Using Computer Modeling for Estimating Manipulability of Social Choice Rules

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Coalitional Manipulation (Example)

Plurality Rule is considered

Number of agents	3	2	2
1-st place	a	b	c
2-nd place	b	c	b
3-rd place	c	a	a

Social choice: {a}

Number of agents	3	2	2
1-st place	a	b	<u>b</u>
2-nd place	b	c	<u>c</u>
3-rd place	c	a	a

Social choice: {b}

Framework

1. Voting procedure (not dictatorial) with n agents and m>2 alternatives
2. Each agent has preferences (linear order)
3. Social choice is calculated on the basis of preferences

Manipulation problem: an agent or a group of agents deviate their preferences to obtain a better social choice

Every not dictatorial social choice rule is manipulable (Gibbard(1973), Satterthwaite(1975))

Nitzan-Kelly index

n – number of agents (voters)
m - number of alternatives
$m!$ – number of different preferences (linear orders)
$(m!)^n$ - total number of profiles (profile – the set of preferences of n agents)
d_0- number of profiles, where manipulation may take place

$$NK = \frac{d_0}{(m!)^n}$$

From individual to coalitional manipulability

1. A coalition consists of several agents with the same preferences
2. All members of the coalition deviate their preferences in the same way

$$NK_{coalitional\ k=l} = \frac{d_0}{(m!)^n}$$

where l – maximum number of agents in one coalition
d_0 - the number of profiles where coalition of l
or less agents may manipulate

Voting rules

8 Positional Voting Rules are considered
1. Approval q=2
2. Plurality
3. Borda's Rule
4. Black's Procedure
5. Nanson's Procedure
6. Threshold Rule
7. Hare's Procedure
8. Inverse Plurality Rule

Extended preferences

Extended preferences: allow an agent to compare all possible social choices
There are several rules to construct extended preferences.
In this work we consider
1. Leximin
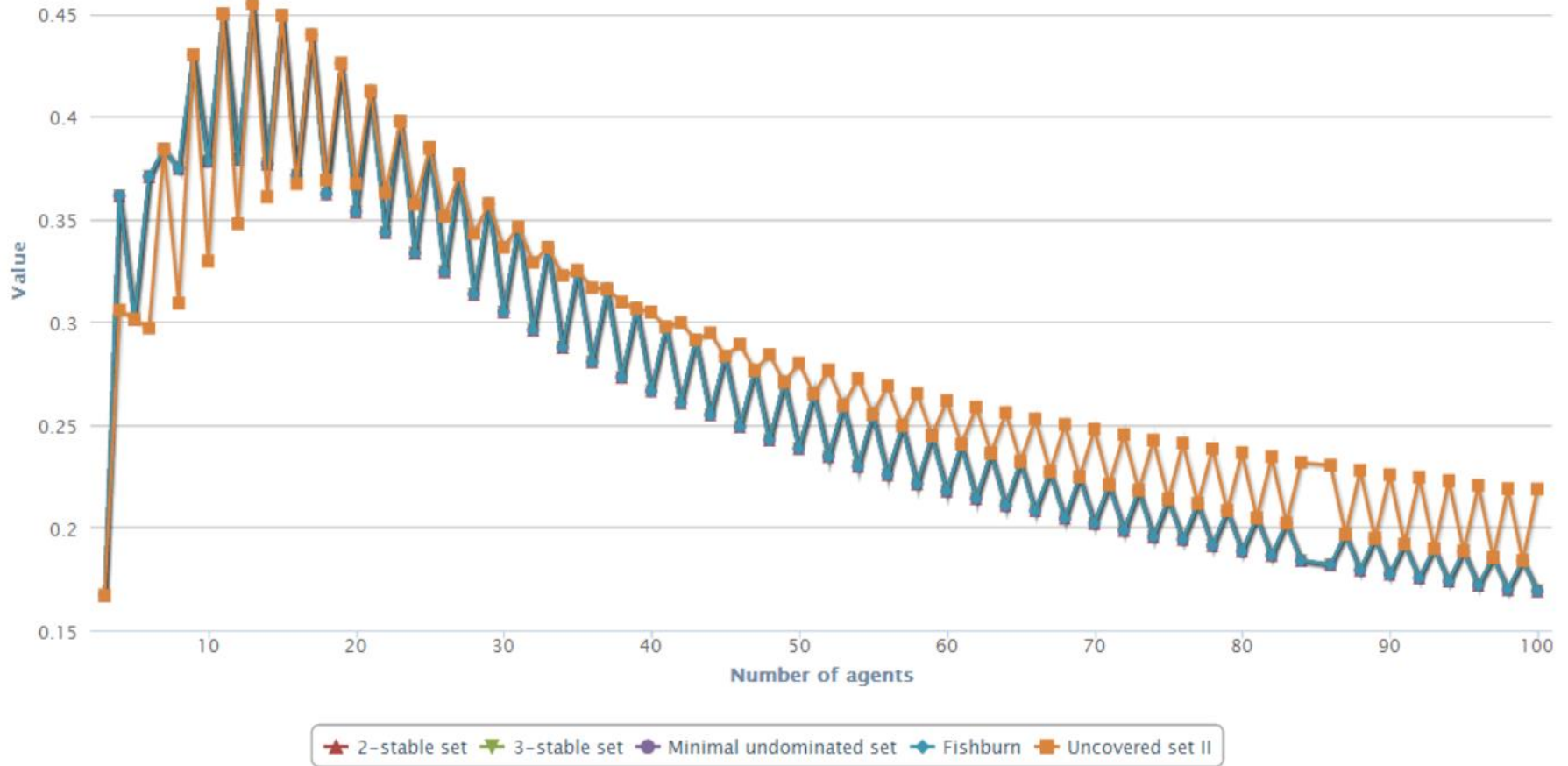2. Leximax
3. Risk-lover
4. Risk-averse

