

# Stat 230: Probability

## Lecture 16

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## Example

Let  $X$  denote the outcome of a fair six sided die roll. Compute  $\text{Var}(X)$ .

# Review

Last time we talked about:

- (1) Expected Value
- (2) Variance

For today:

- (1) Review
- (2) Variance
- (3) Existence of moments

Reading: Chapter 7

# Review

- Monday: Quiz 3
- R Code Modules
- Review

## Example

Suppose we are give the following probability function:

| $x$ | $f(x)$         |
|-----|----------------|
| 1   | $\frac{1}{2}p$ |
| 2   | $p$            |
| 3   | $\frac{3}{2}p$ |
| 4   | $2p$           |
| 5   | $\frac{5}{2}p$ |

What is  $P(X > 3)$ ?

## Example

Suppose goose droppings are spread across UW according to a Poisson process with 6 droppings per 10 steps.

- (1) Define  $X$  to be the number of droppings stepped in  $t$  steps. Give the probability function and the range of  $X$ .
- (2) Give the probability of stepping in exactly 63 droppings in the 100 step journey to class.

Suppose we take a 1000 step journey, segmented into 100 step legs.

- (3) What is the probability in exactly 1 of these 10 legs, you encounter 63 droppings?
- (4) What is the probability you take at least 5 legs before stepping in 63 droppings in 2 legs?

# Variance, Moments, and SD

## Definition

The  $k^{\text{th}}$  **moment** of a random variable  $X$  is defined by

$$E(X^k)$$

# Variance, Moments, and SD

## Definition

The **standard deviation** of a random variable  $X$  is denoted  $SD(X)$ , and defined by

$$SD(X) = \sqrt{\text{Var}(X)} = \sigma$$

## Example

Let  $X$  denote the outcome of a fair six sided die roll. Compute  $SD(X)$  and compare to  $\text{Var}(X)$ .



# Variance Properties

## Theorem

*Variance of a linear combination:*

$$\text{Var}(aX + b) = a^2 \text{Var}(X)$$

## Example

Suppose that  $X$  has variance  $\text{Var}(X) = 2$ . Compute the standard deviation of  $Y$ , where  $Y = -2X + 3$ .