Analysis of Teaching Methods and Reward Systems

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Objective

The objective of this study is to determine whether patient skill test scores differ based on:

1. The **Teaching Method** used (Methods A, B, and C),
2. The **Reward System** applied (None, Praise, Tangible),
3. The **Interaction** between the teaching method and the reward system.

The experiment follows a Factorial Design with replication: - **Factor 1 (Method):** 3 levels (A, B, C) - **Factor 2 (Rewards):** 3 levels (None, Praise, Tangible) - **Replications:** 4 scores per cell - **Total Observations:** $3 \times 3 \times 4 = 36$

Statistical Model

The model used for this analysis is:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \epsilon_{ijk}$$

where: - μ is the overall mean score. - α_i is the effect of the i^{th} Teaching Method. - β_j is the effect of the j^{th} Reward System. - $(\alpha\beta)_{ij}$ is the interaction effect between Method and Reward. - ϵ_{ijk} is the random error term.

Data Entry

```
method <- rep(c("A", "B", "C"), each = 4, times = 3)
rewards <- rep(c("NONE", "PRAISE", "TANGIBLE"), each = 12)


scores <- c(

  52, 76, 60, 58,
  58, 56, 68, 74,
  58, 24, 32, 39,

  60, 78, 75, 72,
  60, 70, 74, 77,
```

```
  56, 66, 54, 49,

  98, 94, 96, 98,
  78, 80, 84, 80,
  72, 74, 76, 70
)

medical_data <- data.frame(method, rewards, scores)
head(medical_data)
```

```
##   method rewards scores
## 1      A    NONE     52
## 2      A    NONE     76
## 3      A    NONE     60
## 4      A    NONE     58
## 5      B    NONE     58
## 6      B    NONE     56
```

Statistical Analysis (ANOVA)

We use the aov() function to test for main effects and the interaction.

```
model <- aov(scores ~ method * rewards, data = medical_data)
summary(model)
```

```
##                Df Sum Sq Mean Sq F value   Pr(>F)
## method          2   2780  1390.2  21.848 2.27e-06 ***
## rewards         2   5033  2516.7  39.552 9.46e-09 ***
## method:rewards  4    548   137.0   2.154    0.101
## Residuals      27   1718    63.6
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Results and Interpretation

Based on the ANOVA table generated from the data:

Teaching Method: $p = 2.27 \times 10^{-6}$ (Significant). Since the p-value is much smaller than 0.05, we conclude that the choice of teaching method significantly impacts the patients' test scores.

Reward System:

$p = 9.46 \times 10^{-9}$ (Significant). which is much smaller than 0.05. , indicating that the type of reward (None, Praise, or Tangible) is a highly influential driver of performance.

Interaction (Method $\times$ Rewards): $p = 0.101$ (Not Significant). Since $p > 0.05$, there is no evidence of a significant interaction.

This suggests that the effectiveness of a teaching method does not depend on which reward system is being used; they work independently.

Final Conclusion

At the 5% level of significance, we draw the following conclusions:

Teaching Methods: We reject the null hypothesis (H_0) and conclude that there is a statistically significant difference in mean skill scores between the three teaching methods.

Reward Systems: We reject the null hypothesis (H_0) and conclude that the type of reward significantly affects the patients' skill acquisition.

Interaction: We fail to reject the null hypothesis (H_0). There is no significant interaction between the teaching method and the reward system.

Summary:

Both the Teaching Method and the Reward System are critical factors in determining patient success. Because the interaction is not significant, practitioners can choose the best-performing teaching method and the most effective reward system independently to achieve the highest possible skill scores.