

Ecological Genomics

Ecology is a vast subject with solid genetic, mathematical, and statistical underpinnings. The field is mature with many standard protocols for both experimental and theoretical studies. With the advent of genome era (since 2000's), even this evergreen field felt a way to enhance its reach by studying individual and population genomes (metagenomics). Many books have been written on the concepts and methodologies of ecological studies. We do not want to add redundancy to the already existing lot of standard textbooks. We will be specifically focusing on populations genetics and genomics in this book. We will adopt a computational approach.

In contrast to the age of information, we are in the age of data. Increasing amounts of data are being generated each year, in various disciplines and walks of life, and the need to analyze and create value from this asset is more important than ever. Institutions, individuals, and industries that know what to do with their data and how to do it well, will have a competitive advantage over others that don't tread the same path. Due to this, there will be an increasing demand for people who possess both the analytical and technical abilities to extract valuable insights from data and create valuable and pragmatic solutions that put these insights to practical use. This book provides multiple opportunities to learn how to create value/insights from genomics and other ecological data through a variety of individual projects.

The goal of this book is to introduce you to the ecological genomics as a discipline, emphasizing on computational aspects of the population studies. It also attempts to show you how it applies to a variety of different topics. This will make you comfortable enough to apply it in future to projects of your own. Along the way, you'll learn different analytical and programming techniques, and the fact that you are working through an actual project while learning will help cement these concepts and facilitate your understanding of them. I have found this example-based approach to be more fruitful, when compared to a highly technical and theoretical description of topics. I hope that the readers would easily sync with this approach. We have profusely used the freely available, open-source packages in R and Python. The datasets which come preinstalled with these packages, serve as a good starting point in cementing the basic concepts.

Each chapter stands on its own, with step-by-step instructions that include code snippets, and with a focus on practical application of computational tools in genomics. Focus is on practical understanding the concepts and its application in existing programming environments.

We start with a minimal introduction to the subject and quickly shift to programming lessons. We introduce BioPython in second chapter. Several worked examples are given. The third chapter deals with the usage of additional data processing skills specifically applicable to ecological models and examples. In Chapter 4, we introduce the basics of genetics and take the reader to the implementation of next generation sequencing (NGS) concepts in R. The next chapter introduces the basics of NGS data interpretation and the computational ways of addressing it. Chapter 6 introduces the core concepts of population genetics, from an ecological and evolutionary perspective. We introduce the reader to many computational tools and packages as we go on explaining many concepts. In Chapter 7, we introduce population genomics, which borrows the concepts from the previous chapter and presents more advanced analyzes. The final chapter introduces population stratification and the way in which can be addressed using computational tools.

We have extensively employed R in this book. Although, Python too has the same set of parallel modules available under different package implementations, we have chosen R for its nice integration with different statistical techniques and corresponding packages. It is my view that a computational take at this important subject is very much needed to get a good grasp of the important concepts. I wish the reader all the very best.



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