Stat 343, Tue 24-Nov-2020 -- Tue 24-Nov-2020
Probability and Statistics
Fall 2020

Tuesday, November 24th 2020

Exam:: Exam #3

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Wk 13, Tu
Topic:: RMarkdown practice

1. In RStudio, write DeMorgan's Laws as displayed in Exercise 2.13, p. 114. Or try to produce the extension of these laws to n sets:

$$\left(\bigcup_{i=1}^{n} A_i\right)^c = \bigcap_{i=1}^{n} A_i^c, \qquad \text{and} \qquad \left(\bigcap_{i=1}^{n} A_i\right)^c = \bigcup_{i=1}^{n} A_i^c.$$

2. In RStudio, reproduce Bayes' Theorem, as displayed in Exercise 2.26, p. 117.

3. The pmf for a multinomial random vector $\mathbf{X} \sim \mathsf{Multinom}(n, \boldsymbol{\pi})$ in $\mathbb{R}^k$ is given on p. 104. In RStudio reproduce the formula

$$\Pr(\mathbf{X} = \mathbf{x}) \;=\; \binom{n}{x_1}\binom{n-x_1}{x_2}\binom{n-x_1-x_2}{x_3}\cdots\binom{x_k}{x_k}\pi_1^{x_1}\pi_2^{x_2}\cdots\pi_k^{x_k}.$$

4. Look over the variables in the `BodyTemp50` data frame found in the **Lock5WithR** package.
   (a) Produce a scatterplot with `Pulse` on the vertical axis and `BodyTemp` on the horizontal.
   (b) Produce side-by-side scatterplots like in part (a), with one plot devoted to the female cases in the data frame, the other to the male cases.
   (c) Merge the side-by-side scatterplots of part (b) into one, with different-colored dots to differentiate the female cases from the male ones.

5. Consider a variable whose cdf is $F(x) = [\![x \in [2, \infty)]\!]$.
   (a) Is the variable discrete or continuous? What is its pmf/pdf?
   (b) Make a graph of $F(x)$ in the region $-2 \le x \le 5$ in RStudio.

6. A health insurance company covers visits to a doctor's office. Each visit costs \$100. The annual deductible is \$250. For a policy, the number of visits per year has the following probability distribution:

Number of visits	0	1	2	3	4	5	6 or more
Portion of clients	0.60	0.15	0.1	0.08	0.04	0.02	0.01

   (a) Assume that every client must exhaust his deductible before the insurance company pays anything, after which insurance pays 100% of the cost of each visit. Let X represent the annual payout for a randomly-selected client. Make a probability table that reflects the pmf for X.
   (b) Make a graph of this pmf.
   (c) Use notation that demonstrates the calculation of the expected value of X and its variance.

7. Write $\Phi(a) = \ldots$ and give the formula for the cdf of the standard normal variable Z. Also, write the appropriate symbols to indicate the type of variable Z is, as in $X \sim \mathsf{Binom}(n, \pi)$, or $X \sim \mathsf{Exp}(2)$.

8. Make a plot of the discrete distribution for the sample proportion $\hat{\pi}$ of heads in 100 flips of a fair coin, and color as red the rejection region corresponding to

$$\mathbf{H}_0\colon\ \pi = 0.5 \qquad \text{vs.} \qquad \mathbf{H}_a\colon\ \neq 0.5$$

   when $\alpha = 0.05$.

9. (a) What exactly does the `rbinom()` command do?

   (b) How can you achieve the same thing as `rbinom(30, 20, .25)` using alternate commands?