Stat 135 HW6

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Throwing Thumbtacks

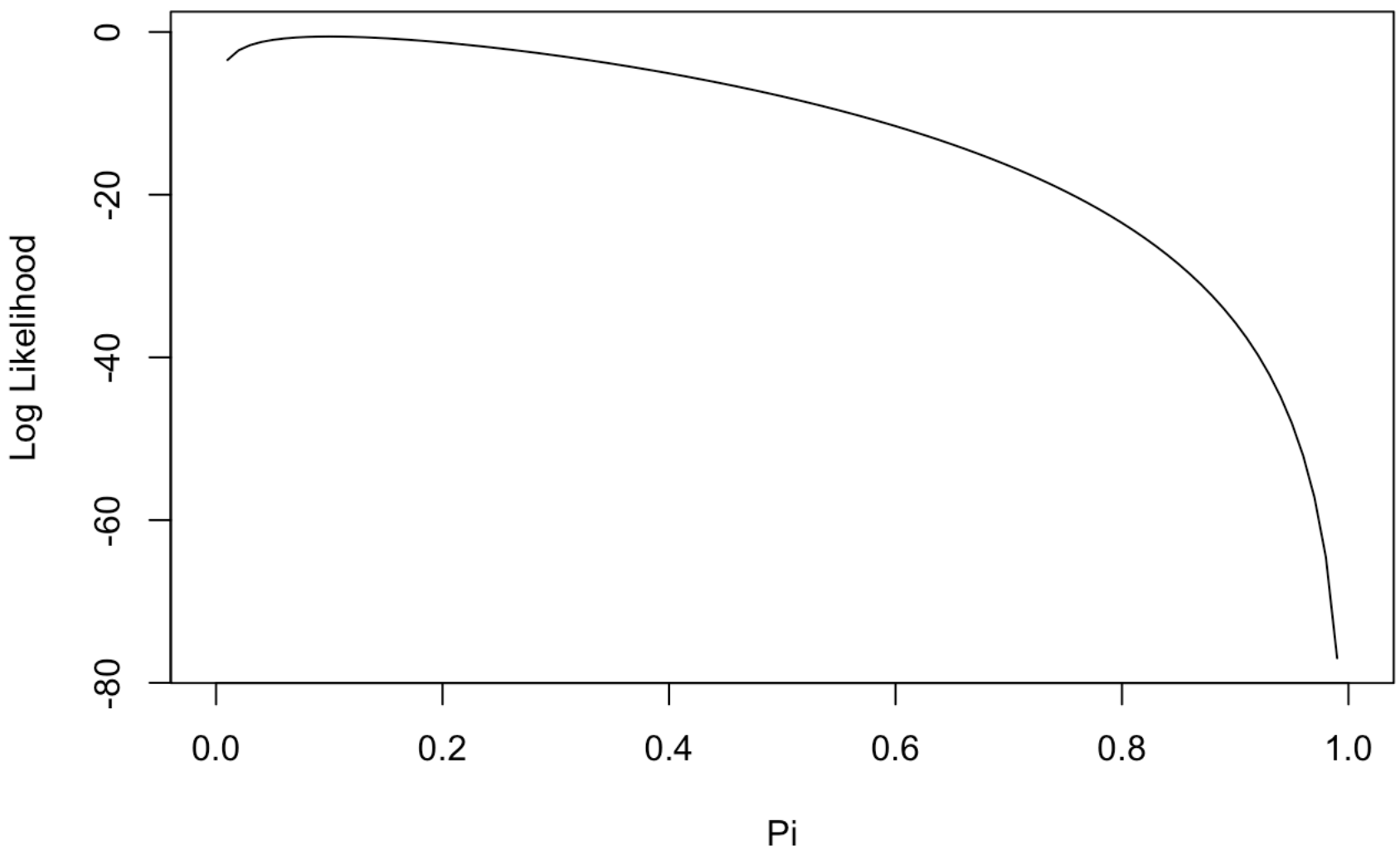
Ch8 Q25

The prior distribution of π (the probability that a thumbtack thrown lands point up) is Uniform[0,1].

