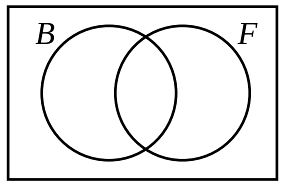
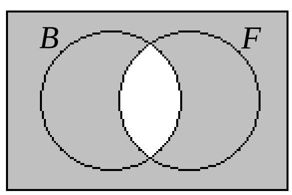
Business Mathematics I

FINAL EXAM STUDY GUIDE

1. Let B be the event that a student reads *Business Week* and let F be the event that a student reads *Fortune*. Suppose that $P(B) = 0.45$, $P(F) = 0.5$, and $P(B \cup F) = 0.65$.



   (a) Shade the regions that represent the following events: (*i*) not B. (*i*) B and F. (*ii*) B but not F.
   (b) Compute the following: (*i*) $P(\text{not } B)$. (*ii*) $P(B \text{ and } F)$. (*iii*) $P(B \text{ but not } F)$. (*iv*) $P(B^C \cup F)$. (*v*) $P((B \cap F^C) \cup (F \cap B^C))$. (*vi*) $P(B^C \cap F^C)$. (*vii*) $P(B \mid F)$. (*viii*) $P(F \mid B)$.
   (c) Describe the shaded region (*i*) in words, and (*ii*) in set symbols.



   (d) Are B and F independent? Are B and F mutually exclusive?
   (e) Are B and B^C independent? Are B and B^C mutually exclusive?

2. Among the new vehicles delivered to a dealership in Tucson, 30% are SUV's, 24% are painted a metallic color, and 52% are neither SUV's nor painted a metallic color.

   (a) What percent of the vehicles are not SUV's?
   (b) What percent of the vehicles are SUV's or are painted a metallic color?
   (c) What percent of the vehicles are SUV's and are painted a metallic color?
   (d) What percent of the vehicles are SUV's and are not painted a metallic color?
   (e) What percent of the vehicles are SUV's or are not painted a metallic color?
   (f) What percent of the vehicles are not SUV's or are not painted a metallic color?
   (g) What percent of the SUV's are painted a metallic color?
   (h) What percent of the vehicles that are painted a metallic color are SUV's?

3. Among the students in a particular math class,

    50% are female,
    60% are juniors,
    70% are business majors,
    40% are female and business majors,
    50% are juniors and business majors,
    40% are female and juniors, and
    30% are female, juniors, and business majors.

    What percent of the students in this class have exactly one of the three characteristics (female, junior, business major)?

    (A) 0%
    (B) 10%
    (C) 30%
    (D) 40%
    (E) None of the above

4. The table given below shows the number of students that began to repay their loans during a particular year and the number of those students that defaulted on their loans during that year.

	Number that began to repay loans	Number that defaulted on loans
4-year institutions	1,200,000	75,500
2-year institutions	260,000	37,200
Other	622,000	189,000

    (a) What percent of the students were from 4-year institutions?
    (b) What percent of the students from 2-year institutions did not default on their loans?
    (c) What percent of the students who defaulted on their loans were from 4-year institutions?

5. A card is drawn from a standard deck of 52 playing cards. What is the probability that it is an ace, given that it is not a king or a jack?

    (A) 1/13
    (B) 1/12
    (C) 1/11
    (D) 2/13
    (E) 12/13

6. For any two events A and B, which of the following expressions (if any) give the probability that A and B both happen?

   $(i)\ P(A \cap B)$
   $(ii)\ P(A) \cdot P(B)$
   $(iii)\ P(A \mid B) \cdot P(B)$

   (A) (i) only
   (B) (i) and (ii) only
   (C) (i) and (iii) only
   (D) (i), (ii), and (iii)
   (E) None of the above

7. Evaluate $\sum_{j=1}^{20}(j+2) - \sum_{j=1}^{20} j$.

8. What is the value of $\sum_{i=1}^{100}(0.92^{i-1} - 0.92^{i})$, rounded to four decimal places?

   (A) 0.0002
   (B) 0.9998
   (C) 1
   (D) 1.0002
   (E) None of the above

9. Re-index $\sum_{k=4}^{10}(5k+3)$ so that the index of summation is j, where j starts at 9.

10. Which of the following sums is equivalent to $\sum_{k=3}^{8}(3k^2 - k + 4)$?

(A) $\sum_{i=1}^{6}(3i^2 - 13i + 18)$

(B) $\sum_{i=1}^{6}(3i^2 - i + 4)$

(C) $\sum_{i=1}^{6}(3i^2 + 11i + 14)$

(D) $\sum_{i=1}^{6}(3i^2 + 11i + 18)$

(E) None of the above

11. Given $\sum_{i=1}^{25} a_i = 40$ and $\sum_{j=1}^{25} b_j = 125$, find $\sum_{k=1}^{25}(3a_k - b_k + 2)$.

(A) -83
(B) -35
(C) 3
(D) 45
(E) None of the above

12. Two boxes are placed in front of you. One contains a \$5 bill and a \$10 bill. The other contains a \$2 bill and a \$20 bill. You are to draw, at random, one bill from each box. Let X be the random variable that is the total value of the two bills that you have drawn.

