Pointers – Section 6.1

A **random variable** is a numerical measure of the outcome of a probability. It can either be **discrete** or **continuous**.

A discrete random variable has a finite or countable number of values. These values are typically only whole numbers that result from counting a number of successes.

A continuous random variable has infinitely many values. These values can take on decimal values and usually result from some sort of physical measurement.

A **discrete probability distribution** is like a probability model, except the possible outcomes will always be whole numbers instead of categories like male & female. The total of all the probabilities has to equal 1 $\left(\sum P(x)=1\right)$, and each probability must be between 0 and 1 $\left(0 \le P(x) \le 1\right)$.

We can use a discrete probability distribution to find the probability of certain events.

Probability	Process
$P(x=4)$	Look up the probability next to $x=4$.
$P(x<4)$	Add up the probabilities for every value of x that is less than 4.
$P(x\le 4)$	Add up the probabilities for every value of x that is 4 or lower.
$P(x>4)$	Add up the probabilities for every value of x that is greater than 4.
$P(x\ge 4)$	Add up the probabilities for every value of x that is 4 or above.
$P(2\le x\le 6)$	Add up the probability for every value of x from 2 through 6.

Mean & Standard Deviation

The **mean of a random variable** is what we would expect to happen in the long run, it is also called the **Expected Value *E(X)***. If we repeated an experiment over and over the mean would be the average outcome. We can also calculate the **standard deviation of a random variable.**

To compute the mean, multiply each value of *x* by its probability and total all of these products.

$$\mu_X = \sum\left[x \cdot P(x)\right]$$

To compute the standard deviation, use the following formula.

$$\sigma_X = \sqrt{\sum\left[(x-\mu_X)^2 \cdot P(x)\right]}$$

1. Subtract the mean from each value *x*.
2. Square each difference.
3. Multiply by x's probability.
4. Total.
5. Take the square root.

Example

Mean

x	*P(x)*	$x \cdot P(x)$
0	0.2	0
1	0.3	0.3
2	0.25	0.5
3	0.15	0.45
4	0.1	0.4
		$\mu_X = 1.65$

Standard Deviation

x	*P(x)*	μ_X	$x-\mu_X$	$(x-\mu_X)^2$	$(x-\mu_X)^2 \cdot P(x)$
0	0.2	1.65	-1.65	$(-1.65)^2$	$(-1.65)^2 \cdot 0.2$
1	0.3	1.65	-0.65	$(-0.65)^2$	$(-0.65)^2 \cdot 0.3$
2	0.25	1.65	0.35	0.35^2	$0.35^2 \cdot 0.25$
3	0.15	1.65	1.35	1.35^2	$1.35^2 \cdot 0.15$
4	0.1	1.65	2.35	2.35^2	$2.35^2 \cdot 0.10$
					$Total = 1.5275$

$$\sigma_x = \sqrt{1.5275} = 1.24$$