Medical Grade Masks In CPP Library

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Executive Summary

Our team performed a three day study to report if the California Polytechnic State University's library was meeting the required minimum of 65% of its students and staff wearing appropriate medical grade masks. In order to minimize bias in our data, we constructed our study by randomly choosing the days, times, and library floors at which we collected our data.

We collected a total sample of 308 throughout the three days Tuesday, Wednesday, and Thursday in which we found that the proportion of students and staff who were wearing medical grade masks was 77.88%, 73.23% and 61.76% respectively. The overall result for the three days was 72.4% of students and staff wearing medical grade masks in the library. Therefore, our findings show that based on our sample there was insufficient evidence that less than 65% of students and staff in the library wear the appropriate medical grade masks.

Background

Cal Poly Pomona received a new mandate that at least 65% of the people in the library need to be wearing medical grade masks. If they do not meet this mandate, then they will have to organize a campaign to get people in the library to wear the medical grade masks. A concern regarding this situation is if less than 65% of the people in the library are wearing medical grade masks, then the school would have to use a portion of their funds towards a campaign instead of other projects that could benefit the learning and overall college experience of students. Another concern is the health safety of students and staff members. If Cal Poly Pomona reports that they are following the mandate when in reality they are not, then they would be putting the well being of students, staff members, and other visitors in higher risk of getting COVID-19.

Our goal is to provide as precise of an answer as we can to the question being asked to make our client happy. We also want to assist Cal Poly Pomona in creating a safe environment for their students and staff members. First, we want to pick a sample size that matches how accurate we want our sample proportion to be to the population. Since, this question is regarding the health of people we will choose a high confidence level. Also, we want to design a way of collecting our sample that would produce a precise result.

Analysis

We began by using an effect size calculator to determine the sample size needed to assure our client that we are being as accurate as possible. We decided to choose an effect size of 0.15 and minimize our chances of a type 1 error by picking our $\alpha = .01$. This resulted in us needing a minimum sample size of 127 observations, given that we construct a simple random sample.

Next, we needed to decide how we will be collecting our sample. A simple random sample was not probable given that we would need to know our population and randomly pick from there. We decided to choose a cluster because we can then randomize when and where to collect the sample instead of the people. So, we randomly chose 3 days to sample and of those 3 days we randomly chose times and floors of the library to collect our data.

We needed to test whether we believe 65% of students were wearing medical grade masks at the library. Therefore we set up a hypothesis test to test our data.
$H_0 : p \geq 0.65$ This means that at least 65% of students are wearing a medical grade mask in the library.
$H_A : p < 0.65$ This means that less than 65% of students are wearing a medical grade mask in the library.

