

JUMP!

Bekir Ufuk Haman
bekirhaman@iyte.edu.tr

November 2021

1 Introduction

Jumping from one place to another is an activity that we come across, voluntarily or involuntarily, at many points in our lives. Many sports involve jumping in various ways. Moreover, even in the Olympics, there is a discipline for long jumping. It appears that jumping has its place in our lives. So, what are the factors that affect jumping? Of course, there are features that instinctively come to mind. In this study, the effect of these features on the jumper score, which is the jump distance, was evaluated, ignoring the athletic characteristics of the jumper.

2 Variables

Name	- Setting	+ Setting
Security	with eyes closed	with eyes open
Balance	hands tied	hands-free
Motivation	not shouting	shouting

Table 1: Independent Variables

Numerous factors can affect the distance of a jump, such as ground conditions, weather, or the jumper's momentary performance. However, these noise parameters tried to be controlled by jumping several times under the same time and ambient conditions. This study focuses on three independent variables being; security, balance and motivation, and a dependent variable being jump distance. These variables are shown in Table 1 and 3. An example data can be seen in Table 2

Jump ID	Security	Balance	Motivation	Jump distance
001	+	+	-	135
...				
160	+	-	+	127

Table 2: Jump Table

All combinations of the three binary options create 8 different setups for the jump. Each jump setup being repeated ten times, a total of 80 standing forward jumps (a jump ahead that does not start with a run) will be performed, and the jump distance will be recorded in centimeters. Since the jumper's performance might gradually decrease with successive jumps, 80 jump setups will be executed in a random order so that the effect of possible performance drop due to exhaustion will be distributed equally to all setups, thus statistically eliminated.

Name	Value
Jump distance	cm

Table 3: Dependent Variables

3 Expected Results

Can a person jump forward with confidence without seeing the way ahead? Or, as a tennis player once said, does one have to shout to reveal their full potential? Can a bird fly with its hands tied? These are not questions for which it is difficult to foresee the answers. However, the truth will only be revealed with the results of the experiment. Our prediction about the results; for all three variables, the mean jump distance will increase in cases with the '+' setting. The most impactful independent variable would probably be security, while balance would be the least. Of course, predictions might not meet up with the data, for this is a low-budget experiment in which the same jumper will perform all jumps, and the number of jumps is limited to 80, which may not be enough to grasp the essence of the jumping.

4 Results

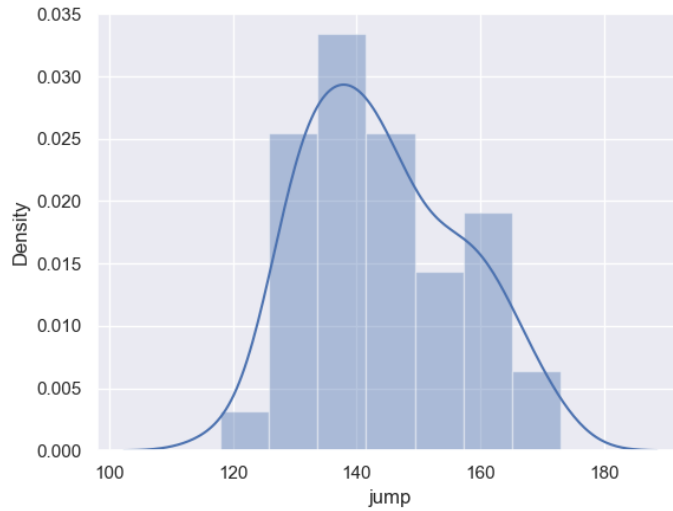


Figure 1: Jump Distance Distribution

It seems that the findings agree exactly with the predictions made before the experiment. The data distribution and the relationship between them were as expected, and the null hypothesis presented at the end of the document was rejected. It should be noted that this strong consistency of predictions to experiments raises the question of whether there is bias in the experiment. The fact that the person making the predictions is the same as the person making the jump is certainly not the combination that will lead us to the most independent and objective results however, the experiment was conducted this way anyway for convenience reasons.

4.1 Data Distribution

First, let's look at the overall distribution of all jumps in Figure 1. Distribution of all jumps based on jump distance is close to a normal distribution which is desired outcome. Main values for the jump data

can be observed below.

count : 80, *mean* : 144.30, *std* : 12.46, *min* : 118, *max* : 173

4.1.1 Feature Correlation

In Figure 2, a Pearson correlation table of the all of the variables can be seen. As expected, independent variables have zero correlation with each other. This is normal since we emphasised these values for them to be contain every possible arrangement among them. On the other hand, dependent variable jump distance, is in fact correlated with all the other variables. Moreover, as expected again, the most correlated feature is security, while balance being the least. This results fits exactly to the pre-experiment.

