$$I(X_{-M:0}; X_{0:N}) = I(X_{-M:0}; X_{0:N} | \theta) + H(\theta) + H(\theta | X_{-M:N}) - H(\theta | X_{-M:0}) - H(\theta | X_{0:N})$$

nonzero

$$I(X_{-M:0}; X_{0:N} | \theta) = I(X_{-M:0}; X_{0:N} | \theta, S) + H(S|\theta) + H(S | X_{-M:N}, \theta) - H(S | \theta, X_{-M:0}) - H(S | X_{0:N}, \theta)$$

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$I(X_{-M:0}; X_{0:N} | \theta) = 0$

$H(\theta | X_{-M:0}) \sim -\frac{1}{2}\log M$ ← $H(\theta | X_{-M:N}) = ? - \frac{1}{2}\log(M+N)$

$H(\theta | X_{0:N}) \sim -\frac{1}{2}\log N$

$H(\theta) = 1$

$p(\theta | X_{-M:N}) = \frac{p(X_{-M:N} | \theta)\, p(\theta)}{p(X_{-M:N})}$

$\downarrow \mathcal{N}\left(\hat{\rho}, \frac{\sigma_\rho^2}{M+N}\right)$

$I(X_{-M:0}; X_{0:N}) \overset{M}{\simeq} \frac{1}{2}\log \frac{MN}{M+N}$

$\frac{MN}{M+N} = M \cdot \frac{N}{M+N}$

STAPLES