Crafton Hills College Tutoring Center

Chapter 4 Probability Distributions

	Discrete Random Variable 4.1	Poisson Dist. 4.3	Geometric Dist. 4.3
Checks	A variable is Discrete when it has a countable (finite) # of possible outcomes. 1. The probability of each value of the discrete random variable is between 0 and 1, inclusive: $0 \leq P(x) \leq 1$ 2. The sum of all probabilities equal 1: $\Sigma P(x) = 1$	Is a Discrete Probability Distribution of a Random Variable x. 1. The experiment consists of counting the number of times and event, x, occurs in a given interval: time, area, or volume. 2. The probability of the event occurring is the same for each interval. 3. The number of occurrences in one interval is independent of the occurrences in the other interval. $\boldsymbol{x}$ = The # of successes that occur in a specified region. $\boldsymbol{\mu}$ = The mean # of occurrences per interval unit.	Is a Discrete Probability Distribution of a Random Variable x. 1. A trial is repeated until a success occurs. 2. The repeated trails are independent of each other. 3. The probability of success, p, is the same for each trial. 4. The random variable x represents the number of the trial in which the first success occurs. The prob. that the first success will occur on trial number x.
Formula		$P(x) = \frac{\mu^x e^{-\mu}}{x!}$ Where, e is an irrational number: $e \approx 2.71828$	$P(x) = pq^{x-1}$ Where, q= 1-p
Excel		**Exactly**: =POISSON.DIST(x,μ,FALSE) **All other Poisson Calculations**: =POISSON.DIST(x,μ,TRUE) *Note: following the same function setup as Binomial Distribution	
Mean	$E(x) = \mu = \sum [x \cdot P(x)]$	If Mean Is Not Given: $\mu_x = \lambda t$	$\mu = \frac{1}{p}$
Variance	$\sigma^2 = \sum [(x-\mu)^2 p(x)]$		$\sigma^2 = \frac{q}{p^2}$
St. Dev.	$\sigma = \sqrt{\sum [(x-\mu_{\bar{x}})^2 \cdot P(x)]}$	$\sigma_x = \sqrt{\mu_x}$	$\sigma = \sqrt{\frac{q}{q^2}}$

Notes:

p = probability of a successes in a single trial x = number of successes in n n = fixed number of trials	$q = 1 - p$ **False** = 0 **True** = 1	t = the length of time λ = average number of successes in the interval

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Chapter 4.2 The Binomial Probability Distribution

Checks:

1. *Fixed number of trials, where each trial is independent of the other.*
2. *Only two possible outcomes (success (s) and fail (f))*
3. *Probability of success is the same for each trial.*
4. *The random variable x counts the # of successful trials.*

Word Phrases:	Math Symbols:	Excel Commands:	Examples:
"Exactly," "Equal," "Is"	$P(X = x)$	*=BINOM.DIST(x, n, p, **false**)*	$P(X = 5)$ *=BINOM.DIST(5, n, p, **false**)*
"Between"	$P(a \le X \le b)$	*=BINOM.DIST(Larger x, n, p, true) − BINOM.DIST(Smaller x−**1**, n, p, true)*	$P(5 \le X \le 7)$ *= BINOM.DIST(7, n, p, **true**) − BINOM.DIST(**4**, n, p, **true**)*
"No more than," "At most"	$P(X \le x)$	*=BINOM.DIST(x, n, p, true)*	$P(X \le 5)$ *=BINOM.DIST(5, n, p, **true**)*
"Fewer than," "Less than"	$P(X < x)$	*=BINOM.DIST(x−**1**, n, p, true)*	$P(X < 5)$ *= BINOM.DIST(**4**, n, p, **true**)*
"At least," "No less than"	$P(X \ge x)$	*=**1** − BINOM.DIST(x−**1**, n, p, true)*	$P(X \ge 5)$ *=**1**−BINOM.DIST(**4**, n, p, **true**)*
"More than," "Greater than"	$P(X > x)$	*=**1**−BINOM.DIST(x, n, p, true)*	$P(X > 5)$ *=**1**−BINOM.DIST(5, n, p, **true**)*
Mean	$\mu = n \cdot p$	**Notations:**	**Formula:**
Variance	$\sigma^2 = n \cdot p \cdot q$	*n =The total number of trials p =The probability of **success** **in a single trial** q =The probability of **failure** **in a single trial** x = Represents the # of **successes** in n **trials** **q = 1-p** **False** = 0 **True** = 1*	$P(x) = {}_nC_x p^x (1-x)^{n-x} = \frac{n!}{(n-x)!x!} p^x q^{n-x}$
Standard Deviation	$\sigma = \sqrt{n \cdot p \cdot q}$		