# ECE 313
## In-Class Activity 2
Write your name and UID here:

_____

**Q1**. Let $X$ be a discrete random variable with probability mass function $p$ given by

| $a$ | $-1$ | $0$ | $1$ | $2$ |
|---|---|---|---|---|
| $p(a)$ | $\frac{1}{4}$ | $\frac{1}{8}$ | $\frac{1}{8}$ | $\frac{1}{2}$ |

and $p(a) = 0$ for all other a.

a) Let the random variable $Y$ be defined by $Y = X^2$. Calculate the probability mass function of $Y$.

b) Calculate the value of the distribution functions of $X$ and $Y$ in $a = 1$, $a = 3/4$, and $a = \pi - 3$.

**Q2.** You decide to play monthly in two different lotteries, and you stop playing as soon as you win a prize in one (or both) lotteries of at least one million euros. Suppose that every time you participate in these lotteries, the probability to win one million (or more) euros is $p_1$ for one of the lotteries and $p_2$ for the other. Let $M$ be the number of times you participate in these lotteries until winning at least one prize. What kind of distribution does $M$ have, and what is its parameter?

**Q3.** We throw a coin until a head turns up for the second time, where $p$ is the probability that a throw results in a head and we assume that the outcome of each throw is independent of the previous outcomes. Let $X$ be the number of times we have thrown the coin.

a) Determine $P(X = 2)$, $P(X = 3)$ and $P(X = 4)$.

b) Determine $P(X = n)$ for $n \geq 2$.

**Q4.** A group of m people decides to use the elevator in a building of 21 floors. Each of these persons chooses his or her floor independently of the others and completely at random, so that each person selects a floor with probability 1/21. Let $S_m$ be the number of times the elevator stops. In order to study $S_m$, we introduce for $i = 1,2,....21$ random variables $R_i$, given by

$$R_i = \begin{cases} 1 & \text{if the elevator stops at the } i\text{th floor} \\ 0 & \text{if the elevator does not stop at the } i\text{th floor.} \end{cases}$$

a) What is the distribution of $R_i$?
b) What is the distribution of $S_m$? Derive the probability mass function for $S_1$, $S_2$ and $S_3$.