

# DATA 605: Assignment 10

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## Problem: Gambler's Ruin

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

### Part A: Timid strategy

He bets 1 dollar each time.

#### Answer

Using the formula on page 489, Section 12.2

$$q_z = \frac{(q/p)^z - 1}{(q/p)^M - 1}$$

```
p <- .4
q <- 1 - p
z <- 1
M <- 8

result_a <- ((q/p)^z - 1) / ((q/p)^M - 1)

result_a
```

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

### Part B: Bold strategy

He bets, each time, as much as possible but not more than necessary to bring his fortune up to 8 dollars.

### Answer

This scenario requires Smith to win the bet 3 times in a row without losing. 1 doubled is 2, 2 doubled is 4, and 4 doubled is 8. That's the only scenario in which he reaches 8 dollars. Otherwise, he loses. So the probability of reaching 8 is .4 to the third power.

```
result_b <- p^3  
result_b
```

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

### Part C: Better strategy

Which strategy gives Smith the better chance of getting out of jail?

### Answer

The **bold strategy** gives Smith a slightly better chance of getting out of jail based on the betting arrangement. The bold strategy gives Smith a probability of 0.064, over 6% chance, while the timid strategy gives Smith a probability of 0.0203013, a hair over 2% chance.