How to Make a Free Throw Shooter Miss

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Research Question & Background

Questions

- What factors influence a player's free throw percentage for good or for bad?
- Does crowd noise make a difference?
- Do inflation levels make an impact?

Experimental Design

Experimental Design

- Response Variable: Free throw makes

- 2x2 Basic Factorial Design
- Factor 1: Crowd Noise
- Factor 2: An Inflated or Deflated Ball
- Control: Shooting free throws without noise and with an inflated ball

Statistical Model

- We used the following statistical model to design our experiment:
- $x_{ijk} = \mu + Noise_j + Inflation_j + Interaction_{jk} + \epsilon_{ijk}$
  - x_{ijk} = observed made shots for individual i
  - μ = the mean shots made for each student
  - $Silence_j$ = effect due to j th level of “Silence" factor
  - $Inflated_k$ = effect due to kth level of “Inflated" factor
  - $Interaction_{jk}$ = effect due to interaction between levels j and k
  - ϵ_{ijk} = random error associated with individual i

The Experiment

- We asked 20 people to shoot 20 free throws.
- Before they shot the free throws, we separated them, with the help of a random number generator, into four different groups. Each group represented a different situation. Each situation is shown in the table below.

Inflated/No Noise	Inflated/Noise	Deflated/No Noise	Deflated/Noise
Shooter	“	“	“
“	“	“	“
“	“	“	“
“	“	“	“
“	“	“	“

Precautions Against Confounding Variables

- The response variable (free throws made in 20 attempts) follows a poisson distribution to make each shooter independent of each other. Therefore, the confounding variables wouldn't significantly affect the analysis.

