Statistical Results from Modified Policy Shaping Experiments

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Loading libraries and reading files

```
library(dplyr)
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(ggplot2)
```

```
d1 <- read.csv("AMPS_results.csv")
d2 <- read.csv("Best_Actions_Results.csv")
d3 <- read.csv("Similarity_Results.csv")
d <- read.csv("experiment_results.csv")
```

Cleaning Data

```
new1 <- d1 %>%
  group_by(Episode) %>%
  summarize(reward_per_episode = mean(Reward))
```

```
new2 <- d2 %>%
  group_by(Episode) %>%
  summarize(reward_per_episode = mean(Reward))
```

```
new3 <- d3 %>%
  group_by(Episode) %>%
  summarize(reward_per_episode = mean(Reward))
```

```
avg_reward <- d %>%
  group_by(Experiment_Name, Episode) %>%
  summarise(avg_reward = mean(Reward))
```

```
## `summarise()` has grouped output by 'Experiment_Name'. You can override using
## the `.groups` argument.
```

Creating Comparison Graph

```
ggplot(d, aes(x = Episode, y = Reward, color = Experiment_Name)) +
  geom_rect(aes(xmin = 1, xmax = 5, ymin = -Inf, ymax = Inf), fill = "grey", color = NA, alpha = 0.01) +
  geom_rect(aes(xmin = 20, xmax = 25, ymin = -Inf, ymax = Inf), fill = "grey", color = NA, alpha = 0.01)
  geom_line()+
  labs(x = "Episode Number", y = "Total Reward",
       title = "Reward for 50 episodes averaged over 15 runs")+
  theme_linedraw()+
  guides(color = guide_legend(title = NULL))
```

ANOVA and Tukey HSD

```
anova_model <- aov(Reward ~ Experiment_Name, data = d)
anova_model
```

```
## Call:
##    aov(formula = Reward ~ Experiment_Name, data = d)
##
## Terms:
##                 Experiment_Name Residuals
## Sum of Squares         2166.944  6827.609
## Deg. of Freedom               2       147
##
## Residual standard error: 6.815154
## Estimated effects may be unbalanced
```

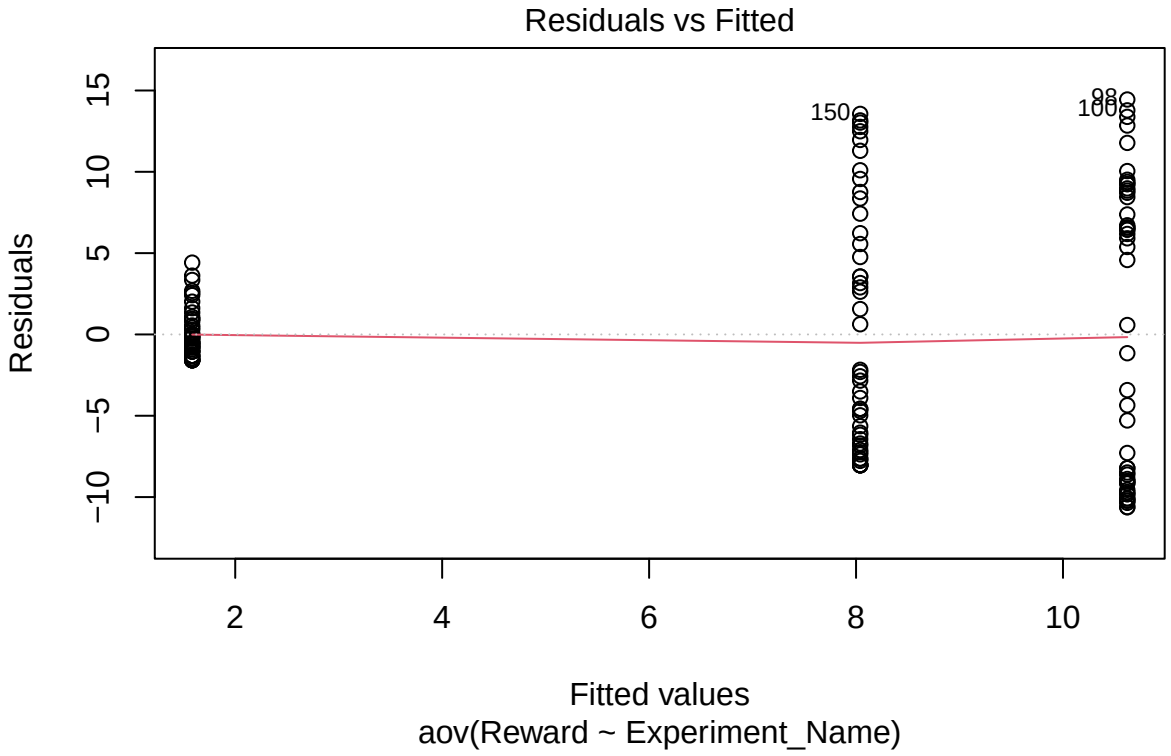
```
hsd <- TukeyHSD(anova_model)
hsd
```

