

# Discrete Random Variables 1

## STAT-S520

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~~01-26-23~~

(continued)

## Properties of the expected value and variance

*This is a new random variable*

Let  $X$ ,  $Y$  be random variables and  $a$ ,  $b$  scalars (constant values).

- ▶  $E(a + X)$  =  $a$  +  $EX$
- ▶  $E(bX)$  =  $bEX$
- ▶  $E(X + Y)$  =  $EX$  +  $EY$

If in addition,  $X$  and  $Y$  are independent:

- ▶  $Var(a + X)$  =  $VarX$
- ▶  $Var(bX)$  =  $b^2 \cdot VarX$
- ▶  $Var(X + Y)$  =  $VarX$  +  $VarY$

$$\begin{aligned} \longrightarrow Var(-X) &= Var((-1) \cdot X) \\ &= (-1)^2 VarX \end{aligned}$$

## Exercise 5

Let  $X, Y$  be independent random variables with  $EX = 1$ ,  $EY = 2$ ,  
 $VarX = 4$ ,  $VarY = 9$ . Find the expected value and variance of  
 $(2X + 1)$  and  $(X - Y)$

$$E(\underline{2X+1}) = E(2X) + 1 = 2EX + 1 = 2 \cdot 1 + 1 = 3$$

$$Var(2X+1) = Var(2X) = 2^2 \cdot VarX = 4 \cdot 4 = 16$$

$$E(X - Y) = EX - EY = 1 - 2 = -1$$

$$\begin{aligned} Var(X - Y) &= Var(X + (-1)Y) \\ &= VarX + Var[(-1)Y] = \\ &= VarX + (-1)^2 VarY \\ &= 4 + 9 = 13 \end{aligned}$$

*(Note: A bracket and double slash are drawn under the first line of the variance calculation, pointing to the final result.)*