

# Advanced Quantitative Methods

## Exercises 1: Math review

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1.

$$\mathbf{A} = \begin{bmatrix} 2 & 5 \\ 8 & 3 \end{bmatrix} \quad \mathbf{B} = \begin{bmatrix} 3 & 0 \\ 0 & 2 \end{bmatrix}$$

Calculate

- (a)  $\mathbf{A} + \mathbf{B}$
- (b)  $\mathbf{A} - \mathbf{B}$
- (c)  $\mathbf{AB}$
- (d)  $\mathbf{AB}'$

2.

$$\mathbf{A} = \begin{bmatrix} 3 & 2 & 2 \\ 3 & 4 & 6 \end{bmatrix}$$

Calculate

- (a)  $\frac{1}{2}\mathbf{A}$
- (b)  $\mathbf{A} + \mathbf{A}$
- (c)  $\mathbf{AA}'$
- (d)  $\mathbf{A}'\mathbf{A}$
- (e)  $tr(\mathbf{A}'\mathbf{A})$

3. Let  $x$  be a random variable containing only ones and zeros. Let  $\pi$  be the probability of observing a one. Show that

- (a)  $E(x) = \pi$
- (b)  $var(x) = \pi(1 - \pi)$

4.

$$\mathbf{X} = \begin{bmatrix} 1 & -1 & 2 \\ 1 & 0 & 3 \\ 1 & -1 & 3 \\ 1 & 1 & 3 \\ 1 & 0 & 2 \end{bmatrix} \quad \mathbf{y} = \begin{bmatrix} 3.6 \\ 6.2 \\ 4.8 \\ 6.1 \\ 4.4 \end{bmatrix} \quad \hat{\beta} = \begin{bmatrix} 1.62 \\ 0.68 \\ 1.36 \end{bmatrix}$$

- (a)  $\mathbf{X}\hat{\beta}$
- (b)  $\mathbf{y} - \mathbf{X}\hat{\beta} = \mathbf{e}$
- (c)  $\mathbf{e}'\mathbf{e}$