

# Limit Theorems For Markov Chains And Stochastic Properties Of Dynamical

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1. Limit theorems for Markov chains 1 2. Stochastic properties of dynamical Systems 2 3. Historical background to the method 3 4. Purpose of the paper 4 II. The central limit theorems for Markov chains 6 1. The concept of quasi-compact Operator 6 2. Conditions  $\rho_m$  and  $V$ , notations  $A_f$  8 3. Statements of the central limit theorems 11 III.

fer operator. This contributes towards a better understanding of the concept of dynamical phase transitions and the properties of the output measurement process in general. In general, the existence of a LDP for a stochastic process does not imply that the process also satisfies a central limit theorem (CLT).

can establish stochastic properties, in general, and further  $\rho_m$  stochastic properties, like local limit theorems, in particular. The choice of local limit theorems may seem eventual but it is not. This will be clear from section 4, where we apply the local limit theorems to planar dispersing billiards. In

ample of a Markov chain on a countably infinite state space, but first we want to discuss what kind of restrictions are put on a model by assuming that it is a Markov chain. Within the class of stochastic processes one could say that Markov chains are characterised by the dynamical property that they never look back.

[3] H. Hubert, L. Hervé, *Limit Theorems for Markov Chains and Stochastic Properties of Dynamical Systems by Quasi-Compactness* Springer-Verlag Berlin Heidelberg (2001) [4] R. Montenegro, P. Tetali, *Mathematical Aspects of Mixing Times in Markov Chains*, *Journal Foundations and Trends in Theoretical Computer Science*, (2006)

The following is a list of models, each being both stochastic and dynamical. Random walks Law of large numbers Markov chains and ergodic distributions Central limit theorem Domain of attraction in limit theorems Extreme value theory and other transformations Functional limit theorems Monte-Carlo techniques 6

Extended renovation theory and limit theorems for stochastic ordered graphs 417 The two functional central limit theorems hold both for the stationary version of the infinite bin model as well as the infinite bin model that starts from a trivial initial state (transient infinite bin model). From a physical point of view,

most commonly discussed stochastic processes is the Markov chain. Section 2 describes Markov chains and goes through their main properties as well as some interesting examples of the actions that can be performed with Markov chains. The conclusion of this section is the proof of a fundamental central limit theorem for Markov chains.

0, in particular, to functions of Markov chains satisfying Doeblin's condition or to those which are constructed from sufficiently fast mixing dynamical systems. The continuous time version holds true, in particular, when  $X(t)$  is a function of an irreducible continuous time Markov chain or of a non-

2 Limit theorems 25 2.1 Probability spaces, random variables, independence . . . . . 25 [103], for Markov chains to [26, 90], for entropy and Markov operators [62]. For applications in physics and chemistry, see [111]. Geometry or dynamical systems. As with any fundamental mathematical construction, the theory starts by adding more

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#### 4.9 Dynamical Systems and Markov Chains Part 1

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(ML 18.3) Stationary distributions, Irreducibility, and Aperiodicity Definitions of the **properties** of **Markov chains** used in the Ergodic **Theorem**: time-homogeneous MC, stationary distribution of a