

$$\sum_{i=1}^m n_i = N \left\{ \underbrace{\begin{bmatrix} \mathcal{X}^{(1)} \\ \mathcal{X}^{(2)} \\ \vdots \\ \mathcal{X}^{(m)} \end{bmatrix}}_{\mathcal{X}} \quad \underbrace{\begin{bmatrix} n_1 & n_2 & \dots & n_m \\ \begin{bmatrix} C^{(1,1)} & C^{(1,2)} & \dots & C^{(1,m)} \end{bmatrix} \\ \begin{bmatrix} C^{(2,1)} & C^{(2,2)} & \dots & C^{(2,m)} \end{bmatrix} \\ \vdots & \vdots & \ddots & \vdots \\ \begin{bmatrix} C^{(m,1)} & C^{(m,2)} & \dots & C^{(m,m)} \end{bmatrix} \end{bmatrix}}_{Cov(\mathcal{X})} \right.$$

Diagram illustrating the relationship between the data matrix \mathcal{X} and its covariance matrix $Cov(\mathcal{X})$.

The data matrix \mathcal{X} is a vertical stack of m blocks, each of size n_i , totaling N rows. The blocks are labeled $\mathcal{X}^{(1)}, \mathcal{X}^{(2)}, \dots, \mathcal{X}^{(m)}$.

The covariance matrix $Cov(\mathcal{X})$ is a block matrix of size $N \times N$. It is partitioned into m columns and m rows, corresponding to the blocks in \mathcal{X} . The diagonal blocks are $C^{(i,i)}$, and the off-diagonal blocks are $C^{(i,j)}$. The dimensions of the blocks are indicated by n_1, n_2, \dots, n_m above the columns and n_1, n_2, \dots, n_m to the right of the rows.