



PROBABILITY PUZZLES IN R

Factoring a Quadratic

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What's the probability that a quadratic will factor?

<https://mathcoachblog.com/2012/05/29/whats-the-probability-that-quadratic-will-factor/>

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What's the Probability That Quadratic Will Factor?

Posted on [May 29, 2012](#) | [3 Comments](#)

A comment from my post last week about the need for factoring led me to re-visit a question I have posed to classes before, but never allowed to move beyond the “gee, that’s interesting” stage.

Given a polynomial in standard form, with random non-zero integer parameters a , b and c , what is the probability that the polynomial will factor?*

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Factoring a quadratic

$$x^2 + 3x + 2$$

- $a = 1$
- $b = 3$
- $c = 2$

$$x^2 + 3x + 2 = (x + 2)(x + 1)$$



Quadratic formula

Quadratic Equation: $ax^2 + bx + c = 0$

Quadratic Formula: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Discriminant: $b^2 - 4ac$



Using the discriminant

Quadratic Formula: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Discriminant: $b^2 - 4ac$

Example. $x^2 + 3x + 2$

```
if(3^2 - 4*1*2 < 0) {  
  return(FALSE)  
}
```

Is it a perfect square?

Quadratic Formula: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Discriminant: $b^2 - 4ac$

Example. $x^2 + 3x + 2$

```
sqrt_dscr <- sqrt(3^2 - 4*1*2)
sqrt_dscr == round(sqrt_dscr)
[1] TRUE
```

`is.integer` does not work:

```
is.integer(sqrt_dscr)
[1] FALSE
```



The else conditional

Square root is not evaluated:

```
value <- (-1)
if(value < 0){
  print("The value is negative.")
} else {
  print(sqrt(value))
}
[1] "The value is negative."
```

Value is positive, so square root is evaluated:

```
value <- 4
if(value < 0){
  print("The value is negative.")
} else {
  print(sqrt(value))
}
[1] 2
```

Nested for loops

```
for(i in 1:10){  
  for(j in 1:10){  
    print(i+j)  
  }  
}
```

```
[1] 2  
[1] 3  
[1] 4  
[1] 5  
[1] 6  
[1] 7  
[1] 8  
[1] 9  
[1] 10  
[1] 11  
[1] 3  
[1] 4  
[1] 5  
...
```




PROBABILITY PUZZLES IN R

**Let's factor some
quadratics**



PROBABILITY PUZZLES IN R

iPhone Passcodes

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Unlocking an iPhone





Four digits vs. three digits



Presh Talwalkar

ABOUT ME: PRESH TALWALKAR

I am the author of [The Joy of Game Theory: An Introduction to Strategic Thinking](#). I have also written books about mathematical puzzles, paradoxes, and related topics available on [Amazon](#).

Why repeating a digit may improve security on your iPhone's 4-digit lockscreen PIN

Posted January 27, 2011 By Presh Talwalkar. Read [about me](#), or [email me](#).

Presh Talwalker: [Mind Your Decisions](#)



The sample function

```
sample(x, size, replace = FALSE, prob = NULL)
```

From Monty Hall:

```
sample(doors, 1)
```

```
three_values <- c(1, 2, 3)
sample(three_values)
[1] 3 1 2
```



Sampling from repeated values

```
two_values <- c(1,2)
```

```
all_values <- c(two_values, sample(two_values,1))  
all_values  
[1] 1 2 2
```

```
sample(all_values)  
[1] 2 2 1
```



The identical function

```
set1 <- c(4, 3, 5)
set2 <- c(4, 3, 9)

set1 == set2
[1] TRUE TRUE FALSE
```

Two non-identical sets; FALSE returned:

```
identical(set1, set2)
[1] FALSE
```

Two identical sets; TRUE returned:

```
set3 <- c(4, 3, 5)
identical(set1, set3)
[1] TRUE
```



PROBABILITY PUZZLES IN R

**Let's guess some
iPhone passcodes!**



PROBABILITY PUZZLES IN R

Sign Error Cancellations in a Math Problem

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The inspiration

**bill chen**

@billchenpoker

Following



A student can make a sign error independently in any step of a math problem. Each sign flip is less than 50% to occur, and an even number of sign flips gets you the right sign. Does the student necessarily have over a 50% chance of getting the right sign?

1:30 PM - 30 Nov 2017 from [Dublin City, Ireland](#)

5 Likes



3



5





The rbinom function

```
rbinom(n = 10, size = 5, prob = 0.4)
[1] 0 3 4 2 2 1 1 2 3 3
```



Checking whether a value is even

```
value <- 3  
value/2 == round(value/2)  
[1] FALSE
```

```
value <- 4  
value/2 == round(value/2)  
[1] TRUE
```



Using the mean function to estimate a probability

```
result <- c(TRUE, TRUE, FALSE, TRUE)
mean(result)
[1] 0.75
```

Revisiting the sapply function

```
sapply(X, FUN, ..., simplify = TRUE, USE.NAMES = TRUE)
```

```
rbinom(n, size, prob)
```

```
result <- sapply(X = c(0.25, 0.75, 0.1, 0.9), FUN = rbinom, n = 1, size = 1)
```

```
result  
[1] 0 1 0 1
```

```
sum(result)  
[1] 2
```



PROBABILITY PUZZLES IN R

Let's do it!