

# Developments in Business Simulation & Experiential Exercises, Volume 9, 1982

## THE USE OF SIMULATION TO TEST THEORIES OF BARGAINING IN A BUSINESS CONTEXT

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### ABSTRACT

The purpose of this research is to demonstrate how simulation can be used to empirically test theories of bargaining in a business context. Business negotiations are private, complex and multi-issue; there are thus limitations to investigating them through field study. The advantage of simulation as a theory-testing methodology is that it can provide a rich context while at the same time permit experimental control and measurement. In particular, this research demonstrates how simulation can be used to test a game-theoretic model of bargaining. The experiment reported here is highlighted by the use of multi-attribute preference measurement and an experimental design that allows a rigorous test of the game-theoretic model as well as unconfounded estimation of bargaining skill and situational power effects. The results of this research support the game-theoretic model. Implications for educators and practitioners are discussed.

### INTRODUCTION

Negotiation is a central process in most business situations. Despite its pervasiveness and importance, negotiation has received surprisingly little empirical research attention. Several theories have been developed that are of potential value in understanding negotiations, most notably, Nash's theory of two-person games [8; 9], but few researchers have investigated their applicability to business transactions.

One reason for the lack of empirical investigation of negotiated business transactions is that business negotiations are not amenable to field study. First, they are often private and involve understood but unstated issues. They are thus not amenable to observational study. Second, business negotiations tend to be complex, involving several interrelated issues; it is important but difficult for the field researcher to discover the relative importance of issues to negotiators. Third, negotiation is a power process, and inherent power advantages are difficult to assess in a field study. This is because situational power is often confounded with other variables such as individual bargaining skill.

The use of simulation can directly address the above problems: first, confining the transaction to the laboratory increases the chances of capturing a process that is for the most part inaccessible to the field researcher. Second, a properly designed simulation can be sufficiently complex so as to re-create the multi-issue nature that characterizes most business negotiations. The researcher can then directly measure the importance each negotiator attaches to these issues. Third, the researchers can use principles of classical experimental design to measure situational power advantages. For example, in order to separate the inherent power advantages from individual bargaining skill, the researcher can make sure that over a series of simulations, each role gets its turn to be represented by the more skilled negotiator. This permits unconfounded estimation of the power inherent in each role.

Simulation has a major advantage over field research beyond overcoming the specific problems noted above; namely, that it permits replication. In testing any theory, replication of the test is important if one is to be confident that confirmation (or disconfirmation) of the theory is not spurious. Furthermore, the more uncontrolled elements in the test, the greater the number of replications desirable. Replication of field research is imprecise and inefficient in comparison to simulation.

The purpose of this research is to describe how simulation was used to test the applicability of a negotiation theory to a multi-attribute business transaction. In particular, we will test the ability of Nash's theory of two-person games to predict the outcome of sales negotiations. The paper first describes how a simulation was developed and then used to provide the realism required. 'Conjoint analysis' [2;3] was then used to measure negotiator preferences for the issues at stake. This provides the inputs necessary for testing the Nash model. Relative bargaining skill was assessed using paired comparison measurements. Dyads were then formed on the basis of this variable so that individual bargaining skill effects could be separated from inherent power advantages.

In summary, the paradigm proposed by this research is to test theories of bargaining by using simulation in conjunction with a sophisticated procedure of preference measurement and classical experimental design. This line of research is important because theory-testing can 1) provide educators with conceptual guidance on how to design future experiential learning exercises and 2) help bargaining practitioners to understand the factors that affect the outcomes of negotiations.

### METHOD

#### Simulation

The first task was to develop a case that was valid in terms of its correspondence with the real-life situation, and was also suitable for use in a laboratory simulation. We first reviewed industry publications that provided useful information concerning the procedures and issues involved with media purchasing. Next, network, advertising and corporation executives involved with the purchase of media time were interviewed. A pilot case was written, validated by industry experts, and then pre-tested with experimental subjects. The case was then revised to the final form used in this research.

The case involved an "opportunistic buy" of a number of 30-second spots ("units") on the television show M\*A\*S\*H. CBS television was the seller and "National Products", represented by its advertising agency, "Owens and Nott", was the buyer. Both parties had a strong interest in completing a deal, but were not compelled to come to a settlement at any cost. CBS valued National Products as an important customer, yet realized that commercial time on M\*A\*S\*H could certainly be

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sold to someone else if CBS and Owens and Mott were unable to reach agreement. National Products had a particular interest in M\*A\*S\*H because of the match between its audience and National Products' target market. However, other suitable programs were available from other networks if agreement could not be reached on M\*A\*S\*H.

