國立臺灣科技大學
九十一學年度碩士班招生考試試題
系所組別： 企業管理系甲組、乙組、丙組、財務金融研究所
科　目： 統計學

總分 100 分

1a "When investigating students' scholastic performance, there seems to exist an interaction between the length of class hours and student's preference for the subject. More specifically, if students like the subject, 6 hours per week will have a positive effect on students' test scores than will 3 hours per week. While for those subjects that students dislike, 6 hours per week will have a negative effect on the test scores than will 3 hours per week."
Draw a 2-dimensional line chart manifesting the above statement. Show clearly all needed labels (e.g., marks, and legends) to get full credit (8 points).

1b In addition to the table for t distribution, what information do we need to compute the p-value when testing a population mean with a small sample? (No need to show any calculation) (10 points)

1c In the 1860s, the Austrian monk Gregor Mendel wrote an important paper about inheritance. He postulated the existence of entities, now called genes, that determine how various characteristics are passed on from one generation to the next. For example, according to one of his theories (now known as Mendel's Second Law of Inheritance), the cross-fertilization of two pure strains of pea plants – one producing only round yellow seeds, the other one only wrinkled green seeds – would produce a first generation of hybrids with nothing but round yellow seeds. Yet a mating of these hybrids with one another would yield plants with round yellow, round green, wrinkled yellow, as well as wrinkled green seeds, and would produce these in definite proportions of 9:3:3:1. Mendel performed numerous experiments to back up his theories. Suppose the sample data for the second-generation hybrids resulted from one experiment involving the just-mentioned law is given.
What kind of hypothesis test should be performed if we want to know whether this sample has come from a population obeying Mendel's Second Law? What test statistic will you compute for this study? (No need to show any calculation) (7 points)

※ 如須計算時可使用一般型計算器，但不可使用可程式之計算器.

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2. Considering the following data:

y	-3.01	1.10	-2.12	1.07	2.2	-3.04	-2.08
x	-1	3	4	1	2	5	0

Regress x as the explanatory variable and y as the dependent variable.

a. What is the estimated linear regression equation relating y to x ? (7%)

b. Test the hypothesis $H_0: \beta_1 = 0$ at the 1% level of significance.

What conclusion can be drawn from the result of the test? (10%)

c. Despite the outcome of the test in (b), does there appear to be a "strong" or "weak" association between x and y? Discuss. (8%)

3. (25 分)

欲知理工及管理學院大學畢業生第一年工作的平均薪資 (Y) 是否與畢業的學院別有關，設三虛擬變數：D_1，D_2，D_3；其中 D_1=1 表示畢業於理學院，D_1 =0 表示其他；D_2 =1 表示畢業於工學院，D_2 =0 表示其他；D_3 =1 表示畢業於管理學院；D_3 =0 表示其他。已知 Y 對 D_1，D_2 的迴歸估計式為：

$$\hat{Y} = 69 + 45D_1 + 18D_2$$

a. 試求 Y 對 D_1，D_3 的迴歸估計式。

b. 試求 Y 對 D_2，D_3 的迴歸估計式。

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4. (25%) Consider a research problem. Once the researcher has clearly specified the problem and developed an appropriate research design and data collection instrument, the next step in the research process is to select those elements from which the information would be collected. One way to do this is to collect information from a portion of the population by taking a sample of elements from the larger group, and, on the basis of the information collected from the subset, to infer something about the larger group. One's ability to make this inference from subset to larger group depends on the method by which the sample of elements was chosen. A major part of sampling theory is devoted to the "why" and "how" of taking a sample. Sampling technique can be divided into the two broad categories of probability and nonprobability samples. Probability samples are distinguished by the fact that each population element has a known, nonzero chance of being included in the sample. It is only necessary that one can specify the probability with which each element of the population will be included in the sample.

In case of probability samples, one can calculate the likelihood that any given population element will be included in a probability sample. The objective selection of elements, in turn, allows the objective assessment of the reliability of the sample results. Before answering the sampling problem, please first answer the following probability problem. Assume that each child is born is equally likely to be a boy or girl. If a family has four children, what is the probability that all the children are boys given that (a) the eldest is a boy, (b) at least one is a boy? (Show your calculation in detail.)

Now, we would like to consider the sampling problem. A sample of size 2000 adult women is drawn for a survey in which each woman is asked two questions: (i) How many children did your mother have? (ii) How many children did you have? (Assume their childbearing days are over.) Suppose the distribution of children per woman has not changed over time and is a_j=1/4, j = 1,2,3,4. Then please answer the question (c): Evaluate the average response to question (i) and discuss the relationship between the average response to question (i) and the average response to question (ii).