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7.4 - Two-tailed tests

Q1) $X \sim B(15, 0.4)$

$H_0: p = 0.4$

$H_1: p \neq 0.4$

$P(X \leq 3) = 0.0905$

Using Cal
Distribution
Binomial CD
↳ Variable
$x = 3$
$N = 15$
$p = 0.4$

$\leq$ because expected value $= 15 \times 0.4 = 6$

Sig level $\div 2$

$0.0905 > 5\%$

$\therefore$ Accept H_0.

Q2) $X \sim B(40, 0.7)$

$H_0: p = 0.7$

$H_1: p \neq 0.7$

$P(X \geq 34) = 1 - P(X \leq 33)$

$= 1 - 0.9762$

$= 0.0238$

Expected $= 28$ (avoid!)

Using Cal
Distribution
Binomial CD
↳ Variable
$x = 33$
$N = 40$
$p = 0.7$

$\because 0.0238 < 2.5\%$

$\therefore$ Reject H_0.

Q3) $X \sim B(200, 0.05)$

$H_0: p = 0.05$

$H_1: p \neq 0.05$

Using Cal
Distribution
Binomial CD
↳ Variable
$x = 15$
$N = 200$
$p = 0.05$

$P(X \geq 16) = 1 - P(X \leq 15)$

expected $= 200 \times 0.05 = 10$

$= 1 - 0.95564$

Sig. level $\div 2$

$= 0.04436 > 2.5\%$

$\therefore$ Accept H_0 and conclude that the proportion of people in the south west who have the disease is NOT different from the national average.

Q4a) $X \sim B(50, 0.1)$

Significance level $= 10\% \div 2 = 5\%$

Left tail
$P(X \leq 1) = 0.0337$
$X \leq 1$

Right tail
$P(X \leq 9) = 0.9754$
$X \geq 10$

$\therefore$ Critical regions: $X \leq 1$ and $X \geq 10$.

Using Cal
Distribution
Binomial CD
↳ List
1
2
3
4
⋮
$N = 50$
$p = 0.1$

Q4b) Actual sig. level = Left tail + Right tail

Left tail $= 0.0337$

Right tail $= 1 - 0.9754 = 0.0246$

$\therefore$ Actual sig. level $= 0.0337 + 0.0246$

$= 0.0583$

Q4c)

$\because$ 2 is not in the critical region

$\therefore$ Accept H_0 and conclude that there is no evidence that the proportion of her clients has changed.

7.4 - Two-tailed tests

Q5) $X \sim B(120, \frac{1}{8})$

$H_0: p = \frac{1}{8}$ (not biased)

$H_1: p \neq \frac{1}{8}$ (biased)

$P(X \geq 25) = 1 - P(X \leq 24)$

expected $= 120 \times \frac{1}{8} = 15$

$= 1 - 0.9932$

$= 0.0068$

Using Cal
Distribution
Binomial CD
↳ Variable
$x = 24$
$N = 120$
$p = 0.125$

$\because 0.0068 < 2.5\%$ ← sig level $\div 2$

$\therefore$ Reject H_0 and conclude that the dice is biased.

Q6a) $X \sim B(30, 0.25)$

sig. level = 5%

Using Cal
Distribution
Binomial CD
↳ List
$N = 30$
$p = 0.25$

Left tail

$P(X \leq 3) = 0.0374$

~~$P(X \leq 4) = 0.0938$~~

$\Rightarrow X \leq 3$

Right tail

$P(X \leq 11) = 0.9493$ (1, 2, 3, 4, ...)

~~$P(X \leq 12) = 0.9784$~~

$\Rightarrow X \geq 12$ ($\because 0.9493$ is closer to 0.95, read the question again)

$\therefore$ Critical regions: $X \leq 3$ and $X \geq 12$

Q6b) Actual sig. level = Left tail + Right tail

Left tail $= 0.0374$

Right tail $= 1 - 0.9493 = 0.0507$

$\therefore$ Actual sig. level $= 0.0374 + 0.0507$

$= 0.0881$

Q6c) 11 is not in the critical regions, therefore accept H_0

Q7) $X \sim B(50, \frac{1}{50})$

$H_0: p = \frac{1}{50} = 0.02$

$H_1: p \neq 0.02$

$P(X \geq 3) = 1 - P(X \leq 2)$

Expected value $= np = 50 \times \frac{1}{50} = 1$

avoid!

$= 1 - 0.92157$

$= 0.07843$

Using Cal
Distribution
Binomial CD
↳ Variable
$x = 2$
$N = 50$
$p = 0.02$

$\because 0.07843 > 5\%$

$\therefore$ Accept H_0 and conclude that the chance of a double yolk has NOT changed.

(chance remains at $p = 0.02$)