5. Censored data

In a given population, n individuals are sampled randomly, with replacement, and each sampled individual is asked whether his/her salary is greater than some fixed threshold z. Assume that the salary of a randomly chosen individual has the exponential distribution with unknown parameter λ. Asking whether the salary overcomes a given threshold rathen than directly asking for the salary increases the number people that are willing to answer and decreases the number of mistakes in the collected answers.

Denote by $X_1, \ldots, X_n$ the binary responses of the n sampled individuals, so that $X_i \in \{0, 1\}$. We call the X_i **censored data** .

(a)

2/2 points (graded)

What kind of distribution do the X_i s follow?

- Exponential distribution with parameter $\mu(\lambda)$
- Bernoulli with parameter $\mu(\lambda)$ □
- Poisson with parameter $\mu(\lambda)$

Give the parameter of this distribution in terms of λ and z:

Parameter $\mu(\lambda) =$ exp(-lambda*z) □

$\exp(-\lambda \cdot z)$

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□ 正确 (2/2 分)

(b)

1 point possible (graded)

Let $\overline{X}_n$ be the proportion of sampled individuals whose response was 1 (corresponding to *Yes*). Convince yourself that $\overline{X}_n$ is asymptotically normal.

What is its asymptotic variance?

$V(\overline{X}_n) =$

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(c)

1 point possible (graded)

Find a function f such that $f(\overline{X}_n)$ is a consistent estimator of λ.

Write **barX_n** for the sample average $\overline{X}_n$.

$f(\overline{X}_n) =$

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(d)

1 point possible (graded)

Convince yourself that $f(\overline{X}_n)$ is asymptotically normal and compute its asymptotic variance.

$V(f(\overline{X}_n)) =$

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(e)

1 point possible (graded)

What equation must z satisfy in order to minimize the asymptotic variance computed in part (d)? Write this equation in the form $g_\lambda(z) = z$, where g_λ is a function that depends on the unknown parameter λ.

$g_\lambda(z) =$

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(f)

1 point possible (graded)

Let $Y_1, \ldots, Y_n$ be the salaries of the n sampled people. If one could actually observe $Y_1, \ldots, Y_n$, what would be the Fisher information of Y, $I_Y(\lambda)$, depending on λ?

$I_Y(\lambda) =$

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(g)

1 point possible (graded)

In the model where only the X_i 's are observed (with fixed threshold z), what is the Fisher information? Denote it by $I_X(\lambda)$.

$I_X(\lambda)$

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(h)

2 points possible (graded)
Compare $I_Y(\lambda)$ and $I_X(\lambda)$:

- $I_Y(\lambda) \geq I_X(\lambda)$ for all λ
- $I_Y(\lambda) \leq I_X(\lambda)$ for all λ
- $I_Y(\lambda) \geq I_X(\lambda)$ for some λ, $I_Y(\lambda) < I_X(\lambda)$ for others.

How do you interpret this in this model?

- It depends on the parameter λ whether the censored data or the actual data provides a better estimate.
- The actual data always provides a better estimate
- The censored data always provides a better estimate.

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讨论

隐藏讨论

主题： Unit 3 Methods of Estimation:Homework 6 Maximum Likelihood Estimation and Method of Moments / 5. Censored data

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[STAFF] Can you check my answer for part (e) I think i got the correct answer, but getting red X.	1
5. Censored data	18
part(e) Interpretation 社区助教	6
[Staff] Question G Is the question asking Fisher Information for Xi or for Y? I have computed it for Xi and been graded wrong. Can you pls check?	8
Solution How do we see the solutions?	2
part d I am getting a -ve answer again and again for part d. I might be missing something of course. Can anyone please help?	2
[Staff] part d I am getting a -ve answer again and again for part d. I might be missing something of course. Can you please check my answer and give me a hint?	4
(b)	2
[Staff] log vs ln for c) Are we allowed to use "log" for "ln"? Thanks!	3
[Staff] I mistakenly corrected the wrong field Hello, When recalculating my answer to the question (g), I mistakenly wrote the answer in in the field of the question (e), although I did submit the right answer...	3