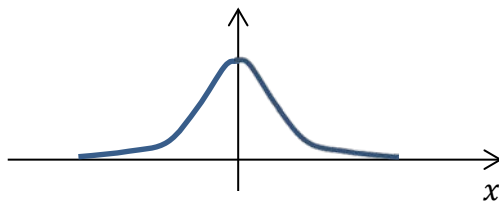
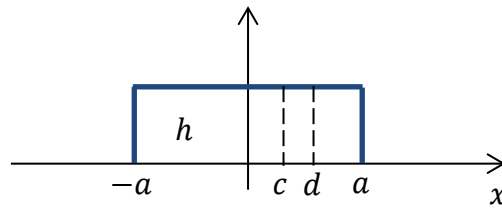


## Homework Set 1

### Problem 1 (Probability density function)



(A)



(B)

- Figure (A) shows a Cauchy probability density function whose density is given by  $\frac{1}{K} \frac{1}{1+x^2}$ . What is the value of  $K$  for the density to be a probability density function? What are the mean and variance of the distribution?
- Figure (B) shows a uniform probability density function. What is the height  $h$  of the density function? What are the mean and variance of the distribution? What is the probability that  $x$  lies in the interval between the vertical lines marked by  $c$  and  $d$ ?
- Consider two fair dice with six sides marked with the usual numbers 1 through 6. What is the probability that a throw of the dice results in a score of 7? What is the mean of the numbers that arise when two dice are thrown? What is the variance?

### Problem 2 (Sample statistics and confidence intervals)

In characterizing the noise in an amplifier, which is normally distributed, we have the following noise voltages in micro Volts ( $\mu V$ ):

-0.4326 -1.6656 0.1253 0.2877 -1.1465 1.1909 1.1892 -0.0376 0.3273 0.1746

- Estimate the mean of the noise voltages and the variance of the mean.
- Calculate the 95% and 99% confidence intervals of the mean (of noise voltages).
- How confident are we that the noise voltage at any time lies between  $1\mu V$  and  $1.1\mu V$ ?

### Problem 3 (Calculus)

Let  $f(x, y) = 3x^2 + y^2 - xy - 11x$

- Find  $\frac{\partial f}{\partial x}$ , the partial derivative of  $f$  with respect to  $x$ . Also find  $\frac{\partial f}{\partial y}$ .
- Find the pair  $(x, y) \in \mathbb{R}^2$  that minimizes  $f$ .
- Show that the pair  $(x, y)$  you found in b. is a minimizer instead of a maximizer.

### Problem 4 (Vector Norms)

Compute the 0, 1, 2, and  $\infty$  norms for  $[3 \ -1 \ 3 \ 5 \ 0 \ 2]^T$ .

**Problem 5 (t-Test)**

Consider the “French fries” data, which reports the number of fries in a small bag for a sample of 10 McDonald’s bags and 5 Burger King bags. The sample data are:

McDonald’s: 35 39 43 52 53 55 34 37 45 40

Burger King: 51 55 52 43 44

- a) Determine a 90% confidence interval for the difference in population means.
- b) Find out if the two means are different with significance level of 0.01 and 0.05.