HW1

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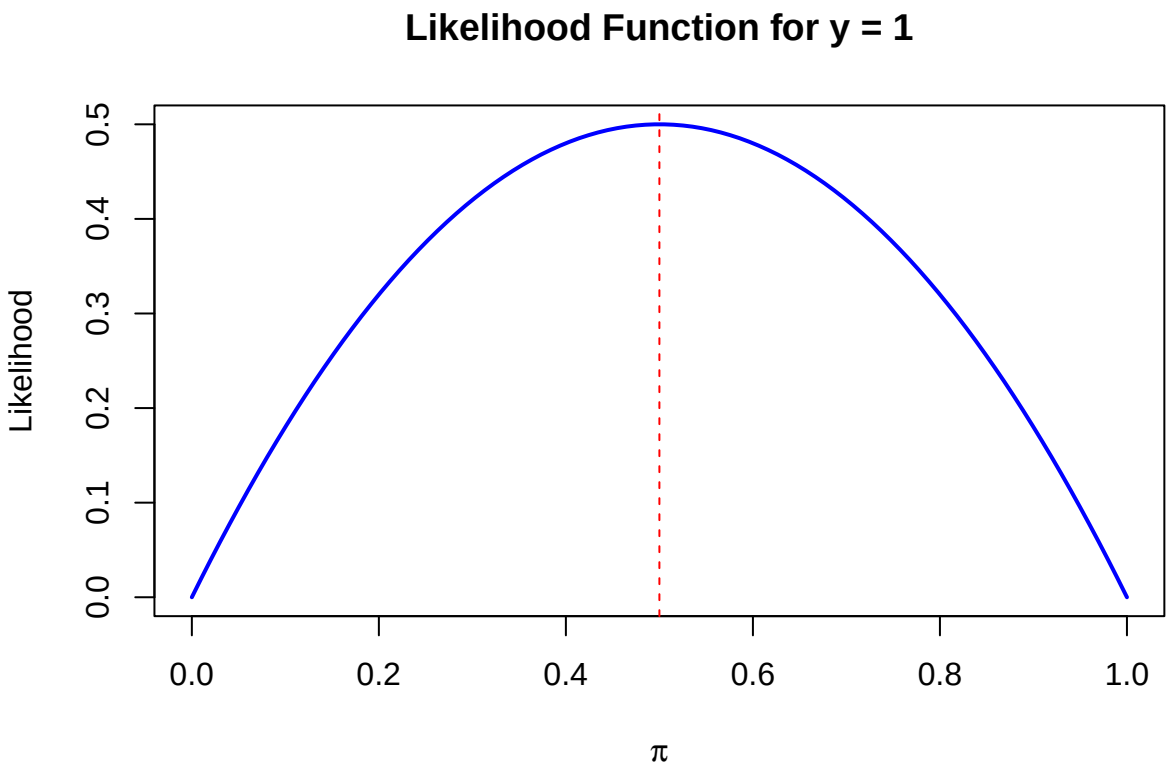
2024-09-07

