**Hypothesis Testing**

* Hypothesis testing
  + To conduct an experiment to determine how credible a statement is in light of observed data
* Types of errors
  + Type I error: reject H0 when it is true (when it shouldn’t be rejected)
    - E.g. convicting an innocent person of a crime
    - P(type I) = α
  + Type II error: do not reject H0 when it is false (when it should be rejected)
    - E.g. letting a guilty person go free
    - P(type II) = 1 − β
    - β = power of the test = (correctly) reject H0 when it is false
* Null hypothesis − the default hypothesis; a statement about the parameter/population of interest
  + Choose H0 to be the more likely outcome
  + E.g. H0: p = ½
* Alternative hypothesis − the hypothesis to support if H0 is rejected
  + E.g. H1/HA: p < ½ or p > ½ or p ≠ ½
  + Use one of the alternatives, depending on the problem given
* Ex: let population = X ~ N(μ, σ)
  + Sample = X1 … Xn
  + Step 1 – state H0 and HA
    - Test H0: μ = 3 vs. HA: μ ≠ 3 or μ > 3 or μ < 3
  + Step 2 – choose a test statistic
    - Test statistic/discrepancy measure – function of the data X1 … Xn that measures the degree of agreement between the data and the null hypothesis
    - i.e. T(X1 … Xn; θ)
  + Step 3 – find observed value of T
    - T\_obs = T(x1 … xn; θ)
  + Step 4 – critical value approach/P-value approach (see below)
  + Step 5 – compare T\_obs and t\_crit
    - Reject H0 if T\_obs falls into critical region
    - If right-sided i.e. HA: θ > θ0 → reject if observed > critical value
    - If left-sided i.e. HA: θ < θ0 → reject if observed < critical value
    - If two-sided i.e. HA: θ ≠ θ0 → reject if observed > critical or observed < − critical
* **Critical value approach**
  + T as a r. v. − possible values of T are divided into 2 regions:
    - Acceptance region – i.e. H0 is true
    - Rejection/critical region – i.e. H0 is false
  + If H0: θ = θ0 vs. HA: θ > θ0 → alternative is right-sided
    - i.e. critical region is right-sided → accept | reject
  + If HA: θ < θ0
    - i.e. critical region is left-sided → reject | accept
  + If HA: θ ≠ θ0
    - i.e. critical region is two-sided → reject | accept | reject
    - critical values are usually symmetric
  + t\_crit = critical values of the test = values at the boundaries between the acceptance & rejection regions (found from table)