

## Standard Deviation

### Concepts

1. The **variance** of a random variable is defined as  $E[(X - \mu)^2]$  and there is a shortcut formula that we can use to define it as  $E[X^2] - \mu^2$ . For continuous random variables, we replace summation with

$$\sigma^2 = E[X^2] - \mu^2 = \int_{-\infty}^{\infty} x^2 f(x) dx - \mu^2.$$

### Example

2. Let  $f(x) = e \cdot e^x$  for  $x \leq -1$  and 0 otherwise. Find the standard deviation of this distribution.

### Problems

3. True    False    The standard deviation always exists.
4. True    False    Sometimes, we take the standard deviation to be the negative square root of the variance.
5. True    False    The variance is always nonnegative.
6. True    False    If the mean doesn't exist, then the standard deviation doesn't exist.
7. True    False    If the mean exists, then the standard deviation exists.
8. Let  $f(x)$  be  $2/3x$  from  $1 \leq x \leq 2$  and 0 everywhere else. Find the standard deviation of this distribution.
9. Let  $f(x)$  be  $-4/x^5$  for  $x \leq -1$  and 0 everywhere else. Find the standard deviation of this distribution.
10. Let  $f(x)$  be the uniform distribution on  $0 \leq x \leq 10$  and 0 everywhere else. Find the standard deviation of this distribution.