Department of Computer Science & Engineering
University of Asia Pacific (UAP)

Final Examination **Spring 2022** **2nd Year 1st Semester**

Course Code: CSE 205 **Course Title: Data Structures** **Credits: 3**

Full Marks: 150 **Duration: 3 Hours**

Instructions:

1. There are **Six (6)** Questions. Answer all of them. All questions are of equal value. Part marks are shown in the margins.
2. Non-programmable calculators are allowed.

1. a) Design a simple data structure using array with example. 5
   b) Suppose you have been given an array of 8 elements which contains YOUR_UAP_ID as sequential digits. Your task is to print the array after removing all the non-duplicate elements from the Array. Now you need to write a pseudo code to solve this problem along with necessary iterations. Example- if the input array is {2, 0, 3, 0, 1, 0, 0, 1} your output should be {1, 0}. 20

2. a) Compare 'Linear Search' with 'Binary Search'. 5
   b) Suppose you have been given a sorted binary array which contains only 0 and 1 as its element. Your task is to count the number of '1's in this array using 'Linear Search'. Write down the algorithm for this problem. Show the iteration with diagrams if necessary. 20

   or

   a) Discuss 'Position Probing' in interpolation search with example. 5
   b) "Interpolation search is an improved variant of binary search"- justify your opinion with necessary example. 20

3. a) Discuss the time complexity of linked list. 5
   b) Suppose you have been given an array of 8 elements which contains first 10 numbers of Fibonacci series. Your task is to insert the array into a linked list. Now you need to write a pseudo code to solve this problem along with necessary iterations. 20

4. UAP appreciates the meritorious students, thus it provides scholarships to those who got GPA minimum 3.5 and above in previous semester. Now you are being asked to make a list of those students who are eligible for merit scholarship in entire UAP in Spring 2022.
   a) Which data structure you will choose and why? 5
   b) Write the necessary pseudo code to manage this list. Show necessary block diagrams and perform some iterations on a sample dataset of at least 10. 20

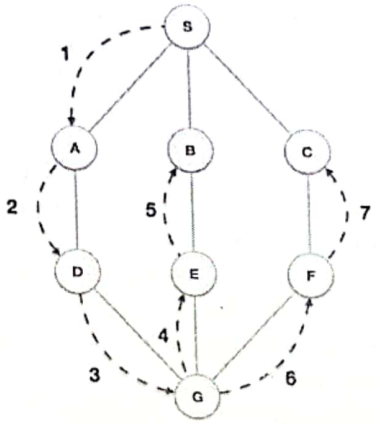
5. Standard Chartered plc is a British multinational banking and financial services company headquartered in London, England. It operates a network of more than 1,200 branches and outlets across more than 70 countries and employs around 87,000 people. Now the authority of bank is looking for a smart software package to operate its daily services like trade finance, cash management, lending, securities services, foreign exchange etc. As the part of this software the company is asking you to design a smart cash counter. Now you need to explain your preferable data structure to do job as following:

a) Which data structure you will choose and why? 5

b) Write the necessary pseudo code to manage the cash counter. Consider that the maximum number of customers that you can allow at a time in the preferred data structure is the sum of all the digits of YOUR_UAP_ID as well as the maximum number of the counters is the maximum value of the digits of YOUR_UAP_ID. 20

6. a) Why Stack is essential in 'Depth First Search' algorithm? 5

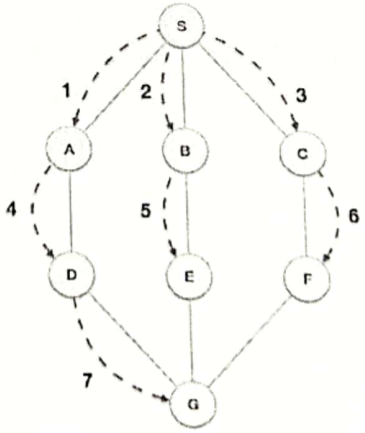
b) Perform DFS operation on the following graph: 20



Or

a) Why Queue is essential in 'Breadth First Search' algorithm? 5

b) Perform BFS operation on the following graph: 20



University of Asia Pacific
Department of Basic Sciences & Humanities
Semester Final Examination, Spring-2022
Program: B. Sc. Engineering (CSE)
(2nd Year / 1st Semester)

Course Title: Math III: Multivariable Calculus **Course No:** MTH 201 **Credit:** 3:00
Time: 3.00 Hours. **Full Mark:** 150

There are **Eight** Questions. Answer **Six** questions including Question **1, 2, 3 & 4.** All questions are of equal value. Figures in the right margin indicate marks.

1. (a) What do you know about gradient, divergence and curl? Calculate the work done when a force $\vec{F} = 3xy\,\vec{i} - y^2\vec{j}$ moves a particle in the xy- plane from $(0,0)$ to $(1, 2)$ along the parabola $y = 2x^2$. **15**

   (b) Show that the curvature of a circle of radius a is $\frac{1}{a}$. **10**

2. (a) Find the points on the sphere $x^2 + y^2 + z^2 = 36$ that are closet to and farthest from $(1,2,2)$. **10**

   (b) Show that the function $f(x,y) = x^3 + y^3 - 63(x+y) + 12xy$ is maximum at $(-7, -7)$ and minimum at $(3, 3)$. **15**

3. (a) Find the directional derivative of $F = x^2y^4 + z^2y^4 + x^2z^4$ at the point $(2,0,3)$ in the direction of $\frac{1}{\sqrt{14}}(3\hat{i} + 2\hat{j} + \hat{k})$. **10**

   (b) Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at the point $(2, -1, 2)$. **15**

4. (a) Let $\phi = x^2z$ and V denotes the region bounded by the plane $4x + 2y + z = 8, x = 0, y = 0, z = 0$. Evaluate $\iiint_V \phi\, dV$. **15**

   (b) Evaluate any one of the following integrals: **10**

   (i) $\int_0^{\frac{\pi}{2}} \int_0^{\frac{\pi}{2}} \int_0^1 \rho^3 \sin\phi \cos\phi \, d\rho \, d\phi \, d\theta$ (ii) $\int_1^3 \int_x^{x^2} \int_0^{\ln z} xe^y \, dy \, dz \, dx$

5. (a) Using Green's theorem evaluate $\oint_C (x^2 - 2xy)dx + (x^2y + 3)dy$ where C is the closed curve of the region bounded by the $y^2 = 8x$ and $x = 2$. **10**

(b) Use the change of variables $u = x - 2y$, $v = 2x + y$ to evaluate the integral $\iint_R \left(\frac{x-2y}{2x+y}\right) dx dy$, where R is the region enclosed by the lines $x - 2y = 1$, $x - 2y = 4$, $2x + y = 1$, $2x + y = 3$. 15

OR

6. Use Spherical coordinates to evaluate $\int_{-2}^{2} \int_{-\sqrt{4-x^2}}^{\sqrt{4-x^2}} \int_{0}^{4-x^2-y^2} z^2 \sqrt{x^2 + y^2 + z^2}\, dz\, dy\, dx$. 25

7. (a) Use Divergence theorem to evaluate $\iint_S \underline{F}.\underline{n}\, dS$ where $\mathbf{F} = 4x\,\mathbf{i} - 2y^2\,\mathbf{j} + z^2\,\mathbf{k}$ and S is the surface bounded by the region $x^2 + y^2 = 4$, $z = 0$, and $z = 3$. 15

(b) Evaluate the integral $\iint_R \sin\theta\, dA$, where R is the region in the first quadrant that is outside the circle $r = 2$ and inside the cardioid $r = 2(1 + \sin\theta)$. 10

OR

8. (a) Using Stoke's theorem or otherwise evaluate $\oint_C \underline{F}.d\underline{r}$ where $\underline{F} = (x^2 + y^2)\hat{i} - 2xy\,\hat{j}$ taken round the rectangle bounded by the lines $x = \pm a$, $y = 0$, $y = b$. 15

(b) Evaluate the integral $\iint_R (x^2 + y^2) dA$, where R is the region in the first quadrant bounded by the circle $x^2 + y^2 = a^2$. 10

University of Asia Pacific
Department of Computer Science & Engineering
Semester Final Examination, Spring-2022
Program: B. Sc. In CSE (2nd Year / 1st Semester)

Course Title: Electrical & Electronic Engineering II Course Code: EEE 221 Credit: 4.00

Time: 3.00 Hours Full Marks: 150

[There are Six Questions. Answer all of them. Figures in the right margin indicate marks.]

