Economics 250 — Term Test 1   **Monday, 19 October 2015**

Instructions: You may use a hand calculator.

Do not hand in the question and formula sheets.

Answer all **four** questions in the answer booklet provided.

The grade weight of each question is shown. **Allocate your time accordingly**.

There are 90 points in total and 80 minutes to complete the exam.

Show your work: incorrect answers without any work shown cannot be given partial marks. If using your calculator, it is acceptable to only write down the first few terms of a calculation.

Formulas and tables are provided at the end of the question pages; you may wish to detach these from the question pages for easier reference.

Best of Luck!

1. **[25]** The S&P 500 is an American stock market index based on the market capitalizations of 500 large companies. The following are monthly returns for S&P 500 from June 2014 to December 2014

S&P 500 Monthly Returns	1.57%	-1.35%	3.87%	-1.86%	2.33%	2.71%	-0.80%

   a) **[4]** Find the mean and median of S&P 500 monthly returns.

   b) **[4]** Find the first and third quartiles of S&P 500 monthly returns.

   c) **[4]** Find the standard deviation of S&P 500 monthly returns.

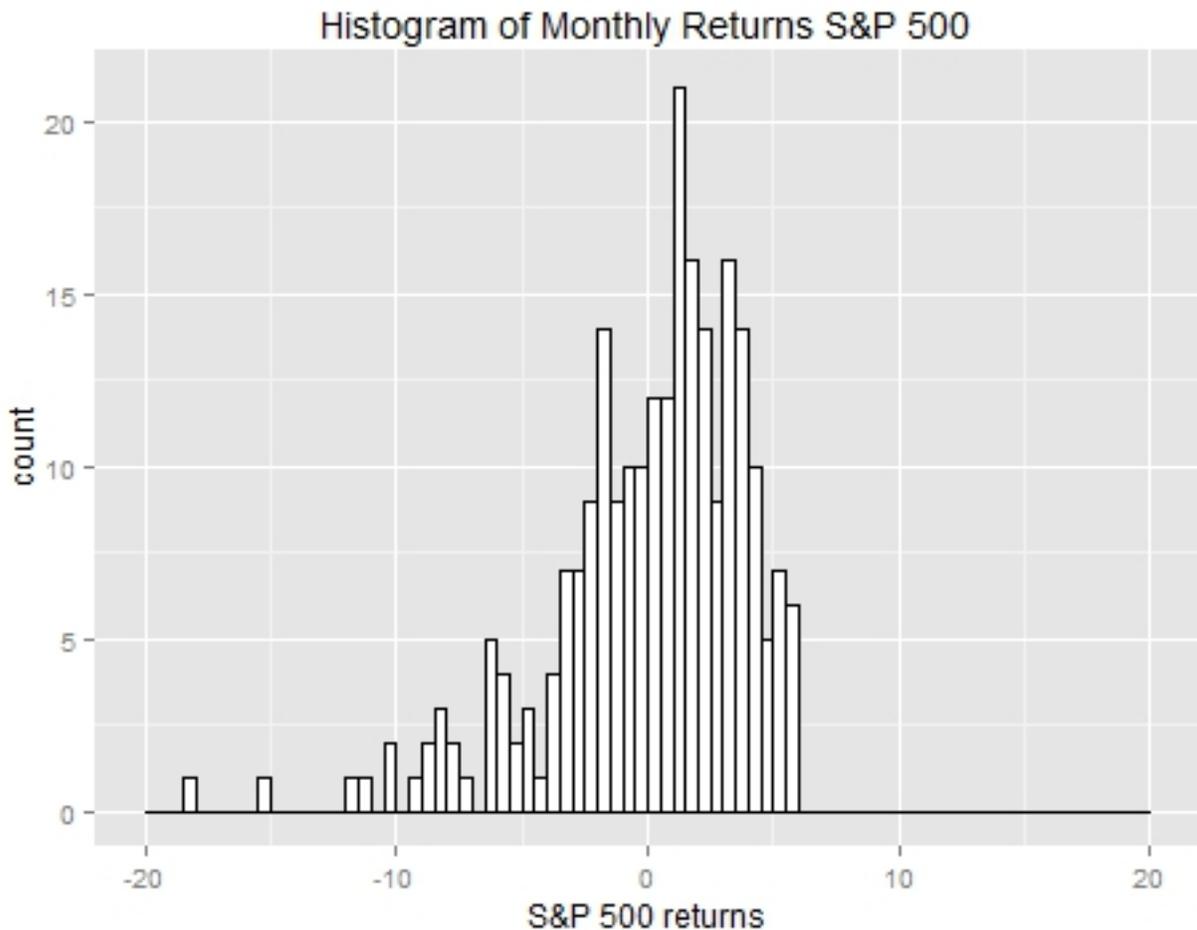Figure 1 is a histogram for S&P 500 monthly returns for the time period January 1993 to December 2014.

