

$$\left| \bigcup_{i=1}^k E_i \right| = \sum_{j=1}^k (-1)^{j+1} \sum_{\substack{i_1, i_2, \dots, i_j \\ 1 \leq i_1 < i_2 < \dots < i_j \leq k}} |E_{i_1} \cap E_{i_2} \cap \dots \cap E_{i_j}| = \sum_{j=1}^k (-1)^{j+1} \binom{k}{j} (k-j)^n.$$