

# Real Analysis Bootcamp Syllabus

August 2023

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- **Class Time:** 9:45 am – 11:45 am, Aug 7-11, 14-17
  - **Class Location:** Rosenau Hall 133 (Aug 7-11); Michael Hooker Research Center 0001 (Aug 14,16,17); McGavran Greenburg Hall 2306 (Aug 15)
  - **Zoom:** <https://unc.zoom.us/j/95349764682?pwd=TEVNNXdma2pZaTRSS1Bta1ZFtXBIdz09>  
**Meeting ID:** 95349764682      **Passcode:** tarheel
  - **Office hour:** By appointment.
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- **Instructor:** Tianhao Song ([dqsth@live.unc.edu](mailto:dqsth@live.unc.edu))
  - **Grader:** TBD
  - **Grading:** Attendance + 2 assignments
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- **Who should come:** This course is required if you are taking BIOS-760 in fall 2023. Anyone else is welcome but assignments will not be graded.
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## Course Description:

This 2-week bootcamp is intended to get you prepared for BIOS-760 (Advanced Probability and Statistical Inference) as well as other upcoming PhD-level courses. Only if you get permission from director of graduate studies, Joe Ibrahim, can you be exempted. Course attendance and assignments grades will be recorded and sent to professors as proof of completion.

In-person attendance is strongly encouraged (a lot of on-site handwriting work will be performed). Those who cannot make it must attend via zoom with video on to prove attendance. Lecture slides and recordings will be available after class. Assignments will mimic in-class practice and should be worked out independently.

**Main Topics:**

This course is intended as a rough but necessary preparation of advanced statistics, and can be nowhere compared to a formal, structured real analysis lesson. Understanding basic concepts and getting familiar with essential methods will be more emphasized. There will be contents that you may have learned already or will learn in upcoming courses, but they are worth learning twice.

- Statistical inference: Gamma and Beta distributions, convolution formula, multi-variable distributions
- Fundamental calculus: sequences, limits, big O, little o, differentiation, integration
- Multi-variable derivatives: Taylor expansion, matrix derivatives, Newton-Raphson Algorithm, Lagrange Multiplier
- **Measure theory:** Lebesgue measure, Lebesgue integration, set theory,  $\sigma$ -field, measure, measurable function, integrable function, Radon-Nikodym derivative, random variables