1. This week's Problem of the Week in Math is described as follows:

> There are thirty positive integers less than 100 that share a certain property. Your friend, Blake, wrote them down in the table to the left. But Blake made a mistake! One of the numbers listed is wrong and should be replaced with another. Which number is incorrect, what should it be replaced with, and why?

The numbers are listed below.

6	10	14	15	21
22	26	33	34	35
38	39	46	51	55
57	58	62	65	69
75	77	82	85	86
87	91	93	94	95

Use the fact that the "certain" property is that these numbers are all supposed to be the product of *unique* prime numbers to find and fix the mistake that Blake made.

Reminder: Code your solution in an R script and copy it over to this .Rnw file.

Hint: You may find the %in% operator and the setdiff() function to be helpful.

Solution:

```r
#needed package:
#install.packages("numbers")
library("numbers")

#list of numbers to check
provided.nums <- c(6, 10, 14, 15, 21,
                   22, 26, 33, 34, 35,
                   38, 39, 46, 51, 55,
                   57, 58, 62, 65, 69,
                   75, 77, 82, 85, 86,
                   87, 91, 93, 94, 95)

#Function to determine which numbers are products of unique primes
#Function takes in a number and returns true if num is a product of unique
#primes and false otherwise
get_valid_numbers <- function(num){
  factors <- primeFactors(num) #get prmime factors of the num
  unique.factors <- unique(factors) #get unique factors
  if (length(unique.factors) ==1){ #if the number contains only 1 prime
    return(FALSE)
  }
  return(length(factors) == length(unique.factors))
}

num.to.check <- c(1:99)
valid.nums <- c()
#check every number if it has unique factors
#if true, add to the list of valid numbers
for (i in 1:length(num.to.check)){
  if (get_valid_numbers(num.to.check[i])){
    valid.nums <- c(valid.nums, num.to.check[i])
  }
}
#numbers that are valid but not in provided list
valid.not.included.nums <- setdiff(valid.nums, provided.nums)
#numbers that are in provided list but not valid
wrong.num <- setdiff(provided.nums, valid.nums)

#get index of the wrong number
wrong.index <- which(provided.nums==wrong.num)
#get the number after wrong
next.index <- wrong.index+1
next.after.wrong = 99
if (next.index <= length(provided.nums)){ #check bounds
  next.after.wrong = provided.nums[next.index]
}
#get the number before wrong
previous.index <- wrong.index-1
```

```
prev.before.wrong = 1
if (previous.index > 0){
  prev.before.wrong = provided.nums[previous.index]
}
current.to.replace = 0 #placeholder for the number that will replace the wrong one
#replace the wrong number with a valid product of unique prime numbes
for (i in 1:length(valid.not.included.nums)){
  #iterate the valid numbers until we find the one in bounds of previous and next
  if (valid.not.included.nums[i] > prev.before.wrong && valid.not.included.nums[i] < next.after.wrong){
    current.to.replace = valid.not.included.nums[i]
  }
}
#replace the wrong number with the correct one
provided.nums[wrong.index] = current.to.replace
```

The wrong number was 75 and it was replaced with 74.

Correct list of numbers: 6, 10, 14, 15, 21, 22, 26, 33, 34, 35, 38, 39, 46, 51, 55, 57, 58, 62, 65, 69, 74, 77, 82, 85, 86, 87, 91, 93, 94, 95.