

Minitab 17 Exercise #10 – Practice Problems including Variance (Rev 12/15)

The Story

Two new vendors are being considered to supply a critical part for assembly into a new product. Both vendors provided a sample of the parts for evaluation. You are the quality engineer assigned to evaluate the product and make a recommendation for the vendor to be chosen.

Part 1. Evaluation of Vendor A – Work problems by hand.

A random sample of 16 parts, submitted by Vendor A for evaluation, yielded the following measurements:

2.13 2.15 2.16 2.18 2.15 2.18 2.16 2.13 2.16 2.16 2.14 2.15 2.13 2.17 2.12 2.17

$$\bar{x} = 2.1525 \quad s = 0.0184$$

- a) Based on the sample data, what is the 95% confidence interval for the population mean?
- b) The vendor claimed that the mean of his process is 2.1. With 95% confidence, can you reject the null hypothesis that the true mean is 2.1? (Two tailed test. Use comparison to t_{critical} –note the p value when you check with Minitab.)

P value (from Minitab)= _____

- c) Based on the sample data, what is the 95% confidence interval for the population standard deviation?

- d) If the specifications for the part are 2.1 ± 0.15 , what would you estimate the process capability ratios of C_p and C_{pk} to be? (We cannot verify the process is stable, but we can get an estimate the capability using the mean and standard deviation from the sample.) Do you consider the vendor capable?

Part 2. Evaluation of Vendor B – Work problems by hand.

A second vendor, B, is also being evaluated. 12 parts are submitted for evaluation. The measurements on these parts are as follows:

2.09 2.13 2.17 2.13 2.08 2.18 2.12 2.10 2.12 2.13 2.17 2.07

| $\bar{x} = 2.1242$ $s = 0.0358$

- e) Based on the sample data, what is the 95% confidence interval for the population mean?
- f) The vendor claimed that the mean of his process is 2.1. With 95% confidence, can you reject the null hypothesis that the true mean is 2.1? (Two tailed test. Use comparison to $t_{critical}$ –note the p value when you check with Minitab.)

P value (from Minitab)= _____

g) Based on the sample data, what is the 95% confidence interval for the population standard deviation?

h) If the specifications for the part are 2.1 ± 0.15 , what is would you estimate the process capabilities C_p and C_{pk} to be? Do you consider this vendor capable?

Part 3. Comparison of vendors – Work problems by hand.

i) Perform a two sample hypothesis test of the means to assess if vendor A has a larger mean than vendor B with 95% confidence. (Assume variances not equal. Degrees of Freedom is equal to 15. Use comparison to $t_{critical}$ – note the p value when you check with Minitab.)

P value (from Minitab)= _____

- j) Perform a two sample hypothesis tests of the variances. With 95% confidence can you conclude that the variance of vendor A is lower than vendor B? (Use comparison to $F_{critical}$. Note the p value when checking with Minitab.)

P value (from Minitab) = _____

Part 4. Check work in Minitab.

Check your answers to the above problems using Minitab. Enter the observation data into the worksheet. (For more detailed instructions, you may want to refer to prior Minitab exercises. Always check Options to be sure they are set correctly.)

For sample CI and test against claim use: Stat>Basic Statistics>1-Sample t

For Variance CI use: Stat>Basic Statistics> 1 variance

For capability analysis: Stat>Quality Tools>Capability Analysis>Normal

- Single column with subgroup size 1
- Compare your answer with the PP_k . It uses standard deviation (overall) using all the data to calculate the ratios.

For means comparison: Stat>Basic Statistics>2-Sample t

For variance comparison: Stat>Basic Statistics> 2 variances

- Use the dropdown box to select "Sample Standard deviations" *
- Put higher standard deviation vendor data in First.
- Verify confidence interval in options
- Change alternative hypothesis as needed.
- Check 'Use test and confidence intervals based on normal distribution'

*Easiest method to check your work and help understanding, but you could also select the columns.

Part 5. Summary and conclusions

Complete the following table:

	Vendor A	Vendor B
Sample mean		
Sample standard deviation		
Confidence interval for mean		
Confidence interval for standard deviation		
Cp		
Cpk		
P value(from Minitab output) for difference of the means, and hypothesis test conclusion		
P value (from Minitab output)for the difference of the variances and hypothesis test conclusion		

Which vendor was closer, on average, to the target value of the specification?

Which vendor had a lower standard deviation?

Compare Cp and Cpk for the two vendors. How do these relate compared to their closeness of the means to the target and their standard deviations?

Based on the above data, which vendor would you select? Why?