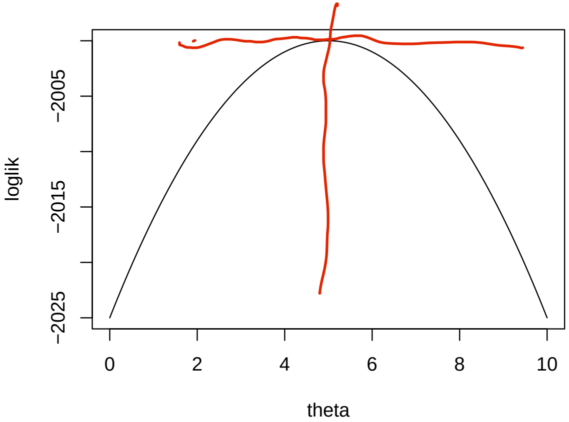
The Python function `statsmodels.tsa.arima.model.ARIMA.fit` and the R function `arima()` provide standard errors calculated by observed Fisher information. This question tests your understanding of what that means. Suppose a parametric model has a single parameter, θ, and the log-likelihood function when fitting this model to dataset is as follows:



$$I_{obs} = -\frac{d^2}{d\theta^2} \log f_{Y_{1:N}}(y^*_{1:N};\theta)$$

observed Fisher information, at $\theta = \hat{\theta}_{MLE}$

$$I = \mathbb{E}\left[\left(\frac{\partial}{\partial\theta} \log f_{Y_{1:N}}(Y_{1:N};\theta)\right)^2\right]$$

$$= -\mathbb{E}\left[\frac{\partial^2}{\partial\theta^2} \log f_{Y_{1:N}}(Y_{1:N};\theta)\right]$$

What is the observed Fisher information (I_{obs}) for θ?

Hint 1. The observed Fisher information is accumulated over the whole dataset, not calculated per observation, so we don't have to know the number of observations, N.

Hint 2. Observations in time series models are usually not independent. Thus, the log-likelihood is not the sum of the log-likelihood for each observation. Its calculation will involve consideration of the dependence, and usually the job of calculating the log-likelihood is left to a computer.

Hint 3. The usual variance estimate for the maximum likelihood estimate, $\hat{\theta}$, is $\mathrm{Var}(\hat{\theta}) \approx 1/I_{obs}$.

A: $I_{obs} = 2$

B: $I_{obs} = 1$

C: $I_{obs} = 1/2$

D: $I_{obs} = 1/4$

E: None of the above