

Exercise Your Understanding

The Hypergeometric Probability Distribution and P -Value

- a. Derive the equation for the hypergeometric distribution-based P -value by starting from the most basic combinatorial principles. For example, derive even the Newton binomial coefficient if you are using it. Explain.
- b. Write two additional different yet mathematically equivalent formulations of the hypergeometric P -value. Explain.
- c. A clinical trial tests a new drug for pain relief. Of the 251 patients that enrolled in the trial, 86 were in the treatment arm. The trial resulted with 86 patients who experienced pain relief, of which 84 were in the treatment arm. Write the hypergeometric P -value for these results. If this P -value evaluates to 8.01×10^{-62} , how would you interpret the results? Explain.
- d. “Catastrophic cancellation” is the loss of significant digits and accuracy when subtracting two nearly equal numbers by using floating-point arithmetic. This means that in subtracting $1 - 8.01 \times 10^{-62}$ from 1, a computer may return 0 instead of 8.01×10^{-62} . Knowing this, which of the mathematically equivalent formulations of the hypergeometric P -value are computationally advantageous? Explain.