After tossing a thumbtack 20 times, I got 2 times where it landed point up, so the log likelihood of π is

$$log(\binom{20}{2}\pi^2(1-\pi)^{20-2})$$

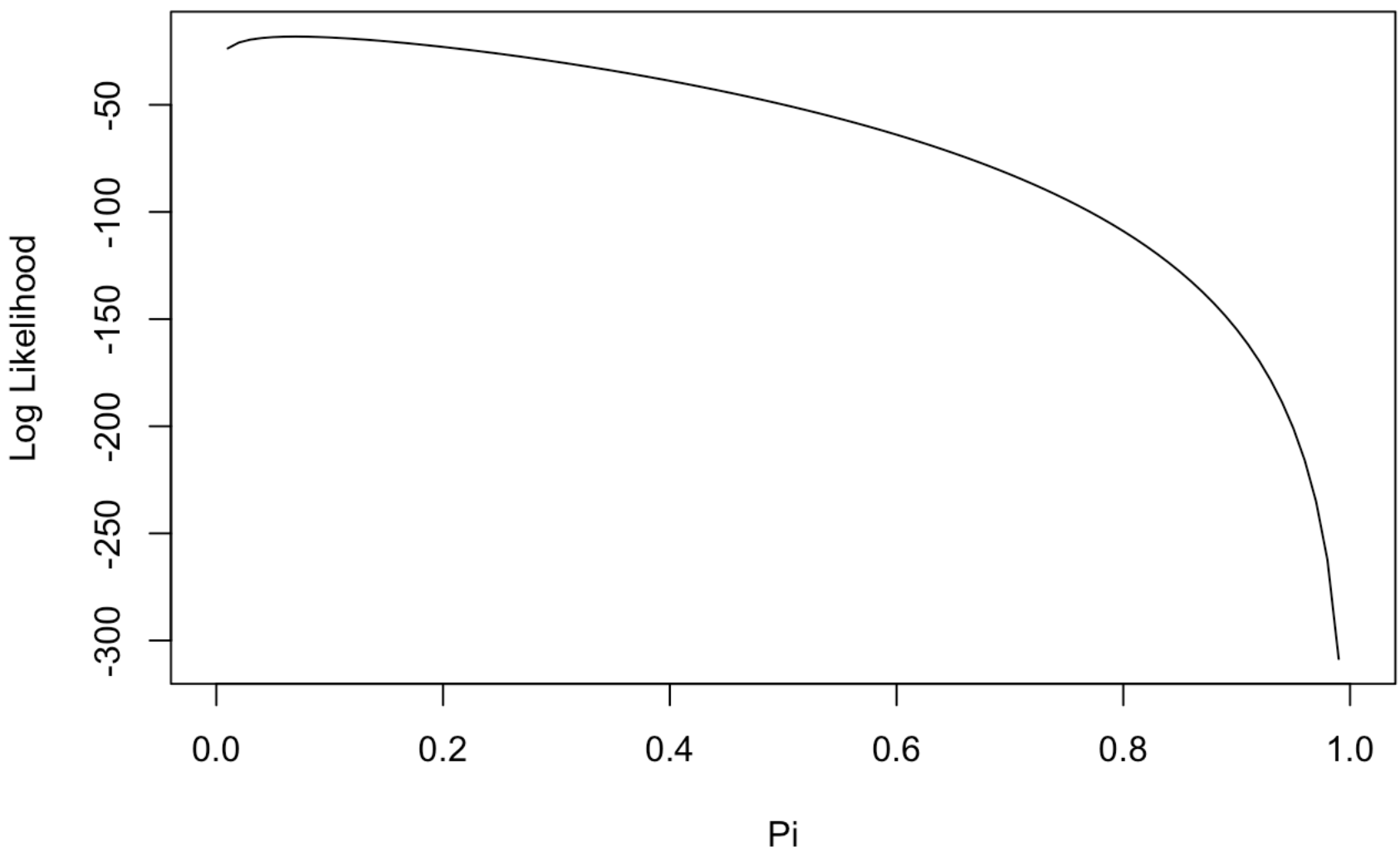
```
curve(log(length(combn(20,2))*(x^2)*(1-x)^(18)), xlab = "Pi", ylab = "Log Likelihood"
)
title(main = "Log Likelihood for 20 Tosses")
```



In the second experiment, it took me 72 tosses to get 5 landing point up, so the log likelihood is

