Math AA HL Chapter 21 Discrete Probability Distribution

Section 21.1 Introduction to discrete random variables.

Discrete random variable has the following properties:

It is a discrete variable – exact value

It can only assume certain values, $x_1, x_2, x_3, \dots x_n$.

Each value has an associated probability, $P(X = x_1) = p_1$, $P(X = x_2) = p_2$ etc.

($P(X = x_1) = p_1$ is read the probability that $X = x_1$ is p_1)

The probabilities add up to 1, so $\sum_{i=1}^{i=n} P(X = x_1) = 1$

A discrete variable is only random if the probabilities add up to 1.

To find the probability you can use a tree diagram or look for a pattern. There is also the possibility that a function will be given so you can determine the probability.

Section 21.2 Expectation and Variance

Practical approach – what happens when you practice or try the experiment. A practical approach will result in data that can be used to find a frequency distribution and a mean value.

Theoretical approach – what we think or predict the outcomes will be. A theoretical approach results in a probability distribution and an expected value.

Expected value – what we expect the mean to be if we have a large number of terms averaged together.

Expected value $\sum_{\text{all } x} x \cdot P(X = x)$

The expectation of any function f(x) $\sum_{\text{all } x} f(x) \cdot P(X = x)$

Variance - Var(X) $\mathrm{Var}(X) = E(X^2) - E^2(X)$

Section 21.3 Binomial Distribution

Binomial distribution deals with events that can either happen or NOT happen. If a random variable X follows a binomial distribution we say $X \sim \mathrm{Bin}(n, p)$ where n = number of times an event occurs and p = probability of success. The probability of failure = $q = 1 - p$. n and p are called the parameters of the distribution. Also the probability must stay the same for successive trials.

If $X \sim \mathrm{Bin}(n, p)$ then $P(X = x) = {}^nC_r p^x q^{n-x}$.

Calculator

binompdf – binomial probability distribution function. n = number of trials, p = probability of success and s = successes On the calculator binompdf(n, p, s) It is located in distr menu, press 2nd Vars and choose option “0”.

binomcdf – Binomial cumulative distribution function. n = number of trials, p = probability of success and S = successes up to and including (≤ S). On the calculator binomcdf(n, p, S) It is located in distr menu, press 2nd Vars and choose option “0”.

Expectation and variance of binomial distribution.

If $X \sim \mathrm{Bin}(n, p)$ $E(X) = np$ $\mathrm{Var}(X) = npq$