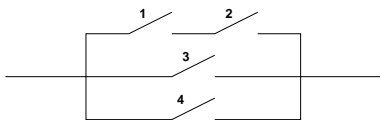1.

- If 2% of the cars that BMW makes are lemons and your dealership buys 100 cars, find the probability that 2 or more of the cars you buy will be lemons.

- The switches in the following network are independent. Each switch is closed with probability p. Find the probability that there is a closed path between the input and output.

2. A *skilled* dart thrower tosses darts at a square dartboard. The coordinates X and Y of where the dart lands are random variables with the following joint probability density function:

$$f_{X,Y}(x,y) = \begin{cases} \frac{9}{16}(1-x^2)(1-y^2), & |x| \le 1, |y| \le 1 \\ 0 & \text{otherwise.} \end{cases}$$

- Find the marginal pdf of X.

- One random variable of interest here is the distance Z of the dart from the center of the dartboard, i.e. $Z = \sqrt{X^2 + Y^2}$. Find $E[Z^2]$.

- Find the pdf of $W = 2 \cdot \max\{X, Y\}$.

3. Ursula rolls a fair *4-sided* die (a tetrahedron) 600 times. Virgil tosses a fair coin 600 times. Assume all tosses and rolls are independent. Wilma counts up the total number of dots and heads. Call the sum W.

- Find an exact expression for the probability that W takes the value 601.
  Hint: consider S_W.

- Find an approximation for the probability that W is less than 1845.
  Hint: form the sum by adding up the dots and heads in pairs: $W = \sum_i (U_i + V_i)$.

4. A RAID (redundant array of disks) system consists of n disk drives connected in parallel to provide maximum redundancy, where $n > 1$. The lifetime of each disk drive is an exponential random variable with mean failure time of 1 year. The RAID system fails when *all* of the n disk drives fail. Let T denote the failure time of the RAID system.

- A customer asks you to configure a RAID system for which the probability of system failure within the first year is less than $\alpha = 0.05$. Determine how many disk drives are required.

- You also sell this customer a monitor. The lifetime of your monitor is an exponential random variable X with mean 2 years. The customer also buys a monitor from a competitor of yours; the lifetime of that monitor is an exponential random variable Y with mean 3 years. Find the probability that your monitor will fail before the competitor's monitor. Assume the two monitor's failure times are independent.

end