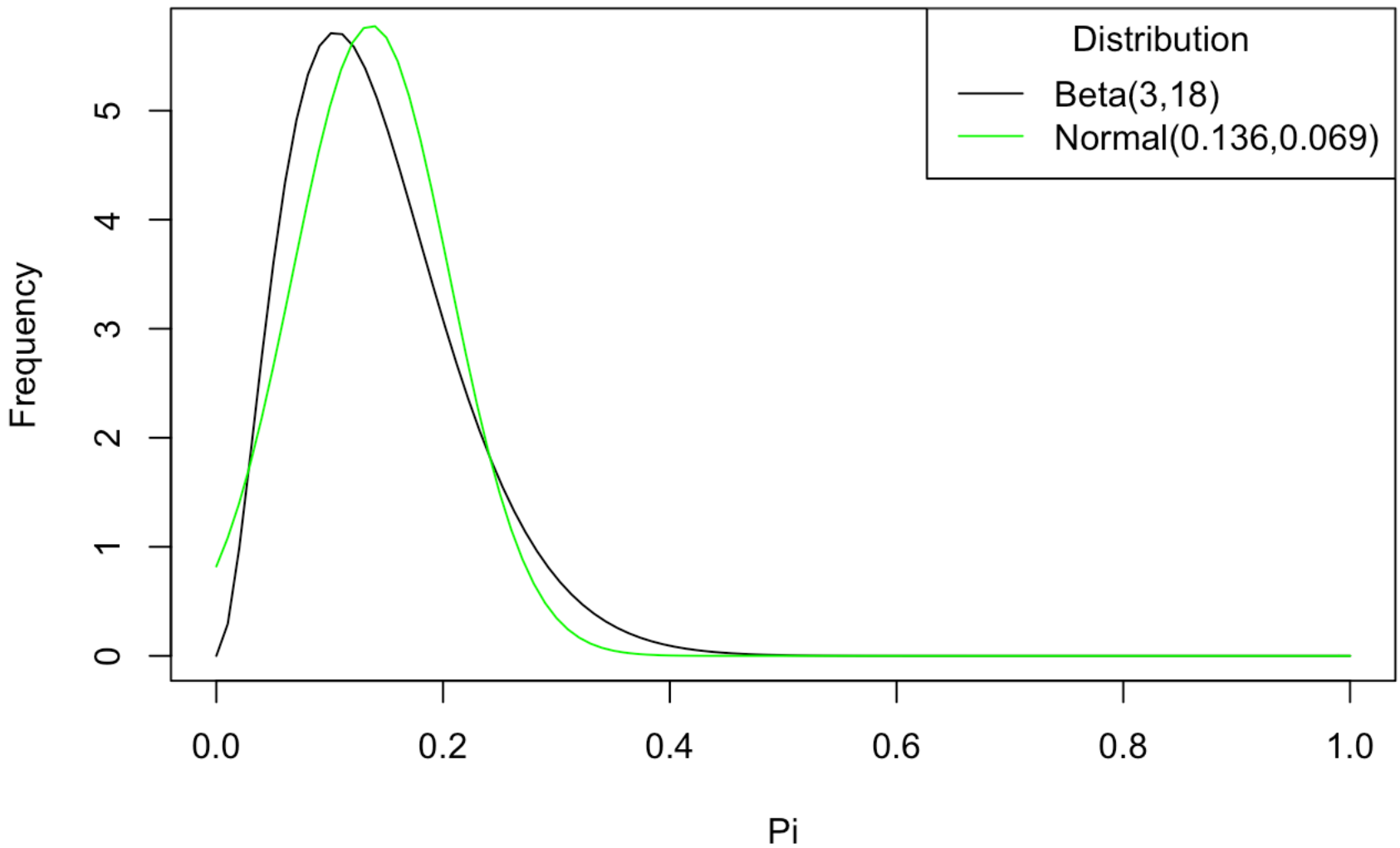
$$log(\pi^4(1-\pi)^{72-5}\pi)$$

```
curve(log((x^5)*(1-x)^(72-5)), xlab = "Pi", ylab = "Log Likelihood")
title(main = "Log Likelihood for Tosses until 5 Point-Up")
```



Next, we will graph the posterior distribution, found to be Beta(3,18) distribution.

