

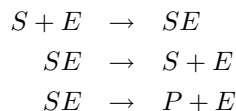
LECTURE 3-5: EXERCISES

- (1) You live in a town of $n + 1$ people. You study rumors. You start a rumor by telling it to one other person, who then picks a person at random from the town and passes the rumor on. The second person likewise picks a recipient at random and so forth. What is the probability that the rumor you started is told k times and then comes back to you?
- (2) In a game you roll a single, six sided, classical die. Every time you roll a 6, 50E is added to your casino account, every time you do not roll a 6, 10E is subtracted from your account. At the end of 10 rolls you receive your earnings or pay your debt.
 - (a) After 10 throws, how much money do you expect to win/lose?
 - (b) During these 10 throws, how much is your account likely to fluctuate?
 - (c) If you start with 30E, what is the probability that you will be broke or in debt after 10 rolls?
 - (d) The casino decides that it will no longer allow you to go temporarily in debt: as soon as your account is 0E or less you are broke. What would be the answer to (c) then?
- (3) Lets imagine that the Mensa is giving the photo of random Hertha player each time you visit it and take a dessert (we assume that there is 11 different cards).
 - (a) How many times should you take a dessert on average to have at least one photo of 5 random players?
 - (b) How many times should you take a dessert on average to have at least one photo of each team member?
- (4) In a hypothetical population of fish, the cumulative probability of dying is given by:

$$P(x) = \left(\frac{x}{10}\right)^2$$

All fishes are dead at the age of 10.

- (a) what is a probability density function for this population?
 - (b) how likely it is that the fish will die between the age 3 and 4?
- (5) A particle undergoes a random walk along x-axis. A step to the right has probability p , a step to the left q . Calculate and graph the probability distributions after ten steps if:
 - (a) $p = 0.5$
 - (b) $p = 0.9$
 - (6) Consider the example of Michaelis-Menten enzyme kinetics:



- (a) represent this example using Petrinet diagram,
- (b) represent it as $N = (P, T, Pre, Post, M)$ assuming that we have $S = 100, E = 20, SE = 0, P = 0,$

- (c) calculate matrices S, A ,
- (d) if the first reaction occurs 20 times, second 10 and last 5 what would be the new state of the system?
- (e) can you find another way to reach this state?