CONNECTED MATHEMATICS PROJECT

CARNIVAL GAMES

Have fun, eat, and win prizes at the CMP Carnival!

Prizes include items such as: calculators, t-shirts, books, etc.

A complete copy of the Carnival Game packet is available on the Getting to Know CMP Workshop page at: http://connectedmath.msu.edu/

By providing this our carnival game packet,
we encourage you to offer similar activities in your communities.

Also, note that the website contains a section that provides additional information to help parents support their CMP student.
Visit it at: http://www.connectedmath.msu.edu/families

Carnival Fun

1. At the beginning of the carnival, you will receive $30 of CMP play money.

2. Play the CMP Carnival games.

    - You have one hour to win as much money as possible!
    - Rules for each game are displayed or can be explained at each game area.
    - When you are done playing, turn in your money (at the exchange table), and you will receive one raffle ticket for each **$10** of CMP money you turn in.
    - Carnival Packets containing rules for each of the games you played tonight are available. You may download the Carnival Packet on the Getting to Know CMP Workshop page of the CMP website:

      https://connectedmath.msu.edu/_connectedMath/assets/File/Conferences/carnival_instructions.pdf

3. Submit your tickets to win prizes! The prizes will be displayed with a bag in front of them. Tear apart each double ticket, placing one (or more) in the bag for the prize(s) of your choice, making sure to keep the other half for yourself.

4. After all tickets have been placed into the bags, our "Emcee" will draw a ticket from the bag and read off the number. The winner must present the matching ticket to claim the prize. You must be present to win!

Note: Any children who are present will play with only white CMP money, which is exclusively used for kids. Those running the games will have this special money to give to kids as they play. Kids will turn in their money when done playing at the kids' prize table, and each child will receive a fun prize!

During the prize drawings, we will start with our less expensive prizes and end with the most expensive prize. Since you are free to place your raffle tickets in whichever bag(s) you want, there is a chance for someone to win more than one prize, and for people who did not win a lot of money to win a major prize. For identical prizes, we will have multiple draws from the same bag, as marked on the prize table.

You must be present to win!

- **You may ONLY use carnival tickets received at the money exchange table!**
- **Any other raffle tickets will be discarded.**

Anyone who turns in money before 1 hour of play must have $10 to get 1 raffle ticket.
At the end of the carnival, money is rounded-up to the nearest $10 for the ticket exchange (for example $45 is rounded up to $50 for 5 tickets).

Have fun and enjoy the evening!

CMPlinko

Underlying mathematics—binary probabilities

Materials needed:

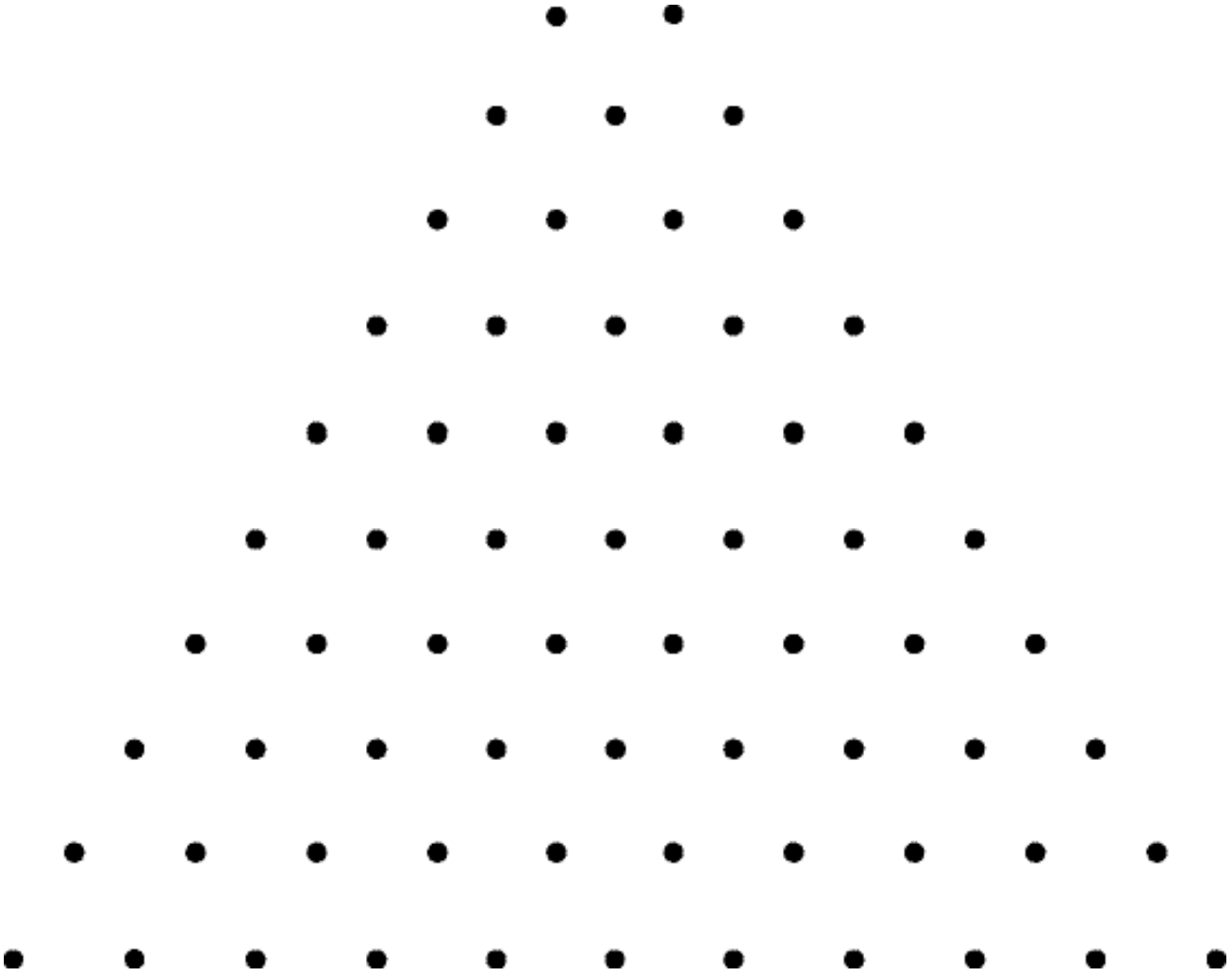
- A Plinko board made by arranging nails in the arrangement shown on the dot paper below
- A coin

