A) what the data/sources you used and how it was collected B) what the research question was C) what analysis/summary you did and why D) what the results are E) what implications you think there are F) what limitations there are in what you did.

Target population: paper airplanes

Experimental unit: one paper airplane

Paper airplane: <https://en.wikipedia.org/wiki/Paper_plane>

Paper Aeroplan design: <https://www.origamiway.com/paper-airplane-designs.shtml>

Aerodynamics: <https://en.wikipedia.org/wiki/Aerodynamics>

Background information:

* Aerodynamics theory, which is influenced by weight and the shape of a flight, therefore, we are interested in investigating which design X texture combination shows the furthest flying distance without external disruption. In other words, which combination has the best aerodynamics shape.
* Current study, we are using four types of airplane design, and two paper textures: lined notebook paper and printing paper;
  + Paper texture: because they have different weights
  + Design: each design has a unique aerodynamic shape; different centre of gravity (CG)
  + Control:
    - we control the size of paper (A$4 – inches) between two paper texture levels
    - Indoor, to eliminate the effect of wind; same location;
  + Blocking:
    - Throwing order of the designs;
  + Randomization:
    - Thrower: rotating among 5 people, each person throws each design for 5 times, therefore, to eliminate noise;
  + Single blind:
    - People will close their eyes when throwing, to control bias;
* Hypothesis:
  + Different design has difference effect on the flying distance
  + Interaction effect?
* Sample size: 8 designs;

Method:

The current experiment deployed a 4 by 2 between-subject factorial design. The first factor is the airplane design, which includes 4 different designs: Hammer, Dart, Nakamura, and Professional. Meanwhile, the second factor is paper texture, we used printing sheet and lined notebook sheet. These two different types of sheet have different weights (4.5 grams and 4.2 grams), but the same dimension (e.g., 8.5 inches \* 11 inches). Therefore, we generated a total of 8 (2 X 4) different designs. The target population contains all types of paper-crafted airplane; the current sample includes the 8 various paper airplanes mentioned above. Please refer to appendix A for the pictures of each design. The current experiment is a between-subject design, since each experiment unit (e.g., each airplane) represented an experiment treatment. In other words, an airplane couldn’t qualify the requirements of two treatments.

**Procedure:**

In the airplane creating phase, the group discovered four different types of design from this paper craft design website (<https://www.origamiway.com/paper-airplane-designs.shtml>), and we randomly chose four different types of design as the four targets, by using excel randomization function. One group member made all 8 designs by following the online instruction, therefore, we eliminated random noise produced by between person difference in making airplanes.

The following step is experiment conduction, we assigned 5 group members to be airplane throwers, and the rest are responsible for distance measuring. Considering individual difference or random errors, we used the average of these two measures as the results. Due to similar reason, we employed 5 throwers, and each person threw each design for 5 times. Noteworthy, since we expected that thrower would get physically tired after throwing planes, we randomized the throwing order among 40 trials (8 design X 5 throw).

In the experiment design procedure, we utilized multiple methods to incorporate the principles of an experiment. First, we controlled the size of each piece of paper and airplane throwing location to eliminate external variance. Second, the randomized throwing order also eliminate unwanted errors. For example, since 40 throws took around 10 minutes to complete, we concerned that some throwers would get physically tired, which could interreference the throwing force of later trials. Third, we asked each thrower to close their eyes when they are throwing an airplane. This is consistent with a blindness design, which eliminated a thrower’s bias towards one experiment unit.