Basics of Matrix Algebra in R

Math 430, Winter 2017

Vectors

Defining

```
a <- c(1, 3, 2)
```

Note: `a` will be printed as a row vector, but R defines it as a column vector. This can be seen through transposition

Transposing

```
t(a)
```

```
##      [,1] [,2] [,3]
## [1,]    1    3    2
```

```
t(t(a))
```

```
##      [,1]
## [1,]    1
## [2,]    3
## [3,]    2
```

Scalar multiplication

```
3.14 * a
```

```
## [1] 3.14 9.42 6.28
```

Vector addition

```
b <- c(2, 8, 9)
a + b
```

```
## [1]  3 11 11
```

Matrices

Defining

```
A <- matrix(c(1, 3, 2, 2, 8, 9), ncol = 3)
A
```

```
##      [,1] [,2] [,3]
## [1,]    1    2    8
## [2,]    3    2    9
```

```
 A2 <- matrix(c(1, 3, 2, 2, 8, 9), ncol = 3, byrow = TRUE)
A2
```

```
##      [,1] [,2] [,3]
## [1,]    1    3    2
## [2,]    2    8    9
```

Transposing

```
t(A)
```

```
##      [,1] [,2]
## [1,]    1    3
## [2,]    2    2
## [3,]    8    9
```

Scalar multiplication

```
3.14 * A
```

```
##      [,1] [,2]  [,3]
## [1,] 3.14 6.28 25.12
## [2,] 9.42 6.28 28.26
```

Addition

```
B <- matrix(c(5, 8, 3, 4, 2, 7), ncol = 3, byrow = TRUE)
A + B
```

```
##      [,1] [,2] [,3]
## [1,]    6   10   11
## [2,]    7    4   16
```

Multiplication

Matrix multiplied by a vector

A tempting, but incorrect, approach:

```
X <- matrix(c(1, 1, 1, 2, 4, 6), ncol = 2, byrow = FALSE)
b <- c(5, 8)
X * b
```

```
##      [,1] [,2]
## [1,]    5   16
## [2,]    8   20
## [3,]    5   48
```

Instead, use the %*% operator

```
X %*% b
```

```
##      [,1]
## [1,]   21
## [2,]   37
## [3,]   53
```

Matrix multiplied by a matrix

```
t(X) %*% X
```

```
##      [,1] [,2]
## [1,]    3   12
## [2,]   12   56
```

Inverting a matrix

```
Y <- c(1.5, 2.3, 3.7)
XtX <- t(X) %*% X
XtXinv <- solve(XtX)
XtXinv %*% t(X) %*% Y
```

```
##      [,1]
## [1,] 0.30
## [2,] 0.55
```

Special matrices

The identity

```
diag(3)
```

```
##      [,1] [,2] [,3]
## [1,]    1    0    0
## [2,]    0    1    0
## [3,]    0    0    1
```