Research Track 2 assignment 3

Statistical analysis on first assignment

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# Hypothesis

The hypothesis made is the following: the algorithm we developed (A) is faster than the one another student did(B).

T is the time needed to sort all tokens

Null hypothesis: H0: TB = TA

Alternative hypothesis: Ha: TB > TA

# Description and motivation of the experimental setup

Une image contenant capture d’écran, diagramme, ligne, pixel

Description générée automatiquementWe will evaluate both algorithms in the case where the tokens are displayed in two circles without any obstacle. This is what the arena looks like:

We will start the timer when the robot starts moving and stop it when the robot will have ordered every token. We will take into consideration only successful runs, if the robot doesn’t order all the tokens correctly, this time will not count.   
We will make 25 iterations for each algorithm tested.

# Results

After conducting the tests for each algorithm, we registered the values analyzed them.

We will use a one tail test as we are only checking which algorithm the fastest. We just want to see if TB > TA.

First, the classmate’s algorithm, the average time needed to sort every token is 100,7 seconds. With the minimal time being 92 seconds and the maximum time 112.   
  
The average time for our algorithm is 84,5 seconds with a minimal time of 78 and a maximum of 102.

We then displayed the number of occurrences of each time for both algorithms:

We can also note that the standard deviations are similar for both algorithms (5,22 against 5,05 for our algorithm).

As we did only 25 iterations for each algorithm, the curves look closer to a T distribution that to a proper Z distribution. However, this is to be expected with less than 30 iterations.

In our case, we wanted our algorithm to sort the tokens quicker than the mean of the classmate’s algorithm in 95% of the cases. This means that 95% of our values should be under 100,7 seconds. This is a one tail test, in which only 5% of the values can be over 100,7s for the hypothesis to be validated.

We only have one value over 100,7 seconds which is 1/25 = 4%.

**96% of values**

**4%**

With those results, we could validate the alternative hypothesis. However, in our case we don’t really have a control group, we are comparing two very similar algorithm. Therefore, we will still do a statistical analysis in the next section to have more accurate results.

# Discussion of the results with statistical analysis

The statistical analysis chosen is the T-Test. We decided to use this analysis because we only have 25 values, and the repartition of those values is nearly normal.

As we do not have one single sample but two samples that we need to compare, we need to use the pooled standard deviation.

The T-value obtained for our sample is: 11.16. We followed this formula with the following values:

**t = (x̄₁ - x̄₂) / sqrt((s₁²/n₁) + (s₂²/ n₂))**

- average of classmate’s algorithm: x̄₁: 100.7s

-average of our algorithm: x̄₂ :84.48s

- standard deviation of classmate’s algorithm: s₁: 5.22

-standard deviation of our algorithm: s₂: 5.05

- sample size: n₁ / n₂: 25

The value we can find in the T-table for a confidence level of 95% with a degree of freedom of 48 (25+25-2) is 1.677.   
Now we compare our T-value to the value obtained in the T-table:   
11.16 > 1.677.

# 5. Conclusion

Based on the t-test analysis we performed, we can draw the following conclusions.

With a 95% confidence level, the t-test results indicate that there is a significant difference between the performance of our algorithm and our classmate’s algorithm in terms of speed. The null hypothesis, which stated that there is no significant difference, can be rejected in favor of the alternative hypothesis.

Therefore, based on the data and analysis, it can be concluded that our algorithm is faster than our classmate’s algorithm at least 95% of the time for the specific task being evaluated.