Probability and Statistics 2023

Where was Molly the dog

Open this in the Word app not Word Online if you want brackets to appear in equations

Or, look at “2023 Probability and Statistics (pdf version)” > 2a.pdf for handwritten version

1ai) S = success, P = picture, A = audio

P(S|P) = 1 – q, P(S|A) = 1 – v

P(S|A) = P(A|S)P(S) / P(A) 🡨 Bayes theorem

P(S|A)P(A) / P(S) = P(A|S)

P(S|A) = 1 – v, P(A) = 1 – p

P(S) = P(S|A)P(A) + P(S|P)P(P)

= (1 – v)(1 – p) + (1 – q)(p)

P(A|S) = (1 – v)(1 – p) / (1 – v)(1 – p) + (1 – q)(p)

1aii) P(S|A) = 1 – v, P(S|P) = 1 – q

SSS = “new succ” lol

P(SSS|A) = 3C2 x P(S’|A) x P(S|A)2 + 3C3 x P(S|A)2

= 3v(1 – v)2 + 1(1 – v)3

= (3v – 6v2 + 3v3) + (1 – 3v + 3v2 – v3)

= 1 – 3v2 + 2v3

P(SSS|P) = [same steps, but replace v with q]

= 3q(1 – q)2 + 1(1 – q)3

= 1 – 3q2 + 2q3

P(SSS) = P(SSS|A)P(A) + P(SSS|P)P(P)

= (1 – 3v2 + 2v3)(1 – p) + (1 – 3q2 + 2q3)(p)

1bi) word online is allergic to brackets, it should be f[-∞, ∞] in the second conjunct

1bii)

1biii) k = 1, b = 4a

1ci) π0 = (1, 0, 0, 0)

Let π∞ = (b, c, d, e)

π∞ R = π∞

(e/2, b, c, d + e/2) = (b, c, d, e)

e/2 = b = c

d + e/2 = e --> d = 3/2 e

π∞ = multiple of (1, 1, 3, 2)

Need to make the probabilities in π∞ add to 1, so we divide by 1 + 1 + 3 + 2 = 7:

π∞ = 1/7 (1, 1, 3, 2)

1cii) a = 1

Since it permutes x in xR, π∞ R = π∞ would yield (b, c, d, e) = (e, b, c, d)

2ai)

2aii) is biased if

where

BE CAREFUL here, the 2 are around the WHOLE SUMS in fractions 2 and 3 below (see handwritten screenshot of same step for clarification)

A close-up of a white board

Description automatically generated

Now,

So let

and

Bias detected

2aiii)

2aiv)

98%:

2bi) 90% confidence interval, assume 2 tailed

z0.95 = 1.645

µ ≈ 4/5

σ = =

2bii) n = 15, n-succ = 9

Posterior ~ Beta(17, 8)

µ = 17/25

σ = 0.091483

17/25 ± 1.645 x 0.091483

2biii)

H0 : p =< 0.5

H1 : p > 0.5

Given the Bayesian distribution of P, and H0 places P’s upper bound at 0.5, at the 5% level, the lower bound of the posterior was 0.52... > 0.5.

Since 0.5 falls in the critical region, there is sufficient evidence to reject H0.

2c) Degrees of freedom: (rows – 1)(col – 1) = (4 – 1)(3 – 1) = 6

Read off table at degrees of freedom 6, and the significance levels:

|  |  |
| --- | --- |
| Sig level | Critical value |
| 20% | 8.558 |
| 10% | 10.645 |
| 5% | 12.592 |

icba to write full sentences, u get the vibe just write it fully in the exam

(the hypotheses and the conclusions!!)

H0 : There is no correlation... The data are independent...

H1 : There is correlation... The data are not independent...

At the:

20% level, X2 > 8.558, reject H0

10% level, X2 > 10.645, reject H0

5% level, X2 < 12.592, cannot reject H0