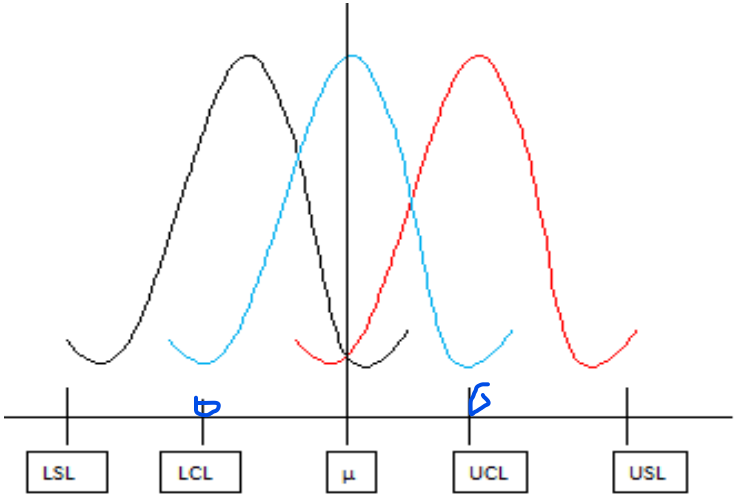
PROCESS CAPABILITY INDEX

Process Capability



C_P = (USL – LSL)/(UCL- LCL)

= (USL – LSL)/6σ

Industry desired value of Cp is 1.33.

The curve with red color is likely to face no rejection as it is falling only on upper limit.Failure rate is on the lower side.

The opposite of the above occurs but failure rate is on the upper side for the curve with black.

Though in both the above, the central tendency has shifted but dispersion remains same for the curve with blue color.

Thus, PCI of red and black curves:-

PCI_{red} = (USL – LSL)/(UCL - LCL)

PCI_{black} = (USL- LSL)/(UCL-LCL)

Specification limits are decided by the designers whereas control limits are decided by consumers. Both are independent of each other.

Redefined $C_p = C_{pk} = \min\left[\frac{USL-\mu}{3\sigma}, \frac{\mu-LSL}{3\sigma}\right]$

$$C_{pm} = \frac{USL-LSL}{6\sqrt{\sigma^2+(\hat{u}-T)^2}}$$

$$= \frac{USL-LSL}{6\sigma\sqrt{1+\left(\frac{\mu-T}{\sigma}\right)^2}}$$

$$= \frac{Cp}{\sqrt{1+\left(\frac{\mu-T}{\sigma}\right)^2}}$$

$$C_{pkm} = \frac{Cpk}{\sqrt{1+\left(\frac{\mu-T}{\sigma}\right)^2}}$$

A problem data

- Consider a Quality Characteristic with target of 100 units (UoM) and upper and lower specification limits of 105 and 95 units and compute Cpm and Cpkm

$$C_{pm} = \frac{\text{USL} - \text{LSL}}{6\sigma\sqrt{1+\left(\frac{\mu - T}{\sigma}\right)^2}}$$

$$= \frac{10}{6*1\sqrt{1+\left(\frac{99-100}{1}\right)^2}}$$

$$= \frac{10}{6\sqrt{2}} = 1.17$$

$$C_{pkm} = \frac{\text{Cpk}}{\sqrt{1+\left(\frac{\mu - T}{\sigma}\right)^2}}$$

$$= \frac{1.33}{\sqrt{1+\left(\frac{99-100}{1}\right)^2}}$$

$$= \frac{1.33}{\sqrt{2}}$$

$$=0.94$$

When $T=\mu$

Then $C_p=C_{pk}=C_{pm}$

If the process is centered then number of defectives will be 0.002 ppm (parts per million). Therefore, this reduction in σ is forcing the system to reduce the process variable.

If the process is not centered and is with a process wriggle (shift) of 1.5σ then number of defectives will be 3.4 ppm (nearly zero) or zero defect.