Class Exercise

1. **Rebel Magpies**

   In a 2022 pilot study, scientists fitted 5 Australian magpies with tiny GPS trackers that could only be removed using a magnet or scissors. Within 10 minutes, a dominant female had successfully removed the tracker from a younger bird, and within 3 days all of the devices had been removed.

   In a larger follow-up study, a wildlife ecologist fits a random sample of 40 magpies with the same type of tracker and records how long (in hours) each device stays on before being removed by the bird or a flock-mate. The sample yields an average attachment time of $\bar{x} = 20.0$ hours. From previous deployments, the population standard deviation of attachment times is known to be 4.0 hours.

   (a) What are the underlying assumptions for creating a 95% z-score interval?

   (b) Construct and interpret a 95% z-score confidence interval for the true mean attachment time of the trackers on Australian magpies.

   (c) A technology company that manufactures the trackers claims that the devices stay attached for *at least* 22 hours on average when used with magpies. Based on the 95% confidence interval you constructed, can this claim be validated? Justify your answer.

   (d) If the ecologist wants the margin of error for a 95% confidence interval to be no more than 0.75 hours, what is the minimum sample size needed?

2. **ChatGPT Energy Use**

   At a clean-tech research lab, an engineer collects data on the electricity required (in watt-hours) for each of 12 randomly selected Claude queries under controlled conditions. The sample of 12 queries yields a mean electricity consumption of 8.2 watt-hours per query, with a sample standard deviation of 2.5 watt-hours.

   (a) What are the underlying assumptions for creating a 95% t-score interval?

   (b) Construct and interpret a 95% t-score confidence interval for the true mean electricity consumption of a Claude query.

   (c) A "typical" Google search uses about 0.8 watt-hours of electricity. Using your 95% confidence lower bound, does the data provide evidence that a Claude query uses more energy on average than a Google search? Explain.

   (d) Construct and interpret a 98% t-score confidence upper bound for the true mean electricity consumption of a Claude query.