STAT 2200: Problem Set 5

Jack Ambery

Due: Wednesday, 3/27 at the beginning of class

- You may discuss this assignment with other students in the class, but you may not sit down and type it up with them or show them your code. You also may not discuss the assignment with anyone who isn't in our class, nor may you look up anything online.
- You must type up your homework using R Markdown. I want to see all of your code and output, and any answers you provide that aren't code must be typed above the respective `R` code chunk.
- Make sure none of your code runs off the page, otherwise you will lose points.
- You must print and turn in a PDF of your homework. I won't accept anything else (e.g., a Word document). All pages must be stapled together.
- This assignment is worth 75 points.

1. Write a function that converts temperatures measured in degrees Celsius into temperatures measured in degrees Fahrenheit. The equation for doing so is: $F = \frac{9}{5}C + 32$. Then use the function to convert the following three temperatures from degrees Celsius to degrees Fahrenheit: 0, 14, and 31. Print the resulting temperatures (in degrees Fahrenheit).

```
celsiusToFahrenheit <- function(celsiusTemp) {
  fahrenehitTemp = ((9/5) * celsiusTemp) + 32
  fahrenehitTemp
}
celsiusToFahrenheit(0)
```

```
## [1] 32
```

```
celsiusToFahrenheit(14)
```

```
## [1] 57.2
```

```
celsiusToFahrenheit(31)
```

```
## [1] 87.8
```

2. The formula for calculating the amount of money someone has after investing an initial amount of money in an account that earns interest compounded a certain number of times per year is: $A = P(1 + \frac{r}{n})^{nt}$, where A = the final amount, P = the principal balance (the amount invested initially), r = the annual nominal interest rate (as a proportion), n = the number of times the interest is compounded per year, and t = the number of years the entire amount is invested without any money being withdrawn from (or more added by the investor to) the account. Write a function that calculates A using the formula above. Then use the function to calculate (and print) the amount of money someone has in their account after investing \$4,500 with a 3.5% nominal interest rate, compounded monthly, for 20 years.

```
investmentCalc <- function(P, r, n, t) {
  finalBalance <- P()
  finalBalance
}
```

3. Write a function that accepts a vector of values and returns the following statistics as a named vector: mean, median, standard deviation, IQR, range, 2.5^{th} percentile, and 97.5^{th} percentile. Then use the function to find this set of statistics for the annual amount of precipitation in US cities as recorded in the *precip* dataset, which comes with base `R`. Make sure the set of statistics is printed.

4. Write a function with three arguments: `x`, `y`, and `z`, all of which are meant to be individual numbers. The function must do the following:

- if the sum of `x` and `y` is under 10, then the function returns the product of `y` and `z`, minus 2;
- if the sum of `x` and `y` is between 10 and 15, inclusive, then the function returns the sum of `x` and `z`, plus 6;
- otherwise, the function returns the product of `x`, `y`, and `z`.

Then use the function for the following three scenarios: (1) x = 1, y = 6, z = 3, (2) x = 8, y = 6, z = 2, and (3) x = 10, y = 7, z = 9. Make sure the three results are printed separately.

5. Quadratic functions follow the form $f(x) = ax^2 + bx + c$, and the graph of a quadratic function is a parabola. To find where a parabola passes through the x-axis (values known as roots), you set the equation equal to 0 and find the x value(s) that satisfy the equation. There are three possibilities for the number of roots of a quadratic function: 0, 1, or 2. The quadratic formula, as you may remember from a previous math course, finds the root(s) of a quadratic function, if any exist. The formula is:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

It turns out that if the part under the square root (called the discriminant) is a negative number, then there are no roots; if the discriminant equals 0, then there is only one root; and if the discriminant is a positive number, then there are two roots. Note that I'm ignoring imaginary numbers here, for anyone who knows what those are.

Write a function – with default values of 1 for a, 2 for b, and 1 for c – that does the following:

- if no root exists, then a message is printed saying there are no roots;
- if only one root exists, then a message is printed saying there is only one root, and the root must be printed as well; and
- if two roots exist, then a message is printed saying there are two roots, and both roots must be printed as well.

Then find the roots for the following quadratic functions: (1) $f(x) = 5x^2 - 8.5x + 2.8$, (2) $f(x) = -3x^2 + 5x - 11$, and (3) $f(x) = 4x^2 - 7x + 12.25$. Make sure the result is printed for each of the three functions.