

Introduction to Game Design

9/23/08: The Auction and the Biggest Number Game

“People of privilege will always risk their complete destruction rather than surrender any material part of their advantage.”

- John Kenneth Galbraith

Ladies and Gentlemen...



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bring a dollar bill with you!

“Ladies and Gentlemen, I have here in my hand one legal tender federal reserve note in the amount of one dollar that I will be auctioning off to the highest bidder! The rules are the same as a standard auction, with one exception. While the winning bid will get the dollar for the amount that they bid, the *second* highest bidder must *also* pay the amount that they bid, even though they win nothing.

Let's open with a penny!”

have fun with this

The Macbeth Effect

- “I am in blood / Stepped in so far that, should I wade no more / Returning were as tedious as go o’er”

-William Shakespeare

- When performed in a psychology lab, subjects experience galvanic skin responses similar to parachutists immediately prior to jumping out of a plane
- Answers to questions during the course of the game changed from profit to competition

are you forced to continue forward in a game like this?

at a point you realize you're not going to profit, so the point starts being that you need to win to "lose less" than the other person.

Buyer's Remorse

- Is there an obvious place to draw the line between a **rational** bid and an **irrational** bid?
- “A game theory analysis alone will probably never be adequate to explain such a process.”

-Martin Shubik

- “If at first you don't succeed, try, try again. Then quit. No use being a damn fool about it”

-W.C. Fields

This is nonsense!

- Real auctions don't work this way! How is this supposed to prove anything?
- Don't think of it as an auction, but an activity model that inspired several figures of speech:
 - “throwing good money after bad”
 - “saving face”
 - persevering “so that it all won't have been in vain”
 - having “too much invested to quit.”

True Life Examples

- Calling tech support
 - Do you immediately hang up when you're put on hold? It's long distance, after all
 - Do you stay on the line as long as necessary?
 - How do you decide just how long to wait?

True Life Examples

- Crowded amusement park rides
 - People wait in a line for hours for a ride that lasts a minute
 - “Human-engineered” snake-like lines prevent you from seeing how long the line actually is
 - By the time you realize how long the line actually is, you’ve invested too much time to give up

True Life Examples

- TV movies
 - Even when we realize that the movie is bad, we are reluctant to turn it off – we've watched it so long by this point that we might as well see how it ends
 - As the movie progresses, length and quantity of commercials increase, often every five minutes towards the end

True Life Examples

- Labor strikes
- Architectural design competitions
- Patent races
- Repairing an old car
- Waiting for the bus just a few more minutes before hailing a taxi
- Refusing to leave a bad job
- Refusing to leave a bad relationship/marriage

True Life Examples

- Vietnam
 - LBJ's speeches changed from those of freedom, democracy, and justice to speeches of national honor, halting the spread of Communism, and avoiding the appearance of weakness
 - There came a point where winning (justifying the lives lost and money spent) was scarcely possible
 - 39,242 pounds of ammunition and \$2,436,657 per fatality
 - Push a little harder for “peace with honor” so that our dead will not have died in vain

It's a good thing we've learned our lesson, right?

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Bush urges patience as support for war shrinks

Says 'best way to honor' the Iraq war dead is to complete mission

SHIT!

This is a headline from october 30th, 2005!

True Life Examples

- First Gulf War
 - “Iraq’s material losses are already so great that we must now fight to the end.”
 - Saddam Hussein, to his troops on the southern front
 - This is a particularly troubling incident - even with Vietnam, both sides could have plausibly thought that they could hold out and win, but the conflict in Iraq was completely lopsided

It's easy to dismiss Hussein as a lunatic, but this type of lunacy is quite common

True Life Examples

- Animal World
 - In territorial struggles, animals will rarely fight to the death
 - They face off and make threatening gestures, until one animal gives up and leaves
 - Both animals pay the same price (time), but only the one that's willing to hold out longer wins

the animal world revolves around life and death... it's "the circle of life!"

As soon as one animal thinks they're going to lose, they give up facing defeat rather than death (of course this isn't always the case, but common enough)

True Life Examples

- The Bomb
 - Escalation, and the possibility of ruin to both sides are characteristic of arms races
 - The nation that doesn't keep up with size and number of bombs not only is less secure, but the defense budget is effectively “wasted”
 - Spend a little more money to close the missile gap

History Repeats Itself

- When the crossbow was invented in medieval times, it was judged to be so terrible, that kingdoms petitioned the Church to outlaw them
- Alfred Nobel thought that dynamite was so powerful that it would make war too terrible to imagine
- The British thought that the Dreadnought would force France and Germany to submit
- Oppenheimer thought that the A-bomb would put an end to war and usher in a new world government

Dreadnought was a revolutionary battleship of the Royal Navy of the United Kingdom in 1906

The bomb cost a lot of money, but in the long run did not make anyone more secure

