Q.1. If vector $\mathbf{w}$ is of dimension 10×1 and matrix $\mathbf{A}$ of dimension 20×10, then what is the dimension of $\mathbf{w}^\top \mathbf{A}^\top \mathbf{A}$?

- (A) 20×1
- (B) 1×20
- (C) 1×10
- (D) 10×1
- (E) 1×1

[2.5 marks]

Q.2. Which of the following models with input x_1, x_2, parameters w_1, w_2 and noise $\varepsilon \sim \mathcal{N}(0, \sigma^2)$, are linear in the parameters and satisfy Least Squares assumptions (mark all suitable models):

- (A) $y = w_1 x_1 + \sin(w_1 x_2 + w_2 x_2 + 0.1) + \varepsilon$
- (B) $y = w_1 x_1 + w_2 x_2 + 10 + \varepsilon$
- (C) $y = \exp(x_1)(w_1 + w_2 x_2^2) + \varepsilon$
- (D) $y = w_1 w_2^2 x_1 + \varepsilon$

[2.5 marks]

Q.3. Which of the following models with input x_1, x_2, parameters w_1, w_2 and noise $\varepsilon \sim \mathcal{N}(0, \sigma^2)$, are linear in the parameters and satisfy Least Squares assumptions (mark all suitable models):

- (A) $y = w_1 x_1 + w_1 x_2 + 2\varepsilon$
- (B) $y = w_1 x_1 + w_2 x_2 + \varepsilon^2$
- (C) $y = w_1 x_1 + w_2 x_2 + 3 + \varepsilon$
- (D) $y^2 = w_1 x_1 + w_2 x_2 + \varepsilon$

[2.5 marks]

Q.4. We are trying to fit a 3rd degree polynomial to a dataset using Least Squares. We know that the underlying model is indeed a 3rd degree polynomial and we are trying to estimate the polynomial coefficients. However, we are having issues with overfitting. Which strategy/strategies will give us the best chance of finding the best estimate of the true polynomial coefficients?

- Ⓐ increasing the size of the training set
- Ⓑ increasing the size of the test set
- Ⓒ descreasing the size of the test set
- Ⓓ increasing the Tikhonov regularisation
- Ⓔ decreasing the size of the training set
- Ⓕ increasing the polynomial order model to 4

[2.5 marks]