(a) Set up a sample space, S, for this experiment, and assign realistic probabilities to each of the four outcomes.
(b) Compute $P(X = 25)$
(c) Compute $P(X < 15)$.
(d) Compute the expected value of X.
(e) What is the real-world interpretation of $E(X)$?

13. You are trying to develop a strategy for investing in two different stocks. The possible annual return for a $1,000 investment in each stock and the corresponding probabilities are given below.

RETURNS		
Probability	**Stock A**	**Stock B**
0.1	– $100	$ 50
0.3	0	$150
0.3	$ 80	– $ 20
0.3	$150	– $100

If you could only invest in one of the two stocks, which one would you choose? Explain.

14. A department store has a box that contains 70 green, 20 blue, and 10 red balls. As a sales promotion, a customer enters the store and selects a ball at random from the box. If the ball is green, the customer is given a $10 discount on a purchase of $100 or more; if the ball is blue, the customer is given a $25 discount; and if the ball is red, the customer is given a $50 discount. The ball is then returned to the box.

(a) A customer selects one ball at random. What is the customer's expected discount?
(b) Suppose that the store wants to decrease the discount when a customer draws a red ball while keeping all of the other numbers in the problem the same. What is the smallest discount for drawing a red ball that the store could offer so that the expected customer discount is at least $15?

15. Let X be the number of heads obtained in 3 tosses of a coin. We find that $E(X) = 1.5$. How can this be interpreted?

(A) 1.5 is the number of heads that will be obtained most often in many sets of 3 tosses.
(B) We will obtain 1.5 heads, on average, in many sets of 3 tosses.
(C) 1.5 is not a possible value of X; therefore, this result is extraneous.
(D) The coin is not fair because the probability of heads is not 0.5.
(E) None of the above

16. The expected number of heads obtained in two tosses of a biased coin is 0.6. What is the probability of tossing a head in a single toss?

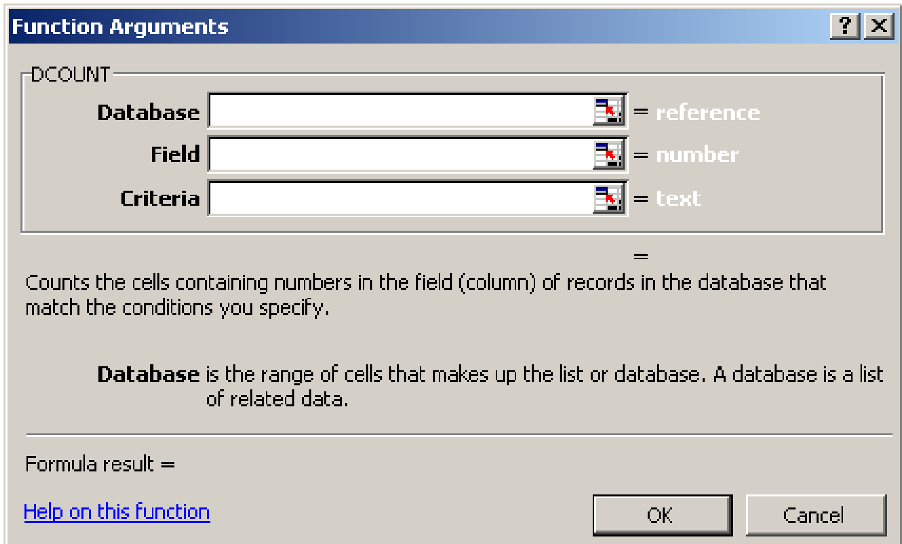
(A) 0.2
(B) 0.3
(C) 0.4
(D) 0.5
(E) None of the above

17. An excerpt of concession sales (slices of pizza and cups of soda) from baseball games played at Tucson Electric Park is given below.

