

AnSci/Genetics 610: QUANTITATIVE GENETICS, Fall 2025
Homework 1: Exercises with Matrices

$$1. \begin{bmatrix} 1 & 4 \\ 2 & 5 \\ 3 & 6 \end{bmatrix} + \begin{bmatrix} 0 & -2 \\ -1 & -3 \\ 1 & -4 \end{bmatrix} =$$

$$2. \begin{bmatrix} 1 & 2 \\ 2 & 3 \end{bmatrix} - \begin{bmatrix} -1 & 0 \\ 1 & 1 \end{bmatrix} =$$

$$3. 3 \times \begin{bmatrix} 1 & 2 & 0 \\ 3 & -1 & -2 \end{bmatrix} =$$

$$4. \begin{bmatrix} 1 & 4 \\ 2 & 5 \\ 3 & 6 \end{bmatrix} \begin{bmatrix} 0 & -2 \\ -1 & -3 \\ 1 & -4 \end{bmatrix} =$$

$$5. \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} \begin{bmatrix} 1 & 1 & 1 \end{bmatrix} =$$

$$6. \begin{bmatrix} 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} =$$

$$7. \begin{bmatrix} 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} =$$

Note: The first matrix above is called a “permutation” matrix. Please notice how it permutes the rows of the second matrix. A permutation matrix is a square matrix consisting of 0s and 1s, with a single 1 in each row and column.

$$8. \begin{bmatrix} 1 & 5 \\ 2 & 0 \\ 3 & 1 \end{bmatrix}^T =$$

$$9. A = \begin{bmatrix} 1 & -1 \\ 0 & 2 \\ 3 & 2 \end{bmatrix}; a_{31} - a_{22} =$$

$$10. \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \pi & 3 & -1 \\ 2 & 0 & 0 \\ 5 & 3^{-1} & 0.5 \end{bmatrix} =$$

$$11. \text{Solve for } x \text{ and } y: \begin{bmatrix} 1 & y \\ 2 & 3 \\ x & 6 \end{bmatrix} = \begin{bmatrix} 1 & 2 \\ 2 & 3 \\ 0 & 6 \end{bmatrix}$$

$$12. \begin{bmatrix} 2 & 1 \\ 0 & 1 \end{bmatrix}^{-1} =$$

$$13. B = \begin{bmatrix} 3 & 1 \\ 3 & 2 \end{bmatrix}; \det(B) =$$

$$\text{tr}(B) =$$

$$14. \begin{bmatrix} 1 & 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \end{bmatrix} =$$

(use the summation notation
for questions 14 and 15)

$$15. Y = \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \end{bmatrix}; Y^T Y =$$

$$16. \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} \begin{bmatrix} y_1 & y_2 & y_3 \end{bmatrix} =$$

$$17. \begin{bmatrix} 1 & -1 & 0 & 0 \\ 0 & 1 & -1 & 0 \\ 0 & 0 & 1 & -1 \end{bmatrix} \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \end{bmatrix} =$$

$$18. \begin{bmatrix} 1 & 2 \\ -1 & 1 \end{bmatrix} \begin{bmatrix} 3 & 1 \\ 2 & 3 \end{bmatrix} =$$

Solve the following linear systems of equations:

$$19. \begin{cases} x_1 + x_2 + x_3 = 3 \\ x_1 - x_2 + x_3 = 3 \\ x_1 - x_2 - x_3 = -1 \end{cases}$$

$$20. \begin{cases} y_1 + 2y_2 - y_3 - y_4 = -2 \\ 2y_1 - y_2 - y_3 + y_4 = 6 \\ 2y_1 + y_2 + 3y_3 - y_4 = -4 \\ 3y_1 + 3y_2 + y_3 + y_4 = 1 \end{cases}$$