Decide whether the given matrix could be a probability vector.

1) \[
\begin{bmatrix}
.03 & .15 & .46 & .36 \\
\end{bmatrix}
\]

2) \[
\begin{bmatrix}
\frac{7}{13} & \frac{6}{13} \\
\end{bmatrix}
\]

Solve the problem.

3) At a liberal arts college, students are classified as humanities or science majors. There is a probability of 0.5 that a humanities major will change to science and of 0.4 that a science major will change to humanities. What are the long-term predictions for each major? Round numbers to the nearest thousandth.

Decide whether the given matrix could be a transition matrix.

4) \[
\begin{bmatrix}
\frac{7}{8} & 1 \\
8 & 8 \\
\frac{1}{9} & \frac{8}{9} \\
\end{bmatrix}
\]

5) \[
\begin{bmatrix}
.8 & .1 & .1 \\
.2 & .4 & .5 \\
.4 & .2 & .4 \\
\end{bmatrix}
\]

Sketch a transition diagram for the given transition matrix.

6) \[
\begin{bmatrix}
.4 & .6 \\
1 & 0 \\
\end{bmatrix}
\]

7) \[
\begin{bmatrix}
.7 & .3 & 0 \\
.17 & .54 & .29 \\
0 & 0 & 1 \\
\end{bmatrix}
\]

If the given diagram can be a transition diagram, then write it as a transition matrix. If it cannot be a transition diagram, then state this.

8) 

![Transition Diagram]

A = .1  B = .2  
C = .4  D = .5
9)

\[ A = \frac{1}{3} \quad B = \frac{1}{5} \quad C = \frac{1}{4} \]
\[ D = \frac{1}{3} \quad E = \frac{1}{4} \quad F = \frac{1}{4} \]
\[ G = 1 \]

For the given transition matrix, find the probability that state 2 changes to state 1 after three repetitions of the experiment.

\[ A = \begin{bmatrix} .4 & .1 & .5 \\ 0 & 0 & 1 \\ .6 & .1 & .3 \end{bmatrix} \]

Construct the transition matrix that represents the data.

10) If it snows today, there is a 30 percent chance of snow tomorrow; however if it does not snow today, there is a 90 percent chance that it will not snow tomorrow.

11) Of those who voted as liberals in the last election: 50% will vote as liberals in the next election; 15% will vote as conservatives; and 35% will vote as independents. Of those who voted as conservatives: 70% will do the same in the next election; 9% will vote as liberals; and 21% will vote as independents. Of those who voted as independents: 88% will do the same in the next election; 10% will vote as liberals; and 2% will vote as conservatives.

A small town has only two dry cleaners, Fast and Speedy. Fast hopes to increase its market share by conducting an extensive advertising campaign. The initial market share for Fast was 40% and 60% for Speedy. Solve the problem.

12) Find the probability that a customer using Fast initially will use Fast for his second batch of clothes. Use the following transition matrix.

\[
\begin{bmatrix}
.89 & .11 \\
.56 & .44 \\
\end{bmatrix}
\]

13) Find the probability that a customer using Fast initially will use Fast for his second batch of clothes. Use the following transition matrix.

\[
\begin{bmatrix}
.89 & .11 \\
.56 & .44 \\
\end{bmatrix}
\]

14) Find the probability that a customer using Fast initially will use Fast for his fourth batch of clothes. Use the following transition matrix. Round your answer to the nearest hundredth.

\[
\begin{bmatrix}
.53 & .47 \\
.82 & .18 \\
\end{bmatrix}
\]
Find the equilibrium vector for the transition matrix.

15) \[
\begin{bmatrix}
\frac{2}{3} & 1 & \frac{1}{3} \\
\frac{1}{4} & 3 & \frac{3}{4}
\end{bmatrix}
\]
Round the numbers in your answer to the nearest thousandth.

16) \[
\begin{bmatrix}
.85 & .15 \\
.44 & .56
\end{bmatrix}
\]
Round the numbers in your answer to the nearest thousandth.

17) \[
\begin{bmatrix}
.1 & .1 & .8 \\
.3 & .3 & .4 \\
.4 & .4 & .2
\end{bmatrix}
\]
Round the numbers in your answer to the nearest hundredth.

Solve the problem.

18) Weather is classified as sunny or cloudy in a certain place. What are the long-term predictions for sunny and cloudy days? Round numbers to the nearest thousandths.

\[
\text{Sunny} \quad \text{Cloudy} \\
\text{Sunny} \begin{bmatrix} .4 & .6 \end{bmatrix} \quad \text{Cloudy} \begin{bmatrix} .3 & .7 \end{bmatrix}
\]

For the transition matrix, find the probability that state 2 changes to state 4 after 5 repetitions of the experiment.

19) \[
\begin{bmatrix}
.2 & .1 & .1 & .4 & .2 \\
.1 & .3 & .1 & .1 & .4 \\
.1 & .2 & .3 & .2 & .2 \\
.2 & .2 & .1 & .4 & .1 \\
.1 & .1 & .3 & .2 & .3
\end{bmatrix}
\]
A) .14519 \quad B) .00032 \quad C) .26132 \quad D) None of these

Decide on the payoff in this game when the specified strategy is used.

20) (1, 3)

21) (2, 2)
Remove a dominated strategy if one exists in the game.

22) \[
\begin{bmatrix}
6 & 11 & -4 \\
-1 & 2 & 8
\end{bmatrix}
\]

23) \[
\begin{bmatrix}
3 & 4 & 0 & -6 \\
-2 & 6 & 4 & 0 \\
2 & -5 & 3 & -4
\end{bmatrix}
\]

If a saddle point exists, identify it along with the value of the game.

24) \[
\begin{bmatrix}
8 & 1 \\
2 & 5 \\
6 & 2
\end{bmatrix}
\]

25) \[
\begin{bmatrix}
0 & 3 & -4 & 0 & -2 \\
1 & 4 & -1 & 3 & 9 \\
0 & -4 & -3 & 4 & 1
\end{bmatrix}
\]

Find the saddle point and value of the game.

26) Two merchants in the same city plan on selling a new product. Each merchant has 3 strategies to enhance sales. The strategies chosen by each will determine the percentage of sales of the product each gets.

\[
\begin{array}{c}
A \\
B
\end{array}
\begin{bmatrix}
-15 & -41 & -2 \\
55 & 15 & 57 \\
-2 & 8 & 65
\end{bmatrix}
\]

27) Two boxers enter a fight, each with three different strategies. The strategy each chooses will determine who lands more punches.

\[
\begin{array}{c}
A \\
B
\end{array}
\begin{bmatrix}
-4 & 4 & 7 \\
-1 & 7 & 2 \\
-6 & 7 & 3
\end{bmatrix}
\]

Suppose a game has this payoff matrix. Find the expected value of the game for the specified strategies of R and C.

C

\[
\begin{bmatrix}
0 & -3 & 2 \\
4 & 3 & -3 \\
2 & -2 & 0
\end{bmatrix}
\]

28) R = [.4 .3 .3]; C = [.5]

29) R = [.4 .3 .3]; C = [.4]
Find the optimum strategies for player A and player B in the game.

30) $$\begin{bmatrix} -3 & 0 \\ 5 & -6 \end{bmatrix}$$

31) $$\begin{bmatrix} -3 & 4 \\ 2 & -3 \end{bmatrix}$$

Remove any dominated strategies and find the optimum strategy for each player.

32) $$\begin{bmatrix} 3 & 7 & -4 \\ 1 & -2 & 0 \\ 6 & 8 & -1 \end{bmatrix}$$

33) $$\begin{bmatrix} 4 & 2 & -1 \\ -5 & -6 & 0 \end{bmatrix}$$

Solve the problem.

34) The payoffs in the matrix below represent the differences in profits between Dealers A and B for two prices on small trucks, with positive payoffs in Dealer A’s favor. Determine Dealer A’s price strategy and the results.

\[
\begin{bmatrix}
4.9 & 4.75 \\
4.9 & 4.75 & -6 \\
4 & 0 \\
\end{bmatrix}
\]

35) Joe and Amy play a game in which they throw either one or two slips of paper on the table at the same time. If there is a match, Joe wins the amount of dollars equal to the total number of slips of paper on the table. If there is no match, Amy wins the amount of dollars equal to the number of slips of paper on the table. Find optimum strategies for Joe and Amy and the value of the game.
Answer Key

1) Yes
2) Yes
3) \[
\begin{bmatrix}
.444 & .556 \\
\end{bmatrix}
\]
4) Yes
5) No
6)

![Diagram 1]

A = .6 B = .4
C = 1

7)

![Diagram 2]

A = .3 B = .54 C = .29
D = .7 E = .17 F = 1

8) \[
\begin{bmatrix}
.1 & .9 & 0 \\
.4 & .2 & .4 \\
0 & .5 & .5 \\
\end{bmatrix}
\]
9) Not a transition diagram
10) .42
11) \[
\begin{bmatrix}
.3 & .7 \\
.1 & .9 \\
\end{bmatrix}
\]
12) \[
\begin{bmatrix}
.5 & .15 & .35 \\
.09 & .7 & .21 \\
.1 & .02 & .88 \\
\end{bmatrix}
\]
13) .89
14) .62
15) \[
\begin{bmatrix}
.875 & .125 \\
.746 & .254 \\
.29 & .29 & .42 \\
.333 & .667 \\
\end{bmatrix}
\]
16) \[
\begin{bmatrix}
.875 & .125 \\
.746 & .254 \\
.29 & .29 & .42 \\
.333 & .667 \\
\end{bmatrix}
\]
17) C
18) No payoff
20) $1 from A to B
21) \[
\begin{bmatrix}
6 & -4 \\
-1 & 8 \\
3 & 4 & -6 \\
-2 & 6 & 0 \\
2 & -5 & -4 \\
\end{bmatrix}
\]
22) Does not exist
25) (2, 3), value -1
26) (2, 2), value 15
Answer Key
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27) (2, 1), value -1
28) .69
29) .58
30) A: 1: 11/14, 2: 3/14
    B: 1: 3/7, 2: 4/7
31) A: 1: 5/12, 2: 7/12
    B: 1: 7/12, 2: 5/12
    B: 1: 1/11, 2: 10/11
33) A: 1: 2/3, 2: 1/3
    B: 1: 1/9, 2: 8/9
34) 4.75 strategy; 5/7
35) Joe: 1: 7/12, 2: 5/12; Amy: 1: 7/12, 2: 5/12; value -1/12