The H-bomb is of course far more devastating than a crossbow or a battleship

Strategies

- So what should you do? Should you bid at all?
- Not everyone takes the dollar auction seriously – some inflict losses on other players “just because”, others incline towards being “sporting”
- To do justice to the spirit of the game, we assume that the monetary amounts are meaningful, and players are interested in **maximizing gain** and **minimizing loss**

Strategies

- Assume two players – minimum bid is 1 cent, minimum increment is 1 cent, you get to make first bid
- After play has begun, either top bid or pass, granting victory to your opponent
- **Bid 1 cent:** Maximum profit, minimum bid. What more could you want? Of course, the other player has every incentive to top your bid. The ultimate outcome of this opening is unclear

Strategies

- **Bid between 2 and 98 cents:** Gives you some profit, but also lets the other player top it and make a profit themselves. Hard to say what will happen
- **Bid 99 cents:** Often the best choice when bankrolls are unknown. Other player has no real incentive to top you, and you make a profit, albeit a small one
- **Bid \$1:** Doesn't make much sense – if other player passes, everyone's time was wasted

Strategies

- **Bid more than \$1:** You're an idiot
- **Pass:** Don't win anything, don't risk anything. However, you leave the bidding to your opponent, who will likely bid 1 cent. Well, at least you're not spoiling it for the other player
- Coming around to the beginning, if Player 1 bids 1 cent, why shouldn't Player 2 pass?
- **No one can guarantee themselves a profit by topping a previous bid**

What does Game Theory tell us?

- “After high school, there’s no such thing as algebra.”
- Mathematics, including game theory, is often far removed from real life
- For the record, however, game theory calculates that the best opening bid is (bankroll % \$1), and that bidding limits must be known (!)

Conclusion (Part I)

- It's a matter of personalities, group psychology, and luck – not game theory
- Rationality has nothing to do with it



1974. McDonald's holds a contest with many prizes. No cost to enter, and you can enter as many times as you want. CalTech students Steve Klein, Dave Novikoff, and Barry Megdal submitted about 1.1 million entries on 3x5 cards. They won 20% of all the prizes, including a station wagon, \$3000 cash, and \$1500 in free food. The press quoted many people who felt cheated by this.

The Largest Number Game

- Devised by Douglas Hofstadter in 1983
- A contest that costs nothing to enter, and allows **unlimited** entries for a \$1 million prize
- Each player must act alone – no teams, deals, or communication
- Extra bonus: Just write the number of entries you'd like to submit on a 3x5 card
- There is one catch...

The Largest Number Game

- The prize money will be \$1 million, **divided by the total number of entries received**
- If you write “100 million” on your card, the prize will **at most** be 1 cent
- The game is **not** a sham! *Scientific American* put \$1 million into an escrow account and was fully prepared to give it away

On Competitions for Prizes

- Like the dollar auction, this game is quite simple, but its twist makes it amenable to modeling complex phenomena
- Competitions for a set prize have in common the characteristic that the greater the number of competitors, the smaller the chance an individual has of winning
- More competitors decrease the **chance** of winning, but not how **happy** the winner is (utility)

On Competitions for Prizes

- In Hofstadter's game, each competitor reduces the happiness of the winner
- **This also holds for the winner** – by competing, they reduce their own happiness, but if they didn't enter, someone else would have won!
- Every competitor justly brings dishonor amongst themselves
- What if everyone thought this way?

True Life Examples

- Taxi Drivers
 - If there is only one (or a few) taxi drivers in the city, then they become rich very quickly
 - If everybody becomes a taxi driver, no one will be able to make a decent living
 - City authorities may intervene and issue a limited number of taxi permits

True Life Examples

- Immigration
 - Each year, the U.S. Immigration Office draws lots for 55,000 green cards
 - Permanent residency in the land of unbounded opportunity is determined by blind chance
 - Everyone competing for a green card has an equal chance of winning – there is no authority judging the capabilities of the competitors

What Should You Do?

- A respectable person wouldn't play this stupid game (?)
- **But**, players demand that a great opportunity is not missed
- Is it truly **common interest** if only one person enters? (Why that person and not me?)
- If everyone wants to serve the **same** common interest, then everyone enters or no one enters — either way, no one wins

How do we Resolve the Stalemate?

- We ask mathematicians
- If there is no authority to draw lots, then each participant does it themselves
- Currently 27 students, so everybody rolls a $d27$ (pretend there is such a thing)
- If you roll a 27, submit one entry, if not — do not play the game

Assuming this Actually Happens...

- Every player has an **equal chance** of entering the competition
- Every player makes their decision on whether or not to participate on the basis of **some principle**
- There is a good chance that there will be **only one competitor**, whose prize will be the greatest possible, namely one million dollars

A Thought Experiment

- Alien culture
- Part of their being is the ability to compute random numbers
- How would it look to us?
- Millions of peaceful, hard-working aliens don't enter, the one aggressive jerk takes all the resources, and **no one cares??**

lets take an alien culture

the one alien that ends up with 1mil as his random number enters... he also happens to be a complete jerk but he wins!... No one cares because they didn't compute the random number they should have in order to enter

So the Reality is...

It's hopeless

