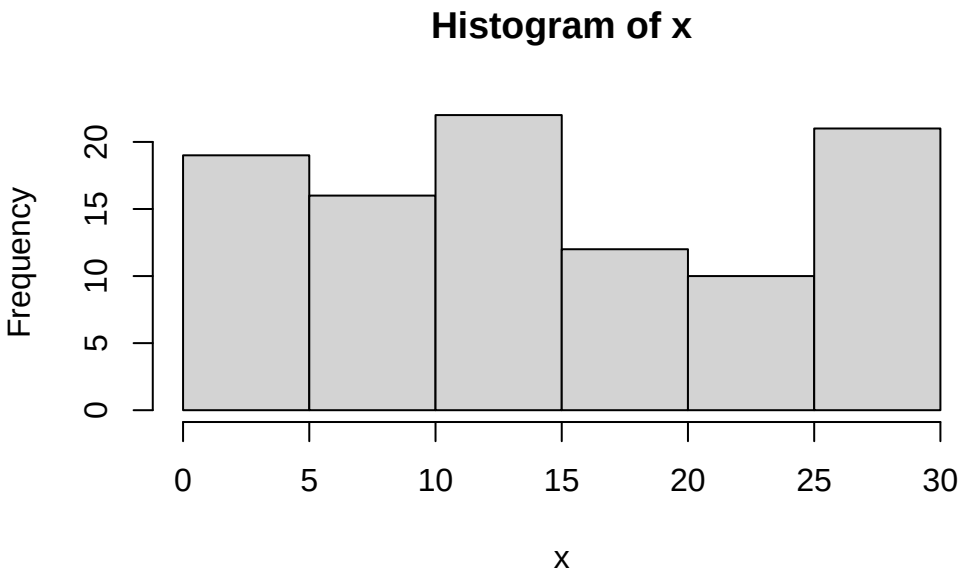
Continuous Distributions: Uniform, Normal, Student's t

Uniform Distribution

Generate 100 uniform random variables with values between 0 and 30.

```
x = runif(100, min = 0, max = 30)
hist(x)
```



Given that X is distributed as $Unif(0, 30)$, find $P(15 < X < 20)$.

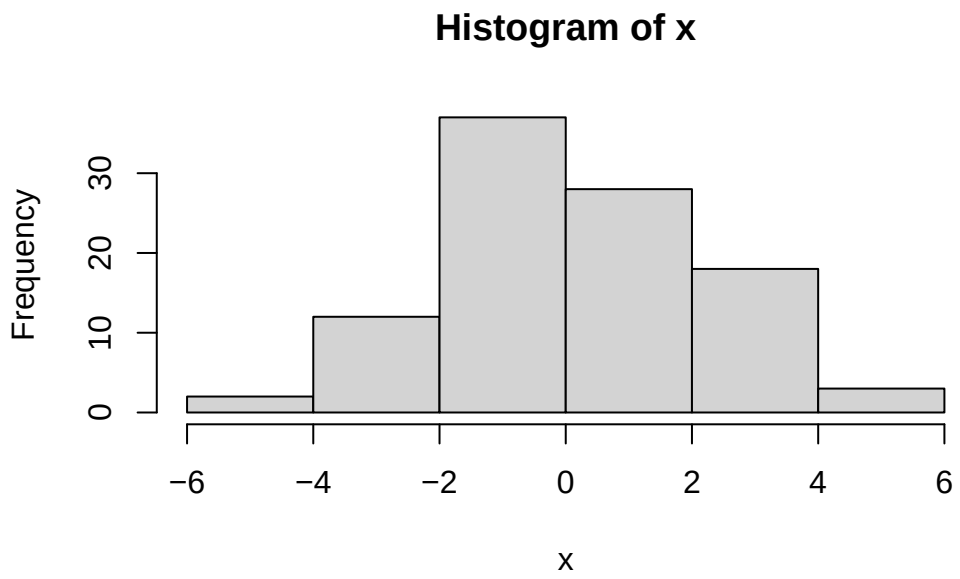
```
punif(20, min = 0, max = 30) - punif(15, min = 0, max = 30)
```

```
[1] 0.1666667
```

Normal Distribution

Generate 100 normal random variables with mean 0, standard deviation 2.

```
x = rnorm(100, mean = 0, sd = 2)
hist(x)
```



Given that X follows normal distribution with mean 70 and standard deviation 10, find the following probabilities

