Paper Helicopter Design and Analysis

MATH 740

Nick Bealo

Kris Fargo

Erik Gustafson

Brad Olsen

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# Methods

The material selected for the paper helicopter was file folder cardstock. For this size sheet, and with the intent of using the full size we picked maximum values for the nose length, rotor length, and rotor width. We then decided on minimum dimensions that would give a significant difference to the maximum and remain functional.

To significantly reduce error in the construction of the helicopters, a laser cutter was used to cut the profile dimensions specified out of the paper. To remove more variability between samples, the same paperclip was used for all of the units and a plum bob was used to mark the landing point at exactly 120 inches below the drop point. Each unit was dropped with the same technique by holding the ends of the rotors. We also instituted mock subsampling by repeating the same drop three times and taking the average of each value of drop time and radial distance from the ideal landing point. The drop time was converted to velocity in inches per second. To allow for more consistency the distance value was measured from the end of the nose of the helicopter’s original landing point to the floor marker, to remove error caused by the helicopter sliding on the ground after making contact.

For analysis, a JMP DOE generated table was filled which utilized a full factorial design. The factorial design incorporated 3 continuous factors, rotor width, rotor length, and nose length as given in the design constraints of the project. 3 center points were specified when creating the table format. The minimum and maximum bounds were entered as shown in Table 1 below.

|  |  |  |
| --- | --- | --- |
|  | Minimum (in) | Maximum (in) |
| Rotor Length | 3 | 6 |
| Rotor Width | 1.5 | 4.25 |
| Nose Length | 2 | 4 |

Table - Dimensional Constraints

The Fit Model tool in JMP was then used to analyze the resulting effects of velocity and distance individually. The model analysis results included the actual by predicted plot to check for linearity, as well as effect summary, and effect tests. The results also showed a prediction profiler for each of the factors, which was also independently viewed in the graph profiler tool in JMP.

# Results

Asdasd

Velocity – linear, strong response is rotor width, remove every factor except rotor width and nose length

Distance – non-linear, rotor length

# Conclusion

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