Unit 3 Day 6:
Probability Distribution
(5-2/5-3) Mean, Variance, Standard Deviation

Mean:

Notation: $\overline{X}$

$$\overline{X} = X_1 \cdot P(X_1) + X_2 \cdot P(X_2) + ... + X_n \cdot P(X_n)$$

Where x_1, x_2,...x_n are the outcomes
$P(x_1)$, $P(x_2)$, ...$P(x_n)$ are the corresponding
probabilities

(Same as expected value)

Variance

$$s^2 = \sum(x^2 \bullet P(x)) - \left(\overline{x}\right)^2$$

Step 1: outcome squared multiplied by the probability (add them all up)

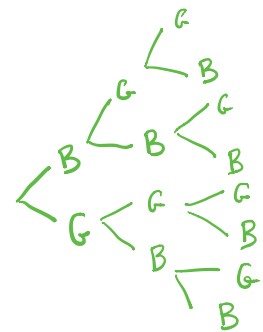**Step 2:** take that total and subtract the mean squared.

Standard Deviation

$$s = \sqrt{s^2}$$

Mean, Variance, and Standard Deviation   Example:

In a family with three children...

#of girls (X)	0	1	2	3
Probability P(X)	1/8	3/8	3/8	1/8

$$\overline{X} = 0\left(\tfrac{1}{8}\right) + 1\left(\tfrac{3}{8}\right) + 2\left(\tfrac{3}{8}\right) + 3\left(\tfrac{1}{8}\right) = 1.5$$

$$S^2 = \left(0^2\left(\tfrac{1}{8}\right) + 1^2\left(\tfrac{3}{8}\right) + 2^2\left(\tfrac{3}{8}\right) + 3^2\left(\tfrac{1}{8}\right)\right) - (1.5)^2$$

$$= 3 - 2.25$$

$$= 0.75$$

$$S = \sqrt{0.75} = 0.866$$

Mean, Variance, and Standard Deviation   Example:

Number of Trips of Five Nights or More

X	0	1	2	3	4
P(X)	.06	0.7	0.2	.03	.01

$$\overline{X} = 0(0.06) + 1(0.7) + 2(0.2) + 3(0.03) + 4(0.01) = 1.23$$

$$S^2 = 0^2(0.06) + 1^2(0.7) + 2^2(0.2) + 3^2(0.03) + 4^2(0.01) - (1.23)^2 = 0.417$$

$$S = \sqrt{0.417} = 0.646$$

Mean, Variance, Standard Deviation for a binominal distribution.

New Formulas:

Mean: $\overline{X} = np$

Variance: $s^2 = npq$

standard deviation: $s = \sqrt{s^2}$

Mean, Variance, Standard Deviation   Example

A die is rolled 480 times. Find the mean, variance, and
standard deviation of the number of 2's that will be rolled.

$n = 480$

$p = 1/6$

$q = 5/6$

$\bar{x} = 480(1/6) = 80$

$s^2 = 480(1/6)(5/6) = 66.67$

$s = \sqrt{66.67} = 8.165$

Example

Mean, Variance, Standard Deviation

2% of all American births result in twins. If a random sample of 8000 births is taken, find the mean, variance, and standard deviation of the number of births that would result in twins.

$$n = 8000 \qquad \bar{x} = 8000(0.02) = 160$$

$$P = 0.02 \qquad S^2 = 8000(0.02)(0.98) = 156.8$$

$$q = 0.98 \qquad S = \sqrt{156.8} = 12.5$$

Please Be Discrete Packet

Assignment: Gold HW Worksheet

Working Model of Game Wednesday 3/11
Project Write up Friday 3/13
Unit 3 Test Friday 3/13