

# Problem Set 1

## Math Camp 2023

### 1 Definitions

Given information on slides, in the chapters available from Moore and Siegel 2013 (chapters available [here](#)), or sources that you find online, provide an informal definition of the following concepts. If it is useful, you can provide an illustration or figure to demonstrate your understanding.

1. Set
2. Function
3. Derivative
4. Integral

### 2 Practice Problems

For the following problems, you should try to solve them by hand or in R, but you should also feel free to use the [Mathway problem solver](#) that we discussed in class.

#### 2.1 Solve the following algebraic equations

1.  $7x^2 - 4 = 0$
2.  $2x + 9 > 14$
3.  $\frac{4x}{\sqrt{x}} = 18$

4.  $\log(x) = 1$

5.  $e^x = 4$

## 2.2 Functions

1. Identify the domain of values over which the following functions are defined. At what points are these functions **not continuous**? Write your answer in **interval notation**.

**Example:**  $f(x) = \sqrt{x}$  is continuous over the range  $[0, \infty)$

- $f(x) = \frac{1}{x}$

- $f(x) = \frac{1}{x-2}$

- $f(x) = \sqrt{x^2 - 4}$

## 2.3 Find the derivative of the following functions.

1.  $f(x) = 2x^2 + 14$

2.  $f(x) = (x - 3)^3 + 2x$

3.  $f(x) = x^2(x - 2)$

4.  $f(x) = \frac{x^2}{x-2}$

5. **BONUS** Find the partial derivative with respect to  $x$

$$f(x, z) = 7xz + 8x^2 + 2z^2$$

## 2.4 Evaluate the following integrals.

1.  $\int 2x^2 + 14 \, dx$

2.  $\int_2^4 15x \, dx$

3.  $\int_0^{0.5} e^x \, dx$

4.  $\int_a^b \frac{1}{(x-2)} \, dx$

### 3 Decoding R

1. Imagine that you are helping a friend try to understand some lines of R code using a mix of base R and tidyverse functions. Based on your knowledge of the tidyverse so far and **sources that you find online**, explain to your friend what is going on in the following code. Indicate what each function's purpose is and what kinds of result we should expect. In case it is useful, the code is also available [here](#), and you can run it as is.

```
install.packages("tidyverse")

library(tidyverse)

base_df <- read.csv("base_df.csv")

names(base_df)

glimpse(base_df)

base_df %>%
  mutate(new_var = rowSums(base_df[,c(2,3)], na.rm = T)) %>%
  group_by(unit) %>%
  summarize(avg_cost = mean(new_var, na.rm = T))-> summary_df

summary_df %>%
  count(count_above450 = avg_cost > 450)
```

2. Find a dataset of interest to you on the internet and download it to your computer. Use [this tutorial](#) to identify which import function you need to use relative to the file type (e.g., .csv, .dta, etc.) and import the data into R. **Below, mention the function that you used to import the data, and indicate what was difficult about this task or anything weird that might have occurred when you imported the data.**

Find a variable or set of variables of interest in the dataset, and provide some summary information about the data below. What is the variable's name and what is it intending to measure? How is it measured? Does it have missing values? If so, how are they coded? What are the summary statistics of the variable?