Math 32

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Binomial Distribution

The binomial distribution is a discrete probability distribution where we can compute the probability of observing k successes, each with probability p, among n trials with the probability mass function

$$P(X = k) = \binom{n}{k} p^k (1-p)^{n-k}$$

Parameters

In this `LearnR` app, we will practice making graphs of the PMF (probability mass function) and cumulative probabilities for a binomial distribution.

Setting

In constructing a music playlist in YouTube, suppose that 63 percent of the songs had official music videos (and fan-made videos otherwise). Let us create a playlist of 10 songs. Fill in the parameters for $X \sim Bin(n, p)$ below.

Code | Start Over | Run Code

```
1 n <- 10
2 p <- 0.63
3
```

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Probability Mass Function

Press `Run Code` to visualize the distribution, and then add code comments on the lines where there is an octothorpe (`#`) to describe what those lines of code do.

Code | Start Over | Run Code

```
kvals <- 0:n # creates a list of numbers from 0 to n
pmf   <- dbinom(kvals, n, p)
tf    <- kvals == 7 # creates a list of booleans
df    <- data.frame(kvals, pmf, tf)
df %>%
  ggplot(aes(x = kvals, y = pmf, fill = tf)) +
  geom_bar(stat = "identity") + # we will provide out own y values
  labs(title = "Probability Mass Function",
       subtitle = "k is exactly 7",
       caption = "Math 32",
       x = "k",
       y = "probability") +
  scale_x_continuous(breaks = 0:n,
                     labels = as.character(0:n))
```

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- Probability Mass Function
- Cumulative Probability
- PMF Exercise
- Cumulative Exercise
- Submission

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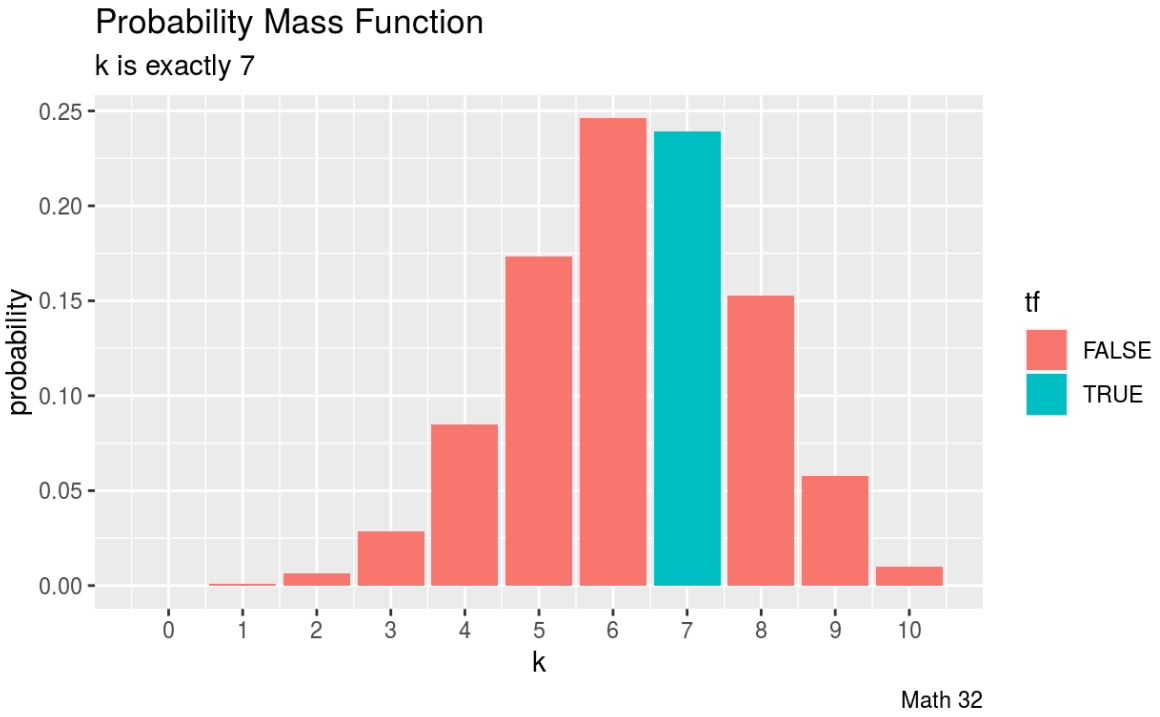

