HyperGeometric Distribution

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2018-02-22 Thr

Outline

1. HyperGeometric Distribution
   - Based on
   - HyperGeometric Random Variables
   - Cumulative Distributive Function
   - Lottery
   - Hypergeometric vs. Binomial

Based on

"Probability with R: An Introduction with Computer Science Applications"
Jane Horgan

Calculating hypergeometric pdfs

```
x <- 0:5
dhyper(x, 13, 39, 5)

x <- 0:3
dhyper(x, 3, 3, 3)

x <- 0:4
dhyper(x, 4, 16, 10)

x <- 0:10
dhyper(x, 30, 70, 20)
```

Plotting hypergeometric pdfs

```
par (mfrow = c(2,2))

x<-0:5
plot(x, dhyper(x, 13, 39, 5),
     xlab="X= number of trials", ylab="P(X=x)",
     type="h", main="N=52, M=13, n=5");

x<-0:3
plot(x+1, dhyper(x, 3, 3, 3),
     xlab="X= number of trials", ylab="P(X=x)",
     type="h", main="N=6, M=3, n=3");

x<-0:4
plot(x+1, dhyper(x, 4, 16, 10),
     xlab="X= number of trials", ylab="P(X=x)",
     type="h", main="N=20, M=4, n=10");

x<-0:20
plot(x+1, dhyper(x, 30, 70, 20),
     xlab="X= number of trials", ylab="P(X=x)",
     type="h", main="N=100, M=30, n=20");
```

Calculating hypergeometric cdfs

```
phyper(q, m, n, k)
```

- q : vector of quantiles representing the number of white balls drawn without replacement from an urn which contains both black and white balls
- m : the number of white balls in the urn
- n : the number of black balls in the urn
- k : the number of balls drawn from the urn

```
phyper(2, 13, 39, 5)
```

Plotting geometric cdfs

```
par (mfrow = c(2,2))

x<-0:5
plot(x, phyper(x, 13, 39, 5),
     xlab="X= number of trials", ylab="P(X<=x)",
     type="h", main="p=.95");

x<-0:3
plot(x, phyper(x, 3, 3, 3),
     xlab="X= number of trials", ylab="P(X<=x)",
     type="h", main="p=.5");

x<-0:10
plot(x, phyper(x, 4, 16, 10),
     xlab="X= number of trials", ylab="P(X<=x)",
     type="h", main="p=.2");

x<-0:20
plot(x, phyper(x, 30, 70, 20),
     xlab="X= number of trials", ylab="P(X<=x)",
     type="h", main="p=.01");
```

Lottery

```
n random numbers are selected from the N
n=6 favorable
N-n=30 unfavorable

x<- 0:6
round( dhyper(x, 6, 30, 6), 7)

the length of time expected
x <- choose(36, 6)
x/52
x/(2*52)
x/(100*52)
```

Winning

```
1-phyper(2, 6, 30, 6)
1-phyper(2, 6, 33, 6)
1-phyper(2, 6, 36, 6)
1-phyper(2, 6, 39, 6)
```

```
n random numbers are selected from the N
n=6 favorable
N-n=30 unfavorable

x<- 0:6
round( dhyper(x, 6, 30, 6), 7)

the length of time expected
x <- choose(36, 6)
x/52
x/(2*52)
x/(100*52)
```

Hypergeometric vs. Binomial

```
M <-2
L <-18
y <- dhyper(x, M, L, 10)
yround = round(y, 3)
names <- c(yround)
plot(x, y, type="h", ylim= c(0, .51), xlab= " ",
     main= Hyper(N=20, p=0.1, axes=FALSE)
text(x, dhyper(x, M, L, 10), names)
axis(1)
axis(2)
```

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