Ising model on random graphs with non-limited range of interactions

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Abstract

The Ising model, renowned for its simplicity and effectiveness in capturing phase transitions, serves as a powerful tool to analyze the emergent properties of complex systems. The core objective of this research is to unravel the implications of non-limited interaction ranges in the context of random graphs. Traditional Ising models often assume a fixed range of interactions among neighboring spins. This work challenges that assumption by considering scenarios where interactions extend beyond the nearest neighbors, incorporating a broader and more realistic perspective on the interplay between spins.

1 Introduction

- brief historical overview of the Ising model and its significance in statistical physics
- define the Ising model and its conventional assumptions
- introduce the concept of random graphs and their relevance

2 Literature Review

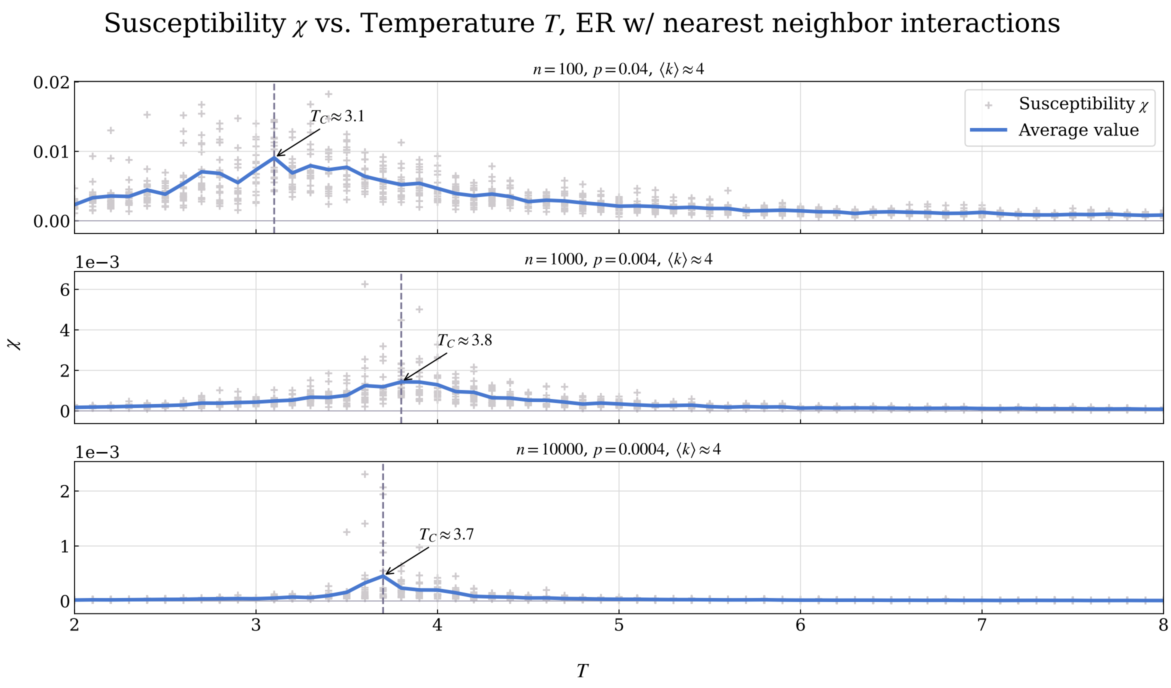
- review existing literature on the Ising model
- state the objectives and research questions.

