AP Statistics Name: F Per: ______
Chapter 16 (Random Variables)

Scaling/Shifting with Means and Variances

remember: variance is (st. dev)^2

$E(X \pm c) = E(X) \pm c$

$Var(X \pm c) = Var(X)$

$SD(X \pm c) = SD(X)$

$E(aX) = a \cdot E(X)$

$Var(aX) = a^2 \cdot Var(X)$

$SD(aX) = a \cdot SD(X)$

For <u>any</u> two random variables, "X" and "Y":

$E(X \pm Y) = E(X) \pm E(Y)$

If "X" and "Y" are <u>independent</u>:

ALWAYS a plus!

$Var(X \pm Y) = Var(X) + Var(Y)$

$SD(X \pm Y) = \sqrt{SD(X)^2 + SD(Y)^2}$

> "X" and "Y" **MUST** be **independent!!!**
> If they're <u>NOT</u>, then we <u>cannot determine</u> the variance (or standard deviation) of the combined random variable.

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important for SD on C, D, and F

1. X and Y are two independent random variables with the following attributes:

E(X) = 11 E(Y) = 24
SD(X) = 9 SD(Y) = 5

Find the mean and standard deviation of each of these random variables:

a) 3X

$E(3X) = 3(11) = \boxed{33}$

$SD(3X) = 3 \cdot 9 = \boxed{27}$

b) Y – 15

$E(Y-15) = 24 - 15 = \boxed{9}$

$SD(Y-15) = \boxed{5}$

* shift does NOT affect SD!

c) X + Y

$E(X+Y) = 11 + 24 = \boxed{35}$

$SD(X+Y) = \sqrt{9^2 + 5^2} = \boxed{10.296}$

d) X – Y

$E(X-Y) = 11 - 24 = \boxed{-13}$

$SD(X-Y) = \sqrt{9^2 + 5^2} = \boxed{10.296}$

ALWAYS ADD VARIANCE!

e) X1 + X2 + X3 (not the same as "3X"!!!)

$E(X_1 + X_2 + X_3) = 11 + 11 + 11 = \boxed{33}$

$SD(X_1 + X_2 + X_3) = \sqrt{9^2 + 9^2 + 9^2}$

$= \sqrt{3} \times 9 = \boxed{15.58}$

f) 5X – 3Y

$E(5X - 3Y) = 5(11) - 3(24)$

$= \boxed{-17}$

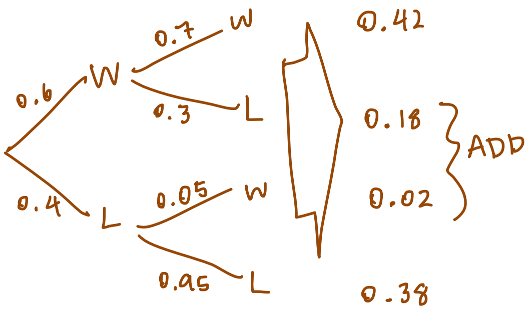
$SD(5X - 3Y) = \sqrt{(5 \times 9)^2 + (3 \times 5)^2}$

$= \boxed{47.43}$

2. **The Podunk Polar Bears** (a football team) have two games left in their season (so far they are winless). Experts estimate that the team has a 60% probability of winning the first game. If they win the first game, they have a 70% chance of winning the 2nd game. Otherwise, they only have a 5% chance of winning the second game.

make a table

Construct a probability model for the number of games that the Polar Bears will win.



x = # of wins	0	1	2
$P(x)$	0.38	0.20	0.42

The Die (Singular) Game Problem

3. You roll a die. If it comes up a 6, you win $100.
If not, you get to roll again, and if you get a 6 the second time, you win $50. If not, you lose ☹
Create a probability model for the amount you win at this game, and find the expected amount you'll win.

x = \$ won	100	50	0
$P(x)$	$1/6$	$5/36$	$25/36$
	roll a "6"	$\frac{5}{6}\cdot\frac{1}{6}$	$\frac{5}{6}\cdot\frac{5}{6}$

(if we round)

$E(x) = \$24 \qquad SD(x) = \$38$

Does "$X_1 + X_2$" = "$2X$"? (continuing the Die Game Problem…)

Find the mean and standard deviation of the amount of money won if…

a) we **double** the dollar amounts (and play the game once)

$E(2x) = 2(24) = \boxed{\$48}$

$SD(2x) = 2(38) = \boxed{\$76}$

Not the same!

b) we **play the game twice** (without doubling the $ amounts)

$E(x_1 + x_2) = 24 + 24 = \boxed{\$48}$

$SD(x_1 + x_2) = \sqrt{38^2 + 38^2} = \boxed{\$54}$