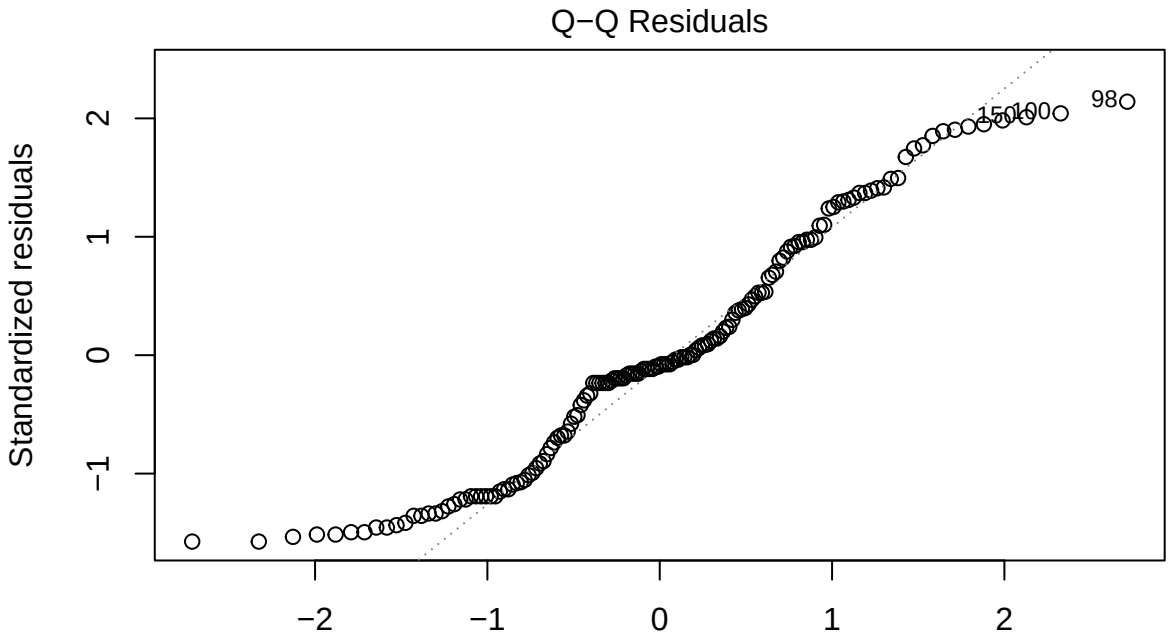
```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = Reward ~ Experiment_Name, data = d)
##
## $Experiment_Name
##                              diff       lwr        upr     p adj
## Best_Action-AMPS         9.037333  5.810095 12.2645721 0.0000000
## Similarity-AMPS          6.456000  3.228761  9.6832388 0.0000151
## Similarity-Best_Action -2.581333 -5.808572  0.6459055 0.1440660
```

