Questions Module 3.2

In the text box beside each characteristic, enter the letter of the appropriate type of limit:

a for Control Limits
b for Specification Limits

Scroll down if necessary and click the **Check My Answer** button. The correct answer will display below the button.

- [ ] used to determine whether product is good or bad
- [ ] calculated from data
- [ ] can be based on subgroup means
- [ ] defined by the customer
- [ ] calculated based on observed variability
- [ ] defines a range of acceptable values

Incorrect.
The correct answers from top to bottom are **b**, **a**, **a**, **b**, **a**, **b**. Control limits are calculated from data, can be calculated based on subgroup means, and are calculated based on observed variation. Specification limits are used to determine whether product meets expectations or requirements, are defined by an internal or external customer, and define a range of acceptable values. This range of values is sometimes called the tolerance.

In the box beside each capability index, enter the letter for the correct description of the process centering and spread.

1. $C_p = 0.8$ and $C_{pk} = 0.5$	a. The process mean is outside the spec limits, and the process spread is the same as the width of the spec limits.
2. $C_p = 1.5$ and $C_{pk} = 1.5$	b. The process is off-target, and the process spread is wider than the spec limits.
3. $C_p = 1.0$ and $C_{pk} = -0.5$	c. The process is on-target, and the process spread is narrower than the spec limits.

Incorrect.
The correct answers from top to bottom are **b**, **c**, **a**.

Calculate C_pCp and C_{pk}Cpk for this process using the formulas below. Scroll down if necessary and click the **Show Answer** button. The correct answer will display below the button.

Mean = 32
Standard Deviation = 1.5
Lower Spec = 25

Upper Spec = 35

$$C_p = \frac{USL - LSL}{6s}$$

$$C_{pl} = \frac{\overline{X} - LSL}{3s}$$

$$C_{pu} = \frac{USL - \overline{X}}{3s}$$

$$C_{pk} = \min\{C_{pl}, C_{pu}\}$$

The correct answer is $Cp=1.11$Cp=1.11 and $Cpk=Cpu=0.667$Cpk=Cpu=0.667.

Consider a stable process with these capability indices: C_p = 1.4 and C_{pk} = 0.5. Your team is tasked with improving this process. Which of the following should you focus on first?

- *a.* Reducing the variability.
- *b.* Shifting the process to target.
- *c.* Nothing. Leave the process alone.
- *d.* Both reducing the variability and shifting the process to target.

Incorrect.
The correct answer is **b**. The C_p is 1.4, so the potential capability is good, but C_{pk} is much lower than C_p, so the process is off target.

You conduct a capability study and calculate the following indices: Short-term C_p = 1.5 and long-term C_p (or P_p) = 0.9. How do you interpret this?

- *a.* You have a lot of within-subgroup variability.
- *b.* You have a lot of common cause variation.
- *c.* Your process is unstable; you have special cause variation.

Incorrect.
The correct answer is **c**. If the long-term estimate of capability is lower than the short-term estimate of capability, your process is unstable.

This question relates to sample size, which we haven't directly discussed in this lesson. In the **Metal Parts** example we have 25 subgroups, and we use data from these subgroups to estimate the short-term and the long-term capability.

In general, which of the following would give us a better, or more precise, estimate of process capability?

- *a.* using data from 5 subgroups
- *b.* using data from 25 subgroups
- *c.* using data from 50-100 subgroups
- *d.* not using rational subgroups

Correct.
In statistics, we use data to estimate unknown parameters. Sample capability indices are point estimates for the true, unknown capability. The more data we have, the more precise our estimates. Capability indices are highly variable. So we need a reasonable amount of data to calculate reasonable estimates.