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09/02/15 Analytics 511

G.W. Leibniz on Computing, 1685

D. Benoulli on Probabilistic Models, 1713

A. Be Moivre on Statistics, 1718

Contents of the Course:
- Probabilistic modeling: about four weeks
- Basic Statistical Methods: about four weeks
- Some advanced topics: about weeks

Connection to other courses
- Needed for all other Prob& Stat courses
- Optimization - methods
- Statistical learning theory, simulation, Regression extends knowledge

How to succeed in this course
- OH/text/ virtual OH (Skype?)
- Weekly HW assignments -
- Class participation
- Midterm exam (60 minutes in-class / take home portion)
- Final Exam (in class and take-home)
  - take home like home, but no drill problem

Collaboration Rules
- check link

For HW, collaborate, don't hand in the same solution
- Form study group
- try problems by yourself first
- then ask for help, critize hw

Take-home exam
- no human resource (no forum)
  - use notes, books, blackboard

Exam, no electronics, no notes
possible one page of notes

Howard success 1, 2, 3, 4, 5 P(6) = 1.00
Joshua success 4, 5, 6, 7, 11

A Probabilistic Model
- define success
- each event is independent?
- success happen with a fixed probability p

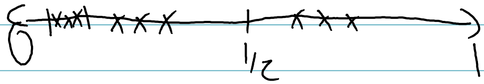
Reduction of data = forget something, but is it important?

Implement this in R

```
mytoss = function(p){
 u = runif(1)
 x = as.numeric(u<p)
 return(x)
 }
```

Computer represent numbers in bits

$u \in (0,1)$



$\approx 2^{60} \approx 10^{18}$

runif() has $\approx 10^{12}$ possible values

```
> (100+1) - 100
1
> (10^20 + 1) - 10^20
0
> (10^20+10000) - 10^20
[1] 16384
```

$\approx 2^{14}$

result same for 100 & 1000

10^20 isn't stored into computer so computer has a represented number. The one won't affect the value

A function that simulates tosses until the first success and returns the number of attempts

```
myattempts = function(p) {
    counter <- 1
    while (mytoss(p) == 0) {
      counter <- counter + 1 }
    return(counter)
    }
```

Probability theory

$p_j = p(1-p)^{j-1}$ ⟶ geometric distribution

for $j = 1, 2, 3, \ldots$

Expected

Let X be a random variable

$$E(X) = \sum_{j=1}^{\infty} j \cdot P(X=j) = \sum_{j=1}^{\infty} j p (1-p)^{j-1} = 1/p$$

Fix k

$$Y = X_1 + X_2 + \ldots + X_k$$

$$E(Y) = E(X_1) + E(X_2) + \ldots + E(X_k) = k/p$$

bias — Theoretical bias

$$E(\hat{p}) - p$$