Calculators, Baseball and Mathematics: A Winning Team

A. Craig Loewen, Dino Pasquotti and Lon Bosch

In honor of the recent triumph of the Toronto Blue Jays, we have constructed a small collection of estimation and calculator games built around a baseball theme.

Most people have well-formed opinions about the use of calculators in the mathematics classroom, which tend to stem from personal experiences while learning math. For example, people who were allowed to use the calculator (or some other computing device such as a slide rule) during class instruction believe that the application of the calculator is desirable, or at least acceptable. Those of us who were not allowed to use such computing devices are somewhat more hesitant to embrace the calculator.

Some more common arguments put forward by those of us reluctant to use the calculator in the classroom are (1) "students must learn how to add, subtract, multiply and divide. How will they ever develop these abilities if they are permitted to use the calculator in class?" and (2) "the calculator quickly becomes a crutch. Students will become too dependent on it and forget their number facts." The first argument is quite incorrect in its assumptions. The first argument assumes that the major goal of mathematics instruction is the development of fluent arithmetic computation skills. The learning of mathematics is far more comprehensive than these skills—mathematics involves the development of number sense, estimation and mental computation skills, reading and writing skills, generalized thinking and problem solving skills and abilities, not to mention a broad host of other important concepts, relationships, algorithms, communication skills and exploratory talents. In short, mathematics involves much more than simple arithmetic computation skills, and the calculator can play a role developing and retaining these important skills and abilities.

The second argument, that the calculator is a crutch, is also fraught with difficulties. No current research evidence supports the claim that using the calculator diminishes retention of number facts (see Hembree and Dessart 1992 for a nice summary of research). It is also important to realize that where and how the calculator is used is a negotiable topic in any classroom. The students and teacher in every mathematics classroom should take the opportunity to discuss appropriate applications of the calculator. For example, it may not be sensible to turn to the calculator to complete computation such as

- simple addition or subtraction, for example, $2 + 3 = 5$ or $9 - 7 = 2$;
- multiplication or division by powers of 10, for example, $3 \times 10 = 30$ or $540 \div 100 = 5.4$;
- finding certain percents of a number, for example, 10% of 920 is 92 or 1% of 3,000 is 30.

In short, it is fair to say that the calculator is not necessary for instructing each and every arithmetic concept in the mathematics curriculum: its limitations and appropriate applications need to be discussed and explored through honest communication between the teacher and students.

The best application of the calculator is in the teaching of estimation and mental computation skills. The problem with teaching these concepts is that students need a means to check their estimates and their mental computations for accuracy and reasonability. The question is, If students are asked to estimate the product of 289 and 21, how would they know when a reasonable estimate has been found? However, if the students complete the estimate ($300 \times 20 = 16{,}000$) and then are allowed to compare the result with the actual product computed with the aid of the computer (6,069), the reasonability of the estimate is quickly determined. In this sense, the calculator's speed and accuracy make it a useful tool for providing effective and immediate feedback.

The application of the calculator to the instruction of estimation skills can be housed within a game format. The following three games each employ the calculator in a problem solving, gaming situation based on estimation skills and a baseball context. The games are offered as examples of how calculators can be used in an effective and enjoyable manner in the junior high mathematics classroom.

Game 1: Calculator Baseball

Objective

- Given the product, player identifies probable multiplicands from the range of numbers provided.

Goal

- To maximize the number of correct estimates while minimizing the number of strikes.

Number of Players

- Players work as individuals, but any number of people can play the game at one time.

How to Play

- Each player needs his or her own game board (see Figure 1).
- Beginning with Line 1, the player tries to identify the correct multiplicands for each product shown in that line. Multiplicands are selected from the Pitching List at the top of the game board. The player works from left to right across each line.
- The player records the two multiplicands in the boxes underneath the product, and then using a calculator multiplies these two numbers.
- If the player has correctly identified the two multiplicands for a given product, a check mark is placed next to the product. If the multiplicands the player has chosen do not produce the correct product, an "X" is placed under a strike at the end of the line.
- If a player reaches the end of a line before receiving three strikes, then he or she simply continues on to the next line.
- If a player gets three strikes before reaching the end of a line, then he or she must leave that line and proceed to the next line.

