Week 12 PYQs
Machine Learning Foundations
May 22 - Sep 25

Note

1. If no questions are listed in that term Quiz, it indicates that the corresponding quiz did not include questions from that week.

2. The answer key may contain minor inaccuracies, as answers were taken directly from the original quiz/exam papers. Some of these might have been corrected later.

3. For any issues or suggestions regarding this document, feel free to contact:
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   or reach out on Discourse: `@23f3004032`

Quiz 1 May 22

Quiz 2 May 22

ET May 22

1. Data is generated by $Y = X + 5$. A learned model is $f(x) = X + 3$. What is the MSE (mean squared error) of the output model? *NOTE: Enter your answer to the nearest integer.* [Ans: 4]

Quiz 1 Sep 22

Quiz 2 Sep 22

ET Sep 22

1. If X Poisson(λ), then the upper bound for $P(X \geq k)$ where $a > 0$ using Markov's inequality is

   (a) λk

   (b) $\frac{\lambda}{k}$

   (c) $\frac{1}{\lambda k}$

   (d) $\frac{1}{\lambda}$

   [Ans: 2]

Quiz 1 Jan 23

Quiz 2 Jan 23

ET Jan 23

1. Let p denote the proportion of voters who support Candidate A for the post of college president. Randomly n selected voters are interviewed, and the fraction who are in favour of candidate A is recorded. Using Chebyshev inequality, find the minimum number of voters who should be interviewed such that the probability that sample mean is within 0.01 of p with probability at least 0.95. Enter the answer as integer. Hint: If $X \in [a, b]$, population variance $\leq \frac{(b-a)^2}{4}$. [Ans: 50000]

Quiz 1 May 23

Quiz 2 May 23

ET May 23

1. The time (in hours) it takes for a computer system to reboot after a crash follows an exponential distribution, with a parameter λ. Last five observations are noted as 1, 2, 3, 1, 3. Find the maximum likelihood estimate for λ. Enter the answer correct to one decimal place. [Ans: 0.5]

Quiz 1 Sep 23

Quiz 2 Sep 23

ET Sep 23

1. Suppose you want to check whether a coin is fair or not. The coin shows heads with probability p each time it is flipped. Suppose you flip the coin 1000 times and observe a total of 485 heads, then find the ML estimate of p. Enter the answer correct to three decimal places. [Ans: 0.480 to 0.490]

2. Let $X = \begin{pmatrix} X_1 \\ X_2 \\ X_3 \end{pmatrix} \sim Normal(\mu, \Sigma)$, where $\mu = \begin{pmatrix} 2 \\ 5 \\ 1 \end{pmatrix}$ and $\Sigma = \begin{pmatrix} 5 & 2 & -2 \\ 2 & 6 & 3 \\ -2 & 3 & 8 \end{pmatrix}$. If $Y = BX$ where $B = \begin{pmatrix} 2 & 0 & 1 \\ 0 & 3 & 1 \end{pmatrix}$, then find the distribution of Y.

   (a) $Y \sim Normal([\begin{smallmatrix} 5 \\ 16 \end{smallmatrix}], [\begin{smallmatrix} 80 & 25 \\ 25 & 20 \end{smallmatrix}])$

   (b) $Y \sim Normal([\begin{smallmatrix} 5 \\ 16 \end{smallmatrix}], [\begin{smallmatrix} 20 & 25 \\ 25 & 80 \end{smallmatrix}])$

   (c) $Y \sim Normal([\begin{smallmatrix} 2 \\ 5 \end{smallmatrix}], [\begin{smallmatrix} 20 & 25 \\ 25 & 80 \end{smallmatrix}])$

   (d) $Y \sim Normal([\begin{smallmatrix} 2 \\ 5 \end{smallmatrix}], [\begin{smallmatrix} 80 & 25 \\ 25 & 20 \end{smallmatrix}])$

   [Ans: 2]

Quiz 1 Jan 24

Quiz 2 Jan 24

ET Jan 24

1. A quality control manager at a factory measures the thickness of glass sheets produced. Five randomly selected sheets have the thicknesses (in mm) 10, 8, 11, 9, 12 respectively. Assuming the thickness follows a normal distribution and the variance is known, what is the maximum likelihood estimator (MLE) of the mean thickness, (μ), in mm of the glass sheets? [Ans: 10]

Quiz 1 May 24

Quiz 2 May 24

ET May 24

1. Suppose a random variable X has a mean μ of 70 and a standard deviation σ of 8. Using Chebyshev's inequality, determine the maximum probability that X will deviate from the mean by more than 16 units. Enter the answer correct to two decimal places. [Ans: 0.25]

Quiz 1 Sep 24

Quiz 2 Sep 24

ET Sep 24

1. Let $Y = aX$ where $a = (1, 1, 2)$ and $X \sim N(\mu, \Sigma)$ with $\mu = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}$ and $\Sigma = \begin{pmatrix} 7 & -2 & 0 \\ -2 & 9 & 3 \\ 0 & 3 & 6 \end{pmatrix}$. Find the distribution of $Y = x_1 + x_2 + 2x_3$.

   (a) $Y \sim N(9, 48)$

   (b) $Y \sim N(4, 16)$

   (c) $Y \sim N(9, 16)$

   (d) $Y \sim N(4, 48)$

[Ans: 1]

Quiz 1 Jan 25

Quiz 2 Jan 25

ET Jan 25

1. A non-negative random variable Y has $E[Y] = 20$ Compute the Markov bound for $P(Y \geq 100)$. [Ans: 0.2]

Quiz 1 May 25

Quiz 2 May 25

ET May 25

1. Let X denote the number of heads in n independent tosses of a p-biased coin (i.e., $\mathbb{P}(Head) = p$) What do Markov's and Chebyshev's inequalities imply about the probability that X exceeds 2pn?

   (a) $\mathbb{P}(|X - \mathbb{E}[X]| > pn) \leq \frac{1-p}{np}$

   (b) Markov's inequality gives $\mathbb{P}(X > 2pn) \leq \frac{1}{2}$; Chebyshev's inequality gives $\mathbb{P}(X > 2pn) \leq \frac{p^2}{n(1-p)}$.

   (c) Markov's inequality gives $\mathbb{P}(X > 2pn) \leq \frac{1}{2}$ Chebyshev's inequality gives no bound since the variance is unknown.

   (d) Markov's inequality gives $\mathbb{P}(X > 2pn) \leq \frac{1}{2}$ Chebyshev's inequality gives a bound independent of p and n.

   [Ans: 1, 2]

Quiz 1 Sep 25

Quiz 2 Sep 25

ET Sep 25