CEE110
Homework #3

You must show all work for full credit. Submit your homework through the Gradescope.

**Problem 1.**
At a computer repair shops, suppose X be the number of the computers being repaired with the following information:

- There are at most 3 computers being repaired at any time.
- The probability of having 2 computers at the shop is the same as the probability of having one computer.
- The probability of having no computer at the shop is the same as the probability of having 3 computers.
- The probability of having 1 or 2 computers is half of the probability of having 0 or 3 computers.

a. What is the sample space?

b. What is the pmf of X? Draw the histogram of pmf.

c. What is the cdf of X? Draw the histogram of cdf.

d. What is the expected number of computers being repaired?

**Problem 2.**
A bit transmitted through a digital communication can be received in error. Suppose X be the number of bits in error in the next four bits transmitted. The following shows the pmf.

| X | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| P(X) | 0.6561 | 0.2916 | 0.0486 | 0.0036 | 0.0001 |

a. Find the expected number of bits in error.

b. What is the expected value of the square of the number of bits in error?

c. Find the variance of the number of bits in error.

**Problem 3.**

A commuter boat can carry automobiles with passengers up to six people with the following sales information:

| Passengers/car | 1 | 2 | 3 | 4 | 5 | 6 | Total |
|---|---|---|---|---|---|---|---|
| Cars | 35 | 18 | 12 | 21 | 4 | 10 | 100 |

a. Find the expected value of their sales.

b. What is the variance of their sales?

c. The revenues are as follows:
   - Cost per car is $50 (driver included)
   - Cost per extra passenger is $5

   Find the expected revenues.

**Problem 4.**

In California, 10% of all the registered vehicles violate the state emissions standard. 12 vehicles are selected at random for an emission test.

a. What is the probability that exactly three of them violate the standard?

b. What is the probability that fewer than three of them violate the standard?

c. What is the probability that none of them violate the standard?

**Problem 5.**
The maximum contaminant levels from water treatment plants are specified to have nitrogen concentration of 10 mg/L. From 10 days of daily monitoring, the probability of violation of the maximum contaminant level is 0.1.

a. What is the probability that at most 8 days of monitoring will comply (=not violate) with the maximum contaminant level?

b. What is the probability that at least 8 days of monitoring will comply (=not violate) with the maximum contaminant level?

c. What is the probability that exactly 2 days of monitoring will violate the maximum contaminant level?

d. Calculate expected value and standard deviation of the days with compliance (= no violation).

**Problem 6.**
A geologist has collected 10 specimens of basaltic rock and 10 specimens of granite. The geologist instructs a laboratory assistant to randomly select 15 of the specimens for analysis.

a. What is the pmf of the number of granite specimens selected for analysis?

b. What is the probability that all specimens of one of the two types of rock are selected for analysis?

c. What is the probability that the number of granite specimens selected for analysis is within 1 standard deviation of its mean value?