1. (a) What are the losses involved in a DC Generator? How these losses can be minimized? [10]

   (b) A short shunt compound DC generator delivers a load current of 35A at 250V and has armature, shunt field and series field resistance of 0.2Ω, 250Ω and 0.1Ω respectively. Calculate the generated voltage and the armature current. [15]

$E_g = V_o + I_a R_a + I_L R_s$

2. (a) Why a filed is required in a DC Motor? Explain how field current affects the speed of a DC Motor. [10]

   (b) A 250-V, 4-pole, wave-wound DC series motor has 800 conductors on its armature. It has armature and series field resistance of 0.75 ohm. The motor takes a current of 40 A. Estimate its speed and gross torque developed if it has a flux per pole of 25 mWb. [15]

3. (a) The number of stator teeth in a variable reluctance stepper motor is 18 and the number of rotor teeth is 10. Calculate the stepping angle of the motor. [10]

   (b) Explain operation of a switch mode power supply with a block diagram. Write the advantages of SMPS over linear power supply. [15]

4. (a) What is a Transformer? Briefly explain how transformers help to reduce the transmission line losses. [10]

   (b) A transformer has 500 turns of the primary winding and 20 turns of the secondary winding. Determine the secondary voltage if the secondary circuit is open and the primary voltage is 150 V. [15]

OR

(a) Why analog to digital conversion is required? Explain the steps involved in analog to digital conversion with necessary figure. [10]

(b) A PWM motor controller requires a PWM signal of a variable duty cycle from 60% to 90% for a specific application. The controller shows best performance when PWM frequency is within the range of 20KHz to 30KHz. Design a PWM signal generator circuit for the controller using a 555 timer. [15]

5. (a) Explain the difference between an ideal and practical operational amplifier. [5]

(b) Design an inverting and non-inverting amplifier circuit where each amplifier will provide a gain of 10. [20]

6. (a) What mathematical operations can be performed using op-amp? [5]

(b) For an inverting summing amplifier if the input voltages are 3V, 5V and 7V and corresponding resistance are 3K, 5K and 7K respectively. Calculate the output voltage for the amplifier having a 10K feedback resistor. [20]

OR

(a) What are the different types of filter circuit used in electronic system? [5]

(b) A mixed audio signal contains 200Hz, 300Hz, 450Hz, 1KHz and 2.1KHz frequency components. Design an appropriate active filter using operational amplifier to separate 450Hz signal from the mixed audio signal. [20]

Department of Computer Science & Engineering
University of Asia Pacific (UAP)

Final Examination **Spring 2022** **2nd Year 1st Semester**

Course Code: CSE 203 **Course Title: Object-Oriented Programming I: Java** **Credits: 3**

Full Marks: 150 **Duration: 3 Hours**

Instructions:

1. There are **Six (6)** Questions. Answer all of them. All questions are of equal value. Part marks are shown in the margins.
2. Non-programmable calculators are allowed.

1. Write short notes on the following topics. **[8+ 8+ 9]** **CO1**
   a) Object Oriented Programming
   b) Inheritance
   c) Thread Life Cycle

2. Write a java program that will take 2 integer inputs from the user and do the following. **[25]** **CO2**
   - If the first number is even, take 10 inputs from user and sum up only the even numbers and print the result.
   - If 2nd number is greater than the first number, print the first 5 prime numbers.

3. Answer (a, b) or (c)

   a) Define a class and name it as "**Alligator**". Add the following inside the class. **[13]** **CO3**
      i. Declare 3 instance variables ***length, weight, color***
      ii. Add a parameterized **constructor** which will take 3 parameters. Inside the constructor initializes the attributes with the parameters passed to the constructor.
      iii. Add the following methods.
         - public void ***incubateEgg***(int ***temp***)- Inside the method, show different output depending on the ***temp*** parameter. If ***temp*** is 34 degree and above, print "mostly male baby alligator"; if 30 or less, print "mostly female baby alligator"; for the other cases, print "could be male or female baby alligator".
         - Override the ***toString***() method
           – inside the method, return the concatenated value of all three attributes.

   b) Define a class and name it as "**Zoo**". Declare the **main** method inside the class. Inside the main method, do the following. **[12]** **CO3**
      i. Create an object of **Alligator** class with ***length***=11.6, ***weight*** = first 2 digits of your id, and ***color*** ="Black". Store the reference of the object to ***alligtr*** variable.
      ii. Call the incubateEgg(...) method using the ***alligtr*** variable and pass the last 2 digits of your id as the parameter of the method.
      iii. Print the ***alligtr*** variable on console.
         - What will be printed here?

