

ECE 411 Homework 7 (Fall 2022)
Instructor: Dr. Chau-Wai Wong
Material Covered: Multiple Linear Regression

Problem 1 (20 points)

- a) (10 points) [p -value and Implied Hypothesis Testing] Quiz 1 follow up.
- (i) Please attach the graded Quiz 1 paper.
 - (ii) If your score is less than 10' (including those who missed the quiz), you may recover at most 50% of the lost points by correctly completing the following question: On slide 20 “Results for advertising data” of Lecture 16 (10/19/2022), what hypothesis test does the p -value of the “radio” row imply? Please specify the null hypothesis H_0 and alternative hypothesis H_1 as detailed as possible.
- b) (10 points) [Estimators' Reliability] Exam 1 follow up.
- (i) Derive the analytic form of the variance of estimators \hat{k} , \tilde{k} , and \check{k} in Problem 1 of Exam 1.
 - (ii) Plug in the numerical values of $\{x_i\}_{i=1}^4$. Which estimator has the smallest variance?
 - (iii) In Exam 1, you have proved that all three estimators are unbiased estimators. Based on the results in (ii), argue which one may be the best and give justification in your own words.

Problem 2 (20 points) [Interaction, Nonlinear Transformations, Qualitative Predictors] Read the “Nonlinear Relationship” subsection on p.90 of ISLR and complete *ISLR-3.6.4-6* and write a concise report.

For Python users, please download *Boston.csv data* and *Carseats.csv data* and follow the text book's instructions while referring to the “equivalence” Python codes of *ISLR-3.6.4-6*.

Problem 3 (20 points) [k -Nearest Neighbors] (Please Work on this problem after 10/24 lecture) Complete *ISLR-2.4.7*. Repeat (a)–(c) for $(X_1, X_2, X_3) \in \{(1, 2, 3), (1, -1, 1)\}$.

(Bonus, 10 points): Using a programming language of your choice, refactor your code into a function named `MyKnn` with the following input and output variables. We have shown below examples in R and Matlab, but you may also use Python.

R:	Matlab:
<code>MyKnn = function(x1, x2, x3, k) {</code>	<code>function Y = MyKnn(x1, x2, x3, k)</code>
<code>...</code>	<code>...</code>
<code>return(Y)</code>	<code>end</code>
<code>}</code>	

The file containing the function should be named `MyKnn` with extension `.r`, `.m`, or `.py` and appended to the homework submission in plaintext. The performance of `MyKnn` will be manually assessed, and bonus will be given solely on the percentage of correct classifications using

test data. You can assume that when the function is evaluated, the input variables x_1 , x_2 , x_3 will be any value in \mathbb{R} , k will be less than 6, and the return value being checked against will be either "Red" or "Green".

(You are only given 3 required problems. The rest of time should be devoted to the term project.)

Problem 4 (Bonus, 10 points) Complete ISLR-3.7.9. (Doing this problem may help resolve challenges that you may encounter in topic 1 of the term project.)