

# Statistical Analysis of the Virtual Safety Car in Formula One

**Abstract** This paper reviews the potential statistical impacts that the Virtual Safety Car has on actual Safety Car Deployments in Formula One.

# 1 Introduction

In Formula One cars and drivers speed around a racetrack, occasionally creating accidents or situations that require caution. In 2015 Formula One introduced the Virtual Safety Car (VSC). Instead of deploying a physical safety car, a “virtual” safety car can be deployed to automatically slow down drivers when necessary. This paper analyzes the impact that the VSC may have had on actual safety car deployments.

# 2 Data

This paper analyzes data provided by Kaggle with supplementary stats compiled manually.

**Year** Year at which the race took place.

**Race** Name of the race.

**Type** Permanent (racing facility) or Street (street circuit).

**Round** The n-th round of the season (year).

**TotalRounds** Number of races for that season (year).

**TotalLaps** Total number of laps completed for that race.

**Condition** Dry (dry track), Mixed (mixed condition of dry and wet), or Wet (wet track)

**Cause** Cause of deploying the safety car.

**Deployed** The lap at which the safety car was deployed.

**Retreated** The lap at which the safety car returned to the pit lane. If empty, the race had a safety car finish.

**FullLaps** The number of laps led by the safety car.

# 3 Method

The data was analyzed using the R programming language to generate visual graphs and numerical comparisons. A histogram was generated for Formula One season 2010-2015 and 2015-2019 with a best-fit poisson line overlayed. Similarly, the interval between safety car deployments was graphed with a best-fit exponential line overlayed. Lastly, we conducted two-sample t-tests comparing both intervals, one with variance assumed equal and one without.

## 4 Results

Looking first at the means and standard deviations of the two samples, we see that the mean (# of safety car deployments) of the 2010-2015 sample is 0.7291667 and the standard deviation is 1.061074.

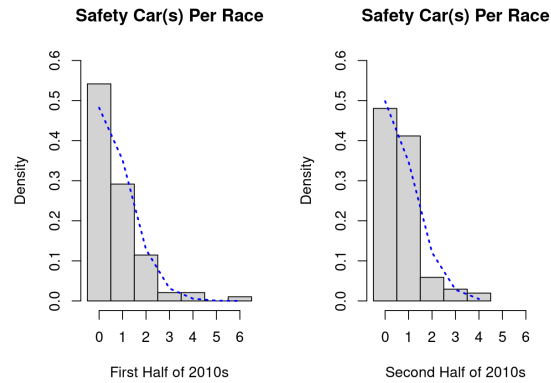


Figure 1: Histogram of Safety Car Deployments

The mean of the 2015-2019 sample is 0.6960784 and the standard deviation is 0.8650441. We can see the histogram of deployments in Figure 1.

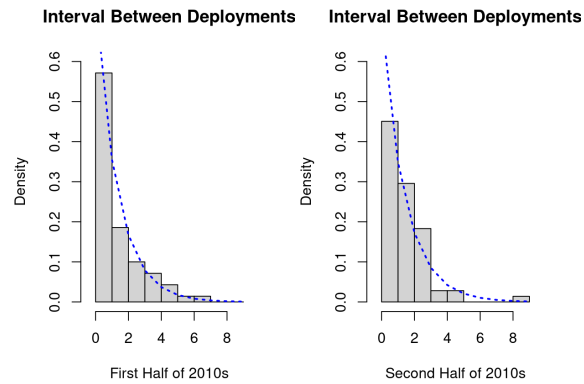


Figure 2: Histogram of Safety Car Intervals

Similarly, the mean of the intervals between deployments for 2010-2015 is 1.328827 vs 1.421543 for 2015-2019. We can see the histogram of intervals in Figure 2.

Finally, we conducted two-sample t-tests comparing both intervals, one with variance assumed equal and one without.

### **Assuming Equal Variance**

$$\begin{aligned}t &= -0.39129 \\df &= 139 \\p\text{-value} &= 0.6962\end{aligned}$$

Which generated a p-value of 0.6962, indicating that the two samples are not significantly different. More specifically, the 95% confidence interval for the difference in means is [-0.5612108, 0.3757772].

### **Not Assuming Equal Variance**

$$\begin{aligned}t &= -0.39133 \\df &= 139 \\p\text{-value} &= 0.6962\end{aligned}$$

Which generated a p-value of 0.6962, the same as the previous test. Lastly, the 95% confidence interval for the difference in means is [-0.5611611, 0.3757275].

## **Conclusion**

Going by our t-tests and visually comparing histograms, we can conclude that there is not a significant impact on safety car deployments due to the introduction of the VSC.