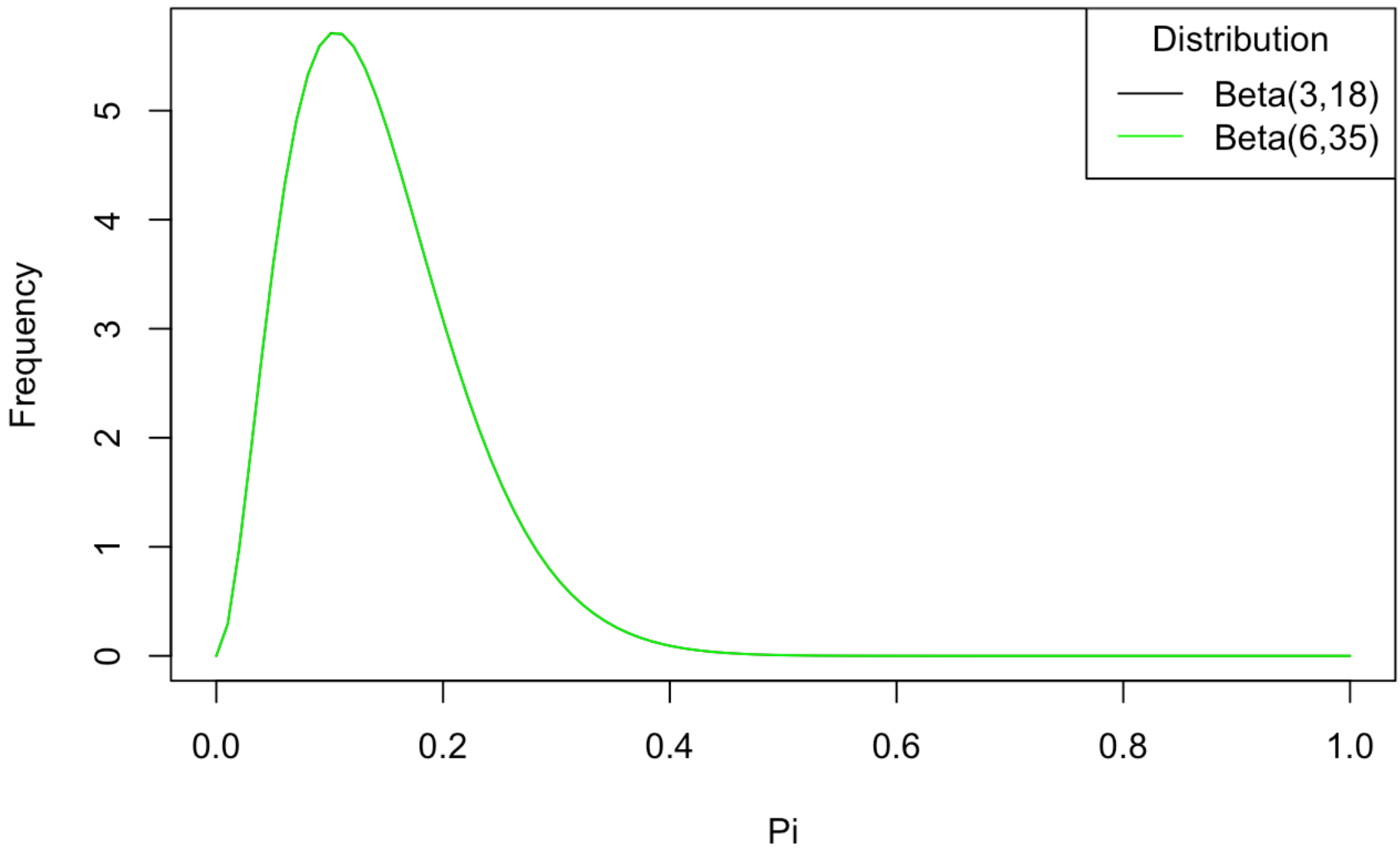
```
x=seq(0,1,length=100)
y=dbeta(x,3,18)
plot(x,y, type="l", xlab = "Pi", ylab = "Frequency")
title(main = "Posterior Distribution vs Normal")
curve(dnorm(x, mean = 3/22, sd = 0.069), add = TRUE, col = "green")
legend("topright", legend = c("Beta(3,18)", "Normal(0.136,0.069)"), lty = 1, col = c(
"black", "green"), title = "Distribution")
```



The two curves overlap quite a bit, meaning our posterior curve is close to normal.

After 20 more tosses, we find that the posterior distribution for all 40 tosses (including the first 20) is Beta(6,35). Let's compare this with the posterior Beta(3,18) from the first 20 tosses.

```
plot(x, dbeta(x,3,18), type="l", xlab = "Pi", ylab = "Frequency")
title(main = "Comparing Posterior Distributions")
curve(dbeta(x,3,18), add = TRUE, col = "green")
legend("topright", legend = c("Beta(3,18)", "Beta(6,35)"), lty = 1, col = c("black",
"green"), title = "Distribution")
```



The curves are almost indistinguishable! Our estimate for π seems to be legitimate.