AssRT2 Stats

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Introduction

In this document will be presented the statistical study made on the comparison of two robots running in the same circuit with the same obstacles to move on their path.

Hypothesis

The formulation of hypotheses in research is very important as it allows us to give life to new experiments or observations. Formulating a good hypothesis is fundamental as it allows us to simplify the understanding of what we have to do and makes the objective clearer even to those who observe from outside.

When we talk about hypotheses we cannot fail to refer to Null Hypothesis and Alternative Hypothesis, they are fundamental concepts regarding the comparison of multiple methods, in particular we identify with the Alternative Hypothesis (Ha) the one we want to accept and with the Null Hypothesis the one we want to refuse.

In this particular case we want to make a comparison on the speed of completing a lap of the track by the robots. The hypothesis I want to accept is that the robot provided by the professor completes the single lap faster than mine.

Consequently Ha: "Does the professor's algorithm allow the robot to complete a lap faster?"

Measurements

For each robot 30 measurements were made divided into three tracks whose differences are in the position of the obstacles to be moved. It was chosen to always keep the same number of obstacles so as not to influence the measurements too much which would not have been comparable in case of different number of obstacles between the tracks. Summarizing, for each robot 10 measurements were made in each circuit.

As indicated in the table in Figure 1 all the measurements are taken in seconds. The measurements are done adding in both the codes the use of the function time() and making a check on the starting point to know when the lap ends.

Statistics

The main statistical values obtained are the means, standard deviations and normal distributions.

	Measurements(s)			
	Robot 1	Robot 1	Robot 2	Robot 2
Track 1	258,89	267,72	170,33	175,91
	265,51	266.12	171,42	174,36
	268,44	260,23	175,53	171,26
	267,44	265,85	176,37	172,84
	264,7	268,1	170,73	174,77
Track 2	283,23	270,28	182,94	182,94
	267,09	275,34	177,04	178,27
	272,2	273,09	179,32	176,82
	268,54	271,45	180,45	177,35
	275,82	276,59	176,59	179,61
Track 3	265,77	274,67	172,11	173,22
	276,33	273,96	169,39	174,03
	275,18	272,51	174,31	172,41
	272,14	273,37	171,38	170,71
	270,3	275,44	173,2	171,82

Measurements

Figure 1: In this image we can see the table of the measurements

Means and Standard Deviations

Various averages were carried out, first of all the averages of the two robots were made in the individual tracks, then the averages were made on all 15 values obtained for each robot. The same thing was done for the standard deviations(see Figure 2).

	Means(s)	
	Robot 1	Robot 2
Track 1	265,2089	173,352
Track 2	273,363	179,133
Track 2	272,967	172,258
Total	270,6959	174,9143

Means

	Standard Deviation	
	Robot 1	Robot 2
Track 1	3,456163	2,3046031
Track 2	4,653792	2,3829209
Track 2	6,837723	1,5199766
Total	5,245179	3,6795799

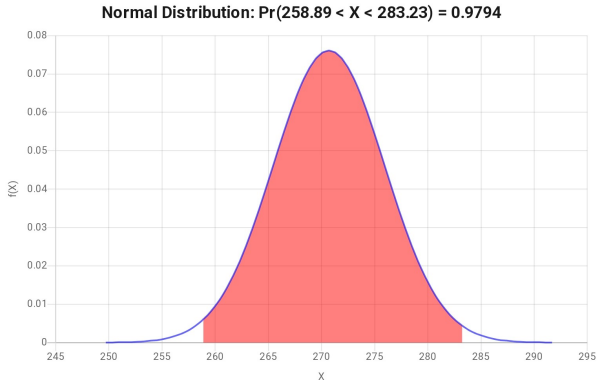
Standard Deviations

Figure 2: In this image we can see the table of the means and of the standard deviations

Taking a look at the averages relating to the individual tracks we can see that for both robots the second track took longer to complete. Furthermore we can also see how the average of the individual tracks, but also the total one, relating to the first robot are much higher than those relating to the second robot.

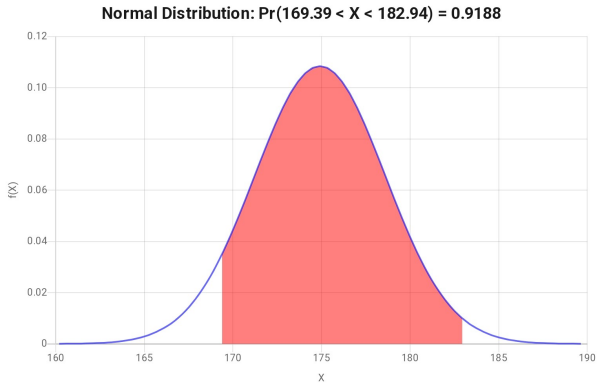
Normal Distribution

As far as the normal distributions are concerned, they have been made only by taking into consideration the means and the standard deviations calculated on the 30 values of each robot since for the purposes of the statistic that there are more significant values(see Figure 3 and Figure 4).



Normal Distribution Robot1

Figure 3: In this image we can see the Normal Distribution given by the mean and the standard deviation of the first robot measurements



Normal Distribution Robot2

Figure 4: In this image we can see the Normal Distribution given by the mean and the standard deviation of the second robot measurements

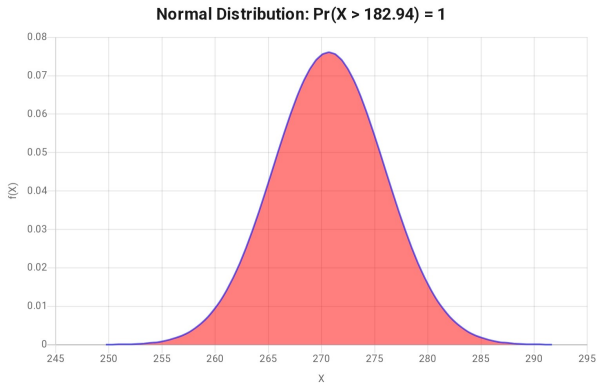
Test

To test if my hypothesis is actually right and acceptable, I use the One Tailed Test. I need to understand with what probability the professor's robot is faster than mine, so I take the highest value obtained from the simulation of robot2 (professor's robot) and calculate with what probability I can get a value greater than the one taken into consideration, this referring to the distribution calculated relative to robot1 (my robot).

The maximum value obtained by robot2 is 182.94s.
From this value we can calculate the Z value for the test:

Listing 1: Z value

```
1 X=182.94
2 mean=270.6959
3 ds=5.245179
4 Z=(X-mean)/ds=-16.73
```



Test

Figure 5: In this image we can see the probability that the first robot have to complete a lap in more than 182.94s

Conclusion

In conclusion, from what could already be deduced by comparing the collected data, the drone2 is about 96 seconds faster than the drone1. Hypothesis also graphically confirmed by the one tailed test, in which we see the normal distribution all in red, this means that robot2 will always be faster than robot1 as the probability that X2 (robot2 value)> X1 (valorer robot1) is equal to 1.