Data from the Television Game Show "Friend or Foe?".

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Abstract

The data discussed in this paper are from the television game show Friend or Foe, and can be used to examine whether age, gender, race, and the amount of prize money affect contestants’ strategies. The data are suitable for a variety of statistical analyses, such as descriptive statistics, testing for differences in means or proportions, and estimating discrete choice models.

1. Introduction

Television game shows have provided unique opportunities for researchers to observe strategic behavior. Friend or Foe is a relatively new game show on the Game Show Network, which is only available through cable television or satellite dish. The show first aired June 3, 2002 and is shown daily several times throughout the day. The Game Show Network’s Web site (http://www.gameshownetwork.com) gives the following description of the game:

The show consists of six strangers who pair up at the start of the show to form three teams of two. Each team is separated into isolation chambers where all trivia rounds will be played. The newly formed teams have to work together and agree on answers to trivia questions, in order to build a bank account. At the end of each round (there are 3 rounds total) the lowest scoring team is eliminated. Before the team is dismissed, they enter the "Trust Box" where they decide how their winnings up to that point are divided. In the Trust Box, each player has a button. No one else can see this button. Each team enters the box, and the division of their winnings is dependant upon which button each player chooses. There are (3) possible outcomes:

- FRIEND - FRIEND If both players do not press the button (Choosing to be
FRIENDS) the total winnings will be divided equally between the two.

- FRIEND - FOE If only one player presses the "FOE" button, he or she will walk away with the entire amount, leaving the other player with nothing.
- FOE - FOE If both players choose to press the "FOE" button, then all the money is lost, and both players walk away with nothing.

In the third round, the remaining team has 60 seconds to answer 10 questions, as quickly as possible, to accumulate more money. Once three wrong answers are given, or the ten questions are answered, the round is over.

Those familiar with game theory will recognize that contestants are playing a classic prisoner’s dilemma game inside the trust box. This is a one-shot simultaneous move game—i.e., contestants play the game only once and their choices are made simultaneously. The payoff matrix of the contestant’s choices is represented by

| Contestant 1 | Contestant 2 |
|--------------|--------------|
| Friend       | 0.5X, 0.5X   |
| Foe          | X, 0         |
| Foe          | 0, X         |
| Foe          | 0, 0         |

where X is the amount of money in the Trust Box.

The weakly dominant strategy is for each contestant to play foe, the non-co-operative strategy. For example, if a contestant believes his partner will choose friend, the income-maximizing choice is for the contestant to play foe. If a contestant believes his partner will choose foe, the contestant will be indifferent between playing foe or friend. (However, there may be an increased propensity of playing foe for those contestants who believe their partners are playing foe in order to reciprocate the “unfair” play and deny them any winnings.) Therefore, it is said that foe weakly dominates friend. In a typical prisoner’s dilemma game, players are also expected to choose the non-co-operative strategy, confessing to the crime. Oberholzer-Gee et. al (2003) contains further information and analysis.

Students can explore the outcomes of these games by examining whether the player’s age, gender, race, and the amount of prize money in the trust box affect a player’s choice between playing either friend or foe. Because the player’s choice is binary, discrete choice models (e.g., probit regression) are appropriate for estimation.

2. Data

The data were obtained by taping episodes of *Friend or Foe* from the Game Show Network. No information was obtained directly from the producers of the show. A total of 76 episodes (28 from Season 1 and 48 from Season 2) were recorded between August 2002 and March 2003. Each episode contains three prisoner’s dilemma games, which are played by six different contestants, and hence I observed 227 prisoner’s dilemma games played by 454 different contestants. (One prisoner’s dilemma game was not observed due to a taping malfunction.) The prize money available in the trust box and the player’s choice of strategy (friend or foe) were recorded for all 227 games. The contestants on average were playing for approximately $3,335 (i.e. money in the trust box).
Information on the contestants’ age and first name was given before each show, and I was able to observe and record each contestant’s gender and race. Unfortunately, the educational status of the contestants was not given. The contestants’ demographics are shown in Table 1. The mean age is 29 years, which is less than the U.S. population mean of approximately 37. The age of contestants ranged from 18 to 65. As for the gender and racial breakdown, approximately 50 percent are male and 83 percent white.

