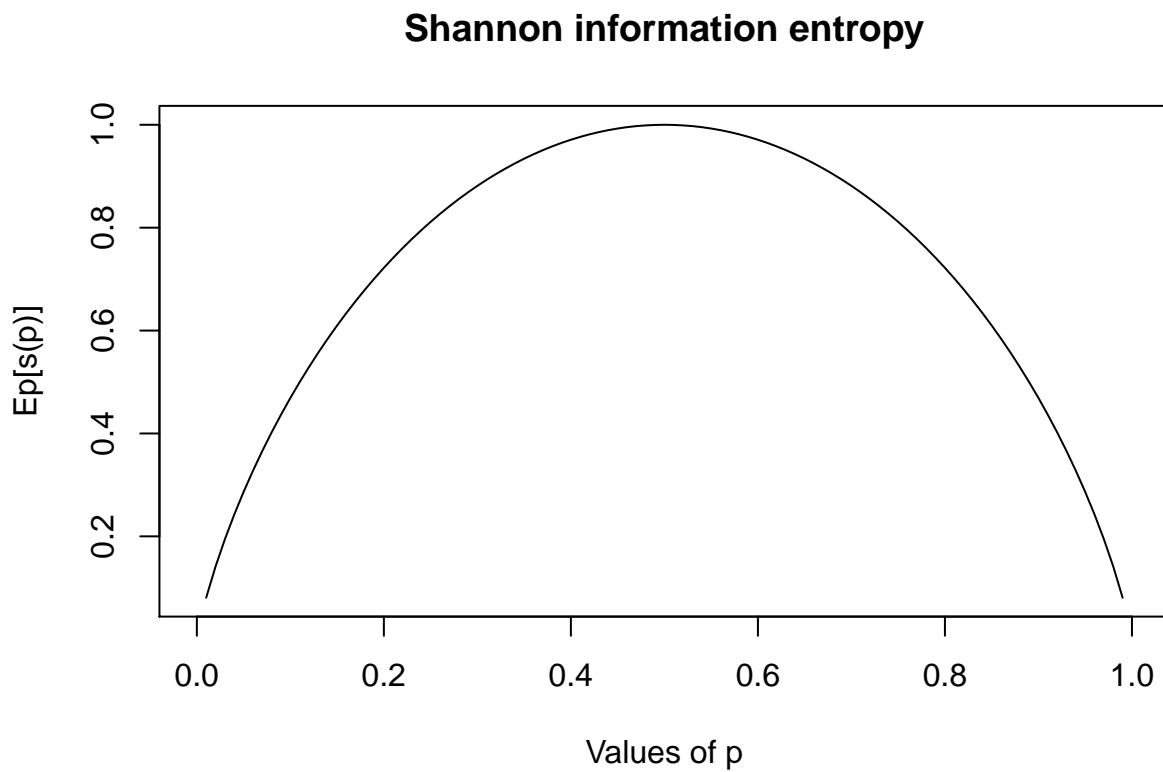# STA365_homework1_code

Ruike Xu

03/02/2022

Question 2

Part b

```r
# Assume that r = p
p <- seq(0, 1, by=0.01)
Ep_Sp <- -log2(p)*p - (1-p)*log2(1-p)
plot(p, Ep_Sp,type="l", xlab="Values of p", ylab="Ep[s(p)]", main ="Shannon information entropy")
```

