Infinitely Repeated Games Analysis

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```r
# Load necessary libraries
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
```

```r
library(knitr)
library(kableExtra)
```

```
##
## Attaching package: 'kableExtra'

## The following object is masked from 'package:dplyr':
##
##     group_rows
```

```r
library(tidyr)
```

```r
# Load the data
data <- read.table("~/Columbia Dropbox/Kwon Hana/Prof. W.Bentley MacLeod & Hana Kwon/Data/Embrey_2018a_r
                   header = TRUE, sep = "\t", stringsAsFactors = FALSE)

# Inspect the data
head(data)
```

```
##   id oid supergame round horizon  r  s  t  p g        l   sizebad session coop
## 1 73  77         1     1       8 51 22 63 39 1 1.416667 0.1910112       4    0
## 2 73  80         2     1       8 51 22 63 39 1 1.416667 0.1910112       4    0
## 3 73  75         3     1       8 51 22 63 39 1 1.416667 0.1910112       4    0
## 4 73  78         4     1       8 51 22 63 39 1 1.416667 0.1910112       4    0
## 5 73  81         5     1       8 51 22 63 39 1 1.416667 0.1910112       4    1
## 6 73  86         6     1       8 51 22 63 39 1 1.416667 0.1910112       4    1
```

1. DATA PREPARATION: PREPROCESSING

```r
# Sort the data by session, player ID, supergame, and round
sorted_data <- data %>%
  arrange(session, id, supergame, round)

# Add opponent's cooperation variable (ocoop)
sorted_data <- sorted_data %>%
  left_join(
    sorted_data %>% select(session, supergame, round, id = oid, ocoop = coop),
    by = c("session", "supergame", "round", "id")
  )

# Add strategy variables (ACA, ADA, TFTA)
sorted_data <- sorted_data %>%
  mutate(
    ACA = ifelse(coop == 1, 1, 0),
    ADA = ifelse(coop == 0, 1, 0),
    TFTA = ifelse(round == 1, 1, lag(ocoop))
  )

# Calculate payoff
sorted_data <- sorted_data %>%
  mutate(
    payoff = case_when(
      coop == 1 & ocoop == 1 ~ r,
      coop == 1 & ocoop == 0 ~ s,
      coop == 0 & ocoop == 1 ~ t,
      coop == 0 & ocoop == 0 ~ p
    )
  )

# Save sorted data
save(sorted_data, file = "TFT_infinite_game_sorted_data.RData")
```

2. DATA ANALYSIS

```r
# Load sorted data
load("TFT_infinite_game_sorted_data.RData")
```

```r
collapsed_data <- sorted_data %>%
  group_by(session, id, supergame) %>%
  summarise(
    mean_ACA = mean(ACA, na.rm = TRUE),
    mean_ADA = mean(ADA, na.rm = TRUE),
    mean_TFTA = mean(TFTA, na.rm = TRUE),
    avg_payoff = mean(payoff, na.rm = TRUE),
    .groups = "drop"
  )
```

```r
summary_table <- collapsed_data %>%
  summarise(
    min_ACA = min(mean_ACA, na.rm = TRUE),
    max_ACA = max(mean_ACA, na.rm = TRUE),
    avg_ACA = mean(mean_ACA, na.rm = TRUE),
    avg_payoff_ACA_1 = mean(avg_payoff[mean_ACA == 1], na.rm = TRUE),
    min_ADA = min(mean_ADA, na.rm = TRUE),
    max_ADA = max(mean_ADA, na.rm = TRUE),
    avg_ADA = mean(mean_ADA, na.rm = TRUE),
    avg_payoff_ADA_1 = mean(avg_payoff[mean_ADA == 1], na.rm = TRUE),
    min_TFTA = min(mean_TFTA, na.rm = TRUE),
    max_TFTA = max(mean_TFTA, na.rm = TRUE),
    avg_TFTA = mean(mean_TFTA, na.rm = TRUE),
    avg_payoff_TFTA_1 = mean(avg_payoff[mean_TFTA == 1], na.rm = TRUE)
  )
```

```r
summary_table %>%
  kbl(caption = "Summary Table of Strategies in Infinitely Repeated Game") %>%
  kable_styling(latex_options = c("striped", "hold_position", "scale_down"))
```

Table 1: Summary Table of Strategies in Infinitely Repeated Game

min_ACA	max_ACA	avg_ACA	avg_payoff_ACA_1	min_ADA	max_ADA	avg_ADA	avg_payoff_ADA_1	min_TFTA	max_TFTA	avg_TFTA	avg_payoff_TFTA_1
0	1	0.3155698	43.72635	0	1	0.6844302	42.14482	0.125	1	0.4949647	51.20666

```r
# Pivot the table for vertical display
vertical_table <- summary_table %>%
  pivot_longer(cols = everything(), names_to = "Metric", values_to = "Value")

# Display the vertical table
vertical_table %>%
  kbl(caption = "Vertical Summary Table of Strategies in Infinitely Repeated Game") %>%
  kable_styling(latex_options = c("striped", "hold_position", "scale_down"))
```

Table 2: Vertical Summary Table of Strategies in Infinitely Repeated Game

Metric	Value
min_ACA	0.0000000
max_ACA	1.0000000
avg_ACA	0.3155698
avg_payoff_ACA_1	43.7263514
min_ADA	0.0000000
max_ADA	1.0000000
avg_ADA	0.6844302
avg_payoff_ADA_1	42.1448184
min_TFTA	0.1250000
max_TFTA	1.0000000
avg_TFTA	0.4949647
avg_payoff_TFTA_1	51.2066613

```r
library(ggplot2)

# Generate histogram for average payoff
ggplot(data = collapsed_data, aes(x = avg_payoff)) +
  geom_histogram(binwidth = 1, fill = "steelblue", color = "black", alpha = 0.7) +
  labs(
    title = "Histogram of Average Payoff",
    x = "Average Payoff",
    y = "Frequency"
  ) +
  theme_minimal()
```