

1. It is known that 20% of the adults in the U.S. can name both Senators from their state of residence. What is the probability that at least 140 of 625 adults chosen at random in the U.S. can name both of their Senators? (*Use the normal approximation to the binomial.*)
- (a) 0.0668 (b) 0.1357 (c) 0.1857 (d) 0.0735 (e) 0.0606

2. If A is a 5×4 matrix, and B is a 4×5 matrix, then the size of BA is (*note the order*):
- (a) 5×5 (b) 3×2 (c) 4×4
(d) 4×3 (e) none of these

3. A loan of \$ 8,000.00 at 12% APR compounded monthly is to be amortized over 7 years. What is the amount of each monthly payment?

(a) $\$ 8,000 \times 1.01^{84}$

(b) $\$ \frac{80.00 \times 1.01^{84}}{1.01^{84} - 1}$

(c) $\$ 80.00 \times 1.01^7$

(d) $\$ \frac{8,000 \times 1.01^7}{1.01^7 - 1}$

(e) $\$ 80.00 \times 1.12^{84}$

4. Let Z be the standard normal random variable. Find a value z_0 so that

$$P(-z_0 \leq Z \leq z_0) = 0.383$$

(a) $z_0 = 0.05$

(b) $z_0 = -1.6$

(c) $z_0 = 1.6$

(d) $z_0 = 0$

(e) $z_0 = 0.5$

5. The 3×4 matrix \mathbf{A} displayed below shows the amounts of Spanish olive oil (in thousand liters) sold in the three cities of Atlanta, Boston and Chicago respectively during each quarter of 1997.

	Jan - Mar	Apr - Jun	Jul - Sept	Oct - Dec
Atlanta	3	2	2.5	4
Boston	4	4.5	3	5
Chicago	5	2	3.5	4

During all of 1997 the price of Spanish olive oil in Atlanta held steady at p_A dollars, in Boston at p_B dollars and in Chicago at p_C dollars. The entry in the first row, fourth column of the matrix product $(p_A \ p_B \ p_C) \mathbf{A}$ represents:

- Total amount (in thousand liters) of Spanish olive oil sold during the first quarter of 1997.
- Total amount (in thousand liters) of Spanish olive oil sold during the fourth quarter of 1997.
- Total revenues (in dollars) from the sale of Spanish olive oil during the first quarter of 1997.
- Total revenues (in dollars) from the sale of Spanish olive oil during the fourth quarter of 1997.
- none of the above.

6. Let A be the matrix $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$. Then A^{23} equals the matrix (*Hint: compute the first four powers of A*)

- $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$
- $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$
- $\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$
- $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$
- none of the above

7. The transition matrix A for a four-state Markov process is shown below.

$$A = \begin{pmatrix} & \mathbf{I} & \mathbf{II} & \mathbf{III} & \mathbf{IV} \\ 0.3 & 0.1 & 0.2 & 0.3 \\ 0.2 & 0.3 & 0.2 & 0.2 \\ 0.4 & 0.2 & 0.5 & 0.3 \\ 0.1 & 0.4 & 0.1 & 0.2 \end{pmatrix}$$

What is the probability of going from state **III** to state **IV** in one step?

- (a) 0.5 (b) 0.4 (c) 0.3 (d) 0.2 (e) 0.1
8. The amount of regular gasoline sold weekly by Luie UnLadro service station is normally distributed with $\mu = 10,000$ gallons and $\sigma = 800$ gallons. Mr. UnLadro starts each week with 12,000 gallons of gasoline in his tanks. What is the probability that Mr. UnLadro will run out of gasoline before the end of any given week?

- (a) 0 (b) 1.0062 (c) 0.0062 (d) 0.0876 (e) 0.1056

9. Each time a soccer player shoots a penalty kick, her probability of scoring a goal is 0.7 . Let X be the number of goals she scores out of 5 penalty kicks. What is the standard deviation of X ?

(a) $\sqrt{1.5}$ (b) 1.05 (c) $\sqrt{1.05}$ (d) 3.5 (e) $\sqrt{3.5}$

10. One in 10 of the batteries manufactured by Frate Co. is defective. Estimate the probability that at least 27 batteries will be defective in a lot of 400 batteries chosen an random from the total production of Frate Co.

