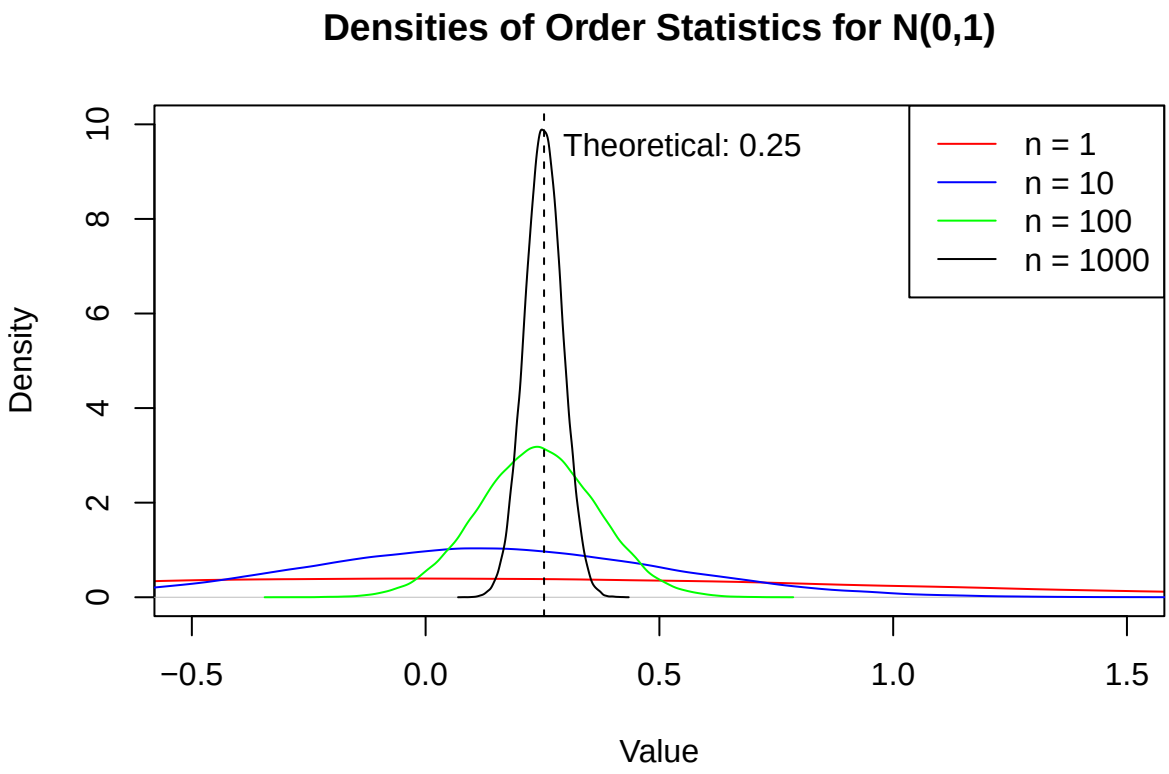
R Notebook

```r
#Q.3(a)
set.seed(123)
k <- 10^5
alpha <- 0.6
n_values <- c(1, 10, 100, 1000)
results <- list()
for (n in n_values) {
  j <- ceiling(alpha * n)
    samples <- replicate(k, sort(rnorm(n))[j])
  density_est <- density(samples)
  results[[as.character(n)]] <- list(samples = samples, density = density_est)
}
plot(results[["1"]][["density"]], col = "red", xlim = c(-0.5, 1.5), ylim = c(0, 10),
     main = "Densities of Order Statistics for N(0,1)", xlab = "Value", ylab = "Density")
lines(results[["10"]][["density"]], col = "blue")
lines(results[["100"]][["density"]], col = "green")
lines(results[["1000"]][["density"]], col = "black")

legend("topright", legend = c("n = 1", "n = 10", "n = 100", "n = 1000"),
       col = c("red", "blue", "green", "black"), lty = 1)

theoretical_value <- qnorm(alpha)
abline(v = theoretical_value, col = "black", lty = 2)
text(theoretical_value, 9.5, labels = paste("Theoretical:", round(theoretical_value, 2)), pos = 4)
```




```
#Q.5(a)
library(UsingR)
```

```
## Loading required package: MASS
```

```
## Loading required package: HistData
```

