What-if Model Games in Excel

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Abstract

This case presents games for developing what-if skills in Excel. They can be added to existing curriculum in classes covering data analysis. The games require students to create decision-making models, and then use those models in interactive class auctions. The auctions generate significant classroom energy and unpredictability. Since each auction proceeds differently, students cannot rely on peers to give them the "right" answer. This helps reduce plagiarism, and the rules of each game can be tweaked to provide a unique competition for each section. Professors can grade each team on their earned profit, as well as an optional written analysis or presentation. The games help students understand the value of Excel in quickly generating and choosing between multiple options. The public competition engages students, and supplements more traditional instructional material.

Keywords

What-if, Spreadsheets, Excel, Collaborative Learning, Gamification

Introduction

Games in education are a promising new pedagogical approach, and generally lead to increased student learning (Ke 2009). Games have been proven effective in business education, with a variety of studies showing superior learning gains to traditional methods (Faria, 2001). Educational gaming takes different forms, from gamifying an entire course to simply adding a game to a single class session. This paper proposes several games that can be added to an existing class with minimal course redesign. The games help students develop higher-level thinking skills and give a good example of how Excel can help them in business.

Each game requires student teams to create a what-if spreadsheet model. They then use their model in an in-class auction. Each game requires 1-3 hours of class time and does not require any additional materials or software. The games can be easily customized to provide a fresh scenario for each section.

These games align with courses teaching quantitative thinking and modeling. For example, an Introduction to MIS class could use an auction in its decision-support section. Or, an Office Application course may use all four auctions to help students develop Excel modeling skills.

These games support learning through four aspects. First, the team-based nature of the competition promotes cooperation, which increases learning (Johnson et al. 2000). Cooperative learning with intergroup competition has been shown to be superior to individualistic approaches (Hattie 2009).

Second, the dynamic nature of the auctions discourages academic dishonesty by providing a unique challenge in each class. The public nature of winning or losing also increases student motivation to do well. Both elements combine to create a holistic approach that encourages students to take greater ownership of their work. This reduces the incentive to cheat (McHaney et al. 2016).

Third, the games are unsolvable with intuition. Students who come to class without a model will do very badly on the competitions. Students can simply mimic peer bids, but this tends to result in over-bidding.

Fourth, the games do not have a single right answer. Student must stay engaged, as each auction consistently requires students to re-evaluate their strategy.

Different debrief activities may be used. The quickest approach is to have the instructor lead a discussion immediately after each auction. A more time-intensive approach requires students to create their own
analysis, with either a written paper or presentation due a week after each auction. Grading may be based entirely on profit, or also on each team’s analysis.

**Game 1: Simple Value Bid**

The first game introduces students to the auction game structure. No student preparation is needed. Students will learn how the auction works, and become more comfortable with profit and loss terminology.

Start the game by giving each student team a fixed amount of cash. Explain that they will use this money to bid for properties in an open auction. Provide a list of properties for the auction. Each property should have an intrinsic property value that is roughly double the cash provided to students. After allowing students to collaborate on a strategy, begin bidding.

Several techniques can help the bidding process. Starting bids 40% below their ideal value encourages energetic early bidding. Requiring each new bid to increase by a set amount also keeps the auction from dragging.

Once the game has ended, figure out the winner by calculating the highest profit (property value – bid price). It is generally useful to also explain the difference between profit/loss and assets, as many students will want to count remaining cash towards their profit.

Students should end this small intro game with a basic understanding of the need to allocate cash carefully to purchases, and an understanding of the bid mechanic.

**Game 2: Rental Auction**

The second game requires students to create a decision-making model for buying rental properties. Students must balance each property’s intrinsic value against its rental income. Students outcomes include building a model, choosing appropriate bid amounts, and comparing different success strategies.

Provide students with a data file containing each property’s name, market value, and rental income. Post the below instructions explaining the rules of the game.

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Your team has formed a real-estate company. You will buy local houses and condos, and then rent them out to tenants. A wealthy aunt has agreed to loan you as much money as you need to operate the business (interest free).

