

| The Faculty of Business and Social Sciences  |   |
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| Study board of Market and Management Anthropology, Economics, Mathematics-Economics, and Environmental Economics |   |
| Market Design  |   |
| Market Design  | Teaching activity id: x2.                           |
| Teaching language: English.  | ECTS / weighting: 5 ECTS / ** full-time equivalent. |
| Exam activity id: Not chosen.  |   |
| Examination language: English.   | Approved: .   |
| Period: Autumn 2019.   |   |
| Grading: Internal Examiner.  |   |
| Assessment: 7-point scale.   |   |
| Offered in: Odense.  |   |

Subject director:

Ryan Tierney, Department of Business and Economics.

Teachers:

Ryan Tierney, Department of Business and Economics.

#### **Prerequisites:**

There are no fixed prerequisites, but familiarity with elementary game theory and probability will be helpful.

#### **Purpose:**

The assignment of students to public schools in Boston; The matching of all doctors in the United States to their first job after education; The transplantation of organs in the United States and Scandinavia: All of these social systems have been and continue to be revolutionized by the discipline of Market Design. Unlike traditional Economic thought, which largely confines itself to the application of taxes and subsidies, Market Design reconsiders social arrangements from the bottom-up, building institutions that sometimes resemble the classical "free-market" but at other times are completely different. We apply the mindset of an engineer, and optimization tools that engineers might recognize, to solve social problems and make people's lives better. The source of these problems is often the opposed interests of the various stakeholders, and the strategic considerations that this implies for them. Thus, we must also use methods from Game Theory. In sum, Market Design synthesizes ideas from various disciplines, with various intellectual heritages, to tailor a solution to a given social problem, not being beholden to orthodoxy, nor forgetting the fundamental economic insights of the last century.

This course will give students an overview of the recent contributions of Market Design and the techniques behind them. Students will find they do not need to be experts to apply these techniques to their careers. Many of the solutions are surprisingly simple. Moreover, their application is not limited to large-scale, high visibility cases; normal companies and even small teams may benefit as well.

#### **Content - Key areas:**

The classes of models to be analyzed are:

- One-to-one matching of discrete agents to discrete units or other agents.
- One-to-many matching of discrete agents to discrete units or other agents.

- Matching of the above kind with finitely many available match types.
- Assignment of discrete agents to objects when the objects are owned by other agents.
- One-to-one (bilateral trade) or one-to-many (auctions) matching of an indivisible object to discrete agents in the presence of transfers and probabilistic information structures about the preferences of agents.

### Goals description (SOLO taxonomy):

To fulfill the purposes of the course the student must be able to:

Demonstrate *knowledge* about the course's focus areas enabling the student to:

- Explain the relationship between Game Theory and Market Design.
- Define a social choice rule and its role in economic theory.
- Explain the definition of and the use of the concept of the *game form*.
- Describe some applications of each model in the real world.
- Describe matching theory and its application to school assignment, labor markets, and organ transplantation.
- Describe auction theory and its applications to trade.
- Describe the major general results of the theory and their implications.
  - The "Rural Hospitals" Theorem.
  - The lattice structure of the core.
  - Revenue equivalence principle.
  - Revelation principle.

Demonstrate *skills*, such that the student is able to:

- Find a stable matching in a two-sided, one to one market.
- Find a core allocation of indivisible goods to agents with unit-demand.
- Find the core of a matching market when there are multiple terms of trade.
- Find an extremal stable matching in a two-sided, one-to-many market.
- Demonstrate the manipulability of core-extremal matching rules by one side of the market.
- Calculate the optimal bidding strategies in common auction forms.
- Calculate the top-trading-cycles algorithm, and its generalization when there are waiting lists.
- Calculate Myerson's optimal mechanism for auctions with independent private values.
- Calculate Vickrey-Clarke-Groves payment schemes for auction problems.

