



1. Consider a supply chain consisting of two firms: a manufacturer and a carrier. To satisfy a known demand, the manufacturer chooses its production amounts for four plants that produce the same product but have different requirements of resources and different margins, as summarized in Table 1(a). The total demand of the market is 100 units, and overproduction is not allowed. Once the production is finished, the manufacturer will deliver products to the market arranged by a carrier. The carrier considers each plant as a node and decides its distribution plan after the manufacturer's production plan is determined. Table 1(b) summarizes the information of carrier's unit shipping cost of each path and path capacities. Each of the firms makes decisions by optimizing the individual profit or cost. (The manufacturer's and carrier's problems satisfy the properties required for LP models.)
- What properties are required for formulating the firms' problems as LP models? If the market demand follows a uniform distribution, what property is violated? (10%)
 - Find the optimal production quantities of the four plants and profit obtained by the manufacturer. (10%)
 - From part (2), find the shadow price of each resource, and interpret that increasing what resource provides the greatest profit improvement? (10%)
 - Solve the carrier's problem as a minimum-cost flow problem. Please show the optimal decisions and total cost borne by the carrier. (10%)
 - If the margin of Plant 3 decreases to \$20, does the basis obtained in part (d) of the carrier's problem remain optimal? Explain. (10%)

Table 1: Information of resources, margins, and shipping costs

(a) Resource requirements and margins					(b) Shipping costs and path capacities				
Plant	Resources			Margin	Plant 1	Plant 2	Plant 3	Plant 4	Market
	A	B	C						
Plant 1	2	4	2	\$40	-	\$7 (∞)	\$4 (∞)	\$4 (20)	-
Plant 2	3	2	3	\$30	-	-	\$3 (30)	\$3 (40)	-
Plant 3	2	3	4	\$40	-	-	-	-	\$5 (50)
Plant 4	2	3	3	\$20	-	-	\$2 (∞)	-	\$5 (∞)
Available amount	280	320	300						

Note: - unavailable path; (·) path capacity



2. Consider the inventory control problem of a product of a store. The inventory of the product is checked at the end of each day, if the inventory level is less than s , we place a replenishment order to bring the inventory level up to S . The replenishment will arrive at the store at the beginning of the next day. Let D_n be random demand at day n with probability $P(D_n = k) = d_k, k = 0, 1, 2, \dots$. D_1, D_2, \dots be iid random variables. Assume that unsatisfied demands are lost with a cost of $\$b$ per unit of unsatisfied demand. Besides, there is a setup cost $\$M$ of placing a replenishment order and a holding cost $\$h$ per unit charged for each unit of inventory held at the end of the day. Let X_n be inventory level of the product at the end of day n . $\{X_n\}$ is a Markov chain.
- (a) Find the transition probability matrix of $\{X_n\}$. (% 15)
- (b) Assume that $\{X_n\}$ has steady state distribution $\lim_{n \rightarrow \infty} P(X_n = i) = \pi_i$, express the following terms in terms of $\$M, \$b, \$h, \pi_i, i = 0, 1, 2, \dots$
- Average inventory level. (% 5)
 - Average unmet demand per day. (% 5)
 - Average replenishment order size. (% 5)
 - Average time between placing replenishment orders. (% 5)
 - Average system cost per day. (% 10)
- (c) If the product considered is perishable, say the product are boxes of milk. Assume each box of milk has to be sold within three days after it arrives to the store and we always sell boxes of milk in the shop longest of time first. If a box of milk has been in store for more than 3 days, we need to discard it. The status of each box of milk is checked at the end of each day. The inventory system of the product considered is still a Markov chain. Define the state of this Markov chain and find the transition probabilities. (% 5)



Part A 試題說明：

Part A 試題共有 4 題，題號由 A-1 至 A-4。每題配分標示於題號右邊的括號內，Part A 合計 50 分。

A-1: (15%) 某一工廠使用相同之設備生產 A、B 兩種產品。生產 A、B 兩種產品所需之單位生產時間分別為 0.5 與 0.3 小時。兩種產品在未來 4 季之需求如下表。A、B 兩種產品之單位生產成本分別為 \$20 與 \$30、二種產品每一季之單位存貨成本皆為 \$5。若該設備每季之產能為 500 小時。請在最小化成本之目標下，以線性規畫法建構最佳之生產計劃模式(無需求解)。

	1	2	3	4
A	300	600	700	400
B	800	800	1000	600

A-2: (15%) 某工廠使用一龍門車床進行產品之加工作業。為避免設備故障時因停機等待維修所造成之損失，設備維修部門對該車床保有若干單位之備用零件。該備用零件之單位購入成本為 \$1000，且時效性為 1 年，若一年內未使用則其殘值為 0。經該公司之設備工程師長期統計後，該設備平均一年發生 3 次故障，且呈布松分配($P(X=x) = \frac{e^{-\lambda} \lambda^x}{x!}$ ，機率值如下表所示)。請試估計該零件缺貨成本之範圍。

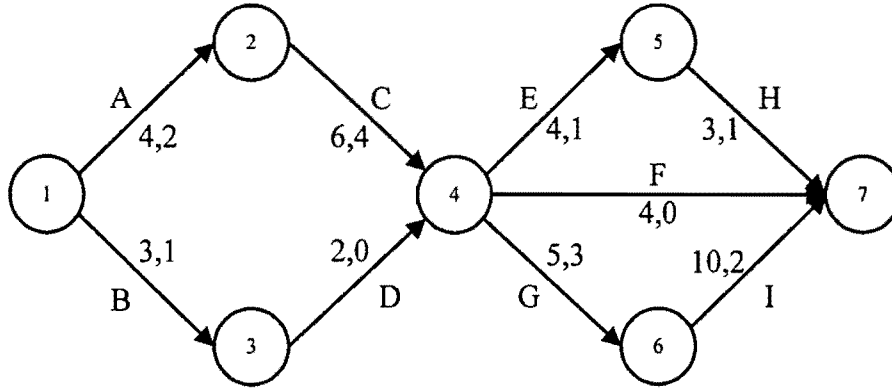
x	0	1	2	3	4
P	0.0498	0.1494	0.2240	0.2240	0.1680

A-3: (10%) 針對下列之單機排程問題請以 CR(critical ratio) 法則求解排序，並計算系統中之平均工作數。

工 作	1	2	3	4	5	6
作業時間	5	8	14	6	3	2
到期日	12	25	42	20	18	6



A-4:(10%)若可用資源為 4 單位請以 ACTRES 法則，針對下列資源受限之專案管理問題進行完工時間之求算。[註：下圖中之數字分別表示各作業之作業時間及所需之資源數]





Part B 試題說明：

1. Part B 試題共有 9 題選擇題，其中 4 題單選題(題號：B-1 至 B-4)，5 題複選題(題號：B-5 至 B-9)。
2. 單選題每題 5 分(共 20 分)，複選題每題 6 分(共 30 分)。Part B 合計 50 分。
3. 單選題請以最接近的答案選答，複選題須完全答對才計分。

B-1. (單選題) 某公司年銷售量呈現直線趨勢的變化，去年及今年的年銷售量依序分別為：2,000 及 2,400。此外，公司每年四季的銷售量呈現穩定的季節變化，估計每年前三季的季節指數依序分別為：1.2, 0.7, 0.8。依照前述資料，估計明年第四季的銷售量。

- (A) 780 (B) 910 (C) 2080 (D) 3120 (E) 3640

B-2. (單選題) 在產品的設計與開發的階段，下述何者與「環保」的理念最為接近？

- (A) Reverse Engineering (B) Mass Customization
(C) Quality Function Deployment (D) Remanufacturing
(E) Service Blueprint

B-3. (單選題) 某規劃中的醫院為一棟五層樓的獨棟建築。目前醫院的整體規劃為：一樓為掛號批價區及藥局區，二樓為各科門診及候診區，三樓為檢驗區及庫房，四樓及五樓為住院病房區。下列何種佈置的理念與該醫院的整體規劃理念最為相似？

- (A) Product Layout (B) Fixed-Position Layout (C) Process Layout
(D) Cellular Layout (E) U-Shaped Layout

B-4. (單選題) 某公司正在選擇海外製造工廠的位址，公司已決定將綜合考量五種因素做為選址依據。考量的因素包含：(1)製造成本、(2)運輸成本、(3)氣候條件、(4)勞工技術水準、(5)投資優惠措施。依照公司上述的需求，則下列評估方法何者最為適合？

- (A) Locational Cost-Profit-Volume Analysis (B) Center of Gravity Method
(C) Closeness Rating Method (D) Transportation Model
(E) Factor Rating Method

B-5. (複選題) 下列何種措施可以降低預測值的波動(即減少預測值的變化量)？

- (A) 若採移動平均法預測($F_t = (\sum_{i=1}^n A_{t-i})/n$)，則可將 n 值增加
(B) 若採加權移動平均法預測($F_t = (\alpha A_{t-1} + \beta A_{t-2} + \gamma A_{t-3})$)，則權重值可調整為： $\alpha + \beta + \gamma = 2.00$
(C) 若採指數平滑法預測($F_t = F_{t-1} + \alpha (A_{t-1} - F_{t-1})$)，則可將平滑係數 α 值減小
(D) 若採直線型趨勢法預測($F_t = a + bt$)，則可將趨勢線之 a 值調降
(E) 可將 MAD 值及 MSE 值調降

B-6. (複選題) 某製造現場由機器 A 生產製造產品 B。成本及製造資料如後：機器 A 每年的固定成本為 \$20,000 元/台，產品 B 的變動成本為 \$50 元/件，製造工時為 20 小時/件，機器 A 每年有效生產工時為 2,000 小時/台。製造時產生的不良率為 20%，且不良品將以報廢處理。產品 B 的年出貨量為 96 件。下述敘述何者正確？

- (A) 達成年出貨量之下，則機器 A 的需求量為 2 台
(B) 達成年出貨量之下，則年生產總成本為 24,800 元
(C) 達成年出貨量之下，則年生產總成本為 44,800 元
(D) 達成年出貨量之下，若售價訂為 500 元/件，則年獲利總額為 2,000 元
(E) 若在年出貨量之下僅達損益平衡，則此時售價為 383.33 元



B-7. (複選題) 依照下表資料安排生產線。該生產線的基本要求有四項：(1)只安排兩個工作站，且兩工作站的作業內容不同。(2)儘量減少工作站的閒置時間。(3)不考慮平行工作站。(4)各作業單元(Task)的工作時間不可再分割。依據上述要求安排最佳生產線，在充分投料的運作之下，選擇下列正確的敘述。

Task	Task Time (分鐘)	Immediate Followers
a	0.2	b
b	0.4	d
c	0.3	d
d	1.3	g
e	0.1	f
f	0.8	g
g	0.3	h
h	1.2	—

- (A)作業單元 d 應安排於第二個工作站 (B)作業單元 f 應安排於第一個工作站
 (C)第一個工作站的閒置時間為0.2分鐘 (D)二個工作站的使用率均達100%
 (E)若每天加工時間為460分鐘，則生產線每天產量高於180件

B-8. (複選題) 零件 A 由公司自行批量生產，並供給後續裝配線所需。零件 A 的基本資料彙整如後：零件 A 的年需求量為 30,000 件，後續裝配線每日消耗零件 A 的數量相同且穩定。每批生產之設置成本為 5,000 元/次，每個零件 A 的年存貨成本佔該零件材料購價的 5%，而該零件的材料平均採購價格為 2,000 元/件。批量生產時，每日生產速率是每日消耗速率的三倍。每年以 250 個工作天計算。系統在最佳生產批量的運作下，則下列敘述何者正確？

- (A)零件 A 每批的生產批量大於 2,000 件
 (B)年存貨成本大於 70,000 元，且年總成本是年存貨成本的兩倍
 (C)零件 A 的平均庫存量大於 1,000 件
 (D)一年中，零件 A 總生產天數佔年工作天數的 33.33%
 (E)本系統並無考量安全庫存，故最低庫存量為 0

B-9. (複選題) 某零件經 MRP 展開之後，第 1 期至第 6 期之淨需求量依序為：20, 70, 30, 60, 50, 40。依 Fixed-Period Ordering 或 Fixed-Quantity Ordering 觀念決定採購的 Lot Size。則下述第 1 期至第 6 期之 Planned-Order Receipts 何者正確？

- (A)採 Fixed-Period Ordering 且整合三期需求下：0, 0, 120, 0, 0, 150
 (B)採 Fixed-Period Ordering 且整合三期需求下：120, 0, 0, 150, 0, 0
 (C)採 Fixed-Period Ordering 且整合二期需求下：0, 90, 0, 90, 0, 90
 (D)採 Fixed-Period Ordering 且整合二期需求下：90, 0, 90, 0, 90, 0
 (E)採 Fixed-Quantity Ordering 且採購批量為 150 下：150, 0, 0, 150, 0, 0



本份試卷第一部分為 25 題單選題，每題 2 分，請依題目順序將答案寫在答案卷上

1. The term "inverse demand curve" refers to
 - (A) the demand for "inverses."
 - (B) expressing the demand curve in terms of price as a function of quantity
 - (C) the difference between quantity demanded and supplied at each price
 - (D) a demand curve that slopes upward
2. Assume the price of a movie is \$10. Jenna demands 2 movies per week, Sam demands 3 movies per week, and Jordan demands 8 movies per week. From this information we can conclude that
 - (A) Sam is irrational compared to Jenna or Jordan
 - (B) Jordan is obviously more wealthy than either Sam or Jeanna
 - (C) the movie industry is unprofitable.
 - (D) the market quantity demanded at a price of \$10 is at least 13 movies per week
3. A vertical demand curve for a particular good implies that consumers are
 - (A) not interested in that good
 - (B) irrational.
 - (C) not sensitive to changes in the price of that good
 - (D) sensitive to changes in the price of that good
4. If the demand function for orange juice is expressed as $Q = 2000 - 500p$, where Q is quantity in gallons and p is price per gallon measured in dollars, then the demand for orange juice has a unitary elasticity when price equals
 - (A) \$0
 - (B) \$1
 - (C) \$2
 - (D) \$4
5. On a linear demand curve, the lower the price,
 - (A) the elasticity equals -1.
 - (B) the less elastic is demand.
 - (C) the elasticity equals zero.
 - (D) the more elastic is demand
6. Convexity of indifference curves implies that consumers are willing to
 - (A) settle for less of both "x" and "y"
 - (B) acquire more "x" only if they do not have to give up any "y"
 - (C) give up more "y" to get an extra "x" the more "x" they have
 - (D) give up more "y" to get an extra "x" the less "x" they have.
7. If the utility function (U) between food (F) and clothing (C) can be represented as $U = \sqrt{F \times C}$, the marginal rate of substitution of clothing for food equals
 - (A) $-F/C$
 - (B) $-C/F$
 - (C) $-\sqrt{C/F}$
 - (D) $-\sqrt{F/C}$



8. An inferior good exhibits
- (A) a decline in the quantity demanded as income rises
 - (B) a downward sloping Engel curve
 - (C) a negative income elasticity
 - (D) All of the above
9. What is the primary difference between the substitution and the income effect of a price change?
- (A) The substitution effect holds income constant and the income effect holds utility constant
 - (B) The substitution effect is always negative and the income effect is always positive
 - (C) The substitution effect holds utility constant and the income effect holds prices constant
 - (D) The substitution effect is always positive and the income effect is always negative
10. Isoquants that are downward-sloping straight lines exhibit
- (A) a decreasing marginal rate of technical substitution
 - (B) an increasing marginal rate of technical substitution
 - (C) a marginal rate of technical substitution that cannot be determined
 - (D) a constant marginal rate of technical substitution
11. Let the production function be $q=AL^aK^b$. Returns to scale are equal to
- (A) $a + b$
 - (B) $L^a + K^b$
 - (C) $a * b$
 - (D) $A * L$
12. Suppose the short-run production function is $q = 10 * L$. If the wage rate is \$10 per unit of labor, then MC equals
- (A) $q/10$
 - (B) q
 - (C) 1
 - (D) $10/q$
13. Assuming that w and r are both positive, if the long-run expansion path is horizontal, then
- (A) MRTS is a function of capital only
 - (B) $w = r$
 - (C) $MP_K = 0$
 - (D) All of the above
14. If all conditions for a perfectly competitive market are met
- (A) firms demand curves are horizontal
 - (B) the market demand curve is horizontal
 - (C) firms face sunk cost when entering the market
 - (D) the firms' demand curves are downward-sloping
15. Producer surplus equals
- (A) total revenue minus total variable cost
 - (B) profit plus fixed cost
 - (C) total revenue minus the sum of all marginal cost
 - (D) All of the above
16. Which of the following is not a potential result of a price floor?
- (A) Price greater than free-market equilibrium price
 - (B) Excess supply



- (C) Lower quality inputs are used which increases marginal cost
 (D) All of the above
17. If a society only cares about efficiency and not equity, then
 (A) all points on the contract curve yield the same level of social welfare
 (B) it will not rely on competitive markets to allocate goods
 (C) an equitable outcome is impossible
 (D) it will maximize the utility of its worst-off member
18. If a monopoly discovers that the demand for its output has become more elastic at the original output level, then it will respond by
 (A) setting a lower price
 (B) producing more while leaving price unchanged
 (C) producing more and setting a higher price
 (D) setting a higher price
19. The producer surplus to a monopolist must be
 (A) positive, otherwise why would the monopoly produce?
 (B) at least as great as the producer surplus in a competitive market.
 (C) less than zero or the firm is in violation of anti-trust statutes.
 (D) the same as for a competitive market.
20. A perfect-price-discriminating monopoly's marginal revenue curve
 (A) varies for each consumer.
 (B) is the demand curve.
 (C) lies below the demand curve.
 (D) is the same as the monopolist's marginal revenue curve.
21. Airlines offer lower prices to vacationers than to business travelers because
 (A) of government regulations requiring them to do so.
 (B) business travelers are less flexible in their travel plans than vacationers are.
 (C) airlines know that business travelers enjoy flying more than vacationers do.
 (D) business travelers do not care at all about costs.
22. A typical firm in a cartel will hold which of the following attitudes?
 (A) If everyone cheats, I'm better off, and so is everyone in the cartel.
 (B) If I suspect others are planning to cheat, I'll do best for myself by deciding not to cheat.
 (C) I can never do better for myself than following agreed-upon cartel rules.
 (D) If I alone cheat, I'm better off; if everyone cheats, I'm worse off.
23. Suppose a market with a Cournot structure has five firms and a market price elasticity of demand equal to -2. What is a Cournot firm's Lerner Index?
 (A) 1 (B) 0.2 (C) 0.1 (D) 0.5
24. A strategy is dominant if
 (A) the player cannot gain by changing strategy, assuming that no other player changes strategy



- (B) it yields a greater payoff than any other player receives.
- (C) it is part of a Nash equilibrium.
- (D) it yields a payoff at least as large as that from any other strategy, regardless of the actions of other players.
25. If a Cournot duopolist announced that it will double its output
- (A) the other firm does not view the announcement as credible.
- (B) it becomes the leader.
- (C) the other firm will double output also.
- (D) the other firm will shut down.

本份試卷第二部分為 9 大題填充題，每小題 2 分，請在答案卷上依照以下格式作答，僅填答案即可，不需說明原因及計算過程。

作答範例:

(1) 答案... (不需說明原因及計算過程) _____

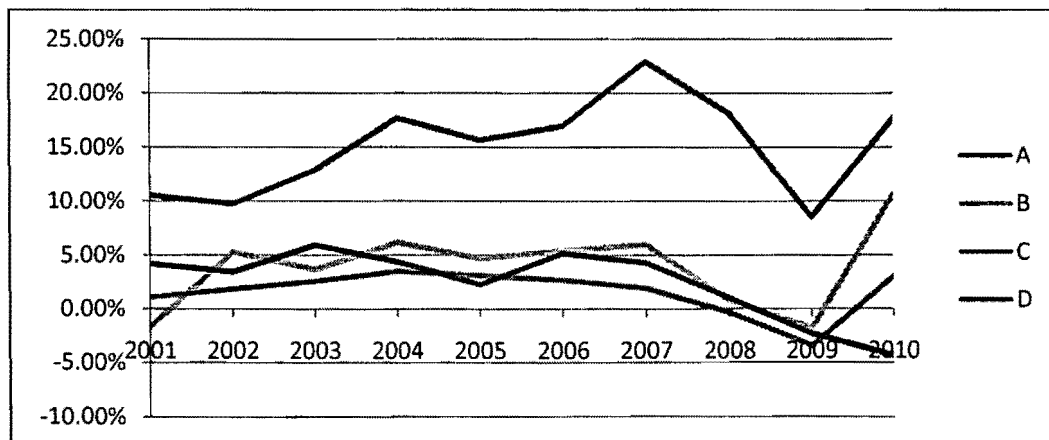
(2) 答案... _____

(3) 答案... _____

... _____

(25) 答案... _____

1. 下圖畫出台灣、中國大陸、美國及希臘 2001 到 2010 的國內生產毛額(GDP)成長率的走勢，2010 年的值由高到低分別為 A 線，B 線，C 線，及 D 線。請問這四條線分別為哪個國家的 GDP 成長率走勢？A 線為(1)，B 線為(2)，C 線為(3)，D 線為(4)。(答案請填國家名稱)



2. 大四的小花寒假從韓國進口 200 件成衣回台網拍，每件成本為 500 元。一開始售價為 1,000，但銷路不好只賣出 50 件，開學後小花急需現金繳學費，無奈之下只好以 300 的價格將其餘 150



件賠本賣出。假設小花會誠實的申報所得，請問小花的網拍活動使得台灣國內生產毛額(GDP)的金額增加了(5)。

3. 在台灣年滿 65 歲，曾加入過農保滿 6 個月以上之農民，並符合老年農民福利津貼暫行條例第 3 條之規定者，可向所屬農會申請老農津貼，每月領取 NT\$6,000 元。發放其死亡當月止。以下為 2012.1.3 中央社的新聞報導：

總統去年底公布修正老農福利津貼暫行條例，明定今年 1 月起，老農津貼調整為每月新台幣 7,000 元。勞保局今天說，老農津貼加碼將在 2 月 20 日首次入帳，約 68 萬多人受惠。

為落實照顧老年農、漁民生活，總統在去年 12 月 21 日公布修正老年農民福利津貼暫行條例，修法同時明定未來每 4 年，將依消費者物價指數成長率調整發放金額，但成長率為零或負數時，不予調整。

行政院勞工委員會勞工保險局補充說明，這次修法也增訂排富規定：所得部分，非農業所得超過 50 萬元以上者，不能領取老農津貼；不動產方面，扣除農地、農舍後，個人所有土地及房屋價值，合計超過 500 萬元以上者，不能領取老農津貼；但沒有農舍且是個人所有實際居住的唯一房屋，最多可扣除 400 萬元。

(a) 請問老農津貼在總統大選前由 6,000 加碼到 7,000 元，老農樂開懷。請問根據新聞報導的數字計算加碼後政府每年需要增加的開銷為(6)。

(b) 老農津貼 1995 年首次實施時的額度為 3,000 元，後來每隔幾年便加碼 1,000 元，上次調整到 6,000 的日期為 2007 年 8 月，當時的物價指數為 102。2012 年年初的消費者物價指數來到 108。請問這次加碼若是依照物價成長率進行調整而非直接加 1,000 元，則應每月發放金額應調整到(7)。

4. 貧富差距向來是總統大選的重要議題。花旗銀行於 2011 年 6 月出具的亞洲經濟展望報告便指出，台灣總統大選的決勝點，就在就業與縮短貧富差距。2008 年總統大選辯論時，馬總統在電視對全國民眾承諾一定要把家庭所得的貧富差距倍數拉到 6 倍以下。根據行政院主計處「家庭收支調查」，從 2008 至 2010 台灣貧富差距分別為 6.05、6.34、6.19 倍。

(a) 行政院主計處「家庭收支調查」中的貧富差距是根據最有錢 X%的平均家庭可支配所得除以最貧窮的 X%家庭平均可支配所得。請問 X 為多少?(8)

(b) 以下何者較可能是造成近 20 年來台灣貧富差距逐漸擴大的原因:(9) (請填 i, ii 或 iii)

- i) 有錢人的所得增加的比窮人增加的快。
- ii) 有錢人的所得增加，但窮人的所得原地踏步。
- iii) 有錢人的所得原地踏步，窮人的所得不增反減。

(c) 請寫出一項政府目前正在推動可能有助於縮小貧富差距的政策 (限 10 字以內):(10)

5. 請閱讀以下中央社 2011.12.14 日的報導後回答問題：



義大利國會準備通過 300 億歐元緊急預算方案，該國最新標售 30 億歐元 (39 億美元) 5 年期公債，達最高籌資目標，惟舉債成本飆上 1997 年以來新高。義國國庫局今天以 6.47% 殖利率售出這些債券，比 11 月 14 日上回標售時的 6.29% 還高。本次發債需求達標售額度 1.42 倍，投標倍數不及上月的 1.47 倍。

蒙蒂昨晚在羅馬向義國眾議院財政及預算委員會表示：「我們有信心，市場將對義大利所作的努力給予正面回應，也許不會是明天，但我們預期未來幾個月舉債成本降低，將有助於提振經濟。」

台北時間晚間 6 時 14 分，義國標債後的基準 10 年債殖利率為 6.65%，和德國同期公債間的殖利率差來到 4.62 個百分點。

- (a) 請寫下債券殖利率的定義 (限 10 個字以內)。 (11)
- (b) 義大利的公債殖利率比德國的要高 4.62%，其背後反應了何種風險 (限 5 個字以內)? (12)

6. 某開放經濟體系的國民所得資料如下

Y (國民所得)=10,000

C (民間消費)=6,000

T (稅收)=1,500

G (政府支出)=1,700

I (民間投資) = 3,300 - 10000r, (r=實質利率)

NX (淨出口) = -500

請計算以下的總體經濟變數:

- (a) 民間儲蓄(private saving) = (13)
- (b) 政府儲蓄(public saving) = (14)
- (c) 資本淨流出(net capital outflow) = (15)
- (d) 均衡投資 I^* = (16)
- (e) 均衡實質利率 r^* = (17)

7. 台灣可口可樂一罐 25 元，美國可口可樂一罐 0.8 美元。目前新台幣兌美元的匯率約為 30。

- (a) 假設沒有運輸及交易成本，請問要如何在兩國間買賣可樂而獲利 (請填 i 或 ii)? (18)
- i) 台灣買進，美國賣出
- ii) 美國買進，台灣賣出。
- (b) 請問根據購買力平價假說(Purchasing Power Parity)，用可樂的價格所計算出的合理新台幣兌美元匯率應是多少? (19)
- (c) 若台灣政府突然增加貨幣供給量兩倍，在貨幣數量說以及購買力平價假說的假設之下，新台幣兌美元匯率將變為(20)。

8. 請閱讀以下中國時報 2012.1.27 日的報導後回答問題:



美國聯邦準備理事會廿五日微幅下修今明兩年的美國經濟成長預測，同時以經濟前景面臨「顯著下滑風險」為由，宣示可能將現行趨近零的超低利率延長至二〇一四年底，並表示倘若經濟態勢惡化，可能推出新的寬鬆貨幣政策；市場認為這代表第三波量化寬鬆（QE3）必要時會推出。針對聯準會突然宣示可能將超低利率延長十八個月，直至二〇一四年底。投資銀行「RBC Capital Markets」美國首席經濟學家波切利（Tom Porcelli）指出，這代表聯準會「嚇壞了」，其低利率政策並未收到應有的成效。

- (a) 請問聯邦準備銀行實際上如何執行量化寬鬆政策? (21) (答案限 10 字以內)
- (b) 請問除了量化寬鬆以外，請舉出其他 2 個貨幣主觀機關可以引導市場利率下降的方法? (22), (23)。
- (c) 凱因斯提出量化寬鬆政策無法收到應有的成效的原因稱之為 (24)。
9. 以下何者與 2011 年諾貝爾經濟學獎得主 T. Sargent 的研究方法及研究成果較不相關: (25) (請填 i, ii, iii 或 iv)
- i) 以理性預期的概念來推導總體經濟模型
 - ii) 使用向量自我迴歸(vector auto-regression)來估計總體經濟模型中的參數
 - iii) 被預期到的政府政策是無效的
 - iv) 菲利浦曲線是一條垂直線



填充題共 20 題，每題 5 分

1. Please solve the inequality $|x-1| - |x-3| \geq 5$
2. Find the value of a such that the $\lim_{x \rightarrow -2} \frac{3x^2 + ax + a + 3}{x^2 + x - 2}$ exists.
3. For a function $f(x) = x^2 - x - 4$, please find a number δ such that if $|x-2| < \delta$ then $|f(x)+2| < 1$.
4. Find the limit $\lim_{x \rightarrow 2} \left(\frac{1}{x-2} - \frac{1}{x^2 - 3x + 2} \right)$
5. Please find the normal line of the tangent for equation $x^2 + xy + y^2 = 3$ at point $(1, 2)$.
6. Find the limit value of $\lim_{x \rightarrow -1} \frac{\sin(x+1)}{x^2 - 2x - 3}$.
7. A boat is pulled into a dock by a rope attached to the bow of the boat and pass through a pulley on the dock that is 1 m higher than the bow of the boat. If the rope is pulled in at the rate of 1 m/s, how fast is the boat approaching the dock when it is 8 m from the dock?
8. If $f(2)=8$ and $f'(x) \geq 5$ for $2 \leq x \leq 6$, how small can the $f(6)$ possible be?
9. Using Newton's method to find a root of the equation $x^5 = 5x - 2$. Calculate two iterations.
10. Find the limit value of $\lim_{x \rightarrow \infty} (xe^{1/x} - x)$.
11. Find the sum of the series $1 + \sum_{n=1}^{\infty} (-1)^n \left(\frac{e^n}{n!} \right)$
12. Find the radius of convergence of the series $\sum_{n=1}^{\infty} \frac{(2n)!}{(n!)^2} x^n$
13. Find $\int_0^{\pi/2} \frac{\sin x}{1 + \cos x^2} dx$
14. If $f(x) = x + x^2 + e^x$ and $g(x) = f^{-1}(x)$, find $g'(1)$.
15. Find $\int_0^{\ln 10} \frac{e^x \sqrt{e^x - 1}}{e^x + 8} dx$
16. Find $\int_0^1 \frac{\ln x}{\sqrt{x}} dx$
17. $y'+y = \sqrt{x}e^{-x}$, $y(0) = 3$, find $y(x)$



18. Find $\iint_D (x^2 + y^2)^{3/2} dA$, where D is the region in the first quadrant bounded by the lines $y = 0$ and $y = \sqrt{3}x$ and the circle $x^2 + y^2 = 9$.
19. Find the maximum rate of change of f at the given point and the direction in which it occur.
 $f(x, y, z) = \ln(xy^2z^3)$, $(1, -2, -3)$
20. $yz = \ln(x + z)$, find $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial y}$.



本試題共八題，合計 100 分，請依題號作答並將答案寫在答案卷上，違者不予計分。

1. The probability of a customer arrival at a grocery service counter in any 1 second is equal to 0.15. Assume that customers arrive in a random stream and hence that the arrival any 1 second is independent of any other.
 - (a) Find the probability that the first arrival will occur during the third 1-second interval. (5%)
 - (b) Find the probability that the first arrival will not occur until at least the third 1-second interval. (5%)

2. Let the moment-generating function for Y be $m(t) = \frac{1}{6}e^t + \frac{2}{6}e^{2t} + \frac{3}{6}e^{3t}$. Find the distribution of Y and its expected value and variance. (10%)

3. As a measure of intelligence, mice are timed when going through a maze to reach a reward of food. The time(in seconds) required for any mouse is a random variable Y with density function given by

$$f(y) = \begin{cases} \frac{b}{y^2} & y \geq b \\ 0 & \text{elsewhere} \end{cases}$$

where b is the minimum possible time needed to traverse the maze.

- (a) Show that $f(y)$ has the properties of a density function. (5%)
 - (b) Find $F(y)$. (3%)
 - (c) Find $P(Y > b + c)$ for a positive constant c . (2%)
4. A soft drink machine can be regulated so that it discharges an average of μ ounces per cup. If the ounces of fill are normally distributed with standard deviation of 0.3 ounce, give the setting for μ so that 8-ounce cups will overflow 1% of the time. (10%)
 5. The length of life(measured in hundreds of hours) Y for fuses of a certain type is modeled by the exponential distribution, with

$$f(y) = \begin{cases} \left(\frac{1}{3}\right)e^{-y/3} & y > 0 \\ 0 & \text{elsewhere} \end{cases}$$

- (a) If two such fuses have independent lengths of life, Y_1 and Y_2 , find the joint probability density function for Y_1 and Y_2 . (5%)
- (b) One fuse in (a) is in a primary system and the other is in a backup system that comes into use only if the primary system fails. The total effective length of life of the two fuses is then $Y_1 + Y_2$. Find $P(Y_1 + Y_2 \leq 1)$. (5%)



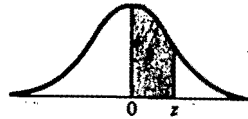
6. (a) 為了解製程中某一品質特性，從製程中抽取了 25 組樣組，每組取樣 5 個樣本，得到 25 組樣組的平均值為 31.0，標準差為 2.0。假設此品質特性值符合常態分配，若欲檢定此平均值是否等於目標值 30.0，請求出允許 0.27% 型一誤差 (type I error) 的臨界值 (critical value)。(10%)
- (b) 若此一品質特性值之標準差為 1.0，今再次取樣 5 個樣本，得到平均值為 31.0，請問在 1% 的型一誤差 (type I error) 下，檢定製程此時 (抽取此 5 個樣本時) 的品質特性值之平均值是否等於目標值 30.0？(15%)
7. 為了解原料成份對品質特性的影響，工程師針對原料中的一個成份，研究三種調配比例 A、B、C，經各自實驗五次的結果如下表，請問不同的調配比例是否會影響此品質特性值之平均值？假設前述資料符合變異數分析的各項假設， $\alpha=0.01$ 。(15%)

調配比例	A					B					C				
平均值	30.5	30.7	30.9	31.1	30.2	29.8	30.4	29.9	30.3	30.6	31.1	31.0	31.2	31.2	30.9

8. 有關最近熱門的進口肉品的話題，某報導聲稱反對變更進口辦法的比率多過贊成的，因為根據其訪談 1000 人次的結果，有 382 人贊成變更進口的辦法，416 人不贊成，其餘的沒有意見。請以統計學的觀點，檢查此報導的立論是否合宜， $\alpha=0.05$ 。(10%)



TABLE 3 Normal Curve Areas



z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.7	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4983	.4984	.4984	.4985	.4985	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990

This table is abridged from Table I of *Statistical Tables and Formulas*, by A. Hald (New York: John Wiley & Sons, Inc., 1952). Reproduced by permission of A. Hald and the publishers, John Wiley & Sons, Inc.

