Misbehaving In The Pits

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Abstract

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

Contents

1 Points system and the pit stop from the strategic point of view **1**
1.1 Basic Rules and Point System 1
1.2 Potential for behavioural biases 2
1.3 Research Approach 3

2 Regression Analyses **3**
2.1 All Pit Stops 3
2.2 "Normal" Pit Stops 3
2.3 More-Than-Average Pit Stops 3

References **5**

1 Points system and the pit stop from the strategic point of view

1.1 Basic Rules and Point System

In Formula 1, there are 2 distinct championship competition that simultaneously takes place during the season; driver's championship and the constructor's championship. All the racers will be ranked based on the accumulation of individual points that results throughout the season. Meanwhile, the constructor's championship title will be given to the teams who achieves the highest accumulated points from their 2 drivers. Therefore, often team have to persecute difficult strategic order, that doesn't coincide with driver's interest, prioritizing the constructors rather than the drivers championship.

Through out the season, each racers will be participating in 21 races (During 2021 season, due to special COVID-19 procedure, the season ended with shorter 17 races). The points will be distributed according to the ascending order of the finishing position from each races, and those accumulation of those outcome will determine the result of both constructors and driver's championship.

Table 1: Shows points awarded to drivers for every Grand Prix based on their position at the end of the race. Since there are 20 drivers on the grid, half of the drivers on the grid will get no points and drivers that not in the points will do whatever they can to get in the points, including taking extra pit stops to get fresher tires to catch up with the drivers right ahead of them.

Position	Points
1st	25
2nd	18
3rd	15
4th	12
5th	10
6th	8
7th	6
8th	4
9th	2
10th	1

The list below are the key factors that determine team's strategic decision during the races.

Amongst the lists of strategic factors, decisions surrounding pit stops are considered to be one of the crucial ones. During the races, each drivers are required to take at least 1 pit stop to replace their tyre. There are 5 types of the tyres that differs based on the softness of the rubber. The softer tyres will provide faster lap time, while compromising on the durability which forces team to pit more often. Pit stops are considered both risk and opportunity, since having fresher tyres will allow faster lap time, but each pit stops will add about 19 seconds on the lap time. Therefore,

team managers will need to find ideal timing to utilize pit stop that minimize the longer lap time, while not giving up position against other competitors.

1.2 Potential for behavioural biases

Pit stop biases

Pit stop is one of the critical elements in the motor sports for teams to reach higher position within the championship. By changing to newer tires, the car can take advantage of the weather and road conditions, as well as, switch to fresh tyre that allows better grip in the corner, thus resulting with higher chances of overtaking. Pit stops decisions can drastically overturn the position, but simultaneously could contain large risks of losing positions due to slow tyre swap or choosing the wrong tyre that does not match the road conditions under extreme weather.

1. Overconfidence in double stacking During the 2020 season, the running pole setting team, Mercedes AMG made critical errors in their tyre swap. The incident occurred during the lap 63, the rookie driver in Williams Racing, J.Aitken crushed into a wall which caused yellow flag. Often, yellow flags are considered to be perfect opportunities for team to return to the pit to replace their tyre with fresher ones without losing the position. When the yellow flag was waved, Mercedes's strategist quickly ordered both driver to immediately get back to the pit for tyre swap. This strategy when two drivers are ordered to simultaneously return to pit, is called "Double Stacking". Usually double stacking can cause chaos in the pit because the team strategists need to precisely schedule the driver's return to avoid overlap which can be detrimental to smoothly pit-stop. This strategy should be employed when the team strategist and the pit crew have strong confidence in executing such high risk strategy. The pit stops is orchestrated by the symphony between pit crew, driver and the strategists' perfect coordination. However, in the Sakhir Grand Prix, Mercedes's decision on sudden double stacking caused chaos and confusion amongst unprepared crew, resulting with miss-placement of tyres and drop in position.

2. Multi 21 Another strategic decision regarding the pit stop in known as "Multi 21". Team strategist often orders the driver to swap position with their teammate, which believed to have better outcome for the constructor's points.

