STAT2203: Probability Models and Data Analysis for Engineering
STAT7203: Applied Probability and Statistics
Week 11 Exercises

1. Serious gaming technology is increasingly being used as a method of training. A 2010 study compared the efficacy of a serious game 'Triage Trainer' to traditional card-sort exercises in preparing learners for a major incident triage. In this study 91 learners were randomly distributed into one of two training groups: 44 participants practiced triage sieve protocol using a card-sort exercise, whilst the remaining 47 participants used 'Triage Trainer'. After the training sessions, each participant was evaluated by triaging eight casualties in a simulated live exercise. Their performance was assessed in terms of accuracy and speed.

   (a) The performance of the leaners in the evaluation exercise is recorded in the table below giving the number of correctly assigned casualties out of eight. Is there any evidence of an association between training method and accuracy? State the null and alternative hypotheses, and use an appropriate test statistic to determine the P-value. What do you conclude?

	8/8	7/8	6/8 or less
Card-sort	24	11	9
Triage Trainer	34	9	4

   (b) The average time taken to triage all eight casualties in the card-sort group was 435s with a sample standard deviation of 74s, whereas the average time taken to triage all eight casualties in the 'Triage Trainer' group was 456s with a sample standard deviation of 62s. Is there any evidence of a difference in the mean time taken to triage casualties between the card-sort group and the 'Triage Trainer' group? State the null and alternative hypotheses, and use an appropriate test statistic to determine the P-value. What do you conclude?

2. A study looked at the effect of tobacco smoking on abnormal blood clots by drawing blood samples from 11 people before and after they smoked a single cigarette. One variable recorded from the blood samples was the percentage of platelet aggregation when exposed to a standard stimulus. The researchers expected that tobacco smoking would give higher platelet aggregation and thus an increased risk of blood clots. The observed average percentage increase was 10.5 with 8.27 sample standard deviation.

   Is there any evidence that smoking one cigarette increases the mean percentage of platelet aggregation? State the null and alternative hypotheses for this test. State the test statistics and give bounds on the P-value. What do you conclude?

3. In a survey students were asked "Do you believe in god?" The results, split by gender, are shown in the following table:

	Yes	No
Female	101	76
Male	90	89

Carry out a hypothesis test to assess whether there is a difference between males and females. Show your working and state your conclusion.

4. A pair of random variables (X, Y) has a joint probability distribution in which $X \sim \mathsf{Exp}(1)$ and the conditional probability density function of Y given $\{X = x\}$ is

$$f_{Y|X}(y|x) = \begin{cases} e^{-(y+x)}, & y \geqslant -x \\ 0, & \text{else.} \end{cases}$$

(a) Determine the marginal probability density function for Y.

(b) Using the fact that $\mathbb{E}[XY] = \mathbb{E}[X\mathbb{E}[Y|X]]$, compute the covariance between X and Y.