

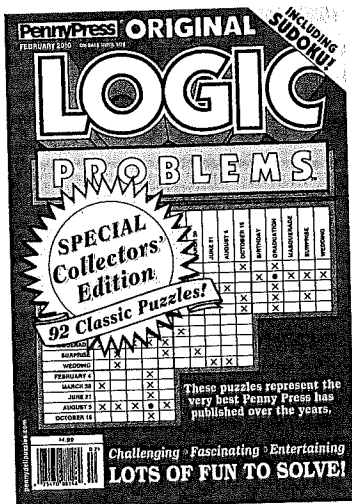
In Exercises 25–30, the premises marked A, B, and C are followed by several possible conclusions. Take each conclusion in turn, and check whether the resulting argument is valid or invalid.

- A. All people who drive contribute to air pollution.
 - B. All people who contribute to air pollution make life a little worse.
 - C. Some people who live in a suburb make life a little worse.
25. Some people who live in a suburb contribute to air pollution. invalid

26. Some people who live in a suburb drive. invalid
27. Suburban residents never drive. invalid
28. Some people who contribute to air pollution live in a suburb. invalid
29. Some people who make life a little worse live in a suburb. valid
30. All people who drive make life a little worse. valid

EXTENSION Logic Problems and Sudoku

How to Solve Logic Problems • How to Solve Sudoku



Logic problems, which are based on deductive reasoning, appear in periodicals such as *Original Logic Problems*, *World-Class Logic Problems*, and *England's Best Logic Problems* (all Penny Press), and *Logic Puzzles* (Dell). The following explanation on solving such problems appeared in the February 2010 issue of *Original Logic Problems*.

How to Solve Logic Problems Solving logic problems is entertaining and challenging. All the information you need to solve a logic problem is given in the introduction and clues, and in illustrations, when provided. If you've never solved a logic problem before, our sample should help you get started. Fill in the Sample Solving Chart as you follow our explanation. We use a "•" to signify "Yes" and an "X" to signify "No."

Sample Logic Problem

Five couples were married last week, each on a different weekday. From the information provided, determine the woman (one is Cathy) and man (one is Paul) who make up each couple, as well as the day on which each couple was married.

1. Anne was married on Monday, but not to Wally.
2. Stan's wedding was on Wednesday. Rob was married on Friday, but not to Ida.
3. Vern (who married Fran) was married the day after Eve.

Sample Solving Chart:

	PAUL	ROB	STAN	VERN	WALLY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
ANNE										
CATHY										
EVE										
FRAN										
IDA										
MONDAY										
TUESDAY										
WEDNESDAY										
THURSDAY										
FRIDAY										

1

	PAUL	ROB	STAN	VERN	WALLY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
ANNE	X	X				•	X	X	X	X
CATHY						X				
EVE						X				
FRAN						X				
IDA		X				X				X
MONDAY		X	X							
TUESDAY		X	X							
WEDNESDAY	X	X	•	X	X					
THURSDAY	X	X								
FRIDAY	X	•	X	X	X					

Explanation

Anne was married Mon. (1), so put a “•” at the intersection of Anne and Mon. Put “X”s in all the other days in Anne’s row and all the other names in the Mon. column. (Whenever you establish a relationship, as we did here, be sure to place “X”s at the intersections of all relationships that become impossible as a result.) Anne wasn’t married to Wally (1), so put an “X” at the intersection of Anne and Wally. Stan’s wedding was Wed. (2), so put a “•” at the intersection of Stan and Wed. (Don’t forget the “X”s.) Stan didn’t marry Anne, who was married Mon., so put an “X” at the intersection of Anne and Stan. Rob was married Fri., but not to Ida (2), so put a “•” at the intersection of Rob and Fri., and “X”s at the intersections of Rob and Ida and Ida and Fri. Rob also didn’t marry Anne, who was married Mon., so put an “X” at the intersection of Anne and Rob. Now your chart should look like **chart 1**.

Vern married Fran (3), so put a “•” at the intersection of Vern and Fran. This leaves Anne’s only possible husband as Paul, so put a “•” at the intersection of Anne and Paul and Paul and Mon. Vern and Fran’s wedding was the day after Eve’s (3), which wasn’t Mon. [Anne], so Vern’s wasn’t Tue. It must have been Thu. [see chart], so Eve’s was Wed. (3). Put “•”s at the intersections of Vern and Thu., Fran and Thu., and Eve and Wed. Now your chart should look like **chart 2**.