Rules

- Final score is calculated by counting the number of check marks in each line.

Example

- The target products in the first line are 273, 1,638, 756, 1,248 and 3,024. Assume the player correctly decides that 13 and 21 will provide a product of 273. After recording the numbers 13 and 21 as shown, and confirming his or her choices with the aid of a calculator, the player places a check mark next to 273. The player now proceeds to find the multiplicands for 1,638.

Adaptations

- The game can be easily adapted by changing the range of numbers from which players must select and by changing the target products in each line.

Game 2: In-Between Hits

Objective

- Player estimates the missing multiplicand given one multiplicand and the product and orders four digit numbers.

Goal

- To score the greatest number of runs by correctly estimating the missing multiplicand.

Number of Players

- Two teams of one or more players each.

How to Play

- Each team needs one copy of the game board (see Figure 2), a calculator and small markers such as buttons, coins or paper squares.
- The team having the oldest player is designated as the home team and will have last "at bats."
- The game begins with each team listing its players in batting order on the game board. The reverse order is known as the pitching order.
- The pitching team sends their first pitcher forward while the batting team sends their first batter forward. The pitcher places a number of his or her choice in the calculator (for example, 101.32) and passes the calculator to the batter.
- The batter now multiplies the number in the calculator by any number that he or she chooses trying to obtain a product that lies in one of the ranges specified as a hit on the Hit Chart.
- If a hit is scored, the batter may move his or her marker to the appropriate space on the team's game board. If the batter fails to score a hit, then a tally mark is recorded as an out.
- Each team now sends forward a new pitcher and a new batter, and the process is repeated until the batting team has three outs. The teams now reverse roles, and the pitching team becomes the batting team for the second half of the inning.
- The team that scores the greatest number of runs is the winner.

Rules

- A game has six complete innings.
- Once a number is entered into the calculator, it may not be changed by either the pitcher or batter.

- When a hit is recorded, all runners on bases move forward the specified number of bases, that is, each runner would move forward one base on a single, two bases on a double and three bases on a triple. All on-base runners advance home in case of a home run.
- The umpire (teacher) decides if a batter is taking too long to enter the second multiplicand. If found to be taking too long, the batter is considered to have struck out.

Example

- Assume a pitcher punches the number 325 into the calculator before passing it to the batter.
- Assume the batter multiplies this number by 17. The product of 325 and 17 is 5,525, and the batter will have "flied out."
- Assume instead the batter multiplied the pitch (325) by 15.2. The product of 325 and 15.2 is 4,940, and the batter will have recorded a double hit.

Adaptations

- The game may be made less difficult by limiting the range of numbers the pitcher uses, or by reducing the magnitude of the products in the Hit Chart.
- The game may be made more difficult by constructing several different Hit Charts. When a batter comes forward, he or she must randomly select a Hit Chart after the pitch.

Game 3: Three Strikes and You're Out

Objective

- Given the product, player identifies probable multiplicands from the range of numbers provided.

Goal

- To correctly identify combinations of multiplicands that give specified products thus avoiding strikes. To be the last player to record three strikes.

Number of Players

- Two players.

How to Play

- The two players will share one game board (see Figure 3) and a calculator. Players also need pencils.
- The youngest player gets to go first.
- This player selects two numbers from the Number Chart at the top of the game board. The product of these two numbers is found with the aid of the calculator.
- If the product of these two numbers is found on the game board, then that product is crossed out and play is passed to the other player.
- If the product of the two selected numbers is not found on the game board, then that player must score a strike by placing an "X" in one of the strike boxes.
- Play continues to pass between the two players until one player has scored three strikes. This player is out of the game, and the remaining player is the winner.

Rules

- If a player chooses two numbers that when multiplied have a product that has already been crossed off the game board, then that player must score a strike.

Example

- Assume a player chooses 9 and 44 that have a product of 396. The product 396 is found on the game board, so it is crossed off and play is passed to the opponent.
- Assume the player chooses 87 and 91 that have a product of 7,917. The product 7,917 is not found on the game board, so the player must score a strike.