Shannon information entropy

Question 4

Part C

```r
theta <- seq(0, 1, by=0.1)
prob_X <- dbinom(66, size = 100, prob = theta)
prob_likelihood <- tibble(theta, prob_X)
ggplot(prob_likelihood, aes(x=theta, y=prob_X)) +
  geom_point(size = 2) + labs(x="value of theta",
  y="Probabilities given theta",
  title="Probabilities against different theta values under binomial distribution")
```
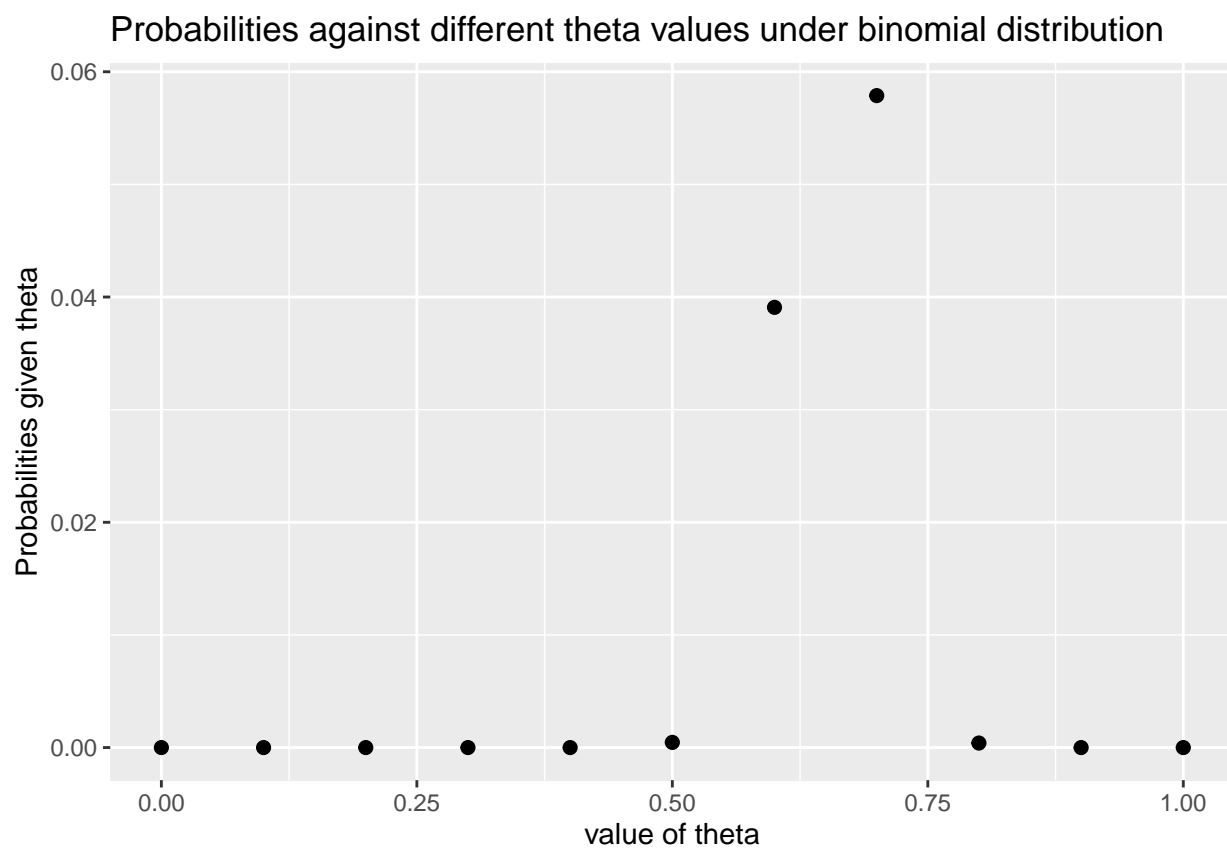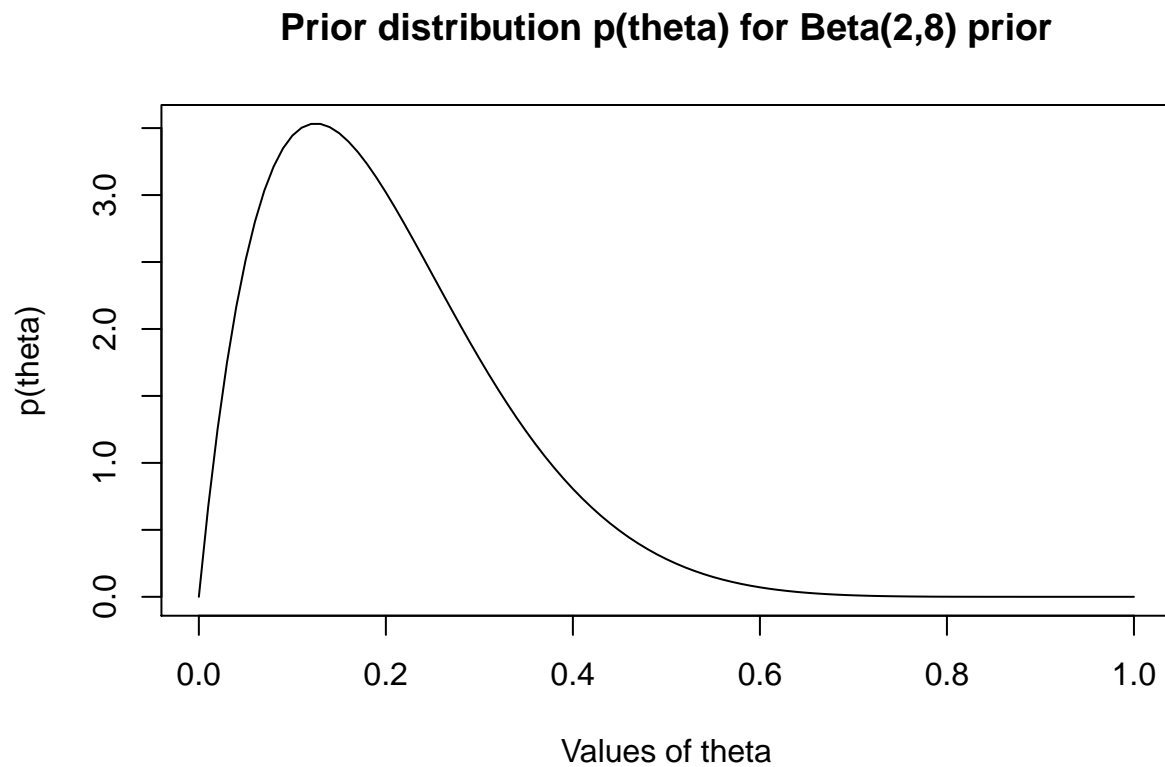
Question 5

