CSE312 Midterm Notes

**Counting:**

* , where A is desired event and is the sample space.
* Product rule: if 1st step has choices and 2nd step has choices, 2 steps together have choices.
* Permutation (order matters): pick objects from and permutes
* Combination (order doesn’t matter): choose objects from / choose

Identity:

Binomial Theorem: Corollary:

* Complementing: P(contains at least 1) = 1 – P(contains 0)
* Inclusion-Exclusion: + single – pairs + triples – quads
* Pigeonhole Principle: If you have pigeons and holes, then some hole has 1 pigeon.

**Probability:**

* 2 events and are *mutually exclusive* if and only if
* Axioms of Probability:
* If and are mutually exclusive, then

Implications of Axioms:

* If , then
* Equally likely outcomes: for every
* Conditional Probability: suppose conditional probability of given

Chain rule:

* Law of Total Probability:
* Conditional Independence: and are conditionally independent if and only if
* Bayes’ Theorem: Corollary:
* Naive Bayes Classifier:
* Assumption: words in the email are conditionally independent given we know the email is spam/ham.
* and are fractions of spam/ham emails in training data.
* Laplace Smoothing for each
* Independent Events: and are independent if and only if

If , then and are independent if and only if .

**Discrete random variables and expectation:**

* Random Variable: numerical function of the outcome

(Discrete: countable number of possible values.)

* Independent Random Variables: Random Variables and are independent if and only if
* Probability Mass Function (pmf): Let be the set of outcomes and be an outcome:
* Expectation of a random variable:
* Linearity of Expectation: ,
* If and are independent,
* Indicator Random Variable: for
* Variance () and Standard deviation ():
* Let , then
* Theorem:
* If and are independent,
* Important Distributions:
* Uniform: if is equally likely to be any integer in .
* Bernoulli: is a random indicator variable with and .
* Binomial: is the sum of independent Bernoulli random variables such that for .
* Geometric: is independent Bernoulli trials with parameter until and including 1st success.
* for
* Summations: