Midterm Review

coverage

everything in text chapters 1-2, slides & homework pre-exam except “continuous random variables” started this week is included, except as noted below.

mechanics

1 page of notes; closed book

I’m more interested in setup and method than in numerical answers, so concentrate on giving a clear approach, perhaps including a terse English outline of your reasoning.

Corollary: calculators are probably irrelevant, but bring one to the exam if you want, just in case.

counting principle (product rule)

permutations

combinations

indistinguishable objects

binomial coefficients

binomial theorem

partitions & multinomial coefficients

inclusion/exclusion

pigeon hole principle

sample spaces & events

axioms

complements, Venn diagrams, deMorgan, mutually exclusive events, etc.

equally likely outcomes

chapter 1: conditional probability and independence

conditional probability

chain rule, aka multiplication rule

total probability theorem

bayes rule yes, learn the formula

odds

independence

conditional independence

gambler's ruin

discrete random variables

probability mass function (pmf)

expectation of X

expectation of g(X) (i.e., a function of an r.v.)

linearity: expectation of X+Y and aX+b

variance

cumulative distribution function (cdf)

- cdf as sum of pmf from $-\infty$

joint and marginal distributions

important examples:

know pmf, mean, variance of these

- bernoulli, binomial, poisson, geometric, uniform

some important (discrete) distributions

Name	PMF	$E[k]$	$E[k^2]$	σ^2
Bernoulli(p)	$f(k) = \begin{cases} 1-p & \text{if } k=0 \\ p & \text{if } k=1 \end{cases}$	p	p	$p(1-p)$
Binomial(p, n)	$f(k) = \binom{n}{k} p^k (1-p)^{n-k}, k = 0, 1, \dots, N$	np		$np(1-p)$
Poisson(λ)	$f(k) = e^{-\lambda} \frac{\lambda^k}{k!}, k = 0, 1, \dots$	λ	$\lambda(\lambda+1)$	λ
Geometric(p)	$f(k) = p(1-p)^{k-1}, k = 0, 1, \dots$	$1/p$	$(2-p)/p^2$	$(1-p)/p^2$
Hypergeometric(n, N, m)	$f(k) = \frac{\binom{m}{k}\binom{N-m}{n-k}}{\binom{N}{n}}, k = 0, 1, \dots, N$	nm/N	$\frac{nm}{N}\left(\frac{(n-1)(m-1)}{N-1} + 1\right)$	$\frac{nm}{N}\left(\frac{(n-1)(m-1)}{N-1} + 1 - \frac{nm}{N}\right)$

Calculus is a prereq, but I'd suggest the most important parts to brush up on are:

taylor's series for e^x

sum of geometric series: $\Sigma_{i\geq0}\ x^i = 1/(1-x)\ \ (0\leq x<1)$

Tip: multiply both sides by (1-x)

$\Sigma_{i\geq1}\ ix^{i-1} = 1/(1-x)^2$

Tip1: slide numbered 32 in "random variables" lecture notes, or text

Tip2: if it were $\Sigma_{i\geq1}\ ix^{i+1}$, say, you could convert to the above form by dividing by x^2 etc.; 1st few terms may be exceptions

integrals & derivatives of polynomials, e^x;

chain rule for derivatives; integration by parts

Good Luck!