Part C

```r
# 95% Credible interval for prior Beta(2,8)
qbeta(c(0.025, 0.975), 17, 36)
```
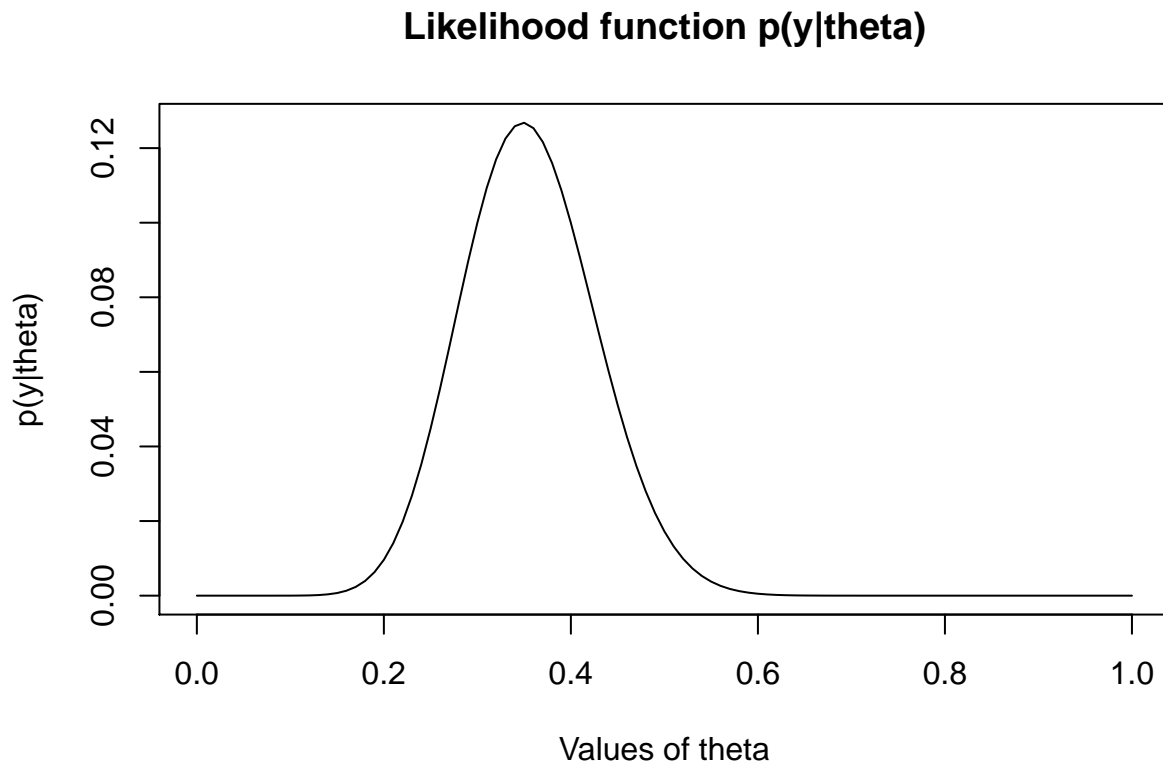
```
## [1] 0.2032978 0.4510240
```

