

$$\text{Var}(X_i) = p_i - p_i p_i$$

$$\text{Cov}(X_i, X_j) = -p_i p_j, \quad i \neq j$$

$\vec{p} \vec{p}^T$  is matrix ( $k \times k$ )  
with elements  $p_i p_j$

$P$  is diagonal matrix with  $i$  term  $p_i$

$$y_k = n - y_1 - y_2 - \dots - y_{k-1}$$

$$= n - \sum_{i=1}^{k-1} y_i$$