Notes

Hypotheses Testing:

* It’s a method to determine whether a claim about a dataset is statistically significant.
  + Null Hypotheses (H0) – Assumes no effect or no difference.
  + Alternative Hypotheses (H1) – Suggests a significant effect or difference.
* Steps in Hypotheses Testing –
  + Define H0 and H1 – A company claims that their new AI model is more accurate than the existing one.
    - H0: The new model has no improvement or accuracy.
    - H1: The new model improves accuracy.
  + Choose a significance level –
    - The significance level is the probability of rejecting the null hypotheses (H0) when it is actually true (Type 1 error).
    - It represents how much risk we are willing to take including that there is an effect when there actually isn’t.
    - The most commonly used values are:
      * 0.05 (5%) – Standard in most studies. If p-value < 0.05, we reject H0.
      * 0.01 (1%) -More Strict, used in medical research or critical fields.
      * 0.10 (10%) – More Relaxed, sometimes used in exploratory research.
  + Select a statistical test –
    - Z-test: Large sample size (n > 30), known population variance.
    - T-Test: Small sample size (n <= 30), unknown variance.
    - Chi-square Test: Categorical Data (e.g., Survey Response).
    - ANOVA: Comparing multiple groups.
  + Calculate the p-value –
    - If p-value < significance, reject H0 (Significant result).
    - If p-value >=a, fail to reject H0.
  + Make a conclusion –
    - Based on p-value, we decide whether to accept or reject the null hypotheses.
  + Common Errors in Hypotheses Testing –
    - Type 1 Error (False Positive): Rejecting H0 when it’s actually true.
      * This means we detect an effect that doesn’t actually exist.
      * The probability of a Type 1 error is equal to the significance level.
      * Example – Falsely identifying a healthy person as COVID Positive.
        + H0: The person does not have COVID 19.
        + H1: The person has COVID 19.
        + A type 1 error occurs if the test wrongly rejects H0, and says the person is sick.
    - Type 2 Error (False Negative): Failing to reject H0 when H1 is true.
      * This means we miss detecting an effect.
      * Example: Failing to detect the virus in an infected person.
        + H0: The person does not have COVD 19.
        + H1: The person has COVID 19.
        + A type 2 error occurs if the test wrongly accepts H0, and says that the person is healthy.

Example: Hypotheses testing in Stock Market Analysis

* To determine if Apple’s stock (APPL) has had a significantly higher daily return than 0.5% on average over the past year.
  + Step 1: Set up the Null and Alternative Hypotheses.
    - Null Hypotheses (H0): The average daily return of APPL is <= 0.5% (no significant increase).
    - Alternative Hypotheses (H1): The average daily return of APPL is > 0.5% (significant increase).
  + Step 2: Choose a significance level.
    - Choice depends on the risk tolerance in decision-making.
    - A low-risk investor (0.01, 1%):
      * Wants to be very sure before rejecting H0.
      * Avoids false positives (Type 1 Error), meaning they won’t mistakenly assume APPL’s return is higher if it’s not.
    - Moderate-risk Investor (0.05, 5%):
      * Accepts a standard level of uncertainty.
      * Common in financial studies.
    - High-risk trader (0.10, 10%)
      * More willing to take risks.
      * May reject H0 more easily, even if there’s a higher chance of a false positive.
  + Step 3: Collect and analyze Data.
    - Take historical daily returns of APPL for the past year.
    - Calculate:
      * Sample Mean Return
      * Sample Standard Deviation
      * Number of observations
    - Decided to perform a One-sample t-test because we are comparing the mean of a sample to known value.
  + Step 4: Compute the test statistic.
    - This test tells us how many standard deviations away our sample mean is from the hypothesized value.
  + Step 5: Compare p-value with significance.
    - If p-value < significance reject H0, meaning APPL’s daily return is significantly higher than 0.5%.
    - If p-value >= significance, Fail to reject H0, meaning there isn’t enough evidence to say APPL’s return is higher.
  + Step 6: Make a conclusion.
    - If we reject H0, we might decide to increase investment in APPL because it’s returns are significantly higher.
    - If we fail to reject H0, we might be cautious and not change our investment strategy.