R Markdown

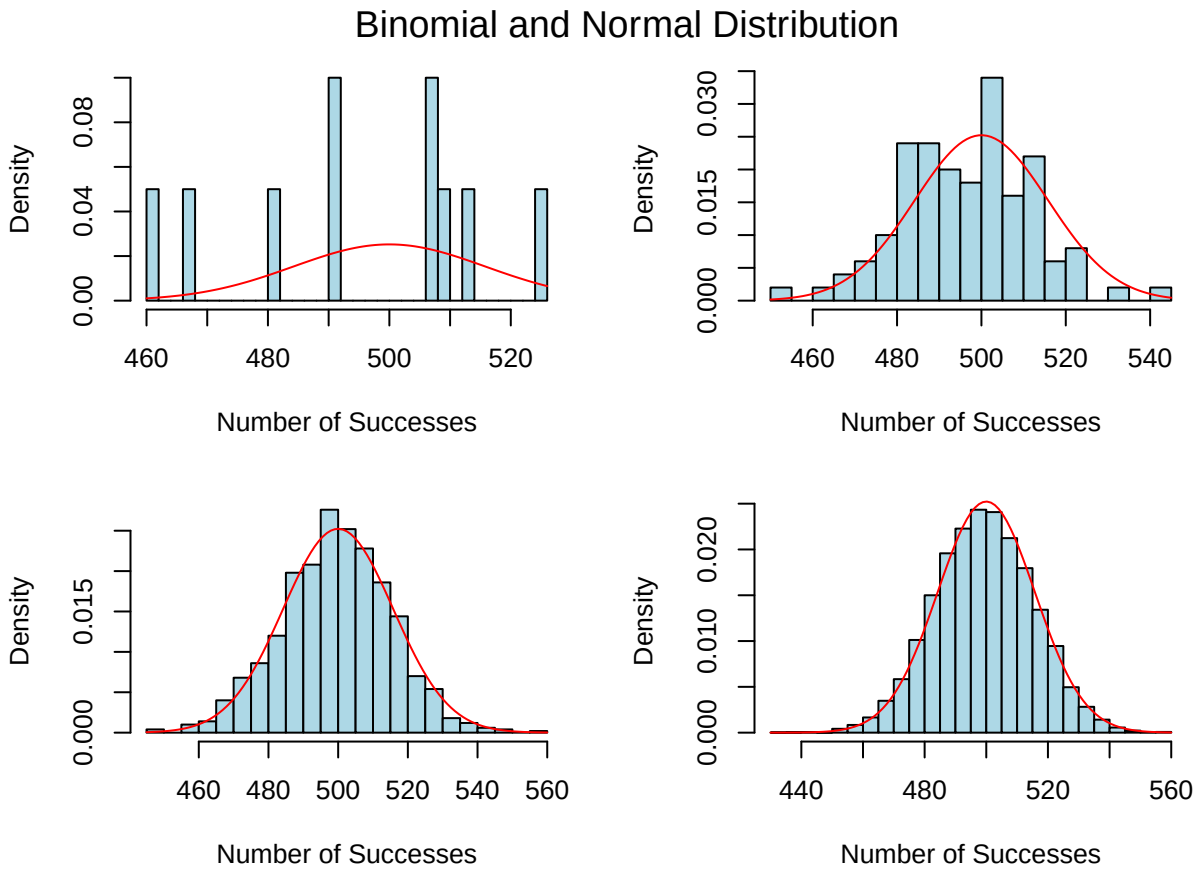
```r
# Define the likelihood function
likelihood = function(p) {
  2 * p * (1 - p)
}

# Generate a sequence of pi values between 0 and 1
p_values = seq(0, 1, length.out = 100)

# Calculate the likelihood for each pi value
likelihood_values = likelihood(p_values)

# Plot the likelihood function
plot(p_values, likelihood_values, type = "l", col = "blue", lwd = 2,
     xlab = expression(pi), ylab = "Likelihood",
     main = "Likelihood Function for y = 1")

# Add a vertical line at the maximum likelihood estimate (MLE)
abline(v = 0.5, col = "red", lty = 2)
```



Extra non-required questions

```r
#Set variables for binomial distribution
n_values = c(10, 100, 1000, 10000)
p = 0.5
par(mfrow = c(2,2), mar=c(4,4,2,2))

#Loop and generate binomial random variables
for (n in n_values) {
  binom_sample = rbinom(n, size = 1000, prob = p)

  #Calculate mean and sd for normal distribution
  mean_value = 1000 * p
  sd_value = sqrt(1000 * p * (1 - p))

  #Histogram for binomial distribution
  hist(
    binom_sample,
    breaks = 30,
    col = "lightblue",
    border = "black",
    main = "",
    xlab = "Number of Successes",
    probability = TRUE
  )
```

