UMLID→ 0198309 2

Assignment 1

Please respond to ALL OF the first three Discussion Posts (Discussion Topics) 1, 2 and 3 in pages 42/43. There will be similar questions in the midterm exam, so choose your numbers carefully according to your UML ID last digit (if >5 then subtract 5 from it). Here is the three discussion posts.

1. If you followed Taguchi's principles, and you wanted to investigate a design with 5 factors at 2 levels, how many experiments do you need? How many would you need if you used 5 factors at 2 levels in Classical Statistics with full factorial experiments; half factorial as well as Saturated ? Some of the students can try their own numbers such as 3 factors at 2 levels; 2 factors at 2 levels; 2 factors at 3 levels, 3 factors at 3 levels, etc… I would like each student to have a unique set of factors and levels so I can be sure that everyone understands the Taguchi principles in DoE.
2. If your company policy decided on a Cp = 1.33 design, what is the Specification limit are going to be equal to in terms of number of σ? And what is the expected defect rate in the product (use the Normal Standard Distribution Table available in Week file list). Some of the students can try their own numbers such as Cp = 1.67, Cp = 1, etc… I would like each student to have a unique Cp so I can be sure that everyone understands the Cp concept in Six Sigma,
3. According to the example of taking the defect rate and translating it into a Cpk (assuming that the specification limits are two sided and the average = design nominal), what is the equivalent Cpk for a defect rate of 5 units per 1000 tested? Some of the students can try their own numbers such as 6 defect rate per 1000 tests etc… I would like each student to have a unique reject rate translated into Cpk, so I can be sure that everyone understands the Cpk concept in Six Sigma and it relation to defect rates.

1. If you followed Taguchi's principles, and you wanted to investigate a design with 5 factors at 2 levels, how many experiments do you need? How many would you need if you used 5 factors at 2 levels in Classical Statistics with full factorial experiments; half factorial as well as Saturated ? Some of the students can try their own numbers such as 3 factors at 2 levels; 2 factors at 2 levels; 2 factors at 3 levels, 3 factors at 3 levels, etc… I would like each student to have a unique set of factors and levels so I can be sure that everyone understands the Taguchi principles in DoE.

a) 5 factors at 2 lvls.

no. of experiments (full factor) $= (\text{no. of levels})^{\text{no. of factors.}}$

∴ for a 5 factor, 2 lvl design

we need
- → 2^5 (i.e 32 full-factorial experiments)
- → $\frac{2^5}{2}$ (i.e 16 half-factorial experiments)
- → 8 Saturated experiments.

b) I choose to try 2 factors, 3 level design

we need
- → 3^2 (i.e 9 full-factored experiments)
- → 9 half-factor experiments
- → 9 Saturated experiments.

2. If your company policy decided on a Cp = 1.33 design, what is the Specification limit are going to be equal to in terms of number of σ? And what is the expected defect rate in the product (use the Normal Standard Distribution Table available in Week file list). Some of the students can try their own numbers such as Cp = 1.67, Cp = 1, etc… I would like each student to have a unique Cp so I can be sure that everyone understands the Cp concept in Six Sigma,

Sol:-

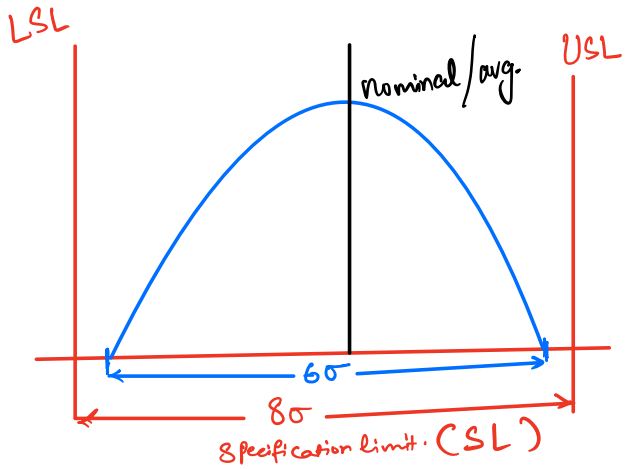
$$C_p = \frac{USL - LSL}{6\sigma} = \frac{\pm SL}{\pm 3\sigma}$$

i) for $C_p = 1.33$

$$1.33 = \frac{\pm SL}{\pm 3\sigma} \Rightarrow \text{Specification limit} = \pm SL = 3 \times 1.33 \approx \pm 4\sigma$$

for $Z = -4$; $f(z) = 32 \times 10^{-6}$ (for one side)

$\Rightarrow$ for both sides, the total defects will be 64×10^{-6} (or) 64 ppm



ii) I will try $C_p = 2$ (last digit of my UML ID)

$$SL = 2 \times (\pm 3\sigma) = \pm 6\sigma \quad / \quad Z = -6$$

for $Z = -6 \rightarrow f(z) = 99 \times 10^{-11}$ & for 2 sides it is 198×10^{-11}

$\Rightarrow$ 198×10^{-11} defects out of 1

3. According to the example of taking the defect rate and translating it into a Cpk (assuming that the specification limits are two sided and the average = design nominal), what is the equivalent Cpk for a defect rate of 5 units per 1000 tested? Some of the students can try their own numbers such as 6 defect rate per 1000 tests etc… I would like each student to have a unique reject rate translated into Cpk, so I can be sure that everyone understands the Cpk concept in Six Sigma and it relation to defect rates.

Sol:- → $\mu \rightarrow$ Nominal.

$$Z = \frac{x-\mu}{\sigma} = 3 \times C_p = 3 \times C_{pk}$$

$f(z)$.

$\therefore$ Total defects $= \frac{5}{1000} = 0.005 = 0.0025$ (one side)

$[2 f(z)]$

↓

Corresponds to $-2.81 \rightarrow Z$

$$\Rightarrow C_p = \frac{Z}{3} = \frac{2.81}{3} = 0.936 < 1$$

(Not feasible)

I would try

→ 5 in 100,000

$$\Rightarrow f(z) = \frac{5}{2 \times 100000} = 0.000025$$

↓

Corresponding Z value is -4.05

$$\Rightarrow C_{pk} = \frac{|Z|}{3} = \frac{4.05}{3} = 1.35 > 1$$

(Acceptable).