OR

c) Assume there is an interface ***CustomerCare*** which has the following 2 methods. **[25]** **CO3**

```
public abstract void welcomeMsg();
void sayBye();
```

Now create 2 concrete classes, ***BanglaLinkCare*** and ***ICPCVolunteer***, implementing the above ***CustomerCare*** interface. Develop the classes in such a way so that the code below produces the expected output shown below.

Main Method	Your code should display the following output when this main method is run:

1 public class TestCustomerCare {
2
3 public static void main(String[] args) {
4 System.out.println("Bangla Link:");
5 CustomerCare bCare = new BanglaLinkCare();
6 bCare.welcomeMsg();
7 bCare.sayBye();
8
9 System.out.println("\nICPC World Final:");
10 CustomerCare iCare = new ICPCVolunteer();
11 iCare.welcomeMsg();
12 iCare.sayBye();
13 }
14 }
	Bangla Link:
	Welcome to Bangla Link customer care.
	Have a nice day.
	
	ICPC World Final:
	Welcome to ICPC World Final 2021.
	Hope you enjoyed the final.

4. a) Find out if the following JAVA programs have any error. **List the errors** if any. Fix the code and **rewrite** after the errors list. You cannot delete any line of code. However, you are allowed to edit existing line or add new code.

[8] **CO4**

i)
```
public class Calculator {
        public void sum(int a, int b) {
                System.out.println(a+b);
        }

        public int sum(int a, int b) {
                return a+b;
        }
}
```

[8] **CO4**

ii)
```
public class FindError {
        int a = 5;
        int b = 7;

        public static void main(String[] args) {
                int sum = a+b;
                System.out.println(sum);
        }
}
```

b) What will be the output of the code below? Show the detailed steps for output [9] CO4

ThreadTest.java

```
1  public class ThreadTest {
2
3      public static void main(String[] args) {
4          Thread t = new Thread("My Thread") {
5              public void run() {
6                  for(int i=1; i<5; i++) {
7                      System.out.println(Thread.currentThread().getName()+":"+i);
8                  }
9              }
10         };
11
12         t.run();
13     }
14 }
```

5. a) Complete the **outerMethod()** and **main** method as per the comment inside the methods. [15] CO3

Outerclass.java

```
1  public class Outerclass {
2      public int outerVar;
3
4      public Outerclass(int outerVar) {
5          this.outerVar = outerVar;
6      }
7
8      public void outerMethod() {
9          // print the inner class's attribute innerVar
10         // call innerMethod
11     }
12
13     class InnerClass{
14         private int innerVar;
15
16         public InnerClass(int innerVar) {
17             this.innerVar = innerVar;
18         }
19
20         public void innerMethod() {
21             System.out.println(innerVar);
22         }
23     }
24
25     public static void main(String[] args) {
26         // Call innerMethod of InnerClass
27     }
28 }
```

b) The following program might throw 2 different exceptions **FileNotFoundException** and **IOException** (here **FileNotFoundException** is the subclass of **IOException**). Update the program such that both excpetions are handled **separately**. [10] CO5

```
import java.io.FileReader;

public class TestThread {
	public static void main(String[] args) {
		new FileReader("test.txt").read();
	}
}
```

6. a) Create a User defined exception **LowAttendanceException** which will take an integer as parameter ***minAtt*** and set the exception message to "Need a minimum attendance of ***minAtt*** days to attend the final exam" where ***minAtt*** is the parameter. **[10] CO5**

OR

Consider the following program, which was written to sort a list of Devices according to their price (from lower to higher). But the code below is showing error at line 13. Write the changes needed to fix the error and sort the list by price. However, **you are only allowed to edit the Device class to solve the problem.** **[10] CO5**

Device.java

```
1
2 public class Device {
3     String name, category;
4     int price;
5
6     public Device(String name, String category, int price) {
7         this.name = name;
8         this.category = category;
9         this.price = price;
10    }
11
12    public void display() {
13        System.out.printf("%s:%s:%d\n", name, category, price);
14    }
15 }
16
```

