

Module 2 - Overview


Stochastic Processes and Probability Models

Goals

Students will gain a basic understanding of the concept of stochastic processes and probability models. Specifically, we will discuss random walks, Markov chains and Poisson processes in some detail. We will have some overview days near the end of the module that briefly introduces some more advanced topics for the interested student to pursue on their own.

Textbook

I feel guilty having you buy a book for a ~5 week module but I did find a resource through the Miami library system (free access!). We will essentially be covering the first 5 chapters in the text

[Stochastic Processes: An Introduction](https://proxy.lib.miamioh.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,ip&db=nlebk&AN=1984388&site=eds-live&scope=site&profile=eds-cat-jy)  (https://proxy.lib.miamioh.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,ip&db=nlebk&AN=1984388&site=eds-live&scope=site&profile=eds-cat-jy), by P.W. Jones (relevant PDFs will be posted)

Other resources I would consider for a course like this (you can likely get older versions of these cheap on ebay and other sites)

- [Introduction to Probability Models](#) by Ross
- [Stochastic Processes](#) by Ross
- [An Introduction to Stochastic Modeling](#) by Taylor and Karlin

Class breakdown/workload

I plan to structure this module such that there is 100 points to be earned over the next 5ish weeks. My anticipated breakdown (subject to change) is

- Three assignments worth 80 points
- An exam (on April 3) worth 20 points

Assignments

Each of the modules in STA 651 and 652 have a distinct curriculum that requires differing mechanisms to assess students (think STA 563 vs STA 504, the courses are fundamentally different and require different assessment tools). I think of this stochastic module in the vein of Regression (563), Design (566) and Time Series (583). As such, your assignments will be a mix of derivation and computing type problems.

Fisher contact information

- Email: fishert4@miamioh.edu (<mailto:fishert4@miamioh.edu>)
- Office hours:
 - Mon & Wed, 2:45-4:00
 - Tues & Thurs, **by appointment** <https://calendar.google.com/calendar/u/0/selfsched?sstoken=UUthSEFSYnNJdm1XfGRIZmF1bHR8MWQxOWY5NGMwMTk5MzUyZDk4ZDdINGVhOTA5Y2FjNzM> (generally afternoon)

Calendar

Date	Topic	Notes/Code	Supplemental Documents
Fri 2/24	Course overview Intro to the Stochastics module Modeling review	day01motivationNotes_part1.html https://miamioh.instructure.com/courses/185302/files/27340074?wrap=1 day01motivationNotes_part2.html https://miamioh.instructure.com/courses/185302/files/27340071?wrap=1	

Mon 2/27	Stochastic Process Random Walks	random_walk.R (https://miamioh.instructure.com/courses/185302/files/27366861?wrap=1) ↓ (https://miamioh.instructure.com/courses/185302/files/27366861/download?download_frd=1)	Stochastic_Processes_An_Introductio _(chapter_3_RandomWalks).pdf (https://miamioh.instructure.com/courses/185302/files/27366861?wrap=1)
Wed 3/01	Continuing Random Walks: Gamblers Ruin Introducing Markov Chains		Stochastic_Processes_An_Introductio _(chapter_2_Some_Gambling_Problen (https://miamioh.instructure.com/courses/185302/files/27366861?wrap=1)
Fri 3/03	Markov Chains & Some basic properties		Stochastic_Processes_An_Introductio _(chapter_4_Markov_Chains).pdf (https://miamioh.instructure.com/courses/185302/files/27366861?wrap=1)
Mon 3/06	Markov Chain Properties - Transition probabilities, accessibility, classes,	Precipitation_ERCweatherStation_1982-1-1_to_2022-10-25.csv (https://miamioh.instructure.com/courses/185302/files/27340073?wrap=1) ↓ (https://miamioh.instructure.com/courses/185302/files/27340073/download?download_frd=1) day01motivationNotes_part1.Rmd (https://miamioh.instructure.com/courses/185302/files/27340070?wrap=1) ↓ (https://miamioh.instructure.com/courses/185302/files/27340070/download?download_frd=1)	

		<p>day01motivationNotes_part2.Rmd ↓ markov_chain_ideas_on_ERCdata.R ↓</p>	
Wed 3/08	Markov Chain properties - accessibility, classes,	<p>rat_matrix_probability.R ↓</p>	
Fri 3/10	Markov Chain properties - irreducible, recurrent vs transient states, limiting distributions, expected time to return, other properties		

	Fitting Markov Chains (back to Dry-Wet day example).		
Mon 3/13	Markov Chain Final Pieces	fitted_markov_chain_on_ERCdata_with_limiting_probabilities.R ↓ (https://miamioh.instructure.com/courses/185302/files/27522301/download?download_frd=1) rat_matrix_probability_transitions.R ↓ (https://miamioh.instructure.com/courses/185302/files/27522302/download?download_frd=1)	
Wed 3/15	Intro to counting processes Poisson Process Properties		Stochastic Processes An Introduction (chapter 5 Poisson Processes).pdf ↓ (https://miamioh.instructure.com/courses/185302/files/27522303/download?download_frd=1)
Fri 3/17	More advanced Poisson Process ideas		
Mon-Fri	Spring Break!		

3/20- 3/24			
Mon 3/27	<p>Hodgepodge Days:</p> <ul style="list-style-type: none"> • Reward Processes • Queuing theory ideas 	<p>Note: Schedule after spring break may change depending on pace of progress</p>	
Wed 3/29	<p>Hodgepodge Days:</p> <ul style="list-style-type: none"> • Continuous time Markov Chains • Hidden Markov Chains 		
Fri 3/31	<p>Hodgepodge Days:</p> <ul style="list-style-type: none"> • Branching Processes • Life-Death Processes 		

Mon 4/03	Exam Day		
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