The game will run for six years. Each year begins with an auction of 1-3 buildings. Each building has a minimum purchase amount, but you can bid as high as you like. You may only buy one building each year. Each property has two important features.

1. **Rental Income** is the amount an owner will receive each year.
2. **Market Value** is the amount the property is worth on the local real estate market.

Your aunt will only allow you to own a single building. Building owners who win an auction must immediately sell the old building at market value (not what you bid for it). The old house cannot be purchased by anyone in class, and you will not receive rental income on it that year.

After all of the houses are purchased, the year passes. We end the year with an accounting phase on December 31. Each team with a house receives rental income. They must also pay taxes on what they spent for the house (not the market price). If they do not own a house, they receive no income and pay no taxes.

At the end of six years, each team will sell their house at market value. The team who earned the most profit wins the game. Profit and loss comes from two sources:

1. Operating income is calculated as **Rental Income - Taxes**.
2. Auction income is calculated as **Market Value - Auction Bid Price**.
You can win by buying properties below market value, or by concentrating on those with higher rental returns. Selecting properties carefully will be very important. Some are great, some are ok, and some are huge money losers.

**Game Notes:**

1. As the game progresses the value of the properties should increase. This incentivizes teams to keep engaged in the auction.

2. Properties need to have a wide variation in payoff. Some should have extremely high market values, but low rents. Students can make money on these only if they buy them below market value. Often, teams will forget to account for tax, which at 5% of the bid can add up significantly. Other properties should have low market values but high rental income. Students buying these will generally need to pay a significant premium for each property, which incentivizes them to hold onto them for several rounds.

3. Only allowing students to hold a single property at a time is critical. This means that students must quickly and accurately decide as a group if it is more profitable to stay with their current property, or to bid for the new one. This restriction also simplifies their decision model.

4. For classes where students have taken accounting, the game can be complicated by allowing profit to remain inside of each firm (thereby reducing the amount spent on loan interest). However, in my experience this leads to unnecessary complexity. As a result, I generally tell the teams to direct all profit into dividends.

**Game 3: Movie Script Auction**

The third game builds students’ skills in creating conditional formulas. They must calculate the revenue and cost for potential movies, and carefully verify their work. Outcomes include making IF statements, validating formulas, and describing how Return on Investment (ROI) can measure success.

I provide a file with information on movie scripts, but not their revenue or expenses. Students must use IF statements to build out the different variables. Checking their work becomes a critical part of the game. Distribute a data file with 50-100 movie scripts and the instructions below.

Your team has formed a movie distribution company. You will participate in a single auction to buy the rights for a group of movie scripts. A wealthy uncle has given you $100,000 to fund the business. No other cash is available for the game. The game is composed of a single auction. Once all of the scripts have been auctioned, the team with the highest profit wins.

Add a separate column for each rule. Each column should use an IF function that returns the positive or negative adjustment to cost or revenue.

The example below shows two movies starting with a base cost of $20 (all figures are in millions). The first rule requires that large movies add an extra $40 million dollars to their cost. The second rule requires that niche movies subtract $5 million from their cost. Once all rules are calculated, the total cost is the sum of the cost columns.

<table>
<thead>
<tr>
<th>ID</th>
<th>Script Title</th>
<th>Genre</th>
<th>Actors</th>
<th>State</th>
<th>Base Cost (m)</th>
<th>Large Movies +40m</th>
<th>Niche Movies -5m</th>
<th>Total Cost (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Robot Turtles</td>
<td>Large</td>
<td>8</td>
<td>CA</td>
<td>$20</td>
<td>$40</td>
<td>$0</td>
<td>$60</td>
</tr>
<tr>
<td>13</td>
<td>Blacktop Paving</td>
<td>Niche</td>
<td>0</td>
<td>TX</td>
<td>$20</td>
<td>$0</td>
<td>$(5)</td>
<td>$15</td>
</tr>
</tbody>
</table>
Table 1. Example IF Calculation Table

Below is a set of rules you should apply to all movies. Make each rule into its own column. All figures are in millions.

