

### Answer on Question #46154, Math, Statistics and Probability

Steel rods are manufactured to be 3 inches in diameter but they are acceptable if they are inside the limit 2.99 inches and 3.01 inches. It is observed that 5% are rejected as oversized and 5% are rejected undersized. Assuming that the diameters are normally distributed, find the standard deviation of the distribution.

Solution

Here we are dealing with normal distribution. Hence, any probability can be found as integral with correspondent limits of integration of function

$$f(x, \mu, \sigma) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

with  $\mu = 3$  and yet unknown  $\sigma$ . Our condition tells us

$$\int_{3.01}^{2.99} f(x, \mu, \sigma) dx = 1 - 0.05 - 0.05 = 0.9$$

We will find  $\sigma$  by picking it up, integrating numerically the integral above with different  $\sigma$ . Hence we find that standard deviation  $\sigma \approx 0.006$

We can do it also in another way. You can find in the attachment Z table. Z is

$$Z = \frac{X - \mu}{\sigma}$$

In our case  $\mu = 3$ ,  $X = 3.01$ , Z is to be determined, but we know entry of table, it said to be  $1 - 0.05 = 0.95$ . Hence, we can just guess Z from table and find  $\sigma$  after. The closest entry in table to 0.95 corresponds to 1.6 row and 0.05 column. Hence, our z is 1.65. So we find  $\sigma$ :

$$\sigma = \frac{X - \mu}{Z} = \frac{0.01}{1.65} \approx 0.006$$