Discrete Random Variables

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Outline

1. Discrete Random Variables
   - Based on
   - Discrete Random Variables

Based on

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

Hardware Failure Example

```
fail <- c(9, 20, 39, 20, 11)
sum(fail)
prob <- fail/sum(fail)
prob
round(prob, 2)

num_fail <- 0:4
plot(num_fail, prob, xlab="Number of hardware failures in a week",
     ylab="Probability", type="h")
```

Cumulative Distribution Function

```
cprob = c(0, 0, 0, 0, 0)
cporb = prob

cprob[1] = sum(prob[1])
cprob[2] = sum(prob[1:2])
cprob[3] = sum(prob[1:3])
cprob[4] = sum(prob[1:4])
cprob[5] = sum(prob[1:5])

for (i in 1:5) {
 cprob[i] = sum(prob[1:i])
}

cprob
plot(num_fail, cprob, xlab="failures",
     ylab="probability", type="S")
```

Discrete Uniform Distribution

```
x <- c(1:6)
prob <-  rep(1/6, 6)
plot(x, prob, type="h", xlab="rolling a die",
     ylab="prob")

plot(x, (1:6)/6, type="s", xlab="rolling a die")
```

Benford's Law

```
x <- 1:9
prob <- c(.306, .185, .124, .094, .080, .064, .051, .049, .047)
plot(x, prob, type="h", xlab="first digit", ylab="probability")
```

```
x <- 1:9
prob <- log10(1+ 1/x)
round(prob, 3)
plot(x, prob, type="h", xlab="first digit", ylab="probability")
```

Expected Values

```
x <- c(1, 2, 3, 4, 5, 6)
mean(x)
avg <- sum(x)/length(x)

x<-1:5
p<-c(1/16, 3/16, 7/16, 3/16, 2/16)
sum(x*p)
```

Measuring the Spread

```
x<-1:5
p<-c(1/16, 3/16, 7/16, 3/16, 2/16)
avg<-sum(x*p)
var<-sum((x-avg)^2 * p)
var
```

Simulating

```
roll = sample(c(1:6), 60, replace=T)
mean(roll)
sum((roll-mean(roll))^2)/60
```

```
roll = sample(c(1:6), 6000, replace=T)
table(roll)
roll
round(table(roll)/6000, 2)
plot(table(roll)/6000, xlab="die face",
     ylab="probability")
```

Simulating Transformation

```
fail <- sample(c(0:6), 1000, replace=T,
        prob=c(0.17, 0.27, 0.25, 0.17, 0.09, 0.05, 0.02))
hist(fail, breaks=6, main="")
mean(fail)
var(fail)


fail10 <- fail*10
mean(fail10)
var(fail10)

fail10p200 <- 10*fail + 200
mean(fail10p200)
var(fail10p200)
```