Part A Simulation and Statistical programming HT15

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Lecture 12: reference slides for matrices in R
R commands for matrices and vectors

Here are some slides of R commands for matrices and vectors. Please refer back to them in the practical as needed.
Vectors and Matrices in R

Matrices can be constructed using the functions `matrix()`, `cbind()` or `rbind()`.

`matrix(data, nrow, ncol)`
# data is a vector of nrow*ncol values

`cbind(d1, d2, ...., dm)`
# d1, .... , dm are vectors (columns)

`rbind(r1, r2, ....,rn)`
# r1, ... , rn are vectors (rows)
Accessing elements

If $X$ is a matrix we can access the element in the $i$th row and $j$th column using $X[i,j]$

We can access the $i$th row using $X[i,]$, and the $j$th column using $X[,j]$.

These commands result in an answer that is a vector with no dimension information kept. If we want to maintain the result as a row or column vector we use the option $\text{drop = FALSE}$ i.e. $X[i, \text{drop = FALSE}]$ and $X[,j,\text{drop = FALSE}]$

If we want to find which elements satisfy a certain property we can use the \texttt{which()} command.

\texttt{which(X >= 0, arr.ind = TRUE)}
Matrix properties
There are a few useful functions that return basic properties of matrices

- **dim()** returns the number of rows and columns
- **det()** returns the determinant of a square matrix
- **diag()** returns the diagonal entries of a matrix
  OR turns a vector into a diagonal matrix.
  `sum(diag())` can be used to calculate the trace.
- **t()** returns the transpose of a matrix
- **upper.tri()** returns a matrix of logical elements with
  **TRUE** for the upper triangular elements.
- **lower.tri()** returns a matrix of logical elements with
  **TRUE** for the lower triangular elements.
- **eigen()** Computes eigenvalues and eigenvectors of real
  or complex matrices.
Matrix arithmetic

\[ X + Y \] element-wise addition (matrices must conform)
\[ X + 2 \] addition of 2 to each element of \( X \)
\[ X \times Y \] element-wise multiplication (matrices must conform)
\[ X \times 2 \] multiplication of each element of \( X \) by 2
\[ X \%*\% Y \] matrix multiplication (matrices must conform)
\[ \text{crossprod}(Y, X) \] calculates \( Y^T X \) efficiently
\[ \text{crossprod}(Y) \] calculates \( Y^T Y \)
\[ \text{solve}(X) \] returns the inverse of a square matrix.
\[ \text{solve}(X, b) \] Solves a system of linear equations \( X\theta = b \)
\[ \text{backsolve}(A, b) \] Solves a system of linear equations \( A\theta = b \) where the coefficient matrix \( A \) is upper or lower triangular.