

$$\begin{aligned}
K_{\mathbf{Y}} &= E\mathbf{Y}\mathbf{Y}^\top - (E\mathbf{Y})(E\mathbf{Y})^\top \\
&= E(A\mathbf{X})(\mathbf{X}^\top A) - (EA\mathbf{X})(E\mathbf{X}^\top A) \\
&= E(A\mathbf{X}\mathbf{X}^\top A^\top) - A(E\mathbf{X})(E\mathbf{X}^\top)A^\top \\
&= A(E\mathbf{X}\mathbf{X}^\top)A^\top - A(E\mathbf{X})(E\mathbf{X}^\top)A^\top \\
&= A \left[E\mathbf{X}\mathbf{X}^\top - (E\mathbf{X})(E\mathbf{X})^\top \right] A^\top \\
&= AK_{\mathbf{X}}A^\top
\end{aligned}$$