Table 1. Descriptive Statistics

| Variable                        | No. Obs. | Mean | Std Dev | Min. | Max. |
|---------------------------------|----------|------|---------|------|------|
| Male (1 if male)                | 454      | 0.49 | 0.50    | 0    | 1    |
| White (1 if white)              | 454      | 0.83 | 0.38    | 0    | 1    |
| Age                             | 454      | 29.05| 7.92    | 18   | 65   |
| Second Season (1 if 2nd season) | 454      | 0.63 | 0.48    | 0    | 1    |

3. Pedagogical Uses

3.1 Testing Differences Between Two Means and Two Proportions

Students can use the data to examine whether males and females play differently. One hypothesis is that males are more competitive and thus more likely to play the non-co-operative strategy foe. Figure 1 shows the choices of 454 contestants, aggregated by gender, in the trust box. The cooperation rate, measuring the proportion of contestants playing the friend strategy, for females is 46.5 percent and for males is 44.6 percent. The z-test for proportions indicates that the difference is statistically insignificant (z-value = 0.398). These results do not support the hypothesis that females are generally less aggressive and more communal than males.
Figure 1. Cooperation Rates by Sex

Note: Female is the cooperation rate of female contestants. Male is the cooperation rate of male contestants. Male/female is the cooperation rate of males partnered with females. Female/male is the cooperation rate of females partnered with males. Male/male is the cooperation rate of males partnered with males. Female/female is the cooperation rate of females partnered with females.

To examine whether contestants’ choices are influenced by the sex of their playing partner, Figure 1 reports the results of mixed- and single-sex games. For the mixed-sex games, the cooperation rate for females is 43.8 percent and for males is 44.5 percent, with the difference statistically insignificant (z-value = 0.11). In single-sex male only games, the cooperation rate is 44.8 percent, whereas the cooperation for single-sex female only games is 50.0 percent. The difference between the single-sex games is statistically insignificant (z-value = 0.73). There is no significant difference in how males play against females (mixed games) or other males (single-sex games).

Because females tend to cooperate more when playing against other females, there is some evidence of solidarity. As previously mentioned, the cooperation rate for these games is 50.0 percent. However, when compared to female-mixed games, where the cooperation rate is 43.8 percent, the difference is not statistically significant (z-value = 0.94).

The differences, or lack thereof, in cooperation rates between genders may be the result of contestants responding differently to the amount of prize money in the trust box. Table 2 shows summary statistics for the level of prize money at stake in mixed- and single-sex games. Male teams are more successful than female teams in answering the trivia questions, given the mean prize money in the trust box for males ($4,467) exceeds that of females ($2,663). Students can use a simple t-test to determine that the difference is statistically significant (t-value = 2.99). Students can be instructed to use analysis of variance (ANOVA) to determine whether all three groups (single-sex male, single-sex female, and mixed sex) have the same mean. The F-value from this exercise is 5.59; therefore, the null hypothesis of no gender differences should be rejected. Furthermore, statistical differences in median prize money
could be tested for using bootstrapping techniques.

|                  | # games | mean  | std. dev. | min. | max. | median |
|------------------|---------|-------|-----------|------|------|--------|
| Single-sex male   | 48      | 4,467 | 3,260     | 200  | 16,400| 4,100  |
| Single-sex female | 51      | 2,663 | 2,743     | 200  | 15,000| 1,700  |
| Mixed-sex games   | 128     | 3,178 | 2,634     | 200  | 10,000| 2,200  |
| All games         | 227     | 3,335 | 2,857     | 200  | 16,400| 2,500  |

