iOS FACE RECOGNITION FINAL REPORT

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Introduction

Face recognition is a technology capable of verifying one's face through facial features of an image. Gradually, it has become an essential verification method for electronic devices. In fact, passwords and fingerprints are gradually being replaced by face recognition technology.

In order to test the success rate of the face recognition function of existing products in the market, an experiment was designed to test the success rate of iOS face recognition if different covers are applied. Our objective is to see if there are any differences between using different covers and which ones had the highest success rate and which ones had the lowest.

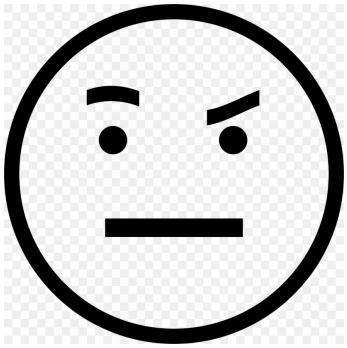
Review of Methodology

In the experiment, different covers were used to cover the face and then the success rate of face recognition was recorded for each cover. Light intensity was a nuisance variable so it was blocked.

The treatment was the different covers used (sunglasses, mask, no cover), the block was light intensity (low, medium, high), and the response variable was the success rate of face recognition (each out of 10 observations). Therefore, we used RCBD design.

Data Collection

For each of the 3 levels of the treatment and for each of the 3 blocks, 4 observations were collected. Each observation was collected as follows: 10 trials were conducted and the number of successes ('x') recorded: then, the observation (success rate) would be 'x'/10. For example, if there were 5 successes out of 10, then 0.5 was recorded as the observation.



No Cover

Mask

sunglasses

Data

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	ROUND1						ROUND2							
2		Treament	block	succesful_rate				Treament	block	succesful_rate				
3		glass	s_l	0.9				glass	s_l	1			s_l =strong light	
4		glass	n_l	0.8				glass	n_l	0.9			n_l=normal light	
5		glass	d_l	1				glass	d_l	0.9			d_l=dim light	
6		mask	s_l	0.4				mask	s_l	0				
7		mask	n_l	0.3				mask	n_l	0.3				
8		mask	d_l	0.4				mask	d_l	0.1				
9		nothing	s_l	1				nothing	s_l	0.8				
10		nothing	n_l	1				nothing	n_l	0.9				
11		nothing	d_l	0.9				nothing	d_l	0.9				
12														
13														
14														
15	ROUND3						ROUND4							
16		Treament	block	succesful_rate				Treament	block	succesful_rate				
17		glass	s_l	0.8				glass	s_l	0.9				
18		glass	n_l	1				glass	n_l	1				
19		glass	d_l	0.9				glass	d_l	1				
20		mask	s_l	0.1				mask	s_l	0.2				
21		mask	n_l	0.4				mask	n_l	0.3				
22		mask	d_l	0.3				mask	d_l	0.2				
23		nothing	s_l	1				nothing	s_l	0.9				
24		nothing	n_l	0.8				nothing	n_l	1				
25		nothing	d_l	0.9				nothing	d_l	0.9				
26														
27														
28														

Analysis

H_0: μ(sunglasses) = μ(mask) = μ(no_cover)
H_A: not all means are equal

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Analysis of Variance Table

Response: y
           Df Sum Sq Mean Sq  F value Pr(>F)
treatment   2 3.6006 1.80028 193.3696 <2e-16 ***
blocks      2 0.0206 0.01028   1.1039 0.3442
Residuals  31 0.2886 0.00931
---
Signif. codes:
0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

