**HW08 Measurement**

This assignment should be submitted to the Blackboard by 03/31 midnight.

Second part of the chapter 08 homework will be assigned on 04/01, will be due by 04/05.

You will be submitting the paper copy of two assignments on 04/06 or 04/08.

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. **Helicopter Experiment**

Please conduct the following experiment after finish reading the entire instruction. You need to use a printer. In case you do not have a printer, please approximate the size and dimension.

Assuming that you are responsible in examining the **flight time** and **landing accuracy** of the newly designed O-334 helicopter.

* Please see the attached PDF. First, please make one O-334 helicopter. (The materials and the instructions to build the helicopters are in the first and the second page.).
* Please print out the third page. It will serve as a landing platform.

Once the helicopter and the landing platform are ready. Please start the experiment by following these steps:

* Go somewhere does not have much air flow (even A/C can generate air flow). Place the landing platform on the floor.
* You will be dropping the helicopter for 6 times.
* Drop the helicopter from about 6 feet height. By the way, please aim the landing platform. Please try your best to keep the height of the dropping point consistent each time.

Questions for Discussion:

1. Insert a photo of your O-334 below.
2. Basically, you need to find a way to measure what you want to know. What type of variable or/and attribute measurements can you use to measure the landing accuracy and total flight time? What would be the scale of those measurements? (Hint: measurement scale can be nominal, ordinal, or interval. Or simply, binary, count, or actual exact unit.)

*Note: if this question is not clear to you, you need to understand different type of measurements first. Don’t fill in arbitrary answers.*

1. Please record and write down all the measurement data and report them using the table at the end.

Data Generated from the Experiment:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Your Measurement Choice | Scale | Drop # | Summary Statistics |
| 1 | 2 | 3 | 4 | 5 | x̅ | s |
| Landing Accuracy |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Landing Speed |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |

1. What did you find out (e.g., lessons learned, unexpected discoveries) about the measuring outcomes? Was measuring those harder than imagined or easier? In order to conduct a serious study (that studies the flight time and the landing accuracy of similar equipment), what are your recommendations?
2. A battery manufacturer makes batteries with 310 mAH of capacity on average, with 13 mAH in standard deviation. A potential client has approached and was hoping to see if the machine can be used to satisfy a specification of [261, 339].
	1. What is the current Cpk and DPMO?
	2. The machine can be adjusted to change its mean capacity to whatever value in $ 20,000 single time cost. Changing the standard deviation requires huge upfront cost, therefore, they are not considering the option at this time. The client is wishing to place a single time order of 25,000 units of battery. Each unit is expected to return $ 1 profit. Each defective unit will cost the manufacturer $ 0.5
3. First, please evaluate the feasibility. Is it possible for firm to meet the specification without generating too much defects with the mean process adjustment? What is the best possible Cpk and DPMO through the adjustment (remember standard deviation is not changing)?
4. Second, can it (adjustment) be justified financially? Please discuss as best as you can.
5. A soft-drink bottle filling facility has been operating in the region PIKE for the past three decades. Recently, the facility replaced the existing filling systems with new systems. While the contractor firm who was responsible for the replacement project promised the machine will be functioning “really really well”, the firm needed to know more about the characteristics of the process. There were total two machines replaced. The process characteristics study data are provided in a separate Excel spreadsheet. Their primary customer is looking for the following specifications: 16.9 ± 0.18

*For question 1) ~ 3), please complete in Excel, then fill in all the answers in the table comes in the next page. In your submission, please also attach your Excel file as a reference.*

1. Please analyze each column of data separately. Please construct the histograms for each column to discuss what is the mean, standard deviation, and the shape of the distribution. Hint: one of the machines is operating more like a uniform distribution. In case of a uniform distribution, its mean is $\frac{1}{2}(max + min)$, the variance is $\frac{1}{12}(max - min)^{2}$
2. Assuming the sample results are a very good representation of the actual working condition, what is the DPMO for both systems? Also, for both systems, please find out the Cpk. (Hint: the specifications are provided in the description)
3. Assuming the loss function constant is k = 8, which machine will generate a greater loss?

Please fill all the blanks in the table below

(You should have already calculated all of them)

|  |  |  |
| --- | --- | --- |
|  | **Machine A** | **Machine B** |
| Mean |  |  |
| SD |  |  |
| Shape |  |  |
| LSL |  |  |
| USL |  |  |
| Cpk |  |  |
|  Cpu |  |  |
|  Cpl |  |  |
| Proportion Defect |  |  |
|  Too small |  |  |
|  Too big |  |  |
| DPMO |  |  |
| *k* |  |  |
| Variance |  |  |
| Deviation^2 |  |  |
| Expected Loss |  |  |

1. Which system is a better system? What is your conclusion when you compare two systems using the Cpk? Does that conclusion sustain when DPMO is being used for the comparison? What about when the expected loss is being used for the comparison? Please briefly discuss this issue by explaining the definition of Cpk, DPMO, and EL in your own words and advise me on which measurement should be used in order to determine which one is a better system.