

# Binomial Distribution

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## 1 Binomial Distribution

- Based on
- Binomial Random Variables
- Cumulative Distributive Function
- Quantile function
- Machine learning examples
- Binomial expectation

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

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# Calculating binomial pdfs

```
dbinom (x=4, size=5, prob=.96)
```

```
dbinom (4, 5, .96)
```

```
x <- 0:4
```

```
dbinom(x, size=4, prob=.95)
```

```
x <- 0:10
```

```
dbinom(x, size=10, prob=.95)
```

```
round(dbinom(x, size=10, prob=.95), 4)
```

# Plotting binomial pdfs

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

```
x<-0:5
```

```
plot(x+1, dbinom(x, size=5, prob=.95),  
      xlab="X= number of trials", ylab="P(X=x)",  
      type="h", main="n=5, p=.95");
```

```
x<-0:10
```

```
plot(x+1, dbinom(x, size=10, prob=.5),  
      xlab="X= number of trials", ylab="P(X=x)",  
      type="h", main="n=10, p=.5");
```

```
x<-0:20
```

```
plot(x+1, dbinom(x, size=20, prob=.2),  
      xlab="X= number of trials", ylab="P(X=x)",  
      type="h", main="n=20, p=.2");
```

```
x<-0:20
```

```
plot(x+1, dbinom(x, size=100, prob=.01),  
      xlab="X= number of trials", ylab="P(X=x)",  
      type="h", main="n=100, p=.01");
```

# Calculating binomial cdfs

```
pbinom(3, 5, .95)
```

```
prob <- pbinom(x, size=20, prob=.9)  
round(prob, 4)
```

```
x<- 0:20  
round(pbinom(x, size=20, prob=.2), 4)
```

# Plotting binomial cdfs

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

x<-0:5
plot(x+1, pbinom(x, size=5, prob=.95),
     xlab="X= number of trials", ylab="P(X<=x)",
     type="s", main="n=5, p=.95");

x<-0:10
plot(x+1, pbinom(x, size=10, prob=.5),
     xlab="X= number of trials", ylab="P(X<=x)",
     type="s", main="n=10, p=.5");

x<-0:20
plot(x+1, pbinom(x, size=20, prob=.2),
     xlab="X= number of trials", ylab="P(X<=x)",
     type="s", main="n=20, p=.2");

x<-0:100
plot(x+1, pbinom(x, size=20, prob=.01),
     xlab="X= number of trials", ylab="P(X<=x)",
     type="s", main="n=100, p=.01");
```

# quantile function

```
qbinom(.75, 20, .2)
```

```
pbinom(6, 20, .2)
```

```
plot(n, .999^n, type="l",  
      ylab="P(error=0)",  
      xlab="number",  
      ylim= c(.9, .999))
```



# Example 1

```
1-pbinom(1, 3, .7)

n <- seq(3, 29, 2)
majority <- (n+1)/2
pm <- 1 - pbinom(majority-1, n, .7)

round(pm, 4)

plot(n, pm, xlab="number", ylab="probability",
      ylim= c(.7,1), type="h")
```

## Example 2

```
p <- c(.1, .2, .3, .4, .5)

plot(p, 1-pbinom(10, 21, p),
      xlab="p error", ylab="p 10+", type="h")

lines(p, p)
```

# Binomial expectation

```
x <- 0.5
dbinom(x, size=5, prob=.25)

defect <- rbinom(50, 20, .2)
table(defect)

table(defect) / length(defect)

par(mfrow = c(1, 2))
plot(table(defective)/length(defect),
      xlab= "number", ylab="rel freq", tyhpe="h")
x<-1:9
plot(x, dbinom(x, 20, .2),
      xlab= "number", ylab="probability", tyhpe="h")

mean(defect)
sd(defect)
sqrt(20*.2*.8)
```









