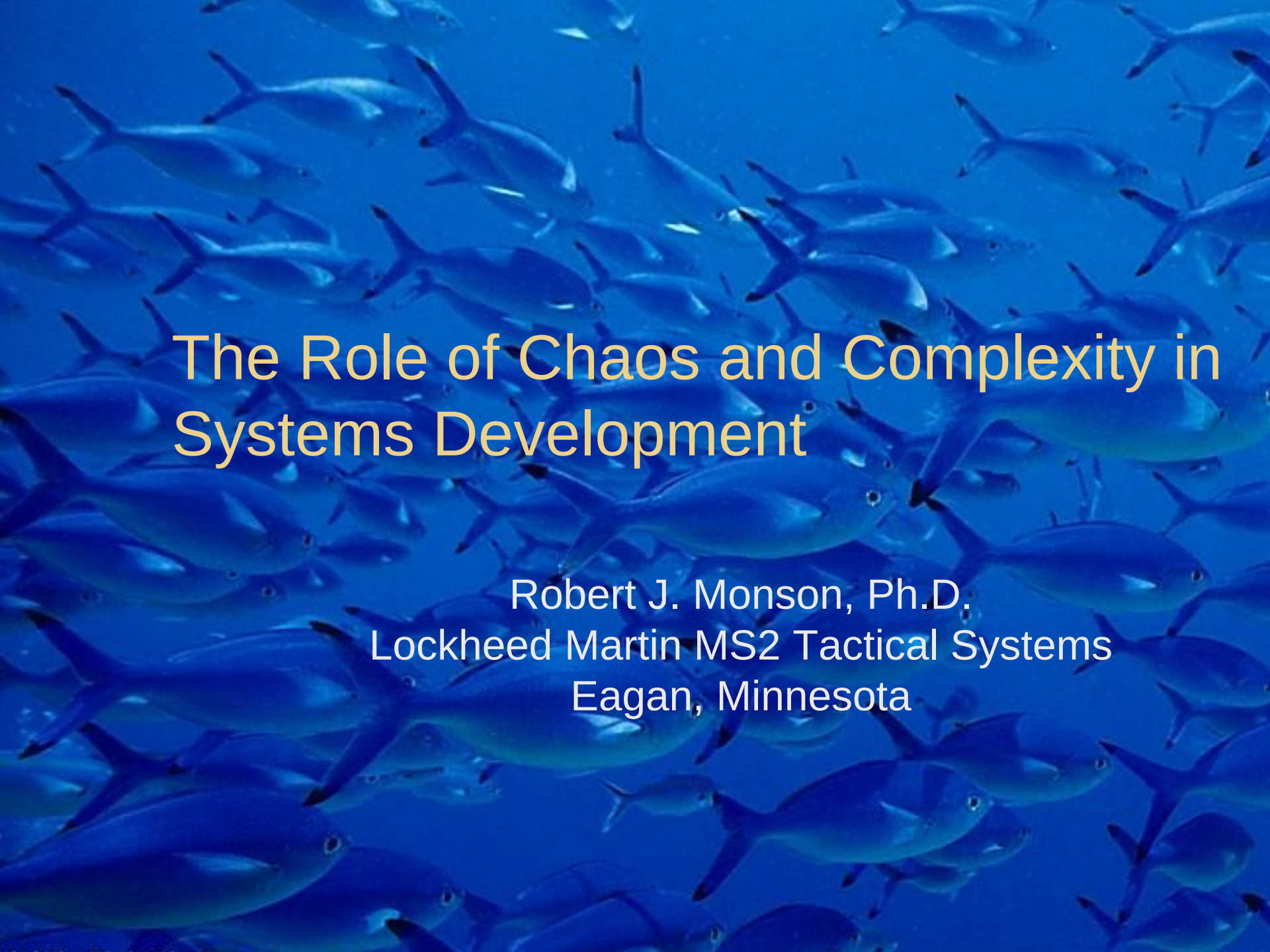

The Role of Chaos and Complexity in Systems Development

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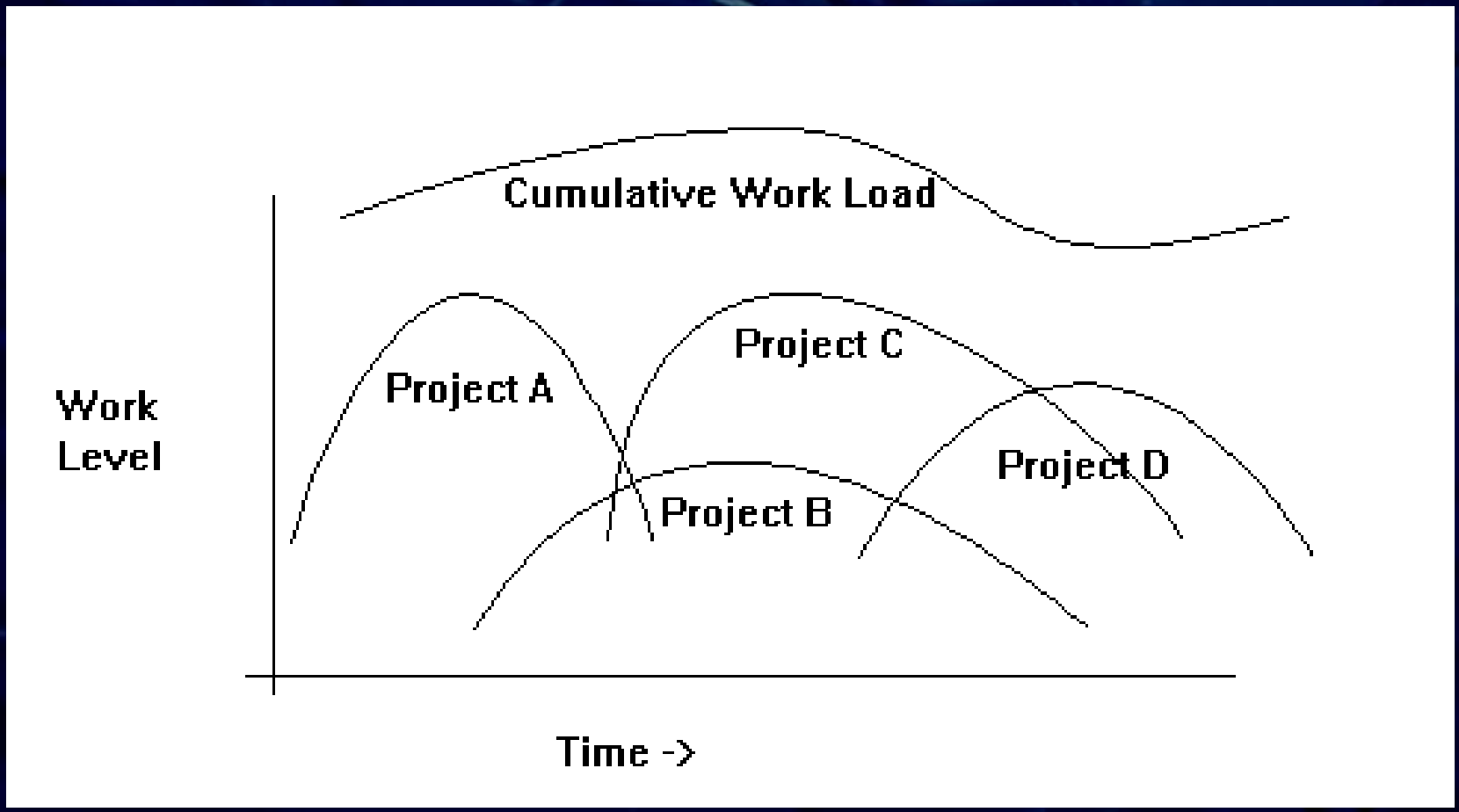
Chaos and Complexity

