Exercise 2

Math Bootcamp

Instructions

- Please show your work! You may lose points by simply writing in the answer. If the problem requires you to execute commands in `R`, please include the code you used to get your answers. Please also include the `.R` file that contains your code. If you are not sure if work needs to be shown for a particular problem, please ask.
- You should submit your work electronically on GitHub in `.pdf` form.

Question 1

Which of the following functions are continuous? If not, where are the discontinuities?

1. $f(x) = \frac{9x^3 - x}{(x-1)(x+1)}$
2. $f(x) = e^{-x^2}$
3. $h(x, y) = \frac{xy}{x+y}$
4. $g(y, z) = \frac{6y^4z^3 + 3y^2z - 56}{12y^5 - 3zy + 18z}$
5. $f(y) = y^3 - y^2 + 1$
6. $f(a, b) = \begin{cases} x^3 + 1x & x > 0 \\ \frac{1}{2} & x = 0 \\ -x^2x & x < 0 \end{cases}$

Question 2

A very famous sequence of numbers is called the Fibonacci sequence, which starts with 0 and 1 and continues according to:

$$0, 1, 1, 2, 3, 5, 8, 13, 21, ...$$

Determine the function which generates the Fibonacci sequence, using subscripted values like x_j for the jth value in the sequence.

Question 3

- Using the change of base formula for logarithms, change $\log_6(36)$ to $\log_3(36)$.
- Sociologists Holland and Leinhardt (1970) developed measures for models of structure in interpersonal relations using ranked clusters. This approach requires extensive use of factorials to express personal choices. The authors defined the notation $x^{(k)} = x(x-1)(x-2)\ldots(x-k+1)$. Show that $x^{(k)}$ is just $\frac{x!}{(x-k)!}$.