Formula sheet.

Identities for the probability of events:
- \( P(\overline{A}) = 1 - P(A) \) (where \( \overline{A} \) denotes the complement of \( A \)),
- \( P(A \cup B) = P(A) + P(B) - P(A \cap B) \),
- \( P(\overline{A} \cap \overline{B}) = 1 - P(A \cup B) \) (\( A \cup B \) being the complement of \( \overline{A} \cap \overline{B} \)),
  and similarly \( P(A \cap B) = 1 - P(\overline{A} \cup \overline{B}) \)

Conditional probabilities:
- \( P(A|B) = \frac{P(A \cap B)}{P(B)} \) (for \( P(B) > 0 \)),
- \( A \) and \( B \) are called independent if \( P(A \cap B) = P(A) \cdot P(B) \),
- Bayes formula: for \( C_1, \ldots, C_m \) a partition of the sample space and for some event \( E \) with \( P(E) > 0 \), we have for every \( i \in \{1, \ldots, m\} \):
  \[
P(C_i|E) = \frac{P(E|C_i)P(C_i)}{\sum_{j=1}^{m} P(E|C_j)P(C_j)}.
\]

Random variables:
- For a random variable \( X \):
  - the probability mass function is \( P(X = x) \),
  - the expected value is \( E[X] = \sum_x xP(X = x) \),
  - the variance is \( V[X] = E[(X - E[X])^2] = E[X^2] - E[X]^2 \),
  and the standard deviation is \( D[X] = \sqrt{V[X]} \).

**Table 1. Common Distributions**

<table>
<thead>
<tr>
<th>Distribution</th>
<th>( P(X = k) )</th>
<th>( E[X] )</th>
<th>( V[X] )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bin((n, p))</td>
<td>( \binom{n}{k}p^k(1-p)^{n-k} )</td>
<td>( np )</td>
<td>( np(1-p) )</td>
</tr>
<tr>
<td>Geom((p))</td>
<td>( p(1-p)^{k-1} )</td>
<td>( 1/p )</td>
<td>( \frac{1-p}{p^2} )</td>
</tr>
<tr>
<td>Poisson((\lambda))</td>
<td>( e^{-\lambda}\lambda^k )</td>
<td>( \lambda )</td>
<td>( \lambda )</td>
</tr>
</tbody>
</table>

**Chebyshev’s inequality:** For \( X \) a random variable of expected value \( \mu \) and for \( \epsilon > 0 \),
\[
P(|X - \mu| \geq \epsilon) \leq \frac{V[X]}{\epsilon^2}.
\]