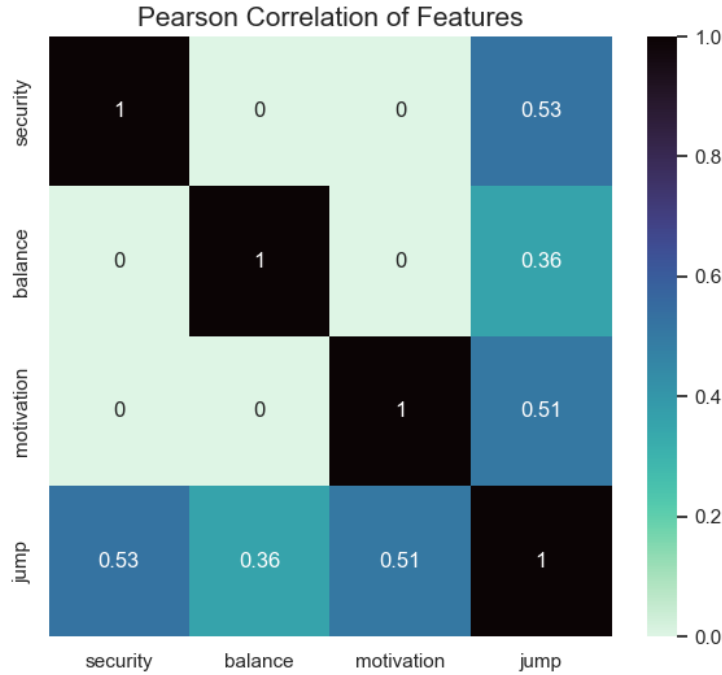


Figure 2: Feature Correlations

4.1.2 Mean Jump Distance

In figure 3, mean and distribution of the jump distance parameter on all three variables being security, balance and motivation are shown. As it can be seen, jumps with the $\{-\}$ setting parameters has lower mean value compared to the $\{+\}$ settings.

5 Jump Distance

In Figure 4 a scatter plot of jump distance over jump id is shown. Category *sbm* indicates a jump with security, (eyes open) balance (hands free) and motivation (shouting)'. Lack of any letter indicates the lacking of that conduct. For example, *bm* indicating a jump with balance (hands free), motivation (shouting) and without security (eyes closed). Moreover, *b* indicating a jump with balance (hands free), without security (eyes closed) and without motivation (no shouting).

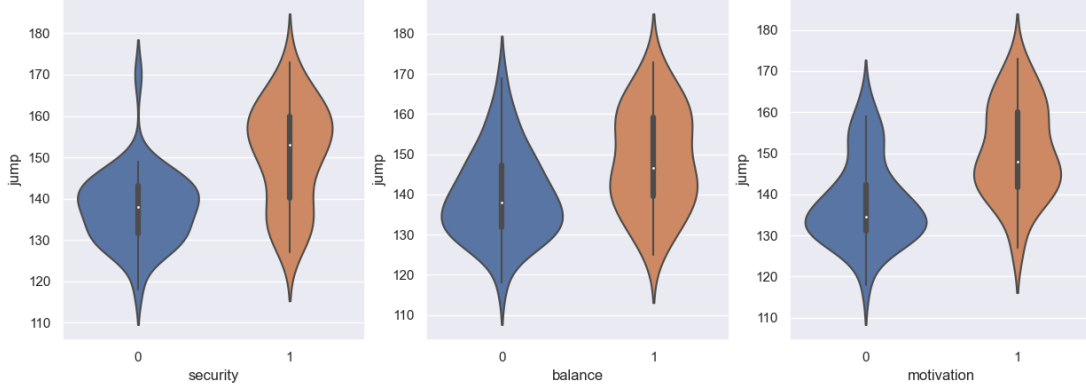


Figure 3: Mean Distribution of Jump Distance with Certain Features

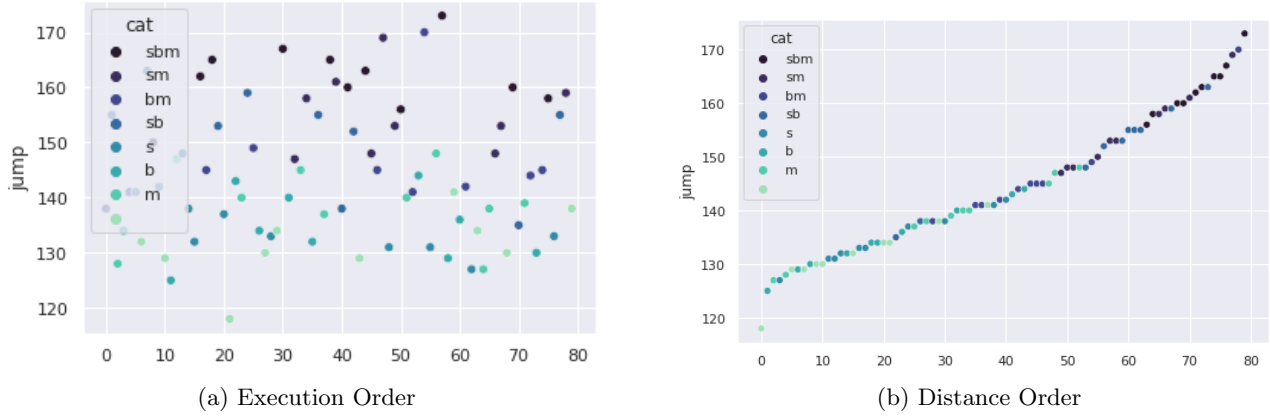


Figure 4: Jump Distances Grouped by Settings

While there are 8 total settings and 10 jumps for each setting, scatter plot shows the jump distances of all these jumps belonging to a certain setting. From Figure 4 (a) a distribution can be seen where dark dots are at the upper side (representing jumps with more $\{+\}$ settings) while the lighter ones are at the bottom generally. It can be seen much more clearly when we sort the dots by their jump value. This operation can be seen in Figure 4 (b).

6 Simple Hypothesis Testing

The null hypothesis is the mean jump distance of a regular jump (setting *sb* indicating a jump with balance (hands free), security (eyes open) and without motivation (no shouting)) will be the same as a jump with setting *m* (a jump without security and balance but with motivation). In conclusion, null hypothesis rejected with the p value of 0.0003. Details of the operation can be seen in code files beside the report.