Solution for ML F16 assignment 2

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1 K-Nearest Neighbors

2 Markovs inequality vs. Hoeffdings inequality vs. binomial bound

Question 2.1

To bound the probability that $\sum_{n=1}^{10} X_i$ we start by plugging the given values into Markovs inequality:

$$P\{S \geq 9\} \leq \frac{\mathbb{E}[S]}{9}$$

Using the random variable we are given and linearity of expectation we get:

$$P\{\sum_{n=1}^{10} X_i \geq 9\} \leq \sum_{n=1}^{10} \frac{\mathbb{E}[X_i]}{9}$$

Since we know that X_1,...,X_{10} are i.i.d Bernoulli random variables with bias $\frac{1}{2}$ the expected value sums to $\frac{5}{9}$.

Question 2.2

Focusing at first at the probability side of Hoeffding's inequeality we can use the information given, and the result of the sum of expected valus from above, to determine ϵ:

$$\mathbb{P}\left\{\sum_{n=1}^{10} X_i - \mathbb{E}\left[\sum_{n=1}^{10} X_i\right] \geq \epsilon\right\} \Leftrightarrow \mathbb{P}\left\{\sum_{n=1}^{10} X_i \geq \epsilon + 5\right\} \Rightarrow \epsilon = 4$$

With this result we can find the bound we are asked for, since we know that $a_i = 0$ and $b_i = 1$:

$$e^{-2(4)^2/\sum_{n=1}^{10}(1-0)^2} = e^{-\frac{16}{5}}$$

Question 2.3

We can use the normal binomial

Question 2.4

3 Probability Theory: Sample Space

4 Probability Theory: Properties of Expectation

5 Probability Theory: Complements of Events