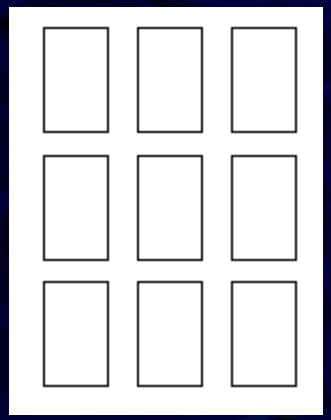
- The Bak Sandpile model
  - Defines the behavior of a simple system
  - Representative of many physical and organizational systems
  - Provides insight into an appropriate method to plan and manage systems

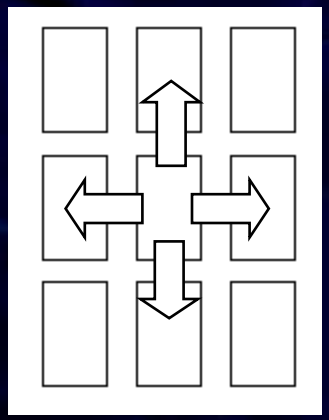
Why do we care?



How does the model work?

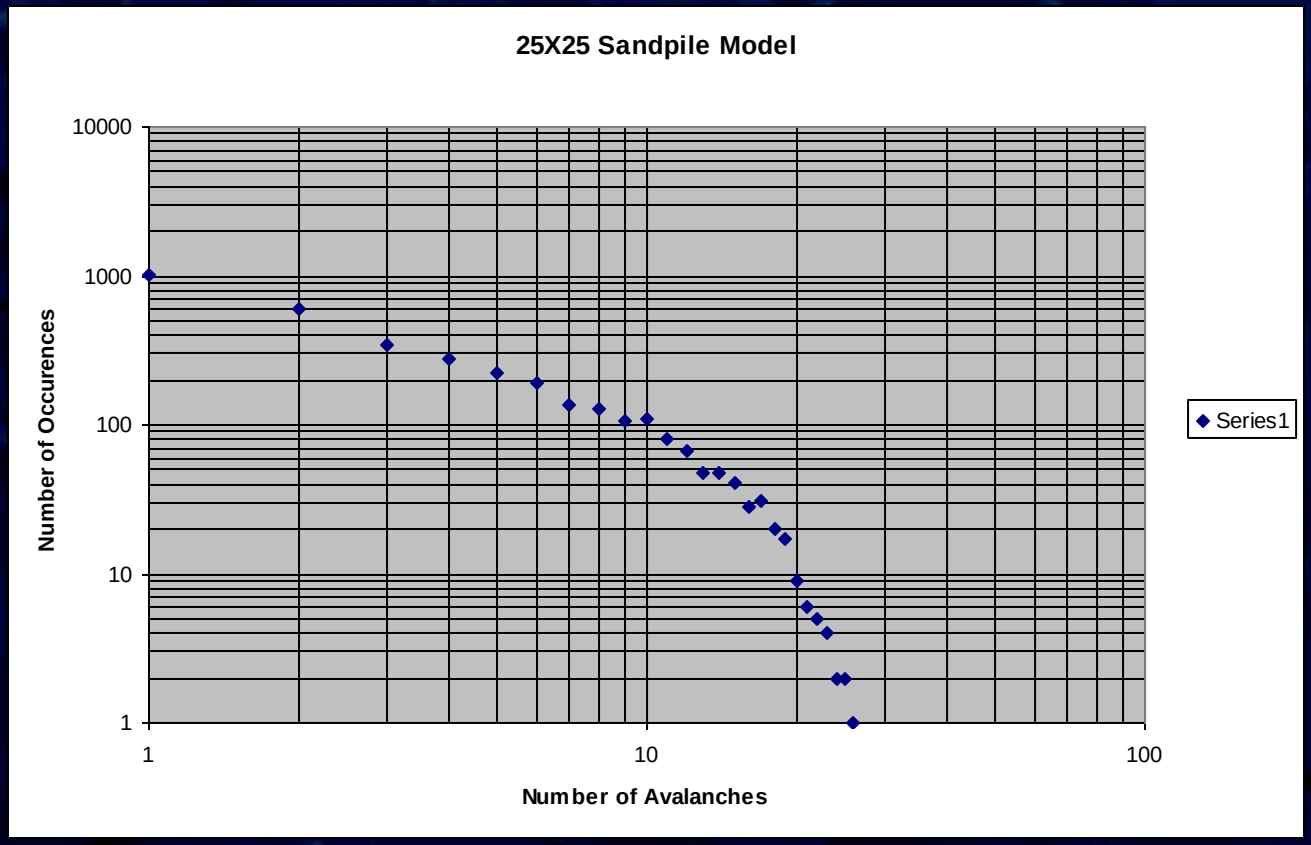
- Complex Systems are frequently governed by simple rules





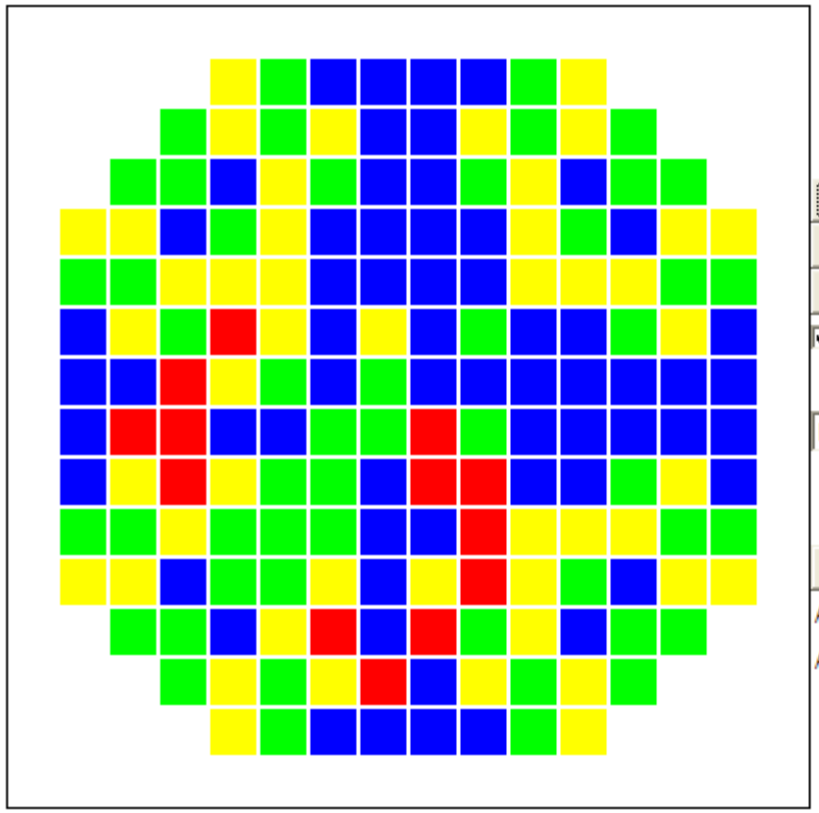
1. Add 1 item randomly to any pile
2. If any pile >= 4 items, distribute 4 items

Typical Results



The Sandpile Model

- Examples utilizing a 3 X 3 matrix
  - Previous example
- Larger examples do not exhibit such a dramatic edge effect
  - 25 X 25 model used most commonly
  - Use simulation to provide behavior information



Ready..

Go!

One Step

Reset

Slow Animation

Select view:

Histogram

System Size:

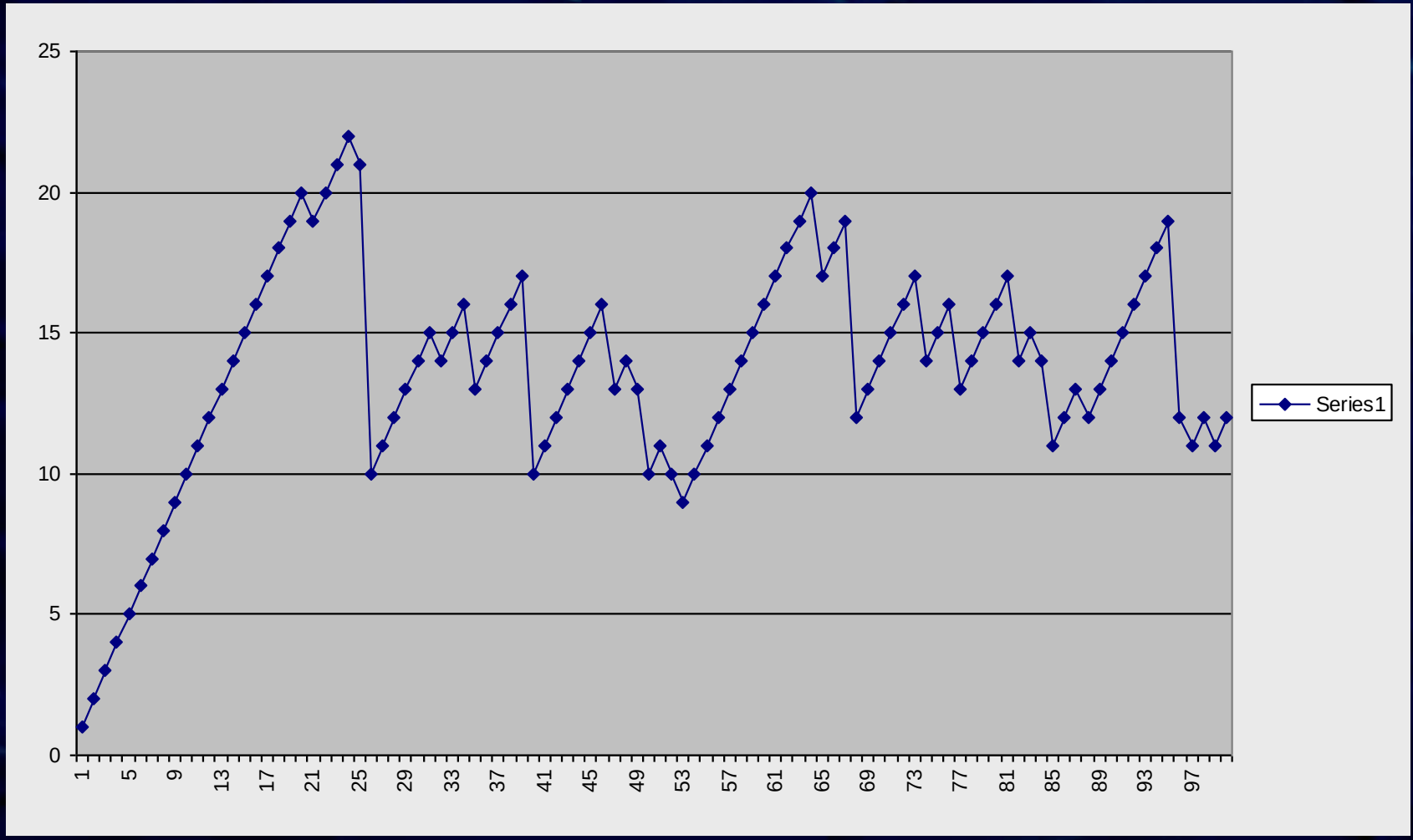
16

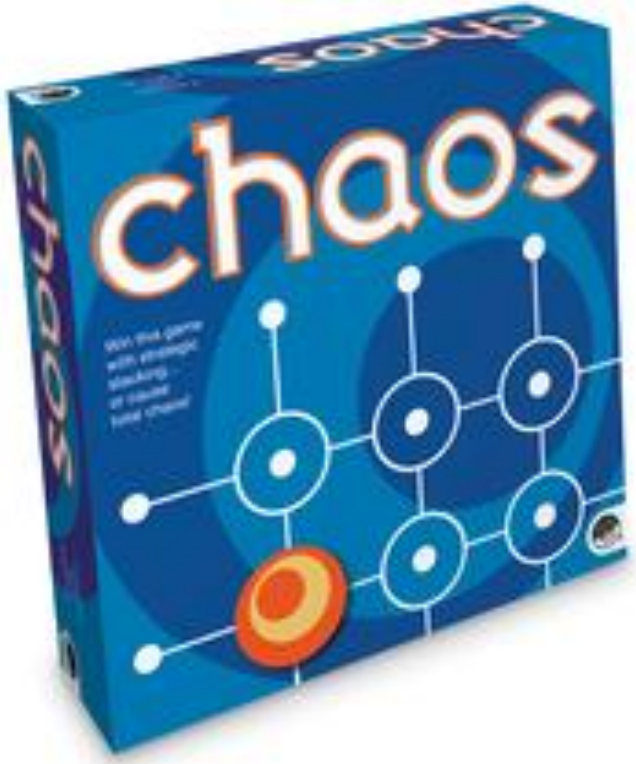
Avalanches: N/A

Aval. size: N/A

- yellow box -- one particle
- green box -- two particles
- blue box -- three particles
- red box -- four particles, critical (unstable) state

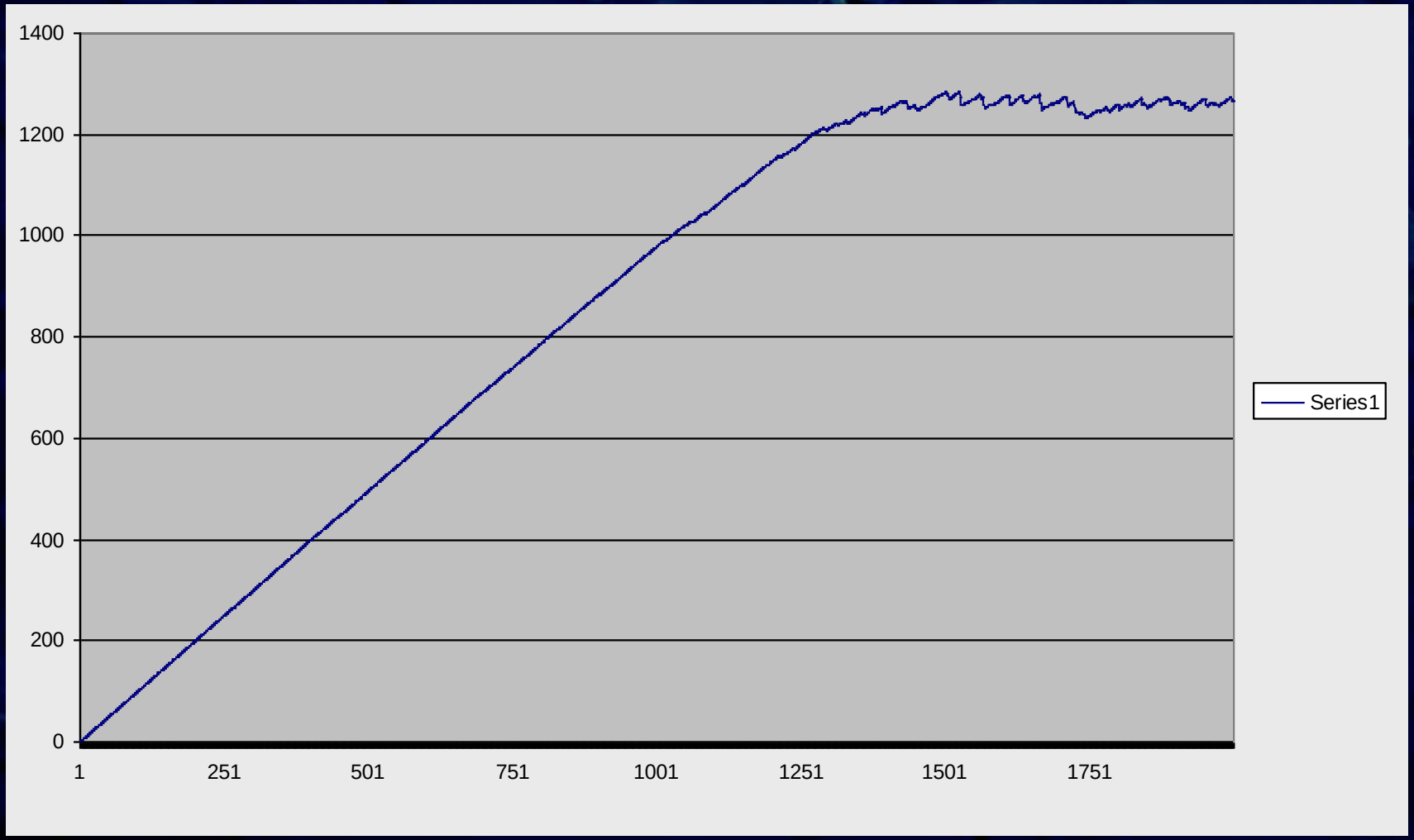
3 X 3 matrix 100 points



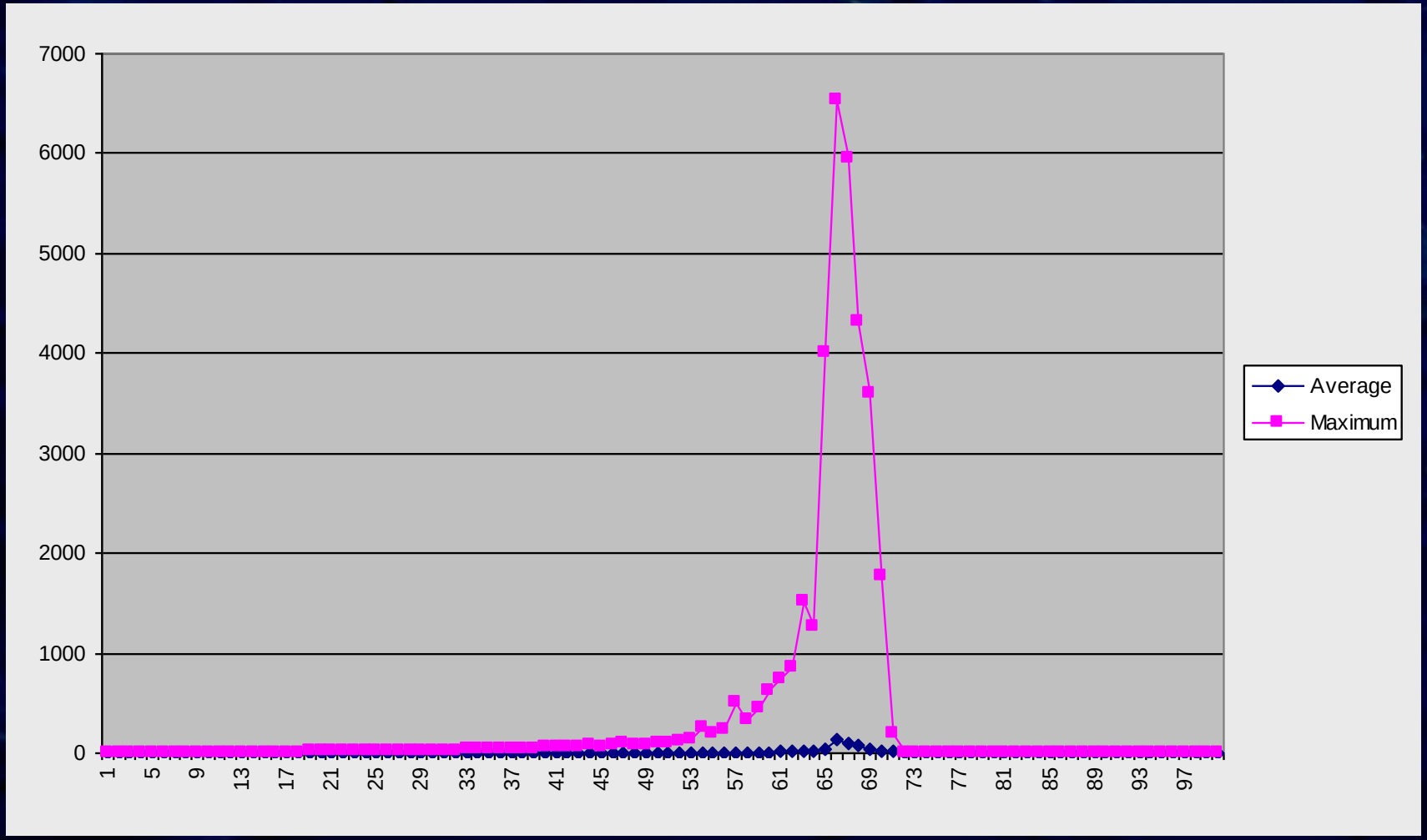

chaos
chaos


chaos
chaos

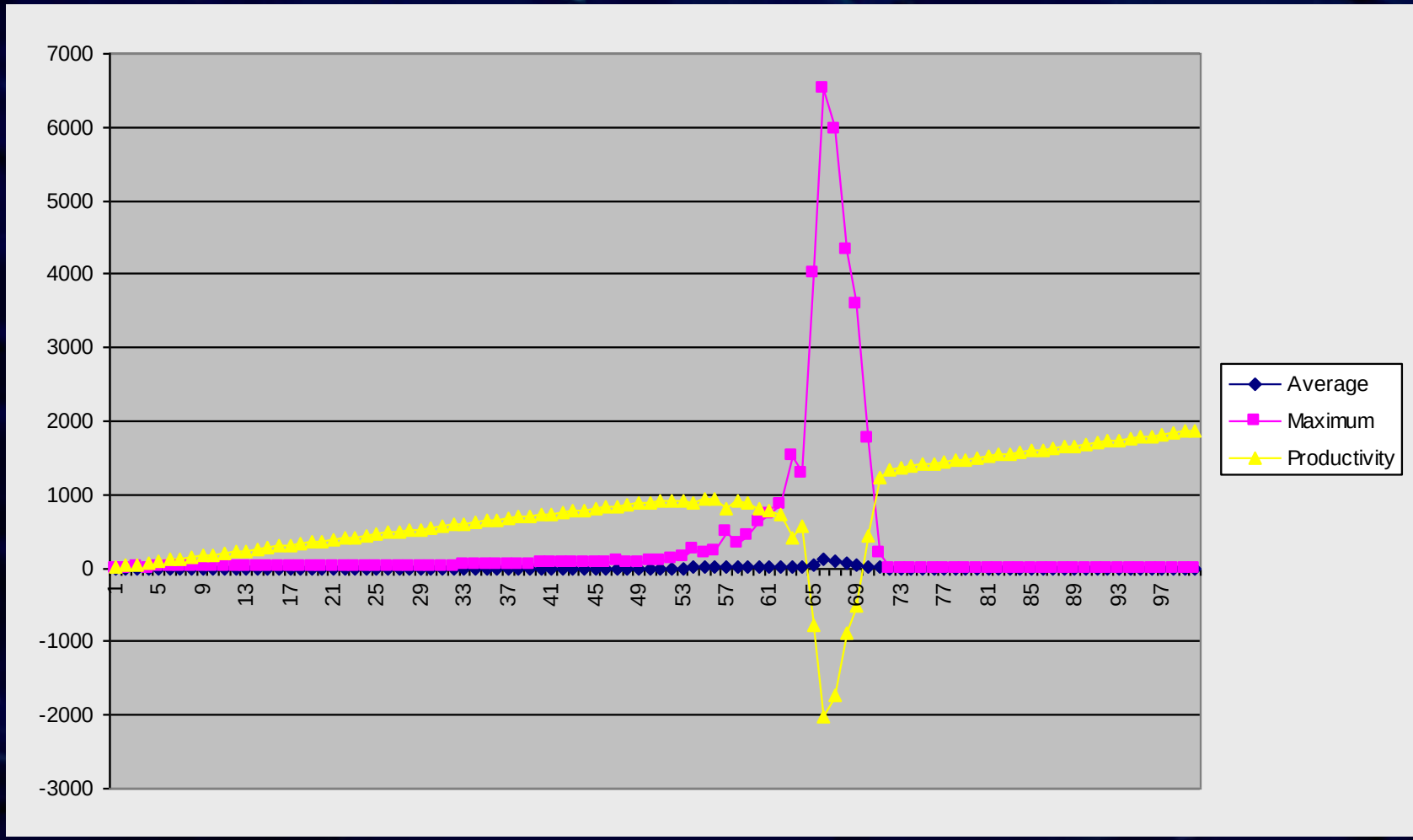
25 X 25 matrix, 2000 pts



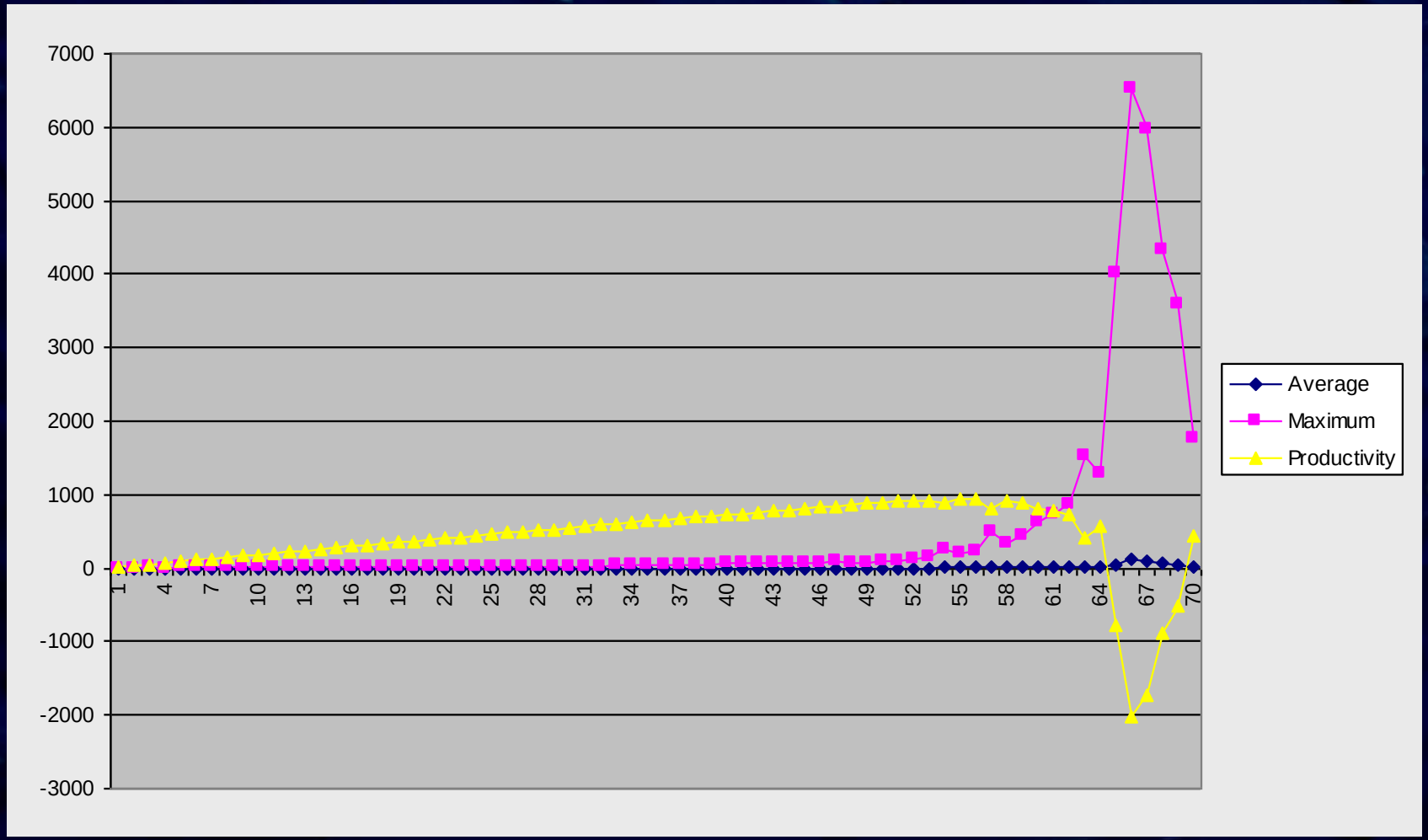
25 X 25, 2M points, 1875 Normalized



25 X 25, 2M points, 1875 Normalized



