1A.

Gonna use the one sample proportion test
Null hypothesis p = 0.4
Alternative hypothesis p > 0.4

Test statistic We will use the z-test statistic

Critical region at a 0.05 significance level: Since the alternative hypothesis is (p > 0.4), we will reject the null hypothesis if test statistic is greater than the critical value for a level of 0.05.

```
> prop.test(approvedCount, sampleSize, p = 0.4, alternative = "greater")

      1-sample proportions test with continuity correction

data:  approvedCount out of sampleSize, null probability 0.4
X-squared = 4.7825, df = 1, p-value = 0.01438
alternative hypothesis: true p is greater than 0.4
95 percent confidence interval:
 0.4073615 1.0000000
sample estimates:
        p
0.4303599
```

1B.

pValue = 0.43

1C.

Since the p-value is less than 0.05, we reject the null hypothesis. There is good evidence to suggest that more than 40% of fans approve the new policy.

1D.

Since the p-value is greater than 0.01, we fail to reject the null hypothesis. There is not enough evidence to suggest that more than 40% of fans approve the new policy.

2A.

Let's use a chi squared test

Null hypothesis (p0 = p1 = p2 = ... = p9 = 1/10 (equal probabilities for each digit)

Alternative hypothesis At least one of the probabilities is different from 1/10

We will use the chi-square test statistic, which follows the chi-square distribution with degrees of freedom equal to the number of categories minus 1

We will reject the null hypothesis if the chi-square test statistic is greater than the critical value for a significance level of 0.05 with 9 degrees of freedom.

2B.

```
>
> observedNumbers = c(1, 6, 9, 9, 3, 8, 5, 0, 6, 7,
+                     4, 7, 5, 9, 4, 6, 5, 6, 4, 4,
+                     4, 8, 0, 9, 3, 2, 1, 5, 4, 5,
+                     7, 3, 2, 1, 4, 6, 7, 1, 3, 4,
+                     4, 8, 8, 6, 1, 6, 1, 2, 8, 8)
>
> expectedFreq = rep(50/10, 10)
>
> chisq.test(table(observedNumbers), p = rep(1/10, 10))

      Chi-squared test for given probabilities

data:  table(observedNumbers)
X-squared = 7.6, df = 9, p-value = 0.5749
```

Test stat: X-squared = 7.6

Degrees of freedom: 9

p-value: 0.5749

2C.

Since the p-value is greater than 0.05, we fail to reject the null hypothesis. There is not enough evidence to suggest that the probabilities of generating each digit are different from 1/10.

2D.

Since the p-value is greater than 0.01, we once again fail to reject the null hypothesis. There is not enough evidence to suggest that the probabilities of generating each digit are different from 1/10 at a significance level of 0.01.

A company that manufactures brackets for an automaker randomly selects brackets from the production line and performs a torque test. The goal is for the mean torque to be equal to 125. Suppose the torque is normally distributed. We shall use a sample size of N = 15 to test the Null hypothesis that u(mu) = 125 against a two-sided alternative hypothesis.

A. Which test will you run on this data? State the test statistic and its associated distribution. Define the critical region at a 0.05 significance level.

B. Use the following observations to calculate the value of the test statistic, the p-value, and your conclusion.

128, 149, 136, 114, 126, 142, 124, 136, 122, 118, 122, 129, 118, 122, 129.

3A.

We will run a two-sided t-test on this data. The test statistic is calculated as:

t = (x - u) / (s / sqrt(N))

where xx is the sample mean, u is the hypothesized population mean (125), s is the sample standard deviation, and N is the sample size.

Under the null hypothesis, the test statistic follows a t-distribution with N-1 degrees of freedom.

The critical region for a two-sided test at a 0.05 significance level is given by rejecting the null hypothesis. I can do this if the absolute value of the test statistic is greater than or equal to the critical value t(0.025, 14), where t(0.025, 14) is the 2.5th percentile of the t-distribution with 1.4 degrees of freedom.

3B.

```
> torque <- c(128, 149, 136, 114, 126, 142, 124, 136, 122, 118, 122, 129, 118,
122, 129)
> n <- length(torque)
> xbar <- mean(torque)
> s <- sd(torque)
>
> tStat <- (xbar - 125) / (s / sqrt(n))
> pValue <- 2 * pt(-abs(tStat), df = n - 1)
>
> cat("T Statistic:", tStat, "\n")
T Statistic: 1.076207
> cat("PValue:", pValue, "\n")
PValue: 0.3000317
>
> alpha <- 0.05
> tcrit <- qt(1 - alpha/2, df = n - 1)
>
> if (abs(tStat) >= tcrit)
+ {
+    cat("Reject Null Hypothesis")
+ }else
+ {
+    cat("Fail to Reject Null Hypothesis")
+ }
Fail to Reject Null Hypothesis>
```

test statistic : 1.07,

p-value: 0.3.

critical value : 2.1

value of the test statistic is less than the critical value, we fail to reject the null hypothesis. Therefore, we do not have sufficient evidence to suggest that the mean torque is significantly different from 125.