(a) 0.8944 (b) 0.0122 (c) 0.9994 (d) 0.9938 (e) 0.9878

11. Which of the following statements is true about the solution of the following system of equations?

$$\begin{cases} 2x - y = 2 \\ x + 3y = 8 \end{cases}$$

- (a) the value of x is -2 (b) the value of x is -1 (c) the value of y is -2
(d) the values of y is 2 (e) none of the above

12. Let $X = \begin{pmatrix} 1 & 5 & -1 \\ 2 & -1 & 1 \end{pmatrix}$ and $Y = \begin{pmatrix} 2 & 5 & 0 & -1 \\ 1 & 1 & -1 & 1 \\ 0 & 1 & -2 & 1 \end{pmatrix}$

Find the entry in the 2nd row and 3rd column of XY .

- (a) -2 (b) -1 (c) 0 (d) 1 (e) 2

13. Which of the following statements is true about the solution of the system shown below?

$$\begin{cases} x + z = 0 \\ x + y + z = 3 \\ y + z = 2 \end{cases}$$

- (a) $z = -1$ (b) $z = 0$ (c) $z = 1$ (d) $z = -2$ (e) $z = 2$

14. Which of the following matrices is a regular stochastic matrix?

$$A = \begin{pmatrix} 1 & 0.6 \\ 0 & 0.4 \end{pmatrix}$$

$$B = \begin{pmatrix} 0.2 & 0.6 \\ 0.8 & 0.4 \end{pmatrix}$$

$$C = \begin{pmatrix} 0 & 0.6 \\ 1 & 0.4 \end{pmatrix}$$

$$D = \begin{pmatrix} 0.6 & 0.7 \\ 0.3 & 0.3 \end{pmatrix}$$

- (a) exactly A and B (b) exactly A, B and C (c) exactly B and C
(d) exactly B, C and D (e) A, B, C and D

THE NEXT TWO QUESTIONS (15 & 16) REFER TO THE FOLLOWING :

Italy is economically divided into three regions (*unfortunately true!*): the **North**, (*rich and industrial*), the **Center** (*agricultural, artisan*), and the **South** (*touristic, somewhat agricultural, generally poorer.*) Each year 20% of the people living in the **Center** move to the other two regions, in equal numbers, The same movement happens to people in the **South** (*20% move to the Center and North, in equal numbers*), while only 10% of the people living in the **North** move, and they only move to the **Center** (*prejudice, you know.*)

15. On January 1, 1998 the Italian population of 60 million people was equally distributed among the three regions. Assuming zero growth in the Italian population during 1998, how many Italians will be living in the **North**, **Center** and **South** on January 1, 1999?

	North (in millions)	Center (in millions)	South (in millions)
(a)	20	20	20
(b)	22	20	18
(c)	20	22	18
(d)	22	18	20
(e)	None of the above.		

16. It is forecast that by the year 2200 the population of Italy will have doubled its present value. How many Italians will be living in the **North**, **Center** and **South** on January 1, 2201?

	North (in millions)	Center (in millions)	South (in millions)
(a)	60	40	20
(b)	45	30	15
(c)	40	40	40
(d)	60	30	30
(e)	None of the above.		

17. For certain types of fluorescent lights the amount of hours a bulb will burn before requiring replacement is a random variable (*not necessarily normal*) with mean $\mu = 3,000$ hours and $\sigma = 250$ hours. Suppose that 5,000 such bulbs are installed in the JACC. Estimate the number that will require replacement between 2,000 and 4000 hours from the time of installation. (*Use Tchebyshev's*)

(a) $\geq \frac{15}{16}$ (b) $\geq 4,844$ (c) ≥ 313 (d) ≤ 313 (e) $\geq 4,688$

18. If

$$x = a \qquad y = b \qquad z = c$$

is the solution of the linear system shown below:

$$\begin{cases} x + z = 3 \\ y + z = 1 \\ 3x - 2y = 3 \end{cases}$$

then $a + b + c$ equals

(a) -1 (b) 0 (c) 1 (d) -2 (e) 2

19. On January 1, 1999 you will deposit \$ 5,000.00 in a savings account which pays 6% APR compounded monthly. You deposit no additional money into the account. How much money will be in the account on January 1, 2001?

- (a) $\$ 5,000.00 \times 1.005^{12}$ (b) $\$ 5,000.00^{24}$ (c) \$ 5,600.00
(d) $\$ 5,000.00 \times 1.005^{24}$ (e) \$ 10,000.00

20. Some illegal operators lend money using the "6 for 5" rule, which means that at the end of each week you owe six dollars for every five you have not yet paid. This gives a periodic weekly interest rate of 20%. What is the corresponding APR? (*There are 52 weeks in one year.*)

- (a) 1040 percent (b) 2080 percent (c) 808 percent
(d) 20 percent (e) 606 percent