STAT 340: FALL 2018: Information sheet for Midterm-1: 11:30, Wed Oct 24

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1. Permutations and combinations

There are $n! = \prod_{i=1}^{n} i = 1.2.3.4.\ldots n$ permutations of n objects.

There are $\binom{n}{k} = n!/(k!(n-k)!)$ ways of choosing a given k objects from n.

2. Joint and conditional probabilities

If C and D are any events: $P(C \bigcup D) = P(C) + P(D) - P(C \bigcap D)$.

The conditional probability of C given D is $P(C \mid D) = P(C \bigcap D) \;/\; P(D)$.

C and D are independent if $P(C \bigcap D) = P(C).P(D)$.

3. Laws and theorems

Suppose $E_1, \ldots, E_k$ is a partition of Ω. That is $E_i \bigcap E_j$ is empty, and $E_1 \bigcup E_2 \bigcup \ldots \bigcup E_k = \Omega$.

The law of total probability states that: $P(D) = \sum_{j=1}^{k} P(D \bigcap E_j) = \sum_{j=1}^{k} P(D \mid E_j)\; P(E_j)$

Bayes' Theorem states that: $P(E_i \mid D) = P(D \mid E_i)\; P(E_i)/P(D)$

4. Random variables and distributions	**discrete (mass)**	**continuous (density)**
Probability mass/density function	pmf: $P(X = x) = p_X(x)$	pdf: $f_X(x)$
defined for	all x with $p_X(x) > 0$	$-\infty < x < \infty$
Probability $P(X \in B)$	$\sum_{x \in B} p_X(x)$	$\int_{x \in B} f_X(x)dx$
Cumulative distrib. func. CDF, $P(X \leq x)$	$F_X(x) = \sum_{y \leq x} p_X(y)$	$F_X(x) = \int_{-\infty}^{x} f_X(y)dy$

5. Standard distributions:	p_X or f_X	values
Discrete		
(a) Binomial; $B(n,p)$; index n, parameter p;	$P(X = x) = \binom{n}{x} p^x (1-p)^{n-x}$	$x = 0, 1, 2, ..., n$
(b) Hypergeometric (N, k, n);	$P(X = x) = \binom{k}{x}\binom{N-k}{n-x}/\binom{N}{n}$	$x = \min(0, k+n-N), ..., \max(n, k)$
(c) Poisson with parameter μ, $\mathcal{P}o(\mu)$	$P(X = x) = \exp(-\mu)\mu^x/x!$	$x = 0, 1, 2, 3, 4.....$
(d) Geometric $Geom(p)$	$P(X = x) = (1-p)^{x-1}p$	$x = 1, 2, ...$
Continuous		
(e) Uniform $U(a,b)$; on interval (a,b)	$f_X(x) = 1/(b-a)$	$a < x < b$
(f) Exponential rate λ; $\mathcal{E}(\lambda)$	$f_X(x) = \lambda \exp(-\lambda x)$	$x > 0$