1. Kullback-Leibler divergence

Instructions:

For the following pairs of distributions $(\mathbf{P}, \mathbf{Q})$, compute the Kullback-Leibler divergence $\mathsf{KL}(\mathbf{P}, \mathbf{Q})$.

If the KL divergence is $+\infty$ or $-\infty$, enter **+inf** or **-inf**.

(a)

1/1 point (graded)

$$\mathbf{P} = \mathcal{N}(a, \sigma^2), \quad \mathbf{Q} = \mathcal{N}(b, \sigma^2), \quad a, b \in \mathbb{R},\ \sigma^2 > 0.$$

(If applicable, enter **ln(x)** for $\ln(x)$. Do NOT enter "log".)

$\mathrm{KL}(\mathbf{P}, \mathbf{Q}) =$ (a-b)^2/2/sigma^2 ✔

$\frac{(a-b)^2}{2 \cdot \sigma^2}$

STANDARD NOTATION

Submit You have used 1 of 2 attempts

✔ Correct (1/1 point)

(b)

1/1 point (graded)

$$\mathbf{P} = \mathrm{Ber}(a), \quad \mathbf{Q} = \mathrm{Ber}(b), \quad a, b \in (0, 1)$$

(If applicable, enter **ln(x)** for $\ln(x)$. Do NOT enter "log".)

$\mathrm{KL}(\mathbf{P}, \mathbf{Q}) =$ (1-a)*ln((1-a)/(1-b))+a*ln(a/b) ✔

$(1-a) \cdot \ln\left(\frac{1-a}{1-b}\right) + a \cdot \ln\left(\frac{a}{b}\right)$

STANDARD NOTATION

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✔ Correct (1/1 point)

(c)

2/2 points (graded)

$$P = \text{Unif}([0, \theta_1]), \quad Q = \text{Unif}([0, \theta_2]), \quad 0 < \theta_1 < \theta_2.$$

Hint: Note the support of each distribution when computing the expectation.

(If applicable, enter **ln(x)** for $\ln(x)$. Do NOT enter "log". If applicable, enter **theta_1** for θ_1 and **theta_2** for θ_2.)

$\text{KL}(\mathbf{P}, \mathbf{Q}) =$ ln(theta_2/theta_1) ✔

$\ln\left(\frac{\theta_2}{\theta_1}\right)$

$\text{KL}(\mathbf{Q}, \mathbf{P}) =$ +inf ✔

$+inf$

STANDARD NOTATION

Submit You have used 3 of 3 attempts

✔ Correct (2/2 points)

(d)

1/1 point (graded)

$$P = \text{Exp}(\lambda), \quad Q = \text{Exp}(\mu), \quad \lambda, \mu \in (0, \infty).$$

(If applicable, enter **ln(x)** for $\ln(x)$. Do NOT enter "log".)

$\text{KL}(\mathbf{P}, \mathbf{Q}) =$ ln(lambda/mu)+mu/lambda-1 ✔

$\ln\left(\frac{\lambda}{\mu}\right) + \frac{\mu}{\lambda} - 1$

STANDARD NOTATION

Submit You have used 1 of 2 attempts

✔ Correct (1/1 point)

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disjoint supports (c.2)

discussion posted 2 days ago by **nbourbon**

I did the first part of exercise d but in the second part I'm finding that Theta_2 is larger than Theta_1... so if I integrate over the entire range even if I split in two parts, there is one part that is [...]. What is the recommended solution in that case?

Note: my question is already answered by following the instructions at the very top of the page.

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1 response

Erocha (Community TA)
2 days ago

Don't you mean (c) ? If you computed correctly you should follow the instructions at the top of this page: "If the KL divergence ..."

sorry yes, part c.. and yes I got my green tick now .. I didn't see it was already included in the instruction. Thanks.. now it makes sense

posted 2 days ago by **nbourbon**

First I assumed $ln\,(0) := 0$ to get rid of the singularity in the function, for which the KL divergence or (c) 2nd part has the form $\frac{\theta_1}{\theta_2}.\,ln\,(\theta_1) - ln\,(\theta_2)$
. I wonder if this has any intuitive meaning.

posted 3 minutes ago by **sandipan_dey**

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