

Student's Name

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Course Name and Number

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Due Date

## **Hypothesis Testing in R: Investigating Respiratory Status in a Clinical Trial**

### **1.0 Introduction**

This report explores the relationship between treatment and respiratory status in a clinical trial using hypothesis testing. The study utilizes the respiratory dataset from the `geepack` library in R, focusing on treatments for respiratory illness. The objective is to examine the relationship between treatment and respiratory status through hypothesis testing and visualization.

### **2.0 Research Question**

Do respiratory treatments significantly impact the respiratory status of patients?

### **3.0 Methodology**

The respiratory dataset includes variables like treatment, age, baseline respiratory status, and outcome. A mosaic plot was generated to visualize the relationships between treatment types, sexes, and outcomes. Additionally, a chi-square test of independence was applied to assess the association between treatment and respiratory status.

#### **3.1 Respiratory Cross-Table**

```
#Load the required libraries and dataset  
library(geepack)  
library(tidyverse)  
data(respiratory)#create a cross table for visualization
```

```
respiratory_data <- xtabs(~treat + outcome + sex,respiratory)
fTable(respiratory_data)
##           sex  F  M
## treat outcome
## A      0      4 65
##      1     20 127
## P      0     42 85
##      1     26 75
```

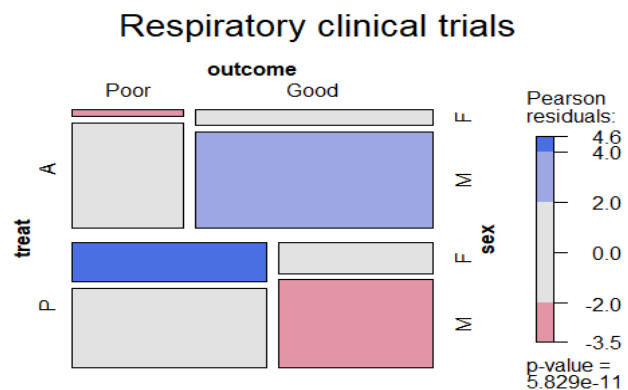
The cross table summarizes the treatment outcomes and sex distribution. In the active treatment group, there were 147 cases of good respiratory status and 69 cases of poor respiratory status. The placebo treatment group had 101 cases of good respiratory status and 129 cases of poor respiratory status. The distribution of sexes varied within each treatment-outcome combination.

### 3.2 Mosaic Plot of Respiratory Data

The mosaic plot below, generated using the “vcd” package, reveals differences in the effect of treatment in different groups, providing insights into the relationships among treatment types, sexes, and outcomes.

```
library(vcd)#for Mosaic plot display
#visualize respiratory data using a mosaic
plot
```

```
mosaic(respiratory_data,shade=TRUE,legend=TRUE,labeling_args=list(set_varnames=c(sex="sex",outcome="outcome"),Treatment = "treat"),set_labels=list(outcome=c("Poor", "Good"),Class=c("A", "P"),sex=c("F", "M")),main="Respiratory clinical trials")
```



#### 4.0 Independence Chi-Square Test

```
#perform chi-square test of independence  
chisq_result <- chisq.test(respiratory$treat, respiratory$outcome)  
chisq_result  
## Pearson's Chi-squared test with Yates' continuity correction  
## data: respiratory$treat and respiratory$outcome  
## X-squared = 24.435, df = 1, p-value = 7.684e-07
```

Hypothesis testing involves comparing two competing hypotheses: the null hypothesis (H0) and the alternative hypothesis (H1). In this study, the null hypothesis states that there is no association between the treatment received and respiratory status, while the alternative hypothesis asserts that there is an association. The Chi-Square test is a non-parametric statistical test, which means that it can be applied independently to any statistical distribution (Ismay & Kim 2019). This test was employed to assess the relationship between treatment and respiratory status. By comparing the calculated Chi-Square test statistic to the critical value and evaluating the associated p-value, we can make informed decisions about the null and alternative hypotheses (McHugh, 2013).

#### 5.0 Results

The Pearson's chi-square test indicates a significant association between the treatment received and respiratory status in the clinical trial dataset ( $\chi^2 = 24.435$ ,  $df = 1$ ,  $p < 0.001$ ). This suggests that the choice of treatment impacts respiratory outcomes. The extremely low p-value (7.684e-07) provides strong evidence against the null hypothesis, supporting the conclusion that there is a significant relationship between treatment and respiratory status.

## 6.0 Conclusion

The analysis of the respiratory dataset demonstrates a significant association between treatment and respiratory status in the clinical trial ( $p < 0.001$ ). These findings reject the null hypothesis and highlight the impact of treatment on respiratory outcomes. The study underscores the importance of tailored interventions for enhancing patient care in respiratory healthcare settings.

## References

Ismay, C., & Kim, A. Y. (2019). *Statistical inference via data science: A ModernDive into R and the tidyverse*. CRC Press.

McHugh, M. L. (2013). The chi-square test of independence. *Biochemia medica*, 23(2), 143-149.

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