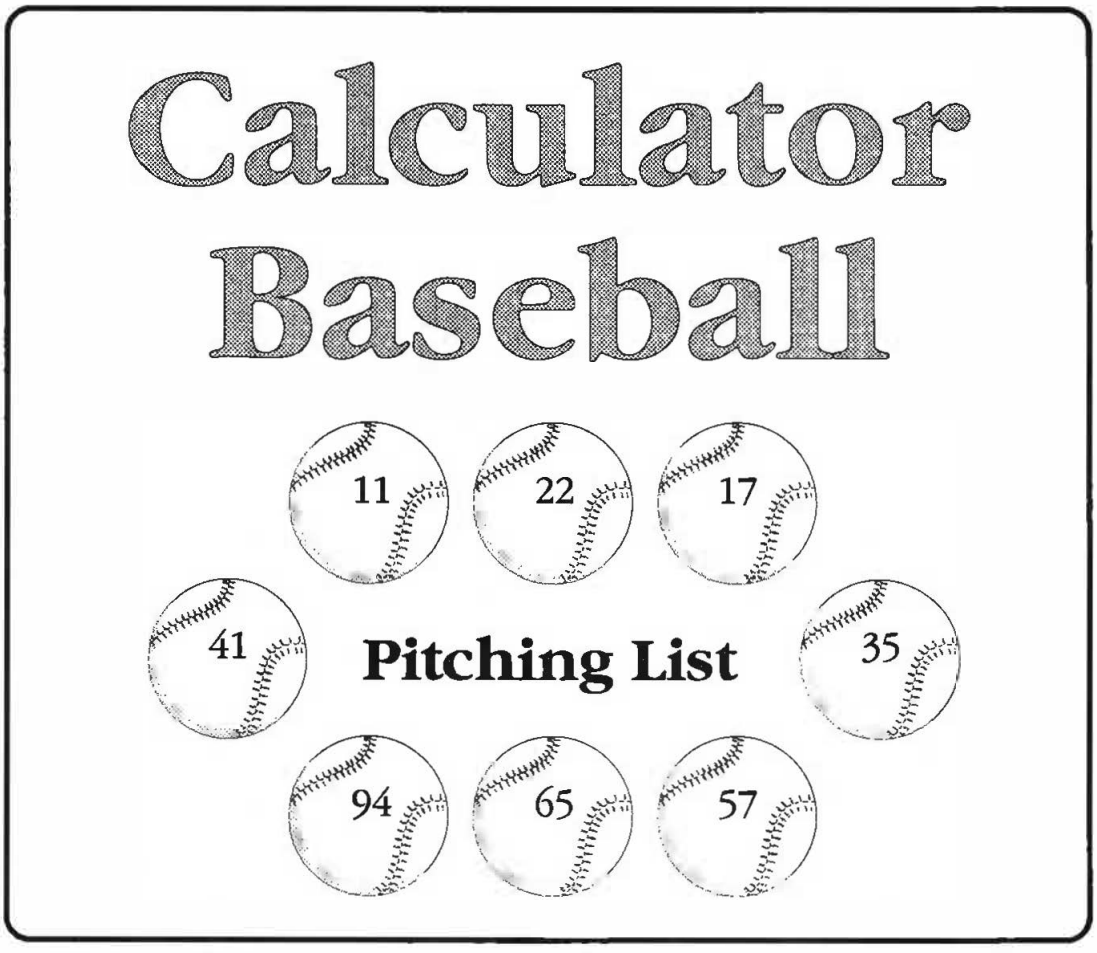
Adaptations

- Change the game so that students must estimate sums instead of products.
- Allow more than two players to play the same game as individuals or as teams. If more than two teams or two individual players play, then they will have to keep track of their strikes on a separate piece of paper.
- To increase the difficulty of the game, have players identify the product they are trying to achieve prior to selecting two numbers from the Number Chart. If the two numbers do not have the specified product, the player must score a strike.

Reference

Hembree, R., and D.J. Dessart. "Research on Calculators in Mathematics Education." In *Calculators in Mathematics Education* (1992 Yearbook), edited by J.T. Fey and C.R. Hirsch. Reston, Va.: National Council of Teachers of Mathematics, 1992.