Students can use the data to analyze racial differences in regards to strategic choices. The impact of the contestant’s race on choice of strategy is summarized in . For the white contestants (376 observations, of which 185 are men), the cooperation rate is 47.1 percent, while the cooperation rate for black contestants (78 observations, of which 39 are men) is 38.5 percent, with a corresponding z-value of 1.39. The lower cooperation rates of black contestants may be the result that almost all of the black contestants (74 out of 78) were partnered with white contestants. There is some evidence, for example, that people from different racial groups or nationalities trust each other less in experimental settings such as those conducted by Glaeser et. al (1999). Unfortunately, there were only two prisoner dilemma games involving all black teams, which precludes a detailed examination of cooperation rates in black-only games. In contrast, the data for white-only (302 observations) and white-black (74 observations) games contains enough observations for more meaningful comparisons. The data suggest that white contestants are more likely to cooperate when paired with white partners than black. The cooperation rate for white contestants in white-only games is 48.7 percent and 40.5 percent in white-black games, with a corresponding z-value of 1.26. In this case, the p-value (one-tailed) is 0.104, indicating the difference is marginally significant, at best.
3.2 Discrete Choice Analysis

Because the player’s choice of strategy in the trust box is binary (friend or foe), the data provide an opportunity for students to experiment with estimating limited dependence models. The linear probability model (LPM) is a good place to start despite its flaws (see Wooldridge, 2003, pp. 243-244), especially for students just being introduced to regression analysis. Students should be cautioned that the model’s predictions might not be constrained to the 0-1-interval and the disturbance is heteroscedastic. Of course, the benefits of the LPM model are ease of estimation (it can be estimated in Excel) and interpretation. The parameter estimates represent slope coefficients, giving the predicted change in the probability of a contestant’s choice when the explanatory variable increases by one unit.

To model the contestant’s choice, set foe equal to 1 if the contestant chooses strategy foe, and zero otherwise. The LPM model for describing foe is

\[ \text{Foe} = \beta_0 + \beta_{\text{male}} + \beta_{\text{white}} + \beta_{\text{age}} + \beta_{\text{round2}} + \beta_{\text{round3}} + \beta_{\text{cash}} + \beta_{\text{season2}} + u \]

where \text{male} is a dummy variable equal to 1 if contestant is male, \text{white} is dummy variable equal to 1 if contestant is white, \text{age} is the contestant’s age, \text{round2} is a dummy variable equal to 1 if contestants were eliminated during the second round, \text{round3} is a dummy variable equal to 1 if contestants made it to the final round, \text{cash} is the amount of money in the trust box (measured in $1000s), and \text{season2} is a dummy variable equal to 1 for games played during Season 2.

The results are shown in Table 3. The intercept, 0.786, is the predicted probability that a contestant chooses foe when each explanatory variable is set to zero. There is no evidence that males play
differently than females since the coefficient on *male* is statistically insignificant. White contestants are 10 percent less likely to choose foe than blacks (p-value = 0.134). Older contestants are also less likely to play foe, with the probability of playing foe falling approximately 8 percent for each 10 years of age. This result is suggestive of the idea that people mellow with age (Carstensen, 1993). The only other significant variable is *season2*, which indicates that contestants were approximately 8 percent more likely to play foe during the second season. It is interesting to note that all episodes for the first season were taped prior to television broadcast, so contestants during the first season could not observe any shows prior to taping. Contestants during the second season had the opportunity of watching the first season broadcasts. Although the game is quite simple, the airing and the watching of the show may have helped some second-season contestants realize that foe is the weakly dominant strategy.

Students should be reminded that the standard errors for the LPM, owing to heteroscedasticity, may give misleading results for t and F statistics. Therefore, students could be asked to calculate heteroscedasticity-robust standard errors, which are commonly referred to as White standard errors in econometrics (see White, 1980).

