

Course > Unit 5 Bayesian statistics > Homework 9: Bayesian Statistics > 3. Jeffreys prior

3. Jeffreys prior

Note: The concepts discussed in the recitation on Jeffreys prior may be helpful to you for these homework exercises.

Instructions:

For each of the following statistical models, compute Jeffreys prior distribution and determine whether it is proper or not.

(a)

2/2 points (graded)

For a family of distribution $\left\{\mathsf{Ber}\left(p\right)\right\}_{p\in(0,1)}$, Jeffreys prior is proportional to:

Therefore, the Jeffreys prior is:



Improper



Solution:

Recall that $\pi_j \propto \sqrt{\det\left(I\left(\theta\right)\right)}$.

$$I\left(p
ight) =rac{1}{p\left(1-p
ight) }$$

$$\pi_j \propto rac{1}{\sqrt{p\left(1-p
ight)}}$$

Therefore, the prior is proper; Beta (0.5, 0.5).

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You have used 2 of 3 attempts

• Answers are displayed within the problem

(b)

2/2 points (graded)

For a family of distribution $\{ \mathsf{Exp} \, (\lambda) \}_{\lambda > 0}$, Jeffreys prior is proportional to:

$$\pi_{j}\left(\lambda
ight) \propto$$
 1/lambda wo Answer: 1/lambda $frac{1}{\lambda}$

Generating Speech Output

Therefore, the Jeffreys prior is:

Proper

Improper

...

Solution:

Recall that $\pi_{j} \propto \sqrt{\det\left(I\left(\lambda\right)\right)}$.

$$I(\lambda) = rac{1}{\lambda^2}$$

$$\pi_j \propto rac{1}{\lambda}$$

Since $\frac{1}{\lambda}$ integrates to infinity, the prior is improper.

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You have used 1 of 3 attempts

1 Answers are displayed within the problem

(c)

2/2 points (graded)

For a family of distribution $\left\{\mathsf{Poiss}\left(\lambda\right)\right\}_{\lambda>0}$, Jeffreys prior is proportional to:

$$\pi_{j}\left(\lambda
ight) \propto$$
 1/sqrt(lambda) wo Answer: lambda^(-1/2) $rac{1}{\sqrt{\lambda}}$

Therefore, the Jeffreys prior is:







Solution:

Recall that $\pi_{j} \propto \sqrt{\det\left(I\left(\lambda\right)\right)}$.

$$I(\lambda) = rac{1}{\lambda}$$

$$\pi_j \propto rac{1}{\sqrt{\lambda}}$$

Since $\frac{1}{\sqrt{\lambda}}$ integrates to infinity, the prior is improper.

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You have used 1 of 3 attempts

• Answers are displayed within the problem

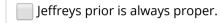
(d) Properties of leffreys prior

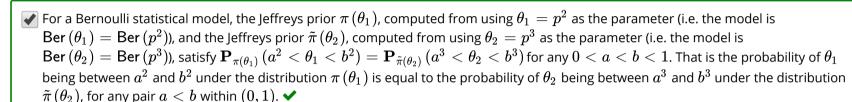
0/1 point (graded)

For each of the statements below about leffreys prior, determine whether it is true or false. Select all the true statements.



📝 It allows us to reflect our prior belief about the possible hypotheses. In other words, Jeffreys prior is not obtained from the statistical model alone.







Solution:

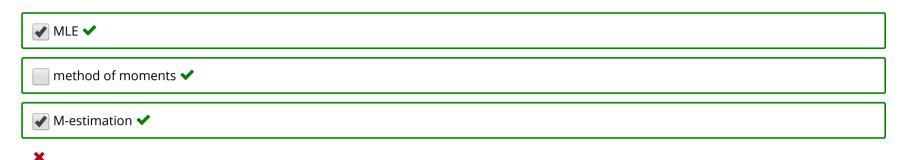
- The first choice is false. Recall that Jeffreys prior is obtained from the model, there is nothing we reflect about our prior belief. Hence, the first choice is false.
- The second choice is false. We have seen examples where it is not necessarily a proper prior as it does not have a finite integral.
- The third choice is true. The last choice is true because Jeffreys prior is invariant under reparametrization.

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You have used 2 of 2 attempts

- Answers are displayed within the problem
- (e) Review: Reparametrization in the frequentist view

Generating Speech Output or r point (5 raded) In the previous units, three of the frequentist methods of estimation we've covered are the maxmium likelihood estimation (MLE), the method of moments, and M-estimation. Let our original parameter is θ , and suppose that our original estimator produces a unique estimate θ^* . We then apply a bijective transformation $f(\theta) = \eta$. For which of the three frequentist methods would the estimator applied to the transformed values η^* be equal to $f(\theta^*)$?



Solution:

The answer is that the estimator applied to the transformed values η^* will always be equal to $f(\theta^*)$. This is because in the frequentist approach, a true parameter is assumed, and thus all our estimator functions (of the observation data) will correspond to a particular parameter value. This value can be converted through different parametrizations, and it will correspond to the exact same value as long as the original estimator produces a unique estimate.



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?	Not sure about the answer of question (b)	2
2	(e) "estimator applied to the transformed values eta*"? I don't understand how an estimator could be applied to the new parameter eta. Isn't an estimator for a parameter a function of the data (only the data) to calculate or estim	13
?	[STAFF] Please clarify the question in part (e)	2
2	[Staff] - Minor typo/gramatical error - Part (e) The sentence reads:"Let our original parameter **is** θ " should be "Let our original parameter **be** θ .	2
?	e) Unsure where I'm going wrong. I reasoned that one of them seems to be preserved only under linearity and another seems to include this as a special case (per the examples we saw in lecture / in the slides)	1

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