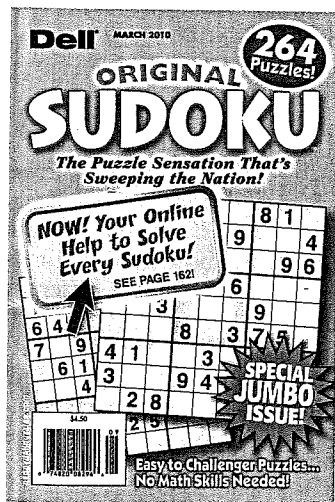
2	PAUL	ROB	STAN	VERN	WALLY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
ANNE	•	X	X	X	X	•	X	X	X	X
CATHY	X					X	X	X	X	X
EVE	X			X		X	X	•	X	X
FRAN	X	X	X	•	X	X	X	X	•	X
IDA	X	X	X	X		X	X	X	X	X
MONDAY	•	X	X	X	X					
TUESDAY	X	X	X	X						
WEDNESDAY	X	X		•	X					
THURSDAY	X	X	X	•	X					
FRIDAY	X	•	X	X	X					

3	PAUL	ROB	STAN	VERN	WALLY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
ANNE	•	X	X	X	X	•	X	X	X	X
CATHY	X	•	X	X	X	X	X	X	X	•
EVE	X	X	•	X	X	X	•	X	X	X
FRAN	X	X	X	•	X	X	X	X	•	X
IDA	X	X	X	X	•	X	•	X	X	X
MONDAY	•	X	X	X	X					
TUESDAY	X	X	X	X	•					
WEDNESDAY	X	X	•	X	X					
THURSDAY	X	X	X	•	X					
FRIDAY	X	•	X	X	X					

The chart shows that Cathy was married Fri., Ida was married Tue., and Wally was married Tue. Ida married Wally, and Cathy’s wedding was Fri., so she married Rob. After this information is filled in, Eve could only have married Stan. You’ve completed the puzzle, and your chart should now look like **chart 3**.

In summary: Anne and Paul, Mon.; Cathy and Rob, Fri.; Eve and Stan, Wed.; Fran and Vern, Thu.; Ida and Wally, Tue.

In some problems, it may be necessary to make a logical guess based on facts you’ve established. When you do, always look for clues or other facts that disprove it. If you find that your guess is incorrect, eliminate it as a possibility.



How to Solve Sudoku Sudoku is a simple game that has gained great popularity in the United States during the past few years. It is believed that the game originated as Number Place in the United States over 25 years ago, but gained in popularity only after it became a sensation in Japan, where it was renamed Sudoku, meaning “single number.” (Source: *Sudoku* #13, 2005, Platinum Magazine Group.)

There is only one rule in Sudoku: “Fill in the grid so that every row, every column, and every 3 × 3 box contains the digits 1 through 9.” This involves scanning the given digits, marking up the grid, and analyzing. Here is a sample Sudoku.

		7	3	2				
8	4		1				9	
						8	2	1
		9		8	7			5
2	8		4		1		6	3
1			5	6		9		
5	3	8						9
	9				2		1	4
				7	5	6		

Given Form

9	1	7	3	2	8	4	5	6
8	4	2	1	5	6	3	9	7
6	5	3	7	4	9	8	2	1
3	6	9	2	8	7	1	4	5
2	8	5	4	9	1	7	6	3
1	7	4	5	6	3	9	8	2
5	3	8	6	1	4	2	7	9
7	9	6	8	3	2	5	1	4
4	2	1	9	7	5	6	3	8

Solved Form

You can find Sudoku puzzles and solving strategies online at www.sudoku.org.uk and at www.pennydellsudokusolver.com.

EXTENSION EXERCISES

Follow the guidelines to solve each logic problem, which appeared in the February 2010 issue of *Original Logic Problems*, published by PennyPress.