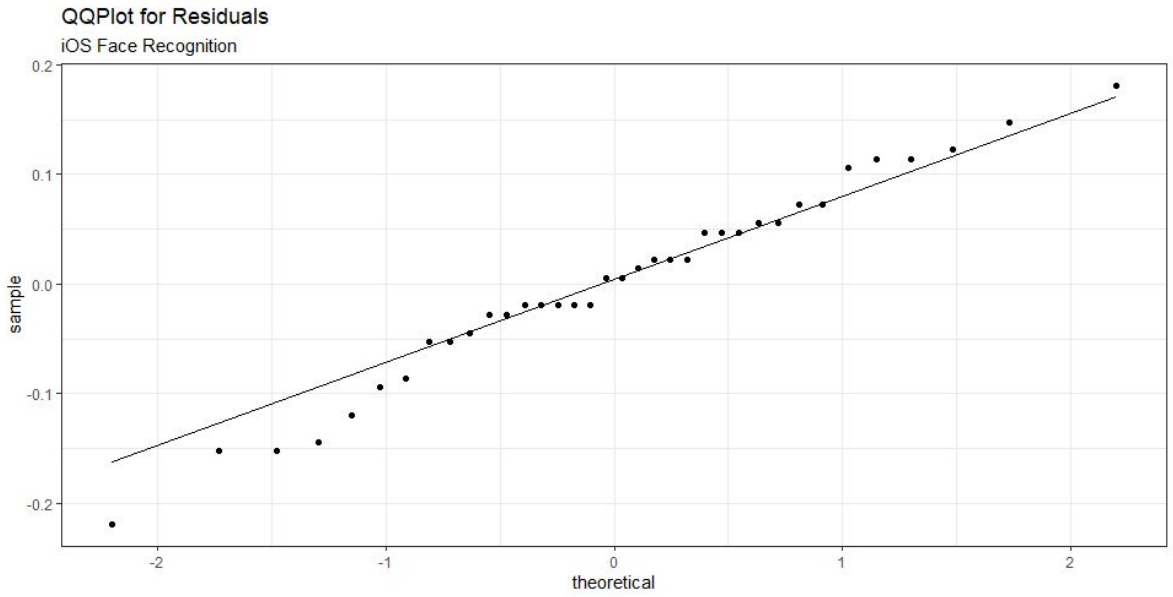
p-value (treatment) < 2e-16 < alpha = 0.05, reject H_0.
p-value (blocks) = 0.3442 > alpha = 0.05, do not reject H_0.

At the 5% significance level, there is sufficient evidence to conclude that there not all treatment means are different; in other words, there are differences between the success rate of face recognition when a sunglasses cover, mask cover, and no cover

are used. Also, at the 5% significance level, there is insufficient evidence to conclude that there are any block effects.

