1. For a Binomial distribution $p(n, N, p)$ show that
   a) the distribution in normalized.
   b) the mean of the distribution is pN
   c) calculate the quantity $\sigma_N/\overline{n}$
2. Two fair dices are rolled. Calculate the conditional probability that at least one lands on 6 given that dice land on different numbers.
3. For the same experiment given above, what is the probability that the first dice lands on 6 given that the sum of the dice is i. Calculate for different values of i between 2 and 12.
4. An ectopic pregnancy is twice likely to develop when the pregnant woman is a smoker as it is when she is a non-smoker. If 32 percent of woman of childbearing age are smokers, what percentage of women having ectopic pregnancies are smokers?
5. A total of 48 percent of the women and 37 percent of the men that took a certain "quit smoking" class remained nonsmokers for at least one year after completing the class. These people then attended a success party at the end of a year. If 62 percent of the original class were male
   a) what percentage of those attending the party were women?
   b) what percentage of the original class attended the party?
6. Suppose that there are four coins of the same type in a bag. Three of them are fair, but the fourth is double-headed. You choose one coin at random from the bag and toss it five times. It comes up heads each time. What is the probability that you have chosen the double-headed coin?
7. Alice plants two types of flowers in her garden: 30 percent of type A and 70 percent of type B. Both types yield either red or yellow flowers, with $P(red|A) = 0.4$ and $P(red|B) = 0.3$.
   a) what percentage of red flowers will Alice obtain?
   b) Suppose a red flower is picked at random from Alices garden. What is the probability of the flower being type A?
8. Even though you have no symptoms, your doctor wishes to test you for a rare disease that only 1 in 10,000 people of your age contract. The test is 98 percent accurate, which means that if you have the disease, 98 percent of the times the test will come out positive, and 2 percent negative. We also assume that if you do not have the disease, the test will come out negative 98 percent of the time and positive 2 percent of the time. You take the test and it comes out positive. What is the probability that you have the disease?
9. Assume that the stars in a certain region of the galaxy are distributed at random with an average number density ρ.
   a) Find the probability density $p(r)$ that for a given star the nearest neighbor is located a distance r away.
   b) evaluate the mean distance $\langle r \rangle$ to the nearest star.
10. The displacement of a harmonic oscillator is given by $x = \sqrt{E/m\omega^2 cos(\phi)}$ and is measured at random times. Calculate the probability distribution of x and hence $\langle x \rangle$.

11. Biased random walk - Consider a particle moving on a lattice, initially located at $X_0 = 0$ and at discrete times $t_i = i\tau$ takes steps of size Z_i. Z_i is a random variable with possible outcomes $\pm a$. The probability to move forward is p and backward is q with $p \neq q$ and $p + q = 1$. Let the position of the particle after n steps be X_n.

    a) calculate $\langle X_n \rangle$ and $\langle X_n^2 \rangle$.

    b) derive the differential equation governing the evolution of the probability density of $X(t)$ in the continuum limit of $N \to \infty$ and $a, \tau \to 0$.