**Question no 2: You now decide to change a few parameters within the learning algorithm used in Question 7.1 and learn two more hypotheses, h2 and h3. The error rates for these new hypotheses observed on the test data set of 45 instances were 8.89% and 13.3%, respectively. To what degree can you be confident that h2 will perform worse than h1 on the underlying population. Is your confidence higher or lower for h3 performing worse than h1 on the underlying population?**

- **h2:** 8.89%
- **h3:** 13.3%

For h1, the confidence interval is approximately **0% to 13.96%**.

# For H2

For h2, with n = 45 and observed error rate e = 0.0889:

Standard Error = sqrt((0.0889 * (1 - 0.0889)) / 45)
= sqrt((0.0889 * 0.9111) / 45)
= sqrt(0.08109679 / 45)
= sqrt(0.00180215)
= 0.042452

Margin of Error (95%) = 1.96 * 0.042452
= 0.08320592

Lower bound = 0.0889 - 0.08320592
= 0.00569408

Upper bound = 0.0889 + 0.08320592
= 0.17210592

The 95% confidence interval for the true error of h2 is approximately **0.57% to 17.21%**.

# For H3

For h3, with n = 45 and observed error rate e = 0.133:

Standard Error = sqrt((0.133 * (1 - 0.133)) / 45)
= sqrt((0.133 * 0.867) / 45)
= sqrt(0.115311 / 45)

= sqrt(0.00256246)
                              = 0.050621

Margin of Error (95%) = 1.96 * 0.050621
                                  = 0.09921716

Lower bound = 0.133 - 0.09921716
                      = 0.03378284

Upper bound = 0.133 + 0.09921716
                      = 0.23221716

The 95% confidence interval for the true error of h3 is approximately **3.38% to 23.22%**.

Summary of the 95% confidence intervals:
        H1     -------------------------------------⟶  **0% to 13.96%**
        H2     ------------------------------------⟶  **0.57% to 17.21%**
        H3     ------------------------------------⟶  **3.38% to 23.22%**

# Conclusion

Based on the 95% confidence intervals :

- We cannot state with 95% confidence that h2 will perform worse than h1, as their confidence intervals overlap.
- Similarly, we cannot state with 95% confidence that h3 will perform worse than h1, as their confidence intervals also overlap.