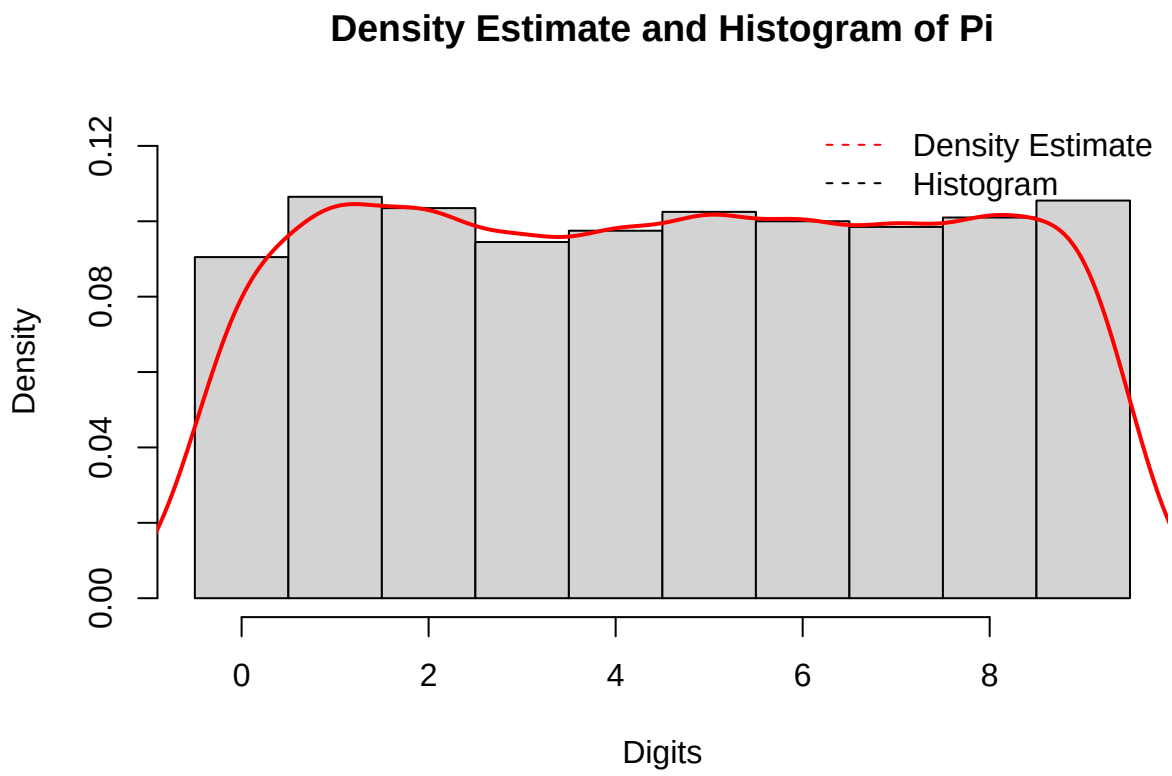
```
## Loading required package: Hmisc
```

```
##
## Attaching package: 'Hmisc'
```

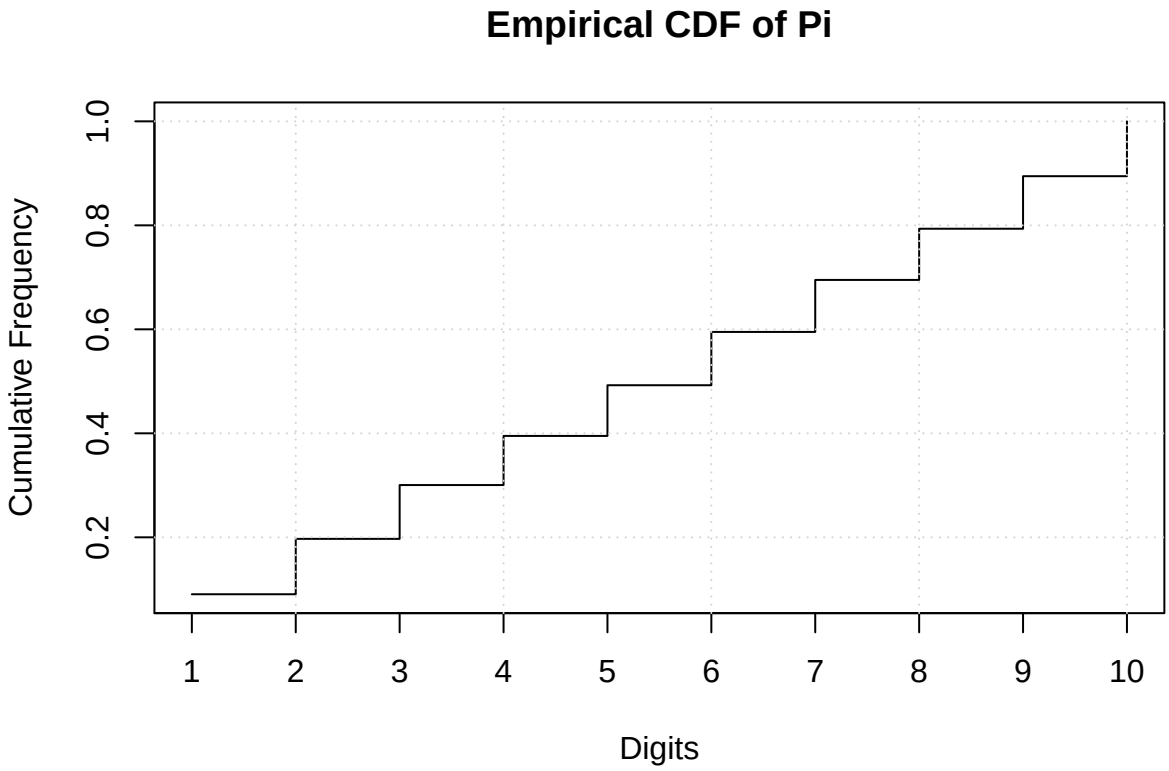
```
## The following objects are masked from 'package:base':
##
##     format.pval, units
```

```
data(pi2000)

density_estimate <- density(pi2000)


hist(pi2000, breaks=0:10-0.5, probability=TRUE,
     main="Density Estimate and Histogram of Pi",
     xlab="Digits", ylim=c(0, max(density_estimate$y)*1.2))
```

```r
lines(density_estimate, col="red", lwd=2)
legend("topright", legend=c("Density Estimate", "Histogram"),
       col=c("red", "black"), lty=c(2, 2), bty="n")
```




```r
#Q.5(b)
freq_table <- table(factor(pi2000, levels=0:9))

plot(cumsum(freq_table)/sum(freq_table), type='s',
     main="Empirical CDF of Pi",
     xlab="Digits", ylab="Cumulative Frequency",
     xaxt='n')
axis(1, at=0:10)
grid()
```


Empirical CDF of Pi
Cumulative Frequency
0.2
0.4
0.6
0.8
1.0
1
2
3
4
5
6
7
8
9
10
Digits