Rules:

1. Place your of $1 to $5 bet.

2. Put the coin at the top of the CMPlinko board and watch the coin travel through the grid.

3. You win the amount of your bet times the amount in the section where the coin lands.



Factor Game

CMP3: *Prime Time*, Problem 1.1, pp. 8-10 and
CMP2: *Prime Time*, Problem 1.1, pp. 7-8

Underlying mathematics—factors and products

Materials needed:

- Factor Game boards (Labsheet 1.1A) and larger board sizes
- Colored markers (if game boards are consumable) or 2 colors of game chips (if game boards are not consumable, i.e., laminated)

Rules—2 players:

1. Place your $1 bet.

2. Player A chooses a number on the game board and shades or covers it.

3. Player B uses a different color and shades or covers all of the proper factors of Player A's number. Recall that the proper factors of a number are all of the factors of a number, except the number itself. For example, the proper factors of 12 are 1, 2, 3, 4, and 6. Although 12 is a factor of itself, it is not a proper factor.

4. Player B now chooses a new number and Player A shades or covers all of the factors of that number that are not already marked.

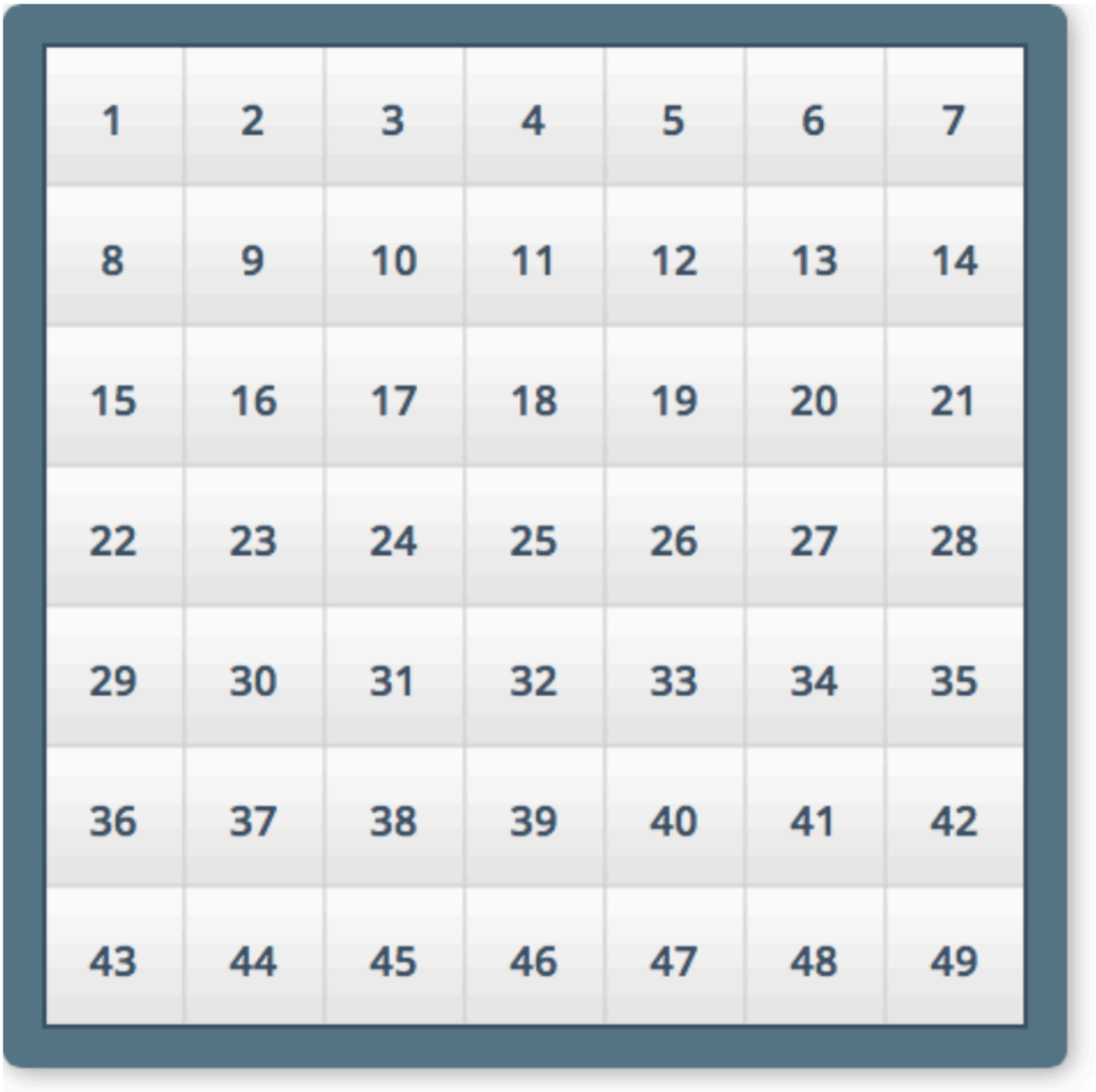
5. The players take turns choosing numbers and marking factors.

6. If a player marks a number that has no factors left that have not been marked, that player loses a turn and does not get the points for the number he or she originally marked.

7. The game ends when there are no numbers remaining with unmarked factors.

8. Each player adds the numbers that are colored or covered with his or her color. The player with the greatest total is the winner and collects all of the money.

