

Vectors

AP Environmental Studies Lesson Summary

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NSF GK-12 Vibes and Waves in Action
AP Environmental Science

Summary of lesson:

This lesson is intended to provide the students with a fundamental understanding of vectors. The assignment operator is reviewed as it applies to scalar variables and is then extended to cover vectors. The geometric and mathematical interpretation of vectors is covered briefly so that students can link the concept to something more tangible. Element by element mathematics, vector subscripting, and useful functions for generating vectors are also covered.

AP Environmental Science Lesson Plan

Objectives: Introduce the use of vectors in R.

Frameworks: Math: N-Q, A-all, A-SSE, A-APR, A-CED, A-REI, F-IF, F-LE. Inquiry: SIS1, SIS2, SIS3, SIS4

L-Side Activities: Teacher

At the bell: Using proper syntax, write the command you would give R to evaluate the following mathematical expressions.

- $a = 5 \times 30^{12}$
- store the value of e raised to a power of three halves in the variable x

Agenda:

1. Assignment Operator Review
2. Scalars and Vectors
 - Mathematics
 - Computing
3. Creating Vectors
4. Special Functions
5. Vector Subscripting
6. Vector Math

R-Side Notes: Students

Outline:

1. Assignment Operator Review
 - a. Variables versus values
 - b. Assign value explicitly
 - c. Assign value from other variable
 - d. Assign values that result from mathematical expressions
2. Scalars and vectors
 - a. Mathematics
 - Scalars on a number line
 - Vectors in the cartesian coordinate system
 - b. Computer Science
 - Scalars are essentially the same as in mathematics
 - Vectors are variables containing multiple scalars (or other things like characters)
3. Creating Vectors
 - a. From scalar values using the c() command
 - b. From scalar variables using the c() command
 - c. Order importance in the c() command.
 - d. Vectors made from other vectors
4. Special Functions
 - a. Vector of repeated elements using the rep() command.
 - b. Vector of sequential elements using the seq()
5. Vector Subscripting
 - a. Square brackets: []
 - b. Subscripting more than one element at a time
6. Vector Math
 - a. Element by element operations
 - b. Vector length considerations

From Special Functions

Sometimes we need to create a vector with a lot of elements inside of it, for example vectors can contain thousands of values. This would be tedious to enter by hand. Therefore, R is equipped with several functions to make creating vectors that have definitive patterns easy. We will take advantage of two of these functions. First lets use the repeat function, which allows us to create vectors of repeated values or repeated groups of values.

1. Enter `f <- rep(2, 3)`
2. Examine f in your workspace and write the values that it contains in the squares below:

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3. Enter `g <- seq(from = 0, to = 10, by = 2)`
4. Examine g in your workspace and write the values that it contains in the squares below:

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5. For extra credit, make the variable h contain the values (1, 2, 3, 1, 2, 3, 1, 2, 3) using just the rep and seq commands. For help try `?rep` and `?seq` in the console.

Vector Math (Element by Element)

In RStudio create the following 3 vectors:

1. `h <- rep(5, 3)`
2. `i <- seq(from = 1, to = 3, by = 1)`
3. `j <- c(0, 1, 4)`

Then evaluate the following mathematical expressions in RStudio

1. `k <- h + i`
2. `l <- i - j`
3. `m <- h * j`
4. `n <- x * y` why does this result appear to behave differently from the other 3?

After you finish save your work by entering `save.image("Name.RData")` . Then email a copy to Ms. Leonard for evaluation.