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$$P(X = k) = \binom{n}{k} p^k (1-p)^{n-k}$$

Cumulative Probability

Press `Run Code` to visualize the distribution, and then add code comments on the lines where there is an octothorpe (`#`) to describe what those lines of code do.

Code | Start Over | Run Code

```
kvals <- 0:n
pmf   <- dbinom(kvals, n, p)
tf    <- kvals <= 5 # creates a list of booleans
df    <- data.frame(kvals, pmf, tf) # merge all the values from kvals, pmf, and tf
df %>%
  ggplot(aes(x = kvals, y = pmf, fill = tf)) +
  geom_bar(stat = "identity") +
  labs(title = "Cumulative Probability", # labels the graph
       subtitle = "k is at most 5",
       caption = "Math 32",
       x = "k",
       y = "probability") +
  scale_x_continuous(breaks = 0:n,
                     labels = as.character(0:n))
```

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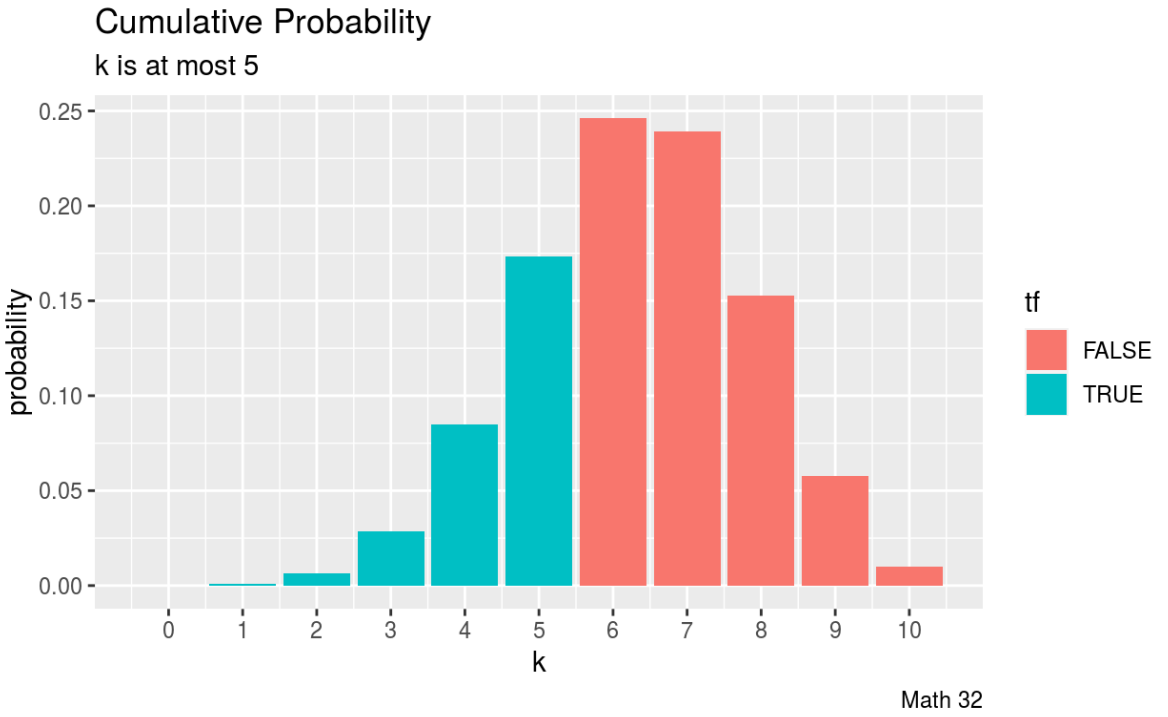

