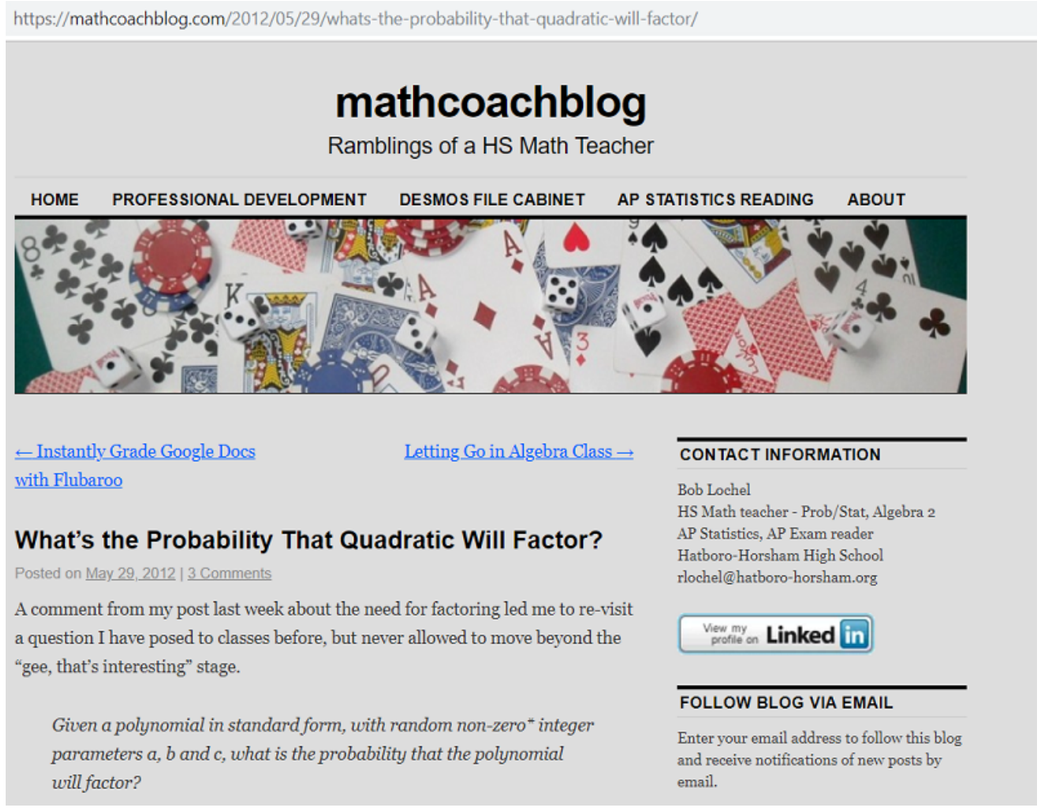
PROBABILITY PUZZLES IN R

Factoring a Quadratic

Peter Chi
Assistant Professor of Statistics
Villanova University

What's the probability that a quadratic will factor?



mathcoachblog.com

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

Peter Chi
Assistant Professor of Statistics
Villanova University

Unlocking an iPhone

Four digits vs. three digits

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.

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.

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

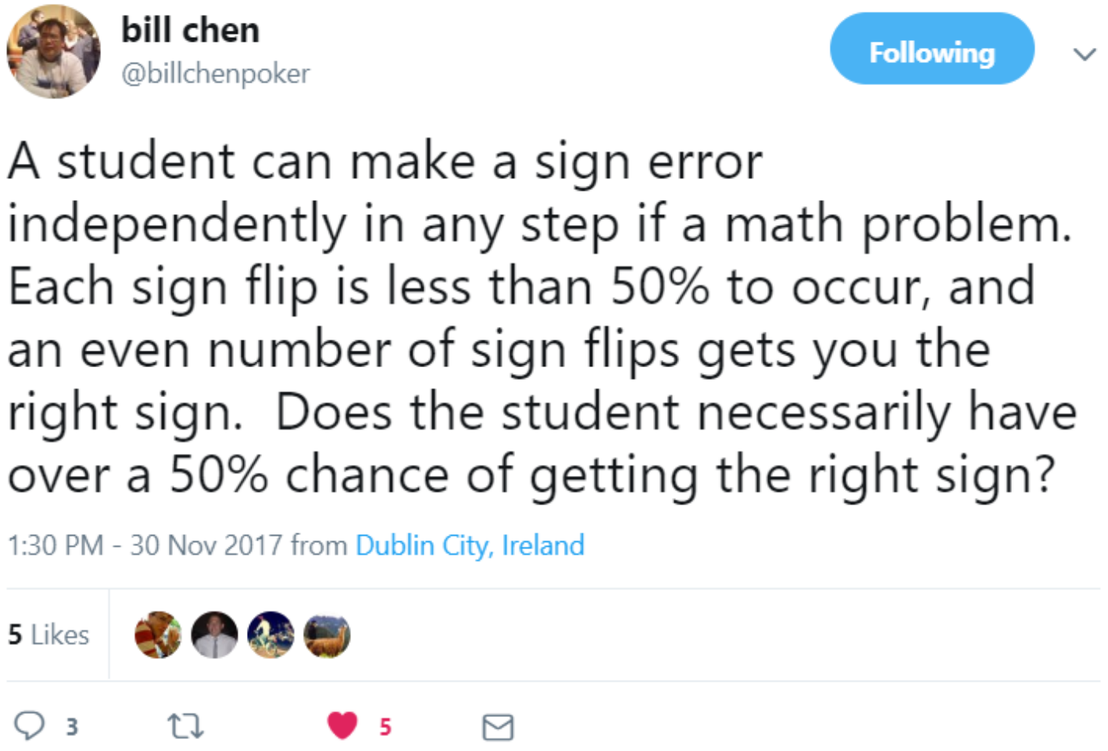
Let's guess some iPhone passcodes!

PROBABILITY PUZZLES IN R

Sign Error Cancellations in a Math Problem

Peter Chi
Assistant Professor of Statistics
Villanova University

The inspiration



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!