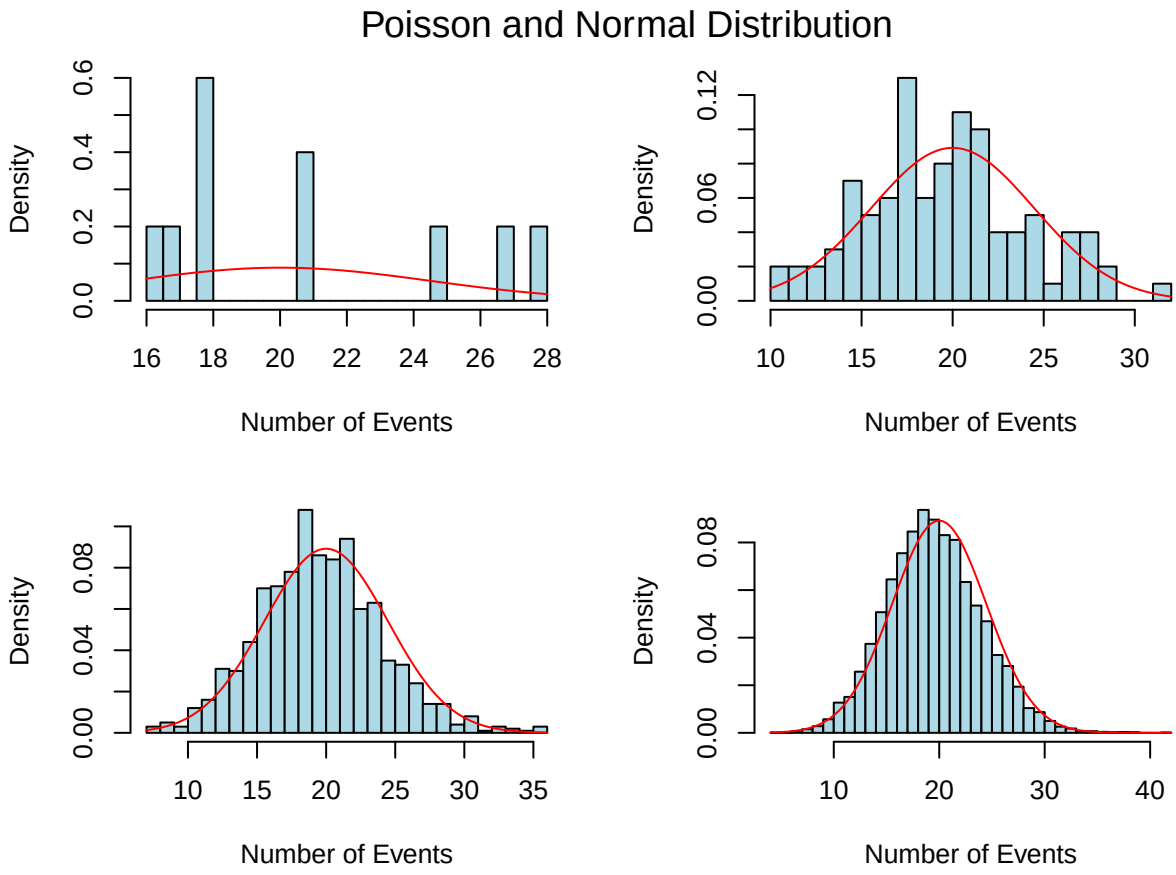
```r
  #Overlay normal distribution
  curve(dnorm(x, mean = mean_value, sd = sd_value),
        col = "red",
        add = TRUE)
}

mtext("Binomial and Normal Distribution", outer = TRUE, cex = 1.2, line = -1.2)
```




```r
#We can see as n increases, the binomial random variables will converge to a normal distribution
```

```r
#Set variables for binomial distribution
n_values2 = c(10, 100, 1000, 10000)
Lambda = 20
par(mfrow = c(2,2), mar=c(4,4,2,2))

#Loop and generate binomial random variables
for (n2 in n_values2) {
  poi_sample = rpois(n2, lambda = Lambda)

  #Calculate mean and sd for normal distribution
  mean_value2 = Lambda
  sd_value2 = sqrt(Lambda)

  #Histogram for binomial distribution
  hist(
```

```
    poi_sample,
    breaks = 30,
    col = "lightblue",
    border = "black",
    main = "",
    xlab = "Number of Events",
    probability = TRUE
  )

  #Overlay normal distribution
  curve(dnorm(x, mean = mean_value2, sd = sd_value2),
        col = "red",
        add = TRUE)
}

mtext("Poisson and Normal Distribution", outer = TRUE, cex = 1.2, line = -1.2)
```




```
#We can see as n increases, the poisson random variables will converge to a normal distribution
```