

# MISG 2019 Graduate Modelling Camp

## On-line auctions

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# 1. The problem

The importance of on-line commerce (and government).

Can we design an **on-line auction** to incorporate interesting features whilst maintaining required behaviour?

Early attempts: eBay and Gumtree.

Privacy? Accountability?

Distribution?

Using Data Analytics to benefit from market data?

## 2. Characteristics

What characterises a typical MISG problem?

How this problem is similar; and different.

What is required: a *design*; its correctness and efficiency.

What is not required: an *implementation*, tested by cases.

The maths is *pure, discrete* and perhaps unfamiliar.

Abstraction.

### 3. Steps

1. Survey types of auction, in order to appreciate the range of potential behaviours/protocols.  
Examples: English, Dutch, Sealed-bid, Vickrey.
2. Consider the features and functionality desired of an on-line auction, including those not possible in a standard auction.  
Avoid undesirable features where possible.  
Privacy? Accountability? Collusion between bidders?  
Can Data Analytics be used to improve the profile of sales?
3. Design a system which incorporates the desired features.
4. Finally prove the chosen auction design behaves as desired.

## Concerns

1. Modelling: how to *abstract* (deciding what is ‘observable’).
2. What *new* possibilities does *on-line* offer?
3. What features does *distribution* require?
4. Exploiting *data analytics*?

## 4. Design . . .

What are the *requirements* of an on-line auction?

Treat it as a black box to describe its behaviour, not its construction.

Decide and express *what* it does, ignoring the mechanism which decides *how*. Our system is *specified* by its

- functionality  
(how do bids work?)
- extra features  
(privacy, anonymity, authenticity, Data Analytics, . . .) .

## ... techniques

- Distinguishing between centralised and distributed designs.  
Invariant properties.
- Describing an interactive design.  
Modularity.  
Information flow by shared variables or message passing.
- Accessing (big) data security.  
Public key encryption. Digital signatures.
- Mathematical notation.  
Z formalism.

## Example: bidding

For simplicity assume: a standard English auction with a single item for sale, a reserve price, and increasing bids.

<i>Bid</i>
$\Delta State(\dots currentbidder, currentbid, \dots)$ $bidder? : \mathbb{U}$ $bid? : \mathbb{R}$
$bid? > currentbid$ $currentbid' = bid?$ $currentbidder' = bidder?$

The *invariant* of *State* ensures *bids* are increasing.

## 5. References

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