CP SEES SPREAD. CPK SEES THE SHIFT.

Calculate Cp and Cpk for a stable, normally distributed process and explain why they differ.

THE DECISION PATH

1 Check the conditions

Establish process stability and whether the normal model is appropriate. Specification limits express requirements; they are not control limits.

[S1, S2]

2 Compare total widths

Cp compares specification width with six standard deviations. It does not account for an off-center mean.

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Cp = (USL - LSL) / (6σ)
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[S1]

3 Check the nearer limit

Cpk uses the smaller standardized distance from the mean to either specification limit. Keep the smaller value, not their average.

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Cpk = min[(USL - μ)/(3σ), (μ - LSL)/(3σ)]
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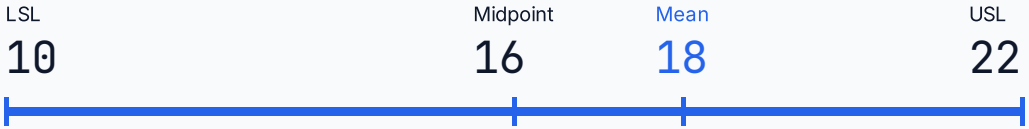
[S1]

WORKED EXAMPLE / ORIGINAL STUDYMAPS SCENARIO

The spread fits; the mean has moved

Assume a stable normal process with LSL = 10, USL = 22, mean μ = 18 and standard deviation σ = 2. All values use the same measurement unit.



1. Specification width: 22 - 10 = 12. Process width: 6 × 2 = 12.
2. Cp = 12 / 12 = 1.00.
3. Upper side: (22 - 18) / 6 = 0.67. Lower side: (18 - 10) / 6 = 1.33.
4. Cpk = min(0.67, 1.33) = 0.67, rounded to two decimals.

RESULT

Cp = 1.00; Cpk = 0.67. The upper limit is closer.

Principles: [S1]. Original example: StudyMaps.

Catch this mistake A favorable Cp alone does not establish acceptable process performance. A shifted mean reduces Cpk; neither index replaces stability checks or customer requirements.

CLOSE THE BOARD. SHOW YOUR WORKING.

02

Recall and apply

Original practice problems. Answer key on page 3.

PRACTICE 1

Assume a stable normal process: LSL = 40, USL = 60, μ = 50, σ = 2. What are Cp and Cpk?

A. Both 1.00
B. Cp = 1.67, Cpk = 0.83
C. Both 1.67
D. Both 3.33

PRACTICE 2

Keep LSL = 40, USL = 60 and σ = 2, but move μ to 56. What is Cpk? Assume stability and normality.

A. 0.67
B. 1.00
C. 1.67
D. 2.67

PRACTICE 3

The process shows special-cause variation. What should precede a routine capability conclusion?

A. Ignore the instability if Cp exceeds 1
B. Replace specification limits with control limits
C. Investigate instability and establish a stable process
D. Report only the larger one-sided index

Return later

Assume stability and normality. LSL = 8, USL = 20, μ = 12, σ = 1. Find Cp and Cpk, rounded to two decimals.

A. Cp = 2.00, Cpk = 1.33
B. Cp = 1.33, Cpk = 2.00
C. Both 2.00
D. Cp = 2.00, Cpk = 2.67

Write your reasoning before checking page 3.

CHECK THE REASONING, TOO.

PRACTICE 1

Both 1.67

Cp = 20 / 12 = 1.67. Each mean-to-limit distance is 10; Cpk = 10 / 6 = 1.67. The mean is centered.

Use 6σ for the full width and 3σ for each one-sided distance.

PRACTICE 2

0.67

Upper side = 4/6 = 0.67; lower side = 16/6 = 2.67. Cpk is the minimum, 0.67. Cp stays 1.67.

Select the smaller side; averaging the two would hide the shift.

PRACTICE 3

Investigate instability and establish a stable process

The conventional capability comparison describes a stable process relative to specifications. Instability undermines that interpretation.

Return to the conditions in step 1 before interpreting the index.

RETURN LATER

Cp = 2.00, Cpk = 1.33

Cp = 12/6 = 2.00. Cpk = min(8/3, 4/3) = 1.33. Here the lower limit is closer.

Check both sides even when the previous example was limited by the upper side.

Sources and scope

Two-sided specifications, stable process, normal-model assumptions and positive process standard deviation. Focused on ASQ Green Belt capability concepts; check your certification provider's syllabus.

[S1] NIST/SEMATECH: What is Process Capability? · https://www.itl.nist.gov/div898/handbook/pmc/section1/pmc16.htm · Checked 2026-09-09

[S2] ASQ Certified Six Sigma Green Belt Body of Knowledge · https://www.asq.org/cert/resource/pdf/certification/cssgb-cert-insert.pdf · Checked 2026-09-09