

Introducing Quantitative Literacy in a Writing Course Using the Ultimatum Game

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Overview

Outline

- 1 Game Theory
 - Background
 - Ultimatum Game
- 2 Game Practice
 - Data
 - A New Model
- 3 Where's the QL?
 - Models Matter
 - Reasoning in real life
 - Extra slides

Quantitative Literacy

The ability and **habitual inclination** to use quantitative information and reasoning to understand the world, communicate with others, and make decisions.

Cultivated Ground

Books on Game Theory and QL

- Rick Gillman & David Housman's *Models of Cooperation and Competition*
 - General education QL course using game theory
- William Poundstone's *Prisoner's Dilemma* (1993), *Priceless* (2011), & *Rock Breaks Scissors* (2014)
 - Popular books on game theory: no mathematical notation
- More books, articles, and web resources

Let's Play a Game!

The Ultimatum Game

Rules:

- Stake: A prize that can be divided into tenths (in class, 10 one dollar bills)
- Two asymmetric players: Proposer and Responder
- 1st, proposer proposes a split of the prize: “none for you, 10 for me;” “1 for you, 9 for me;” ... “10 for you, none for me”
- Then, responder accepts proposed split or rejects it
- If responder accepts, prize is won and split according to proposal. If responder rejects, prize is lost

Classical Model

If this game is about the prize, there is only one rational outcome:

- Proposer offers “1 for you, 9 for me,” and so gets the most while giving disposer something
- Disposer accepts because one is better than none
- This is the unique Subgame Perfect Nash equilibrium (SPE)

Data

What really happens

“In theory, there is no difference between theory and practice. In practice, there is.” – 20th century proverb

- Mathematical analysis is trivial
- Usually at least one proposer in class performs it
- Very rarely do these proposers win (1 time in ~100 games with ~20 attempts)
- Most proposers offer nearly even splits; most responders reject splits that greatly favor proposer

Real Data

My classroom is not an experiment

“The ultimatum game is claimed to be one of the most frequently performed of all human experiments today.” –William Poundstone, in *Priceless*

- No large population of humans plays the ultimatum game using the SPE
- Nature of prevalent strategies varies by culture
- Variations on game show this “nonrational” behavior is robust and contextual
- Practice does not match theory! Now what?

A New Model

Fairness has value

“By stripping away all the customary social, legal, financial, and ethical entitlements, the game lays bare the issue of inequality, something that all societies struggle with.” –William Poundstone, in *Priceless*

- Instead of just the value of the prize, assign a value to equitable treatment
- New value varies from individual to individual, could be modeled as random
- Random model can account for observed behavior *post facto*

Where's the QL?

Models matter

“...the supreme goal of all theory is to make the irreducible basic elements as simple and as few as possible without having to surrender the adequate representation of a single datum of experience.” –Albert Einstein

- The failure of naive analysis is disheartening
- But the lesson of incomplete models is important
- Students appreciate that naive use of numbers can mislead

You did what?!

Reasoning in real life

“... literacies are for the most part practiced invisibly and subconsciously ... not pulled out selectively and applied deliberately ...” –Richard Ewell in *Mathematics & Democracy*

- Responders occasionally make nonsensical choices, like rejecting even-valued splits (10-0, 8-2, 6-4, etc)
- Other responders regret their choices, like accepting only an equal split and then losing.
- Opportunity to consider how emotion and reason interact, in a “real” situation

Whoa! Random!!

More reasoning in real life

- Players confront a meaningful uncertainty via the game
- Mathematical models of uncertainty are rarely understood, and counterintuitive in practice
- Context is centrally important
- Just as behavior in UG is sensitive to context, so is QL

Summary

- UG exposes that a good model is critical for QR to be helpful, but good models often entail much more mathematical machinery than simpler, inaccurate ones
- UG demonstrates that QL is helpful understanding human behavior and establishing productive agreements by making decisions under uncertainty and in diverse contexts
- QR may not be the most elemental knowledge for a useful model, but when understood and used in conjunction with other knowledge, it is uniquely empowering

QL at the NYT?

'The Interview' Brings In \$15 Million on Web

By MICHAEL CIEPLY DEC. 28, 2014

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LOS ANGELES — "The Interview" generated roughly \$15 million in online sales and rentals during its first four days of availability, Sony Pictures said on Sunday.

Sony did not say how much of that total represented \$6 digital rentals versus \$15 sales. The studio said there were about two million transactions over all.

Sunday Review | The Opinion Pages

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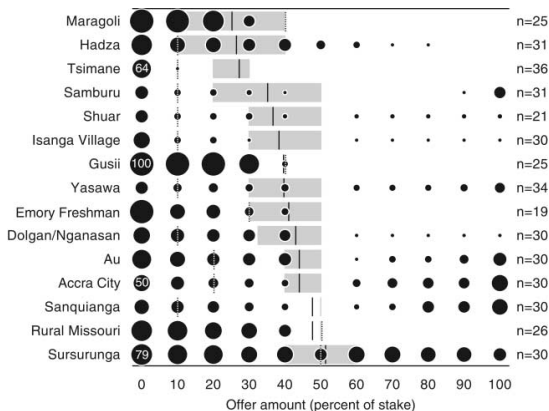
OPINION

Is Algebra Necessary?



Real Data

A Rich Graphic



Graphic for Classroom Data

