

MATH 130

Study Guide for Exam 1, Chapters 1 and 2

This is a list of topics that could be used to generate questions for Exam 1. Pages and questions from the text are included, but be sure to also study the types of problems from the online material, and items covered in class.

- Chapter 1: Voting

1. Summarize a collection of ballots using a preference schedule. (questions 1,2 on page 28)
2. Interpret a top choice ballot, preference ballot and preference schedule. (pages 4-9, questions 7,8 on page 29)
 - (a) Determine number of voters.
 - (b) Determine the number of votes needed for a majority.
 - (c) Identify which candidate has the most first place votes.
 - (d) Explain the difference between having the most first place votes and having a majority of votes.
 - (e) Interpret a preference schedule after one or more candidates are eliminated.
 - (f) Identify a Condorcet Candidate.
3. Given a preference schedule, apply the following voting methods to rank candidates:
 - (a) plurality method (pages 10-12, questions 11-16, 20 on pages 29 and 30)
 - (b) borda count method (pages 12-14 and questions 21-24, 27-30 on page 31)
 - (c) plurality-with-elimination method (pages 15-19 and questions 31-38 on pages 31 and 32)
 - (d) method of pairwise comparisons (pages 19-22 and questions 41-44, 47-50 on pages 32 and 33)
4. Recognize Arrow's Impossibility Theorem and the following fairness criteria, and identify any violations. (pages 22-26 and questions 51-60 on page 33)
 - (a) The Majority Criterion
 - (b) The Condorcet Criterion
 - (c) The Independence of Irrelevant Alternatives Criterion
 - (d) The Monotonicity Criterion
5. Evaluate an election for fairness based on the four fairness criteria.
6. Compare and contrast voting methods and analyze for fairness, flaws and benefits.
7. Construct examples to illustrate fairness violations.
8. Formulate a voting strategy to manipulate an election.

- Chapter 2: Weighted Voting

1. Know the following vocabulary terms: (page 58)

- | | | |
|--------------------------|---------------------|------------------------|
| – weighted voting system | – veto power | – critical count |
| – motion | – coalition | – sequential coalition |
| – player | – grand coalition | – factorial |
| – weight | – winning coalition | – pivotal player |
| – quota | – losing coalition | – pivotal count |
| – dictator | – critical player | – permutation |

2. Weighted voting introduction (pages 38-40 and questions 1-10 on pages 59 and 60)

- (a) Describe a weighted voting system using the standard notation.
- (b) Calculate the quota from a verbal description.
- (c) Calculate the smallest and largest possible quota values.
- (d) Identify if a player is a dictator, has veto power, or is a dummy (pg 47).
- (e) Construct or modify a weighted voting system so that a player is a dictator, or has veto power, or has no power.

3. Banzhaf Power (pages 41-49 and questions 11-26 on pages 60 and 61)

- (a) Compute the number of coalitions given the number of players. (see also page 55)
- (b) List coalitions.
- (c) Identify winning coalitions and losing coalitions.
- (d) Identify critical players.
- (e) Compute the critical count for each player.
- (f) Compute the power distribution using the Banzhaf definition of power.

4. Shapley-Shubik Power (pages 50-54 and questions 27-38 on pages 61 and 62)

- (a) Compute the number of sequential coalitions given the number of players. (see also page 56)
- (b) List sequential coalitions.
- (c) Identify pivotal players.
- (d) Compute the pivotal count for each player.
- (e) Compute the power distribution using the Shapley-Shubik definition of power.