

## 5.1

- $A + B = \begin{bmatrix} 2 & 7 \\ 3 & 10 \\ 5 & 13 \end{bmatrix}$  is a matrix of  $3 \times 2$
- $A - B = \begin{bmatrix} 0 & 1 \\ 1 & 2 \\ 1 & 3 \end{bmatrix}$  is a matrix of  $3 \times 2$
- $AC = \begin{bmatrix} 23 & 24 & 1 \\ 36 & 40 & 2 \\ 49 & 56 & 3 \end{bmatrix}$  is a matrix of  $3 \times 3$
- $AB' = \begin{bmatrix} 13 & 17 & 22 \\ 20 & 26 & 34 \\ 27 & 35 & 46 \end{bmatrix}$  is a matrix of  $3 \times 3$
- $B'A = \begin{bmatrix} 9 & 26 \\ 26 & 76 \end{bmatrix}$  is a matrix of  $2 \times 2$

### 5.3.1

Matrix form:  $Y - \hat{Y} = e$

$$Y = \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \\ Y_4 \end{bmatrix} \text{ is a } 4 \times 1 \text{ matrix}$$

$$\hat{Y} = \begin{bmatrix} \hat{Y}_1 \\ \hat{Y}_2 \\ \hat{Y}_3 \\ \hat{Y}_4 \end{bmatrix} \text{ is a } 4 \times 1 \text{ matrix}$$

$$e = \begin{bmatrix} (Y_1 - \hat{Y}_1) \\ (Y_2 - \hat{Y}_2) \\ (Y_3 - \hat{Y}_3) \\ (Y_4 - \hat{Y}_4) \end{bmatrix} \text{ is a } 4 \times 1 \text{ matrix}$$

### 5.3.2

Matrix form:  $Xe = [X_1e_1 + X_2e_2 + X_3e_3 + X_4e_4] = 0$

$X = \begin{bmatrix} X_1 & X_2 & X_3 & X_4 \end{bmatrix}$  is a matrix of  $1 \times 4$

$$e = \begin{bmatrix} e_1 \\ e_2 \\ e_3 \\ e_4 \end{bmatrix} \text{ is a matrix of } 4 \times 1$$

### 5.8.a

$$\det(B) = 0$$

Since  $\det(B) = 0$ , this is linearly dependent.

## 5.8.b

$$rref(B) = \begin{bmatrix} 1 & 0 & 5 \\ 0 & 1 & -1 \\ 0 & 0 & 0 \end{bmatrix}$$

$$rank(B) = 2$$

## Appendix

### Functions

```
r_matrix_to_mathjax <- function(mat) {  
  nrow <- dim(mat)[1]  
  ncol <- dim(mat)[2]  
  
  result <- "\\begin{bmatrix}"  
  for (i in 1:nrow) {  
    result <- paste(result, "", paste(mat[i, ], collapse = "&"), "\\\\" )  
  }  
  result <- paste(result, "\\end{bmatrix}")  
  
  return(result)  
}
```

## 5.1

```
A <- matrix(c(1, 4, 2, 6, 3, 8), nrow = 3, ncol = 2, byrow = TRUE)  
B <- matrix(c(1, 3, 1, 4, 2, 5), nrow = 3, ncol = 2, byrow = TRUE)  
C <- matrix(c(3, 8, 1, 5, 4, 0), nrow = 2, ncol = 3, byrow = TRUE)  
  
# r_matrix_to_mathjax(A+B)  
# r_matrix_to_mathjax(A-B)  
# r_matrix_to_mathjax(A%%C)  
# r_matrix_to_mathjax(A%%t(B))  
# r_matrix_to_mathjax(t(B)%%A)
```

## 5.8

```
B <- matrix(c(1, 5, 0, 1, 0, 5, 1, 0, 5), nrow = 3, ncol = 3, byrow = TRUE)  
det_B <- det(B)  
rank_B <- qr(B)$rank  
# pracma::rref(B)
```