（考試時間 2 小時）

1. (13%) In testing the hypotheses, H_0: $\mu = 950$ vs. H_1: $\mu \neq 950$, a random sample of 25 light bulbs is drawn from a normal population whose standard deviation is 200. Assume that $\mu = 1000$ and $\alpha = 0.10$..
   (1) (3%) Calculate β, the probability of a Type II error.
   (2) (2%) Calculate the power of the test.
   (3) (4%) Recalculate β if n is increased from 25 to 40. What is the effect of increasing the sample size on the value of β?
   (4) (4%) Recalculate β if α is lowered from 0.10 to 0.05. What is the effect of decreasing the significance level on the value on β?

2. (25%) A trade agreement governing the movement of agricultural products between two countries stipulates that the mean weight of boxes of butter must be 25.00 kilograms. A large shipment of boxes of butter is used to be tested to determine whether it meets this requirement by selecting a random sample of 49 boxes and using the following decision rule:

   If $24.95 \leq \bar{x} \leq 25.05$, conclude $\mu = 25.00$.

   If $\bar{x} < 24.95$ or $\bar{x} > 25.05$, conclude $\mu \neq 25.00$

   The standard deviation of weights of boxes of butter is $\sigma = 0.15$ kilogram.

   (1) (9%) Calculate the rejection probability at $\mu = 24.90$, 25.00, 25.10 for this decision rule, and complete the following table:

μ:	24.90	24.95	25.00	25.05	25.10
$P(\text{Accept } H_1; \mu)$	_____	0.500	_____	0.500	_____

   (2) (4%) What is the α risk at $\mu = 25.00$ for this decision rule? What is the error risk at $\mu = 25.10$? Does the latter relate to a Type I or a Type II error?
   (3) (4%) It is desired to control the α risk at 0.05 when $\mu = 25.00$ and the β risk at 0.05 when $\mu = 24.95$. Using $\sigma = 0.15$ as the planning value, obtain the required sample size.
   (4) (4%) A random sample of the size determined at (3) has been selected, and the number results are $\bar{x} = 25.03$ and $\sigma = 0.183$. Conduct the required test, starting the decision rule, the value of standardized test statistic, and the conclusion.
   (5) (4%) The value of the sample standard deviation σ is larger than the planning value of σ used in obtaining the sample size. What does this difference suggest about the magnitude of the actual β risk for the test at $\mu = 24.95$ in relation to the target β risk of 0.05?

3. (12%) In clinical studies of an allergy drug, 81 of the 900 subjects experienced drowsiness. A competitor claims that 10% of the users of this drug experience drowsiness.
   (1) (2%) State the appropriate null and hypotheses.
   (2) (3%) Is there enough evidence at the 5% significance level to infer that the competitor is correct?
   (3) (2%) Compute the p-value of the test.
   (4) (3%) Construct a 95% confidence interval estimate of the population proportion of the users of this allergy drug who experience drowsiness.
   (5) (2%) Explain how to use this confidence interval to test the hypotheses.

4. (14%) A survey found that 62% of callers complain about the service they receive from a call center if they suspect that the agent who handles the call is foreign. Given this context, what is the probability that
   (1) (3%) the next three consecutive callers complain about the service provided by a foreign agent?
   (2) (3%) the next two calls produce a complaint, but not the third?
   (3) (4%) two out of the next three calls produce a complaint, but not the third?
   (4) (4%) none of the next 10 calls produces a complaint>

5. (10%) Suppose that 20% of the clerical staff in an office smoke cigarettes. Research shows that 60% of smokers and 15% nonsmokers suffer a breathing illness by age 65.
   (1) (5%) Do the percentages indicate that smoking and this breathing illness are independent?
   (2) (5%) What's the probability that a randomly selected 65-year-old employee who has this breathing illness smokes?

6. (16%) A retail company operates two types of clothing stores in shopping malls. One type specializes in clothes for men, and the other in clothes for women. The sales from a men's clothing store average $800,000 annually and those from a women's clothing store average $675,000 annually. The standard deviation of sales among men's stores is $100,000 annually and among women's stores is $125,000. In a typical mall, the company operates one men's store and one women's store (under different names).
   (1) (3%) What are the expected annual sales for the stores owned by this company in one shopping mall?
   (2) (3%) Find the standard deviation of the total sales if the correlation between sales at the men's store and women's store is r = 0.4.
   (3) (5%) The rent for the space in the shopping mall costs $30 per square foot. Both

types of stores occupy 2,500 square feet. What is the expected value and standard deviation of total sales in excess of the rent costs?

(4) (5%) If labor and other expenses (such as the cost of clothing that is sold) to operate the two stores at the mall costs the company $750,00 annually, do you think there is a good chance that the company might lose money?

7. (10%) About Analysis of Variance (ANOVA).

Two of the following statements are incorrect. Identify them, and briefly explain why they are incorrect.

(1) A regression model that uses only dummy variables as explanatory variables is known as an analysis of variances.

(2) The one-way ANOVA requires balanced data, with an equal number of observations in each group.

(3) The F-test in an ANOVA tests the null hypothesis that all of the groups have equal variance.

(4) The average of the residuals within a category used in an ANOVA is zero.

(5) A fitted value (y-hat) in a one-way ANOVA is the mean for some group defined by the explanatory dummy variables.