Optional 49-Game Board for the Factor Game



1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49

Optional 100-Game Board for the Factor Game

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Factor Game II

CMP3: *Function Junction*, Problem 5.4, pp. 94-95

Underlying mathematics—factors and products of polynomials

Materials needed:

- Factor Game boards (Labsheet 5.4A)
- Colored markers (if game boards are consumable) or 2 colors of game chips (if game boards are not consumable, i.e., laminated)

Rules—2 players:

1. Place your $1 bet.

2. Player A chooses an expression on the game board and circles it.

3. Using the same color, Player A circles all the proper factors of Player A's expression.

4. Using a different color, Player B circles a new expression. Player B circles all of the factors that are not already circled.

5. The players take turns choosing expressions and circling factors.

6. If a player chooses an expression with no uncircled factors, that player loses their current turn and scores no points.

7. The game ends when there are no expressions left with uncircled factors.

8. Each player counts the number of expressions that he or she circled. The player with the greatest total is the winner and collects all of the money.

Factor Game II

$x^3 + 5x^2 - 4x - 20$	$x - \sqrt{7}$	$x + 1$	$x^3 + 4x$	$x^3 + 3x - 10$
$4x^2 + 20x + 25$	$x + 2$	$x^4 - 16$	$x + 5$	$x^2 - 4$
$2x^2 + 9x + 10$	$x - 5$	$x - 2$	$x + \sqrt{7}$	$x - 2i$
$x^3 + 3x^2 + 3x + 1$	$2x + 5$	$x + 2i$	x	$x^2 - 10x + 25$
$x^4 - 14x^2 + 49$	$x^2 + 4$	$x^2 - 7$	$x^2 + 2x + 1$	$x^2 - 25$

Four in a Row

CMP3: *Shapes and Designs*, Problem 1.2, pp. 13-14 and
CMP2: *Shapes and Designs*, Problem 2.2, p. 31

Underlying mathematics—coordinate mapping on circular grids, angle measures

Materials needed:

- Four in a Row game boards (Labsheet 1.2), enough for one per pair of players
- Colored markers (if game boards are consumable) or 2 colors of game chips (if game boards are not consumable, i.e., laminated)

Rules—2 players:

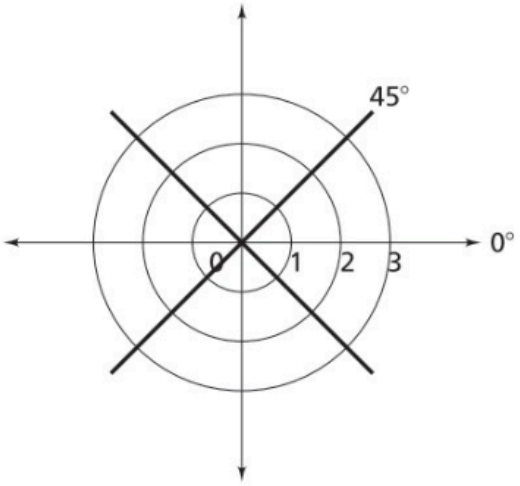
1. Place your $1 bet.

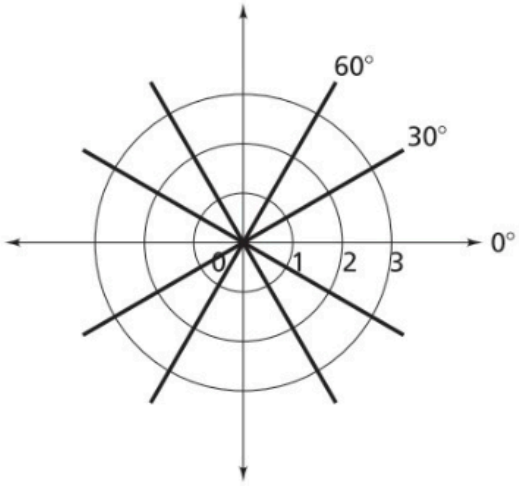
2. Player A names the coordinate of a point on the grid out loud and marks that coordinate.

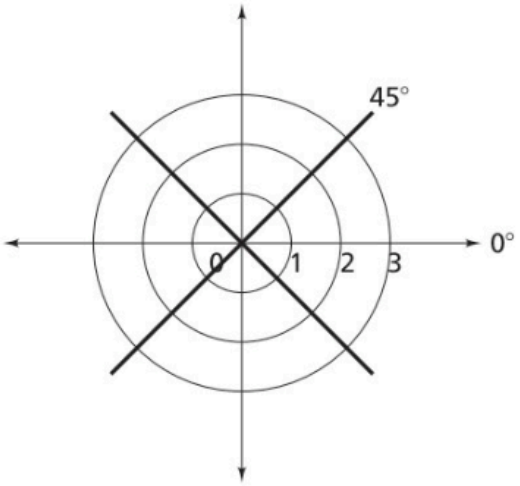
3. Player B names another coordinate and marks that coordinate with a different color.

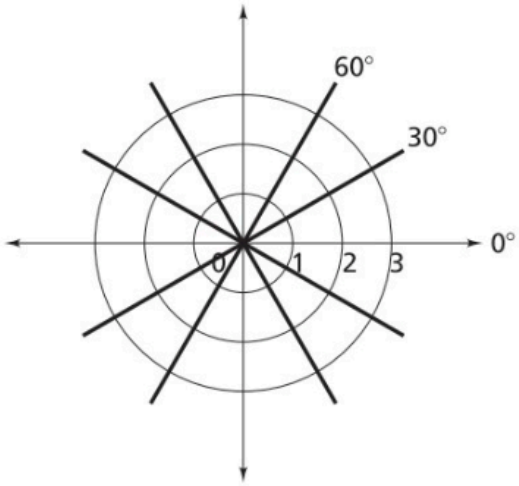
4. The first player to get 4 marks in a row along a line or around a circle wins all of the money.

