

entropy

Chris Parrish

June 9, 2016

entropy

reference: McElreath, Statistical Rethinking, chap 9, p.267

```
library(rethinking)
library(ggplot2)
```

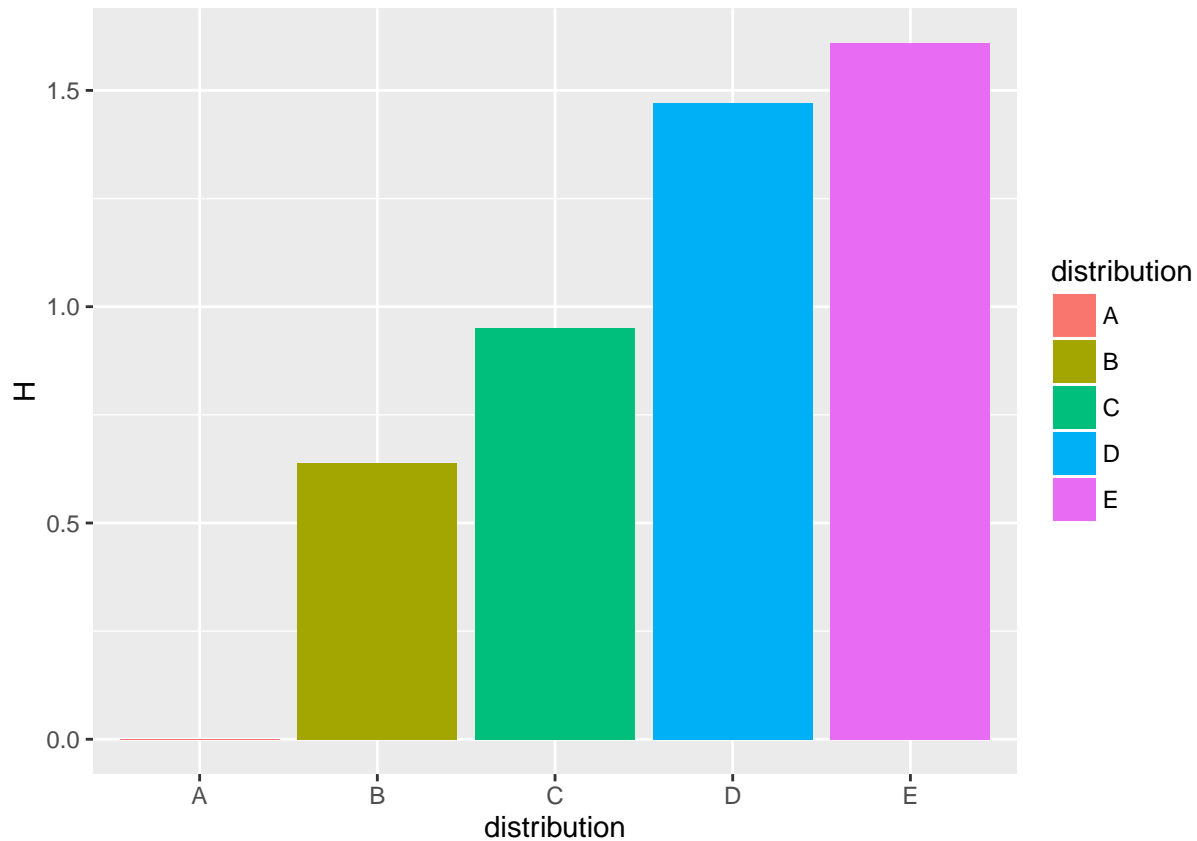
```
## R code 9.1
p <- list()
p$A <- c(0,0,10,0,0)
p$B <- c(0,1,8,1,0)
p$C <- c(0,2,6,2,0)
p$D <- c(1,2,4,2,1)
p$E <- c(2,2,2,2,2)
```

```
## R code 9.2
p_norm <- lapply( p , function(q) q/sum(q))
```

```
## R code 9.3
( H <- sapply( p_norm , function(q) -sum(ifelse(q==0,0,q*log(q))) ) )
```

```
##           A           B           C           D           E
## 0.0000000 0.6390319 0.9502705 1.4708085 1.6094379
```

```
data <- data.frame(distribution = factor(c("A", "B", "C", "D", "E")), H = H)
ggplot(data, aes(distribution, H, fill = distribution)) +
  geom_bar(stat = "identity")
```



```
## R code 9.4
ways <- c(1,90,1260,37800,113400)
logwayspp <- log(ways)/10

## R code 9.5
# build list of the candidate distributions
p <- list()
p[[1]] <- c(1/4,1/4,1/4,1/4)
p[[2]] <- c(2/6,1/6,1/6,2/6)
p[[3]] <- c(1/6,2/6,2/6,1/6)
p[[4]] <- c(1/8,4/8,2/8,1/8)

# compute expected value of each
sapply( p , function(p) sum(p*c(0,1,1,2)) )

## [1] 1 1 1 1

## R code 9.6
# compute entropy of each distribution
sapply( p , function(p) -sum( p*log(p) ) )

## [1] 1.386294 1.329661 1.329661 1.213008

## R code 9.7
p <- 0.7
( A <- c( (1-p)^2 , p*(1-p) , (1-p)*p , p^2 ) )

## [1] 0.09 0.21 0.21 0.49
```

```
## R code 9.8
-sum( A*log(A) )
```

