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

   (b) 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.

   (c) 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. **Dragonfly Evasion**

   Female dragonflies fake sudden death to avoid unwanted male suitors.

   To estimate how common this behaviour is in the wild, a researcher examines 180 randomly selected female dragonflies during the peak mating season and finds that 117 of them display death-feigning behaviour when approached by a male.

   (a) Construct and interpret a 90% confidence interval for the true proportion of female dragonflies that use death-feigning behaviour to avoid unwanted mates.

   (b) The researcher wants to estimate this true proportion with a 90% confidence level and a margin of error of no more than 4%. A preliminary field study suggests that about 68% of females use death-feigning as an avoidance strategy. What is the minimum sample size that should be used?

   (c) Construct and interpret a 99% lower confidence bound for the true proportion of female dragonflies that engage in death-feigning to avoid male suitors.

3. **ChatGPT Energy Use**

A single question to ChatGPT uses ten times as much electricity as a Google search and consumes half a litre of water.

At a clean-tech research lab, an engineer collects data on the electricity required (in watt-hours) for each of 12 randomly selected ChatGPT 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) Construct and interpret a 95% confidence interval for the true mean electricity consumption of a ChatGPT query.

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

(c) Construct and interpret a 95% upper confidence interval for the true mean electricity consumption of a ChatGPT query.