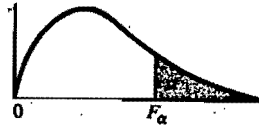
TABLE 4 Critical Values of t



	$t_{.100}$	$t_{.050}$	$t_{.025}$	$t_{.010}$	$t_{.005}$	d.f.
	3.078	6.314	12.706	31.821	63.657	1
	1.886	2.920	4.303	6.965	9.925	2
	1.638	2.353	3.182	4.541	5.841	3
	1.533	2.132	2.776	3.747	4.604	4
	1.476	2.015	2.571	3.365	4.032	5
	1.440	1.943	2.447	3.143	3.707	6
	1.415	1.895	2.365	2.998	3.499	7
	1.397	1.860	2.306	2.896	3.355	8
	1.383	1.833	2.262	2.821	3.250	9
	1.372	1.812	2.228	2.764	3.169	10
	1.363	1.796	2.201	2.718	3.106	11
	1.356	1.782	2.179	2.681	3.055	12
	1.350	1.771	2.160	2.650	3.012	13
	1.345	1.761	2.145	2.624	2.977	14
	1.341	1.753	2.131	2.602	2.947	15
	1.337	1.746	2.120	2.583	2.921	16
	1.333	1.740	2.110	2.567	2.898	17
	1.330	1.734	2.101	2.552	2.878	18
	1.328	1.729	2.093	2.539	2.861	19
	1.325	1.725	2.086	2.528	2.845	20
	1.323	1.721	2.080	2.518	2.831	21
	1.321	1.717	2.074	2.508	2.819	22
	1.319	1.714	2.069	2.500	2.807	23
	1.318	1.711	2.064	2.492	2.797	24
	1.316	1.708	2.060	2.485	2.787	25
	1.315	1.706	2.056	2.479	2.779	26
	1.314	1.703	2.052	2.473	2.771	27
	1.313	1.701	2.048	2.467	2.763	28
	1.311	1.699	2.045	2.462	2.756	29
	1.282	1.645	1.960	2.326	2.576	inf.

From "Table of Percentage Points of the t-Distribution." Computed by Maxine Merrington, *Biometrika*, Vol. 32 (1941), p. 300. Reproduced by permission of Professor E. S. Pearson.

TABLE 6 Percentage Points of the F Distribution; $\alpha = .05$



v_2 (d.f.)	v_1 (d.f.)								
	1	2	3	4	5	6	7	8	9
1	161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04
120	3.92	3.07	2.68	2.45	2.29	2.17	2.09	2.02	1.96
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88

TABLE 6 (Continued)

v_2 (d.f.)	v_1 (d.f.)									
	10	12	15	20	24	30	40	60	120	∞
1	241.9	243.9	245.9	248.0	249.1	250.1	251.1	252.2	253.3	254.3
2	19.40	19.41	19.43	19.45	19.45	19.46	19.47	19.48	19.49	19.50
3	8.79	8.74	8.70	8.66	8.64	8.62	8.59	8.57	8.55	8.53
4	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.69	5.66	5.63
5	4.74	4.68	4.62	4.56	4.53	4.50	4.46	4.43	4.40	4.36
6	4.06	4.00	3.94	3.87	3.84	3.81	3.77	3.74	3.70	3.67
7	3.64	3.57	3.51	3.44	3.41	3.38	3.34	3.30	3.27	3.23
8	3.35	3.28	3.22	3.15	3.12	3.08	3.04	3.01	2.97	2.93
9	3.14	3.07	3.01	2.94	2.90	2.86	2.83	2.79	2.75	2.71
10	2.98	2.91	2.85	2.77	2.74	2.70	2.66	2.62	2.58	2.54
11	2.85	2.79	2.72	2.65	2.61	2.57	2.53	2.49	2.45	2.40
12	2.75	2.69	2.62	2.54	2.51	2.47	2.43	2.38	2.34	2.30
13	2.67	2.60	2.53	2.46	2.42	2.38	2.34	2.30	2.25	2.21
14	2.60	2.53	2.46	2.39	2.35	2.31	2.27	2.22	2.18	2.13
15	2.54	2.48	2.40	2.33	2.29	2.25	2.20	2.16	2.11	2.07
16	2.49	2.42	2.35	2.28	2.24	2.19	2.15	2.11	2.06	2.01
17	2.45	2.38	2.31	2.23	2.19	2.15	2.10	2.06	2.01	1.96
18	2.41	2.34	2.27	2.19	2.15	2.11	2.06	2.02	1.97	1.92
19	2.38	2.31	2.23	2.16	2.11	2.07	2.03	1.98	1.93	1.88
20	2.35	2.28	2.20	2.12	2.08	2.04	1.99	1.95	1.90	1.84
21	2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.92	1.87	1.81
22	2.30	2.23	2.15	2.07	2.03	1.98	1.94	1.89	1.84	1.78
23	2.27	2.20	2.13	2.05	2.01	1.96	1.91	1.86	1.81	1.76
24	2.25	2.18	2.11	2.03	1.98	1.94	1.89	1.84	1.79	1.73
25	2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.82	1.77	1.71
26	2.22	2.15	2.07	1.99	1.95	1.90	1.85	1.80	1.75	1.69
27	2.20	2.13	2.06	1.97	1.93	1.88	1.84	1.79	1.73	1.67
28	2.19	2.12	2.04	1.96	1.91	1.87	1.82	1.77	1.71	1.65
29	2.18	2.10	2.03	1.94	1.90	1.85	1.81	1.75	1.70	1.64
30	2.16	2.09	2.01	1.93	1.89	1.84	1.79	1.74	1.68	1.62
40	2.08	2.00	1.92	1.84	1.79	1.74	1.69	1.64	1.58	1.51
60	1.99	1.92	1.84	1.75	1.70	1.65	1.59	1.53	1.47	1.39
120	1.91	1.83	1.75	1.66	1.61	1.55	1.50	1.43	1.35	1.25
∞	1.83	1.75	1.67	1.57	1.52	1.46	1.39	1.32	1.22	1.00

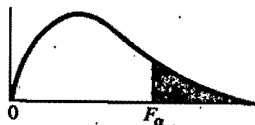
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國立雲林科技大學
101 學年度碩士班暨碩士在職專班招生考試試題

系所：工管系、資管系
科目：統計學(1)