Demonstrate *competence* such that the student is able to:

- Independently suggest the application of one of the models taught in class when confronted with a relevant real-world problem.
- Identify the weaknesses of the various algorithms taught. In particular, compare and contrast deferred acceptance with top-trading-cycles.
- Identify novel applications of the theory, along with any deficits in the theory preventing it from being immediately applied here.

### Literature:

*Examples:*

Tarik, and Tayfun Sönmez. 1996. "Nash Implementation of Matching Rules." *Journal of Economic Theory* 68 (2): 425–39. <https://doi.org/10.1006/jeth.1996.0024>.

Krishna, Vijay. 2010. *Auction Theory*. Burlington, MA: Academic Press/Elsevier.

Alvin E. 1982. "The Economics of Matching: Stability and Incentives." *Mathematics of Operations Research* 7 (4): 617–28. <https://doi.org/10.1287/moor.7.4.617>.

Alcalde, José, and Salvador Barberà. 1994. "Top Dominance and the Possibility of Strategy-Proof Stable Solutions to Matching Problems." *Economic Theory* 4 (3): 417–35. <https://doi.org/10.1007/BF01215380>.

Sönmez, Tayfun. 1994. "Strategy-Proofness in Many-to-One Matching Problems." *Economic Design* 1 (1): 365–80. <https://doi.org/10.1007/BF02716633>.

Abdulkadiroğlu, Atila, and Tayfun Sönmez. 2003. "School Choice: A Mechanism Design Approach." *The American Economic Review* 93 (3): 729–47.

Baïou, Mourad, and Michel Balinski. 2007. "Characterizations of the Optimal Stable Allocation Mechanism." *Operations Research Letters* 35 (3): 392–402. <https://doi.org/10.1016/j.orl.2006.06.004>.

Shapley, Lloyd, and Herbert Scarf. 1974. "On Cores and Indivisibility." *Journal of Mathematical Economics* 1 (1): 23–37. [https://doi.org/10.1016/0304-4068\(74\)90033-0](https://doi.org/10.1016/0304-4068(74)90033-0).

Roth, Alvin E. 1982. "Incentive Compatibility in a Market with Indivisible Goods." *Economics Letters* 9 (2): 127–32. [https://doi.org/10.1016/0165-1765\(82\)90003-9](https://doi.org/10.1016/0165-1765(82)90003-9).

Roth, Alvin E. 1982. "Incentive Compatibility in a Market with Indivisible Goods." *Economics Letters* 9 (2): 127–32. [https://doi.org/10.1016/0165-1765\(82\)90003-9](https://doi.org/10.1016/0165-1765(82)90003-9).

Additional material is to be assigned during the course, e.g. articles from scientific journals, working papers, and reports. All of these will be accessible via the library.

#### **Time of classes:**

#### **Scheduled classes:**

Form of instruction:

These teaching activities result in an estimated distribution of the work effort of an average student as follows:

Face-to-face teaching -  
Preparation -  
Assignments -  
Examination preparation -  
Examination -  
Total 270 hours

#### **Time of examination:**

Ordinary exam in \*\*\*\*\* and re-examination in \*\*\*\*\*.

Registration for the course is automatically a registration for the ordinary examination in the course. Cancellation is not possible. If the student does not participate in the examination, the student will use an examination attempt.

The university may grant an exemption from the rules in case of exceptional circumstances.

Examination form at the re-exam can be changed.

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#### **Form of examination for the certificate:**

Written examination (with pc).

Supplemental information for the form of examination:

Duration: \*\*\*\*\*.

Location: Examination room at the university. Examination takes place using the student's own computer being able to access the university wireless network.

Internet Access: Necessary.

Hand Out: In the examination room.

Hand In: Via SDUassignment in the course page in Blackboard.

Extent: No limitations.

Exam Aids: No exam aids are allowed.

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The examination randomly tests the student's attainment of the course goals. Students are supposed to apply, reflect on and generalize the concepts taught in class.

Comments:

Examination for external guest students: Internal grading.

Programmes: