#### Playing Dice with Epidemics

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• Stochastic Process: A stochastic process is a family  $\{X_t : t \ge 0\}$  of random variables  $X_t$  that evolve through time  $t \ge 0$ .

• **Stochastic Process:** A stochastic process is any process that evolves randomly through time.

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- Finance
- Queuing systems

- Insurance market
- Cell Biology
- Epidemiology

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#### Applications in Weather Forecast





#### • What is the probability of raining tomorrow at Leeds?

- What is the total rainfall expected for tomorrow?
- What is the average rainfall expected for the next month? (Predictions, logistics,...)
- What is the expected wind during the next hour? (Airports, rocket launch,...)

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- If I invest 1000 GBP in this company. What is the probability that I will get profits after 1 month?
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Prediction about the end of the outbreak



Analysis of possible control strategies



Analysis of possible control strategies



Comparison between existing control strategies

Let us consider a particle that moves through positions 0, 1,  $\dots$ , 9. At each step (for example, every day), the particle:

- Moves left with probability p,
- Moves right with probability 1 p.



- When at position 9, the particle moves left with probability one in the next step (*reflecting barrier*),
- When the particle arrives to 0, the process finishes.

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#### Note:

• What is the probability that the particle arrives in 0 in 1 step?

- And in 2 steps?
- And in 3 steps?
- And in 7 steps?

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#### Markov processes

We can carry out these arguments because this is a it Markov process

#### a Markov process is a stochastic process for which the future can be analysed only by knowing its present state, without knowing the past

A. A. Markov, Rasprostranenie zakona bol'shih chisel na velichiny, zavisyaschie drug ot druga, Izvestiya Fiziko-matematicheskogo obschestva pri Kazanskom universitete, 2-ya seriya, tom 15, 9 4, 1906, 135-156

#### Andrey Andreyevich Markov



#### Pavel Nekrasov



#### Markov processes



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Acco

#### Markov chain

From Wikipedia, the free encyclopedia

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19 See also





Choose p = 0.6:

- What is the probability that it arrives in 0 after 1 step? And after 2? And after 3? And for a general value of p?
- Imagine that someone offers you 10£ if, in one simulation, the particle arrives exactly after 5 steps. What probability p would you choose?

