C240424_2

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Exercise 2-1

1. a. Y (Response/Dependent): Attitude Toward Gun Control
   X (Explanatory/Independent): Gender, Mother's Education

   b. Y (Response/Dependent): Heart Disease
   X (Explanatory/Independent): Blood Pressure, Cholesterol

   c. Y (Response/Dependent): Vote for President
   X (Explanatory/Independent): Race, Religion, Annual Income

2. a. Nominal
   b. Ordinal
   c. Ordinal
   d. Nominal
   e. Nominal
   f. Ordinal

Exercise 2-2

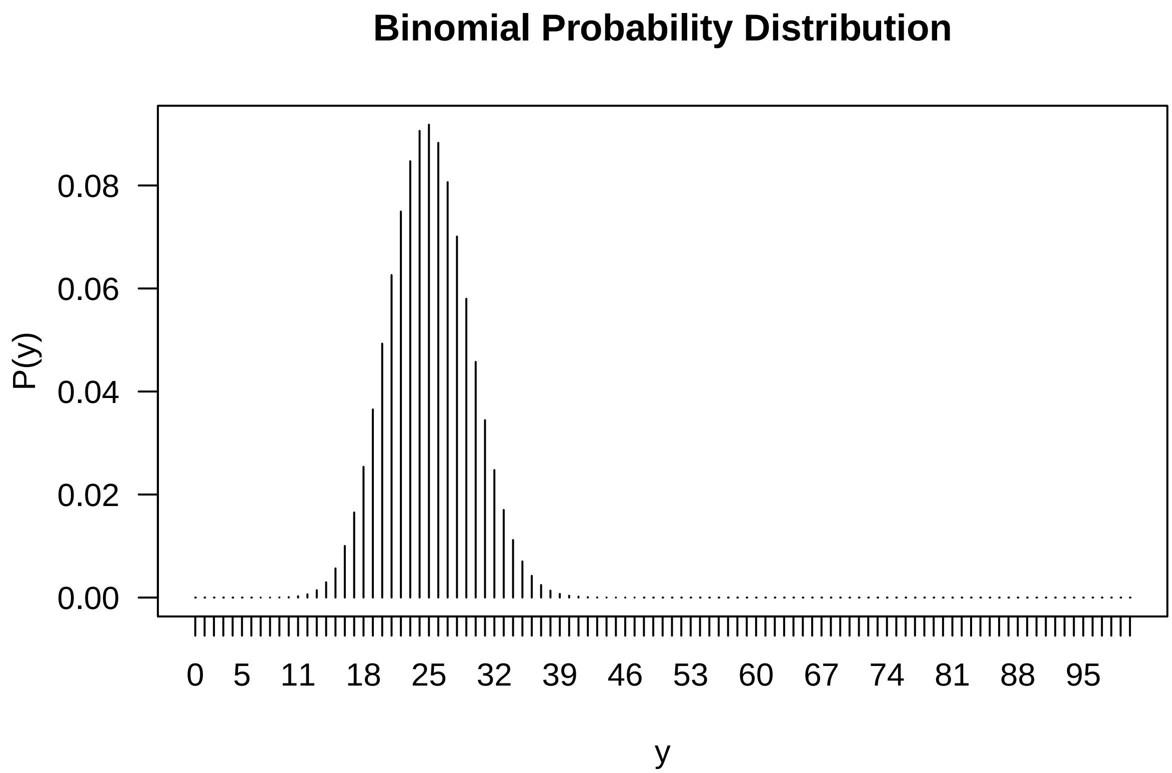
a. $\because n = 100,\ \pi = \frac{1}{4},\ y = \textit{correct answer.}$
   $\therefore Y \sim \mathsf{binomial}(n = 100,\ \pi = 0.25)$
   Probability Mass Function $= P(Y = y) = \frac{100!}{y!(100-y)!}(0.25)^y(1-0.25)^{100-y}$
b. Mean $= E(Y) = 100 * 0.25 = 25$
   Standard Deviation $= \sigma(Y) = \sqrt{100 * 0.25 * (1 - 0.25)} = 4.330127$

It is improbable for a student to randomly get at least 50 correct answers, as this outcome lies beyond the typical range of the binomial distribution centered around the mean of 25 with a standard deviation of 4.33, as shown in the graph below.(In the next page)

Binomial Probability Distribution

```r
plot(x = 0:100, y = dbinom(0:100, 100, .25),
     main = "Binomial Probability Distribution", type = "h",
     xlab = "y", ylab = "P(y)", las = 1, xaxt = "n")

axis(side = 1, at = 0:100)
```



