Biostatistics (BIO545)

Quiz3

Multiple-Choice Questions

1. **Statistical power (1-β) is the probability of:**
   Answer: (a) Correctly rejecting a false null hypothesis.
2. **Holding all other factors constant (alpha, effect size), increasing the sample size (n) will generally:**
   Answer: (b) Increase statistical power.
3. **Survival analysis is primarily concerned with analyzing:**
   Answer: (c) Time-to-event data, where the event could be death, recovery, failure, etc.
4. **The Kaplan-Meier estimator is used to:**
   Answer: (c) Estimate the survival function S(t) from observed data, accounting for censoring.
5. **In a Cox Proportional Hazards model comparing Treatment A (reference) to Treatment B, a Hazard Ratio (HR) of 0.7 for Treatment B indicates that:**
   Answer: (b) Individuals on Treatment B have a 30% lower instantaneous risk of the event compared to Treatment A at any given time point.
6. **The p-value resulting from a hypothesis test represents:**
   Answer: (c) The probability of observing data as extreme or more extreme than the actual data, assuming the null hypothesis is true.
7. **A 95% Confidence Interval for the difference between two population means ($\mu_1 - \mu_2$) is calculated to be [-0.5, +1.5]. This suggests:**
   Answer: (c) The null hypothesis (H_0: $\mu_1 - \mu_2 = 0$) cannot be rejected at the $\alpha = 0.05$ level, as the interval contains zero.
8. **Which of the following scenarios would likely require the largest sample size to detect a specific, small effect size with adequate power (e.g., 80%) at α=0.05?**
   Answer: (d) An ANOVA comparing means across three groups with equal variance.
9. **When interpreting a Kaplan-Meier survival plot, how can you estimate the median survival time?**
   Answer: (A) The time at which the survival probability first reaches 0.5.
10. **A researcher wants to test whether blood pressure significantly decreases after taking a new drug. The same patients are measured before and after treatment. Which test should be used?**
    Answer: (B) Paired t-test.

Short Calculation/Concept Questions (SCQc)

11. **Define Type I error (α) in the context of hypothesis testing.**
    Answer: Type I error occurs when a true null hypothesis is incorrectly rejected. It represents the probability of concluding that an effect exists when it actually does not (false positive).
12. **Besides the desired power (1-β) and significance level (α), list two other crucial factors needed to calculate the required sample size for comparing two means. Answer:**

- **Effect size:** The magnitude of the difference expected between two groups.

- **Variance (σ^2) in the population:** Higher variance requires a larger sample size to detect a difference.

13. **Explain why conducting a post-hoc power analysis (calculating power based on the observed effect size after a study fails to find significance) is generally considered uninformative or misleading.**
    Answer:

    Power is calculated based on the expected effect size before a study begins.When a study fails to find significance, the observed effect size is often small, leading to artificially low power estimates that do not reflect the true design.It does not change the study's actual power and can lead to misinterpretations about the study's adequacy.

14. **Define "right-censoring" in the context of survival analysis and provide one common reason why it occurs in clinical studies.**
    Answer: Right-censoring occurs when the event of interest (e.g., death, failure) has not yet occurred for some individuals by the end of the study. An observation is censored if individual does not experience event during the study.
- **Common reason in clinical studies:** Participants drop out or are still alive at the end of the follow-up period.

15. **What is the primary assumption of the Log-rank test used for comparing survival curves between two or more groups?**
    Answer: The primary assumption is the **proportional hazards assumption**, meaning the hazard ratio between groups remains constant over time.
16. **You are comparing the average test scores between male and female students using an independent samples t-test. State the typical null hypothesis (H_0) and alternative hypothesis (H_1) for this scenario (use μ_male and μ_female).**
    Answer:

- H_0 **(Null hypothesis):** μ_male = μ_female (No difference in mean test scores between male and female students).
- H_1 **(Alternative hypothesis):** μ_male ≠ μ_female (Mean test scores are different between male and female students)