

STAT2203/7203: Week 9 Practical Questions

1. Let X_1, X_2, \dots, X_n be a collection of n independent random variables with $\mathbb{E}X_i = \mu$ and $\text{Var}(X_i) = \sigma^2$. Define the random variables

$$\bar{X} = \frac{1}{n} \sum_{i=1}^n X_i, \quad \text{and} \quad S^2 = \frac{1}{n-1} \sum_{i=1}^n (X_i - \bar{X})^2.$$

- (a) What is the expected value and variance of \bar{X} ?
(b) Compute the covariance of X_1 and \bar{X} .
(c) What is the expected value of S^2 ?
2. 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 assigned to 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.

The file `triage.csv` contains the following variables:

Group: Either `CS` for the card-sort group or `TT` for the ‘Triage Trainer’ group.

Accuracy: `True` if participant correctly triaged all eight casualties in the simulated exercise. Otherwise `False`.

Time: The time (in seconds) for the participant to triage all eight casualties.

Assuming we have set the working directory to be the folder containing `Triage.csv`, then we can obtain summary statistics.

```
> table(Triage$Group, Triage$Accuracy)
      False True
CS       20   24
TT       13   34
> aggregate(Time ~ Group, data = Triage, mean)
      Group Time
1      CS   435
2      TT   456
> aggregate(Time ~ Group, data = Triage, sd)
      Group Time
1      CS    74
2      TT    62
```

Accuracy: In the card-sort group, 24 of the 44 participants got a score of 8/8. In the triage trainer group, 34 of the 47 participants got a score of 8/8.

Speed: 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.

- (a) Describe the distribution of time take to triage all eight casualties for both groups. Is it reasonable to construct confidence intervals for the means based on the t -distribution with this data?

The following code may be useful to construct plots for the time taken split by group.

```
qqmath(~ Time | Group, data = Triage)
bwplot(Group ~ Time, data = Triage)
histogram(~ Time|Group, data = Triage)
```

- (b) Construct a 95% confidence interval for the mean time taken to triage eight casualties by a person trained using the ‘Triage Trainer’ game.
- (c) Construct a 99% confidence interval for the true proportion of learners from the card-sort method who correctly assign all eight casualties.
- (d) How many participants using the card-sort method would be need to reduce the margin of error of the 99% confidence interval to 0.1?