Part D

```r
# Plot prior, likelihood, and posterior functions for Beta(2,8) prior
y = 15
n = 43
a_1 = 2
b_1 = 8
a_p1 = 17
b_p1 = 36
theta_1 <- seq(0, 1, 0.01)

# Prior distribution p(theta)
plot(theta_1, dbeta(theta_1, shape1 = a_1, shape2 = b_1), type = 'l',
     xlab="Values of theta", ylab="p(theta)",
     main ="Prior distribution p(theta) for Beta(2,8) prior")
```
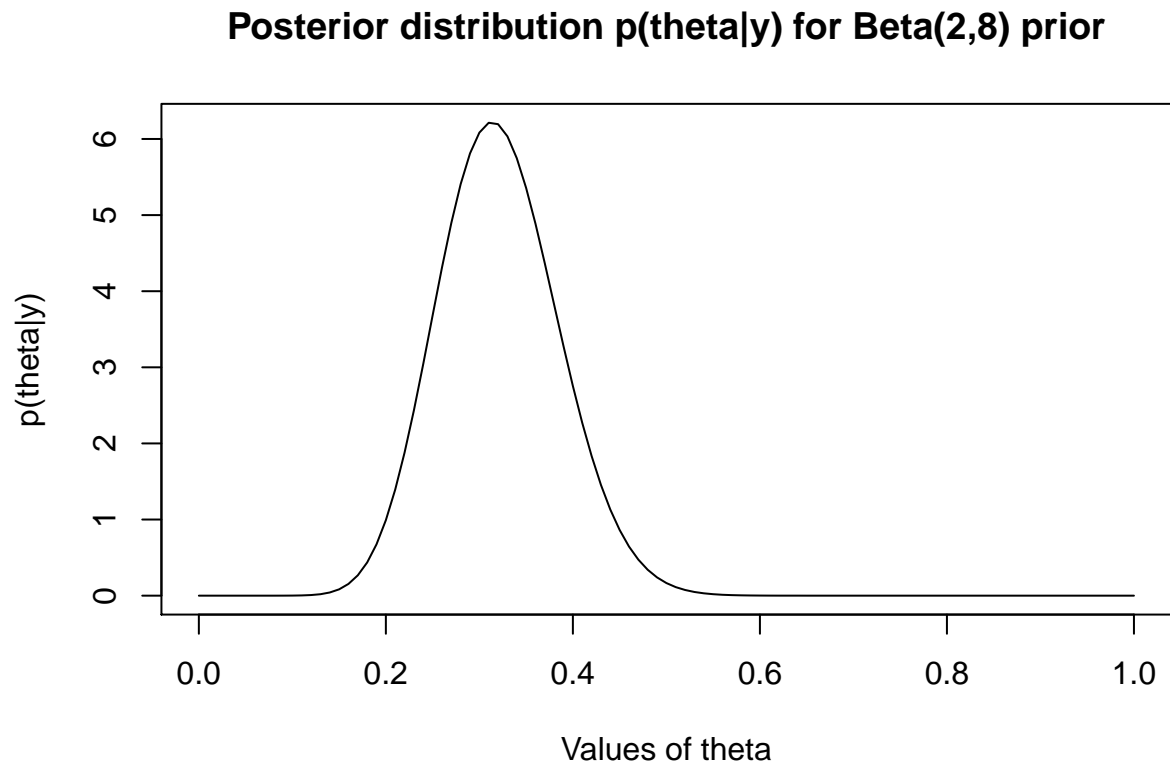
Prior distribution p(theta) for Beta(2,8) prior

```r
# Likelihood function P(y|theta)
plot(theta_1, dbinom(15, size = 43, prob = theta_1), type = 'l',
     xlab="Values of theta", ylab="p(y|theta)",
     main ="Likelihood function p(y|theta)")
```