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The binomial distribution is a discrete probability distribution where we can compute the probability of observing k successes, each with probability p, among n trials with the probability mass function

$$P(X = k) = \binom{n}{k} p^k (1-p)^{n-k}$$

PMF Exercise

Use `R` code with `ggplot` to visualize the PMF for “What is the probability that there are exactly 6 songs with official music videos in a playlist of 10 songs?”

Code | Start Over | Run Code

```
kvals <- 0:n
pmf   <- dbinom(kvals, n, p)
tf    <- kvals == 6
df    <- data.frame(kvals, pmf, tf)
df %>%
  ggplot(aes(x = kvals, y = pmf, fill = tf)) +
  geom_bar(stat = "identity") +
  labs(title = "Probability Mass Function",
       subtitle = "k is exactly 6",
       caption = "Math 32",
       x = "k",
       y = "probability") +
  scale_x_continuous(breaks = 0:n,
                     labels = as.character(0:n))
```

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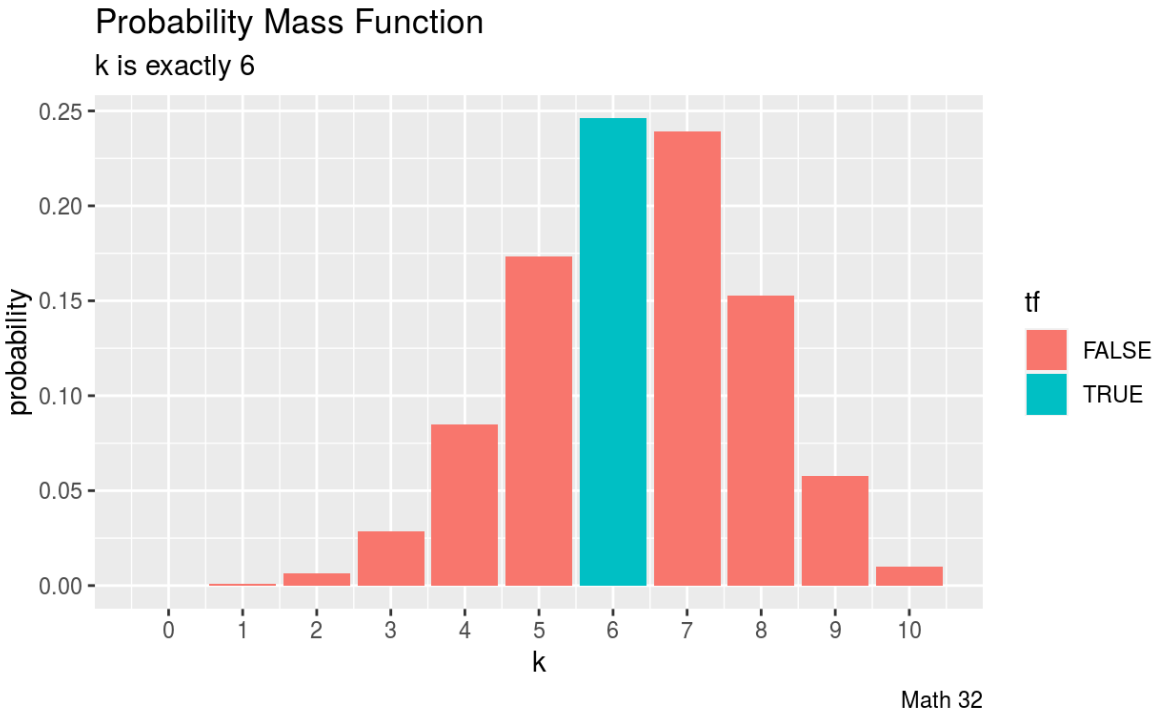

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Binomial Distribution

The binomial distribution is a discrete probability distribution where we can compute the probability of observing k successes, each with probability p, among n trials with the probability mass function

$$P(X = k) = \binom{n}{k} p^k (1-p)^{n-k}$$

Cumulative Exercise

Use `R` code with `ggplot` to visualize the cumulative probability for “What is the probability that there are more than 6 songs with official music videos in a playlist of 10 songs?”

