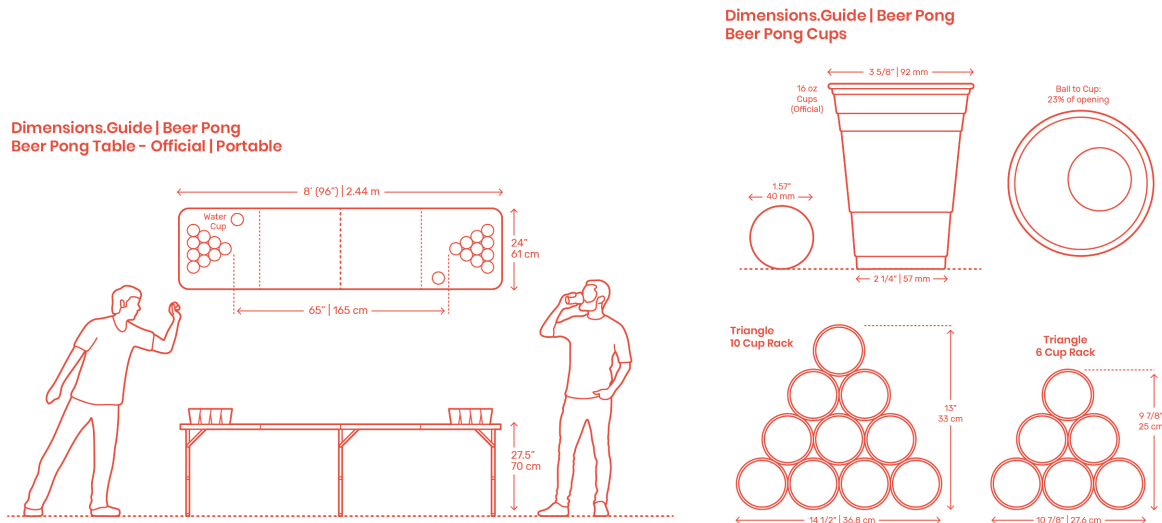# Präsenzaufgabe 5

Exercise 1: Beer Pong is a drinking game where one has to throw a Pingpong ball in glasses of beer. The glasses are arranged as on the picture (we play with 10 glasses). It is played with two players (or two teams of players). Here we consider Carl playing against Émile.


a) Carl is throwing the first ball, what is the probability of the ball landing in one of the glasses, assuming that, when Carl aims at a target point, the ball will fall within a circle of radius 25cm from the target point, with a uniform distribution over the area.

b) Whenever Carl scores by throwing his ball into a cup, the glass is removed (Émile has to drink it). Carl wins when all 10 glasses have been scored and drunk. What is the probability that Carl scores on every one of his ten first throws? (assuming that drinking beer does not affect Carl's aim)

c) What is the average number of throws needed for Carl to win (score 10 glasses), assuming that Émile never scores?

Exercise 2: Flunkyball is another drinking game, played by 2 teams. Initially, players stand outside a square (of side length 10m), with an empty bottle standing in the middle of the square. Teams are positioned on either side of the square, behind their safe line. A member of team A throws the ball at the empty bottle in the middle, trying to make the bottle fall. If the throw fails, the ball goes to team B and it's their turn to throw. If the bottle falls, team B has to put the bottle back up, grab the ball and go back behind their safe line. From the moment the bottle falls up to the moment all of team B is behind their safe line, members of team A are allowed to drink their beers. The winning team is the first one to finish all their beers.
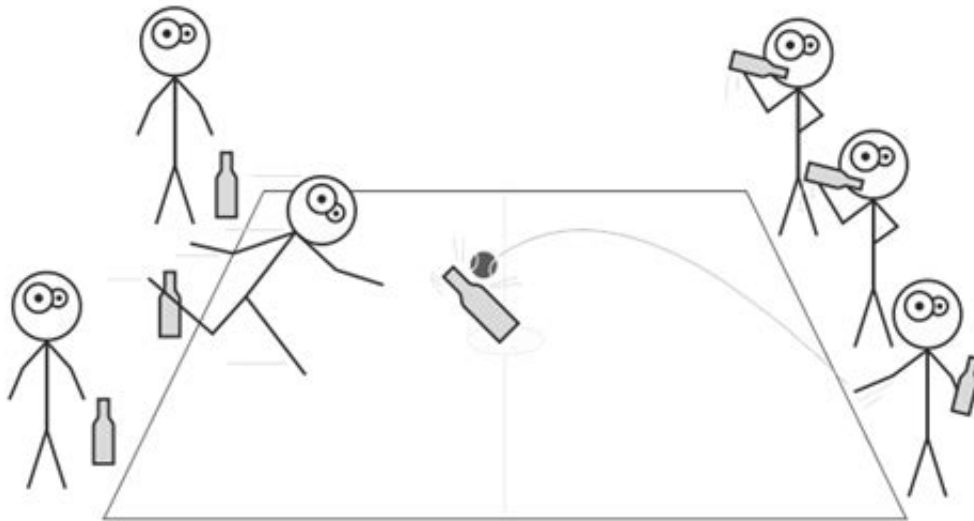
On team B, there is Henri, whose job it is to pick up the ball and run back behind the safe line, and Ada, whose job it is to put the bottle back up. After some playing and chugging, team A only needs 2 seconds of drinking to finish their beers and win. What is the probability that team A finishes all their beers on the next throw (under the following assumptions)?

1. team A will knock the bottle off with probability 1 (100%),

2. the time needed for Ada and Henri to put the bottle back, take the ball and run behind the line is proportional to the distance they need to run,

3. when team A knocks the middle bottle off, the bottle lands on the spot (Ada has to run to the middle of the square and back behind the safe line), but the ball lands in the half of the playing square on the side of team B, with uniform geometric probability (Henri has to run to the ball then back behind the safe line),

4. both Henri and Ada start at the point on their safe line closest to the middle bottle,

5. Henri runs at speed 5 meters per second, while Ada runs at speed 6 meters per second,

6. again, we assume that drinking beer does not impair your ability to play the game.