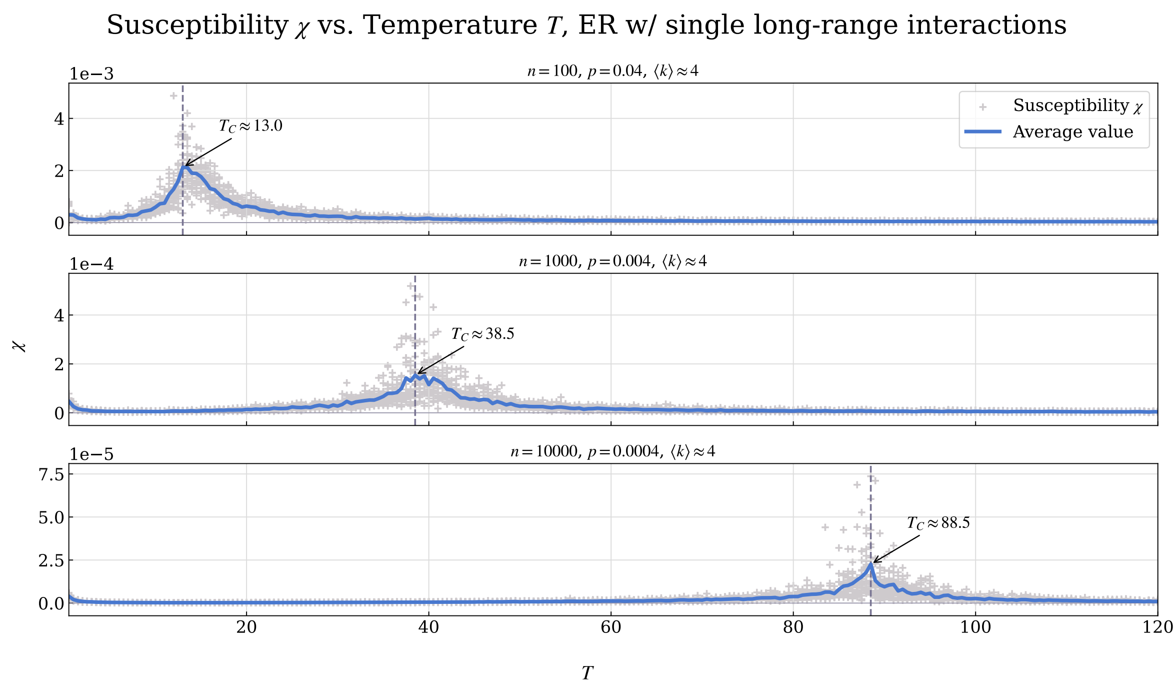
3 Theoretical Framework and Methodology

- derive relevant equations and describe the mathematical foundations.

4 Simulation Results and Analysis

TODO: differences between J generation methods with k constant

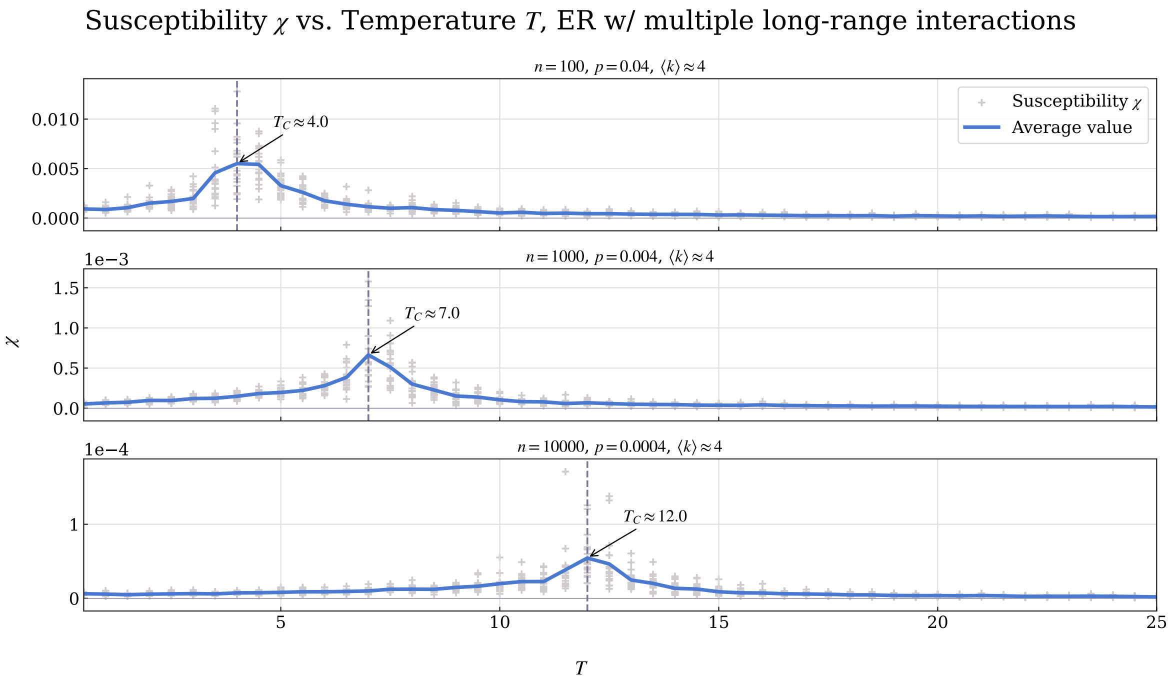




TODO: T_C vs. k with n kept constant

TODO: $e^{-\alpha k}$ vs. $1/k^{\alpha}$

TODO: T_C vs. α for exponential decay



Susceptibility χ vs. Temperature T, ER w/ multiple long-range interactions
$n = 100$, $p = 0.04$, $\langle k \rangle \approx 4$
$T_C \approx 4.0$
Susceptibility χ
Average value
$n = 1000$, $p = 0.004$, $\langle k \rangle \approx 4$
$T_C \approx 7.0$
$n = 10000$, $p = 0.0004$, $\langle k \rangle \approx 4$
$T_C \approx 12.0$
χ
T