Labsheet 1.2 Four in a Row









Gee Whiz Everyone Wins!

Adapted from:
CMP3: *What Do You Expect?,* Problem 2.1, pp.28-29 and
CMP2: *How Likely Is It?*, Problem 2.1 (Predicting to Win)

Underlying mathematics—predicting based on experimental data

Materials needed:

- Bucket or box
- Three colors of blocks or marbles, approximately 10-15 of each color

Preparation:

Before participants arrive, a number of blocks of each color are placed in the bucket. Any number can work, although you should keep it relatively simple at first. For example, you may want to put 2 red, 3 yellow, and 4 blue blocks in the bucket to begin with. Participants should be told that there is at least one block of each color and what the colors are. As the game goes along, participants can watch and keep track of the draws that are made so that they can better make a prediction about the ratio of colors of blocks.

Game 1

Rules:

1. Place your $1 bet.
2. Predict the color of block that will be drawn from the bucket.
3. If the color matches your prediction, then you win $3.

Game 2

Rules:

1. Place your $1 bet.
2. Predict the exact ratio of the number of blocks in the bucket.
3. If you are correct, you win $10.

Making Purple

CMP3: *What Do You Expect?*, Problem 4.2, p. 75 and
CMP2: *What Do You Expect?*, Investigation 2.1 p. 22

Underlying mathematics—basic probability

Materials needed:

- Two spinners divided into equal regions and labeled with colors as shown in the problem (Labsheet 4.2)
- Bobby pins or paper clips for spinners

Rules:

1. Place your $1 bet.

2. Spin each of the spinners once.

3. If one spinner lands on Red and the other spinner lands on Blue, you make purple and win $10.

Spinner A

Spinner B

Product Game

Positive Integer Version:
CMP3: *Prime Time*, Problem 2.1, pp. 12-14 and
CMP2: *Prime Time*, Problem 2.1, pp. 11-13

Underlying mathematics—factors and products

Integer Version:
CMP3: *Accentuate the Negative*, Problem 3.4, pp. 64-65 and
CMP2: *Accentuate the Negative*, Problem 3.4, pp. 48-49

Underlying mathematics—multiplication and division of integers

Materials needed:

- Product Game boards *Prime Time* (Labsheet 1.3) and in *Accentuate the Negative* (Teaching Aid 3.4), enough for one per pair of players
- Colored markers (if game boards are consumable) or 2 colors of game chips (if game boards are not consumable, i.e., laminated)
- Paper clips, two per pair of players

Rules—2 players:

1. Place your $1 bet.

2. Player A puts a paper clip on a factor from the list below the game board. Player A does not mark a square on the grid because only one factor has been marked. It takes at least two factors to make a product.

3. Player B puts the other paper clip on any factor in the list (including the same number marked by A) and shades or covers the product of the two factors on the product grid.

4. Player A moves *either* of the paper clips to another number in the factor list and then shades or covers the new product with a different color from Player B.

5. Each player, in turn, moves a paper clip and marks or covers a product. If a product is already marked or covered, the player does not get a mark for that turn. The winner is the first player to cover four squares in a row—up, down, or diagonally and collects all of the money.

Labsheet 1.3 Product Game Boards

1	2	3	4	5	6
7	8	9	10	12	14
15	16	18	20	21	24
25	27	28	30	32	35
36	40	42	45	48	49
54	56	63	64	72	81

Factors:

1 2 3 4 5 6 7 8 9

Problem 3.4 Integer Product Game

Integer Product Game Board

−36	−30	−25	−24	−20	−18
−16	−15	−12	−10	−9	−8
−6	−5	−4	−3	−2	−1
1	2	3	4	5	6
8	9	10	12	15	16
18	20	24	25	30	36

Factors:

−6 −5 −4 −3 −2 −1 1 2 3 4 5 6

Product Game II

Polynomial Version
CMP3: *Function Junction*, Problem 5.4, optional addition to the problem

Underlying mathematics—factors and products of polynomials

Materials needed:

- Product Game board *Function Junction* (Labsheet 5.4B) enough for one per pair of players
- Colored markers (if game boards are consumable) or 2 colors of game chips (if game boards are not consumable, i.e., laminated)
- Paper clips, three per pair of players

Rules—2 players:

1. Place your $1 bet.

2. Player A puts a paper clip on an expression in the factor list. Player A does not mark a square on the product grid because only one factor has been marked.

3. Player B puts the second paper clip on any expression in the factor list (including the same factor marked by Player A). Player B does not mark a square on the product grid because only two linear factors have been marked.

4. Player A places the third paper clip on any expression in the factor list (including the factor(s) marked by the previous two paper clips). Player A then shades or covers the product on the game board for the first mark of the game. (NOTE: Not all possible products are located on the game board.) If a player's product is not on the game board, the player takes a turn.

5. Player B moves one or two (their choice) of the three paper clips then shades or covers the product of the three factors on the game board.

6. Each player, in turn, moves one or two paper clips and shades or covers a product. If a product is already marked or covered, the player does not get a mark for that turn. The winner is the first player to cover four squares in a row—up, down, or diagonally and collects all of the money.

Labsheet 5.4B Product Game II

In *Factor Game II*, you started with a polynomial expression and found its factors. In this game, you start with factors and find their product. The *Product Game II* board consists of a list of factors and a grid of products. The object is to mark four products in a row—up and down, across, or diagonally—before your opponent does.