Figure 1: Calculator Baseball Game Board



Line 1	273	1638	756	1248	3024	strike	strike	strike
Line 2	2268	234	8736	1728	648	strike	strike	strike
Line 3	5733	624	378	3456	1183	strike	strike	strike
Line 4	468	4608	234	756	819	strike	strike	strike
Line 5	2304	441	1134	1008	6048	strike	strike	strike

Figure 2: In-Between Hits Game Board

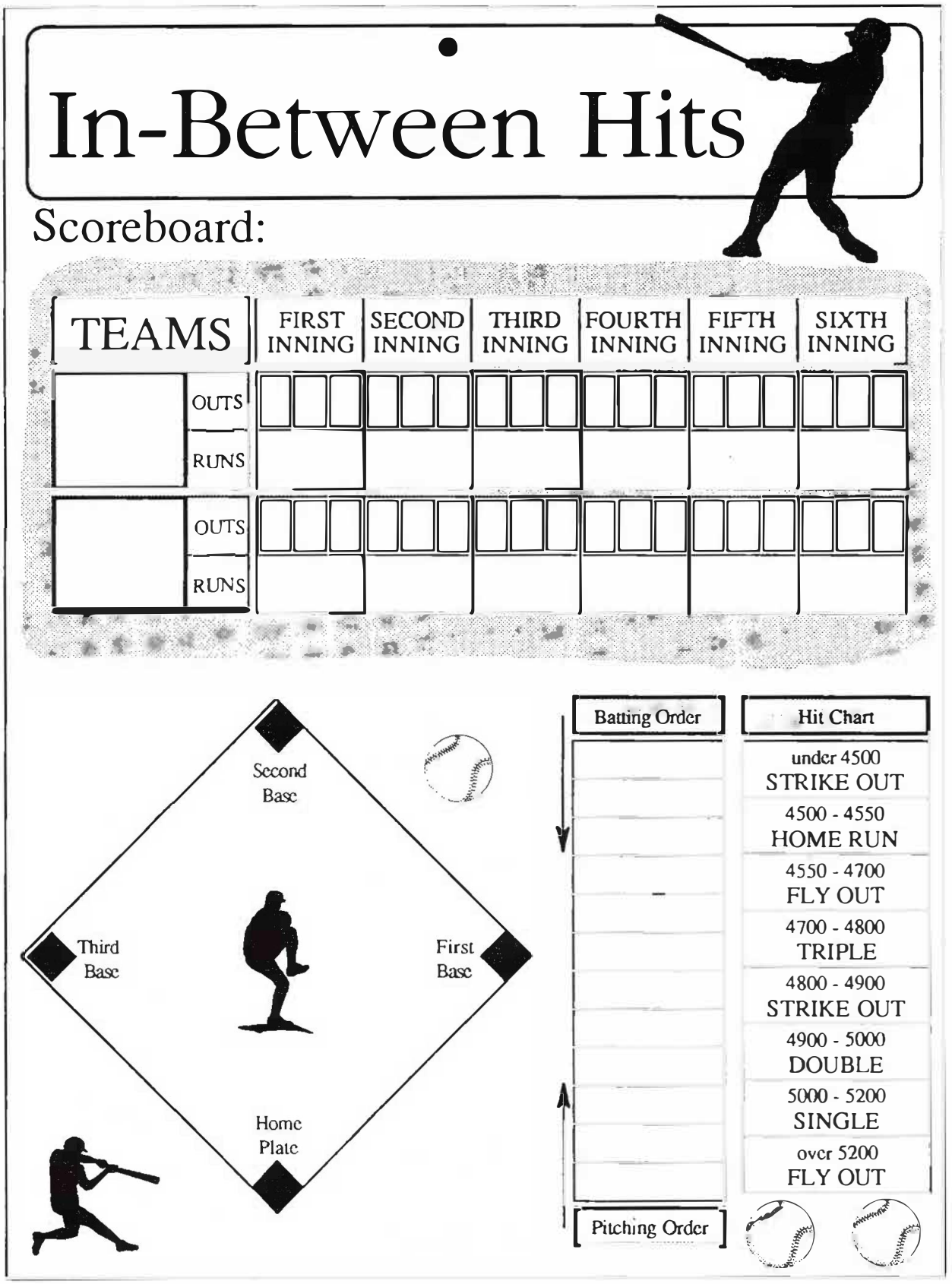


Figure 3: Three Strikes and You're Out Game Boards