1. Suppose that $X \sim \mathrm{U}(0, \theta)$, a uniform distribution over $(0, \theta)$. Note that $\log p(x; \theta)$ is differentiable for all $\theta > x$ and we can define $\partial \log p(x; \theta)/\partial\theta$. (Here, $\log(\cdot)$ denotes natural logarithm.) Show that, however,

(a)

$$\mathrm{E}_{\,p(x;\theta)}\Big[\frac{\partial \log p(X;\theta)}{\partial\theta}\Big] = -\frac{1}{\theta} \neq 0$$

(b)

$$\mathrm{var}_{p(x;\theta)}\Big(\frac{\partial \log p(X;\theta)}{\partial\theta}\Big) = 0$$

and the information bound is infinite.

Yet, show that $2X$ is an unbiased estimator of θ and has finite variance.

2. Problem 3.2 in Kay-I.
3. Problem 3.3 in Kay-I.
4. Problem 3.12 in Kay-I.
5. Problem 3.15 in Kay-I.