   How do you call biases that make people feel overly confident on taking chances when they are approaching the end of the game? This is the same theme as the Hockey team's behavioural biases. The teams often strategically use high risk strategy to take the chances. (Asness and Brown, 2018)

   However, statistical finding indicates that probability of result in better outcome have not been shown.

3. Different measurement of the performance

    - Position
    - Lap time delta against the pole position

1.3 Research Approach

To examine the effectiveness of the pit stop strategy, there needs to be an

2 Regression Analyses

2.1 All Pit Stops

Dep. Variable:	pos_chg	**R-squared:**	0.009
Model:	OLS	**Adj. R-squared:**	0.009
Method:	Least Squares	**F-statistic:**	68.83
Date:	Fri, 16 Apr 2021	**Prob (F-statistic):**	1.27e-16
Time:	22:16:10	**Log-Likelihood:**	-17790.
No. Observations:	7279	**AIC:**	3.558e+04
Df Residuals:	7277	**BIC:**	3.560e+04
Df Model:	1		
Covariance Type:	nonrobust		

	coef	**std err**	**t**	**P$>\|$t$\|$**	**[0.025**	**0.975]**
Intercept	0.9939	0.071	13.947	0.000	0.854	1.134
stop	-0.2957	0.036	-8.296	0.000	-0.366	-0.226

Omnibus:	963.412	**Durbin-Watson:**	2.204
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	9564.628
Skew:	0.275	**Prob(JB):**	0.00
Kurtosis:	8.589	**Cond. No.**	5.26

Table 2: OLS Regression for all pit stops.

2.2 "Normal" Pit Stops

2.3 More-Than-Average Pit Stops

Average Driver Position at End of Race ———————————— All Pit Stops: 9.69 Control Pit Stops: 9.85 Extra Pit Stops: 9.07

What's up

Dep. Variable:	pos_chg	**R-squared:**	0.011
Model:	OLS	**Adj. R-squared:**	0.011
Method:	Least Squares	**F-statistic:**	62.79
Date:	Fri, 16 Apr 2021	**Prob (F-statistic):**	2.76e-15
Time:	22:16:10	**Log-Likelihood:**	-14212.
No. Observations:	5625	**AIC:**	2.843e+04
Df Residuals:	5623	**BIC:**	2.844e+04
Df Model:	1		
Covariance Type:	nonrobust		

	coef	**std err**	**t**	**P> |t|**	**[0.025**	**0.975]**
Intercept	1.3037	0.097	13.465	0.000	1.114	1.494
stop	-0.4738	0.060	-7.924	0.000	-0.591	-0.357

Omnibus:	638.114	**Durbin-Watson:**	2.171
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	5161.235
Skew:	0.227	**Prob(JB):**	0.00
Kurtosis:	7.671	**Cond. No.**	5.17

Table 3: OLS Regression for control pit stops.

Dep. Variable:	pos_chg	**R-squared:**	0.007
Model:	OLS	**Adj. R-squared:**	0.007
Method:	Least Squares	**F-statistic:**	11.41
Date:	Fri, 16 Apr 2021	**Prob (F-statistic):**	0.000748
Time:	22:16:11	**Log-Likelihood:**	-3505.9
No. Observations:	1539	**AIC:**	7016.
Df Residuals:	1537	**BIC:**	7026.
Df Model:	1		
Covariance Type:	nonrobust		

	coef	**std err**	**t**	**P> |t|**	**[0.025**	**0.975]**
Intercept	0.9418	0.201	4.675	0.000	0.547	1.337
stop	-0.2292	0.068	-3.378	0.001	-0.362	-0.096

Omnibus:	158.776	**Durbin-Watson:**	1.915
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	1100.240
Skew:	-0.172	**Prob(JB):**	1.22e-239
Kurtosis:	7.128	**Cond. No.**	11.0

Table 4: OLS Regression for more-than-average stops.

References

Asness, Clifford S, and Aaron Brown, 2018, Pulling the goalie: Hockey and investment implications, *Available at SSRN 3132563* .