Figure 1: Histogram of S&P 500 monthly returns

d) [**3**] Briefly comment on the distribution of S&P 500 returns.

e) [**4**] Based on your answer to part d) what can you conclude about the the relationship between the mean and median of S&P 500 monthly returns? State the reasoning to your conclusion.

Figure 2 is a scatter plot of Microsoft monthly stock returns versus S&P 500 monthly returns for the time period January 1993 to December 2014.
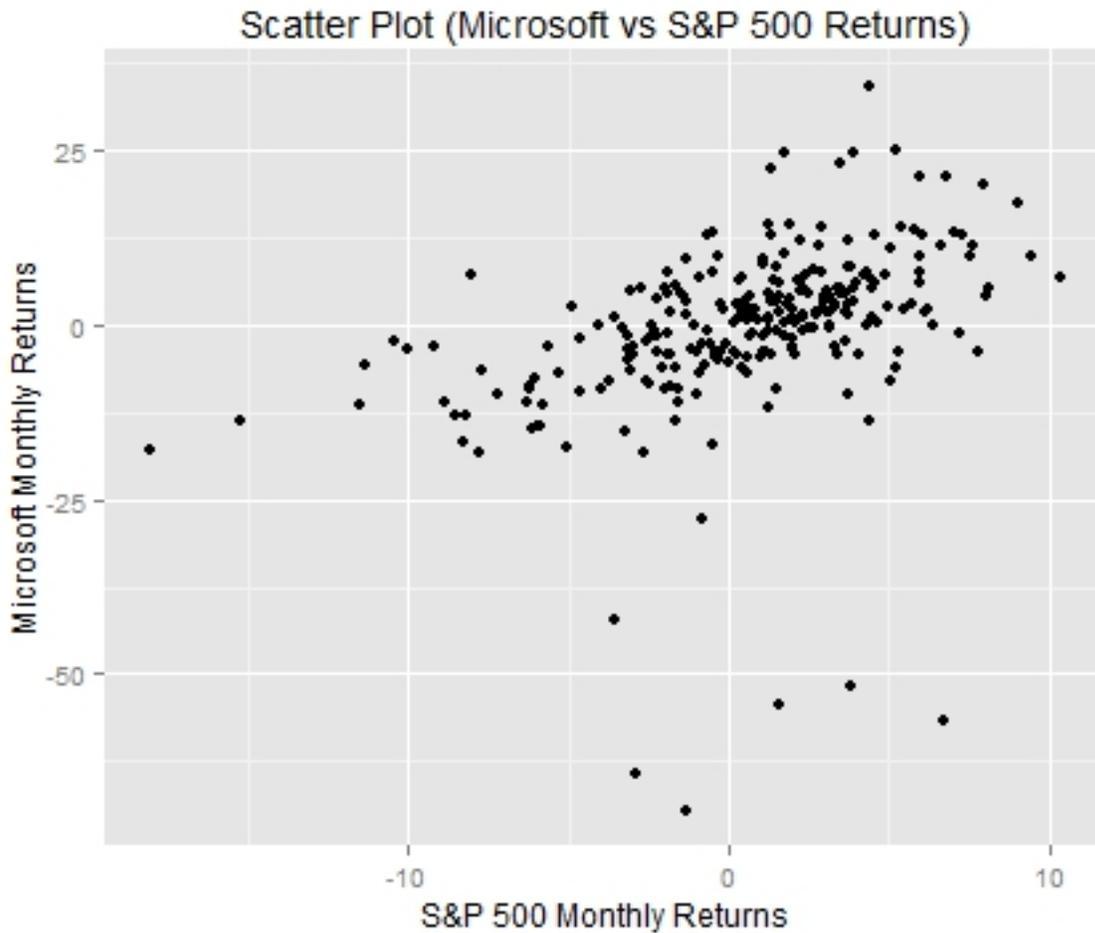