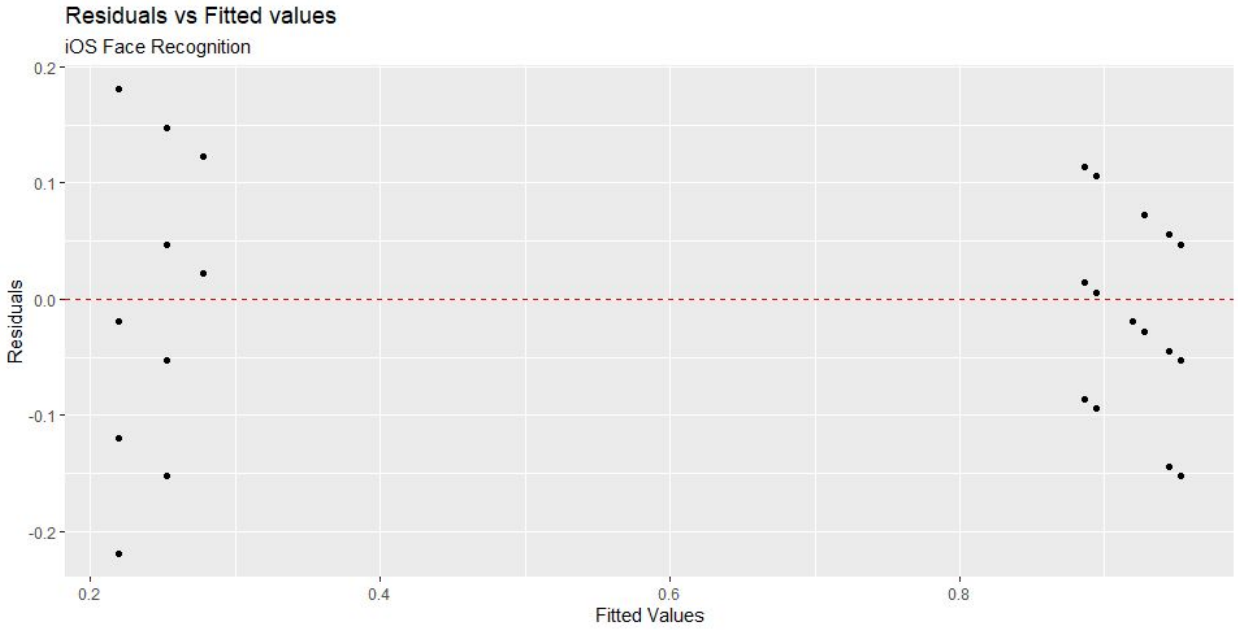
Model Checking

QQPlot

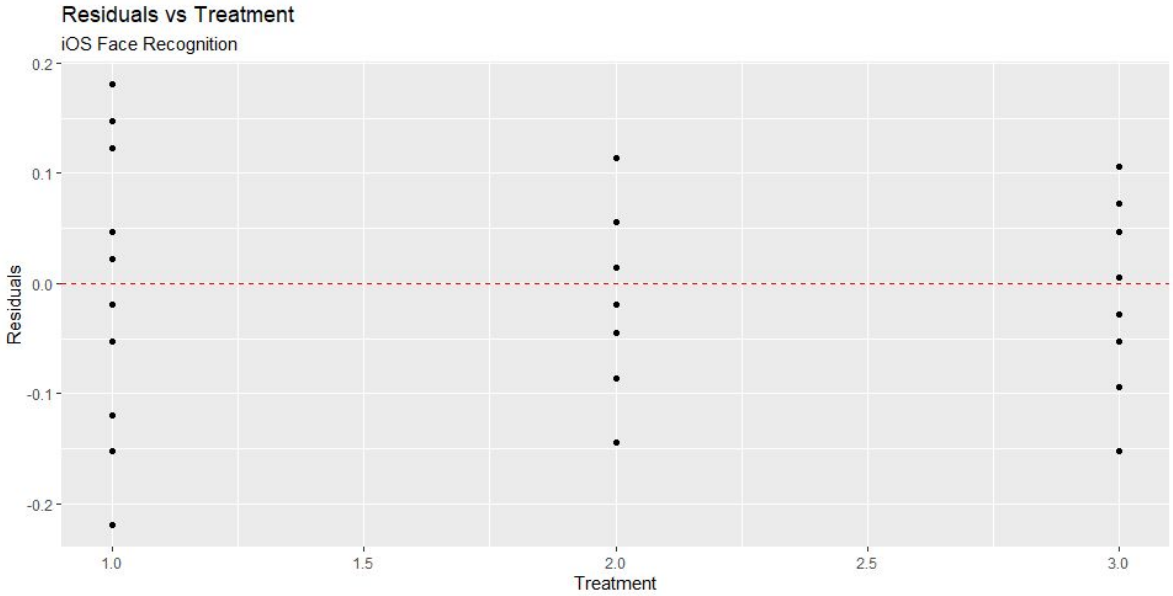


The residuals are randomly scattered across the normality line - therefore, the assumption of normality of the residuals is satisfied.

Residuals vs Fitted Values plot



Residuals vs Treatment plot

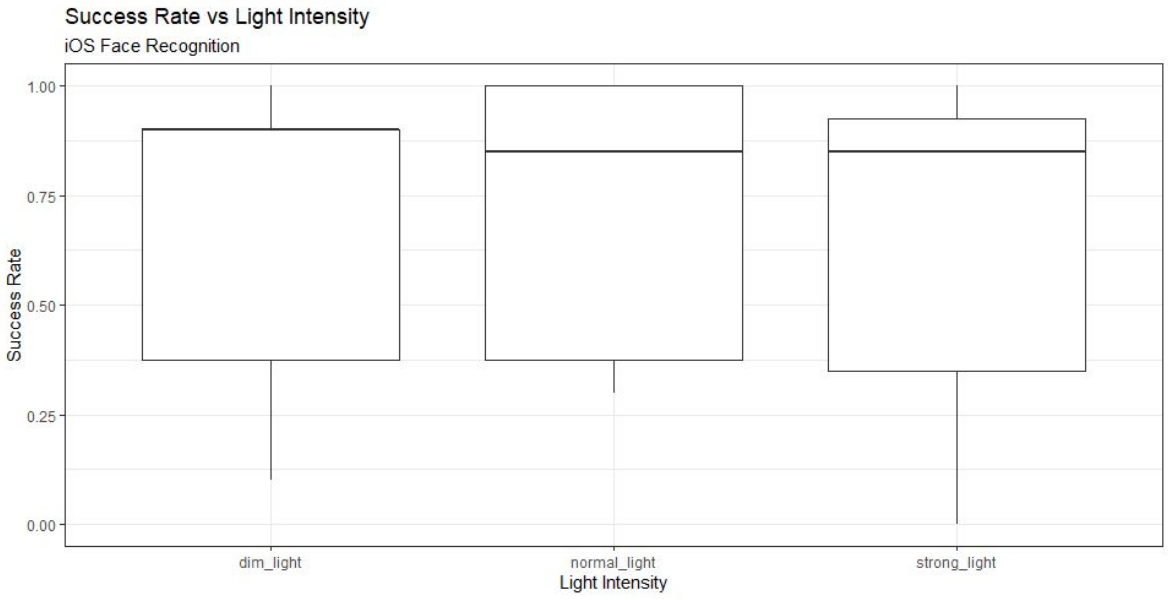


There are no patterns in the residual plots - all of the points appear to be randomly scattered along y=0. Therefore, the assumption of randomness of the residuals is satisfied.