1. Breath Taking As part of a weekly tradition, Drew and four of his friends met for lunch at Aristotle's Grill. Each person enjoyed a different lunch special, but when it came time for the post-meal conversation, the five quickly realized that they were all in need of a mint or two. Luckily, each person had a container of mints on his or her person. No two friends had the same brand of mint (one is *Inti-mints*), and no two friends had mints with the same flavor. A few seconds later they were all ready to talk, but they agreed that next week, they'll be a little more careful about what they order for lunch! From the information provided, can you determine the meal enjoyed by each friend, as well as the brand and flavor of mint each person used afterward? □

		MEAL				BRAND			FLAVOR							
		BUFFALO CHICKEN	FRENCH ONION SOUP	GARLIC SHRIMP	SPANAKOPITA	TUNA-SALAD SANDWICH	DELTOIDS	FRESH AIR	INTI-MINTS	LIPLICKERS	TKO	CINNAMON	ORANGE	SPEARMINT	VANILLA	WINTERGREEN
FRIEND	DREW															
	ILSE															
	NASH															
	UMA															
	XERXES															
FLAVOR	CINNAMON															
	ORANGE															
	SPEARMINT															
	VANILLA															
WINTERGREEN																
BRAND	DELTOIDS															
	FRESH AIR															
	INTI-MINTS															
	LIPLICKERS															
TKO																

- (a) The friend who had garlic shrimp ate a couple of orange-flavored mints (which weren't *Fresh Air* mints). The person who ordered the spanakopita isn't the one who had wintergreen-flavored *TKO* mints.
- (b) The friend who ate French onion soup followed it with a few *Liplickers* mints. Nash (who didn't have the spearmint-flavored mints) didn't order garlic shrimp.
- (c) Neither Nash nor Xerxes is the one who ate a tuna-salad sandwich. The friend who had a buffalo-chicken sandwich isn't the one who freshened his or her breath with spearmint-flavored mints.
- (d) One friend had a couple of cinnamon-flavored *Deltoids* mints. The *Liplickers* mints were vanilla-flavored.
- (e) Ilse (who ate a buffalo-chicken sandwich) didn't have wintergreen-flavored mints. Neither Uma nor Xerxes is the friend who had a couple of *Fresh Air* mints.

2. Kings of Hearts Although the exact origins of the holiday are murky, the tradition of Valentine's Day probably harkens back to the Middle Ages, when it was better known as the feast of Saint Valentine. Couples exchanged gifts on this February holiday even back then, and no one gave more expensive and elaborate valentines than the royalty of that time. One Valentine's Day, each of four kings, each whom ruled a different small kingdom, gave his queen a different valuable gift. It just goes to show that love (or at least the idea of it) stands the test of time! From the information provided, can you determine the king and queen of each kingdom, as well as the gift each king gave his wife for the feast of Saint Valentine? □

- (a) King Jacobus didn't give his queen a platinum crown.

- (b) Neither the jeweled scepter nor the platinum crown was the gift given to Queen Meyla (who was married to either King Kevrick or King Vermont).
- (c) Queen Dejah (who was married to either King Fedris or King Jacobus) wasn't the ruler of Undervale.
- (d) King Kevrick wasn't the ruler of the Dalelands.
- (e) Neither the platinum crown nor the set of velvet robes was the gift given by King Vermont.
- (f) The queen of Undervale (who was married to either King Fedris or King Jacobus) was given a golden throne by her husband.
- (g) Queen Tilnara wasn't given a jeweled scepter by her husband. Queen Aasta ruled Hightop.

		QUEEN		KINGDOM				GIFT				
KING	FEDRIS											
	JACOBUS											
	KEVRICK											
	VERMOND											
GIFT	GOLDEN THRONE											
	JEWELLED SCEPTER											
	PLATINUM CROWN											
	VELVET ROBES											
KINGDOM	DALELANDS											
	HIGHTOP											
	SHADOW COAST											
	UNDERVALE											

3. New Year's Revelations Lucy and four of her friends met at the Golden Panda for dinner one evening in January. Much to their surprise, they had wandered in to the restaurant during a celebration of the Chinese New Year. Luckily for the five, this meant a discount on their meals and a free session with the mysterious medium Madame Wau Pei. The five friends had their fortunes told, one at a time. Each person told the mystic the date and year of his or her birth and learned that, according to Chinese astrology, each friend's birth year is designated by a different animal. Also, each of the five was told that he or she has a different lucky element. Before leaving the restaurant, the five friends compared their predictions, noticing that all of them had a long journey in their future—the trip back home! From the information provided, determine the order in which the five friends had their fortunes told, the year in which each person was born, and each person's lucky element. □

- (a) Toni was the third person to get her fortune told. The person whose lucky element is wood was the last person to see the fortune-teller.
- (b) Earl (whose lucky element is fire) had his fortune told immediately before the person who was born in the Year of the Rooster. The fourth person to visit the fortune-teller was born in the Year of the Dragon.

