6.4: Using R to Find Confidence Intervals

The confidence interval for a population's mean, μ, given an experimental mean, $\bar{x}$, for n samples is defined as

$$\mu = \bar{x} \pm \frac{z\sigma}{\sqrt{n}}$$

if we know the population's standard deviation, σ, and as

$$\mu = \bar{x} \pm \frac{ts}{\sqrt{n}}$$

if we assume that the sample's standard deviation, s, is a reasonable predictor of the population's standard deviation. To find values for z we use R's `qnorm ()` function, which takes the form

```
qnorm(p)
```

where `p` is the probability on one side of the normal distribution curve that a result is not included within the confidence interval. For a 95% confidence interval, $p = 0.05/2 = 0.025$ because the total probability of 0.05 is equally divided between both sides of the normal distribution. To find t we use R's `qt ()` function, which takes the form

```
qt(p, df)
```

where `p` is defined as above and where `df` is the degrees of freedom or $n - 1$.

For example, if we have a mean of $\bar{x} = 12$ for 10 samples with a known standard deviation of $\sigma = 2$, then for the 95% confidence interval the value of z and the resulting confidence interval are

```
# for a 95% confidence interval, alpha is 0.05 and the probability, p, on either end of the distribution is 0.025;

# the value of z is positive on one side of the normal distribution and negative on the other side;

# as we are interested in just the magnitude, not the sign, we use the abs() function to return the absolute value

    z = qnorm(0.025)
    conf_int_pop = abs(z * 2/sqrt(10))
    conf_int_pop

    [1] 1.23959
```

Adding and subtracting this value from the mean defines the confidence interval, which, in this case is 12 ± 1.2.

If we have a mean of $\bar{x} = 12$ for 10 samples with an experimental standard deviation of $s = 2$, then for the 95% confidence interval the value of t and the resulting confidence interval are

```
    t = qt(p = 0.025, 9)
    conf_int_samp = abs(t * 2/sqrt(10))
    conf_int_samp

    [1] 1.430714
```

Adding and subtracting this value from the mean defines the confidence interval, which, in this case is 12 ± 1.4.