

DATA 605 - Homework 9

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library(ggplot2)
library(psych)
library(dplyr)
library(knitr)
library(tidyr)
```

Prisoner's (gambling) dilemma

Smith is in jail and has 1 dollar; he can get out on bail if he has 8 dollars.

A guard agrees to make a series of bets with him. If Smith bets A dollars, he wins A dollars with probability .4 and loses A dollars with probability .6.

Find the probability that he wins 8 dollars before losing all of his money if

- (a) he bets 1 dollar each time (timid strategy).
- (b) he bets, each time, as much as possible but not more than necessary to bring his fortune up to 8 dollars (bold strategy).
- (c) Which strategy gives Smith the better chance of getting out of jail?

Solution:

- (a) from https://en.wikipedia.org/wiki/Gambler%27s_ruin we can use:

```
n1 = 1 #starting amount
n2 = 7 #opponents amount / amount needed
q=.6
p=.4
```

we want to calculate when the opponent has no more coins / we have 8 using this formula:

$$P_2 = \frac{1 - (\frac{q}{p})^{n_1}}{1 - (\frac{q}{p})^{(n_1 + n_2)}}$$

```
(1-(q/p)**n1)/(1-(q/p)**(n1+n2))
```

```
## [1] 0.02030135
```

- (b)

Since he puts in all his money every time he will be out of money if he loses just once:

This will be his money balance if he wins without losing:

1 -> 2 -> 4 -> 8.

We can see that he would need to win 3 times in a row which has a chance of $0.4^3 =$

```
.4**3
```

```
## [1] 0.064
```

(c)

He has a higher likelihood making it to 8 dollars with the more risky strategy from b. This is primarily due to the fact that his chance of winning is less than .5, so the less he needs to play to win the higher his chances.

The longer the game goes on the less his chances

Github (both PDF and RMarkdown):

https://github.com/chilleundso/Data605_CompMath/tree/master/Homework10