1. A company that produces snack foods uses a machine to package 454 oz bags of peanuts. We will assume that the net weights are normally distributed. We checked the weights of 25 randomly selected bags.

```
# Step 1: Input the data

weights <- c(456.1044, 454.9274, 463.3754, 454.4481, 439.9364, 439.4287,
433.9606, 454.4112, 441.1862, 451.7071, 451.0081, 454.1241, 449.0997,
450.0831, 449.5649, 449.8206, 448.2421, 451.3955, 447.9808, 449.1918,
455.0977, 454.4666, 459.1979, 453.7098, 456.4588)


# Step 2: Calculate the sample mean and standard deviation

sample_mean <- mean(weights)

sample_sd <- sd(weights)

sample_size <- length(weights)

error_margin <- qt(c(0.95, 0.975, 0.995), df = sample_size - 1) *
sample_sd / sqrt(sample_size)


# Step 3: Calculate the confidence intervals

ci_90 <- c(sample_mean - error_margin[1], sample_mean + error_margin[1])

ci_95 <- c(sample_mean - error_margin[2], sample_mean + error_margin[2])

ci_99 <- c(sample_mean - error_margin[3], sample_mean + error_margin[3])


# Print the results
```

a) Calculate a 90% confidence interval for the mean weight of a bag of snack.

```
cat("90% Confidence Interval:", ci_90, "\n")

90% Confidence Interval: 448.5143 452.9999
```

b) Calculate a 95% confidence interval for the mean weight of a bag of snack.

```
cat("95% Confidence Interval:", ci_95, "\n")

95% Confidence Interval: 448.0515 453.4627
```

c) Calculate a 99% confidence interval for the mean weight of a bag of snack.

```
cat("99% Confidence Interval:", ci_99, "\n")

99% Confidence Interval: 447.0905 454.4236
```

2. In a group of 371 students, 45 chose the number seven when picking a number between one

and twenty at random.

```
# Step 1: Define the sample size, the number of students who chose the number seven, and the proportion

sample_size <- 371

number_of_students_chose_seven <- 45

proportion <- number_of_students_chose_seven / sample_size


# Step 2: Calculate the confidence interval for the proportion

ci_99_margin <- qnorm(0.995) * sqrt(proportion * (1 - proportion) / sample_size)

ci_99 <- c(proportion - ci_99_margin, proportion + ci_99_margin)
```

a) Construct a 99% confidence interval for the proportion of students in favor of the number

seven.

```
# Print the results

cat("99% Confidence Interval (a):", ci_99, "\n")

99% Confidence Interval (a): 0.07763505 0.1649525
```

3. Scientists measured lizard tail lengths as

6.2, 6.6, 7.1, 7.4, 7.6, 7.9, 8, 8.3, 8.4, 8.5, 8.6, 8.8, 8.8, 9.1, 9.2, 9.4, 9.4, 9.7, 9.9, 10.2, 10.4, 10.8, 11.3, 11.9 It is known that these lengths have a normal distribution. But the population standard deviation is unknown.

```
# Step 1: Input the data

tail_lengths <- c(6.2, 6.6, 7.1, 7.4, 7.6, 7.9, 8, 8.3, 8.4, 8.5, 8.6, 8.8, 8.8, 9.1, 9.2, 9.4, 9.4, 9.7, 9.9, 10.2, 10.4, 10.8, 11.3, 11.9)


# Step 2: Calculate the sample mean and standard deviation

sample_mean <- mean(tail_lengths)

sample_sd <- sd(tail_lengths)

sample_size <- length(tail_lengths)


# Step 3: Calculate the confidence intervals and widths for various levels

levels <- c(0.5, 0.6, 0.7, 0.8, 0.9, 0.95)
```

```
error_margins <- qt(1 - (1 - levels) / 2, df = sample_size - 1) *
sample_sd / sqrt(sample_size)

ci_lower <- sample_mean - error_margins

ci_upper <- sample_mean + error_margins

ci_widths <- ci_upper - ci_lower


# Print the results
```

a) Find a 95% confidence interval for the population mean length of lizard tail $\boldsymbol{\mu}$.

```
cat("95% Confidence Interval (a):", c(ci_lower[6], ci_upper[6]), "\n")

95% Confidence Interval (a): 8.292017 9.499649
```

b) Find the width of the interval and the margin of error of the interval.

```
cat("Width of the interval (b):", ci_widths[6], "\n")

cat("Margin of error (b):", error_margins[6], "\n")

Width of the interval (b): 1.207632

Margin of error (b): 0.603816
```

c) Make a table with columns of the C. Is 50%, 60%, 70%, 80%, and 90%, their width and margin of errors.

```
# Create and print the table (c)

table <- data.frame(Level = levels, CI_Lower = ci_lower, CI_Upper =
ci_upper, Width = ci_widths, Margin_of_Error = error_margins)

print(table)

  Level CI_Lower CI_Upper     Width Margin_of_Error

1   0.50 8.695801 9.095866 0.4000652       0.2000326

2   0.60 8.645531 9.146136 0.5006049       0.2503025

3   0.70 8.586334 9.205333 0.6189987       0.3094994

4   0.80 8.510699 9.280968 0.7702688       0.3851344

5   0.90 8.395575 9.396092 1.0005166       0.5002583

6   0.95 8.292017 9.499649 1.2076321       0.6038160
```

d) How does the width change as the level increases?

```
cat("d) As the level increases, the width of the confidence interval increases.\n")
```

```
d) As the level increases, the width of the confidence interval increases.
```

e) How does the sample mean change as the level increases?

```
cat("e) The sample mean does not change as the level increases; only the width of the confidence interval changes.\n")
```

```
e) The sample mean does not change as the level increases; only the width of the confidence interval changes.
```