Multinomial Test

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# Abstract

Outcome variable: *CAT\_usage*  
Null probabilities: *0.3333333, 0.3333333, 0.3333333*

A Multinomial test is employed to check if the parameters equal *0.3333333, 0.3333333, 0.3333333*. According to the result, we can reject the null probabilities at the significance level of 0.05.

### Multinomial Test

Multinomial Test determines whether the parameters of a multinomial distribution equal specified values. It is used for categorical data.

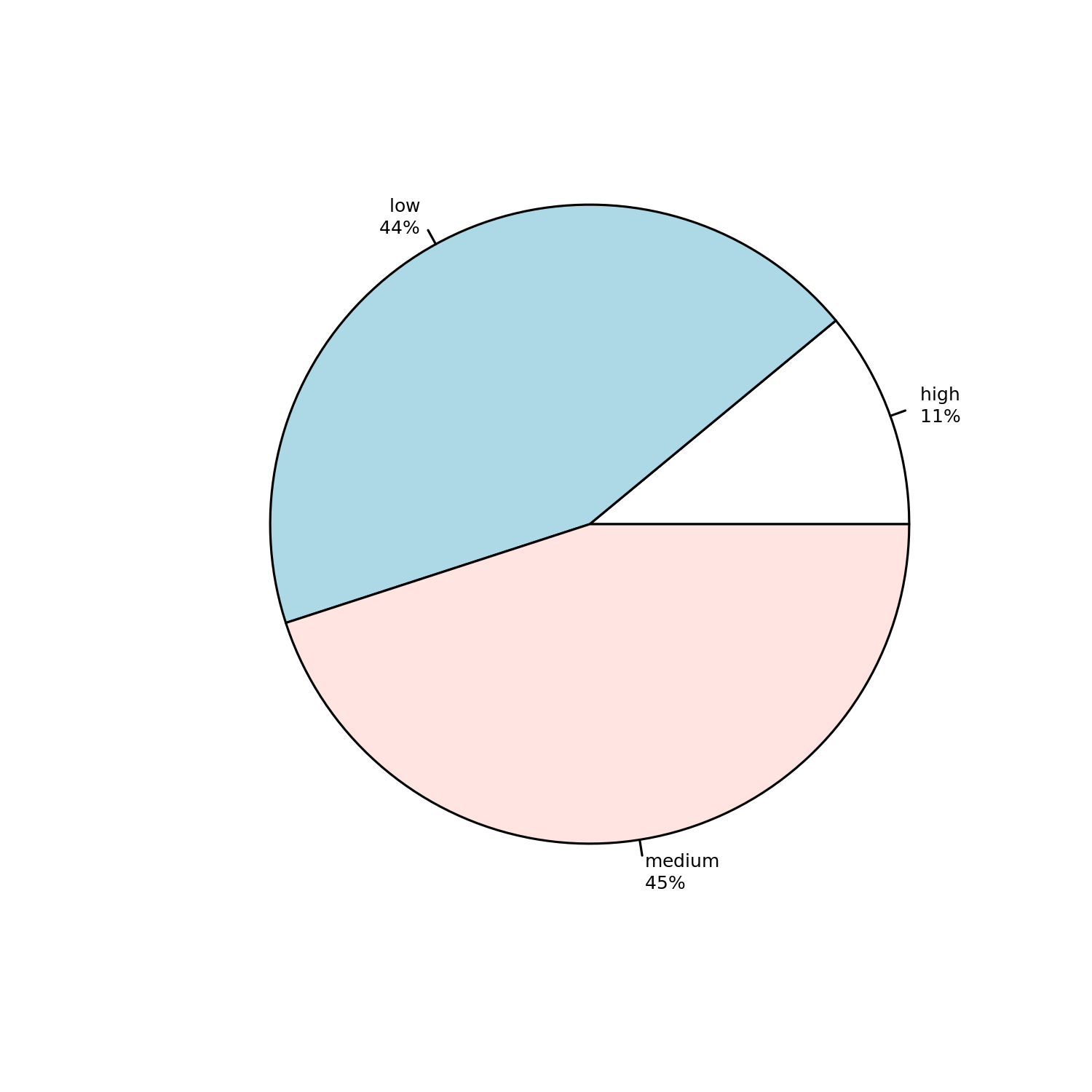
# Descriptive Statistics

Table 1 gives the basic information of the analyzing data set. Observations with missing values are removed when calculating. It shows that there is no missing value in the data.

Completeness of Data.

|  |  |  |
| --- | --- | --- |
|  | Observation | Incomplete Observation (not used) |
| Number | 100 | 0 |

The pie chart of *CAT\_usage* is given in Figure 1.



Pie chart for *CAT\_usage*.

The detailed frequencies of *CAT\_usage* is given in Table 2.

Frequencies of CAT\_usage.

|  |  |  |
| --- | --- | --- |
| CAT\_usage=high | CAT\_usage=low | CAT\_usage=medium |
| 11 | 44 | 45 |

# Results

A multinomial test is performed (Read and Cressie 2012). An exact test is performed. Table 3 shows the results

Result of Multinomial Test.

|  |  |
| --- | --- |
| Test Method | p-value |
| Exact multinomial test | 1.7e-06 |

Here, the p-value is 1.72^{-6}, which means there is a significant difference between the distribution parameters and the null values at the level of 0.05.

Confidence intervals for multinomial proportions are calculated simultaneously and given in Table 4.

Estimated Probability and its 95% Confidence Interval.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Estimated Probability | Lower | Upper |
| CAT\_usage=high | 0.11 | 0.01 | 0.213 |
| CAT\_usage=low | 0.44 | 0.34 | 0.543 |
| CAT\_usage=medium | 0.45 | 0.35 | 0.553 |

After a global multinomial test for given probabilities, pairwise comparisons are performed using exact binomial tests. The *p*-value adjustment method is fdr.

Pairwise Comparisons.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Observed Proportion | Expected Proportion | p-value |  |
| CAT\_usage=high | 0.11 | 0.3333333 | 0.0000011 | \*\*\* |
| CAT\_usage=low | 0.44 | 0.3333333 | 0.0259732 | \* |
| CAT\_usage=medium | 0.45 | 0.3333333 | 0.0221545 | \* |

It shows the comparison results together with the observed and expected proportions using exact binomial tests. A small p-value (less than 0.05) means there is a significant difference between the population proportion and the expected proportion.

# Conclusions

Based on the above results, we can get the following conclusion:

* There is a significant difference between parameters of the multinomial distribution and 0.333, 0.333, 0.333 at the level of 0.05.

# Terminologies

***Null hypothesis***: In inferential statistics, the null hypothesis is a general statement or default position that there is no relationship between two measured phenomena or no association among groups.

***p-value***: In statistical hypothesis testing, the *p*-value is, for a given statistical model, the probability that, when the null hypothesis is true, the statistical summary would be greater than or equal to the actual observed results.

# References

Read, Timothy RC, and Noel AC Cressie. 2012. *Goodness-of-Fit Statistics for Discrete Multivariate Data*. Springer Science & Business Media.