Three design factors in this experiment:

|  |  |  |  |
| --- | --- | --- | --- |
| code | paper height(mm) | width-height ratio | leg length(mm) |
| -1 | 148.5 | 0.4 | 8 |
| 1 | 210 | 0.5 | 10 |



Unwanted noises:

1. The material property of papers may vary in each frog.
2. The humidity in air will affect the elasticity of paper.
3. The angle between the finger and a frog will vary in each jumping test.
4. The friction coefficient between frog and finger may change because of sweat on hand.
5. The finger’s force and placement on a frog will vary in each jumping test.

* X1: paper height
* X2: width-height ratio
* X3: leg length

factorial experiment:

|  |  |  |  |
| --- | --- | --- | --- |
| test | x1 | x2 | x3 |
| 1 | -1 | -1 | -1 |
| 2 | 1 | -1 | -1 |
| 3 | -1 | 1 | -1 |
| 4 | 1 | 1 | -1 |
| 5 | -1 | -1 | 1 |
| 6 | 1 | -1 | 1 |
| 7 | -1 | 1 | 1 |
| 8 | 1 | 1 | 1 |

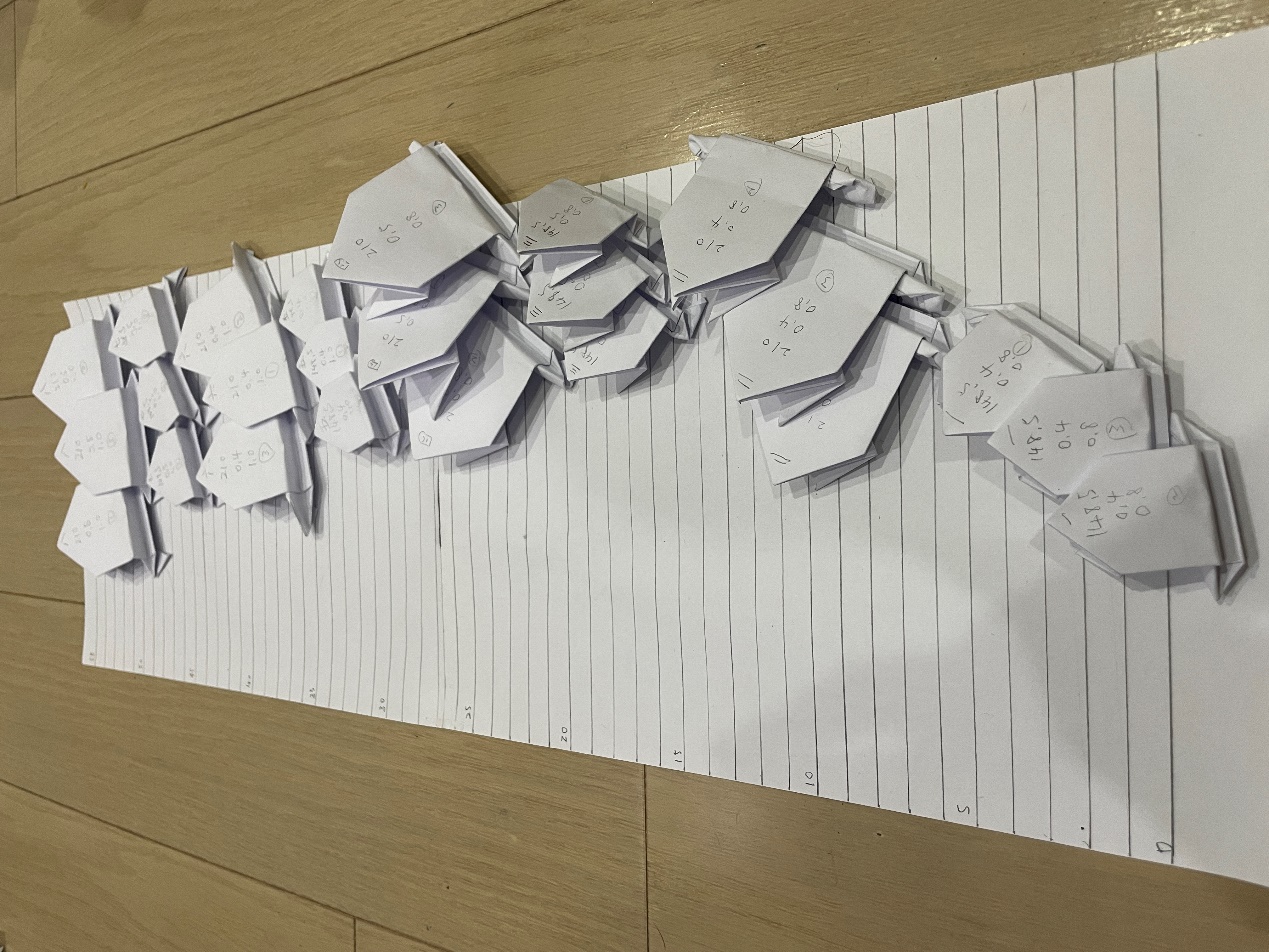
In my experiment, I will create three identical frogs for each combination of factors. To ensure randomization, I will randomize the order of the jumping trials instead of following a fixed sequence for each run. Since there are three runs, each frog will perform three jumps.