Product Game II

$x^3 + 2x^2 + x$	$x^3 - 4x^2 - 16x + 64$	$x^3 + 4x^2 - 2x + 8$	$x^3 + x^2 + 25x + 25$	$x^3 - 3x^2 - 4x$
$x^3 + 4x^2 - 2x - 8$	$x^3 - 12x^2 + 48x - 64$	$x^3 + 3x^2 + 3x + 1$	$x^3 + 9x^2 + 24x + 16$	$x^3 + 4x^2 + 25x + 100$
$x^3 + 25x$	$x^3 - 7x^2 + 8x + 16$	Free Space	x^3	$x^3 + 5x^2 + 4x$
$x^3 + 12x + 48 + 64$	$x^3 - 2x$	$x^3 - 4x^2 + 25x + 100$	$x^3 + x^2$	$x^3 - 16x$
$x^3 + x^2 - 16x - 16$	$x^3 - 4x^2$	$x^3 + 6x^2 + 9x + 4$	$x^3 + x^2 - 2x - 2$	$x^3 + 4x^2 - 16x - 64$

Factors:

$x + 4$ $x - 4$ $x + 1$ x $x + \sqrt{2}$ $x - \sqrt{2}$ $x + 5i$ $x - 5i$

Roller Derby

Adapted from
CMP3: *What Do You Expect?*, Problem 3.3, pp. 54-55
CMP2: *How Likely Is It?*, Problem 4.3, pp. 60-61

Underlying mathematics—equally-likely and not equally-likely outcomes

Materials needed:

- Roller Derby game boards (Labsheet 3.3), enough for one per player
- Small markers (centimeter cubes, tokens, pennies, beans), enough for 12 per player
- Six-sided Dice, enough for 2 per player

Rules—As many players as wanted can play at a time:

1. Place your $1 bet.

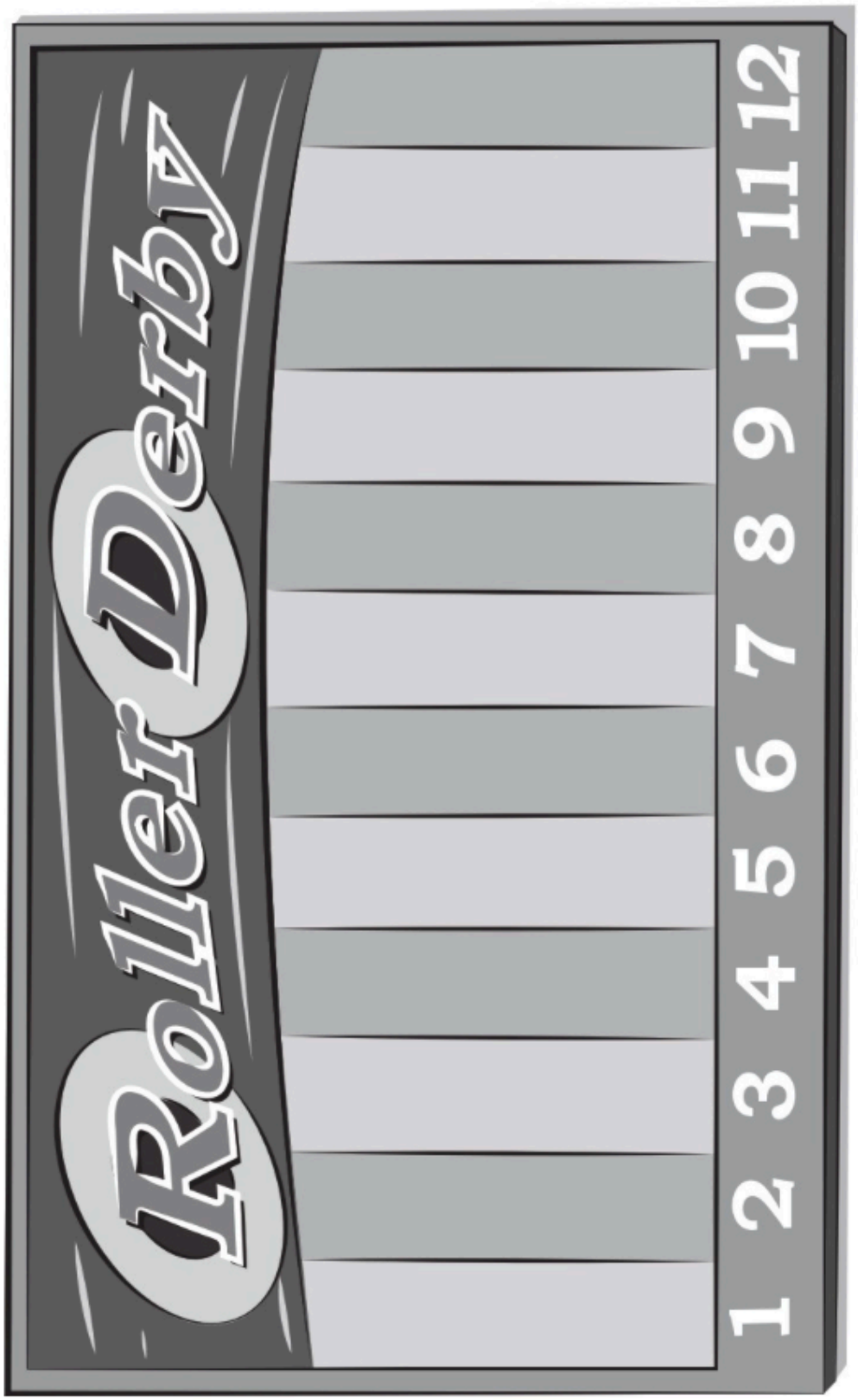
2. Place 12 markers into the columns of the game board any way you choose.

3. Roll a pair of dice. It does not matter who rolls the dice, but players should take turns.

4. Add the numbers on the dice. Remove a marker from your game board that is in the same column as the sum. If that column is blank, you do not remove any markers.

5. The first person to remove all of his or her markers wins all of the money.

Labsheet 3.3 Roller Derby



Rolling Digits

Adapted from:
CMP1: *Data Around Us*, Problem 3.1, pp. 24-25
Compatible with using alternate labsheet:
CMP2: *Bits & Pieces I*, Problem 3.5, pp. 45-46; *Bits & Pieces III*, Problem 1.1, pp. 5-7
CMP3: *Decimal Ops*, Problem 1.1, pp. 8-9; *Comparing Bits and Pieces*, Problem 3.4, pp. 74-78

Underlying mathematics—basic probability, number sense, ordering decimals

Materials needed:

- Copies of the "Dialing Digits" game cards (found in *Data Around Us* Teachers Edition 2004, pg. 96) or copies of the Rolling Digits sheet below, cut into strips
- A ten-sided die (or a spinner divided into 10 equal regions if you want to play "Dialing Digits," found in *Data Around Us* Teachers Edition 2004, pg. 95)
- Pencils or pens for participants to use

Rules—As many players as wanted can play at a time:

1. Place your $1 bet in the pot.

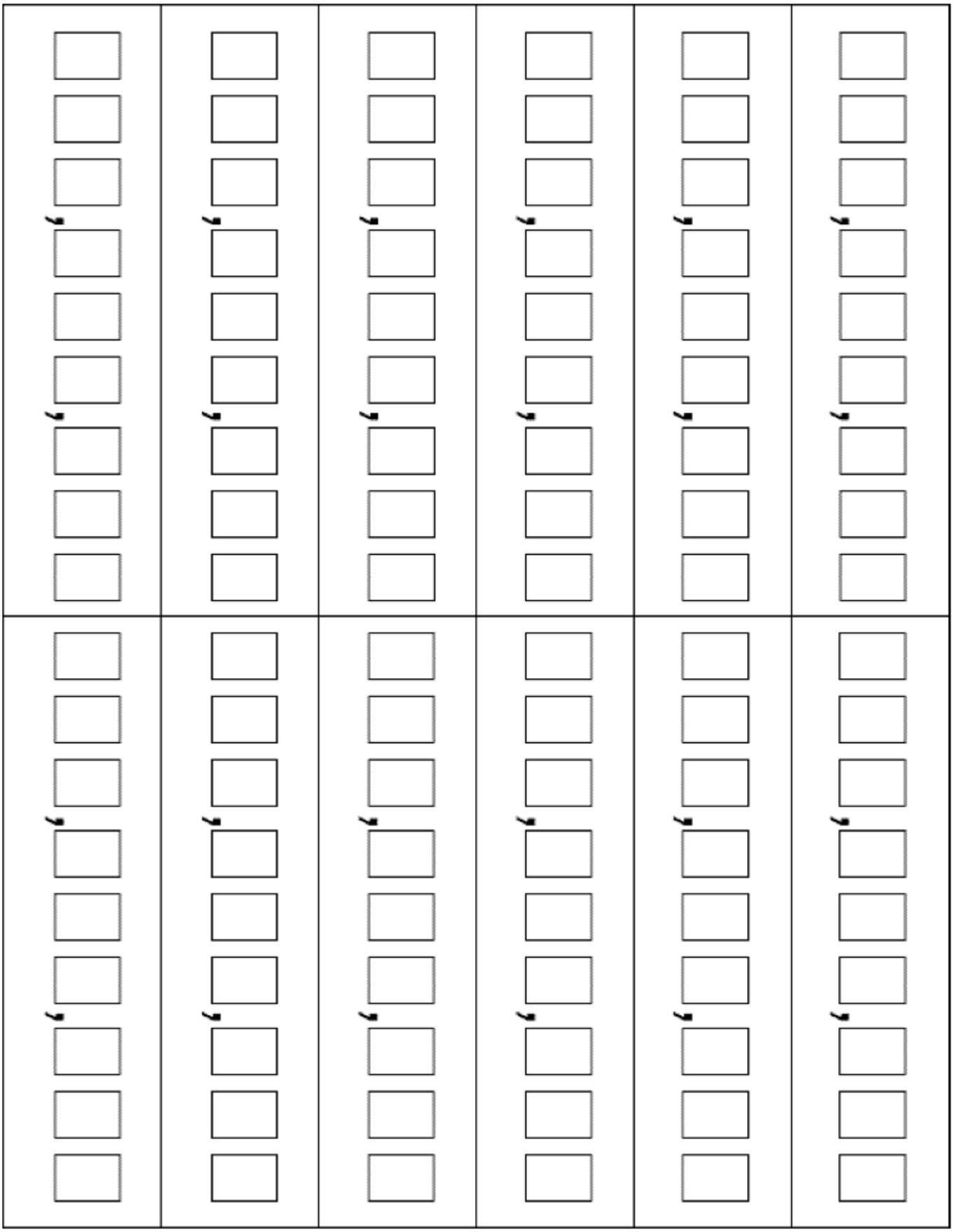
2. With each roll of the die, write down the rolled number in one of the spaces on your sheet.

3. Once a number is placed, it cannot be erased or changed.

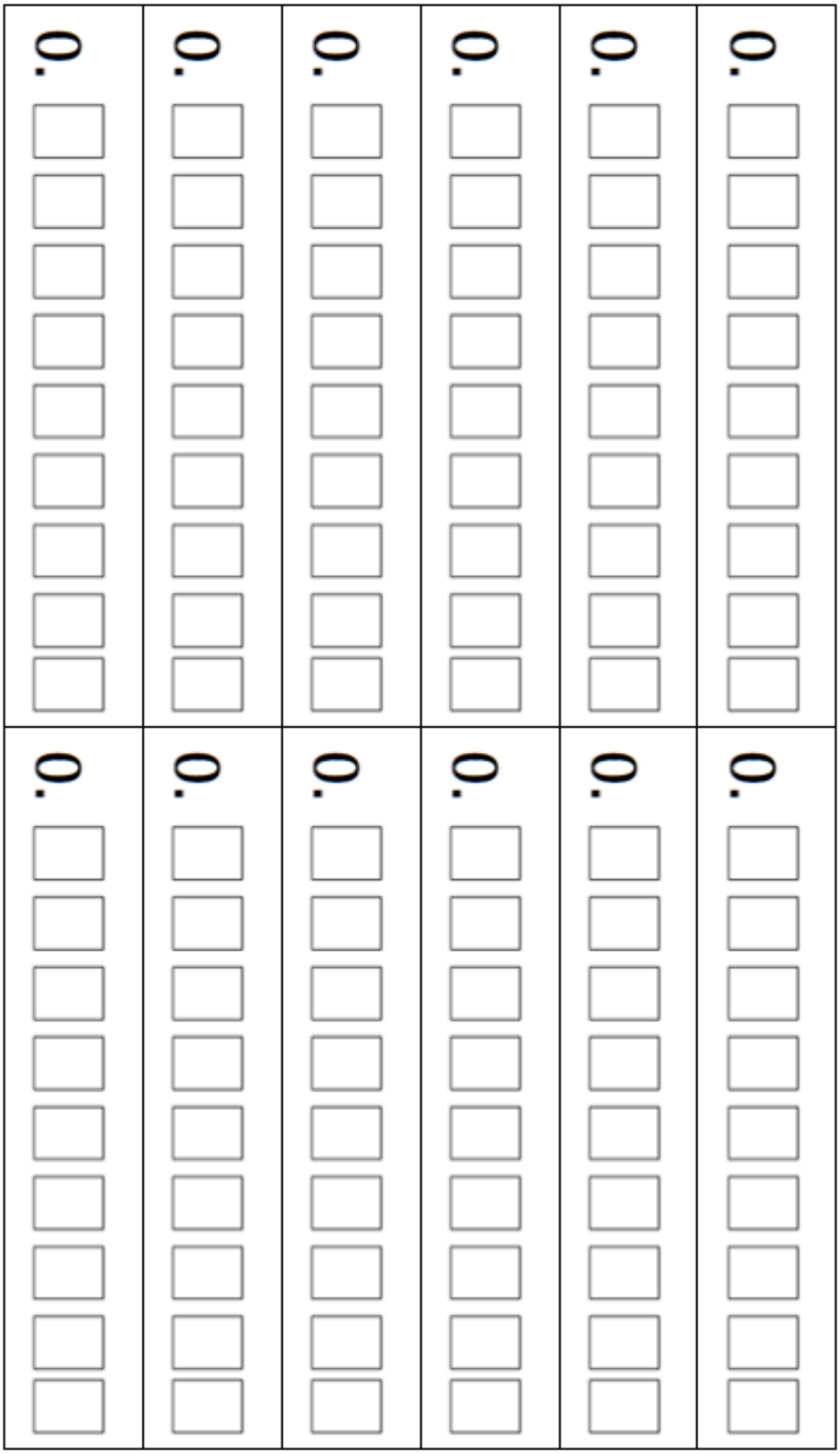
4. The winner is the person who writes the largest nine-digit number.

5. The winner gets all but $1 of the pot. In case of a tie, the award is divided evenly among the winners (the house keeps the remainder which must be at least $1).

6. BONUS: Anyone writing down the highest possible nine-digit number receives an additional $5.



Dialing Digits Alternate Labsheet to use with
CMP2: Bits and Pieces I or Bits and Pieces II OR CMP3: Comparing Bits and Pieces or Decimal Ops



Scratching Spots

Adapted from
CMP3: *What Do You Expect?,* Problem 3.4, pp. 56-57 and
CMP2: *How Likely Is It?*, Problem 3.3, pp. 43

Underlying mathematics—random predictions

Materials needed:

- Eight cards, 4 pairs of matching cards

Preparation:

Without players seeing, five cards are chosen so that there is exactly one matching pair and placed face down on the table. After each game, the same cards can be kept or switched for a new set.

Rules:

1. Place your $1 bet.

2. Select two cards.

3. If the cards match, you win $10.

Switch/No Switch

Underlying mathematics—random predictions

Materials needed:

- Three cards, one designated the winning card (i.e., an ace)

Preparation:

The game operator places the three cards face down after making a mental note which one is the winning card.

Rules:

1. Place your $1 bet.

2. Select one of the covered cards, but do *not* turn it over.

3. The game operator shows you one of the remaining cards that do not have the prize. You now decide either to keep your original card or switch to the remaining card.

4. If the card you select has a prize, you win $2.

CMP Hold'em

Adapted from
CMP3: *Let's Be Rational*, Problem 1.1 (Getting Close), pp. 7-10 and
CMP2: *Bits and Pieces II*, Problem1.1 pp 5-7

Underlying mathematics—estimating sums of rational numbers and random predictions

Materials

- Getting Close cards for the dealer (from Labsheets 1.1A and 1.1B)
- Set of Number Squares for the dealer to use as a Goal Card (adapted from Labsheet 1.1C) The squares need to include the numbers (0, ½, 0.5, 1, 1½, 1.5, 2, 2½, 2.5, 3, 3½, 3.5, 4, 4½, 4.5, 5)
- Calculator for the dealer

Rules:

1. All players place initial bet of minimum $1 in the center of the table.

2. Dealer deals each player 2 Getting Close cards. These are cards that the player holds and does not show anyone until the end of the hand.

3. Dealer turns over one Number Square card that will be the "Goal" for this hand. (All players are trying to add 3 Getting Close cards together to get as close to the Goal card as possible.)

4. After seeing the Goal card, each player has the choice to fold, make an additional bet or raise the bet. If the bet is raised, each player must meet the raised amount or fold.

5. Dealer then turns over Getting Close card on to the table for everyone to see. (The "turn") This card is considered a part of all players' hands. After seeing the turn card, each player has the choice to fold, make an additional bet or raise the bet. If the bet is raised, each player must meet the raised amount or fold.

6. Dealer then turns over another Getting Close card for everyone to see. (The "river") This card is considered a part of all players' hands. Players now use three of the four cards (two that they are holding and two shown to everyone) to make a sum that is as close as possible to the Goal Card.

