

Practice Assignment: Sampling Variability

Encounters between cruise ships and whales are perhaps inevitable, but researchers for the National Park Service are hoping to implement strategies to reduce these encounters. In 2009, observers for the National Park Service recorded over 1,600 unique encounters between whales and cruise ships in the Glacier Bay National Park and Preserve. In 20% of these encounters, the whale came within 3,281 feet of the bow of the ship, representing a “near miss”.¹

- 1) Suppose another team of researchers in 2009 believed that the rate of encounters in which the whale comes within 3,281 feet of the bow in the lower bay sub-region of Glacier Bay was higher than 20%. This team observed a sample of 85 encounters between cruise ships and whales in the lower bay; the whale came within 3,281 feet of the bow in 25 of these encounters.

Part A: Assuming $p = 0.20$, is it valid to use the normal approximation to the sampling distribution of \hat{p} , the sample proportion of encounters where the whale came within 3,281 feet of the bow? Justify your answer.

Part B: Assuming $p = 0.20$, calculate the mean and standard deviation of \hat{p} for samples of size 85.

Part C: Assuming $p = 0.20$, use the normal distribution to approximate the probability that the whale came within 3,281 feet in 25 or more of a sample of 85 encounters. Round to the nearest thousandth.

Part D: Based on your answer in Part C, do these data provide evidence that the rate by which a whale came within 3,281 feet in the lower bay was higher than the overall rate of 20%? Justify your answer.

- 2) Researchers plan to take another sample of whale and cruise ship encounters in the west arm sub-region of Glacier Bay. Assuming $p = 0.20$, if the researchers would like to ensure that the standard deviation of the sample proportion is no larger than 0.03, how many encounters would they need to include in their sample?

¹ Gende, S. M., Harris, K., Nielsen, J., & Hendrix, A. N. (n.d.). *Using observers to record encounters between cruise ships and humpback whales*. National Park Service. <https://www.nps.gov/articles/aps-9-2-4.htm>

- 3) The National Park Service observers also reported that 3% of whale-ship encounters occurred within 985 feet of the bow of the ship. Let \hat{p} be the sample proportion of encounters where a whale came within 985 feet of the bow in a sample of 85 encounters.

Part A: Assuming $p = 0.03$, calculate the mean and standard deviation of the sampling distribution of \hat{p} .

Part B: Assuming $p = 0.03$ and $n = 85$, use the *DCMP Normal Distribution* tool (<https://lumen-learning.shinyapps.io/normaldist/>) to calculate the probability that \hat{p} falls between 0 and 0.06.

Part C: Use the *DCMP Sampling Distribution of the Sample Proportion* tool (https://lumen-learning.shinyapps.io/sampdist_prop) to simulate 10,000 sample proportions when $p = 0.03$ and $n = 85$. Use the simulation results to find the proportion of samples where \hat{p} falls between 0 and 0.06.

Part D: Explain why the probabilities calculated in Parts B and C are so different.

Hint: Are the conditions met to use the normal approximation to the sampling distribution of \hat{p} in this case?