1. **Review**
   1. Basic Probability
      1. Random variable (r.v.)
      2. Conditions

|  |  |
| --- | --- |
| Types of probability | |
| Marginal probability | or |
| Joint probability |  |
| Conditional probability |  |
| Total probability |  |

|  |  |
| --- | --- |
| Laws of probability | |
| Law of total probability |  |
| Addition law of probability |  |
| Multiplicative law of probability |  |
| Independence | *X* and *Y* are independent if |
| Bayes’ Theorem |  |

* 1. Binomial Distribution
     1. Bernoulli r.v. *Y* ~ *Ber*(*π*)
        1. Parameters
           1. Bernoulli trials: *Y*  = {0 = *F*, *S* = 1}
        2. Statistics
     2. Binomial r.v. *X* ~ *B* (*n*, *π*)
        1. Parameters
           1. *n* identical, independent Bernoulli trials
           2. Constant
        2. Probability function
        3. Statistics
  2. Multinomial Distribution
     1. Multinomial r.v. *X* ~ *Mult*(*n*, *π*)
        1. Parameters
           1. *k* > 2 outcomes
           2. *X*i trials resulting in outcome *i*
           3. *n* identical, independent multinomial trials
        2. Probability function
        3. Statistics
  3. Poisson Distribution
     1. r.v. *X* ~ *Pois*()
        1. Parameters
           1. Fixed time *t*
           2. *X* trials resulting in outcome *x*
        2. Uses
           1. Random events over fixed time/space
           2. Law of small numbers: large *n*, small *π*
        3. Probability function
        4. Conditions
           1. Independent events
           2. Fixed time
        5. Statistics
        6. Table process
           1. *k* = *j*
           2. Frequency *f* 🡪 *p*(*X* = *k*) 🡪 E(*x*) = *kp*(*X* = *k*)
           3. *p*(*Y* = *j*) = *p*(*X* = *x*) 🡪 E(*f*) = *np*(*Y* = *j*)
     2. Overdispersion: when
  4. Hypergeometric distribution
     1. r.v. *X* ~ *Hyp*(*N*, *r*, *n*)
     2. Parameters
        1. *N* trials{*S* = *r*, *F* = *N* – r}
     3. Probability function

1. Types of Data

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Continuous** | **Quantitative** | **Discrete** | **Qualitative** | **Nominal** | **Ordinal** |
| Continuous on an entire interval | | Dichotomous-binary | | | Ordered groups |  | Ordered groups |
|  |  | Unordered groups | | |  |
|  | Ordered groups | |  |  |  |
|  | Integer-valued | |  | | |

1. Univariate Analysis
   1. Maximum Likelihood Estimation (Binomial)