*MyCollection.java

```
1 import java.util.*;
2
3 public class MyCollection {
4     public static void main(String[] args) {
5         ArrayList<Device> myDevices = new ArrayList<>();
6         myDevices.add(new Device("Samsung Galaxy Tab", "Tablet", 10600));
7         myDevices.add(new Device("HUAWEI Mate 40 Pro", "Smart Phone", 80000));
8         myDevices.add(new Device("HP 250 G8 Core i3 11th Gen","Laptop",64000));
9
10        for(Device d: myDevices)
11            d.display();
12
13        Collections.sort(myDevices); // Sort by Price
14
15        for(Device d: myDevices)
16            d.display();
17    }
18 }
```

b) Create a multi-threaded program with 3 threads where each thread will take 2 integer numbers **min** and **max** and print 10 random numbers between **min** and **max**. The first thread will print between 10 to 20, 2nd thread between 50 to 60, and the 3rd thread between 100 to 120. **[15] CO5**

OR

Assume the information about each person of your neighborhood/area are stored in a file named **voters.txt**. Develop a java application which will read the data from the file and only print information about **those people who are eligible to vote**. Any person who is 1) 18 and older and 2) 90 or younger is eligible to vote. **[15] CO5**

Sample voters.txt file	Expected output for the sample input file
voters.txt - Notepad File Edit View Asad 25 Shahed 18 Nasima 15 Shamsun 44 Maliha 33 Hashem 95	Asad 25 Shahed 18 Shamsun 44 Maliha 33

University of Asia Pacific

Department of Basic Sciences & Humanities

Semester Final Examination, Spring 2022

Program: B. Sc. in Engineering (CSE)

(2nd Year / 1st Semester)

Course Title: Probability and Statistics **Course No:** MTH 203 **Credit:** 3.00

Time: 3.00 Hours. **Full Mark:** 150

There are **Eight** Questions. Answer **Six** questions including Question **1, 2, 3 & 4**. All questions are of equal value. Figures in the right margin indicate marks.

1. (a) Calculate mean for the following data: **10**

Earning (Thousands TK)	30-40	40-50	50-60	60-70	70-80	80-90
No. of Employees	20	30	18	32	42	32

(b) Calculate the first four moments about assumed mean. Convert the result into moments about the mean. Comment about Kurtosis. **15**

Earning (tk)	50-70	70-90	90-110	110-130	130-150	150-170
No. of employees	10	6	2	15	7	6

2. (a) Find Karl Pearson's correlation coefficient between the sales and expenses from the data given below and interpret its value: **12**

Firm	1	2	3	4	5	6	7	8	9	10
Sales (Lakhs)	51	52	55	62	65	62	65	60	60	45
Expenses (Lakhs)	13	11	12	18	16	16	15	14	13	13

(b) The following table shows the distance to transmitter (X) and corresponding wireless signal strength (Y). 13

(i) Find the regression line of Y on X.
(ii) Predict what the signal strength would be if the distance was 10 meters.

Distance to transmitter (m)	13	4	17	19	14	15
Wireless Signal Strength(dB)	34	38	30.5	30	30.5	32.5

3. (a) Calculate standard deviation for the following data: 10

Weights (kg)	50-55	55-60	60-65	65-70	70-75	75-80
No. of People	10	15	24	13	13	16

(b) Calculate co-efficient of Skewness for the following data: 15

Profit (Lakh's)	10-12	12-14	14-16	16-18	18-20	20-22
No. of companies	53	17	199	23	208	327

4. (a) A manufacturer produces light-bulbs that are packed into boxes of 100. If quality control studies indicate that 0.5% of the bulbs produced are defective, what percentage of the boxes will contain: 15

(i) No defective?
(ii) 3 or more defectives?
(iii) Fewer than 5 defectives?

(b) During a check-in in an airport, the average number of passengers passing through a counter in 1 hours is 4. The counter can handle at most 7 passengers per hour. What is the probability that 10

(i) 6 passengers enter the counter in a given hour?
(ii) What is the probability that on a given hour passengers have to be turned away?

5. (a) When looking at a person's eye color, it turns out that 25% of people in the world has green eyes. Consider a group of 15 people. Then 15

(i) What is the probability that exactly 5 have green eyes?
(ii) What is the probability that at most 4 have green eyes?
(iii) What is the probability that at least 5 have green eyes?

(b) In a Badminton series between two players, who wins 3 games out of 5 is the winner. Suppose that Rafael Nadal and Novak Djokovic face each other in the series and that Nadal has probability 0.5 of winning a game over Djokovic. 10

(i) What is the probability that Nadal will win the series in 4 games?
(ii) What is the probability that Nadal will win the series?
(iii) What is the probability that Djokovic will win the series?

