Let $Z_i(s) = R_i(s)$.

$$\boxed{\mathbb{E}\, R_i(s) = 0?}$$

Let $R_i(s) = \dfrac{Y_i - \hat{\mu}}{\hat{\sigma}}$

QQ:

is $\underline{\mathbb{E} R_i(s) = 0}$

Then $\hat{\Lambda}(s) = \dfrac{1}{n} \sum_{i=1}^{n} R_i(s) R_i(s)^T$

$= \underline{\frac{1}{n} R^T R}$

$$\boxed{\text{Book ~~UK~~ flights tonight.}}$$

$\cancel{\mathbb{E}\left[R_i(s)\right] = \mathbb{E}\left[\mathbb{E}\left[R_i(s) \mid \hat{\sigma}\right]\right]}$.

$\cancel{= \mathbb{E}\left[\frac{1}{\hat{\sigma}} \mathbb{E}\left[Y_i \mid \hat{\sigma}\right]\right]}$ ~~as~~ $\cancel{\mathbb{E}}$

By Fubini

Need to show that $\mathbb{E}\left[\det(\hat{\Lambda}(s))^{1/2}\right] = \det(\Lambda(s))^{1/2}$.

Proof: $\cancel{\nabla R_i(s) = \Big(I - (Y_i - \hat{\mu})}$

$\cancel{R_i = \dfrac{Y_i - \hat{\mu}}{\hat{\sigma}}} \Rightarrow \cancel{\nabla R_i = \dfrac{\nabla(Y_i - \hat{\mu})}{\hat{\sigma}} + \dfrac{(Y_i - \hat{\mu}) \nabla \hat{\sigma}}{\hat{\sigma}^2}}$.

$\cancel{R = \dfrac{N}{D}, \; D = \hat{\sigma}}$ $\quad R = \dfrac{Z}{\sqrt{n}\,\hat{\sigma}} \quad Z = \begin{pmatrix} Y_1 - \hat{\mu} \\ \vdots \\ Y_n - \hat{\mu} \end{pmatrix}$

$\cancel{\frac{1}{n} R^T R} \; \boxed{\dfrac{\frac{1}{n}(Y_i - \hat{\mu})}{\hat{\sigma}}} = \underline{\underline{\dfrac{Z}{\|Z\|}}}$. $\quad \hat{\sigma} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(Y_i - \hat{\mu})^2}$