1) $P(X \leq 65)$

2) $P(40 \leq X \leq 60)$

```
# P(X <= 65)
pnorm(65, mean = 70, sd = 10)
```

```
[1] 0.3085375
```

```
# P(40 <= X <= 60)
pnorm(60, mean = 70, sd = 10) - pnorm (40, mean = 70, sd = 10)
```

```
[1] 0.1573054
```

```r
# What is this?
dnorm(65, mean = 70, sd = 10)
```

```
[1] 0.03520653
```

Find the standard normal percentiles for probabilities 0.95, 0.975, and 0.995.

```r
qnorm(c(0.95, 0.975, 0.995), lower.tail = TRUE)
```

```
[1] 1.644854 1.959964 2.575829
```

```r
qnorm(c(0.95, 0.975, 0.995))
```

```
[1] 1.644854 1.959964 2.575829
```

```r
qnorm(c(0.05, 0.025, 0.005), lower.tail = FALSE)
```

```
[1] 1.644854 1.959964 2.575829
```

The binomial distribution can be approximated by the normal distribution.

Generate and plot 1,000 binomial random variables.

```r
# tell R to show plots together
par(mfrow=c(2,2))

# n = 5, p = 0.3
x1 = rbinom(1000, 5, 0.3)

hist(x1, breaks = seq(0,50,1),
     xlab="N successes", main="Bin(n=5, p=0.3)")

# n = 50, p = 0.3
x2 = rbinom(1000, 50, 0.3)

hist(x2, breaks = seq(0,50,1),
```

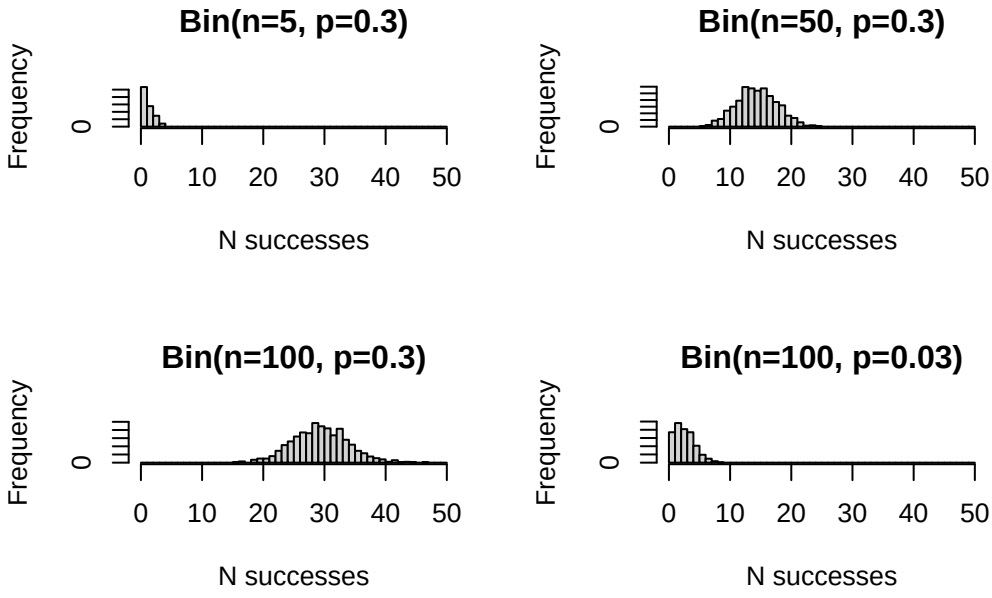
```
     xlab="N successes", main="Bin(n=50, p=0.3)")

# n = 100, p = 0.3
x3 = rbinom(1000, 100, 0.3)

hist(x3, breaks = seq(0,50,1),
     xlab="N successes", main="Bin(n=100, p=0.3)")

# n = 100, p = 0.03
x4 = rbinom(1000, 100, 0.03)

hist(x4, breaks = seq(0,50,1),
     xlab="N successes", main="Bin(n=100, p=0.03)")
```



Student's t-distribution

Compare t distributions with different degrees of freedom (df).

```
par(mfrow = c(1,1))

# generate normal density
x = seq(-5, 5, length = 100)
densnorm = dnorm(x)
```

```r
# define dfs and corresponding colors
df = c(1, 2, 5, 29)
colors = c("red", "blue", "green", "orange", "black")

# begin plot
plot(x, densnorm,
     type = "l", lty = 2, ylab = "Density",
     main = "Student's t Distributions")

# generate t densities with for loop
for (i in 1:4) {
  lines(x, dt(x, df[i]), lwd = 2, col = colors[i])
}

# finish plot
legend("topright",
       legend = c("df = 1", "df = 2", "df = 5", "df = 29", "Normal"),
       bty = 'n', lwd = 2, lty = c(1, 1, 1, 1, 2), col = colors)
```