Results

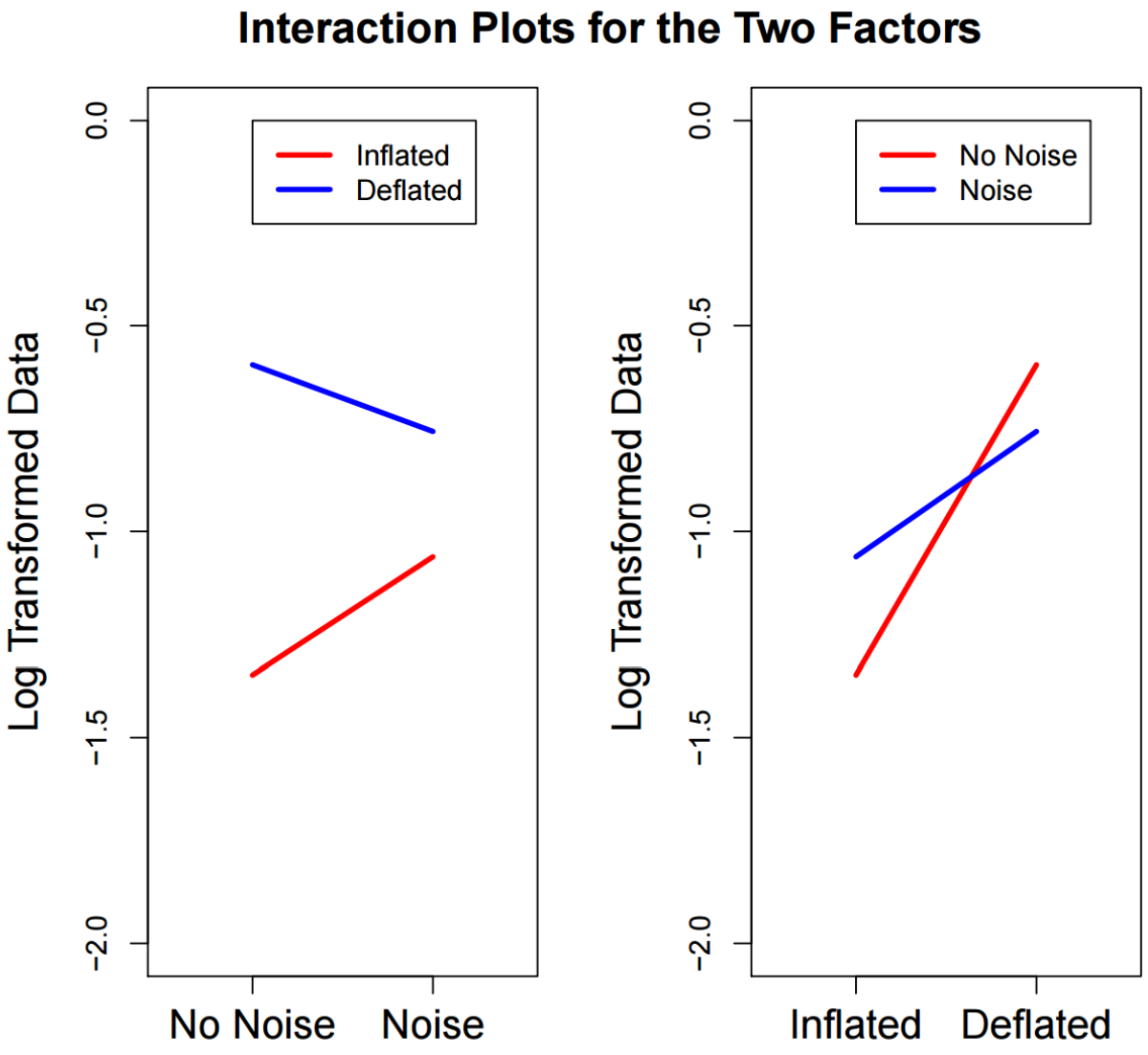
The Experiment's Results

Group	Response	Silence	Inflated
1	3.00	1	1
1	6.00	1	1
1	5.00	1	1
1	7.00	1	1
1	6.00	1	1
2	16.00	1	0
2	5.00	1	0
2	12.00	1	0
2	17.00	1	0
2	10.00	1	0
3	8.00	0	1
3	9.00	0	1
3	11.00	0	1
3	10.00	0	1
3	2.00	0	1
4	12.00	0	0
4	10.00	0	0
4	11.00	0	0
4	11.00	0	0
4	5.00	0	0

Table 1: The response variable is the amount of free throw makes in 20 attempts. In the 'Silence' and 'Inflated' columns, a one means 'Yes' and a zero means 'No'.

Analysis

The Interaction Plots



Method of Analysis

- We performed a poisson regression model to compare the average amount of shots made per player. If we do regression for all factors and the interaction, the degrees of freedom is 16.

Poisson Analysis Results

```
## Call:
## glm(formula = freethrows$Response * 20 ~ Silence, family = poisson,
##     data = freethrows)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.7979  -1.0687   0.1975   0.6786   2.4852
##
## Coefficients:
##             Estimate Std. Error z value Pr(>|z|)
## (Intercept)  2.18605    0.10600  20.623   <2e-16 ***
## Silence1    -0.02273    0.15076  -0.151     0.88
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for poisson family taken to be 1)
##
##     Null deviance: 35.945  on 19  degrees of freedom
## Residual deviance: 35.922  on 18  degrees of freedom
## AIC: 118.28
##
## Number of Fisher Scoring iterations: 4
```

Significant Findings

```
pois_diff <- 35.945 - 22.174
1 - pchisq(pois_diff, df = 3)
```

```
## [1] 0.003234027 = Impact of all the Factors
```

```
pois_diff_2 <- 25.802 - 22.174
1 - pchisq(pois_diff_2, df = 2)
```

```
## [1] 0.1630008 = Impact of the Interaction
```

```
pois_diff_3 <- 25.825 - 22.174
1 - pchisq(pois_diff_3, df = 1)
```

```
## [1] 0.5603556 = Impact of the Silence Factor
```

```
pois_diff_4 <- 35.922 - 22.174
1 - pchisq(pois_diff_4, df = 1)
```

```
## [1] 0.0002090433 = Impact of the Inflated Factor
```

- The inflation levels in the ball made a statistically significant difference on the amount of made free throws by a free throw shooter after 20 attempts.

Conclusions

Practical Significance

- The predict.glm function helped find practical significance.

```
##         1         2         3         4
          1.686399  1.686399 1.686399 1.686399
5         6         7         8
1.686399 2.484907 2.484907 2.484907
##         9         10         11         12
          2.484907 2.484907 2.079442 2.079442
## 13        14        15        16
  2.079442 2.079442 2.079442 2.282382
##        17         18         19         20
         2.282382   2.282382  2.282382  2.282382
```

- I believe the difference between the null model (1.6864) and the inflation factor (2.4849) is big enough (0.7985) to be practically significant. This is true because the difference would be four percent in a shooter's free throw percentage.

Conclusion

- Finally, my research concludes that basketball players will not be affected enough by crowd noise alone or by the interaction of noise and inflation.A basketball player, though would be significantly influenced by the inflation levels of the ball.

Questions?