Final Exam Review: MTH 201, Summer 2020

Here is a summary of topics that are relevant for the final exam. Study notes, text, and your homework. Exam coverage: the exam covers all sections on the course schedule that we have discussed. Roughly 75-80% of the exam will deal specifically with topics since the midterm (after section 4.3). With that said the material obviously builds on itself so fundamentals from the early part of the course are relevant throughout:

https://web.math.rochester.edu/courses/current/201-A2/schedule/

Generally speaking, you will be expected to know or derive most formulas that we have discussed whenever necessary. This includes pmfs, densities, cdfs, means, and variance of named variables that we have discussed at length: binomial, geometric, normal/gaussian, Poisson, and exponential (the only exception is variance of the geometric distribution; I will give that formula on the exam if it is needed). You should be able to derive the mgfs for all these distributions if asked, but I will not expect that you have them memorized.

For the sections prior to the midterm, refer to HW1 - HW5 (both written and webwork) and the midterm itself:

- Appendix: Appendix B, C.
- Ch 1: Sections 1.1-1.5.
- Ch 2: Sections 2.1-2.5.
- Ch 3: Sections 3.1-3.5.
- Ch 4: Sections 4.1-4.3.

Topics since the midterm I will outline in more detail. This is meant to highlight important topics but is **not** an exhaustive list of everything you should know:

Ch 4: Sections 4.4, 4.5.

- Know the basics of the Poisson distribution (pmf, mean, variance) and be comfortable working with it. Know which situations Poisson is good for modeling. Relevant examples: HW6(P1), webwork6(P1,P2).
- Be comfortable using the Poisson approximation to the binomial and know/understand the error bound formula. Be able to determine when/why the Poisson or normal approximation is appropriate. Relevant examples: HW6(P1).
- Know the basics of the exponential distribution (density, cdf, mean, variance) and be comfortable working with it. Relevant examples: HW6(P2).
- Understand the memoryless property of the exponential distribution and how to apply it in practice. Know which situations exponential is good for modeling (e.g. waiting times). Relevant examples: HW6(P2), webwork6(P3,4,5,6).

Ch 6: Sections 6.1, 6.2, 6.3.

- Know the basics of joint distributions of discrete random variables and be comfortable working with them to find the probability of different events. Be able to compute expectations and marginal pmfs given a joint pmf. Relevant examples: webwork6(P7,8,9,10).
- Know the basics of distributions of jointly continuous random variables and be comfortable working with joint densities to find the probability of events by integrating over regions in $\mathbb{R}^2$ and similarly finding cdfs. Relevant examples: HW7(P1,2,3), webwork7(P4,5,6,7,8,9).
- Be able to compute expectations and marginal densities given a joint density. Relevant examples: HW7(P1,3), webwork7(P4,5,9).
- Be comfortable working with uniform distributions on intervals in $\mathbb{R}$ and regions in $\mathbb{R}^2$. Relevant examples: HW7(P3), textbook examples 6.19 and 6.20 on pg. 217-218.
- Understand independence of discrete RVs in terms of joint and marginal pmfs. Understand independence of jointly continuous RVs in terms of joint and marginal density. Relevant examples: HW7(P2), webwork7(P4,6,7,8,9)

Ch 8: Sections 8.1, 8.2, 8.4.

- Be comfortable using linearity of expectation and how to use indicator random variables to help find expectations when direct computation is difficult. Relevant examples: HW8(P1,2,3), webwork8(6,7,8,9).
- Understand the basic implications of independence on expectation. Relevant examples: textbook Fact 8.10 (pg. 277), webwork8(P2).
- Know the general formula for the variance of a sum of variables and how independence simplifies the formula. Relevant examples: textbook Facts 8.11, 8.27(pg. 277, 286), HW8(P3), webwork8(P6,9).
- Know the basics of covariance and correlation. Be comfortable using bilinearity of covariance (Fact 8.33 on pg. 289). Relevant examples: HW8(P2,3), webwork8(P1,3,4,5,6,7,9).

Sums and MGFs: Sections 5.1, 7.1, 8.3.

- Given pmfs of 2 independent variables, understand how to use convolution to find the pmf of the sum. Similarly for densities in the continuous case. Relevant examples: HW9(P3), webwork9(P4).
- Be comfortable computing moment generating functions from a pmf (discrete variable) or a density (continuous variable) and know how to use mgfs to find moments. Relevant examples: HW9(P1,2,3), webwork9(1,2,3,4).

- Understand how the mgf determines the distribution of a variable and how to use this to find a pmf given the mgf of a discrete variable. Relevant examples: example 5.15 (pg. 187).

- Know that the mgf of a sum of independent variables $X_1, \cdots, X_n$ is the product of the mgfs of $X_1, \cdots, X_n$ and how this can be used to find distributions of sums of independent variables. Relevant examples: textbook examples 8.19, 8.20, 8.21, 8.22 (pg 283-284), HW9(P2), webwork9(3).

- Know the distributions of sums of the named variables we have discussed. In particular, see the section 8.3B video and notes posted in blackboard. Be able to use these ideas in practice. Relevant examples: textbook examples 7.2, 7.3, 7.10, 7.11.

Ch 9: Sections 9.1, 9.2, 9.3.

- Know and be able to apply the Markov and Chebyshev inequalities. Relevant examples: HW10(P1), webwork10(1).

- Know the general versions of the law of large numbers and central limit theorems discussed in sections 9.2-9.3 and be able to apply them in examples. Relevant examples: HW10(P1,2), webwork10(2).