$$
\begin{aligned}
\mathrm{Cov}[\mathbf{x}, \mathbf{y}] &= E[(\mathbf{x} - E[\mathbf{x}]) \times (\mathbf{y} - \mathbf{E}[\mathbf{y}])] \\
&= E[\mathbf{xy}] - 2E[\mathbf{x}]E[\mathbf{y}] + E[\mathbf{x}]E[\mathbf{y}] \\
&= E[\mathbf{xy}] - E[\mathbf{x}]E[\mathbf{y}]
\end{aligned}
$$