Figure 2: Scatter Plot - Microsoft vs S&P 500 monthly returns

f) [**6**] Briefly comment on the form, strength and direction of the relationship between S&P 500 and Microsoft monthly returns. Are there any potential outliers from the overall association and form?

2. [**30**] Hens usually begin laying eggs when they are about six months old. Young hens tend to lay smaller eggs, often weighing less than the desired minimum of 54 grams. (***Hint**: For this question if you cannot find the exact value on the standard normal table, use the closest value listed on the table.*)

a) [**4**] The average weight of the eggs produced by young hens is 50.9 grams, and only 28% of their eggs exceed the desired minimum weight. If a Normal distribution is appropriate for the weight distribution of eggs laid by young hens, what would the standard deviation be?

b) [**4**] By the time these hens have reached the age of one year, the eggs they produce average 67.1 grams, and 98% of them are above the minimum weight. What is the standard deviation for the appropriate Normal distribution for the eggs laid by these older hens?

c) [**4**] Are egg weights more consistent (around their average) for the younger hens or the older ones? State your reasoning.

d) [**12**] A farmer finds that 8% of her hens' eggs are underweight and 13% weigh over 70 grams. Find the mean and standard deviation for the the eggs laid by hens in her coop. (***Hint**: You will need to solve for two unknowns using two equations)*

Suppose the farmer wishes to sample ten eggs from her farm and compute the sample weight. She is considering the following sampling procedures.

(*i*) The farmer has a preference for large hens and selects an egg laid by each of the ten largest hens in her coop.

(*ii*) Suppose the roosting area of the coop is at an angle so that eggs can slide towards the entrance of the coop making the collection process convenient for the farmer. The farmer decides to select ten eggs closest to the entrance of the coop.

e) [**6**] For each of the above procedures state which sampling design is being used and give **one** possible reason the sampling procedure is likely to be biased.

3. **[20]** A researcher wants to determine the possible association between using a cell phone while driving and incidents of car accidents. She surveyed 180 drivers and found that 78 regularly used a cell phone while driving, of which 20 had accidents in the past year, whereas 102 drivers did not use cell phones while driving, of which 10 had accidents in the past year.

(***Hint***: *There are two categorical variables : accidents in the past year and cell phone use. You may choose to abbreviate the two variables to 'accidents' and 'cellphone'.)*

  a) **[5]** Construct a two-way table.

  b) **[5]** Find the joint distribution

  c) **[6]** Find the distribution of accidents in the past year **conditional** on each value/category of cell phone use.

  d) **[4]** Based on your answers to parts b) and c) would you conclude that the use of a cell phone increases the risk of car accidents? Briefly explain your answer.

4. **[15]** You toss a fair coin three times.

  a) **[4]** List the sample space

Let A be the event that you observe at least two consecutive tails and let B be the event that you observe exactly three tails. Find the following probability.

  b) **[3]** $P(A \cap B^c)$

Let C be the event that the first toss is a head. Find the following probability.

  c) **[3]** $P(A \cup C)$

  d) **[5]** By explicitly listing the outcomes in events A and A^c, show that A and A^c partition the sample space.