25 X 25, 2M points, 1875 Normalized



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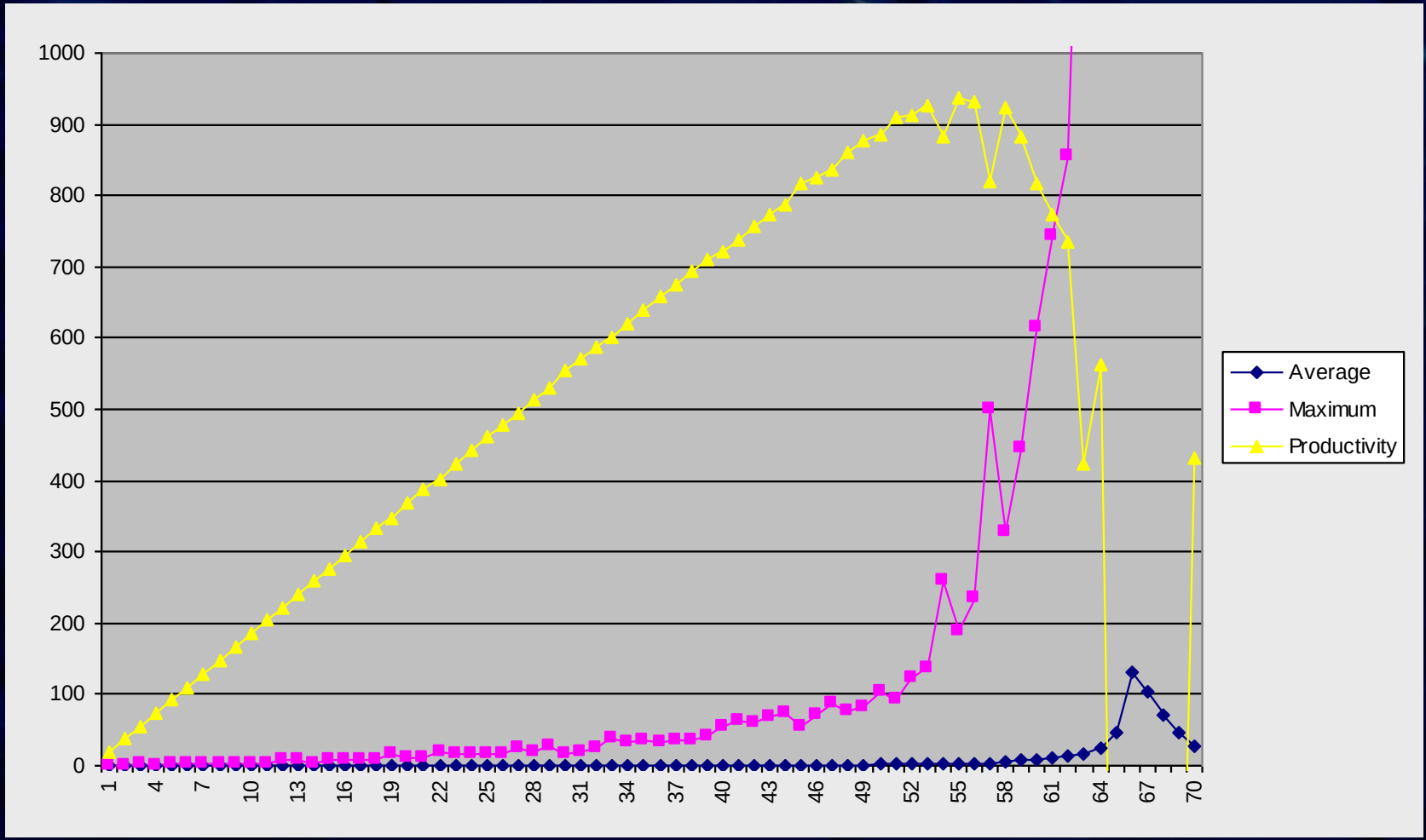


