

# ECE 341 - Homework #7

Uniform and Exponential Distributions. Summer 2024

## Uniform Distributions

Let

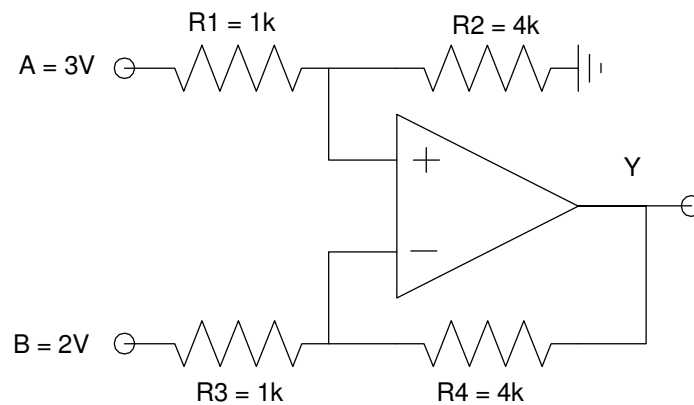
- $\mathbf{a}$  be a sample from A, a uniform distribution over the range of (1, 3)
- $\mathbf{b}$  be a sample from B, a uniform distribution over the range of (1, 4)

1) Determine the pdf for  $\mathbf{a} + \mathbf{b}$  using moment generating functions (i.e. LaPlace transforms)

2) Determine the pdf for  $\mathbf{a} + \mathbf{b}$  using convolution (by hand or Matlab)

3) Assume each resistor has a tolerance of 5% (i.e. a uniform distribution over the range of (0.95, 1.05) of the nominal value. For the following circuit, determine

- The voltage at Y as a function of  $\{R1, R2, R3, \text{ and } R4\}$ , and
- The mean and standard deviation for the voltage at Y using a Monte Carlo simulation.



## Exponential Distributions

Let

- $\mathbf{d}$  be a sample from D, an exponential distribution with a mean of 10 seconds
- $\mathbf{e}$  be a sample from E, an exponential distribution with a mean of 8 seconds
- $\mathbf{f}$  be a sample from F, an exponential distribution with a mean of 6 seconds

4) Let  $X = d + e$

- a) Use convolution to find the pdf of X
- b) Use moment generating functions to find the pdf of X
- c) Check that the two answers match at  $t = 10$  seconds.

5) Let  $Y = d + e + f$

- a) Use convolution to find the pdf of Y
- b) Use moment generating functions to find the pdf of Y
- c) Check that the two answers match at  $t = 10$  seconds.

## Queueing Theory

Assume you are running a fast-food restaurant.

- The time between customers arriving at a restaurant is an exponential distribution with a mean of 60 seconds.
  - The time it takes to serve each customer is an exponential distribution with a mean of 30 seconds.
- 6) Run a single Monte-Carlo simulation for this restaurant over the span of one hour.
- Give the formula for each column in your simulation
  - What is the longest waiting time for a customer in your simulation?
  - What is the largest queue over the span of one hour?