13 Jul 2021

Quiz: Chap 3 and Chap 4

Max marks: 20
Max time: 40 minutes + 10 minutes for uploading
Give formal notation for full credit. Upload one pdf file for Q1(b), Q2 and Q3.

1. (a) Consider a two class and three action problem with the following loss matrix.

Action \ Actual Class	C1	C2
α_1: Choose C1	0	0.8
α_2: Choose C2	1	0
α_R: Reject instance	0.5	0.5

Calculate the expected risk and match the the correct decision rule for each action.

1. Choose Action α_1	A. $P(C1\|x) > 0.8$
2. Choose Action α_2	B. $P(C1\|x) < 3/8$
3. Reject	C. $P(C1\|x) > 3/8$
	D. $P(C1\|x) < 0.5$
	E. $P(C1\|x) < 0.5 < P(C2\|x)$
	F. $3/8 < P(C1\|x) < 0.5$

(b)Upload the calculations as pdf file. (3+4 Marks)

2. Consider the following log likelihood function for parameters (α, β^2) and the data sample X. Find the MLE for the parameters.(5 Marks)

$$\mathcal{L}(\alpha, \beta|\chi) = -N \log \beta - \frac{\Sigma_t (x^t - \alpha)^2}{2\beta^2} \tag{1}$$

3. Consider a sample $X = \{x^t, r^t\}$ and model $g(.)$ trained over it. Explain in one sentence each the semantics of noise, bias and variance. (3 Marks)

4. If θ is the true value of the parameters and $\hat{\theta}(X)$ is its estimate from data set X, then $E[(\hat{\theta}(X) - \theta)^2]$ is the ———- of the estimator. (1 Mark)

a. Bias b. Variance c. Squared error d. Mean squared error

5. Consider a K-class problem with one independent real variable x, which is normally distributed $\sim N(\mu, \sigma^2)$ and the discriminant for i^{th} class is $g_i(x) = -\frac{1}{2}\log \pi - \log s_i - \frac{(x-m_i)^2}{2s_i^2} + \log \hat{P}(C_i)$. We can write $g_i(x) = (x - m_i)^2$ when ——-. (2 Marks)

(a) All classes have equal mean and std dev

(b) All classes have same std dev and number of instances

(c) All classes have equal mean and number of instances

(d) All classes have equal mean, std dev and number of instances

6. Suppose that we fit a linear and 4^{th} degree polynomial to data, $\mathcal{M}1$ and $\mathcal{M}2$ respectively, coming from a cubic function. Assume that there exists standard Gaussian noise in data. Choose the correct statement. (1 Mark)

   (a) Bias(M1) $\leq$ Bias(M2); Variance(M1)$\leq$ Variance(M2)

   (b) Bias(M1) $\geq$ Bias(M2); Variance(M1) $\leq$ Variance(M2)

   (c) Bias(M1) $\leq$ Bias(M2); Variance(M1) $\geq$ Variance(M2)

   (d) Bias(M1) $\geq$ Bias(M2); Variance(M1) $\geq$ Variance(M2)

7. In polynomial regression, the model is linear in —-. (1 Marks)