OR

6. (a) Given a standard normal distribution, 12

(i) Find the area under the curve that lies to the right of $z = 1.67$.
(ii) Find the area under the curve that lies between $z = -1.53$ and $z = 0.96$.
(iii) Find the value of k such that $P(-1.34 < z < k) = 0.671$.

(b) An electric firm manufactures washing machine that have an average longevity of 800 hours with a standard deviation of 40 hours. Assuming that the machine follows normal distribution, what is the probability that the washing machine will last between 778 and 834 hours? 13

7. (a) A manufacturing company claims that the average longevity of their product is 6 years with a standard deviation of 0.25 years. A random sample of 35 items give a mean longevity of 4.3 years. Using 5% level of significance discuss whether the sample mean justify the claim of the manufacturer. 13

(b) A random sample of 100 recorded deaths in the United States during the past year showed an average life span of 71.8 years. Assuming a population standard deviation of 8.9 years, does this seem to indicate that the mean life span today is less than 70 years? Use a 0.05 level of significance. 12

OR

8. (a) A steel manufacturing company wishes to know whether the tensile strength of the steel wire has an overall average of 130 pounds. A random sample of 16 units of steel wire produced by the company yields a mean strength of 115 pounds and standard deviation of 15 pounds. Should the company conclude that the strength is not 130 pounds with 5 percent level of significance? 12

(b) An electric company claims that their produced vacuum cleaner uses an average of 48 kilowatt hours per year. If a random sample of 12 vacuum cleaners use an average of 44 kilowatt hours per year with a standard deviation of 10.5 kilowatt hours, does this suggest at the 0.01 level of significance that vacuum cleaners use, on average, less than 48 kilowatt hours manually? 13

Level of significance	.10	.05	.01	.005	.0002
Critical values of z for one-tailed tests	-1.28 or 1.28	-1.645 or 1.645	-2.33 or 2.33	-2.58 or 2.58	-2.88 or 2.88
Critical values of z for two-tailed tests	-1.645 & 1.645	-1.96 or 1.96	-2.58 or 2.58	-2.81 or 2.81	-3.08 or 3.08

Table (continued) Areas under the Normal Curve

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767

Table Areas under the Normal Curve

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
-3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
-3.5	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
-3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
-3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
-3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
-2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
-2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
-2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
-2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
-2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
-2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
-2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
-2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
-2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
-2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
-1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
-1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
-1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
-1.6	0.0548	0.0537	0.0526	0.0513	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
-1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
-1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
-1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
-1.2	0.1151	0.1131	0.1113	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
-1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
-1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
-0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
-0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
-0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
-0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
-0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
-0.4	0.3446	0.3409	0.3372	0.3336	0.3301	0.3264	0.3228	0.3192	0.3156	0.3121
-0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
-0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
-0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
-0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641

Table A.1 (continued) Binomial Probability Sums $\sum_{x=0}^{r} b(x; n, p)$

		p								
n	r	0.10	0.20	0.25	0.30	0.40	0.50	0.60	0.70	0.80	0.90
15	0	0.2059	0.0352	0.0134	0.0047	0.0005	0.0000				
	1	0.5490	0.1671	0.0802	0.0353	0.0052	0.0005	0.0000			
	2	0.8159	0.3980	0.2361	0.1268	0.0271	0.0037	0.0003	0.0000		
	3	0.9444	0.6482	0.4613	0.2969	0.0905	0.0176	0.0010	0.0001		
	4	0.9873	0.8358	0.6865	0.5155	0.2173	0.0592	0.0093	0.0007	0.0000	
	5	0.9978	0.9389	0.8516	0.7216	0.4032	0.1509	0.0338	0.0037	0.0001	
	6	0.9997	0.9819	0.9434	0.8689	0.6098	0.3036	0.0950	0.0152	0.0008	
	7	1.0000	0.9958	0.9827	0.9500	0.7869	0.5000	0.2131	0.0500	0.0042	0.0000
	8		0.9992	0.9958	0.9848	0.9050	0.6964	0.3902	0.1311	0.0181	0.0003
	9		0.9999	0.9992	0.9963	0.9662	0.8491	0.5968	0.2784	0.0611	0.0022
	10		1.0000	0.9999	0.9993	0.9907	0.9408	0.7827	0.4845	0.1642	0.0127
	11			1.0000	0.9999	0.9981	0.9824	0.9095	0.7031	0.3518	0.0556
	12				1.0000	0.9997	0.9963	0.9729	0.8732	0.6020	0.1841
	13					1.0000	0.9995	0.9948	0.9647	0.8329	0.4510
	14						1.0000	0.9995	0.9953	0.9648	0.7941
	15							1.0000	1.0000	1.0000	1.0000