Exercise 2-3

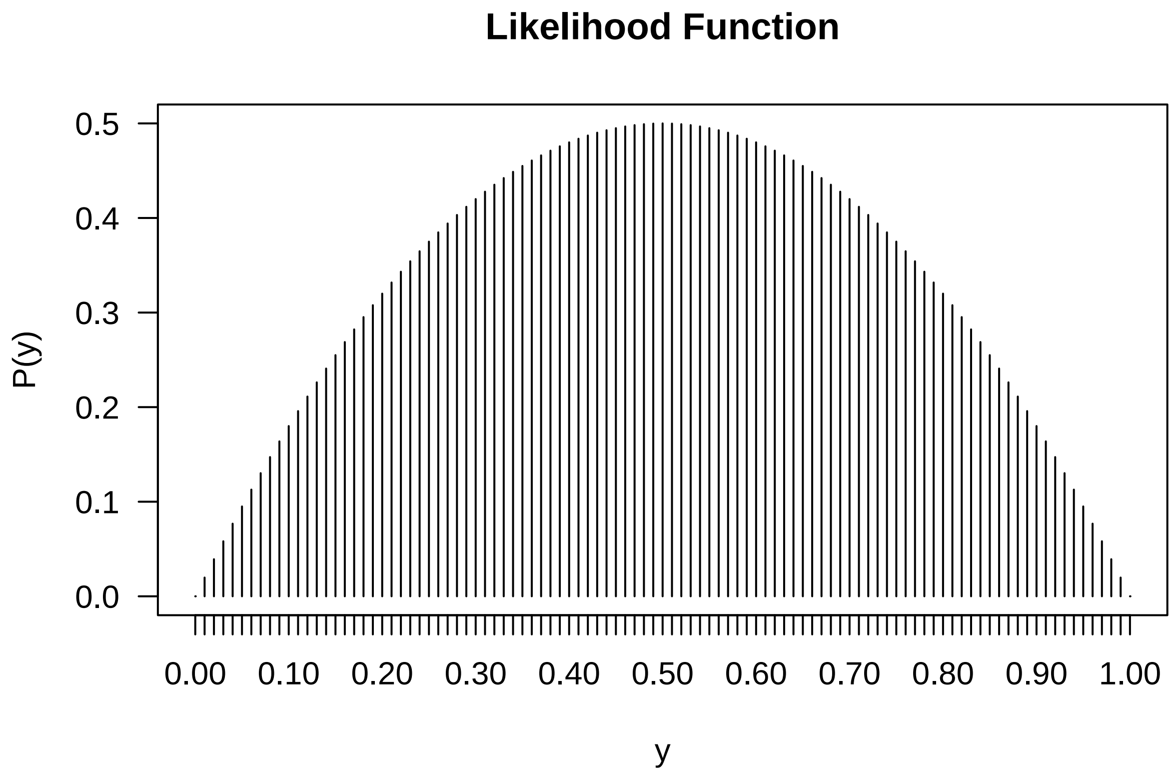
a. $\because n = 2,\ \pi = 0.5,\ y = \textit{support increase}.$
$\therefore Y \sim \mathsf{binomial}(n = 2,\ \pi = 0.5)$
Probability Mass Function $= P(Y = y) = \frac{2!}{y!(2-y)!}(0.5)^y(1-0.5)^{2-y}$
Mean $= E(Y) = 2 * 0.5 = 1$
Standard Deviation $= \sigma(Y) = \sqrt{2 * 0.5 * (1 - 0.5)} = 0.7071068$

b. $P(y = 1) = l(\pi|y) = \frac{2!}{1!(2-1)!}(\pi)^1(1-\pi)^{2-1} = 2(\pi)(1-\pi)$
ML Estimate $= \hat{\pi} = \frac{y}{n} = \frac{1}{2} = 0.5$
That is because $\frac{d}{d\pi} log\ l(\pi|y) = 0$ yields $\pi = \frac{y}{n}$, which is the only candidate for Maximum Likelihood Estimation. In addition, its second derivative yields values less than 0 for $\pi \in [0, 1]$.

The likelihood function sketched:

```r
pi <- seq(0, 1, by = 0.01)
likelihood <- 2 * pi * (1 - pi)
plot(x = pi, y = likelihood, main = "Likelihood Function",
     type = "h", xlab = "y", ylab = "P(y)",
     las = 1, xaxt = "n")

axis(side = 1, at = seq(0, 1, by = 0.01))
```



The English lecture 2 video has stopped until this point for the assignment report.