	A	B	C	D	E
1	**Day**	**Time**	**Conditions**	**Pizza**	**Soda**
2	Monday	Night	Dry	400	502
3	Tuesday	Night	Dry	453	476
4	Wednesday	Night	Wind	389	382
5	Friday	Night	Dry	502	416
6	Saturday	Day	Rain	265	254
7	Sunday	Day	Rain	234	275
8	Tuesday	Night	Wind	402	399
9	Wednesday	Night	Dry	456	506
10	Thursday	Day	Dry	396	599
11	Friday	Night	Dry	426	551
12	Saturday	Night	Dry	358	522
13	Sunday	Day	Wind	379	414
14	Monday	Night	Dry	380	607
15	Tuesday	Night	Dry	426	523
16	Wednesday	Night	Rain	316	248
17	Friday	Night	Dry	468	470
18	Saturday	Night	Rain	282	202
19	Sunday	Night	Wind	359	368
20	Tuesday	Night	Wind	430	389
21	Wednesday	Night	Dry	417	501

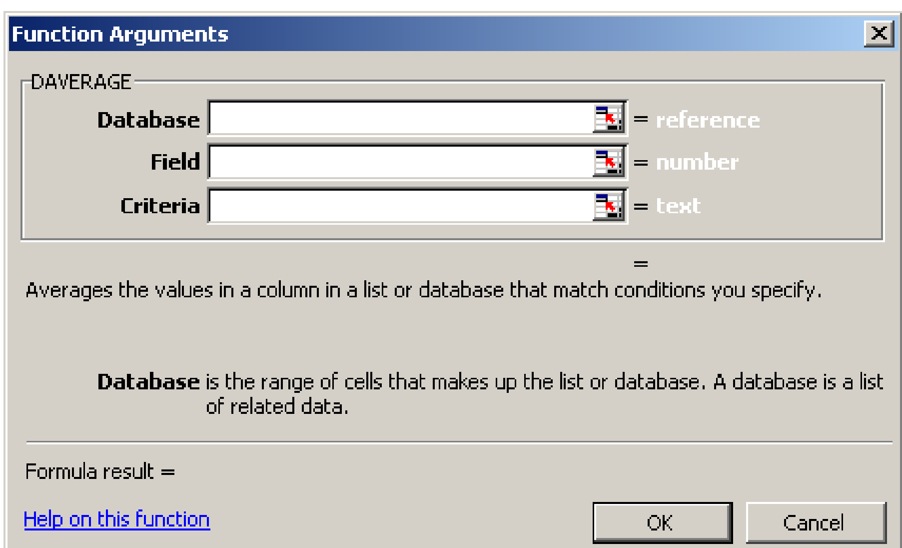
(a) Enter the information that would be needed in cells G2:K3 of the worksheet as well as the dialog box to have *Excel* count the number of games played in the rain on Saturdays or Sundays.

	G	H	I	J	K
1	Day	Time	Conditions	Pizza	Soda
2					
3					



(b) Enter the information that would be needed in cells G6:K6 of the worksheet as well as the dialog box to have *Excel* compute the average number of slices of pizza sold during games played on Fridays.

	G	H	I	J	K
5	Day	Time	Conditions	Pizza	Soda
6					



(c) Find and interpret the value that would be returned by the *Excel* formula =DCOUNT($A$1:$E$21,,$G$9:$K$10).

	G	H	I	J	K
9	**Day**	**Time**	**Conditions**	**Pizza**	**Soda**
10		Night		>=400	>=400

(d) Find and interpret the value that would be returned by the *Excel* formula =DAVERAGE($A$1:$E$21,"Soda",$G$13:$K$14).

	G	H	I	J	K
13	**Day**	**Time**	**Conditions**	**Pizza**	**Soda**
14		Day			

18. Let A be the event that a motorist is stopped by the police and let F be the event that the motorist was speeding. What does the conditional probability $P(F \mid A)$ represent?

(A) The probability that a randomly chosen motorist was speeding.
(B) The probability that a randomly chosen motorist who was speeding is stopped by the police.
(C) The probability that a randomly chosen motorist who is stopped by the police was speeding.
(D) The probability that a randomly chosen motorist is stopped by the police and was speeding.
(E) None of the above

19. According to the chamber of commerce in a particular city, 30 percent of the businesses are "S-type" corporations, and 20 percent of the businesses are in the technical sector. If we assume that these characteristics are independent, what percent of the businesses are neither S-corporations nor in the technical sector?

(A) 0
(B) 0.06
(C) 0.50
(D) 0.56
(E) None of the above

20. A multinational company has five divisions: A, B, C, D, and E. The following table gives the percent of employees from each division who speak at least two languages fluently.

Division	Number of employees	Percent of employees that are bilingual
A	20,000	20
B	15,000	15
C	25,000	12
D	30,000	10
E	10,000	12
Total	100,000	

(a) What percent of the employees are bilingual?
(b) What percent of the bilingual employees work for Division C?

21. A software package has two configurations — Option A, used by 65% of users, and Option B, used by the remaining 35%. Monthly call logs indicate that 2% of Option A users and 4% of Option B users report problems.