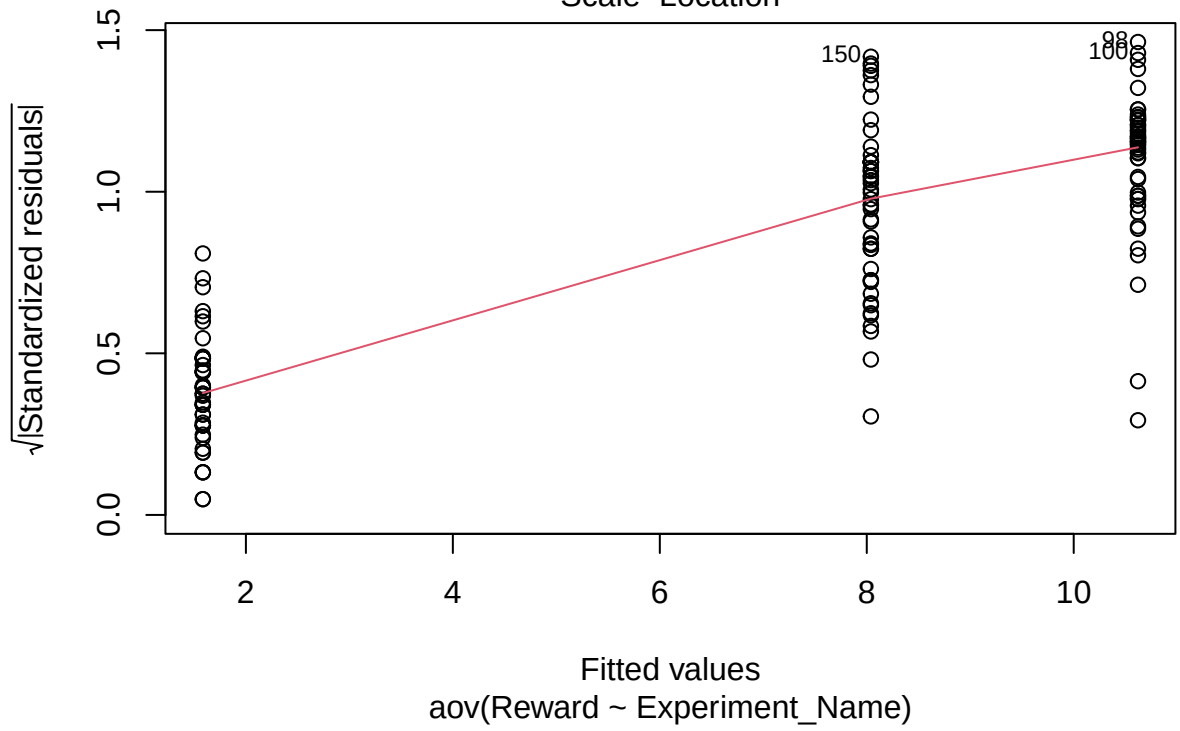
Analysis

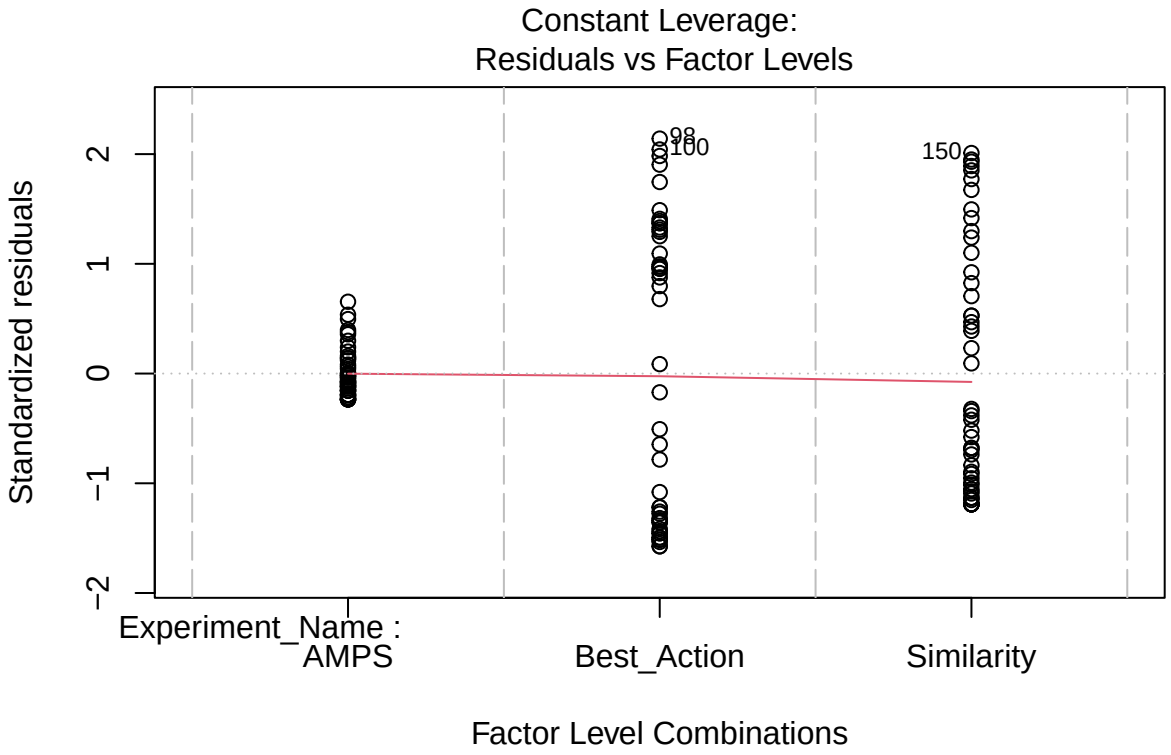
"Best_Action" and "AMPS" have significantly different mean rewards. "Similarity" and "AMPS" have significantly different mean rewards. There is no significant difference in mean reward between "Similarity" and "Best_Action". We are 95% confident that the differences in mean rewards are accurate and not due to random chance assuming all assumptions for ANOVA are satisfied.

```
plot(anova_model)
```




Q−Q Residuals
Standardized residuals
Theoretical Quantiles
aov(Reward ~ Experiment_Name)


Scale−Location
√|Standardized residuals|
Fitted values
aov(Reward ~ Experiment_Name)



The data does not seem completely normal, and but the variance assumption seems satisfied.