Started on	Saturday, 18 November 2023, 4:30 PM
State	Finished
Completed on	Saturday, 18 November 2023, 5:08 PM
Time taken	37 mins 55 secs
Grade	**9.00** out of 10.00 (**90**%)

Question **1**

Incorrect

Mark 0.00 out of 1.00

Remove flag

The probability of symbol error for 64-QAM with $\frac{E_s}{N_0} = 21$ is given as

Select one:

- $\frac{7}{2}Q(1)$
- $\frac{7}{2}Q(2)$ ✗
- $\frac{7}{2}Q\left(\sqrt{\frac{1}{3}}\right)$
- $3Q(2)$

Your answer is incorrect.

The correct answer is: $\frac{7}{2}Q(1)$

Question **2**

Correct

Mark 1.00 out of 1.00

Flag question

Let the decision regions for $\mathcal{H}_1, \mathcal{H}_0$ be R_1, R_0, respectively, and corresponding prior probabilities of the hypotheses be π_1, π_0. The probability of error is given as

Select one:

- $\pi_1 \int_{R_0} p(\bar{\mathbf{y}}|\mathcal{H}_1) d\bar{\mathbf{y}} + \pi_0 \int_{R_1} p(\bar{\mathbf{y}}|\mathcal{H}_0) d\bar{\mathbf{y}}$ ✓
- $\pi_1 \int_{R_1} p(\bar{\mathbf{y}}|\mathcal{H}_1) d\bar{\mathbf{y}} + \pi_0 \int_{R_0} p(\bar{\mathbf{y}}|\mathcal{H}_0) d\bar{\mathbf{y}}$
- $\pi_1 \int_{R_0} p(\bar{\mathbf{y}}|\mathcal{H}_0) d\bar{\mathbf{y}} + \pi_0 \int_{R_1} p(\bar{\mathbf{y}}|\mathcal{H}_1) d\bar{\mathbf{y}}$
- $\pi_0 \int_{R_0} p(\bar{\mathbf{y}}|\mathcal{H}_1) d\bar{\mathbf{y}} + \pi_1 \int_{R_1} p(\bar{\mathbf{y}}|\mathcal{H}_0) d\bar{\mathbf{y}}$

Your answer is correct.

The correct answer is: $\pi_1 \int_{R_0} p(\bar{\mathbf{y}}|\mathcal{H}_1) d\bar{\mathbf{y}} + \pi_0 \int_{R_1} p(\bar{\mathbf{y}}|\mathcal{H}_0) d\bar{\mathbf{y}}$

Question **3**

Correct

Mark 1.00 out of 1.00

Flag question

The min P_e detector chooses $\mathcal{H}_0$ when

Select one:

- $\Pr(\mathcal{H}_1|\bar{\mathbf{y}}) \geq \Pr(\mathcal{H}_0|\bar{\mathbf{y}})$
- $\Pr(\bar{\mathbf{y}}|\mathcal{H}_0) \geq \Pr(\bar{\mathbf{y}}|\mathcal{H}_1)$
- $\Pr(\bar{\mathbf{y}}|\mathcal{H}_1) \geq \Pr(\bar{\mathbf{y}}|\mathcal{H}_0)$
- $\Pr(\mathcal{H}_0|\bar{\mathbf{y}}) \geq \Pr(\mathcal{H}_1|\bar{\mathbf{y}})$ ✔

Your answer is correct.

The correct answer is: $\Pr(\mathcal{H}_0|\bar{\mathbf{y}}) \geq \Pr(\mathcal{H}_1|\bar{\mathbf{y}})$

Question **4**

Correct

Mark 1.00 out of 1.00

Flag question

Consider $\bar{s} = \begin{bmatrix} 1 \\ -1 \\ 1 \\ -1 \end{bmatrix}$, $\sigma^2 = \frac{1}{2}$ and $\pi_0 = \frac{1}{1+e}$. For the binary signal detection problem described in class, the threshold for the MAP decision rule is given as

Select one:

- $\frac{5}{2}$
- . $\frac{3}{2}$ ✔
- 2
- 1

Your answer is correct.