(a) Represent the events and probabilities for this problem in a tree diagram.
(b) Given that a user reports a problem with the software, what is the probability that he or she uses Option A?
(c) Given that a user reports a problem with the software, what is the probability that he or she uses Option B?
(d) Which of the two options should the software company fix first? Explain.

22. Company insurance records show that a new driver who has completed a driver-training program has a 90% chance of completing his or her first year of driving without an accident, but a new driver who has not completed a driver-training program has only a 70% chance. Suppose that 60% of all new drivers have completed a driver-training program.

(a) Compute the probability that a new driver is involved in an accident during his or her first year of driving.
(b) Compute the probability that a new driver who is involved in an accident during his or her first year of driving completed a driver-training program.

23. Your company purchases vinyl from two vendors — Vendor A and Vendor B. Sixty two percent of all vinyl received is of exceptional quality, but only fifty percent of the vinyl received from Vendor B is of this quality. However, the manufacturing capacity of Vendor A is limited, and for this reason, only forty percent of the vinyl purchased comes from Vendor A. The rest comes from Vendor B.

(a) What percent of the vinyl received from Vendor A is of exceptional quality?
(b) What percent of the vinyl received that is of exceptional quality comes from Vendor A?

24. If two events E and F form a partition of a sample space, S, which of the following statements ***must*** be true?

    (i) E and F are mutually exclusive.
    (ii) E and F are independent.
    (iii) The union of E and F is S.

    (A) (i) only
    (B) (ii) only
    (C) (iii) only
    (D) (i) and (iii) only
    (E) (ii) and (iii) only

25. Suppose that $P(E)$, $P(F)$, $P(A|E)$, and $P(A|F)$ are known. Which of the following statements ***must*** be true in order to use Bayes' Theorem to calculate $P(E|A)$ from this information?

    (i) $P(E)+P(F)=1$.
    (ii) $P(E\cap F)=0$.
    (iii) $P(E\cap F)=P(E)\cdot P(F)$.

    (A) (i) only
    (B) (ii) only
    (C) (iii) only
    (D) (i) and (ii) only
    (E) (ii) and (iii) only

26. An excerpt of ***Loan Records.xlsx*** is given below.

Bank Information		**Borrower**			**Result**
Customer Number	**Former Bank**	**Years In Business**	**Education Level**	**State Of Economy**	**Loan Paid Back?**
1	Cajun		High School		No
2	Cajun		Graduate Degree		Yes
3	Cajun		Bachelor’s Degree		No
4	DuPont			Boom	Yes
5	Cajun		High School		No
6	Cajun		High School		Yes
7	DuPont			Normal	Yes
8	DuPont			Boom	No
9	DuPont			Normal	No
10	BR	5			No
11	Cajun		Bachelor’s Degree		Yes
12	DuPont			Normal	No
13	BR	18			Yes
14	BR	3			No
15	BR	9			Yes
16	BR	20			Yes
17	DuPont			Recession	No
18	BR	5			Yes
19	Cajun		High School		Yes
20	Cajun		High School		No

Suppose that a borrower is selected at random from current borrowers who are behind in their payments and attempt a loan work out. Let S be the event that the work out is successful, F be the event that the work out fails, Y be the event that the borrow has five years of experience, T be the event that the borrower has a High School diploma as his or her highest education level, and C be the event that the current state of the economy is normal.

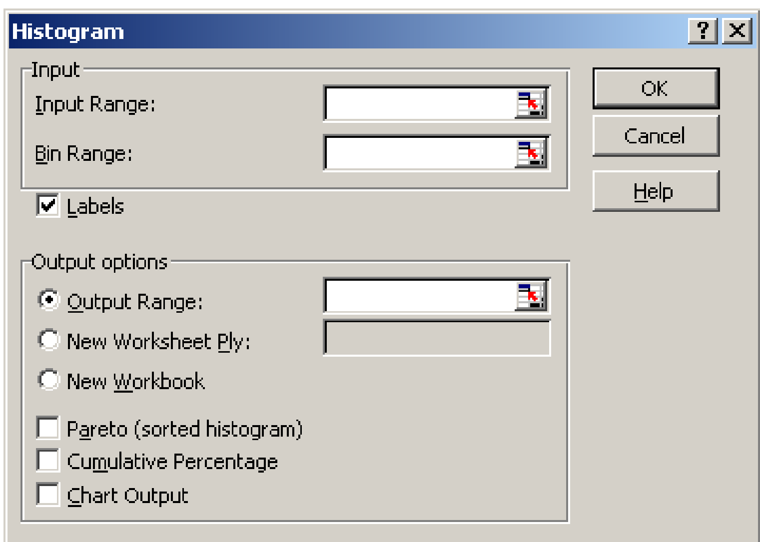
Use the data to estimate the following probabilities.

