



## *The Hebrew University of Jerusalem*

### *Syllabus*

## *Mathematics in Society - 80309*

*Last update 22-09-2024*

*HU Credits: 2*

*Degree/Cycle: 1st degree (Bachelor)*

*Responsible Department: Mathematics*

*Academic year: 0*

*Semester: 2nd Semester*

*Teaching Languages: Hebrew*

*Campus: Mt. Scopus*

*Course/Module Coordinator: Shulamit Solomon*

*Coordinator Email: [shulamit.solomon@gmail.com](mailto:shulamit.solomon@gmail.com)*

*Coordinator Office Hours: By appointment*

*Teaching Staff:*

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Dr. Solomon Shulamit

Course/Module description:

*How do we determine the winner of an election? How many votes should a shareholder get in a corporate voting? Are the seats in the knesset distributed fairly? How do I make all siblings satisfied with a division of inheritance? And finally, how do I handle my morgage?*

Course/Module aims:

*The goal of this hands-on course is to discover a largely unfamiliar and user-friendly side of mathematics that is both practical, accessible, beautiful and fun.*

Learning outcomes - On successful completion of this module, students should be able to:

- use four different voting methods to determine winners of elections, and to rank the candidates*
- understand that different voting methods applied to the same election can produce different results*
- formulate certain mathematically precise notions of fairness and determine whether particular election results violate them*
- understand that every voting method eventually violates one of these notions of fairness*
- use Banzhaf and Shapley-Shubik methods to compute how power is distributed in a weighted voting system, including systems such as the UN Security Council*
- understand that proportional voting schemes do not necessarily lead to proportional distribution of power*
- apply apportionment methods in both political and other contexts*
- analyze Alabama Paradox scenarios arising in apportionment*
- understand and apply the Divider-Chooser, Lone Divider, and Lone Chooser methods for dividing valuable continuous goods, and the Method of Sealed Bids and Method of Markers for distributing valuable discrete goods, fairly*
- understand that if these methods are applied correctly, all players are guaranteed fair shares*
- understand and apply the notion of compound interest and the notion of annuity to solve problems related to loans and savings plans*
- apply these notions to other contexts, such as population growth and decline*

Attendance requirements(%):

Teaching arrangement and method of instruction: Lecture

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Course/Module Content:

- Voting Theory
  - Measuring Power
  - Apportionment
  - Growth and Finance
  - Fair Division
  - Fair Distribution
- \*subject to change

Required Reading:

Weingart M., Seneres A., *Topics in Math for Liberal Arts*

Additional Reading Material:

Grading Scheme:

Written / Oral / Practical Exam 55 %  
Presentation / Poster Presentation / Lecture/ Seminar / Pro-seminar / Research proposal 5 %  
Submission assignments during the semester: Exercises / Essays / Audits / Reports / Forum / Simulation / others 40 %

Additional information: