

The exam will emphasize chapter 4 through section 4. You will need to know some material from chapters 2 and 3. Calculators are allowed but will not be required. The following equations and tables will be provided along with the exam (it will be up to you to know what they mean):

1. The pmf of binomial distributions:

$$b(x; n, p) = \binom{n}{x} p^x (1-p)^{n-x}.$$

2. Appropriate tables of the cdf for the binomial distribution;

3. The pmf of Poisson distributions:

$$p(x; \lambda) = \frac{e^{-\lambda} \lambda^x}{x!}$$

4. Tables for the normal distribution;

5. The pdf of exponential distributions:

$$f(x; \lambda) = \begin{cases} \lambda e^{-\lambda x} & x \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

6. The cdf of exponential distributions:

$$F(x; \lambda) = \begin{cases} 1 - e^{-\lambda x} & x \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

7. The mean and standard deviation of an exponential distribution: $\mu = \frac{1}{\lambda}$ and $\sigma = \frac{1}{\lambda}$.

Some of the things you should know:

1. Basic facts about probabilities:

- (a) $0 \leq P(A) \leq 1$;
- (b) If A_1, A_2, A_3, \dots are mutually disjoint events, then

$$P(A_1 \cup A_2 \cup A_3 \cup \dots) = P(A_1) + P(A_2) + P(A_3) + \dots$$

- (c) $P(A) + P(A') = 1$;
- (d) $P(A \cup B) = P(A) + P(B) - P(A \cap B)$.

2. Counting techniques:

- (a) Product rule for counting;
- (b) $P_{k,n} = \frac{n!}{(n-k)!}$;
- (c) $\binom{n}{k} = \frac{n!}{k!(n-k)!}$.

3. Conditional probability:

(a) If $P(B) \neq 0$, then

$$P(A|B) = \frac{P(A \cap B)}{P(B)};$$

(b) $P(A \cap B) = P(A|B)P(B)$;

(c) The Law of Total Probability: if A_1, A_2, \dots, A_n are mutually exclusive and exhaustive events, then

$$P(B) = P(B|A_1)P(A_1) + P(B|A_2)P(A_2) + \dots + P(B|A_n)P(A_n);$$

(d) Bayes' Rule:

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}.$$

4. Independence. The following are all equivalent:

(a) Events A and B are independent;

(b) $P(A|B) = P(A)$;

(c) $P(A \cap B) = P(A)P(B)$;

(d) A and B' are independent.

5. Discrete Random Variables:

(a) pmf and cdf;

(b) Expected value $E(X) = \mu = \sum xp(x)$.

6. Continuous Random Variables:

(a) pdf and cdf;

(b) Expected value $E(X) = \int_{-\infty}^{\infty} xf(x)dx$;

(c) The uniform distribution;

(d) Working with the normal distribution;

i. Standard normal distribution tables;

ii. Standardization;

iii. Percentiles and un-standardization.

7. All Random Variables:

(a) Short-cut formula for variance $V(X) = E(X^2) - [E(X)]^2$;

(b) Standard deviation: $\sigma = \sqrt{V(X)}$.

(c) Rules for expected value and variance:

$$E(aX + b) = aE(X) + b \text{ and } V(aX + b) = a^2V(X);$$

(d) Percentiles.