Ve401 Probabilistic Methods in Engineering

Summer 2018 — Assigment 8

Date Due: 12:10 PM, Monday, the 23rd of July 2018

This assignment has a total of **(24 Marks)**.

Exercise 8.1

A study of visual and auditory reaction times is conducted for a group of college basketball players. Visual reaction time is measured by the time needed to repsond to a light signal, and auditory reaction time is easured by the time needed to respond to the sound of an electric switch. Fifteen subjects were measured with time recorded to the nearest millisecond:

Subject	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Visual	161	203	235	176	201	188	228	211	191	178	159	227	193	192	212
Auditory	157	207	198	161	234	197	180	165	202	193	173	137	182	159	156

Is there evidence that the visual reaction time tends to be slower than the auditory raction time? Use a paired T-test as well as a Wilcoxon signed rank test.
(6 Marks)

Exercise 8.2

An article in *Knee Surgery, Sports Traumatology, Arthroscopy* (2005, Vol. 13, pp. 273279), considered arthroscopic meniscal repair with an absorbable screw. Results showed that for tears greater than 25 millimeters, 14 of 18 (78%) repairs were successful while for shorter tears, 22 of 30 (73%) repairs were successful.

i) Is there evidence that the success rate is greater for longer tears?
(2 Marks)

ii) Calculate a one-sided 95% confidence bound on the difference in proportions that can be used to answer the question in part (a).
(2 Marks)

Exercise 8.3

Define X as the number of underfilled bottles from a filling operation in a carton of 24 bottles. Seventy-five cartons are inspected and the following observations on X are recorded:

Values	0	1	2	3
Frequency	39	23	12	1

Based on these 75 observations, is a binomial distribution an appropriate model?
(3 Marks)

Exercise 8.4

A study is being made of the failures of an electronic component. There are four types of failures possible and two mounting positions for the device. The following data have been taken:

	Failure Type			
Mounting Position	A	B	C	D
1	22	46	18	9
2	4	17	6	12

Would you conclude that there is evidence that the type of failure is dependent of the mounting position?
(3 Marks)

Exercise 8.5

A study of salary gains by workers in research, development, and quality control is conducted. table below gives a breakdown of the percentage increases over the last yer of men and women woring in these areas.

	% increase					
	$< 2\%$	2-5%	6-9%	10-13%	$> 14\%$	Total
Male	50	47	103	76	24	300
Female	21	27	50	35	17	150

The study is based on a sample of 300 men and 150 women randomly selected from among the workers. Raises were classified according to their integer value. For example, a raise of 5.75% is classified in the category 2-5%. Do these data tend to support the claim that there is an association between the percentage increase in the salary of the worker and the worker's gender? Explain, based on the P-value of your test. Interpret your result in a practical sense by inspecting the data of the above table.
(4 Marks)

Exercise 8.6

Consider the simple linear regression model $Y = \beta_0 + \beta_1 x + E$. Show that

$$\text{Cov}(\overline{Y}, \widehat{\beta}_1) = 0 \qquad \text{and} \qquad \text{Cov}(\widehat{\beta}_0, \widehat{\beta}_1) = -\frac{\overline{x}}{S_{xx}}\sigma^2.$$

(4 Marks)