# Lab 4: Variance-covariance matrices

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# What does this matrix tell us?

$$\begin{bmatrix} \begin{bmatrix} \sigma^2 & 0 & 0 \\ 0 & \sigma^2 & 0 \\ 0 & 0 & \sigma^2 \end{bmatrix} & \begin{matrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{matrix} & \begin{matrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{matrix} \\ \begin{matrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{matrix} & \begin{bmatrix} \sigma^2 & 0 & 0 \\ 0 & \sigma^2 & 0 \\ 0 & 0 & \sigma^2 \end{bmatrix} & \begin{matrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{matrix} \\ \begin{matrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{matrix} & \begin{matrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{matrix} & \begin{bmatrix} \sigma^2 & 0 & 0 \\ 0 & \sigma^2 & 0 \\ 0 & 0 & \sigma^2 \end{bmatrix} \end{bmatrix}$$

# What does this matrix tell us?

$$
\begin{bmatrix}
\begin{bmatrix} \sigma^2 & \sigma^2\rho & \sigma^2\rho \\ \sigma^2\rho & \sigma^2 & \sigma^2\rho \\ \sigma^2\rho & \sigma^2\rho & \sigma^2 \end{bmatrix} & \begin{matrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{matrix} & \begin{matrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{matrix} \\
\begin{matrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{matrix} & \begin{bmatrix} \sigma^2 & \sigma^2\rho & \sigma^2\rho \\ \sigma^2\rho & \sigma^2 & \sigma^2\rho \\ \sigma^2\rho & \sigma^2\rho & \sigma^2 \end{bmatrix} & \begin{matrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{matrix} \\
\begin{matrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{matrix} & \begin{matrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{matrix} & \begin{bmatrix} \sigma^2 & \sigma^2\rho & \sigma^2\rho \\ \sigma^2\rho & \sigma^2 & \sigma^2\rho \\ \sigma^2\rho & \sigma^2\rho & \sigma^2 \end{bmatrix}
\end{bmatrix}
$$

# What's this matrix?

$$\begin{bmatrix} \begin{bmatrix} \sigma^2_{i=1} & 0 & 0 \\ 0 & \sigma^2_{i=1} & 0 \\ 0 & 0 & \sigma^2_{i=1} \end{bmatrix} & \begin{matrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{matrix} & \begin{matrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{matrix} \\ \begin{matrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{matrix} & \begin{bmatrix} \sigma^2_{i=2} & 0 & 0 \\ 0 & \sigma^2_{i=2} & 0 \\ 0 & 0 & \sigma^2_{i=2} \end{bmatrix} & \begin{matrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{matrix} \\ \begin{matrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{matrix} & \begin{matrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{matrix} & \begin{bmatrix} \sigma^2_{i=3} & 0 & 0 \\ 0 & \sigma^2_{i=3} & 0 \\ 0 & 0 & \sigma^2_{i=3} \end{bmatrix} \end{bmatrix}$$

# What's this matrix?

$$
\begin{bmatrix}
\begin{bmatrix} \sigma^2_{i=1} & \sigma^2_{i=1}\rho & \sigma^2_{i=1}\rho \\ \sigma^2_{i=1}\rho & \sigma^2_{i=1} & \sigma^2_{i=1}\rho \\ \sigma^2_{i=1}\rho & \sigma^2_{i=1}\rho & \sigma^2_{i=1} \end{bmatrix} & 0 & 0 & 0 \\
 & 0 & 0 & 0 \\
 & 0 & 0 & 0 \\
 & 0 & 0 & 0 \\
 & 0 & 0 & 0 \\
 & 0 & 0 & 0
\end{bmatrix}
$$

$$
\begin{bmatrix}
 & 0 & 0 & 0 \\
 & 0 & 0 & 0 \\
 & 0 & 0 & 0 \\
\begin{bmatrix} \sigma^2_{i=2} & \sigma^2_{i=2}\rho & \sigma^2_{i=2}\rho \\ \sigma^2_{i=2}\rho & \sigma^2_{i=2} & \sigma^2_{i=2}\rho \\ \sigma^2_{i=2}\rho & \sigma^2_{i=2}\rho & \sigma^2_{i=2} \end{bmatrix} & 0 & 0 & 0 \\
 & 0 & 0 & 0 \\
 & 0 & 0 & 0
\end{bmatrix}
$$

$$
\begin{bmatrix}
 & 0 & 0 & 0 \\
 & 0 & 0 & 0 \\
 & 0 & 0 & 0 \\
 & 0 & 0 & 0 \\
 & 0 & 0 & 0 \\
 & 0 & 0 & 0 \\
\begin{bmatrix} \sigma^2_{i=3} & \sigma^2_{i=3}\rho & \sigma \\ \sigma^2_{i=3}\rho & \sigma^2_{i=3} & \sigma \\ \sigma^2_{i=3}\rho & \sigma^2_{i=3}\rho & \end{bmatrix}
\end{bmatrix}
$$

# What's this matrix?

$$\begin{bmatrix} V_i & 0 & 0 \\ 0 & V_i & 0 \\ 0 & 0 & V_i \end{bmatrix}$$

$$V_i = \begin{bmatrix} \sigma^2_{i1} & Cov(Y_{i1,2}) & Cov(Y_{1,3}) \\ Cov(Y_{i2,1}) & \sigma^2_{i2} & Cov(Y_{i2,3}) \\ Cov(Y_{i3,1}) & Cov(Y_{i3,3}) & \sigma^2_{i3} \end{bmatrix}$$