7. The player whose sum of three cards is closest to the Goal card wins the pot. In the event of a tie the pot is split between the winners.

Labsheet 1.1A

Getting Close Fraction Game Cards

$\frac{1}{10}$	$\frac{1}{8}$	$\frac{1}{5}$	$\frac{1}{4}$	$\frac{1}{3}$
$\frac{1}{2}$	$\frac{3}{10}$	$\frac{7}{10}$	$\frac{9}{10}$	$\frac{2}{5}$
$\frac{3}{5}$	$\frac{4}{9}$	1	$\frac{3}{4}$	$1\frac{4}{10}$
$1\frac{1}{5}$	$1\frac{3}{4}$	$1\frac{2}{3}$	$1\frac{1}{3}$	$\frac{2}{3}$
$\frac{6}{8}$	$\frac{3}{8}$	$\frac{5}{8}$	$\frac{7}{8}$	$\frac{5}{9}$

Labsheet 1.1B

Getting Close Decimal Game Cards

1.375	0.5	0.75	0.6	0.9
0.125	0.375	0.875	1.5	1.75
1.125	0.2	0.8	1.33	1.67
0.33	0.67	1.875	0.1	1.9
1.1	2	1.45	1.25	1.6

Number Squares to be used as a "Goal Card" for CMP Hold'em
adapted from Labsheet 1.1C

0	½	0.5	1
1½	1.5	2	2½
2.5	3	3½	3.5
4	4½	4.5	5

Bean Challenge

Adapted from
CMP3: *Samples and Populations*, Problem 3.4, pp. 67-68
CMP2: *Samples and Populations*, ACE #5, p. 55 and
CMP1: *Comparing and Scaling*, Problem 5.2, p.54 and
Underlying mathematics—making predictions from samples

Materials:

- 1 Large container
- Same sized Beans of two colors — about 1000 beans of one color such as white and some number of beans of another color (50 or 100 or 150 or 200). The beans must be the same size. It might be easiest to spray paint some of the white beans to make the other color of bean. (Also, another object such as beads can be used.)
- Scoop
- Poster paper to record predictions
- Marker to record guesses

Preparation:

Count all of the beans so you know the total amount. Mix all the beans together in a large container. On the poster paper display to everyone how many of the colored beans are in the container. (These are the "tagged" beans. The players will use the sample taken and the number of "tagged" beans in the container to estimate the total amount of beans or the total "population" of beans.)

Rules:

1. Each guess cost $1.

2. The person gets a scoop of beans.

3. After reviewing his/her scoop the person guesses the total number of beans. The guess and person's name get recorded on the poster paper.

4. After each guess, the beans are returned to the jar and mixed up.

5. The person who comes the closest to the correct total number of beans in the container wins.

6. The winner will be announced prior to raffle drawings.

Quadrilateral Game

CMP3: *Shapes and Designs,* Problem 3.5, pp. 74-75
CMP2: *Shapes and Designs,* Problem 4.3, pp. 74-75
Underlying mathematics—making shapes with constraints

Materials:

- Geo Board
- Rubber bands
- Quadrilateral Game Grid (Labsheet 3.5)
- 2 (six-sided) Dice

Rules:

1. Place your bet.

2. Place the rubber band near the center of the geo-board in the shape of a square measuring one unit on each side.

3. Player rolls the number dice one at a time; the first die decides the row and second die decides the column on the quadrilateral game grid.

4. Player then forms the quadrilateral specified on the grid, by moving as few corners as possible.

5. A point is received for each vertex (corner) moved.

6. The next player then rolls the dice and repeats step 3-5.

7. Play continues until each player has had 5 turns, the player with the lowest score wins.

Labsheet 3.5 Quadrilateral Game Grid

Row 6	A quadrilateral that is a square	**Add 1 point to your score and skip your turn**	A rectangle that is not a square	A quadrilateral with two obtuse angles	A quadrilateral with exactly one pair of parallel sides	A quadrilateral with one pair of opposite side lengths equal
Row 5	**Subtract 2 points from your score and skip your turn**	A quadrilateral that is not a rectangle	A quadrilateral with two pairs of consecutive angles that are equal	A quadrilateral with all four angles the same size	A quadrilateral with four lines of symmetry	A quadrilateral that is a rectangle
Row 4	A quadrilateral with no reflection or rotation symmetry	A quadrilateral with four right angles	**Skip a turn**	A quadrilateral with exactly one pair of consecutive side lengths that are equal	A quadrilateral with exactly one right angle	A quadrilateral with two 45° angles
Row 3	A quadrilateral with no angles equal	A quadrilateral with one pair of equal opposite angles	A quadrilateral with exactly one pair of opposite angles that are equal	**Add 2 points to your score and skip your turn**	A quadrilateral with no sides parallel	A quadrilateral with exactly two right angles
Row 2	A quadrilateral with both pairs of adjacent side lengths equal	A quadrilateral with two pairs of equal opposite angles	A quadrilateral with a diagonal that divides it into two identical shapes	A quadrilateral that is a rhombus	A quadrilateral with 180° rotation symmetry	**Subtract 1 point from your score and skip your turn**
Row 1	A quadrilateral with one diagonal that is a line of symmetry	A quadrilateral with no side lengths equal	A quadrilateral with exactly one angle greater than 180°	A parallelogram that is not a rectangle	**Add 3 points to your score and skip your turn**	A quadrilateral with two pairs of opposite side lengths equal
	Column 1	**Column 2**	**Column 3**	**Column 4**	**Column 5**	**Column 6**

1 one

one 1

1 one

one 1

5 five

five 5

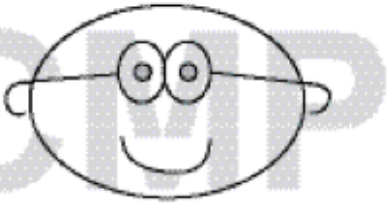
5 five

five 5

10 ten

ten 10

10 ten



ten 10