



Notes:

There are 50 multiple-choice questions included in this test. Each of them has only one best answer and a weight of 2 points.

1. If supply is elastic in the current price range, an increase in price would
 - A. increase the total revenue of producer sellers.
 - B. decrease the total revenue of producer sellers.
 - C. not affect the total revenue of producer sellers..
 - D. be insufficient information to tell what happens to total revenue .

2. Dick owns a dog whose barking annoys Dick's neighbor Jane. Suppose that the benefit of owning the dog is worth \$500 to Dick and that Jane bears a cost of \$700 from the barking. A possible private solution to this problem is that
 - A. Jane pays Dick \$450 to get rid of the dog.
 - B. Dick pays Jane \$650 for her inconvenience.
 - C. Jane pays Dick \$650 to get rid of the dog.
 - D. There is no private solution that would improve this situation.

3. Suppose that the government imposes a tax of 10% on the first \$40,000 of income and 20% on all income above \$40,000. What is the tax liability and the marginal tax rate for a person whose income is \$50,000?
 - A. Both are 12% and 12%
 - B. 12% and \$50,000 respectively
 - C. \$6,000 and 12% respectively
 - D. \$6,000 and 20% respectively

4. A perfectly competitive firm is able to sell its product for \$5 and realizes an average total cost of \$5. Its marginal cost curve crosses the average total cost curve at an output level of 10 units. What is the profit earned by the firm at its current level of output?
 - A. \$0
 - B. -\$50
 - C. \$100
 - D. None of the above



5. In a perfectly competitive market, a decrease in demand will
- A. have no effect on prices
 - B. cause quantity supplied to go down before returning to the original level of output.
 - C. cause prices to go down before returning to their original level.
 - D. have no effect on total market output.
6. If wages rise, profit maximizing firms in competitive markets will _____ employment and marginal product of labor will _____.
- A. increase, rise
 - B. decrease, rise
 - C. increase, fall
 - D. decrease, fall
7. At the current price ratio, a consumer chooses to consume Y_0 units of commodity "Y" and X_0 units of commodity "X". If commodity Y is a normal good for this consumer, a rise in consumer income will necessarily precipitate
- A. an increase in the consumption of X.
 - B. a decrease in the consumption of Y.
 - C. an increase in the consumption of Y.
 - D. a decrease in the consumption of X.
8. You are given the following information with respect to a firm's output position: marginal product of factor A=4; marginal product of factor B=2; price of A=\$8; price of B=\$4. Assume that the firm is at its maximum-profit output. Then marginal revenue must be:
- A. 50cents.
 - B. \$1.
 - C. \$2.
 - D. zero.



		Firm B			
		III		IV	
Firm A	I	Cell a	\$60	Cell b	\$50
		\$25		\$15	
	II	Cell c	\$40	Cell d	-\$10
		\$10		\$20	

Figure A

9. Figure A above shows a payoff table for firm A and firm B. In Cell a, firm A obtains \$25 and firm B obtains \$60. Which strategy is a dominant strategy for firm B?
- Strategy III.
 - Strategy IV.
 - Both strategy III and strategy IV are dominant strategies to firm B.
 - None of the strategies available to firm B is a dominant strategy.
10. As shown in Figure A above, which cell is a Nash equilibrium?
- Cell a.
 - Cell b.
 - Cell c.
 - Cell d.
11. Your budget constraint for the two goods A and B is $30A+5B=I$, where I is your income. You are currently consuming more than 72 units of B. In order to get 4 more units of A, how many units of B would you have to give up?
- 0.17
 - 0.04
 - 6
 - 24
12. Hartman's utility function is $U(x_1, x_2) = x_1 x_2$. His income is \$100. The price of good 2 is $p_2 = 4$. Good 1 is priced as follows: The first 15 units cost \$4 per unit and any additional units cost \$2 per unit. What consumption bundle does Hartman choose?
- (12.5, 12.5)
 - (25, 12.5)
 - (12.5, 25)
 - (15, 10)



13. Miss Chen insists on consuming 2 units of good A per unit of good B. If the price of good A is \$6 and the price of good B is \$3, then if Miss Chen's income is \$M, her demand for good B will be:
- M/3.
 - 6M/3.
 - 3M.
 - M/15.
14. Charlie's utility function is $x_A x_B$. The price of good A used to be \$1, the price of good B used to be \$2, and his income used to be \$40. If the price of good A increased to \$7 and the price of good B stayed constant, the substitution effect on Charlie's good A consumption reduces his consumption by:
- 17.14 units of good A.
 - 6 units of good A.
 - 8.57 units of good A.
 - 13.57 units of good A.
15. Wang has quasilinear preference and his demand function for x is $D(p) = 15 - p/3$. The price of x is initially \$15 per unit and increases to \$24 per unit. Wang's change leads to a consumer surplus whose value is the closest to:
- 168.
 - 76.
 - 27.
 - 75.
16. Harry's demand function for blueberries is $x = 20 - 2p$, where p is the price and x is the quantity demanded. If the price of blueberries is \$3, then what is Harry's price elasticity of demand for blueberries?
- 6/14
 - 2/20
 - 2
 - 14/6



17. The demand function for corn is $q = 200 - p$ and the supply function is $q = 50 + 0.5p$. The government sets the price of corn at \$150 and agrees to purchase and destroy any excess supply of corn at that price. How much money does it cost the government to buy this corn?
- A. 11,250
B. 18,750
C. 7,500
D. 10,750
18. The demand curve for rutabagas is a straight line with slope -5 and the supply curve is a straight line with slope 5. Suppose that a new tax of \$3 per unit of rutabagas is introduced. Which of the following must certainly be true of the change in equilibrium prices and/or quantities?
- A. The total number of rutabagas purchased increases.
B. The price paid by demanders rises by same amount as the price received by suppliers falls.
C. The price received by suppliers falls by more than the price paid by demanders rises.
D. The price paid by demanders rises by more than the price received by suppliers falls.
19. The production function is given by $f(L) = 6L^{2/3}$, where L is labor. Suppose that the cost per unit of labor is \$16 and the price of output is \$12. How many units of labor will the firm hire in order to maximize its profit?
- A. 54
B. 27
C. 13.5
D. 81
20. A competitive firm has a long run total cost function $C(y) = 2y^2 + 162$ for $y > 0$ and $C(0) = 0$. Its long run supply function is described as follows:
- A. $y = p/4$ if $p > 36$; $y = 0$ if $p < 36$.
B. $y = p/2$ if $p > 34$; $y = 0$ if $p < 34$.
C. $y = p/2$ if $p > 39$; $y = 0$ if $p < 42$.
D. $y = p/4$ if $p > 39$; $y = 0$ if $p < 39$.



21. A firm has the short run total cost function $C(y) = 16y^2 + 144$. At what quantity of output is short run average cost minimized?
- A. 3
 - B. 4
 - C. 9
 - D. 1.33
22. Consider a competitive industry with several firms all of which have the same cost function, $C(y) = y^2 + 4$ for $y > 0$ and $C(0) = 0$. The demand curve for this industry is $D(p) = 50 - p$, where p is the price. The long run equilibrium number of firms in this industry is:
- A. 4.
 - B. 23.
 - C. 25.
 - D. 46.
23. A monopolist has the total cost function, $C(q) = 1400 + 10q$ and the inverse demand function is $p = 130 - 5q$, where prices and costs are measured in dollars. If the firm is required by law to meet demand at a price equal to its marginal cost, then
- A. the firm's profit will be zero.
 - B. the firm will loses \$700.
 - C. the firm will make positive profit, but not as much profit as it would make if it were allowed to choose its own price.
 - D. the firm will lose \$1400.
24. An industry has two firms. The inverse demand function for this industry is $p = 190 - 6q$. Both firms produce at a constant unit cost of \$28 per unit. What is Cournot equilibrium price for this industry?
- A. 28
 - B. 31
 - C. 82
 - D. 41



25. Two stores are located side by side. They attract customers to each other and to themselves by advertising. The profit functions of the two stores are $(120 + x_2)x_1 - 2x_1^2$ for store 1 and $(150 + x_1)x_2 - 2x_2^2$ for store 2, where x_1 and x_2 are total advertising expenditures by stores 1 and 2 respectively. If each store sets its advertising expenditures independently (as in Nash equilibrium), how much would store 1 spend on advertising?
- A. 42
B. 44
C. 39
D. 47
26. With a Cobb-Douglas production function, the share of output going to labor:
- A. decreases as the amount of labor increases.
B. increases as the amount of labor increases.
C. increases as the amount of capital increases.
D. is independent of the amount of labor.
27. If the real return on government bonds is 3 percent and the expected rate of inflation is 4 percent, then the cost of holding money is _____ percent.
- A. 1
B. 3
C. 4
D. 7
28. An effective policy to reduce a trade deficit in a small open economy would be to:
- A. increase tariffs on imports.
B. impose stricter quotas on imported goods.
C. increase government spending.
D. increase taxes.
29. If the purchasing-power parity theory is true, then:
- A. the net exports schedule is very steep.
B. all changes in the real exchange rate result from changes in price levels.
C. all changes in the nominal exchange rate result from changes in price levels.
D. changes in saving or investment influence only the real exchange rate.



30. Assume that some large foreign countries decide to subsidize investment by instituting an investment tax credit. Assuming that the home country is a small open economy, then the home country's real exchange rate:
- A. will fall(i.e. depreciate) and its net exports will rise.
 - B. will rise(i.e. appreciate) and its net exports will fall.
 - C. will fall(i.e. depreciate) and its net exports will fall.
 - D. will rise(i.e. appreciate) and its net exports will rise.
31. If a dollar bought 1,000 lire ten years ago and 1,500 lire now, and inflation for that period was 25 percent in the United States and 100 percent in Italy, then:
- A. the purchasing-power parity theory is correct.
 - B. for American residents, traveling in Italy today costs about the same as it did ten years ago.
 - C. for American residents, traveling in Italy is cheaper now than it was ten years ago.
 - D. for American residents, traveling in Italy is more expensive now than it was ten years ago.
32. If the fraction of employed workers who lose their jobs each month (the rate of job separation) is 0.01 and the fraction of the unemployed who find a job each month (the rate of job findings) is 0.09, then the natural rate of unemployment is:
- A. 1 percent.
 - B. 9 percent.
 - C. 10 percent.
 - D. about 11 percent.
33. Sectoral shifts:
- A. lead to wage rigidity.
 - B. explain the payment of efficiency wages.
 - C. depend on the level of the minimum wage.
 - D. make frictional employment inevitable.



34. Government policies directed at reducing frictional unemployment include:
- A. abolishing minimum-wage laws.
 - B. making unemployment insurance 100-percent experience rated.
 - C. increasing the earned income credit.
 - D. making government part of the union-form wage bargaining process.
35. If the per-worker production function is given by $y = k^{\frac{1}{2}}$, there is no population growth or technological progress, the saving ratio is 0.2, and the capital depreciation rate is 0.1, then the steady-state level of output per worker (y) is:
- A. 1
 - B. 2
 - C. 3
 - D. 4
36. Assume that two countries both have the per-worker production function $y = k^{\frac{1}{2}}$, neither has population growth or technological progress, depreciation is 5 percent of capital in both countries, and country A saves 10 percent of output whereas country B saves 20 percent. If A starts out with a capital-labor ratio of 4 and B starts out with a capital-labor ratio of 2, in the long run:
- A. both A and B will have capital-labor ratios of 4.
 - B. both A and B will have capital-labor ratios of 16.
 - C. A's capital-labor ratio will be 4 whereas B's will be 16.
 - D. A's capital-labor ratio will be 16 whereas B's will be 4.
37. If a larger share of national output is devoted to investment, then living standards will:
- A. always decline in the short run but rise in the long run.
 - B. always rise in both the short and long runs.
 - C. decline in the short run and may not rise in the long run.
 - D. rise in the short run but may not rise in the long run.



38. If all wage income is consumed, all capital income is saved, and all factors of production earn their marginal products, then:
- A. the economy will reach a steady-state level of capital stock below the Golden Rule level.
 - B. the economy will reach a steady-state level of capital stock above the Golden Rule level.
 - C. wherever the economy starts out, it will not grow.
 - D. wherever the economy starts out, it will reach a steady-state level of capital stock equal to the Golden Rule level.
39. If the economy moves from a steady state with positive population growth to a zero population growth rate, then in the new steady state total output growth will be _____ and growth of output per person will be _____.
- A. lower; lower
 - B. lower; the same as it was before
 - C. higher; higher than it was before
 - D. higher; lower
40. In a Solow Model with technological change, if population grows at a 2 percent rate and the efficiency of labor grows at a 3 percent rate, then in the steady state output per worker grows at a _____ percent rate.
- A. 0
 - B. 2
 - C. 3
 - D. 5
41. In a steady state with population growth and technological progress:
- A. the capital share of income increases.
 - B. the labor share of income increases.
 - C. in some cases the capital share of income increases and sometimes the labor share increases.
 - D. the capital and labor shares of income are constant.



42. If the central bank reduces the money supply by 5 percent and the quantity theory of money is true, then:
- A. every point on the aggregate demand curve moves 5 percent to the left.
 - B. every point on the aggregate demand curve moves up 5 percent.
 - C. the aggregate demand curve moves down and to the left, but it is impossible to determine exactly by how much.
 - D. the aggregate demand curve moves up and to the right, but it is impossible to determine exactly by how much.
43. If central bank A cares only about keeping the price level stable and central bank B cares only about keeping output at its natural level, then in response to an exogenous decrease in the velocity of money:
- A. both central bank A and central bank B should increase the quantity of money.
 - B. central bank A should increase the quantity of money whereas central bank B should keep it stable.
 - C. central bank A should keep the quantity of money stable whereas central bank B should increase it.
 - D. both central bank A and central bank B should keep the quantity of money stable.
44. In the Keynesian-cross analysis, assume that the analysis of taxes is changed so that taxes, T , are made a function of income, as in $T = T + tY$, where T and t are parameters of the tax code and t is positive but less than 1. As compared to a case where t is zero, the multiplier for government purchases in this case will:
- A. not change.
 - B. be smaller.
 - C. be bigger.
 - D. be equal to 1.



45. If marginal propensity to consume $MPC = 0.75$ (and there are no income taxes but only lump-sum taxes) when T decreases by 100, then the IS curve for any given interest rate shifts to the right by:
- A. 100
 - B. 200
 - C. 300
 - D. 400
46. If money demand does not depend on the interest rate, then the LM curve is _____ and _____ policy has no effect on output.
- A. horizontal; fiscal
 - B. vertical; fiscal
 - C. horizontal; monetary
 - D. vertical; monetary
47. According to the IS-LM model, when the government increases taxes and government purchases by equal amounts:
- A. income, the interest rate, consumption, and investment are unchanged.
 - B. income and the interest rate rise, whereas consumption and investment fall.
 - C. income and the interest rate fall, whereas consumption and interest rise.
 - D. income, the interest rate, consumption, and investment all rise.
48. A fall in consumer confidence about the future, which induces consumers to spend less and save more, will, according to the Mundell-Fleming model with floating exchange rates, lead to:
- A. a fall in consumption and income.
 - B. no change in consumption or income.
 - C. no change in income but a rise in net exports.
 - D. no change in income or net exports.
49. In the Mundell-Fleming model with a floating exchange rate in a small open economy, a rise in the world interest rate will lead income:
- A. and net exports both to fall.
 - B. to rise and net exports to fall.
 - C. to fall and net exports to rise.
 - D. and net exports both to rise.



50. In a small open economy with a fixed exchange rate, if the government imposes an import quota, then net exports:
- A. decrease but the money supply falls and income falls.
 - B. increase, the money supply increases, and income increases.
 - C. are unchanged but the money supply falls and income falls.
 - D. are unchanged, the money supply is unchanged, and income is unchanged.



In this test, there are 25 multiple choice questions with 4 points for each question. Please select the correct answer for each question.

- Flip a fair coin in a sequence of independent trials. What is the probability that the first "head" is observed on the fifth trial, given that "tails" are observed on each of the first three trials?
 (A) 0.15 (B) 0.25 (C) 0.35 (D) 0.45 (E) 0.55
- What is the probability that a person tossing three fair coins will get either all "heads" or all "tails" for the second time on the fifth toss?
 (A) 0.1055 (B) 0.2245 (C) 0.3625 (D) 0.4195 (E) 0.5
- Suppose that four inspectors at a film factory are supposed to stamp the expiration date on each package of film at the end of the assembly line. John, who stamps 20% of the packages, fails to stamp the expiration date once in every 200 packages; Tom, who stamps 60% of the packages, fails to stamp the expiration date once in every 100 packages; Jeff, who stamps 15% of the packages, fails to stamp the expiration date once in every 90 packages; and Pat, who stamps 5% of the packages, fails to stamp the expiration date once in every 200 packages. If a customer complains that her package of film does not show the expiration date, what is the probability that it was inspected by John?
 (A) 0.0899 (B) 0.0945 (C) 0.0998 (D) 0.1033 (E) 0.1124
- In a daily production of a certain kind of rope, the number of defects per foot, denoted by Y , is assumed to have a Poisson distribution with mean 2. The profit per foot when the rope is sold is given by X , where $X = 50 - 2Y - Y^2$. What is the expected profit per foot?
 (A) 30 (B) 32 (C) 35 (D) 38 (E) 40
- A lot containing seven components is sampled by a quality inspector; the lot contains 4 good components and 3 defective components. A sample of size 3 is taken by the inspector. What is the expected value of the number of good components in this sample?
 (A) 1.5 (B) 1.6 (C) 1.7 (D) 1.8 (E) 1.9
- Let X be a random variable with the following probability distribution:

x	-3	6	9
$f(x)$	1/6	1/2	1/3

What is the standard deviation of the random variable $Y = (2X + 1)^2$?



(A) 111.1 (B) 113.6 (C) 115.3 (D) 118.9 (E) 120.8

7. A safety engineer claims that only 40% of all workers wear safety helmets when they eat lunch at the workplace. Assuming that his claim is right, what is the probability that 4 of 6 workers randomly chosen will be wearing their helmets while having lunch at the workplace?
 (A) 0.1382 (B) 0.1513 (C) 0.1728 (D) 0.1998 (E) 0.2156
8. Roll a fair four-faced die twice. (Note that the numbers on the four faces of the die are respectively 1, 2, 3 and 4.) Let X denote the outcome on the first roll, and let Y be the sum of two rolls. What is the covariance of X and Y ?
 (A) 0.5 (B) 0.75 (C) 1 (D) 1.25 (E) 1.5
9. At busy time, a telephone exchange is very near capacity, so people cannot find a line to use. It may be of interest to know the number of attempts necessary in order to gain a connection. Suppose that the probability of a connection during busy time is 0.05. What is the probability that five attempts are necessary for a successful call?
 (A) 0.037 (B) 0.041 (C) 0.045 (D) 0.05 (E) 0.054
10. Gauges are used to reject all components in which a certain dimension is not within the specification $1.5 \pm d$. It is known that this measurement is normally distributed with mean 1.5 and standard deviation 0.2. What is the value of d such that the specifications cover 95% of the measurements?
 (A) 0.333 (B) 0.367 (C) 0.392 (D) 0.418 (E) 0.45
11. In a mathematics examination the average grade was 82 and the standard deviation was 5. All students with grades from 88 to 94 received a grade of B. If the grades are approximately normally distributed and 8 students received a B grade, how many students took the examination?
 (A) 62 (B) 65 (C) 68 (D) 70 (E) 72
12. An electrical firm manufactures light bulbs that have a length of life that is approximately normally distributed, with mean equal to 800 hours and a standard deviation of 40 hours. What is the probability that a random sample of 16 bulbs will have an average life of less than 775 hours?
 (A) 0.0058 (B) 0.0062 (C) 0.0065 (D) 0.0068 (E) 0.0072



13. The distribution of heights of a certain breed of terrier dogs has a mean height of 72 centimeters and a standard deviation of 10 centimeters, whereas the distribution of heights of a certain breed of poodles has a mean height of 28 centimeters and a standard deviation of 5 centimeters. Assuming that the sample means can be measured to any degree of accuracy, what is the probability that the sample mean for a random sample of heights of 64 terriers exceeds the sample mean for a random sample of heights of 100 poodles by at most 44.2 centimeters?

- (A) 0.2231 (B) 0.3379 (C) 0.4435 (D) 0.5596 (E) 0.6628

14. The manager of a grocery store has taken a random sample of 100 customers. The average length of time it took the customers in the sample to check out was 3.1 minutes with a standard deviation of 0.5 minutes. We want to test to determine whether or not the mean waiting time of all customers is significantly more than 3 minutes. The p-value of the test is

- (A) 0.0228 (B) 0.0489 (C) 0.05 (D) .4972 (E) 0.12

15. The following information was obtained from matched samples. The daily production rates for a sample of workers before and after a training program are shown below.

Worker	Before	After
1	20	24
2	25	23
3	27	27
4	23	20
5	22	25
6	20	22
7	17	18

The alternative hypothesis to be tested is $H_a: \mu_{\text{after}} - \mu_{\text{before}} > 0$. The test statistic is

- (A) 0 (B) 0.68 (C) 0.74 (D) 2.56 (E) 1.96

16. Suppose a department store wishes to estimate the average age of the customers of its contemporary apparel department, correct to within 3 years with probability equal to .90. Approximately how large a sample would be required if the estimated standard deviation of the customers' age is 8 years?

- (A) 9 (B) 77 (C) 110 (D) 20 (E) 30



17. Suppose your firm has been experimenting with two different physical arrangements of its assembly line. It has been determined that both arrangements yield approximately the same average number of finished units per day. To obtain greater process control, you suggest that the arrangement with the smaller variance in the number of finished units per day can be permanently adopted. Two independent random samples yield the results shown below.

Assembly Line 1	Assembly Line 2
Sample mean = 85	Sample mean = 87
Sample variance = 1200	Sample variance = 3500
Sample size = 21 days	Sample size = 21 days

What is the value of the test statistic for determining whether two assembly lines differ in the variation of the number of units produced per day?

- (A) 0.13 (B) 1.71 (C) 2 (D) 2.92 (E) 7.434

18. Consider the random variable X with density given by

$$P(x) = \frac{1}{\theta^2} x e^{-x/\theta}, x > 0, \theta > 0$$

Find the maximum likelihood estimator for θ based on a random sample of size n .

- (A) \bar{x} (B) $\bar{x}/2$ (C) $2\bar{x}$ (D) $\sum_{i=1}^n x_i$ (E) S^2

Use the following problem to answer questions 19-20.

Based on a sample of the salaries of professors at a major university, you have performed a multiple linear regression model is

$$\text{Salary} = \$45000 + \$3000(\text{Years}) + \$4000(\text{Gender}) + \$1000[(\text{Year})(\text{Gender})]$$

where Gender = 1 if the professor is male and Gender = 0 if the professor is female.

19. Using the multiple regression equation, you would estimate the average difference in the salaries of a male professor with three years of service and female professor with three years of service to be
- (A) \$45000 (B) \$3000 (C) \$4000
 (D) \$5000 (E) \$7000.



20. Using the multiple regression equation, you would estimate the average salary of male professors with 4 years of experience to be
- (A) \$16000 (B) \$57000 (C) \$61000
(D) \$65000 (E) \$7000.

Use the following problem to answer questions 21-22.

In the past, 35% of the students at a University were in the Business College, 5% of the students were in the Liberal Arts College, and 30% of the students were in the Education College. To see whether or not the proportions have changed, a sample of 300 students was taken. Ninety of the sample students are in the Business College, 120 are in the Liberal Arts College, and 90 are in the Education College.

21. This problem is an example of a
- (A) Normally distributed variable
(B) Test for independence
(C) Multinomial population
(D) Poisson distributed variable
(E) Binomial variable
22. At $\alpha = .05$, which of the following statements is correct?
- (A). Proportions have changed significantly
(B). Proportions have not changed significantly
(C). The critical value is 7.37776.
(D). The degree of freedom of the test statistic is 3.
(E). None of above is correct.

Use the following problem to answer questions 23-25.

A marketing researcher was studying the effect of a supermarket display on sales of a new product. There are two designs for the display: the first had greater visual appeal, and the second contained more factual information about the product. Each type of display could be made in three sizes, small, medium, or large. Eighteen supermarkets were available for the study, and three supermarkets were selected at random for each combination of display and size. The number of units of the product sold over a two week period was record for each supermarket. A partial result of ANOVA table is given below.



Source	DF	SS	MS	F	P
Design					0.613
Size			7256		
Design×Size		41707			
Error			12262		
Total		206664			

23. The degrees of freedom for error are

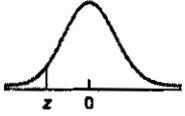
- (A) 1 (B) 2 (C) 6 (D) 12 (E) 17

24. What is the value of the mean square of the main effect for **Design**?

- (A) 2085 (B) 3301 (C) 41707 (D) 12262 (E) 206664

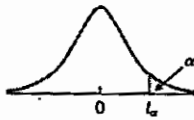
25. The numerical value of the F statistic for testing interaction is

- (A) 0.17 (B) 0.26 (C) 0.59 (D) 3.40 (E) 202.33

TABLE II
 Areas under the
 standard normal curve


Second decimal place in z										z
0.09	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.00	
									0.0000 [†]	-3.9
0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	-3.8
0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	-3.7
0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	-3.6
0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	-3.5
0.0002	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	-3.4
0.0003	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0005	0.0005	0.0005	-3.3
0.0005	0.0005	0.0005	0.0006	0.0006	0.0006	0.0006	0.0006	0.0007	0.0007	-3.2
0.0007	0.0007	0.0008	0.0008	0.0008	0.0008	0.0009	0.0009	0.0009	0.0010	-3.1
0.0010	0.0010	0.0011	0.0011	0.0011	0.0012	0.0012	0.0013	0.0013	0.0013	-3.0
0.0014	0.0014	0.0015	0.0015	0.0016	0.0016	0.0017	0.0018	0.0018	0.0019	-2.9
0.0019	0.0020	0.0021	0.0021	0.0022	0.0023	0.0023	0.0024	0.0025	0.0026	-2.8
0.0026	0.0027	0.0028	0.0029	0.0030	0.0031	0.0032	0.0033	0.0034	0.0035	-2.7
0.0036	0.0037	0.0038	0.0039	0.0040	0.0041	0.0043	0.0044	0.0045	0.0047	-2.6
0.0048	0.0049	0.0051	0.0052	0.0054	0.0055	0.0057	0.0059	0.0060	0.0062	-2.5
0.0064	0.0066	0.0068	0.0069	0.0071	0.0073	0.0075	0.0078	0.0080	0.0082	-2.4
0.0084	0.0087	0.0089	0.0091	0.0094	0.0096	0.0099	0.0102	0.0104	0.0107	-2.3
0.0110	0.0113	0.0116	0.0119	0.0122	0.0125	0.0129	0.0132	0.0136	0.0139	-2.2
0.0143	0.0146	0.0150	0.0154	0.0158	0.0162	0.0166	0.0170	0.0174	0.0179	-2.1
0.0183	0.0188	0.0192	0.0197	0.0202	0.0207	0.0212	0.0217	0.0222	0.0228	-2.0
0.0233	0.0239	0.0244	0.0250	0.0256	0.0262	0.0268	0.0274	0.0281	0.0287	-1.9
0.0294	0.0301	0.0307	0.0314	0.0322	0.0329	0.0336	0.0344	0.0351	0.0359	-1.8
0.0367	0.0375	0.0384	0.0392	0.0401	0.0409	0.0418	0.0427	0.0436	0.0446	-1.7
0.0455	0.0465	0.0475	0.0485	0.0495	0.0505	0.0516	0.0526	0.0537	0.0548	-1.6
0.0559	0.0571	0.0582	0.0594	0.0606	0.0618	0.0630	0.0643	0.0655	0.0668	-1.5
0.0681	0.0694	0.0708	0.0721	0.0735	0.0749	0.0764	0.0778	0.0793	0.0808	-1.4
0.0823	0.0838	0.0853	0.0869	0.0885	0.0901	0.0918	0.0934	0.0951	0.0968	-1.3
0.0985	0.1003	0.1020	0.1038	0.1056	0.1075	0.1093	0.1112	0.1131	0.1151	-1.2
0.1170	0.1190	0.1210	0.1230	0.1251	0.1271	0.1292	0.1314	0.1335	0.1357	-1.1
0.1379	0.1401	0.1423	0.1446	0.1469	0.1492	0.1515	0.1539	0.1562	0.1587	-1.0
0.1611	0.1635	0.1660	0.1685	0.1711	0.1736	0.1762	0.1788	0.1814	0.1841	-0.9
0.1867	0.1894	0.1922	0.1949	0.1977	0.2005	0.2033	0.2061	0.2090	0.2119	-0.8
0.2148	0.2177	0.2206	0.2236	0.2266	0.2296	0.2327	0.2358	0.2389	0.2420	-0.7
0.2451	0.2483	0.2514	0.2546	0.2578	0.2611	0.2643	0.2676	0.2709	0.2743	-0.6
0.2776	0.2810	0.2843	0.2877	0.2912	0.2946	0.2981	0.3015	0.3050	0.3085	-0.5
0.3121	0.3156	0.3192	0.3228	0.3264	0.3300	0.3336	0.3372	0.3409	0.3446	-0.4
0.3483	0.3520	0.3557	0.3594	0.3632	0.3669	0.3707	0.3745	0.3783	0.3821	-0.3
0.3859	0.3897	0.3936	0.3974	0.4013	0.4052	0.4090	0.4129	0.4168	0.4207	-0.2
0.4247	0.4286	0.4325	0.4364	0.4404	0.4443	0.4483	0.4522	0.4562	0.4602	-0.1
0.4641	0.4681	0.4721	0.4761	0.4801	0.4840	0.4880	0.4920	0.4960	0.5000	-0.0

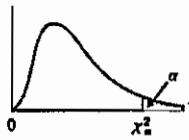
[†] For $z \leq -3.90$, the areas are 0.0000 to four decimal places.


 TABLE IV
 Values of t_α


df	$t_{0.10}$	$t_{0.05}$	$t_{0.025}$	$t_{0.01}$	$t_{0.005}$	df
1	3.078	6.314	12.706	31.821	63.657	1
2	1.886	2.920	4.303	6.965	9.925	2
3	1.638	2.353	3.182	4.541	5.841	3
4	1.533	2.132	2.776	3.747	4.604	4
5	1.476	2.015	2.571	3.365	4.032	5
6	1.440	1.943	2.447	3.143	3.707	6
7	1.415	1.895	2.365	2.998	3.499	7
8	1.397	1.860	2.306	2.896	3.355	8
9	1.383	1.833	2.262	2.821	3.250	9
10	1.372	1.812	2.228	2.764	3.169	10
11	1.363	1.796	2.201	2.718	3.106	11
12	1.356	1.782	2.179	2.681	3.055	12
13	1.350	1.771	2.160	2.650	3.012	13
14	1.345	1.761	2.145	2.624	2.977	14
15	1.341	1.753	2.131	2.602	2.947	15
16	1.337	1.746	2.120	2.583	2.921	16
17	1.333	1.740	2.110	2.567	2.898	17
18	1.330	1.734	2.101	2.552	2.878	18
19	1.328	1.729	2.093	2.539	2.861	19
20	1.325	1.725	2.086	2.528	2.845	20
21	1.323	1.721	2.080	2.518	2.831	21
22	1.321	1.717	2.074	2.508	2.819	22
23	1.319	1.714	2.069	2.500	2.807	23
24	1.318	1.711	2.064	2.492	2.797	24
25	1.316	1.708	2.060	2.485	2.787	25
26	1.315	1.706	2.056	2.479	2.779	26
27	1.314	1.703	2.052	2.473	2.771	27
28	1.313	1.701	2.048	2.467	2.763	28
29	1.311	1.699	2.045	2.462	2.756	29
30	1.310	1.697	2.042	2.457	2.750	30
31	1.309	1.696	2.040	2.453	2.744	31
32	1.309	1.694	2.037	2.449	2.738	32
33	1.308	1.692	2.035	2.445	2.733	33
34	1.307	1.691	2.032	2.441	2.728	34
35	1.306	1.690	2.030	2.438	2.724	35
36	1.306	1.688	2.028	2.434	2.719	36
37	1.305	1.687	2.026	2.431	2.715	37
38	1.304	1.686	2.024	2.429	2.712	38
39	1.304	1.685	2.023	2.426	2.708	39
40	1.303	1.684	2.021	2.423	2.704	40
41	1.303	1.683	2.020	2.421	2.701	41
42	1.302	1.682	2.018	2.418	2.698	42
43	1.302	1.681	2.017	2.416	2.695	43
44	1.301	1.680	2.015	2.414	2.692	44
45	1.301	1.679	2.014	2.412	2.690	45
46	1.300	1.679	2.013	2.410	2.687	46
47	1.300	1.678	2.012	2.408	2.685	47
48	1.299	1.677	2.011	2.407	2.682	48
49	1.299	1.677	2.010	2.405	2.680	49



TABLE VII
Values of χ^2_{α}



df	$\chi^2_{0.995}$	$\chi^2_{0.99}$	$\chi^2_{0.975}$	$\chi^2_{0.95}$	$\chi^2_{0.90}$
1	0.000	0.000	0.001	0.004	0.016
2	0.010	0.020	0.051	0.103	0.211
3	0.072	0.115	0.216	0.352	0.584
4	0.207	0.297	0.484	0.711	1.064
5	0.412	0.554	0.831	1.145	1.610
6	0.676	0.872	1.237	1.635	2.204
7	0.989	1.239	1.690	2.167	2.833
8	1.344	1.646	2.180	2.733	3.490
9	1.735	2.088	2.700	3.325	4.168
10	2.156	2.558	3.247	3.940	4.865
11	2.603	3.053	3.816	4.575	5.578
12	3.074	3.571	4.404	5.226	6.304
13	3.565	4.107	5.009	5.892	7.042
14	4.075	4.660	5.629	6.571	7.790
15	4.601	5.229	6.262	7.261	8.547
16	5.142	5.812	6.908	7.962	9.312
17	5.697	6.408	7.564	8.672	10.085
18	6.265	7.015	8.231	9.390	10.865
19	6.844	7.633	8.907	10.117	11.651
20	7.434	8.260	9.591	10.851	12.443
21	8.034	8.897	10.283	11.591	13.240
22	8.643	9.542	10.982	12.338	14.041
23	9.260	10.196	11.689	13.091	14.848
24	9.886	10.856	12.401	13.848	15.659
25	10.520	11.524	13.120	14.611	16.473
26	11.160	12.198	13.844	15.379	17.292
27	11.808	12.879	14.573	16.151	18.114
28	12.461	13.565	15.308	16.928	18.939
29	13.121	14.256	16.047	17.708	19.768
30	13.787	14.953	16.791	18.493	20.599
40	20.707	22.164	24.433	26.509	29.051
50	27.991	29.707	32.357	34.764	37.689
60	35.534	37.485	40.482	43.188	46.459
70	43.275	45.442	48.758	51.739	55.329
80	51.172	53.540	57.153	60.391	64.278
90	59.196	61.754	65.647	69.126	73.291
100	67.328	70.065	74.222	77.930	82.358


 TABLE VII (cont.)
 Values of χ^2_α

$\chi^2_{0.10}$	$\chi^2_{0.05}$	$\chi^2_{0.025}$	$\chi^2_{0.01}$	$\chi^2_{0.005}$	df
2.706	3.841	5.024	6.635	7.879	1
4.605	5.991	7.378	9.210	10.597	2
6.251	7.815	9.348	11.345	12.838	3
7.779	9.488	11.143	13.277	14.860	4
9.236	11.070	12.833	15.086	16.750	5
10.645	12.592	14.449	16.812	18.548	6
12.017	14.067	16.013	18.475	20.278	7
13.362	15.507	17.535	20.090	21.955	8
14.684	16.919	19.023	21.666	23.589	9
15.987	18.307	20.483	23.209	25.188	10
17.275	19.675	21.920	24.725	26.757	11
18.549	21.026	23.337	26.217	28.300	12
19.812	22.362	24.736	27.688	29.819	13
21.064	23.685	26.119	29.141	31.319	14
22.307	24.996	27.488	30.578	32.801	15
23.542	26.296	28.845	32.000	34.267	16
24.769	27.587	30.191	33.409	35.718	17
25.989	28.869	31.526	34.805	37.156	18
27.204	30.143	32.852	36.191	38.582	19
28.412	31.410	34.170	37.566	39.997	20
29.615	32.671	35.479	38.932	41.401	21
30.813	33.924	36.781	40.290	42.796	22
32.007	35.172	38.076	41.638	44.181	23
33.196	36.415	39.364	42.980	45.559	24
34.382	37.653	40.647	44.314	46.928	25
35.563	38.885	41.923	45.642	48.290	26
36.741	40.113	43.195	46.963	49.645	27
37.916	41.337	44.461	48.278	50.994	28
39.087	42.557	45.722	49.588	52.336	29
40.256	43.773	46.979	50.892	53.672	30
51.805	55.759	59.342	63.691	66.767	40
63.167	67.505	71.420	76.154	79.490	50
74.397	79.082	83.298	88.381	91.955	60
85.527	90.531	95.023	100.424	104.213	70
96.578	101.879	106.628	112.328	116.320	80
107.565	113.145	118.135	124.115	128.296	90
118.499	124.343	129.563	135.811	140.177	100



(You need to define and explain your notations clearly. Points are granted only if detail computations are presented.)

A company produces products 1, 2 and 3 on a machine. The unit profits for products 1, 2 and 3 are \$3.5, \$2 and \$4, respectively. It takes t_i units of time to produce product i on the machine, where $t_1 = 2.5$, $t_2 = 2.2$ and $t_3 = 3$. The daily capacity of the machine is 10 units of time.

1. Formulate this problem as a linear program model and find the optimal production quantity for each product. (10%)
2. Shadow price of a constraint of a linear program is defined as the amount of improvement in optimal objective value if the right hand side of the constraint is increased by 1. Use this definition to find the shadow price of the machine capacity and explain how would you use the information of shadow price in increase and decrease the machine capacity. (15%)
3. If the production quantities have to be integral, solve this problem by dynamic programming. (20%)
4. The linear program formulation defined above assume that we can sell everything we produce. However, in real applications, the production quantity is limited by the production capacity and the demand. Let us focus on demand limit on product 1 only now and assume that demands for products 2 and 3 are infinite. Based on historical data, it is found that the daily demand D for product 1 has the following distribution: $P(D = 1) = 0.5$, $P(D = 2) = 0.4$, $P(D = 3) = 0.1$. How do you incorporate this feature of product 1 in your model (i.e, reformulate your model). (Do not find the optimal solution.) (15%)
5. Turn our attention to the inventory control of product 1. To simplify the problem, let us assume that the company produces only product 1 and the demand D for product 1 is as before ($P(D = 1) = 0.5$, $P(D = 2) = 0.4$, $P(D = 3) = 0.1$). Inventory of product 1 is controlled by base stock policy, which is to produce when inventory level drops below zero and produce a fixed quantity Q). Assume that unmet demand are lost at a cost of \$1 per unit of unmet demand and $Q = 4$. The inventory level of product 1 is reviewed at the end of a day and holding cost is \$0.5 per unit for inventory held at the end of a day. If production is needed, it is conducted during the night and the produced quantity will be ready to sell at the beginning of next day. We are interested in finding the average cost per day of this inventory control system of product 1 and average days between two consecutive productions. (Hint: Formulate the inventory process as a Markov chain) (40%)



1. Yuntech Company plans to manufacture the i-Pod nano MP3 player for the Apple Computer. The LCD monitor is the key component of the i-Pod nano. The director of the Yuntech Company has to decide whether to purchase the LCD monitor from the vendors or to produce it in-house. If the director chooses the in-house strategy, variable costs of \$300 per unit and annual fixed costs of \$ 2,500,000 are required. Moreover, three vendors can provide the LCD monitor. Vendor A (LG-Philips) offers a price of \$350 per unit for any volume up to 30,000 units. Vendor B (AUO) offers a price of \$380 per unit for the demand that is less than 1000 units, and \$320 per unit for the demand that is larger than 1000units. Vendor C (Chi-Mei) offers a price of \$360 per unit for the first 1000 units, and \$330 per unit for the additional units.
- (a) Which alternative is the best if the director expects an annual volume of 10,000 units? (7%)
- (b) Determine the best range of annual volumes for each alternative. (8%)
2. Group technology (GT) is widely applied in just-in-time (JIT) and flexible manufacturing systems (FMS) to enhance the efficiency and flexibility of a production system. An effective manufacturing cell is formed by grouping the parts into the “part families” and clustering the machines into “machine groups”. A part-machine matrix is shown as follows:

machine \ part	A	B	C	D	E	F
M1	0	1	1	0	1	0
M2	1	0	0	1	0	1
M3	0	1	1	0	0	0
M4	1	0	0	0	0	1
M5	0	1	1	0	1	0

On this table, “1” means that the part has to be processed by the machine, and “0” means that the part doesn’t have to be processed by the machine.

- (a) Please use your heuristics to cluster them and find out the “part families” and the “machine groups”. (10%)
- (b) Jaccard (1992) proposed an approach called “similarity coefficient” to form the part families. This approach calculates the “similarity coefficient” for any two parts by using the following equation:

$$S_{ij} = \frac{a}{b + c - a}$$

where, a is the number of machines which is used to process the part i and part j , b is the number of machines which is only used to process the part i , c is the number of machines which is only used to process the part j .



A large S_{ij} value represents a high similar processing between parts i and j , and therefore, the parts i and j can be clustered into a part-family. Please use the "similarity coefficient" to group the six parts into the part families. (10%)

3. Taiwan Semiconductor Manufacturing Company (TSMC) is the world's largest dedicated semiconductor foundry. It provides the industry's leading process technology to serve and support customers' manufacturing needs. In Hsinchu Science Park, TSMC has three 12-inch wafer fabs (12A, 12B, 12C) which provide three customers' manufacturing needs (ATI, n-VIDIA and Nokia). The individual capacity of the three fabs is different. The capacity of the fab 12A is 12000 wafers a month, the capacity of the fab 12B is 15000 wafers a month and the capacity of the fab 12C is 18000 wafers a month. Moreover, the demands of ATI are 18000 wafers a month, the demands of n-VIDIA are 15000 wafers a month and the demands of Nokia are 8000 wafers a month. However, the unit profit of manufacturing a wafer for each customer at each fab is different and the unit profit data is given in the following table:

	ATI	n-VIDIA	Nokia
12A	10	14	12
12B	12	17	15
12C	11	11	12

The objective of the manager is to determine an optimal capacity arrangement and maximize the total profit.

- (a) Please formulate this problem as a linear programming model. (8%)
 (c) Please use the "north-west corner" method to generate an initial feasible solution and calculate the maximum profit. (7%)



第4題至第13題注意事項：

- (1) 第4題至第13題為複選題。每題複選題的正確答案可能有0個至多個。每題完全答對，該題才計分。
 (2) 請先寫題號再書寫答案，並依題號順序作答。各題顯示必要的計算過程。複選題每題5分，合計50分。

4. 某加工站P，目前已有四個加工件(A、B、C、D)等候加工中，各加工件的基本資料如下表所示。今天是12月25日，試以各種排序準則排定加工順序，不必考慮假日。則下列敘述何者正確？

	加工件抵達加工站P的日期	加工件在工站P的加工時間(天)	加工件的交貨日期	加工件後續尚未完成的：	
				總加工時間(天)	總加工次數
A	12月15日	3	12月25日	3	1
B	12月11日	4	12月28日	6	2
C	12月13日	2	12月18日	2	1
D	12月25日	5	12月31日	5	1

- (A)若採用FCFS排序準則，則加工順序為：D-A-C-B (B)若採用SPT排序準則，則加工順序為：D-B-A-C
 (C)若採用EDD排序準則，則加工順序為：A-C-B-D (D)若採用CR排序準則，則加工順序為：C-A-B-D
 (E)若採用S/O排序準則(假設S/O值可為負值)，則加工順序排第四的加工件為：D
5. 續第4題資料，計算FCFS排序及SPT排序後的績效。下列敘述何者正確？
 (A)以FCFS排程及SPT排程，則兩者的Make Span均相同
 (B)以FCFS排程，則平均延遲(Average Tardiness)為7.75天
 (C)以SPT排程，則系統的平均在製品數目(Average Number of Jobs)大於2.0個
 (D)以平均完工時間(Average Flow Time)比較，則FCFS排程優於SPT排程
 (E)以系統的平均在製品數目比較，則SPT排程優於FCFS排程
6. 某產品的期初庫存量有70個，每期最佳生產批量為70個。從第一期至第六期的預測(Forecast)產量依序分別為：30, 30, 30, 40, 40, 30。從第一期至第六期的已確認訂單(Committed Customer Orders)數量依序分別為：35, 40, 20, 30, 10, 0。依照上述資料推導該產品從第一期至第六期的Master Production Schedule(MPS)資料及Available-To-Promise(ATP)資料。下列敘述何者正確？
 (A)第一期至第六期的MPS中，共有三次批量生產，分別排定於第二期、第四期、及第五期
 (B)依照該MPS資料推導，該產品最高庫存量為65個，第五期期末則出現最低庫存量
 (C)依照該MPS資料推導，第一期至第六期的ATP數量總和為145個
 (D)推導MPS及ATP的先後順序應為：先推導出MPS，然後才可推導出ATP
 (E)若在第三期有一個新增訂單，其數量為35。則依照本題所推導出的MPS及ATP判斷結果為：不必改變MPS，該訂單就可以順利完成交貨
7. 某公司預計採用運輸模型(Transportation Model)完成三期的整合規劃(Aggregate Planning)。基本資料收集如下：生產成本為每個15元，存貨成本為每個每期2元，延期交貨罰金為每期每個6元。第一期期初存貨有20個，第三期期末存貨需50個。第一期至第三期的產能(最高)依序分別為：100個、120個、100個。第一期至第三期的需求量依序分別為：80個、140個、80個。下列敘述何者正確？

		Demand			Total
		1	2	3	
Supply	1		P		
	2				
	3		M	N	
Total					

- (A)依整體供需而言，產能供給量不足 (B)上表(Transportation Table)中，單位成本M=17元
 (C)上表(Transportation Table)中，單位成本N=21元 (D)上表(Transportation Table)中，單位成本P=21元
 (E)若要供給(Supply)與需求(Demand)達到平衡，則必須有數量為20的Dummy Demand



8. 某自行生產的物料，其基本資料如下：年需求量20000，每單位年存貨成本為5元，每批生產的準備成本(Setup Cost)為500元，每年250個工作天中均勻消耗該物料，但每天該物料耗用量呈常態分配，標準差為10。生產該物料的經理同意：收到製令經過4天準備後，就可開始生產並交貨，每天生產數量為400。物料主管要求該物料的服務水準須達97%($Z=1.88$)。以最經濟的成本，規劃該物料的定量控管系統。有關該物料控管系統的資訊，下列敘述何者正確？
- (A)最經濟的生產批量為2236 (B)每批生產費時28.0天 (C)安全庫存量為37.6
 (D)最高庫存量為1788.8 (E)再訂購點為320
9. 某書報攤以單期模型分析每天報紙的訂購量。基本資料收集如下：報紙每份售價15元，報紙進貨成本每份10元，若當天無法售完，則報紙只能丟棄。書報攤記錄12月1日至12月10日該報紙每天的需求量，需求量依序為：15, 13, 14, 15, 11, 12, 11, 12, 14, 13。下列敘述何者正確？
- (A)每天最佳訂購量為13份
 (B)最佳的服務水準為66.67%
 (C)單期模型採認：若存貨過多時，則每單位成本為5元
 (D)單期模型採認：若存貨不足時，則每單位成本為10元
 (E)若訂購量為13份，則該單期模型每天的期望總成本為9元
10. 有關物料需求計劃(Material Requirement Planning, MRP)的敘述，下列何者正確？
- (A)Inventory Records資料是MRP的輸入(Input)資料之一
 (B)Bill of Material資料是MRP的產出(Output)資料之一
 (C)MRP Processing推導的順序為：由完成品的MPS開始，推導至各零件製造時程，最後再推導至採購時程
 (D)MRP Processing各階層物料的推導計算時，是先由淨需求(Net Requirement)再逐步推算出毛需求(Gross Requirement)
 (E)MRP Processing各階層物料的推導計算時，是先由Planned-Order Release再推導出Planned-Order Receipt
11. P、Q兩產品的結構為：P產品由E(3個)及F(2個)所組成、Q產品由F(3個)及G(1個)所組成。目前庫存狀況為：10個P、5個Q、20個E、30個F、15個G。若有一個訂單其需求為：20個P及20個Q。則在不考慮Lead Time之下，推算各物料的淨需求量。下列何者正確？
- (A)物料E的淨需求為50個 (B)物料F的淨需求為45個 (C)物料F的淨需求為65個
 (D)物料G的淨需求為15個 (E)物料G的淨需求為0個
12. 專案管理(Project Management)中，下列敘述何者是達到經濟且有效的縮短工期(趕工)應採取的作為？
- (A)選擇工期最長的活動(Activity)進行 (B)選擇要徑(Critical Path)中趕工成本最低的活動進行
 (C)選擇趕工成本最低的活動進行 (D)先選擇總工期最短的路徑，再選擇該路徑中的活動進行
 (E)先選擇工期最長的路徑，再選擇該路徑中趕工成本最高的活動進行
13. 下列有關專案管理(Project Management)的敘述，ES表示最早開始的時間、EF表示最早完成的時間、LS表示最晚開始的時間、LF表示最晚完成的時間。下列敘述何者正確？
- (A)對任一個活動(Activity)而言，右式均正確： $EF-ES=LF-LS$
 (B)對某一個活動，若 $LS=ES$ ，則 $LF=EF$
 (C)對某一個活動，若 $LS=ES$ ，則該活動的寬裕時間(Slack)為0
 (D)要徑上的所有活動，其寬裕時間(Slack)的總和必為0
 (E)在某一要徑上，所有活動的時間加總，即為該專案完工所需的時間



一、(24%) 請說明以下名詞或概念

- 1) Software IC
- 2) Polymorphism
- 3) Exception handling
- 4) Argument & parameter
- 5) GUI
- 6) Foreign key
- 7) XML
- 8) RFID

二、有一餐點系統，目的為接受並處理來自客戶的訂單，並將訂單轉成餐點單至廚房生產，同時產生收據及管理的報表分別給客戶及餐飲店的管理者。經系統的初步分析後，作業處理主要分成四部份，依作業流程順序分別為：1. 接收並轉換客戶的訂單 2. 更新銷貨清單檔案 3. 更新存貨檔案 4. 產生管理報表。各項作業處理說明如下：

- 1) 接收並轉換客戶的訂單：接收客戶的訂單、訂單轉成餐點單並傳至廚房、訂單轉成銷貨清單並傳至更新銷貨清單檔案、訂單轉成存貨資料並傳至更新存貨檔案。
- 2) 更新銷貨清單檔案：接收並更新銷貨單資料，同時將更新的銷貨單資料儲存於銷貨清單檔案。
- 3) 更新存貨檔案：接收並更新存貨資料，同時將更新的存貨資料儲存於存貨檔案。
- 4) 產生管理報表：讀取銷貨清單檔案內的每日銷貨量及存貨檔案內的每日存貨消耗量後，統計並產生管理報表給管理者。

請回答下列問題：

1. 依系統的作業描述，請找出三個外部實體及兩個資料儲存。(5%)
2. 依上述四項的作業處理流程的順序、三個外部實體、兩個資料儲存及資料流，繪製的資料流程圖(DFD, data flow diagram)。(20%)

三、承上題，餐點系統的客戶訂單如附表所示，請回答下列問題：

1. 請由客戶訂單歸納出相關資料實體及屬性，並標示資料實體的主鍵。(6%)
2. 請由客戶訂單內的實體關係，繪出實體關係圖(10%)及正規化後之關聯表或實體關係圖(9%)。



附表：訂單

訂單					
訂單編號:			訂單日期:		
客戶編號:			客戶姓名:		
地址:					
電話:			傳真電話:		
餐點編號:	餐點名稱:	單位:	單價:	數量:	金額:
總金額:					

四、(26%)以任何物件導向程式語言設計 **Statistics**(統計量)類別。此類別應包括以下屬性(attributes):

```
int numberObservation; //到目前為止所收集觀察值的個數
double max; //所收集觀察值的最大值
double min; //所收集觀察值的最大值
double sum; //所收集觀察值的總和
double sum_square; //所收集觀察值的平方和
```

此類別亦應包括以下方法(method)或成員函式(member function):

```
Statistics(); //建構子
void readObservation(double data); //讀入一新觀察值: data
double computeAverage(); //計算到目前為止所收集觀察值的平均值
double computeSampleVariance(); //計算到目前為止所收集觀察值的樣本變異數
double getMax(); //傳回到目前為止所收集觀察值的最大值
double getMin(); //傳回到目前為止所收集觀察值的最小值
```

Hint: 樣本變異數可以用以下公式計算:

$$S^2 = \frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1} = \frac{\sum_{i=1}^n x_i^2 - n\bar{x}^2}{n-1}, \text{ where } \bar{x} = \frac{\sum_{i=1}^n x_i}{n} \text{ 為樣本均數,}$$

n 為觀察值個數。



一、「一條圍脖子，既美觀又可禦寒的絲巾，竟能鋒利如刃，可將一個成人的脖子硬生生切斷！雲林縣斗六市一家洗衣工廠女作業員，因工作時絲巾遭床單平燙機捲入，因拉扯力強大，當場身首異處，慘不忍睹」（中國時報）。「中部科學園區茂德科技發生兩名工程師被氫氟酸噴濺臉部送醫的工安事件，初步調查，肇災為氫氟酸，工程師裝設蝕刻機台時，A機台裝畢測試，氫氟酸因源頭管線標示錯誤，誤送入B機台而致災」（聯合報）。台灣地區之職業災害層出不窮，上兩例即是最近兩個月所發生之工安意外。如果你是上述各廠之管理階層，請你就「分析」、「規劃」、「執行」三方面來探討如何降低與預防工安事件。（30%）

二、某一健身器材工廠有若干條生產線，生產不同形式與尺寸的健身器材。而健身器材因為客製化之故，會在功能上做一些修改，成為一個新產品，而各產品在生產時皆為獨立之生產線。而因設計部門與製造部門分開，使得有不同設計者設計的健身器材，就有不同規格的零件，因而造成庫房中的零件過於繁多，管理不易。而大部分的零件在功能上並無差異，僅是在表面處理上(如拋光、非拋光等)有些微不同。如果你是該健身器材代工廠的管理經理，請你就上述敘述提出「問題分析」、「解決方案」與「方案績效評估」。（30%）

三、請就你目前的工作內容，提出「流程管理」與「流程改善」兩個方案。儘可能應用流程圖與相關表格來表示。（40%）



1.(25%)《遠見》2005 年 9 月號報導指出「2005 年《藍海策略》(Blue Ocean Strategy) 受到全球矚目，短短半年內被翻譯成二十五種語言版本，到底《藍海策略》有何神奇魅力，讓韓國總統盧武炫與 LG 集團指定為高階主管必讀的書籍？任教於歐洲管理學院 (INSEAD) 的《藍海策略》韓籍作者金偉燦 (W. Chan Kim) 與莫伯尼 (Renec Mauborgne) 鼓勵企業徹底跳脫競爭者魔咒，把策略焦點從競爭對手身上移開，專注大局而非數字、超越現有的需求，並且對客戶創造更有價值的創新，大膽改變原有的市場遊戲規則，才能從血流成河的激烈競爭市場中，開創出無人競爭的藍色商機。」試以目前國內醫療機構所面臨的經營困境，闡述《藍海策略》可以帶給經營者的啓示與借鏡，並具體提出如何運用此一思維來調整目前的經營策略。

2.(25%)《MD News 生技與醫療器材報導月刊》2005 年 11 月號報導分析「隨著全球藥物市場的競爭日益激烈，近幾年來，製藥產業價值鏈明顯出現了產業分工的趨勢。從疾病目標研究、藥物化合物研發、人體臨床試驗、FDA 審核至市場銷售的價值鏈，已漸漸由新興研發、生產甚至於銷售的專業服務廠商提供相關的能量。透過利潤共享與風險共擔的概念，製藥產業漸漸形成了產業價值網的型態，在全球的發展環境中形成彼此競爭與合作並存的關係。在降低研發成本的壓力之下，許多大藥廠已不再投入價值鏈前端的研究工作，而是透過授權引進 (licensing in) 的方式，由學術單位或是其它生技製藥公司引入研發中後期的新藥。另一方面，則是將原有的藥物產品委託給外部的專業廠商代為生產，本身則運用既有的通路系統轉型為專業的銷售管道。

在 Contract Pharma 的調查中，也指出影響藥廠選擇生產代工合作夥伴的因素主要可分為 8 項，包括「是否具有 GMP 廠房」、「彼此的關係」、「生產代工的價格因素」、「是否具備特殊技術」、「代工廠的財務狀況」、「整合服務」、「其它廠商的參考推薦與地理環境位置」等。…成本考量、生產代工業者本身的技術能力等等也是藥廠在衡量代工廠時重要的參考指標，尤其以技術是否能夠支援大量生產藥物最為關鍵。

