chapter 3

Question 6

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a) $$\int P[r|s]\,dr = 1 \xrightarrow{\partial/\partial s} \int \frac{\partial P[r|s]}{\partial s}\,dr = 0$$

$$\frac{\partial P[r|s]}{\partial s} = \frac{\partial \ln(P[r|s])}{\partial s} \times P[r|s]$$

chain rule: $\frac{\partial P[r|s]}{\partial s} \times \frac{1}{P[r|s]}$

$$\rightarrow \int \frac{\partial \ln(P[r|s])}{\partial s} \times P[r|s]\,dr = 0$$

$$\xrightarrow{\partial/\partial s} \int \left(\left[\frac{\partial^2 \ln(P[r|s])}{\partial s^2} \times P[r|s] \right] + \left[\frac{\partial P[r|s]}{\partial s} \times \frac{\partial \ln(P[r|s])}{\partial s} \right] \right) dr = 0$$

$$\frac{\partial P[r|s]}{\partial s} = \frac{\partial \ln(P[r|s])}{\partial s} \times P[r|s]$$

$$\rightarrow \boxed{-\int \frac{\partial^2 \ln(P[r|s])}{\partial s^2} P[r|s]\,dr = +\int \left(\frac{\partial \ln(P[r|s])}{\partial s} \right)^2 P[r|s]\,dr}$$

b) for second part of the question we can use $\frac{\partial \ln(P[r|s])}{\partial s} = \frac{\partial [r|s]}{\partial s} \times \frac{1}{P[r|s]}$

in right hand sind of above equation:

$$\int \left(\frac{\partial \ln(P[r|s])}{\partial s} \right)^2 P[r|s]\,dr = \int \left(\frac{\partial [r|s]}{\partial s} \times \frac{1}{P[r|s]} \right)^2 \times P[r|s]\,dr$$

$$= \boxed{\int \left(\frac{\partial [r|s]}{\partial s} \right)^2 \times \frac{1}{P[r|s]}\,dr}$$