This assignment is worth 40 marks (equivalent to $10 \%$ of your total grade.) It is due by 6 pm Friday, September 23rd. Late submissions attract a penalty of $10 \%$ per day (weekends included). You must scan/save your submission as a PDF together with a signed cover sheet that can be found in the Learning Guide Companion on vUWS under 'Unit Information'. You do not need to rewrite every question before your solutions, as long as each solution is clearly identified as the answer to a particular part, e.g., Q. 1 (a).

## Question $1[(4+2+2=8)$ marks]

Assume that the weights of apples are normally distributed with a mean of 100 grams and a standard deviation of 11 grams. The owner of a certain orchard is checking an outgoing shipment of apples because she believes that they may be underweight on average due to poor weather this season. To test this, she takes a sample of 10 apples from the shipment and records an average weight of 91 grams.
(a) State the null and alternative hypotheses in this case using correct statistical notation. Define the variable used. Is this a one-tailed or two-tailed test?
(b) State the null and alternative hypotheses using words instead of statistical notation.
(c) What conclusion would the orchard owner make regarding this shipment of apples at a significance level of $\alpha=0.05$ if the p -value for the sample mean is 0.015 ?

## Question $2[(2+4+2=8)$ marks]

The data in the table below compares the length of a road segment with the time taken to construct it.

| Road Length (km) | 3 | 2 | 4 | 1.5 | 0.5 | 6 | 1.3 | 1.6 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Construction Time (months) | 14 | 10 | 16 | 8 | 3 | 21 | 7 | 7.5 |

Excel gave the following linear regression equation for this data:

$$
T=3.21 L+2.83,
$$

where $T$ is a pure number that represents time in months and $L$ is a pure number that represents length in kilometres.
(a) Identify the slope in the regression equation and interpret its meaning in this specific context.
(b) Use the regression equation to estimate the time it would take to construct a road segment that is 900 metres long. Give your answer to the nearest month.
(c) Given that the correlation coefficient is $r=0.96$, comment on the strength of the correlation between road length and construction time. Justify your answer.

Question $3[(2+2+4+4=12)$ marks]
(a) 16 people in a pub are each given a fair coin and asked to stand up and flip the coin. If the tossed coin comes up 'heads', they are told to toss the coin again, while those people who flipped a coin that came up 'tails' have to sit down. If they do this for four rounds in total, how many people would you expect to remain standing after the fourth round?
(b) If you were to play the pub game as described above, but wanted it to last 6 rounds before the same number of people as in part (a) were left standing, how many people would need to play from the beginning?
(c) Before the first round of the AFL season this year, I received a mysterious letter with no return address that simply said "The GWS Giants will win their game this week". In fact, the Giants did win their game that week, and every week after that I received a letter a couple of days before the game that told me whether the GWS Giants would win or lose, with $100 \%$ accuracy. As a betting man, I started to wonder if this mystery person was going to help me win a lot of money by betting for or against the Giants one week, with full confidence that I knew what the result would be.

However, I was not certain, so I waited to see if this mystery person would continue to make perfect predictions. After I received my 12th letter that correctly predicted the outcome of the Giants game, I received another letter much earlier in the week than the others usually arrived, and it simply said "If you want more tips, send money to this address", and then listed a PO Box address.

Assuming that this mystery letter sender isn't capable of predicting the future and isn't involved in match-fixing, and assuming that I was the only person in the world that received 12 correct predictions via letter, can you explain exactly how they were able to correctly predict the outcome of 12 AFL games in 12 consecutive weeks for me? NOTE: You can pretend that AFL games cannot end in a draw.
(d) Ignoring the cost of paper and envelopes, and just considering that the cost of an Australia post stamp is $\$ 1$, how much would this whole scheme have cost the mystery letter sender in the above question?
Question $4[(6+3+3=12)$ marks]
NOTE: Show full working for all parts of this question; you will receive zero marks if you only show the result. However, no sentences or worded explanations are required for any part of this question.
(a) Re-arrange the following equation to make ' $c$ ' the subject:

$$
x=\frac{-b+\sqrt{b^{2}-4 a c}}{2 a}
$$

(b) Using your answer from part (a), calculate the value of ' $c$ ' when $a=1, b=2$ and $x=3$.
(c) A number called $y$ is twice as large as another number, $x$, and one third of another number we will call $z$. If $z=12$, what does $x+y+z$ equal?