The comparable probit model describing the contestant’s choice is

$$\Pr(Foe = 1) = \Phi(\beta_0 + \beta_{\text{male}} + \beta_{\text{white}} + \beta_{\text{age}} + \beta_{\text{round 2}} + \beta_{\text{round 3}} + \beta_{\text{cash}} + \beta_{\text{season 2}})$$

where $\Phi(\cdot)$ is the standard normal distribution, and the explanatory variables are those given in the LPM. The parameter estimates reported in Table 3 represent slope coefficients, which are calculated at the sample means of the independent variables. As it turns out, the probit results are very similar to those of the LPM. Jeffery Wooldridge (2003, p. 244) states, “...in many applications, the usual OLS statistics are not far off, and it is still acceptable in applied work to present a standard OLS analysis of a linear probability model.” For comparison purposes students may want to estimate the same model but use a logistic distribution. Again, the parameter estimates need to be transformed to slope coefficients before meaningful comparisons can be made.

| Variable                  | LPM       | Probit     |
|---------------------------|-----------|------------|
| **Constant**              | 0.786     | 0.2913     |
|                           | (0.1223)  | (0.1246)   |
| Male (1 if male; 0 otherwise) | 0.0192     | 0.0194     |
|                           | (0.0470)  | (0.0479)   |
| White (1 if white; 0 otherwise) | -0.0923   | -0.0955    |
|                           | (0.0616)  | (0.0635)   |
| Age                       | -0.0083***| -0.0084***|
|                           | (0.0030)  | (0.0031)   |
| Cash (money in the trust box) | -0.0098   | -0.0099    |
|                           | (0.0.0127) | (0.0130)  |
| Round 2 (1 if team made it to 2nd round; 0 otherwise) | 0.0540     | 0.0551     |
|                           | (0.0643)  | (0.0657)   |
Note: The regressions estimate the probability that a contestant plays foe. For the probit regression, the parameter estimates represent slope coefficients \( \frac{\partial \Phi}{\partial X_i} \), calculated at the sample mean. Standard errors are in parentheses.

* statistically significant at 10 percent level (two-tailed)
** statistically significant at 5 percent level (two-tailed)
*** statistically significant at 1 percent level (two-tailed)

There are a number of extensions that can be made to the above models. First, one may want use a quadratic in age to test whether age is nonlinearly related to a contestant’s choice. A number of different interaction effects could be tested as well, such as male·white and male·age. Second, the characteristics of the contestant’s partner can easily be added as explanatory variables to see whether these affect a contestant’s play.

### 4. Conclusion

The data presented are useful for a number of different statistical applications, from simple descriptive statistics and hypothesis testing, to more advanced topics such as linear probability models and probit regression. For econometrics courses, the students’ interest should be piqued, not only because they may have watched the show, but because the data are especially useful for testing predictions about the prisoner’s dilemma model.

### 5. Getting the Data

The file friend_or_foe.dat.txt is a tab delimited text file containing the raw data. The file friend_or_foe.txt is a documentation file containing a brief description of the dataset.

| Label | Description |
|-------|-------------|
| male  | 1 if Male; 0 otherwise |
| white | 1 if white; 0 otherwise |
Notes: If foe and foe1 are both 1, then both contestants receive zero prize money. If foe and foe1 are both zero, the amount of cash in the trust box is split evenly between the players. If one of foe or foe1 is 1 and the other is 0, then the contestant playing foe wins the entire trust box.

| age   | Contestant's age in years |
|-------|---------------------------|
| foe   | 1 if contestant plays foe; 0 otherwise |
| round2| 1 if contestant is eliminated in Round 2; 0 otherwise |
| round3| 1 if contestant is eliminated in Round 3; 0 otherwise |
| cash  | The amount of cash in the trust box |
| male1 | 1 if partner is male; 0 otherwise |
| white1| 1 if partner is white; 0 otherwise |
| age1  | Partner's age in years |
| foe1  | 1 if partner plays foe; 0 otherwise |
| win   | Money won by contestant |
| win1  | Money won by partner |

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