The correct answer is: . $\frac{3}{2}$

Question **5**

Correct

Mark 1.00 out of 1.00

Flag question

For the binary signal detection problem described in class, the minimum P_e achieved using the MAP rule is given as

Select one:

- $\pi_0 Q\left(\frac{\|\bar{s}\|^2+2\sigma^2\ln\frac{\pi_1}{\pi_0}}{2\sigma\|\bar{s}\|}\right) + \pi_1 Q\left(\frac{\|\bar{s}\|^2-2\sigma^2\ln\frac{\pi_1}{\pi_0}}{2\sigma\|\bar{s}\|}\right)$
- $\pi_0 Q\left(\frac{\|\bar{s}\|-2\sigma\ln\frac{\pi_1}{\pi_0}}{2\sigma^2\|\bar{s}\|^2}\right) + \pi_1 Q\left(\frac{\|\bar{s}\|+2\sigma\ln\frac{\pi_1}{\pi_0}}{2\sigma^2\|\bar{s}\|^2}\right)$
- $\pi_0 Q\left(\frac{\|\bar{s}\|+2\sigma\ln\frac{\pi_1}{\pi_0}}{2\sigma^2\|\bar{s}\|^2}\right) + \pi_1 Q\left(\frac{\|\bar{s}\|-2\sigma\ln\frac{\pi_1}{\pi_0}}{2\sigma^2\|\bar{s}\|^2}\right)$
- $\pi_0 Q\left(\frac{\|\bar{s}\|^2-2\sigma^2\ln\frac{\pi_1}{\pi_0}}{2\sigma\|\bar{s}\|}\right) + \pi_1 Q\left(\frac{\|\bar{s}\|^2+2\sigma^2\ln\frac{\pi_1}{\pi_0}}{2\sigma\|\bar{s}\|}\right)$ ✔

Your answer is correct.

The correct answer is: $\pi_0 Q\left(\frac{\|\bar{s}\|^2-2\sigma^2\ln\frac{\pi_1}{\pi_0}}{2\sigma\|\bar{s}\|}\right) + \pi_1 Q\left(\frac{\|\bar{s}\|^2+2\sigma^2\ln\frac{\pi_1}{\pi_0}}{2\sigma\|\bar{s}\|}\right)$

Question **6**

Correct

Mark 1.00 out of 1.00

Flag question

The LDA-based classifier for the classification of two Gaussian classes $\mathcal{N}(\bar{\mu}_0, \mathbf{R})$, $\mathcal{N}(\bar{\mu}_1, \mathbf{R})$ reduces to choose $\mathcal{H}_0$ if

Select one:

- $(\bar{\mu}_0 - \bar{\mu}_1)^T \mathbf{R} \left(\bar{\mathbf{x}} - \frac{1}{2}(\bar{\mu}_0 + \bar{\mu}_1)\right) \geq \mathbf{0}$
- $(\bar{\mu}_0 - \bar{\mu}_1)^T \mathbf{R}^{-1} \left(\bar{\mathbf{x}} - \frac{1}{2}(\bar{\mu}_0 + \bar{\mu}_1)\right) \geq \mathbf{0}$ ✔
- $(\bar{\mu}_0 - \bar{\mu}_1)^T \left(\bar{\mathbf{x}} - \frac{1}{2}(\bar{\mu}_0 + \bar{\mu}_1)\right) \geq \mathbf{0}$
- $(\bar{\mu}_0 + \bar{\mu}_1)^T \mathbf{R}^{-1} \left(\bar{\mathbf{x}} - \frac{1}{2}(\bar{\mu}_0 - \bar{\mu}_1)\right) \geq \mathbf{0}$

Your answer is correct.