TABLE 7 Percentage Points of the F Distribution; $\alpha = .01$ -



v_2 (d.f.)	v_1 (d.f.)								
	1	2	3	4	5	6	7	8	9
1	4052	4999.5	5403	5625	5764	5859	5928	5982	6022
2	98.50	99.00	99.17	99.25	99.30	99.33	99.36	99.37	99.39
3	34.12	30.82	29.46	28.71	28.24	27.91	27.67	27.49	27.35
4	21.20	18.00	16.69	15.98	15.52	15.21	14.98	14.80	14.66
5	16.26	13.27	12.06	11.39	10.97	10.67	10.46	10.29	10.16
6	13.75	10.92	9.78	9.15	8.75	8.47	8.26	8.10	7.98
7	12.25	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.72
8	11.26	8.65	7.59	7.01	6.63	6.37	6.18	6.03	5.91
9	10.56	8.02	6.99	6.42	6.06	5.80	5.61	5.47	5.35
10	10.04	7.56	6.55	5.99	5.64	5.39	5.20	5.06	4.94
11	9.65	7.21	6.22	5.67	5.32	5.07	4.89	4.74	4.63
12	9.33	6.93	5.95	5.41	5.06	4.82	4.64	4.50	4.39
13	9.07	6.70	5.74	5.21	4.86	4.62	4.44	4.30	4.19
14	8.86	6.51	5.56	5.04	4.69	4.46	4.28	4.14	4.03
15	8.68	6.36	5.42	4.89	4.56	4.32	4.14	4.00	3.89
16	8.53	6.23	5.29	4.77	4.44	4.20	4.03	3.89	3.78
17	8.40	6.11	5.18	4.67	4.34	4.10	3.93	3.79	3.68
18	8.29	6.01	5.09	4.58	4.25	4.01	3.84	3.71	3.60
19	8.18	5.93	5.01	4.50	4.17	3.94	3.77	3.63	3.52
20	8.10	5.85	4.94	4.43	4.10	3.87	3.70	3.56	3.46
21	8.02	5.78	4.87	4.37	4.04	3.81	3.64	3.51	3.40
22	7.95	5.72	4.82	4.31	3.99	3.76	3.59	3.45	3.35
23	7.88	5.66	4.76	4.26	3.94	3.71	3.54	3.41	3.30
24	7.82	5.61	4.72	4.22	3.90	3.67	3.50	3.36	3.26
25	7.77	5.57	4.68	4.18	3.85	3.63	3.46	3.32	3.22
26	7.72	5.53	4.64	4.14	3.82	3.59	3.42	3.29	3.18
27	7.68	5.49	4.60	4.11	3.78	3.56	3.39	3.26	3.15
28	7.64	5.45	4.57	4.07	3.75	3.53	3.36	3.23	3.12
29	7.60	5.42	4.54	4.04	3.73	3.50	3.33	3.20	3.09
30	7.56	5.39	4.51	4.02	3.70	3.47	3.30	3.17	3.07
40	7.31	5.18	4.31	3.83	3.51	3.29	3.12	2.99	2.89
60	7.08	4.98	4.13	3.65	3.34	3.12	2.95	2.82	2.72
120	6.85	4.79	3.95	3.48	3.17	2.96	2.79	2.66	2.56
∞	6.63	4.61	3.78	3.32	3.02	2.80	2.64	2.51	2.41

TABLE 7 (Continued)

v_2 (d.f.)	v_1 (d.f.)									
	10	12	15	20	24	30	40	60	120	∞
6056	99.40	99.42	99.43	99.45	99.46	99.47	99.47	99.48	99.49	99.50
6106	27.23	27.05	26.87	26.69	26.60	26.50	26.41	26.32	26.22	26.13
6157	14.55	14.37	14.20	14.02	13.93	13.84	13.75	13.65	13.56	13.46
6209	10.05	9.89	9.72	9.55	9.47	9.38	9.29	9.20	9.11	9.02
6235	7.87	7.72	7.56	7.40	7.31	7.23	7.14	7.06	6.97	6.88
6261	6.62	6.47	6.31	6.16	6.07	5.99	5.91	5.82	5.74	5.65
6287	5.81	5.67	5.52	5.36	5.28	5.20	5.12	5.03	4.95	4.86
6313	5.26	5.11	4.96	4.81	4.73	4.65	4.57	4.48	4.40	4.31
6339	4.85	4.71	4.56	4.41	4.33	4.25	4.17	4.08	4.00	3.91
6366	4.54	4.40	4.25	4.10	4.02	3.94	3.86	3.78	3.69	3.60
1	4.30	4.16	4.01	3.86	3.78	3.70	3.62	3.54	3.45	3.36
2	4.10	3.96	3.82	3.66	3.59	3.51	3.43	3.34	3.25	3.17
3	3.94	3.80	3.66	3.51	3.43	3.35	3.27	3.18	3.09	3.00
4	3.80	3.67	3.52	3.37	3.29	3.21	3.13	3.05	2.96	2.87
5	3.69	3.55	3.41	3.26	3.18	3.10	3.02	2.93	2.84	2.75
6	3.59	3.46	3.31	3.16	3.08	3.00	2.92	2.83	2.75	2.65
7	3.51	3.37	3.23	3.08	3.00	2.92	2.84	2.75	2.66	2.57
8	3.43	3.30	3.15	3.00	2.92	2.84	2.76	2.67	2.58	2.49
9	3.37	3.23	3.09	2.94	2.86	2.78	2.69	2.61	2.52	2.42
10	3.31	3.17	3.03	2.88	2.80	2.72	2.64	2.55	2.46	2.36
11	3.26	3.12	2.98	2.83	2.75	2.67	2.58	2.50	2.40	2.31
12	3.21	3.07	2.93	2.78	2.70	2.62	2.54	2.45	2.35	2.26
13	3.17	3.03	2.89	2.74	2.66	2.58	2.49	2.40	2.31	2.21
14	3.13	2.99	2.85	2.70	2.62	2.54	2.45	2.36	2.27	2.17
15	3.09	2.96	2.81	2.66	2.58	2.50	2.42	2.33	2.23	2.13
16	3.06	2.93	2.78	2.63	2.55	2.47	2.38	2.29	2.20	2.10
17	3.03	2.90	2.75	2.60	2.52	2.44	2.35	2.26	2.17	2.06
18	3.00	2.87	2.73	2.57	2.49	2.41	2.33	2.23	2.14	2.03
19	2.98	2.84	2.70	2.55	2.47	2.39	2.30	2.21	2.11	2.01
20	2.80	2.66	2.52	2.37	2.29	2.20	2.11	2.02	1.92	1.80
21	2.63	2.50	2.35	2.20	2.12	2.03	1.94	1.84	1.73	1.60
22	2.47	2.34	2.19	2.03	1.95	1.86	1.76	1.66	1.53	1.38
23	2.32	2.18	2.04	1.88	1.79	1.70	1.59	1.47	1.32	1.00
24										
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