

Probability And Statistics for Engineers And Scientists (4th Edition)

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Chapter 5.2, Problem 4P

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Problem

Recall Problem where metal plate thicknesses are normally distributed with a mean of 4.3 mm and a standard deviation of 0.12 mm.

(a) If one metal plate is placed on top of another, what is the distribution of their combined thickness?

(b) What is the distribution of the average thickness of 12 metal plates?

(c) What is the smallest number of metal plates required in order for their average thickness to be between 4.25 and 4.35 mm with a probability of at least 99.7%?

Problem

The thicknesses of metal plates made by a particular machine are normally distributed with a mean of 4.3 mm and a standard deviation of 0.12 mm.

(a) What are the upper and lower quartiles of the metal plate thicknesses?

(b) What is the value of c for which there is 80% probability that a metal plate has a thickness within the interval $[4.3 - c, 4.3 + c]$?

Step-by-step solution

1. Step 1 of 4

Given information is related to thicknesses of a metal plate.

Let X a random variable related to thicknesses of a metal plate.

Given that the random variable X follows normal distribution with mean $\mu = 4.3$ mm and standard deviation $\sigma = 0.12$ mm .

Comment

2. Step 2 of 4

(a)

Let the random variable X be the distribution of their combined thickness, it is given by

Therefore, the distribution of their combined thickness is.

$$X \sim N(\mu_1 + \mu_2, \sigma_1^2 + \sigma_2^2)$$

$$X \sim N(4.3 + 4.3, 0.12^2 + 0.12^2)$$

$$X \sim N(8.6, 0.0288)$$

Comment

$X \sim N(8.6, 0.0288)$

3. Step 3 of 4

(b)

The distribution of the individual thicknesses of metal plate is.

Consequently the average thicknesses of 12 metal plates is distributed as follows:

$X \sim N(4.3, 0.12^2)$

Therefore, the distribution of the average thicknesses of 12 metal plates is

Comment

$$\bar{X} \sim N\left(\mu, \frac{\sigma^2}{n}\right)$$

$$\bar{X} \sim N\left(4.3, \frac{0.12^2}{12}\right)$$

$$\bar{X} \sim N(4.3, 0.0012)$$

$$\boxed{\bar{X} \sim N(4.3, 0.0012)}$$

4. Step 4 of 4

(c)

Let n be the smallest number of metal plates.

Calculate the value of n by using the following notation:

$$n \geq 51$$

Therefore, the minimum number of metal plates required should be $\boxed{n \geq 51}$.

Comments (4).

$$P(4.25 \leq \bar{X} \leq 4.35) \geq .997$$

$$2(Z_{0.0015} \times \sigma) \leq 1 - 0.99$$

$$2.9677 \times \frac{0.12}{\sqrt{n}} \leq 0.05$$

$$\sqrt{n} \geq \frac{2.9677 \times 0.12}{0.05}$$

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The amount of timber available from a certain type of fully grown tree has a mean of 63400 with a standard deviation of...

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(a) Suppose that $X_1 \sim N(\mu_1, \cdot)$ and $X_2 \sim N(\mu_2, \cdot)$ are independently distributed. What is the variance...

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Chapter 5.2, Problem 7P

If \$x is invested in mutual fund I, its worth after one year is distributed $X_I \sim N(1.05x, 0.0002x^2)$ and if \$x is invested...

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Chapter 5.2, Problem 5P

A machine part is assembled by fastening two components of type A and three components of type B end to end. The lengths of...

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