNL/F1/SOM.pdf`

Acknowledgements

Special thanks to Gerard Barkema for his lectures about the research methods, how to write a scien-

tific paper and topics about Monte Carlo simulation. We would also like to thank Marinus Veldhorst for his help and information during the seminars.

References

[1] The Pennsylvania State University. *Chi-Square Tests*. Oct. 2017. URL: https://onlinecourses.science.psu.edu/statprogram/node/158.