4A.

```
> T1 <- c(79, 82, 83, 84, 85, 86, 86, 87)

> T2 <- c(74, 75, 76, 77, 78, 82)

> T3 <- c(77, 78, 79, 79, 79, 82)
```

```
>
> n1 <- length(T1)
> n2 <- length(T2)
> n3 <- length(T3)
>
> xbar1 <- mean(T1)
> xbar2 <- mean(T2)
> xbar3 <- mean(T3)
>
> xbar <- mean(c(T1, T2, T3))
>
> SSB <- n1 * (xbar1 - xbar)^2 + n2 * (xbar2 - xbar)^2 + n3 * (xbar3 - xbar)^2
>
> SSW <- sum((T1 - xbar1)^2) + sum((T2 - xbar2)^2) + sum((T3 - xbar3)^2)
>
> dfBetween <- 2
> dfWithin <- n1 + n2 + n3 - 3
>
> MSBetween <- SSB / dfBetween
> MSWithin <- SSW / dfWithin
>
> Fstat <- MSBetween / MSWithin
>
> pvalue <- 1 - pf(Fstat, dfBetween, dfWithin)
>
> atable <- data.frame(Source = c("Between", "Within", "Total"),
```

```
+                           SS = c(SSB, SSW, SSB + SSW),

+                           df = c(dfBetween, dfWithin, n1 + n2 + n3 - 1),

+                           MS = c(MSBetween, MSWithin, NA),

+                           F = c(Fstat, NA, NA),

+                           pvalue = c(pvalue, NA, NA))

>

> print(atable)

   Source    SS df   MS    F       pvalue

1 Between 184.8  2 92.4 15.4 0.0001526436

2  Within 102.0 17  6.0   NA           NA

3   Total 286.8 19   NA   NA           NA

>
```

we can conclude that there is a significant difference between the means of the three types of beams at a 0.05. The p-value (0.0001) is way less than the significance level, indicating that we an reject the null hypothesis and conclude that there is a significant difference in strength among the three types of beams.

<u>5A.</u>

```
> n1 <- 9

> n2 <- 11

> xbar1 <- mean(c(0.9, 1.1, 0.7, 0.4, 0.9, 0.8, 1.0, 0.4))

> xbar2 <- mean(c(1.5, 0.9, 1.6, 0.5, 1.4, 1.9, 1.0, 1.2, 1.3, 1.6, 2.1))

>

> s1 <- sd(c(0.9, 1.1, 0.7, 0.4, 0.9, 0.8, 1.0, 0.4))

> s2 <- sd(c(1.5, 0.9, 1.6, 0.5, 1.4, 1.9, 1.0, 1.2, 1.3, 1.6, 2.1))
```

```
>
> df <- n1 + n2 - 2
>
> tstat <- (xbar1 - xbar2) / sqrt((s1^2 / n1) + (s2^2 / n2))
>
> tcritical <- qt(0.01, df)
>
> cat("Test statistic:", tstat, "\n")
Test statistic: -3.616076
> cat("Critical region: t <", tcritical, "\n")
Critical region: t < -2.55238
>
> pvalue <- pt(tstat, df)
>
> cat("P-value:", pvalue, "\n")
P-value: 0.0009876365
> if (pvalue < 0.01) {
+    cat("Reject the null hypothesis. There is evidence to support the claim
that mux < muy.\n")
+ } else {
+    cat("Fail to reject the null hypothesis. There is not enough evidence to
support the claim that muX < muY.\n")
+ }
Reject the null hypothesis. There is evidence to support the claim that mux <
muy.
>
> tcriticalleft <- qt(0.005, df)
```

```
> tcriticalright <- qt(0.995, df)

>

> cat("Critical region: t <", tcriticalleft, "or t >", tcriticalright, "\n")

Critical region: t < -2.87844 or t > 2.87844

>

> if (tstat < tcriticalleft || tstat > tcriticalright) {

+    cat("Reject the null hypothesis. There is evidence to support the claim that muX is not equal to muY.\n")

+ } else {

+    cat("Fail to reject the null hypothesis. There is not enough evidence to support the claim that muX is not equal to muY.\n")

+ }

Reject the null hypothesis. There is evidence to support the claim that muX is not equal to muY.

>

>
```

Test statistic: -3.6

Critical region: t < -2.87 or t > 2.87

P-value: 0.0009

we reject the null hypothesis. There is evidence to support the claim that muX < muY.

For the two-sided alternative hypothesis, the critical region consists of both tails. Therefore, the critical region is t < -2.87 or t > 2.87 again

Since the t statistic falls into the critical region, we can reject the null hypothesis again. There is evidence to support the claim that muX is not equal to muY.