Solution Homework #6: Process Control

2.008 Design and Manufacturing II
Spring 2004

Problem 1

You are responsible for two different manufacturing lines, both of which produce arms for Karl´s Mechanical Squid. The Upper Specification Limit of the line is 3.52 and the Lower Specification Limit is 3.18. Line 1 produces arms with a μ of 3.35 and an σ of 0.07. Line 2 produces arms with a μ of 3.43 and an σ of 0.05.

a) For Line 1: what is the C_p? What is the C_{pk}?
   For Line 2: what is the C_p? What is the C_{pk}?
b) Which line produces a greater percentage of parts within the specification limits? What are the exact percentages for each line?

Solution

a) Line 1:

$$C_P = \frac{3.52 - 3.18}{6 \bullet 0.07} = 0.81$$

$$C_{Pk} = \frac{z_{min}}{3} = \frac{3.35 - 3.18}{3 \bullet \sigma} = 0.81$$

Line 2:

$$C_P = \frac{3.52 - 3.18}{6 \bullet 0.05} = 1.13$$

$$C_{Pk} = \frac{z_{min}}{3} = \frac{3.52 - 3.43}{3 \bullet \sigma} = 0.6$$

b) Line 1:

$$z_{UCL} = \frac{UCL - \mu}{\sigma} = \frac{3.52 - 3.35}{0.07} = 2.43$$

$$z_{LCL} = \frac{LCL - \mu}{\sigma} = \frac{3.18 - 3.35}{0.07} = -2.43$$

Using the table on slide 17 lecture 15 ("Quality"): $P(z<z_{UCL}) = 0.9925$
Using the table on slide 16 lecture 15 ("Quality"): $P(z<z_{LCL}) = 0.0075$
Percentage of parts within the specification limits: P=(0.9925-0.0075)*100% = 98.5 %

Line 2:

$$z_{UCL} = \frac{UCL - \mu}{\sigma} = \frac{3.52 - 3.43}{0.05} = 1.8$$

$$z_{LCL} = \frac{LCL - \mu}{\sigma} = \frac{3.18 - 3.43}{0.05} = -5$$

Using the table on slide 17 lecture 15 ("Quality"): $P(z<z_{UCL}) = 0.9641$
$P(z<z_{LCL}=-5) \approx 0$
Percentage of parts within the specification limits: P=0.9641*100% = 96.41 %

→ Line 1 produces a greater percentage of parts within the specification limits!