- (c) The person born in the Year of the Ox had his or her fortune told at some point before the one whose lucky element is metal. Ivana was born in the Year of the Horse.
- (d) The person whose lucky element is water (who was born in the Year of the Cow) wasn't the first person to have his or her fortune told.
- (e) The person whose lucky element is earth had his or her fortune told exactly two after Philip.

		FRIEND					YEAR			ELEMENT					
ORDER	FIRST	EARL	IVANA	LUCY	PHILIP	TONI	DRAGON	HORSE	OX	ROOSTER	EARTH	FIRE	METAL	WATER	WOOD
	SECOND														
	THIRD														
	FOURTH														
	FIFTH														
ELEMENT	EARTH														
	FIRE														
	METAL														
	WATER														
YEAR	WOOD														
	COW														
	DRAGON														
	HORSE														

4. Barn Again For as long as I can remember, I've dreamed of owning my own bed-and-breakfast, and it looks like my dream is about to come true! We'd like our inn to be distinctive, so my husband and I have decided to purchase a barn and convert it into unique living quarters. We viewed five barns recently, each of which had once served a different purpose. My husband and I visited each barn with a different contractor, each of whom gave us a different estimate (\$50,000, \$60,000, \$70,000, \$80,000, or \$100,000) for the conversion. Each barn has a different feature that makes it appealing (one has a functioning hoist), but we still haven't decided which one to buy—we're starting to go a little haywire! From the information provided, determine the contractor who visited each barn with us and the special feature of each structure, as well as the estimate given for the renovation of each barn. □

- (a) The apple barn (which has distinctive octagonal windows) will cost exactly \$20,000 less to convert than the barn we visited with a Bill's Building representative. The estimate for renovating the hay barn is higher than the estimate for converting the potato barn.
- (b) The barn we visited with the person from AB Contracting (which isn't the barn that has fabulous heavy beams) will cost more to renovate than the barn we viewed with the contractor from Pine Valley but exactly \$10,000 less to convert than the horse barn.
- (c) The estimates for converting the apple barn and the barn with lovely board-and-batten siding are the lowest and highest estimates, in some order.

- (d) The barn we visited with the contractor from Dekker Ltd. will cost exactly \$20,000 more to renovate than the barn with insulation worth preserving.
- (e) The old dairy barn will cost more to renovate than the one we visited with the representative from Vander Estates.

	BARN					FEATURE				ESTIMATE					
	APPLE	DAIRY	HAY	HORSE	POTATO	BEAMS	HOIST	INSULATION	SIDING	WINDOWS	\$50,000	\$60,000	\$70,000	\$80,000	\$100,000
CONTRACTOR	AB CONTRACTING														
	BILL'S BUILDING														
	DEKKER LTD.														
	PINE VALLEY														
	VANDER ESTATES														
ESTIMATE	\$50,000														
	\$60,000														
	\$70,000														
	\$80,000														
	\$100,000														
FEATURE	BEAMS														
	HOIST														
	INSULATION														
	SIDING														
	WINDOWS														

Solve each Sudoku, which appeared in Dell Original Sudoku, March 2010, Penny Publications. (They are categorized according to difficulty level.)

5. Easy □

	4		1	6	8			5
		9		5				2 8
	6		9					4
		4	7		9			
	3 8		4		2 9			
			2	3	8			
2					1			6
9 7				2		5		
4			6 9 5					7

6. Easy □

2		3			8	1	4	
	7		6	2	4			
	8			3				7
8	4	7	2					6
			8		6			
	1				9	4	8	2
7				6			2	
			9	5	7		1	
	6	9	3			5		4

7. Medium □

8	3		6					1
	1			4				5 6
		6			8			
		7	1					3 8
		1		2		4		
5	4				6	1		
			5			7		
9	8			7				1
6					1		2	3

8. Medium □

			4	5		6		
4	5					3		9
	6	1			3			8
5	8				1			6
		9		3		2		
	4		9				1	7
8			1			7	3	
1		5					9	2
		6		7	2			

9. Hard □

	1			2				4
4		9			1			7
		8				9		
	3		6					2
7				3				9
	9				8			5
		2				4		
	8		2			6		5
9				8				3

10. Hard □

	2			9		6	7	
	5	6						
			6		4			5
	6	9						1
			3	6	9			
8						9	4	
1			4		7			
						4	2	
	4	8		2				3