1. From a sample of 132 college students you find that the average number of hours slept each night is 6.3. Assume the population standard deviation is known, sigma = 1.65 hours.

   (a) Set up hypotheses to test if the average number of hours slept by college students is different from 8.2; use a significance level of alpha = 0.01. $H_0 : \mu = 8.2$ versus $H_1 : \mu \neq 8.2$ at $\alpha = 0.01$.

   (b) Evaluate the above hypothesis test and state your conclusion.

```
z <- (6.3 - 8.2)/(1.65/sqrt(132))
2*(1-pnorm(abs(z)))

## [1] 0
```

   Reject H_0, since the p-value is low. There is sufficient evidence to show that the population mean number of hours slept by college students is different than 8.

   (c) Calculate an appropriately matching confidence interval.

```
round(6.3 + qnorm(c(0.01, 0.99))*(1.65/sqrt(132)), 2)

## [1] 5.97 6.63
```

   (d) Interpret your confidence interval.

   We are 98% confident that the true mean number of hours slept by college students is between 5.97 and 6.63.

   (e) Does your hypothesis test conclusion match the conclusion from your confidence interval?

   Yes, the hypothesis test reject H_0 and similarly the confidence interval provides evidence against the population mean equal to 8.2 since the confidence interval does not contain 8.2 (the number in the null hypothesis).

   (f) How much do we care about the shape of the population distribution? Why?

   We don't much care. Since the sample size is at least moderately large, the Central Limit Theorem will make the sampling distribution of the sample mean appear fairly normal.

2. Biologists are often interested in population dynamics of groups of animals. Some mathematical models claim that if less than half of a population is not producing at least three offspring on average, then that group is destined to population decline. From a sample of 110 (offspring producing) individuals from the Order Carnivora, suppose you found that 58 produced at least 3 offspring. Hint: look up the standard deviation of a Bernoulli random variable.

   (a) Set up hypotheses to test if the Order Carnivora is destined to population decline; use a level of significance of alpha = 0.05.

   $H_0 : p = 0.5$ versus $H_1 : p < 0.5$ at $\alpha = 0.05$

(b) Evaluate the above hypothesis test and state your conclusion.

```
phat <- 58/111
z <- (phat - 0.5)/sqrt(phat*(1-phat)/111)
pnorm(z)

## [1] 0.6826283
```

Because the p-value is greater than the level of significance, α, we fail to reject H_0. There is insufficient evidence to reject the claim that the population proportion of animals from the Order Carnivora is different from 0.5. Hence, we might say the evidence suggests the animals from the Order Carnivora show no sign of population decline.

(c) Calculate an appropriately matching confidence interval.

```
round(phat + qnorm(c(0.025, 0.975))*sqrt(phat*(1-phat)/110), 2)

## [1] 0.43 0.62
```

(d) Interpret your confidence interval.

We are 95% confident that the true population proportion of animals from the Order Carnivora that are producing at least 3 offspring is between .43 and .62.

(e) Does your hypothesis test conclusion match the conclusion from your confidence interval?

Yes, since the confidence interval contains the null value $p = 0.5$, our confidence interval also fails to reject the null hypothesis.