Basic Course on R: Object-Oriented Programming Practical

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Contents

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1 Part A: Object Oriented Programming

1. The ***geometric mean*** can be defined as the nth root of the product of n positive numbers $x_1, x_2, \ldots, x_n$, i.e.

$$\text{gm} \;=\; (x_1 \cdot x_2 \cdots x_n)^{\frac{1}{n}}$$

   Write a function `gm()` that takes a vector argument `x` containing positive numbers and returns their geometric mean. Your function should include a `stop()` statement that returns an error message if any of the values in `x` are nonpositive. **Hint**: The function `prod()` can be used to compute the product of the values in `x`.

2. Determine the class of your output by running the following:

```
class(gm(1:4))
```

3. Modify your geometric mean function, using `class()`, so that the return value has the class `"geometric"`.

4. Verify the new class of your output is correct by running the following

```
class(gm(1:4))
```

2 Part B: Performance Enhancement: Speed

1. This problem concerns efficiency and timing code.

   Using `system.time(expression)`, explore how time changes with size of the inputs. Plot time versus input size and see if algorithm is linear, polynomial, or exponential.

   - Move expressions within loops that are invariant to compute just once and assigned to a variable.
   - Avoid concatenating vectors by pre-allocating and assigning to the ith element. i.e.

     ```
     x <- c(); for(i in seq(along = y)) x = c(x, g(y[i]))
     ```

   What are your conclusions?