Three issues needed to be negotiated. First was the number of units to be purchased. Given the availability of spots as well as National Products' media schedule requirements, this could range between eight and twelve. Second was a rating guarantee provision. A rating guarantee provided by CBS would state that in the event that M\*A\*S\*H did not achieve its usual 20 rating, CBS would make up the difference in free additional spots. A guarantee of between 15 and 20 rating points was possible, while a guarantee of less than 15 was viewed as equivalent to no guarantee. The guarantee became a salient issue because of the threatened departure of the show's star, Alan Alda, which could severely depress future ratings. The third issue for negotiation was the price. The then currently prevailing prices for opportunistic buys ranged from \$6.25 to \$6.75 per thousand viewers. All factorial combinations of the above three attributes were feasible settlements.

Subjects were assigned the role of either Owens and Mott representing National Products, or CBS. Each read a common background statement as well as a separate memo written to each negotiator by his/her superior, outlining the issues from the buyer or seller viewpoint. These materials gave the negotiators a general idea of the relative importances of the bargaining issues from the viewpoint of the constituencies they represented. However, it was expected that each negotiator would develop a somewhat idiosyncratic viewpoint of these issues. After reading the case material, each participant's utility function for alternative settlements was measured using conjoint analysis. Subjects then conducted the actual negotiations and reached a settlement.

### Conjoint Analysis

Conjoint analysis analyzes preference judgments for outcomes in terms of the attributes that compose those outcomes. For this research, the outcomes are alternative negotiation settlements and the attributes are the component issues (price, rating guarantee, and number of units) being negotiated. Subjects rank order a collection of possible settlements in terms of their preferences for achieving each settlement. Each settlement differed in terms of price, number of units, and the type of rating guarantee provided. The rankings are analyzed by the conjoint procedure to yield a set of "part-worths". These part-worths reflect subjects' utilities for different "levels" of each attribute. For example, the part-worths would reflect how important a \$6.75 price is to a negotiator compared to a \$6.50 price. The conjoint analysis also provides a method of combining the part-worths so that a measure of each individual's utility for each possible settlement can be calculated.

### Subjects, Measurement of Bargaining Skill and Experimental Design

Subjects were 54 second-year MBA students at The Amos Tuck School of Business Administration. Subjects were experienced in business and in negotiation, and familiar with each other's abilities. Less experienced subjects have been utilized successfully in previous studies of buyer-seller interaction [4;7].

Subjects were randomly assigned to seven groups. Within each group, constant-sum paired comparisons [11, pp. 106-112] were employed to measure relative bargaining skill. Subjects were asked to allocate 100 points between subjects in each possible pairing among members of their group, so as to reflect relative bargaining ability. The data were scaled using Torgerson's method to provide ratio-scale measures of bargaining ability. The availability of skill measures enabled the researchers to "seed" the subjects within each group in terms of bargaining skill. Pairings were then made so that the highest-seeded subject was assigned to the lowest, second highest to the second lowest, etc. Roles were then randomly assigned so that each side had a chance to be represented by the more skilled bargainer. This experimental design assured a viable spread in the relative skill factor while effectively "crossing" that factor with the role factor.

The resulting experiment enabled the researchers to explain settlement outcomes in terms of preferences (via Nash solutions), bargaining skill, and the advantages inherent in the buyer or seller role.

## RESULTS

The conjoint analysis of negotiator preferences yielded part-worth values for each subject. Taken as a group, CBS negotiators preferred to sell twelve units at \$6.75 CPM with no guarantee. In contrast, the advertising agency preferred to buy ten units at \$6.25 CPM with a 20-guarantee. There was ample conflict between the parties and hence need for negotiation. Variance in part-worths showed that each negotiator weighted the issues somewhat differently. This accurately reflects real-world negotiations and illustrates the importance of directly measuring negotiator preferences when simulating complex business negotiations, rather than assuming all simulation participants react identically to the key dimensions of the simulation.

The conjoint-derived preferences provided the data necessary to operationalize Nash's theory of two-person cooperative games [8;9]. Nash specifies a set of axioms such that the outcome of a negotiation must be that settlement which maximizes the product of the negotiators' utilities (see [6] for further details). The terms necessary for specifying the Nash solution are defined as follows: Let  $U_i$  = utility of player  $i$  for settlement  $j$ , and  $U_i$  = utility of player  $i$  for no settlement. Then the Nash solution is the settlement that maximizes the product  $(U_1 U_2)$ . In order to calculate the Nash solution one needs internally scaled utilities for each negotiator for each possible settlement, including the null option of no settlement. The conjoint-derived preferences provide us with these utilities.