…我國目前的生技醫藥生產代工產業，生產委辦代工的規模仍不大，主要從事與原料藥生產、單株抗體、疫苗產品、檢驗試劑及生物晶片等方面的生產代工業務。不同於過去為我國創下高度營收的資訊技術 (IT) 代工產業，由於藥物生產的製程都必須受到法規嚴格的規範，因此藥物生產並不像 IT 產業容易更換代工廠商。」

(1) 藥廠如何應用全面品質管理 (TQM) 的理念來強化與代工廠之間的夥伴關係。(2) 面對產業價值鏈分工時代的來臨，我國內業者如何因應，在競爭激烈的國際市場中突圍而出，爭取更大的商機。

3. (25%) 國內亞歷山大健身中心敦南分部於民國 95 年 1 月 31 日發生一氧化碳中毒事件，以下是該事件發生之後的相關報導，請簡單評論此事件，並從危機管理五個階段，訊號偵測階段、準備 (防範) 階段、仰制損害 (減少) 階段、恢復階段和經驗學習階段，



分別給於亞歷山大健身中心及政府具體的建議。

根據中央社記者孫承武於民國 95 年 1 月 31 日的報導，知名的亞歷山大健身中心敦南分部上午傳出瓦斯外洩意外，北市消防局獲報緊急疏散四十七人，另有十人身體不適送醫，其中五十歲的男子許德雄送台安醫院到院前不治。消防局會同瓦斯公司進行偵檢，由於地下室一氧化碳濃度標準遠超過安全值，因此研判是一氧化碳中毒釀災。

1 月 31 日是亞歷山大敦南分部在年後第一天營業，上午意外發生後，敦南分部也停止對外營業，對於有消費客人聲稱上午八時多進入健身中心察覺異狀，不滿業者未及早疏散，甚至還讓客人進入，但敦南分部上午並沒有人對外界提出說明，轄區北市松山警分局則是留置健身中心的員工並製作筆錄，進一步瞭解意外發生時處理經過。

此外，中央社記者程啓峰亦於 95 年 2 月 3 日於高雄報導，鑑於台北市發生健身休閒中心一氧化碳外洩，導致一死多傷意外，高雄市消防於 2 月 3 日全面清查全市使用鍋爐燃燒瓦斯的健身休閒中心、三溫暖及室內游泳池等三十八處，其中亞歷山大健身休閒中心三多店等三家消防安全設備不符合規定，被當場開立限期改善通知單，消防局將再複查。

而台灣日報記者許家源於 95 年 2 月 4 日報導：

傳出一人死亡公安意外的亞力山大健身俱樂部董事長唐雅君 2 月 3 日下午宣布，為讓所有亞力山大會員安心運動，2 月 3 日晚上十二時起，全台各分店將停業三天全面安檢，由於停業安檢將對會員造成不便，所有會員使用權將免費延長三個月，以表亞力山大公司對所有會員的歉意。

台北市發生亞力山大健身中心一氧化碳中毒案，台北市副市長葉金川 2 月 3 日帶領消保官、消防局等單位，進行北市全面健身中心的安檢抽查，葉金川說，台北市考慮要求鍋爐操作人員必須要有證照、地下室放置鍋爐的管理等，納入營業衛生管理自治條例，甚至還研擬是否針對三溫暖及健身中心，必須加裝一氧化碳偵測器等，強制業者遵守，最快年中修法通過立即實行。

副市長葉金川說，目前中央的法規，健身中心不管是位於室內還是地下室，都沒有對小型鍋爐的設置及人員進行強制規範管理，台北市會率先討論修法，預計最快年中修法實施，一旦修法通過，未來包括健身中心、SPA、三溫暖的小型鍋爐都必須納入管理規範。至於目前可以依照消保法，業者只要設置一氧化碳安全偵測，可以公告告知消費者，作為選擇健身中心的條件之一。



亞力山大健身中心敦南店 1 月 31 日發生民眾疑因吸入一氧化碳或其他有機化學氣體意外，造成 1 名民眾死亡，11 名民眾受傷，市府在 31 日下午立即由副市長葉金川召集消保官、消防局、法規會、勞檢處、建管處與新聞處成立緊急應變小組，要求亞力山大企業集團立即全面對其所屬健身場所進行檢查，在完成檢查安全無虞前，不得對外營業；同時，2 月 1 日起相關單位立即針對該集團 15 家健身中心全面進行安全檢查。

亞歷山大健身中心發生一死十一傷公安意外，行政院勞工委員亦於 1 月 31 日表示，亞歷山大健身中心不適用勞工安全衛生法，有關消費安全問題，政府相關單位及業者都責無旁貸，應勇於面對問題決。

勞委會說，這起公安意外肇因與鍋爐本體安全無關，是屬於瓦斯鍋爐設置於地下室通風不良造成，對於鍋爐在建築物內的設置，建築法令已有明確規範，查依建築技術規則建築設備編的規定，應安裝於通風足夠的空間，並應設適當的消防設備。

勞委會指出，這起意外如能落實建築物安全檢查，應可避免。勞委會也特別澄清，這起意外是屬法令執行問題，並非無法可管。

4.(25%) 近年來在全民健保只重醫療不重預防的政策，導致健保實施十一年來醫療費用大幅提昇，不得不實施總額預算以抑制醫療費用的上升。在這樣的環境之下，醫療產業已成為一個競爭異常激烈的市場。從另外一個角度來看，由於國人生活水準的提升，民眾觀念的改變，近年來各個健康產業如高級健康檢查、健康食品、養生、抗老醫學和休閒農場等健康產業的蓬勃發展，因此，如何結合其他健康產業，為醫療業開闢一個新的市場，已成為一個新的話題。近年來由大衛·諾頓，羅伯·柯普朗/著所著的平衡計分卡：資訊時代的策略管理工具，在世界各國包括台灣在內的企業掀起很大的迴響，而在醫療界更是引起許多的討論。過去二十年來，企業管理學者專家及業界皆將注意力集中於找出企業制勝策略的議題上，以期創造卓越績效和建立企業的競爭優勢。一時之間，企業應如何發展其競爭策略因而成為最受矚目的課題。

然而值得注意的是，近年來一些研究調查卻不約而同的提出另一項重要的觀點：相對於策略本身的品質，企業是否具備執行策略的能力才是成功的關鍵。

根據一項對 275 位投資經理人的問卷調查顯示，他們評估一個企業的價值時，最重要的考量並非在於企業的願景及策略品質，而是該企業是否有能力將策略成功的落實到日常執行的層面。而另一項對管理顧問的調查發現，只有少於十分之一的策略曾經被成功的實行。



由於您對經營健康產業有濃厚的興趣，亦有許多的經驗。請您就平衡計分卡一書所提之財務、顧客、企業內部流程、學習與成長等四大構面，以一個您所熟悉之健康產業提出您的看法。

〔註〕切勿將您的姓名、您所服務的機構或單位名稱，明示或暗示的呈現出來。



1. Find $\lim_{x \rightarrow -\infty} \sqrt{x^2 - x - 1} - \sqrt{x^2 + x}$ (10%)
2. If $f(x) = \frac{x \ln(x^2 + 2)}{e^x \cos x}$, find $f'(0)$. (10%)
3. Find $\lim_{x \rightarrow 0} \frac{e^{-x} + e^x + 2}{1 + \cos 2x}$ (10%)
4. If $f(x) = (2 + x)e^{-x}$ (a) Find the asymptotes. (b) Find all relative maximum or minimum points. (c) Find all inflection points and describe the concavity. (d) Sketch the graph of the function. (10%)
5. If $xy^2 + y^2 - 2x = 5$, find $\frac{dy}{dx}$. (10%)
6. Find $\int \frac{1}{x^2(x+1)} dx$ (10%)
7. Find $\int e^x \sin x dx$ (10%)
8. If $f(x) = \int_x^{x^2} e^{-t} dt$; find $f'(1)$. (10%)
9. Find $\int_0^1 \int_x^1 \frac{1}{1+y} dy dx$ (10%)
10. Find $\sum_{k=1}^{\infty} \frac{2}{k(k+1)(k+2)}$ (10%)