Learn By Doing Activity

The purpose of this interactive activity is to:

- get a better feel for the behavior of normal random variables.
- check how accurate the Standard Deviation Rule is.
- do some other calculations for the normal distribution that are beyond what the Standard Deviation Rule can help us with.

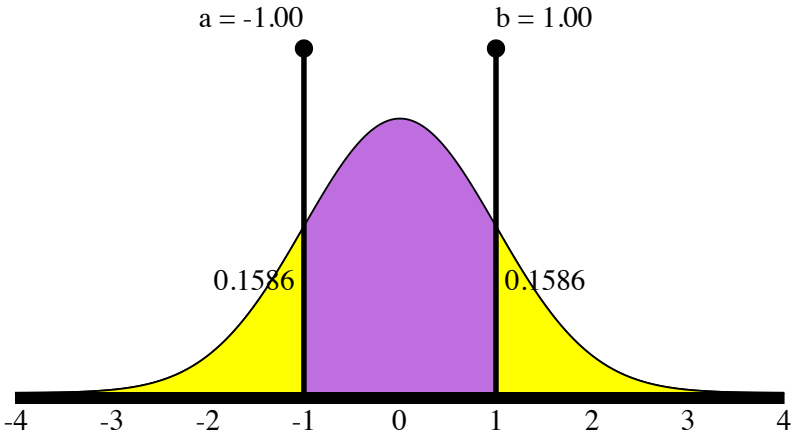
As we've seen, the Standard Deviation Rule for normal random variables is very useful. The following simulation will help you see how accurate the rule is, and do some other calculations for normal distributions that cannot be done using that rule and that will further enhance your understanding of the normal distribution.

Comments

1. Do not change the settings of the simulation.

2. The numbers on the horizontal axis represent the number of SD (standard deviations) above or below the mean. So, 0 is the mean, +1 is one SD above the mean, -1 is one SD below the mean, etc.

To see how accurate the Standard Deviation Rule is, drag one flag across the other, so that the simulation shows the area under the curve **between** the two flags.



2-tail: ☑

Learn By Doing (1/1 point)

(a) Place the flags 1 standard deviation on either side of the mean. What is the area between these two values (the center area should be yellow for area between the two flags)? What does the standard deviation rule say this area is? (b) Repeat for 2 and 3 standard deviations on either side of the mean. Again compare the standard deviation rule with the area given in the simulation.

Your Answer:

0.6827, 0.9545, 0.9973

Our Answer:

(a) According to the simulation, the exact probability that a normal random variable will get a value that is within 1 standard deviation of its mean is 0.6827, which is pretty close to what the Standard Deviation Rule tells us (0.68). (b) According to the simulation, the exact probability that a normal random variable will get a value that is within 2 standard deviations of its mean is 0.9555, which, again, is pretty close to what the Standard Deviation Rule tells us (0.95). Also, according to the simulation, the exact probability that a normal random variable will get a value that is within 3 standard deviations of its mean is 0.9973, which is very close to what the Standard Deviation Rule tells us (0.997). We conclude that the Standard Deviation Rule is very accurate.

Resubmit Reset

Comment

If you drag the flags across each other again, you'll be able to see the probabilities in the tails (above and below 1, 2, and 3 standard deviations from the mean). Recall that we mentioned that according to the Standard Deviation Rule, these tails have probabilities 0.16, 0.025 and 0.0015, corresponding to 1, 2 and 3 standard deviations from the mean). Try it.

Recall from the EDA section the quartiles Q1 and Q3. In the context of random variables, Q1 is the value such that $P(X < Q1) = 0.25$. In other words, the random variable has a 25% chance of having a value that is below Q1. Similarly, Q3 is the value such that $P(X < Q3) = 0.75$. In other words, the random variable has a 75% chance of having a value below Q3. Another way to think about the quartiles is that they mark the highest and lowest 25% of the distribution.

Learn By Doing (1/1 point)

Using the simulation, how many standard deviations above and below the mean do the quartiles of any normal distribution lie? Use the closest available values (the simulation can't hit every value exactly).

Your Answer:

Q1 = 0.68

Our Answer:
By the definition of Q1 and Q3, $P(Q1 < X < Q3) = 0.5$. Setting the flags so that there is a probability of 0.5 between them (or the closest we can get to 0.5 using the simulation, which is 0.5011), we see that Q1 and Q3 of any normal distribution lie approximately 0.68 standard deviations below and above the mean, respectively.

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Learn By Doing (1/1 point)

The deciles of any distribution are the points that mark off the highest and lowest 10% of the observations. How many standard deviations on either side of the mean do the deciles in a normal distribution lie?

Your Answer:

high = 0.20, low = 1.57

Our Answer:

Since the deciles mark the highest and lowest 10% of the observations, there is a probability of 0.8 that the random variable will get a value between them. Setting the flags so that there is a probability of 0.8 between them (or the closest we can get to 0.8 using the simulation, which is 0.8015) we see that the deciles of any normal distribution lie approximately 1.29 standard deviations below and above the mean.

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