	μ								
r	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
0	0.3679	0.2231	0.1353	0.0821	0.0498	0.0302	0.0183	0.0111	0.0067
1	0.7358	0.5578	0.4060	0.2873	0.1991	0.1359	0.0916	0.0611	0.0404
2	0.9197	0.8088	0.6767	0.5438	0.4232	0.3208	0.2381	0.1736	0.1247
3	0.9810	0.9344	0.8571	0.7576	0.6472	0.5366	0.4335	0.3423	0.2650
4	0.9963	0.9814	0.9473	0.8912	0.8153	0.7254	0.6288	0.5321	0.4405
5	0.9994	0.9955	0.9834	0.9580	0.9161	0.8576	0.7851	0.7029	0.6160
6	0.9999	0.9991	0.9955	0.9858	0.9665	0.9347	0.8893	0.8311	0.7622
7	1.0000	0.9998	0.9989	0.9958	0.9881	0.9733	0.9489	0.9134	0.8666
8		1.0000	0.9998	0.9989	0.9962	0.9901	0.9786	0.9597	0.9319
9			1.0000	0.9997	0.9989	0.9967	0.9919	0.9829	0.9682
10				0.9999	0.9997	0.9990	0.9972	0.9933	0.9863
11				1.0000	0.9999	0.9997	0.9991	0.9976	0.9945
12					1.0000	0.9999	0.9997	0.9992	0.9980
13						1.0000	0.9999	0.9997	0.9993
14							1.0000	0.9999	0.9998
15								1.0000	0.9999
16									1.0000

Table A.4 Critical Values of the t-Distribution

	α						
ν	0.40	0.30	0.20	0.15	0.10	0.05	0.025
1	0.325	0.727	1.376	1.963	3.078	6.314	12.706
2	0.289	0.617	1.061	1.386	1.886	2.920	4.303
3	0.277	0.584	0.978	1.250	1.638	2.353	3.182
4	0.271	0.569	0.941	1.190	1.533	2.132	2.776
5	0.267	0.559	0.920	1.156	1.476	2.015	2.571
6	0.265	0.553	0.906	1.134	1.440	1.943	2.447
7	0.263	0.549	0.896	1.119	1.415	1.895	2.365
8	0.262	0.546	0.889	1.108	1.397	1.860	2.306
9	0.261	0.543	0.883	1.100	1.383	1.833	2.262
10	0.260	0.542	0.879	1.093	1.372	1.812	2.228
11	0.260	0.540	0.876	1.088	1.363	1.796	2.201
12	0.259	0.539	0.873	1.083	1.356	1.782	2.179
13	0.259	0.538	0.870	1.079	1.350	1.771	2.160
14	0.258	0.537	0.868	1.076	1.345	1.761	2.145
15	0.258	0.536	0.866	1.074	1.341	1.753	2.131
16	0.258	0.535	0.865	1.071	1.337	1.746	2.120
17	0.257	0.534	0.863	1.069	1.333	1.740	2.110
18	0.257	0.534	0.862	1.067	1.330	1.734	2.101
19	0.257	0.533	0.861	1.066	1.328	1.729	2.093
20	0.257	0.533	0.860	1.064	1.325	1.725	2.086
21	0.257	0.532	0.859	1.063	1.323	1.721	2.080
22	0.256	0.532	0.858	1.061	1.321	1.717	2.074
23	0.256	0.532	0.858	1.060	1.319	1.714	2.069
24	0.256	0.531	0.857	1.059	1.318	1.711	2.064
25	0.256	0.531	0.856	1.058	1.316	1.708	2.060
26	0.256	0.531	0.856	1.058	1.315	1.706	2.056
27	0.256	0.531	0.855	1.057	1.314	1.703	2.052
28	0.256	0.530	0.855	1.056	1.313	1.701	2.048
29	0.256	0.530	0.854	1.055	1.311	1.699	2.045