# Syllabus

31 August 2020

**BIO230-Biostat230 Probability Theory and Applications I**

**Instructor**

- Marcello Pagano
  Building 2, Room 449,  617-432-4911 in normal times

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**Teaching Assistant**

- Molei Liu

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**Lectures/Labs**

- Mon 31 August 2020 through  Fri.  18 December 2020.
- Two 90 minute lectures/week, Mon and Wed, 2:00-3:30, Zoom.
- Labs 90 min  Fridays, 3:45 pm – 5:15 pm. Zoom

**Office Hours**

- Marcello: Mon 11:00-12:00, other times Zoom.
- TAs: Zoom.

**Primary Texts**

- *Statistical Inference*, Chapters 1-5, Casella and Berger
- *An Intermediate Course in Probability*, A. Gut

**Other useful texts:**

- Any reasonably complete calculus book.
- *Mathematical Analysis, 2ed*, T. Apostol.
- *A First Course in Probability, 7th ed.*, S. Ross
- *Introduction to Probability,* Charles M. Grinstead and J. Laurie Snell.

**Prerequisite**

- Working knowledge of calculus and algebra and linear algebra.

**Grading**

- Two 'Mid-terms', in class – each is 20% of grade – Mon. 5 October and Mon. 9 November.2020
- Homework – 20% of grade. Assigned and handed in weekly–class on Wednesday. It is part of grade, so should be done alone. You should not expect any late homework assignments to be accepted.
- Homeworks: Latex produced pdfs should be uploaded to Canvas. (They won't be graded before deadline, so you can edit until deadline.)
- Final exam, Zoom, 40% of grade, Wed. 16 Dec. 2020.

**Hsph Holidays:**

- Mon. 12 Oct. (Columbus Day – Indigenous Peoples Day),
- Wed. 11 Nov. (Veteran's Day)
- Wed. 25 Nov. to Sun. 29 Nov. (Thanksgiving Break)

## Probability Theory and Applications I (BIO230)

**Lecture Topics (approximate)**

1. Intro, history up to the modern Kolmogorov Axioms of probability;. Boole's and Bonferroni inequalities.

2. Language of probability: random experiments; discrete/continuous, sample space,events, sigma/Borel fields; Conditional probability; Bayes' Theorem; Screening; Relative Risks & Odds; Case Control Studies

3. Random variables: distribution function; discrete random variables; continuousrandom variables.

4. Transformations and Expectations

5. Expectations: Moments; Moment Generating Functions; Characteristic Functions

6. Discrete distributions:

7. More on discrete distributions: anticipatory distributions

8. Continuous Distributions & Hazard Function

9. Characteristic Functions; Exponential Families; Inequalities; Bivariate randomvariables

10. Bivariate distributions; conditional distributions

11. Sums of two random variables (convolutions); Conditioning moments

12. Covariance and correlation functions; Bivariate normal distribution.

13. Multivariate Distributions; Linear operators; Multivariate Normal

14. Random samples; linear transformations; t-distribution, independence of samplemean and variance from normal.

15. Min and Max; Order statistics; Joint distributions

16. 2 Lectures

    Asymptotics; Borel-Cantelli Lemmae; Convergence; Relations; Reversals

17. Weak Law of Large Numbers; Strong Law of Large Numbers

18. Strong Law of Large Numbers; Kolmogorov's SLLN

19. Central Limit Theorem

20. Random Experiments; Computing Devices

21. Branching Processes; Criticality Theorem

22. 2 lectures Branching, Counting and Birth and Death Processes

23. (16 Dec) Final