1. (11 pts. total) An association of Christmas tree growers in Indiana sponsored a sample survey of Indiana households to help improve the marketing of Christmas trees. The researchers decided to use a random telephone survey and estimated that each telephone interview would take about 2 minutes. Nine trained students in agribusiness marketing were to make the phone calls between 1:00 pm and 8:00 pm on a Sunday. After discussing problems related to people not being at home or being unwilling to answer the questions, the survey team proposed a sample size of 500. Several of the questions asked demographic information about the household; the key questions of interest had responses of “Yes” or “No.” For example, “Did you have a Christmas tree this year?” Of the 500 respondents, 421 answered “Yes” to this particular question.

   a. Construct, showing all values substituted into your formula, a 95% confidence interval for the proportion of all Indiana households who had a Christmas tree last year. The confidence interval should be given in interval notation.

   b. Interpret the confidence interval given in part a. Remember to interpret the result in full English sentences (no notation, use story problem situation with units of measure where applicable).

   c. State in detail, citing values from the story problem situation, all of the reasons why we are allowed to construct the confidence interval from part a.
2. (7 pts. total) **DR. DOG: Can Dogs Detect Cancer by Smell?**

A recent study investigated whether dogs can be trained to distinguish a patient with bladder cancer by smelling certain compounds released in the patient’s urine. (Article by C.M. Willis et al., *British Medical Journal*, vol. 329, September 25, 2004.) Six dogs of varying breeds were trained to discriminate between urine from patients with bladder cancer and urine from control patients without it. The dogs were taught to indicate which among several specimens was from the bladder cancer patient by lying beside it.

An experiment was conducted to analyze how the dogs’ ability to detect the correct urine specimen compared to what would be expected with random guessing. Each of the six dogs was tested with nine trials. In each trial, one urine sample from a bladder cancer patient was randomly placed among six control urine samples. In the total of 54 trials with the six dogs, the dogs made the correct selection 22 times. Let $p$ denote the proportion of an “infinite” number of trials where a dog makes the correct selection. Since the urine from the bladder cancer patient was one of seven specimens, with random guessing $p = \frac{1}{7}$.

Did this study provide strong evidence that the dogs’ predictions were better than with random guessing?

State the appropriate $H_0$ and $H_a$ to test this suspicion. Carry out the test at the 1% level, showing all steps clearly labeled, including giving the test statistic value derived from its formula with substituted values, and including the calculated P-value showing proper inputs to normalcdf. Remember to interpret the result in full English sentences (no notation, use story problem situation with units of measure where applicable).
3. (7 pts. total) **Gender bias in selecting managers:**

For a large supermarket chain in Florida, a women’s group claimed that female employees were passed over for management training in favor of their male colleagues. The company denied this claim, saying they picked the employees from the eligible pool at random to receive this training. Statewide, the large pool of more than 1000 eligible employees who can be tapped for management training is 40% female and 60% male. Since this program began, 28 of the 40 employees chosen for management training were male and 12 were female. Is there convincing evidence that fewer than 40% of employees selected for management training are women?

State the appropriate $H_0$ and $H_a$ to test this suspicion. Carry out the test at the 5% level, showing all steps clearly labeled, including giving the test statistic value derived from its formula with substituted values, and including the calculated P-value showing proper inputs to normalcdf. Remember to interpret the result in full English sentences (no notation, use story problem situation with units of measure where applicable).