The correct answer is: $(\bar{\mu}_0 - \bar{\mu}_1)^T \mathbf{R}^{-1} \left(\bar{\mathbf{x}} - \frac{1}{2}(\bar{\mu}_0 + \bar{\mu}_1)\right) \geq \mathbf{0}$

Question **7**

Correct

Mark 1.00 out of 1.00

Flag question

The LDA-based classifier for the classification of two Gaussian classes $\mathcal{N}(\bar{\mu}_0, \mathbf{R})$, $\mathcal{N}(\bar{\mu}_1, \mathbf{R})$ for $\mathbf{R} = \sigma^2\mathbf{I}$ reduces to

Select one:

- The plane parallel to $\bar{\mu}_0, \bar{\mu}_1$
- The perpendicular bisector of $\bar{\mu}_0, \bar{\mu}_1$ ✔
- Circle with diameter $\bar{\mu}_0, \bar{\mu}_1$
- Ellipsoid with semi major axis $\bar{\mu}_0, \bar{\mu}_1$

Your answer is correct.

The correct answer is: The perpendicular bisector of $\bar{\mu}_0, \bar{\mu}_1$

Question **8**

Correct

Mark 1.00 out of 1.00

Flag question

Consider the classifier for the **Gaussian classification** problem with the two classes $\mathcal{C}_0, \mathcal{C}_1$ distributed as

$$\mathcal{C}_0 \sim N\left(\begin{bmatrix}4\\2\end{bmatrix}, \begin{bmatrix}\frac{1}{2} & 0\\ 0 & \frac{1}{4}\end{bmatrix}\right), \mathcal{C}_1 \sim N\left(\begin{bmatrix}2\\4\end{bmatrix}, \begin{bmatrix}\frac{1}{2} & 0\\ 0 & \frac{1}{4}\end{bmatrix}\right)$$

The probability of error is given as

Select one:

- $Q(\sqrt{12})$
- $Q(2\sqrt{6})$
- $Q\left(\frac{1}{2}\sqrt{6}\right)$
- . $Q(\sqrt{6})$ ✔

Your answer is correct.

The correct answer is: . $Q(\sqrt{6})$

Question **9**

Correct

Mark 1.00 out of 1.00

Flag question

Consider the LDA-based classifier for the classification of two Gaussian classes $\mathcal{N}(\bar{\boldsymbol{\mu}}_0, \mathbf{R}), \mathcal{N}(\bar{\boldsymbol{\mu}}_1, \mathbf{R})$. The optimal signal $\bar{\mathbf{s}} = \bar{\boldsymbol{\mu}}_0 - \bar{\boldsymbol{\mu}}_1$ that minimizes the probability of error is given as

Select one:

- The eigenvector corresponding to the maximum eigenvalue of $\mathbf{R}$
- Any eigenvector of $\mathbf{R}$
- The eigenvector corresponding to the minimum eigenvalue of $\mathbf{R}$ ✔
- Any unit-norm vector that does not lie in the null space of $\mathbf{R}$

Your answer is correct.

The correct answer is: The eigenvector corresponding to the minimum eigenvalue of $\mathbf{R}$

Question **10**

Correct

Mark 1.00 out of 1.00

Flag question

For a given $SNR = \rho$, the average BER for detection of BPSK symbols over a fading wireless channel is given as

Select one:

- $\frac{1}{2}\left(1 - \sqrt{\frac{2+\rho}{\rho}}\right)$
- $\frac{1}{2}\left(1 - \sqrt{\frac{\rho}{2+\rho}}\right)$ ✔
- $\left(1 - \sqrt{\frac{\rho}{2+\rho}}\right)$
- $\frac{1}{2}\left(1 - \sqrt{\frac{\rho}{2}}\right)$

Your answer is correct.

The correct answer is: $\frac{1}{2}\left(1 - \sqrt{\frac{\rho}{2+\rho}}\right)$

Finish review