Final exam - comments on formula sheet, review, what to expect

What **IS** on the formula sheet:

- The probability functions (for discrete) and density functions (for continuous) for the distributions we have studied.
- The expected value and variance of the distributions we have studied.
- Definition of $\Gamma(\alpha)$.
- Formula for definition of moment-generating function.
- Formula for definition of probability-generating function.
- Formula for factorial moments.
- Any specific moment-generating functions you might need, unless I specifically ask you to derive them.

What **IS NOT** on the formula sheet:

- Which distributions are discrete and which are continuous.
- What the ranges of the distributions are.
- What the parameters of the distributions mean.
- Which distribution is appropriate to use in a given example.
- How to find the moments of X from the moment-generating function or the probability-generating function.
- Counting rules from Chapter 2:

$$n^r \qquad P_r^n = \frac{n!}{(n-r)!} \qquad C_r^n = \frac{n!}{(n-r)!r!} = \binom{n}{r} \qquad \binom{n+r-1}{r}$$

- Instructions on how to determine which counting rule to use.
- Basic formulas such as
  - conditional probabilities $P(A|B) = \frac{P(AB)}{P(B)}$;
  - definition of independent events $P(A|B) = P(A)$, $P(AB) = P(A)P(B)$;
  - Bayes' Rule $P(B|A) = \frac{P(A|B)P(B)}{P(A)}$;
  - odds $P(A)/P(\bar{A})$;
  - expectation $E(X) = \sum xp(x)$ or $\int_{-\infty}^{\infty} xf(x)\,dx$;
  - variance $V(X) = E[(X-\mu)^2] = E(X^2) - E(X)^2$;
  - covariance $\operatorname{cov}(X,Y) = E[(X-\mu_X)(Y-\mu_Y)] = E(XY) - E(X)E(Y)$;
  - correlation $\rho = \frac{\operatorname{cov}(X,Y)}{\sqrt{V(X)V(Y)}}$.

Very important: *Understand which counting rule to apply in a given situation, or which probability distribution is appropriate given a description of a random variable.* Remember that many of our common distributions can be understood in the following framework: we observe a process for a period of time, over which an event occurs some number of times. If the situation is like this, then ask yourself the following questions.

(1) Is time **discrete**, like a series of experiments (flipping a coin repeatedly, etc.), so that it is best described by an integer? Or is it **continuous**, so that it is best described by a real number?
(2) Is time fixed, and the number of events random? That is, do we terminate our observations when a pre-determined amount of time (or number of experiments) has passed, and then count the (random) number of events that occurred?
(3) Or is it the other way round, with a fixed number of events and a random amount of time? That is, do we terminate our observations when the event has occurred (or when success has occurred) a pre-determined number of times, and then count how long it took to get to this point (which is random)?

The following table shows which distribution applies in each case.

	Fixed time, random # of events:	*Fixed # of events, random time:*	
		first event	nth event, $n \geq 2$
Discrete time	binomial	geometric	negative binomial
Continuous time	Poisson	exponential	gamma