Computer Modeling

1. Generate a profile (voting situation)
2. Consider all possible coalitions and possible attempts to manipulate
3. Check whether the profile is manipulable
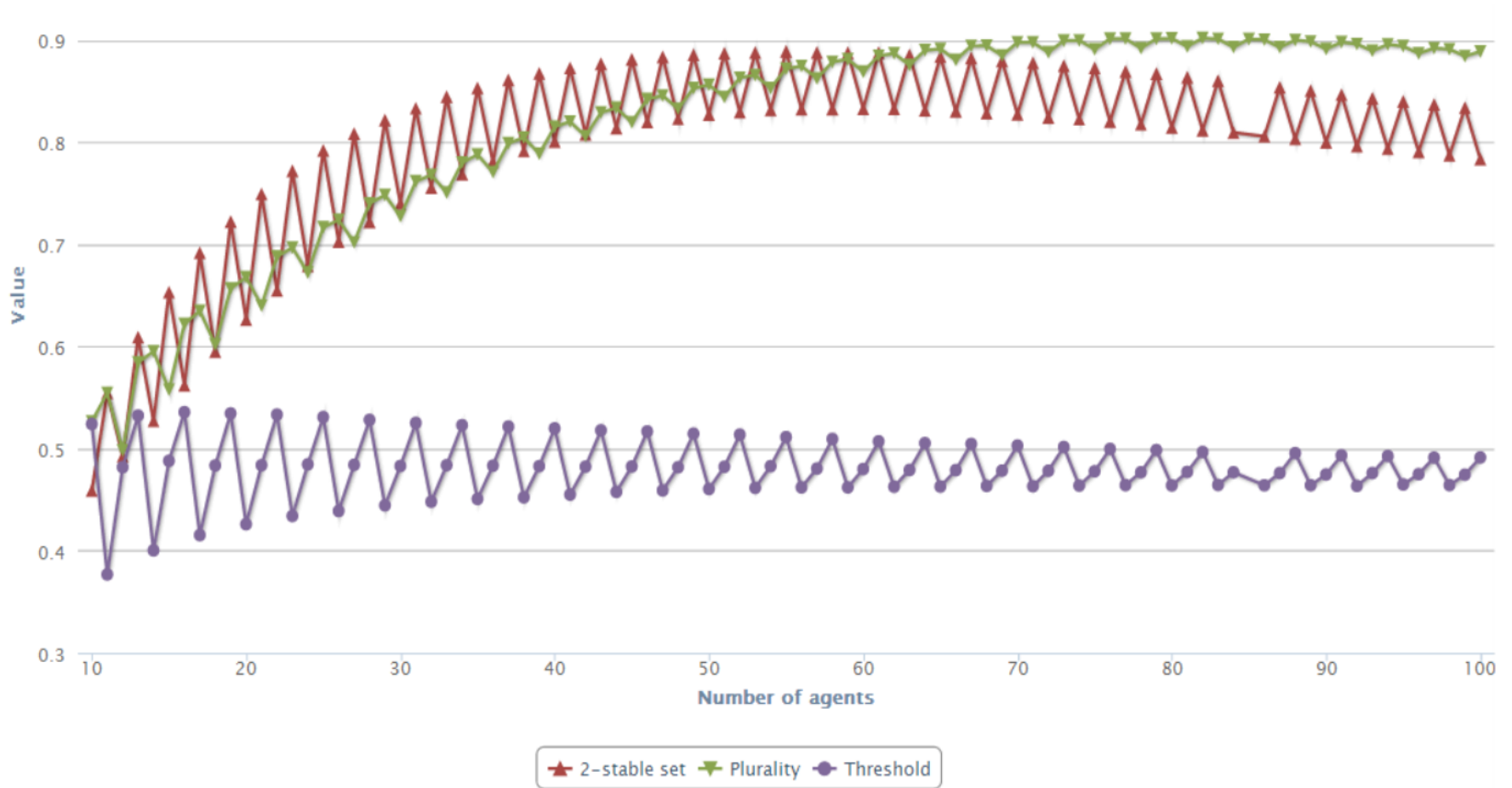4. If yes, increase d_0 by 1

We consider 1,000,000 profiles to get results for NK indices for every m and n

The problem implies lot of computation

l=2, 3 alternatives, Leximax

l=2, 3 alternatives, Leximax

Results

Several months of computations
5 machines
Multiple threads

m = 3,4,5 alternatives
n = 3..100 agents

manip.hse.ru

Thank you!

Questions?