Likelihood function p(y|theta)

```r
# Posterior distribution p(theta/y)
plot(theta_1, dbeta(theta_1, shape1 = a_p1, shape2 = b_p1), type = 'l',
     xlab="Values of theta", ylab="p(theta|y)",
     main ="Posterior distribution p(theta|y) for Beta(2,8) prior")
```

Posterior distribution p(theta|y) for Beta(2,8) prior

Part E

```r
# 95% Credible interval for prior Beta(8,2)
qbeta(c(0.025, 0.975), 23, 30)
```
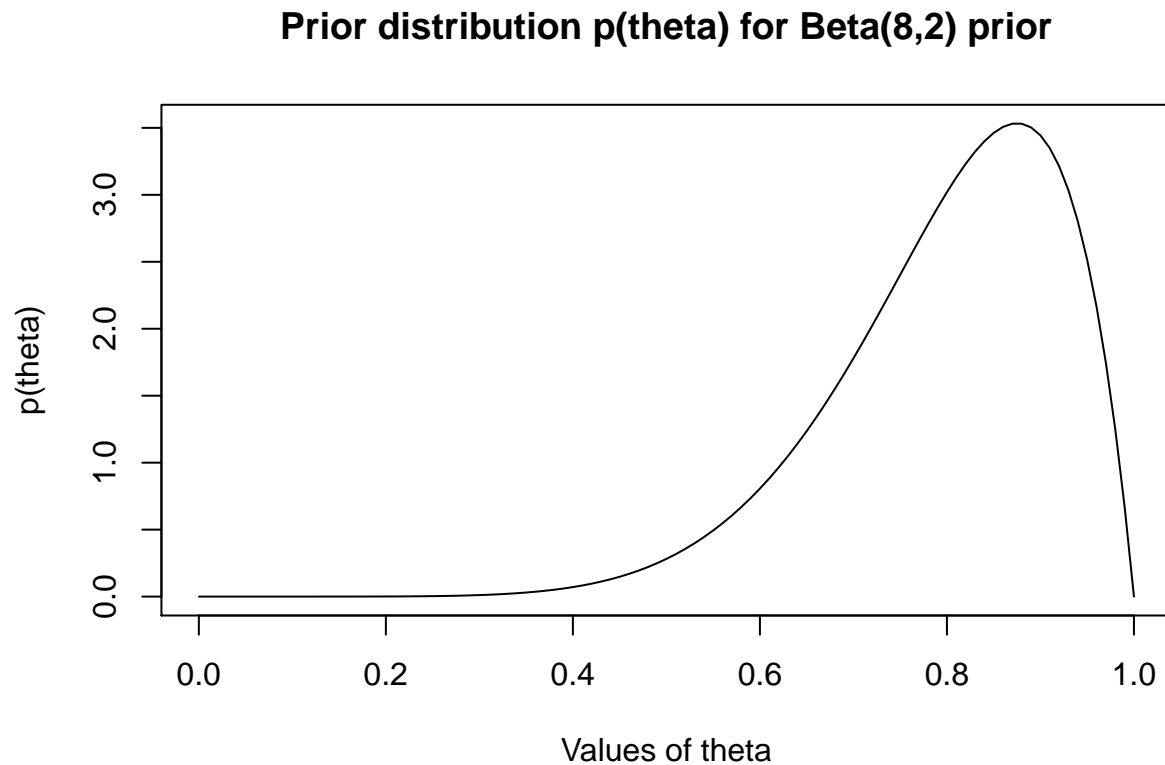
```
## [1] 0.3046956 0.5679528
```

```
# Plot prior, likelihood, and posterior functions for Beta(8,2) prior
y = 15
n = 43
a_2 = 8
b_2 = 2
a_p2 = 23
b_p2 = 30
theta_1 <- seq(0, 1, 0.01)

# Prior distribution p(theta)
plot(theta_1, dbeta(theta_1, shape1 = a_2, shape2 = b_2), type = 'l',
     xlab="Values of theta", ylab="p(theta)",
     main ="Prior distribution p(theta) for Beta(8,2) prior")
```