**Cost**
- Movies start with a base cost: $20
- Large movies: $40
- Niche movies: $(5)
- Movies with less than 5 actors: $5
- Movies with between 5, 6, 7, or 8 actors: $10
- Movies with over 8 actors: $30

**Revenue**
- If an indie film and no big-name director: $(20)
- If a kid or a niche movie: $15
- If a large movie: $50
- Tax benefits to Large, Kid, or Niche films not in CA: $30
- *Each* "A" actor increase revenue by: $5

Some students will try to manually calculate each rule. Providing a large number of potential properties, and then randomly selecting 20 immediately before the auction, can reduce the incentives for this approach.

**Game Notes:**
- When creating rules, use columns that add or subtract fixed amounts instead of percentage changes, as the ordering of the latter can affect the final result.
- Provide check-sums for each rule column. Even a good team can make a single mistake, and providing a sum or average for each rule column allows them to figure out where they went wrong.
- Since it is easy for students to reuse spreadsheets from previous semesters, the rules should be modified for each class.
- Having a wide variation in profitability is important. Since some teams will come without having done any preparation work, at least 15% of the movies should lead to significant losses. Team also sometimes forget to subtract cost from revenue. Some movies should also be extremely profitable, which can lead to very intense bidding as teams go “all in” on a large winner.

**Game 4: Stadium Concession Auction**

The final game requires students to analyze a large dataset of beverage sales, and then estimate future sales based on historical trends. It helps students develop sort, filter, and Pivot Table skills. They should also gain a practical understanding of how averages and standard deviations relate to risk.

Students should be given a data file containing ten years of sales data. The below text should be provided to explain the rules of the game.

Your team has formed a food company. You will bid for the rights to sell coffee and beer at a local baseball stadium. Your aunt and uncle have given you $100,000 to fund the business. The game consists of a single auction. The winner is the team with the highest profit.

You have been given a data file with historical sales. You must analyze the data and then create a forecast for each item in each month for the coming year. You will need to discover past trends to accurately guess future sales.
The cost and price for each item is set in advance. Coffee sells for $4.00, and costs $2.20. Beer sells for $5.00, and costs $2.75. Ignore all other costs.

Each bid will be for a single item for a single month. For example, you may buy the rights to sell coffee in April, or beer in August. Each lot has a minimum bid of $5,000.

After running the auction in class, instructors should then release the actual sales data for the bid year. Students can then see how well their estimates aligned with the actual figures.

Game Notes:

1. The data is based upon actual calendar days and simulated temperature. Higher temperatures decrease coffee sales and increase beer sales. The data generation algorithm introduces interesting patterns into the data, such as increasing year-by-year demand for coffee.
2. Using actual days in the coming year results in a varying number of game days each month. Good teams will look to the coming year to find the number of game days.
3. Beer and coffee should have different variation patterns. This can lead to a good discussion of standard deviation and risk.

Conclusion

Using auctions in my classes has increased student engagement. The team aspect of the activity helps students make connections with their peers, and reinforces learning through social activity. Anecdotally, students report better appreciating Excel's ability to build models, and have a clearer idea of how it can be used in the ‘real world.’ They say that the competition helps them stay engaged in class, and that the auctions are exciting. Student presentations show much more sophisticated analysis that those based on earlier (less dynamic) activities.

I have found that the competition allows different student personalities to have a chance to perform well. Shy students who do their best work alone tend to be more active in building models. Conversely, more social students tend to get engaged by the competition. The two different personality types are forced to work together as they go through the semester.

Games make for more interesting classrooms and provide students with challenging and motivating scenarios. Creating unique data for each section reduces the risk of plagiarism, and the auction dynamics makes each session play out differently based on the personalities inside of class.

Handouts and Excel files for generating unique data are freely available at http://profgarrett.com/auctions.

REFERENCES