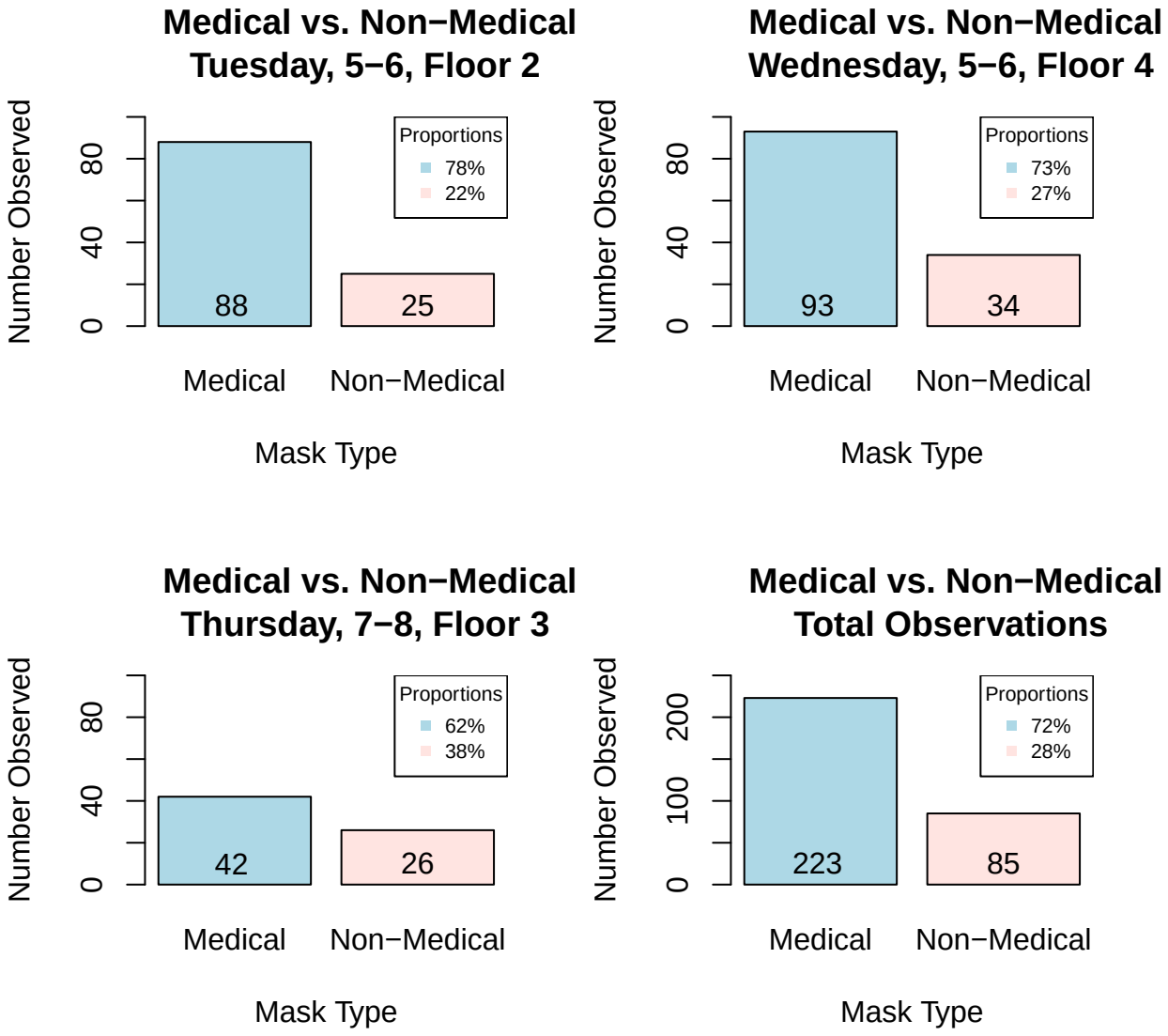
Results

The following table shows the days we observed , the floors observed on the specific day, and the total observation on each day.

Table 1: Frequency Distribution Table of People in The Library

Days	Floor	Medical	Non-Medical
Tuesday	2	88	25
Wednesday	4	93	34
Thursday	3	42	26

From the table you can see that each day and floor more people wore medical grade masks then did not which is partially what we are looking for.
Below represents the frequency of those who wore medical grade masks versus did not based on the day the data was collected.



Looking at our bar graph for the total number of observations we can see that 72% of our sample were wearing medical grade masks. In order to reject our null hypothesis of at least 65% Of people in the library are wearing medical grade masks we would need to observe that less than 58.67% of our sample wore medical grade masks.

Conclusion

We can see from the graph above that 72% of students were wearing a medical grade mask. Since this gives us test statistic of 2.72, we can see that the p-value is 0.9967 which is greater than our significance level of 0.01. This means there is insufficient evidence. In other words, we fail to reject $H_0 : p = 0.65$ which states that 65% of students are wearing masks.
Thus, we are confident that at least 65% of students are wearing medical grade masks in the Cal Poly Pomona Library.

Appendix A (Equations)

$$p = \frac{223}{308} = 0.7240$$

$$\sigma = \sqrt{\frac{p(1-p)}{n}} = \sqrt{\frac{.65(.35)}{308}} = 0.0272$$

$$z = \frac{p-\hat{p}}{\sigma} = \frac{.7240-.65}{0.0272}$$

$$p \rightarrow \text{Sample proportion}$$

$$\hat{p} \rightarrow \text{Expected proportion}$$

$$\sigma \rightarrow \text{Standard deviation}$$

$$P(z \leq -2.33) = 0.01 = \alpha$$

$$P(z \leq 2.72) = 0.9967$$

Appendix B (Codes)

Table:

```
tab <- matrix(c("Tuesday", "Wednesday","Thursday", 2,4,3,88,93,42,25,34,26),ncol=4)
colnames(tab) <- c("Days", "Floor", "Medical", "Non-Medical")
kbl(tab, format = "latex", align = 'lccc', caption = "Frequency Distribution Table of People in The Libi
  kable_styling(latex_options = c("striped", "hold_position"))
```