Prior distribution p(theta) for Beta(8,2) prior

```r
# Likelihood function P(y|theta)
plot(theta_1, dbinom(15, size = 43, prob = theta_1), type = 'l',
     xlab="Values of theta", ylab="p(y|theta)",
     main ="Likelihood function p(y|theta)")
```

Likelihood function p(y|theta)
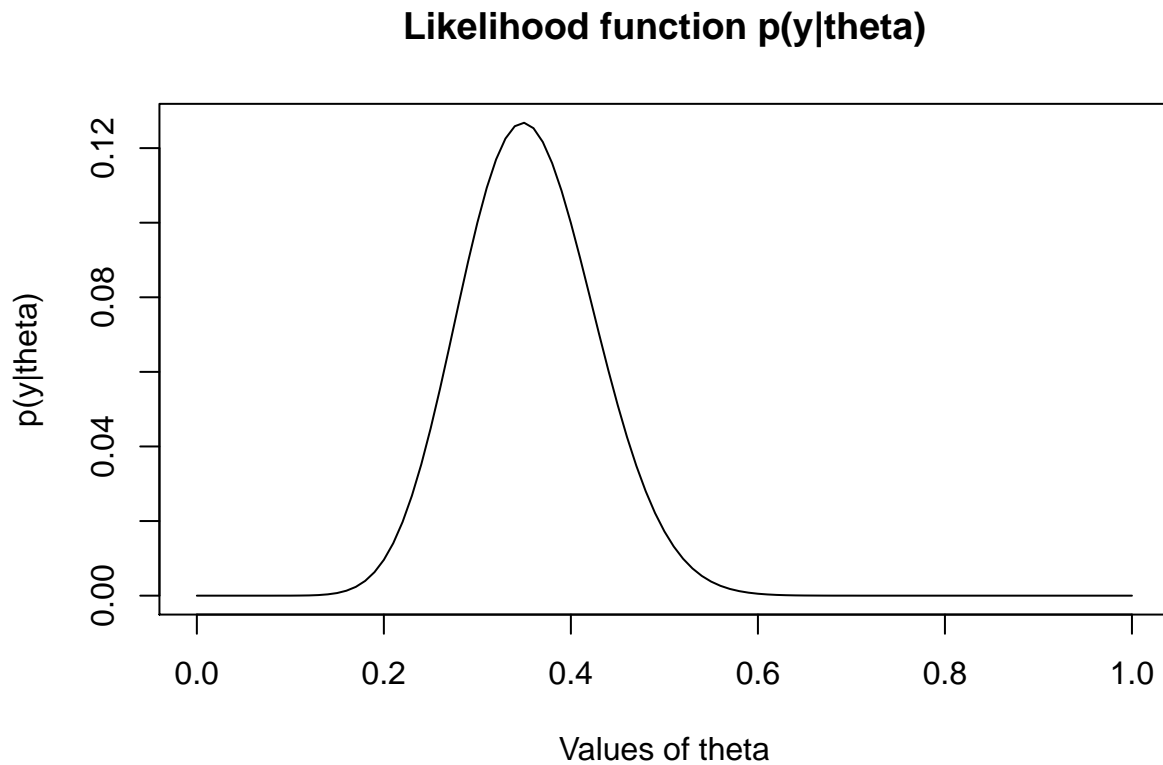
```r
# Posterior distribution p(theta|y)
plot(theta_1, dbeta(theta_1, shape1 = a_p2, shape2 = b_p2), type = 'l',
     xlab="Values of theta", ylab="p(theta|y)",
     main ="Posterior distribution p(theta|y) for Beta(8,2) prior")
```

Posterior distribution p(theta|y) for Beta(8,2) prior