1. 3.3.12.

2. 3.3.14.

3. Let \( \mathbf{x} = (X_1, X_2, X_3) \) be three dimensional normal random vector with

\[
\mu = \begin{pmatrix} 0.7 \\ -0.6 \\ 0.2 \end{pmatrix}, \quad \Sigma = \text{Cov}(\mathbf{x}) = \begin{pmatrix} 0.9 & -0.2 & 0.3 \\ -0.2 & 1.1 & 0.4 \\ 0.3 & 0.4 & 0.8 \end{pmatrix}.
\]

Let \( Y = -0.3X_1 + 0.6X_2 - 0.9X_3 + 1.4 \). Compute the distribution of \( Y \) as well as the value of \( P(Y > 2.7) \).

4. Suppose \( X_1, X_2, X_3, X_4 \) are independent normal random variables with \( \text{E}(X_1) = 0.5, \text{E}(X_2) = 0.6, \text{E}(X_3) = -0.7, \text{E}(X_4) = 0.9 \), \( \text{Var}(X_1) = 1.4, \text{Var}(X_2) = 0.8, \text{Var}(X_3) = 1.6, \text{Var}(X_4) = 0.6 \). Let \( Y = 1.2X_1 - 2.1X_2 - 1.9X_3 + 0.9X_4 + 1.5 \). Compute the distribution of \( Y \) as well as the value of \( P(Y > 1.9) \).

5. It is known that if \( n \) is large then \( B(n, p) \) can be approximated by \( N(np, np(1-p)) \). This is called the Central Limit Theorem for the binomial distribution. Let \( X \) be the total number of heads if one flips a balanced coin 1000 times.

   (a) Approximately compute \( P(X > 550) \).

   (b) Suppose one flips a coin 1000 times and obtain 555 heads but he/she does not know whether it is balanced or not. What can you conclude from this fact. State your conclusion.

6. It is known that if \( \lambda \) is large then \( \text{Poisson}(\lambda) \) can be approximated by \( N(\lambda, \lambda) \). This is called the Central Limit Theorem for the Poisson distribution. Suppose \( X \sim \text{Poisson}(\lambda) \). Approximately compute \( P(X > 120) \) if \( \lambda = 100 \), \( P(X > 240) \) if \( \lambda = 200 \), \( P(X > 600) \) if \( \lambda = 500 \), and \( P(X > 1200) \) if \( \lambda = 1000 \) (i.e., over 20\% of the mean value).

7. Let \( X_1, \ldots, X_{200} \) be iid random variables with the common PMF

\[
\begin{array}{c|ccc}
  x & 1 & 2 & 3 \\
  p(x) & 0.2 & 0.2 & 0.6 \\
\end{array}
\]

Let \( \bar{X} = \frac{1}{200} \sum_{i=1}^{200} X_i \). Use the Central Limit Theorem (CLT) to compute \( P(\bar{X} > 2.36) \).