In order to test the correspondence between the Nash solution and the actual settlement, a two-equation regression model was calibrated. One equation was for the buyer (Owens and Mott) while the other was for the seller (CBS). The dependent variable was the negotiator's utility for the settlement actually achieved in the simulated negotiation. Independent variables included the utility predicted to be achieved using the Nash settlement relative bargaining skill and a dummy variable representing the sex of each negotiator. More specifically, define

$\pi_{CBS}$  = The utility of the CBS negotiator (the seller) CBS for the settlement indicated by the Nash solution.

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- $\pi_{OM}$  = The utility of the Owens and Mott negotiator (the buyer) for the settlement indicated by the Nash solution.
- $\pi_{CBS}$  = The utility of the CBS negotiator for the settlement actually achieved.
- $\pi_{OM}$  = The utility of the Owens and Mott negotiator for the settlement actually achieved.
- SKILLCBS = The relative skill advantage of CBS over Owens and Mott, defined as the ratio of the negotiators' skill ratings.
- SEXCBS = The difference in sex between the two parties. Males were arbitrarily coded as a "1", females as a "0". SEXCBS was calculated as an indicator variable formed by subtracting the sex of the Owens and Mott negotiator from that of the CBS negotiator. As a result we have:

SEX CBS	Sex of CBS Negotiator	Sex of Owens and Mott Negotiator
1	Male	Female
-1	Female	Male
0	Male	Male

There were no instances in which both negotiators were female.

Using the outcomes of the twenty-seven negotiation simulations, the following regression equations were calibrated (t-statistics are in parentheses);

$$\pi_{CBS} = -1.658 + 1.121\pi_{OM} + .156SKILL_{CBS} - .338SEX_{CBS} \quad (2a)$$

(1.70) (5.51) (25) (1.09)

$$R^2 = .573 \quad F(3,23) = 10.27 \quad SEE = 1.048$$

$$\pi_{OM} = .738 + .846\pi_{OM} - .352SKILL_{CBS} + .207SEX_{CBS} \quad (2b)$$

(1.02) (3.97) (.54) (.72)

$$R^2 = .437 \quad F(3,23) = 5.97 \quad SEE = .971$$

Equations 2a and 2b indicate that the negotiations yielded almost pure Nash solutions. The Nash solution utility is a very strong predictor of the actual utility achieved in the negotiation. A skill effect is not significant in either equation, although the signs are in the predicted directions. The sex variables are also not significant, although their signs indicate that females tended to achieve better settlements. Although not highly significant, the values of the constants in relation to the slope coefficients for  $\pi_{CBS}$  and  $\pi_{OM}$  reveal some role effect. In particular, we have

$$-1.658 + 1.121\pi_{CBS} < \pi_{CBS} \text{ for } \pi_{CBS} < 13.70$$

$$.738 + .846\pi_{OM} > \pi_{OM} \text{ for } \pi_{OM} < 4.80$$

We would thus predict an Owens and Mott representative to achieve a settlement somewhat better than the Nash solution, while the CBS representative would achieve a worse settlement. Given the range of the data (the maximum  $\pi_{CBS}$  was 5.45, while the maximum  $\pi_{OM}$  was 4.96), it appears that there is a slight role effect in favor of the buyer (Owens and Mott).

## SUMMARY

This research has demonstrated how simulation can be used to test theories of bargaining in a business context. This work has important implications for both educators and practitioners. Educators have placed more and more emphasis on "theory-based experiential learning exercises" (see for example [5]). Theory-based exercises provide a framework by which both the student and the teacher can evaluate the results of the exercise. Theory-based exercises also provide the student with a personal illustration of theoretical concepts that often seem irrelevant when presented in a formal classroom setting. The research presented here indicates that simulation itself can be used to test the theories which can then be used to guide the formulation of future experiential learning exercises. Simulation can thus be used as both a tester and communicator of bargaining theories.

For bargaining practitioners, theory-testing can provide guidance on how they should prepare for negotiations. For example, the support of Nash's theory demonstrated in this paper reinforces the idea that negotiators should "know their adversary". In particular, we have demonstrated that a precise knowledge of each sides' preferences sheds considerable light on what the final outcome will be.

There are many directions that future research might take. While this paper has demonstrated how Nash's theory can be tested, there are other theories of bargaining that should be investigated (for example, see [1;10]). The present authors are investigating the importance of bargaining process variables through content analysis of videotaped negotiations.

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