Experiment table:

How to handle the noises:

* To prevent I using my fingernails to press paper frogs, I always cut my nails before I do experiment.
* Do more replication and randomize the experimental trials to make noises more uniformly and more randomly distributed.







Experiment details:

* Day: 6/10 Monday
* time: 11:00pm~12:30pm
* place: home
* witness: 王邑宇 (reason: he is my brother)

measurement method:

* Measurement plate: Design a plate with markings ranging from 0 to 55 cm (as the picture in 4.)
* Align frogs: Position each paper frog so that its rear edge aligns with the zero line on the measurement plate before each jump.
* Execute a jump: Use fingertip to press down on the back of the frog and release it to initiate the jump
* Valid jumps: If the frog rolls or bounces twice or more, disregard the result and perform the jump again.
* Distance measurement: For each valid jump, measure the shortest distance between the zero line and the landing point of the frog. This distance is the result for that trial.

experiment result:



Parameters of this experiment:

Average and sample variance in each test:



Effect coefficient:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| E1 | E2 | E3 | E12 | E23 | E13 | E123 |
| -69.4444 | -38.8889 | 9.444444 | 52.22222 | 25.55556 | -15 | 6.111111111 |

Assuming all effects are null effect:

Degree of freedom for t-test:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | t-test | p-value | t\_64,0.025 | t\_64,0.975 |
| E1 | -69.4444 | -10.0616 | 8.28E-15 | -1.99773 | 1.997729654 |
| E2 | -38.8889 | -5.63448 | 4.23E-07 | -1.99773 | 1.997729654 |
| E3 | 9.444444 | 1.368373 | 0.17598 | -1.99773 | 1.997729654 |
| E12 | 52.22222 | 7.566296 | 1.88E-10 | -1.99773 | 1.997729654 |
| E23 | 25.55556 | 3.702656 | 0.000446 | -1.99773 | 1.997729654 |
| E13 | -15 | -2.1733 | 0.033465 | -1.99773 | 1.997729654 |
| E123 | 6.111111 | 0.885418 | 0.379246 | -1.99773 | 1.997729654 |

reject , they are significant factors.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| source of variation | SS | DOF | MS |  |  |
| E1 | 86805.56 | 1 | 86805.56 | 100.2381 | 3.986269 |
| E2 | 27222.22 | 1 | 27222.22 | 31.43468 | 3.986269 |
| E12 | 49088.89 | 1 | 49088.89 | 56.68507 | 3.986269 |
| E23 | 11755.56 | 1 | 11755.56 | 13.57465 | 3.986269 |
| E13 | 4050 | 1 | 4050 | 4.676711 | 3.986269 |
| error | 57155.56 | 66 | 865.9933 |  |  |
| total | 236077.8 | 71 |  |  |  |



Suppose that residuals are normal distributed. The parameters of normal distribution are and

* Rank each residual from 1~72
* The c.d.f. of effect is:
* The normal distribution value of effect:

Plot the residuals vs. run orders:

Plot the residuals vs.

Plot the residuals vs. :

Plot the residuals vs. x1:

Plot the residuals vs. x2:

Plot the residuals vs. x3:

Bartlett’s test ():

Reject if :



SN ratio: Larger-the-best