Bar Graph Tuesday:

```
table_tu <- c(88,25)
barplot(table_tu,main="         Medical vs. Non-Medical
        Tuesday, 5-6, Floor 2",xlab="Mask Type",ylab="Number Observed",ylim=c(0,100),
        names.arg=c("Medical","Non-Medical"),col=c("lightblue","mistyrose"))
legend('topright', title="Proportions",legend=c("78%","22%"),
       col=c("lightblue","mistyrose"),pch=c(15,15))
text(0.68,10,"88")
text(1.9,10,"25")
```

Bar Graph Wednesday:

```
table_wed <- c(93,34)
barplot(table_wed,main="         Medical vs. Non-Medical
        Wednesday, 5-6, Floor 4",xlab="Mask Type",
        ylab="Number Observed",ylim=c(0,100),names.arg=c("Medical","Non-Medical"),
        col=c("lightblue","mistyrose"))
legend('topright', title="Proportions",legend=c("73%","27%"),
       col=c("lightblue","mistyrose"),pch=c(15,15))
text(0.68,10,"93")
text(1.9,10,"34")
```

Bar Graph Thursday:

```
table_th <- c(42,26)
barplot(table_th,main="         Medical vs. Non-Medical
        Thursday, 7-8, Floor 3",xlab="Mask Type",
        ylab="Number Observed",ylim=c(0,100),names.arg=c("Medical","Non-Medical"),
        col=c("lightblue","mistyrose"))
legend('topright', title="Proportions",legend=c("62%","38%"),
       col=c("lightblue","mistyrose"),pch=c(15,15))
```

```
text(0.68,10,"42")
text(1.9,10,"26")
```

Bar Graph Total:

```
table_tot <- c(223,85)
barplot(table_tot,main="         Medical vs. Non-Medical
        Total Observations",xlab="Mask Type",
        ylab="Number Observed",ylim=c(0,250),names.arg=c("Medical","Non-Medical"),
        col=c("lightblue","mistyrose"))
legend('topright', title="Proportions",legend=c("72%","28%"),
       col=c("lightblue","mistyrose"),pch=c(15,15))
text(0.68,25,"223")
text(1.9,25,"85")
```

Table:

```
tab <- matrix(c("Tuesday", "Wednesday","Thursday", 2,4,3,88,93,42,25,34,26),ncol=4)
colnames(tab) <- c("Days", "Floor", "Medical", "Non-Medical")
cap = "Frequency Distribution Table of People in The Library"
kbl(tab, format = "latex", align = 'lccc', caption = cap) %>%
  kable_styling(latex_options = c("striped", "hold_position"))
```

Random Generator:

```
% Randomized schedule maker

clear
clc

    % This is our availabilty for each day.
M = [2:6];
T = [12,1,5:9];
W = M;
Th = T;
F = [5:8];
    % Comment out friday because we want our results by friday, but we
        % can include it if we want.
% F = [5:7];

    % Randomly picks 3 days.

% number of days we are picking.
n = 3;
% number of days we are picking from.
m = 4;
days = randperm(m,n);

for i = 1:length(days)
    if days(i) == 1
            % randomly picks start time.
        T_Begin = randsample(M,1);
        T_End = mod(T_Begin+1,12);
        floor = randi([2,6]);
            % Prints schedule in command window.
        fprintf("Monday: %d - %d\nFloor: %d\n",[T_Begin,T_End,floor])
```

```
    elseif days(i) == 2
        T_Begin = randsample(T,1);
        T_End = mod(T_Begin+1,12);
        floor = randi([2,6]);
            % Prints schedule in command window.
        fprintf("Tuesday: %d - %d\nFloor: %d\n",[T_Begin,T_End,floor])

    elseif days(i) == 3
        T_Begin = randsample(W,1);
        T_End = mod(T_Begin+1,12);
        floor = randi([2,6]);
            % Prints schedule in command window.
        fprintf("Wednesday: %d - %d\nFloor: %d\n",[T_Begin,T_End,floor])

    elseif days(i) == 4
        T_Begin = randsample(Th,1);
        T_End = mod(T_Begin+1,12);
        floor = randi([2,6]);
            % Prints schedule in command window.
        fprintf("Thursday: %d - %d\nFloor: %d\n",[T_Begin,T_End,floor])

    else
        T_Begin = randsample(F,1);
        T_End = mod(T_Begin+1,12);
        floor = randi([2,6]);
            % Prints schedule in command window.
        fprintf("Friday: %d - %d\nFloor: %d\n",[T_Begin,T_End,floor])

    end
end
```