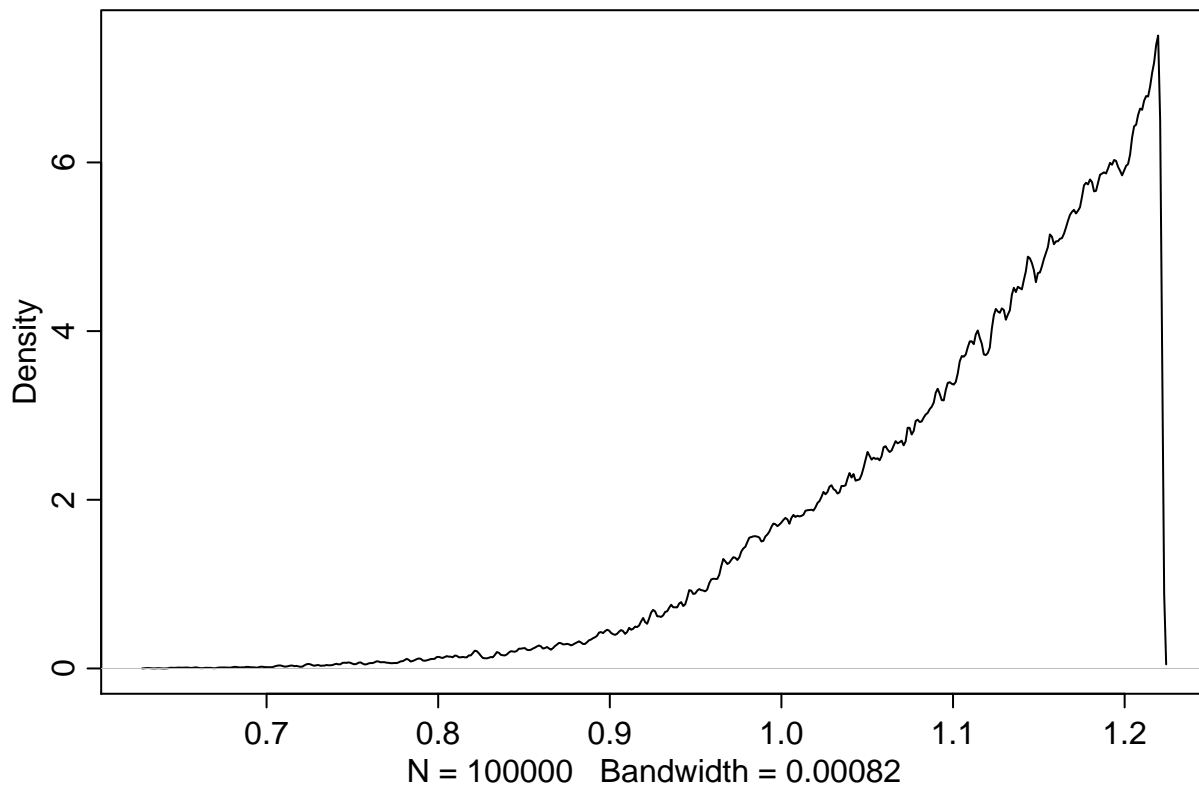
```
## [1] 1.221729
```

```
## R code 9.9
```

```
sim.p <- function(G=1.4) {
  x123 <- runif(3)
  x4 <- ( (G)*sum(x123)-x123[2]-x123[3] )/(2-G)
  z <- sum( c(x123,x4) )
  p <- c( x123 , x4 )/z
  list( H=-sum( p*log(p) ) , p=p )
}
```

```
## R code 9.10
```

```
H <- replicate( 1e5 , sim.p(1.4) )
dens( as.numeric(H[1,]) , adj=0.1 )
```



```
## R code 9.11
entropies <- as.numeric(H[1,])
distributions <- H[2,]
```

```
## R code 9.12
max(entropies)
```

```
## [1] 1.221728
```

```
## R code 9.13
```

```
distributions[ which.max(entropies) ]
```

```
## [[1]]  
## [1] 0.09000888 0.20970963 0.21027261 0.49000888
```