(a) $P(S)$
(b) $P(S \mid T)$
(c) $P(T \mid S)$
(d) $P(Y \cap T \cap C \mid S)$

27. Part of an *Excel* worksheet that contains information about students who are currently enrolled in *Business Mathematics I* is given below.

	A	B	C	D	E	F	G	H
1	**Student**	**Age**	**Class**	**Gender**		Bins		
2	1	19	Freshman	Male		18		
3	2	19	Freshman	Female		20		
4	3	17	Freshman	Female		22		
5	4	23	Sophomore	Male		24		
6	5	18	Freshman	Female				
7	6	18	Freshman	Male				
8	7	24	Junior	Male				
9	8	22	Sophomore	Male				
10	9	17	Junior	Female				
11	10	19	Sophomore	Female				

(a) Fill in the information that would be needed to have *Excel* sort the ages into the bins given in column F. (The output table should be displayed in columns G and H with labels in row 1.)



(b) Compute the frequencies that would be given in the output table.

	G	H
1	*Bins*	*Frequency*
2	18	
3	20	
4	22	
5	24	
6	More	

28. Suppose that you win a lottery drawing on January 1, 2008. After taxes your total winnings will be $100,000. Calculate the future value on January 1, 2011, for the following three scenarios.

    (a) You receive $25,000 on January 1, 2008; $25,000 on January 1, 2009; $25,000 on January 1, 2010; and $25,000 on January 1, 2011; and put each payment into an account that earns 5.5% interest, compounded continuously.
    (b) You receive $100,000 on January 1, 2008. You put the entire amount into an account that earns 5.5% interest, compounded monthly.
    (c) You receive $100,000 on January 1, 2008. You put the entire amount into an account that earns 5.5% interest, compounded continuously.

29. Suppose that $2,000 is needed at the end of four years and that money can be deposited into an account that pays interest at a rate of 5%.

    (a) How much money must be deposited now if interest is compounded quarterly?
    (b) What is the effective annual yield on the account if interest is compounded quarterly?
    (c) How much money must be deposited now if interest is compounded continuously?
    (d) What is the effective annual yield on the account if interest is compounded continuously?

30. An investment of $750,000 made in 2002 was worth $850,000 five years later. What annual rate was earned on the investment if interest was compounded

    (a) Semi-annually?
    (b) Continuously?

31. How long will it take for an investment of P dollars to triple if the interest rate is 7%, compounded

    (a) Daily?
    (b) Continuously?

32. Arrange the following from largest to smallest.

    (*i*) The effective annual yield on an investment of $200,000 for a period of 4 years at an annual rate of 7%, compounded monthly.
    (*ii*) The effective annual yield on an investment of $300,000 for a period of 2 years at an annual rate of 7%, compounded continuously.
    (*iii*) The effective annual yield on an investment of $700,000 for a period of 6 years at an annual rate of 7%, compounded quarterly.

    (A) (*i*), (*ii*), (*iii*)
    (B) (*i*), (*iii*), (*ii*)
    (C) (*ii*), (*i*), (*iii*)
    (D) (*iii*), (*i*), (*ii*)
    (E) (*iii*), (*ii*), (*i*)

33. Find the annual rate that produces an annual yield of 8.5%, when compounded

    (a) Semi-annually.
    (b) Continuously.

34. The City Council of Erehwon is planning their new sewer system. The current population is 125,000, and past data indicates that the population is growing exponentially at a continuous rate of 2.3% per year. If the new sewer system needs to last for 75 years, what population does the sewer system need to be able to handle?

35. Determine if the following random variables are finite or continuous:

    (a) *X* records the length of time in seconds and fractions of seconds between consecutive vehicles that pass by a particular intersection.
    (b) *X* records the number of hours in a 3 month period in which an individual works at her part time job.
    (c) *R* records the sum of the money from a box of coins.

36. True or False? For a continuous random variable, *X*, with *c.d.f.*, F_X, $P(a \le X \le b) = F_X(a) - F_X(b)$.

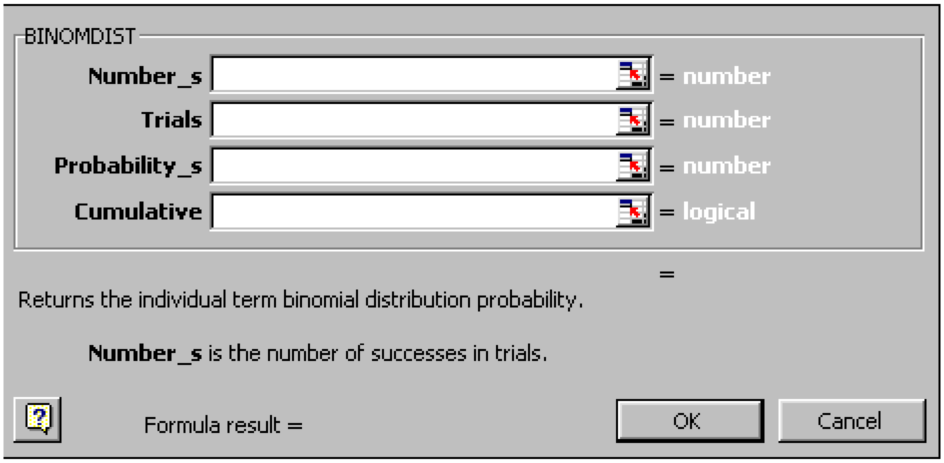
37. The *p.m.f.* of *X*, the number of bicycle crashes on a bike path per day, is given below.

x	0	1	2	3	4	5
$f_X(x)$	0.1225	0.2574	0.2800	0.1895	?	0.0596

    (a) Find $P(X = 4)$.
    (b) Find $P(X < 2)$.
    (c) Find the formula for the *c.d.f.* of of *X*.
    (d) Find and interpret μ_X.

38. Records obtained from a repair shop show that 10% of the articles taken in for repair were returned for a second repair within a week. Let R be the number of articles, in a sample of size five, that are returned for a second repair within a week.

    (a) Fill in the information that would be needed to have *Excel* compute $P(R=0)$.



    What value would be returned by this function?

    (b) Find and interpret the value that would be returned by the *Excel* formula =BINOMDIST(4,5,0.1,FALSE).

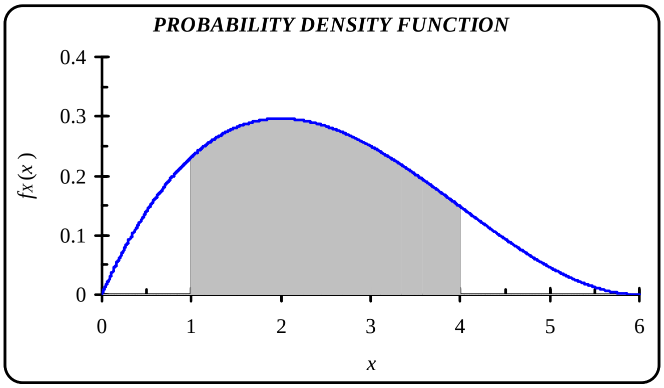
    (c) Find and interpret μ_R.

39. A supplier of kerosene has a 150 gallon tank that is filled at the beginning of each week. His weekly demand increases steadily up to 100 gallons and then levels off between 100 and 150 gallons. If Y denotes weekly demand in hundreds of gallons, the *p.d.f.* is given below.

$$f_Y(y) = \begin{cases} y & \text{if } 0 \le y \le 1 \\ 1 & \text{if } 1 < y \le 1.5 \\ 0 & \text{elsewhere} \end{cases}$$

    (a) Verify that $f_Y(y)$ is a *p.d.f.*
    (b) Compute the probability that the weekly demand is greater than one hundred gallons.
    (c) Compute the probability that the weekly demand is less than one hundred gallons.
    (d) Compute the probability that the weekly demand is exactly one hundred gallons.

40. A graph of the *p.d.f.* of a continuous random variable, *X*, is given below.



Which of the following expressions gives the area of the shaded region of the graph?

(*i*) $P(1 \le X < 4)$

(*ii*) $F_X(4) - F_X(1)$

(*iii*) $P(X = 4) - P(X = 1)$

(A) (*i*) only
(B) (*ii*) only
(C) (*iii*) only
(D) (*i*) and (*ii*) only
(E) (*ii*) and (*iii*) only

41. An airport uses a moving sidewalk that is 600 feet long to assist passengers throughout the terminal. Unfortunately there are no handrails or side supports, so passengers can fall off the sidewalk. When a passenger falls off, he or she is equally likely to do so at any point along the sidewalk. Let *X* be the distance, in feet, from the start of the sidewalk to the point at which a passenger falls off.

(a) Find the formulas for the *p.d.f.* and *c.d.f.* of *X*, and draw well-labeled graphs of both.
(b) Suppose that a passenger's gate is 200 feet from the start of the sidewalk. Use the *c.d.f.* to find the probability that the passenger will fall off before he or she reaches the gate, and illustrate your answer on the graph of the *c.d.f.*
(c) In the hopes of increasing sales, the owner of a coffee cart wants to move her cart to the point at which, on average, a passenger will fall off the sidewalk. Where should the owner position the cart?
(d) Suppose that the coffee cart is positioned according to Part (c). Use the *p.d.f.* to find the probability that a passenger will fall off between the coffee cart and the restroom that is 500 feet from the start of the sidewalk, and illustrate your answer on the graph of the *p.d.f.*

42. Suppose that a random variable, T, has a uniform distribution on the interval $[0, 0.25]$. Which of the following is/are true?

$$(i)\ \sum_{\text{all } t} f_T(t) = 1$$
$$(ii)\ 0 \le f_T(t) \le 1 \text{ for all } t$$
$$(iii)\ 0 \le F_T(t) \le 1 \text{ for all } t$$

(A) (*i*) only
(B) (*ii*) only
(C) (*iii*) only
(D) (*i*), (*ii*), and (*iii*)
(E) None of the above

43. Let L be the random variable that gives the lifetime (in months) of a light bulb. It can be shown that L has an exponential distribution with a mean of 40 months.

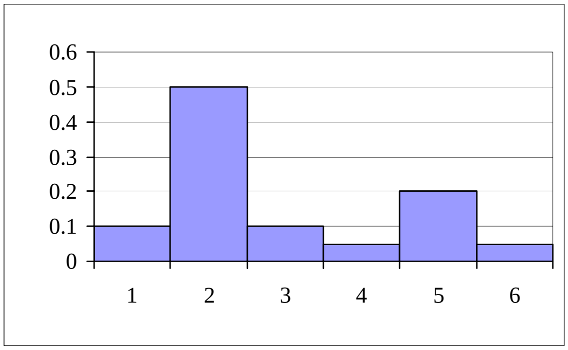
(a) Find the probability that the lifetime of a randomly selected light bulb will be at least 36 months.
(b) Find the probability that the lifetime of a randomly selected bulb will be exactly 36 months.
(c) Find and interpret $f_L(24)$.
(d) Find and interpret $F_L(24)$.
(e) Find the value l_0 such that $P(L \le l_0) = 0.75$.

44. Let X be an exponential random variable with *p.d.f.* given by $f_X(x) = 4 \cdot e^{-4 \cdot x}$, for $x \ge 0$. What is $E(X)$?

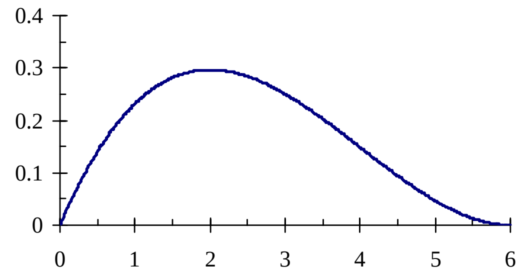
(A) 0.25
(B) 0.5
(C) 2
(D) 4
(E) None of the above

45. Determine if each of the following is a *p.m.f.*, a *p.d.f.*, a *c.d.f.* of a finite random variable, a *c.d.f.* of a continuous random variable, or none of the above.

(a)



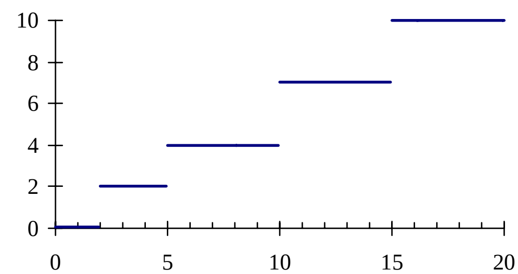
(b)



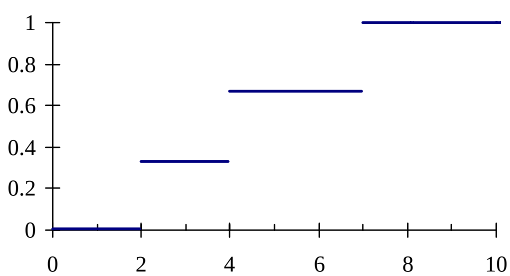
(c)

x	0	1	2	3	4
$f_X(x)$	0.1	0.1	0.3	0.4	0.1

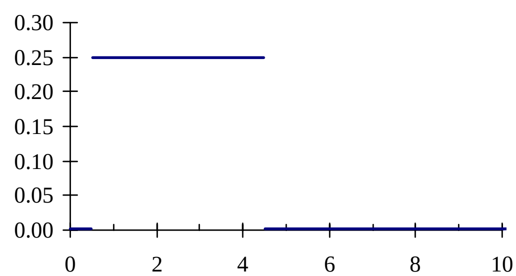
(d)



(e)



(f)



46. A survey of 2000 randomly chosen households finds that 900 use only one brand of toothpaste regularly, 700 use two brands, 200 use three brands, 100 use four brands, and 100 don't use any particular brand of toothpaste regularly. We will use this information to approximate the random variable, *T*, which represents the number of brands of toothpaste used regularly in a household.

(a) Would we use a *p.m.f.* or a *p.d.f.* to represent *T*? Why?
(b) Use this information to estimate the value of $F_T(2)$.
(c) Use this information to estimate $P(T \geq 2)$.
(d) Use this information to estimate $E(T)$.

47. The results of an analysis of the waiting time (in minutes) at the checkout line of a particular grocery store are summarized below.

Bin	*Relative Frequency*
3	0.10
6	0.25
9	0.25
12	0.15
15	0.15
More	0.10

(a) Use the information to estimate the probability that a randomly selected customer will have to wait in line for more than 3 minutes but no more than 15 minutes.
(b) Use the information to estimate the probability that a randomly selected customer will have to wait in line for more than 12 minutes.

48. Which of the following statements are true?

(*i*) Parameters are used to estimate statistics.
(*ii*) Statistics are used to estimate parameters.
(*iii*) Parameters are calculated from sample data.
(*iv*) Statistics are calculated from sample data.

(A) (*i*) and (*iii*) only
(B) (*i*) and (*iv*) only
(C) (*ii*) and (*iii*) only
(D) (*ii*) and (*iv*) only
(E) None of the above

49. Which of the following *Excel* formulas could be used to simulate one toss of a coin that is loaded in such a way that you are three times as likely to get a tail as you are to get a head?

(*i*) =IF(RANDBETWEEN(1,20)<=5,“H”,“T”)
(*ii*) =IF(RAND()<=0.25,“H”,“T”)
(*iii*) =IF(RANDBETWEEN(1,20)<=15,“T”,“H”)

(A) (*i*) only
(B) (*ii*) only
(C) (*i*) and (*ii*) only
(D) (*ii*) and (*iii*) only
(E) (*i*), (*ii*), and (*iii*)

50. Excerpts of the sheets ***Data*** and ***1 ATM*** in ***Queue Focus.xlsm*** are given below.

	F	G	H	I
43		Week 1 Service Times		
44		Number	Time	
45		1	1.09	
46		2	0.64	
47		3	3.23	
48		4	1.80	
49		5	1.28	
50		6	3.21	
51		7	3.27	
52		8	1.71	
53		9	0.62	
54		10	1.26	

	A	B	C	D	E	F	G	H	I	J
34		Index	Random Number		Customer Number	Time of Arrival After Start of Hour	Length of Service	Start of Service After Start of Hour	End of Service After Start of Hour	Number in Queue
35		1	0.0454		1		1.20			0
36		2	0.6419		2	0.56			1.85	1
37		3	0.4348		3	0.86	1.09		2.94	2
38		4	0.9616		4	2.56	0.94		3.88	
39		5	0.3861		5	2.81	1.22		5.10	2
40		6	0.4556		6	3.13	0.64		5.74	2
41		7	0.9931		7	5.71	2.29		8.03	1
42		8	0.3283		8	5.92	0.88		8.91	1
43		9	0.0147		9	5.93	2.33		11.24	2
44		10	0.1345		10	6.00	0.96		12.20	3

(a) Assume that the time (in minutes) until the first arrival or between consecutive arrivals has an exponential distribution with parameter $\alpha = 0.645$, and use the value in cell C35 of ***1 ATM*** to compute the missing value in cell F35.

(b) Use the value that would be returned by the *Excel* formula =VLOOKUP(9,Data!$G$45:Data!$H$54,2) to compute the missing value in cell G36 of ***1 ATM***.

(c) Compute the missing value in cell J38 of ***1 ATM***.

(d) An excerpt of the results of one simulation of customer arrival times and service times for two ATMs is given below.

Summary of 2,000 Hours				
Number That Arrive	**Sum of Numbers in Queue**	**Maximum Number in Queue**	**Sum of Total Numbers Present**	**Maximum Total Number Present**
230,622	1,452,235	31	2,752,433	61

The bank manager plans to advertise the claim that the mean number in the queue will not exceed five. Based only on the given information, does it appear that this claim can be substantiated with two ATMs? Explain.

(e) An excerpt of the results of one simulation of customer arrival times and service times for three ATMs with a serpentine queue is given below.

Information From 2,000 Hours			
Mean Waiting Time	**Percent Delayed**	**Mean Number in Queue**	**Mean of Total Numbers Present**
0.60	0.4%	1.7	3.4

The bank manager plans to offer a $25 gift certificate to any customer who is delayed. When the purchase price of the time stamp machine, its hourly maintenance cost, and its operating cost are considered; it will cost $20 per hour to time stamp customers' numbered slips. Assume that the time (in minutes) until the first arrival or between consecutive arrivals has an exponential distribution with parameter $\alpha = 0.645$, and use the results of the simulation to compute the expected hourly cost of the gift certificate program.