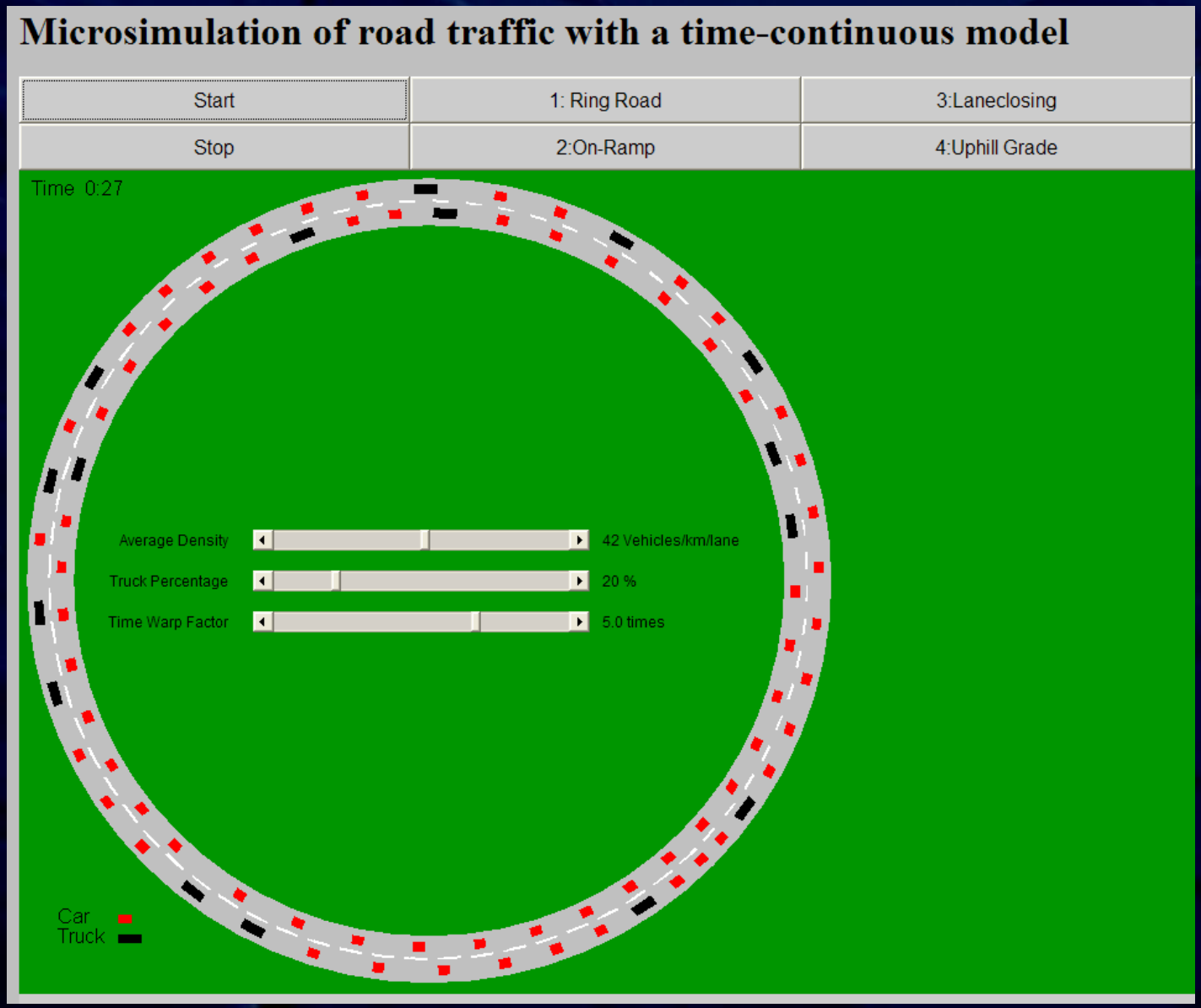
Some Examples

- Physical Models
- Traffic Patterns
- Complex Interactions in Organizational Systems / Systems Development

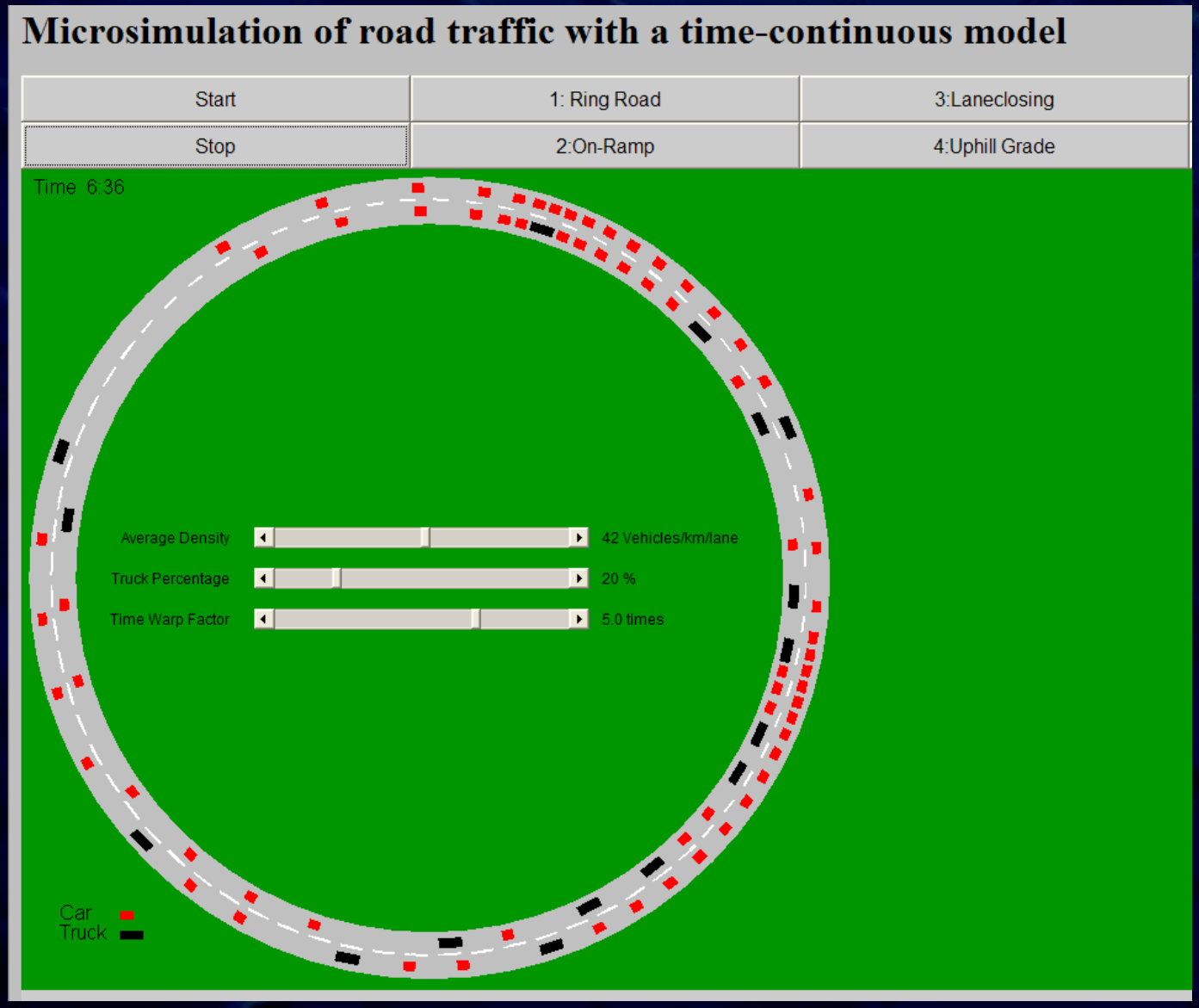
Physical Models

- Fish Schooling
- Oslo Experiment
  - Rice grains between sheets of glass
- Avalanches monitored

Traffic Patterns



Traffic Patterns



Organizational Systems

- Predictability of complex systems is effective in a generalized sense
  - I cannot know when and where earthquakes will occur, but I can know approximately how many to expect and typical magnitudes
  - Overall I will have a good idea what energy will be imparted by the earthquakes
  - This is good enough to know how to design structures for the region
- Systems Design requires predictability in order to achieve plans and projections

Systems Design

- To increase probability of success, we need to dramatically increase operational predictability
- Scheduling work with a consideration for 75% efficiency provides this added predictability
  - Since we do not know what specific disturbances will occur
  - We do not know when they will occur or what magnitude they will be
  - But we know that on average that 25% of our time will be consumed by them

Conclusions

- A complex system will organize itself into a critical (or unstable) state
- We know that a certain amount of disturbances and resultant avalanches within our Systems Development is unavoidable
- We don’t know specifics, but we know 25% of our time will be consumed by interdependencies in the system
- We can increase our probability of success by planning personnel at 75% capacity, which should be treated as our maximum productivity
- This purposeful detuning of the system results in fewer catastrophes with less catastrophic Systems Development results

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