Code | Start Over | Run Code

```
kvals <- 0:n
pmf   <- dbinom(kvals, n, p)
tf    <- kvals > 6
df    <- data.frame(kvals, pmf, tf)
df %>%
  ggplot(aes(x = kvals, y = pmf, fill = tf)) +
  geom_bar(stat = "identity") +
  labs(title = "Cumulative Probability",
       subtitle = "k is more than 6",
       caption = "Math 32",
       x = "k",
       y = "probability") +
  scale_x_continuous(breaks = 0:n,
                     labels = as.character(0:n))

```

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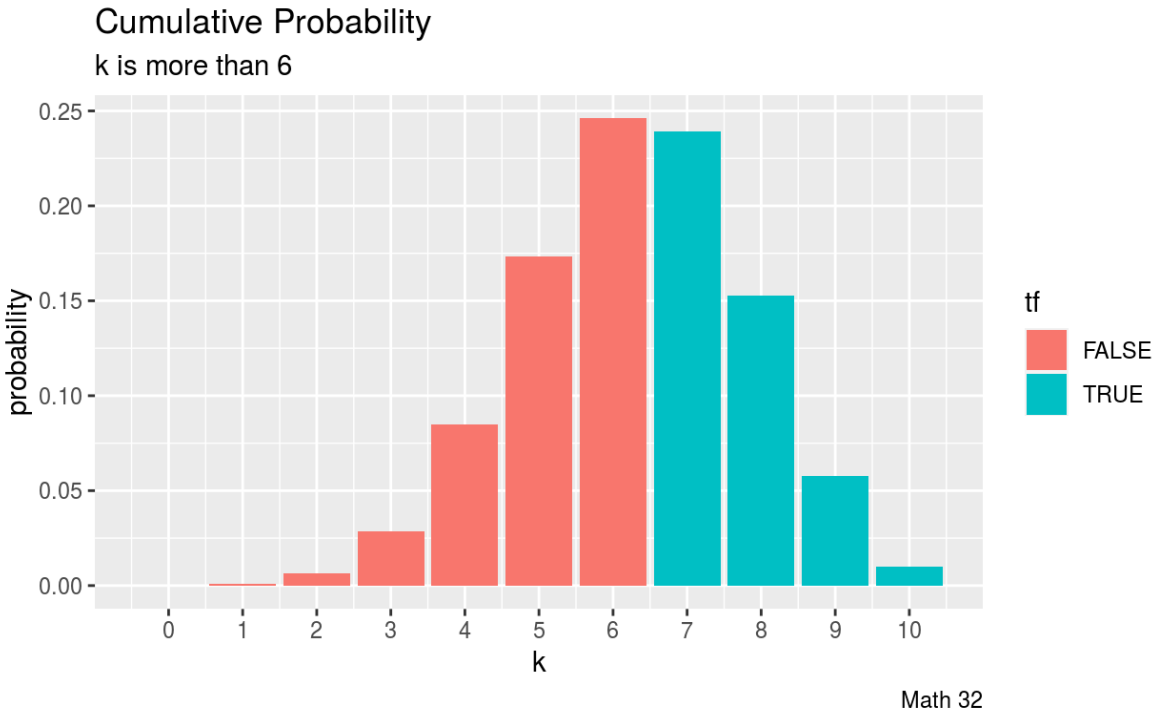

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