Design of Experiments and Optimization project

Paper helicopters[1] (120312)

The objective of this assignment is to investigate four design factors and their influence on flight time of a paper helicopter. The objectives are to show *(1) which of the four factors are statistically significant*, and *(2) find the optimal factor settings for maximum flight time*. The project has to be performed as a team.

Response:

- Flight time in seconds.

Design factors:

- Wing width, levels 1 – 5 (select the right sheets).
- Wing length, levels 1 – 12 (cut sheet to desired length).
- Body length, levels 1 – 12 (cut sheet to desired length).
- Increased body weight by paperclip, levels no – yes.

A helicopter is made by the following steps:

1. Cut the wing and body to the right length (broken thin lines).
2. Cut the lines on the body (solid, bold lines only).
3. Fold the body close (broken solid lines).
4. Staple the body (try to use the approximate same spot in all experiments, see marking).
5. Increase body weight by adding a paperclip (if desired; see marking).
6. Fold the wings (broken line outwards, dashed line inwards).

To run an experiment (requires at least two persons):

1. Operator one drops the helicopter, with two hands, keeping the wings carefully stretched out (try to do this reproducible). Make sure the helicopters are released from the same height each time for a fair comparison.
2. Operator two times the duration between release and first contact with the ground with a stopwatch.
3. Remember to note down the flight times.

[1] Based on: G. Box "Teaching Engineers Experimental Design With a paper Helicopter" Quality Engineering v.4/no.3(1992)453-459

Assignment:

- Make a plan with your team. Discuss how you are going to start the experiment. Think about the cost/workload of your experimental design.
- Remember the 25/75 rule. Consider the role analytical/measurement replicates (testing the same helicopter multiple times) versus technical replicates (building the same paper helicopter multiple times). And how will this potential uncertainty influence your design?
- You can use JMP or your own knowledge to build the experimental design, but remember to evaluate and discuss the suggested experimental coordinates/points with your team before starting the work.
- Note your results down in an Excel worksheet. This way you can systematical keep track of the results (and costs!), make quick calculations and plots of the results, directly import the findings into JMP for analysis, and expand the design if desired.
- Use the JMP software to perform significance testing on your data and to investigate expansion of your experimental domain.