Boxplots

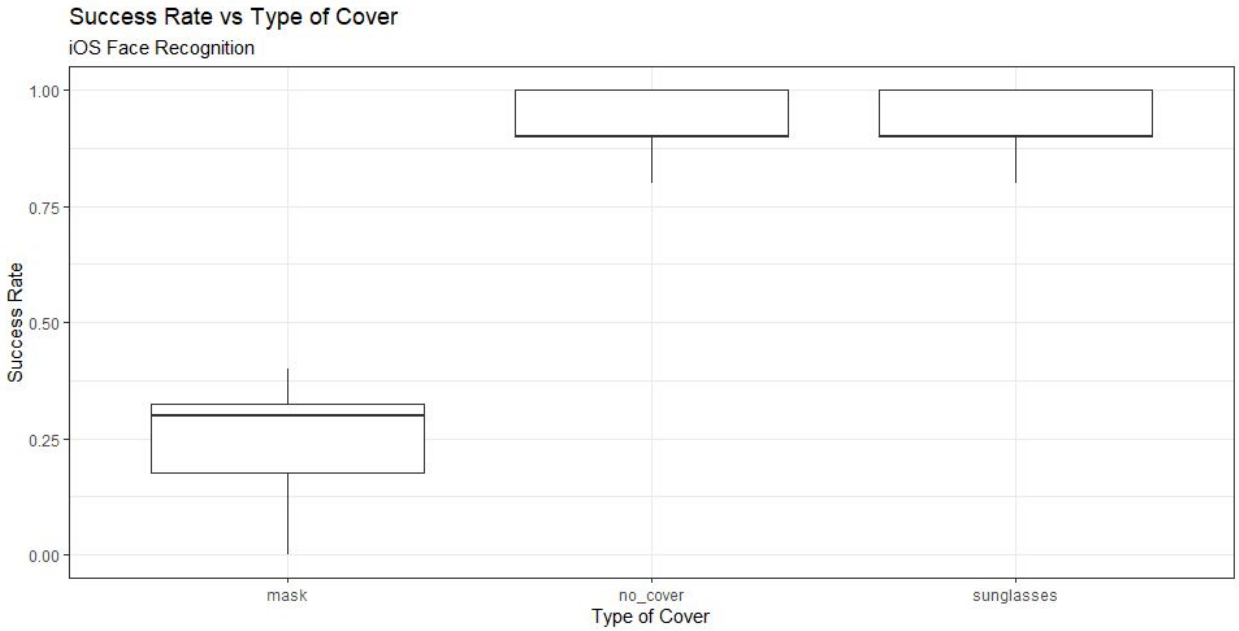
Create boxplots to give us an idea of the distributions between the different covers and between the different light intensities.

Boxplot 1: Success Rate vs Light Intensity



This reaffirms that there are no block effects at the 5% significance level.

Boxplot 2: Success Rate vs Type of Cover



Boxplot2 suggests that the success rate of both sunglasses and no_cover is far higher than the success rate with a mask. We are going to confirm this with a formal Tukey multiple comparisons test.

Tukey Multiple Comparisons

```
  Tukey multiple comparisons of means
    95% family-wise confidence level

Fit: aov(formula = y ~ treatment + blocks)

$treatment
                          diff         lwr       upr    p adj
no_cover-mask       0.666666667  0.56971730 0.7636160 0.000000
sunglasses-mask     0.675000000  0.57805063 0.7719494 0.000000
sunglasses-no_cover 0.008333333 -0.08861604 0.1052827 0.975649
```

p-value(mask-sunglasses) < alpha, reject H_0
p-value(no_cover-sunglasses) > alpha, do not reject H_0.
p-value(no_cover-mask) < alpha, reject H_0

Result: At the 5% significance level, there is sufficient evidence to conclude that there are differences between mask&sunglasses and no_cover&mask, while there is insufficient evidence to conclude that there are any differences between no_cover&sunglasses. In other words, at the 5% significance level, there can be assumed no differences between the success rate of the iOS face recognition for no_cover and sunglasses while the success rate for mask is different from both no_cover and sunglasses. Furthermore, the success rate of the iOS face recognition for both no_cover and sunglasses are very high, while the success rate for mask is far lower.

Conclusion

At the 5% significance level, there is sufficient evidence to suggest that the success rates of face recognition with sunglasses, masks, and with no cover are not equal. In particular, through Tukey multiple comparisons, we found that the success rate of face recognition with sunglasses and no cover are similar, and both of them are very different from success rate with mask. In particular, both the success rate of face recognition with sunglasses and no cover are very high compared to the success rate of face recognition with mask which is very low.