# Pol Sci 630: Problem Set 1 - Probability Theory and Distributions

Prepared by: Jan Vogler (jan.vogler@duke.edu)

Due Date: Tuesday, September 1st, 2015, 10 AM (Beginning of Class)

**Note: It is absolutely essential that you show all your work, including intermediary steps, and comment on your R code to earn full credit. Showing all steps and commenting on code them will also be required in future problem sets.**

## R Programming

### Problem 1

**Calculate the following in R:**

**a)** $10!$, $8!$

**b)** $\frac{15!}{5!}, \frac{10!}{5!}$

**c)** $\binom{12}{3}, \binom{9}{3}$

### Problem 2

**Write the following functions in R:**

**a)** A function that multiplies three numbers $a, b$, and $c$. With $a, b, c \in [-5, 10]$

**b)** A function that returns a permutation.

**c)** A function that throws $n$ fair six-sided dice and returns the average of all throws, with $n \in \mathbb{N}$.

Bonus assignment (not required): Let the function return an error message if $n \notin \mathbb{N}$

## Problem 3 (Bonus Problem)

**This is a bonus problem: Consider the Monty Hall problem from the lecture and the R tutorial notes. If you are not familiar with the problem, please review these notes. Please write a function with the following characteristics:**

**a)** First, as input you have the number of trials. This means you create a function of the number of trials.

**b)** Second, inside the function, for every trial, you draw a location of the prize at random (door 1, 2, or 3). You then draw your chosen door at random and you define a mechanism by which Monty opens an empty door. This mechanism is supposed to look like this: if you have chosen the same location as the prize, he will randomly draw from the two other doors. If the door chosen by you is different from the door with the prize, he will show you the only remaining empty door (because the one you chose is one of the two empty doors). You then always switch to the remaining door (the one that Monty has not revealed).

**c)** Third, as output you get the proportion of trials in which you made the correct decision because you switched. This means the proportion of trials in which the door to which you switched actually was the door with the prize. Your function should return a value of approximately $\frac{2}{3}$ or 0.68 for large numbers of trials.

# Probability Theory

## Problem 4

**Do the following problems. Show every step.**

**a)** Moore and Siegel, Ch. 9, Problem 5 (p. 195).

**b)** Moore and Siegel, Ch. 9, Problem 10 (p. 195).

**c)** Moore and Siegel, Ch. 9, Problem 16 (p. 196).

**d)** Moore and Siegel, Ch. 9, Problem 20 (p. 196).

**e)** This problem is taken from Pitman (1993) Probability: Player A and player B roll a fair six-sided die. Player A wins if he rolls a number that is strictly greater than the number rolled by player B. If player A and player B play this game five times, what is the probability that player A will win at least four times?