

Rounded vs. Approximate Answers Classic View

Objectives

- Determine exact from approximate answers
- Observe how rounding can create error
- Observe when the graphing calculator rounds results to fit the screen

Determine exact from approximate answers

Example 1: Write $\frac{2}{3}$ as an exact decimal, without rounding.

To do this without a calculator, we would do long division, to get an infinitely repeating decimal, like this:

$$\begin{array}{r} 0.666... \\ 3 \overline{) 2.000...} \end{array}$$

We can write this answer using an **ellipsis ...**

Answer: 0.666...

Or we can write this answer using a **repeat bar**

Answer: $0.\overline{6}$

IMPORTANT: Both are **exact** answers because they are exactly the same as $\frac{2}{3}$ and have not been rounded.

CAUTION: Though these two answers are equivalent, your instructor may prefer one or the other.

Example 2: Write $\frac{2}{3}$ as a decimal rounded to the nearest hundredth.

Round the answer from Example 1 to get

Answer: 0.67

IMPORTANT: The rounded answer 0.67 is not exactly the same as $\frac{2}{3}$. It's **approximate**, or close to $\frac{2}{3}$.

Observe how rounding can create error

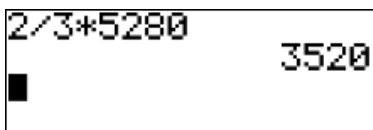
Example 3: Imagine we work for NASA, and we're testing a rocket by firing it $\frac{2}{3}$ mile into the desert.

How many feet do we expect the rocket to go? [Hint: 1 mile = 5280 feet]

- Use an exact version of $\frac{2}{3}$ from Example 1.
- Use the rounded version of $\frac{2}{3}$ from Example 2.
- If we use the rounded answer from Example 2, how far off will the rocket be from the exact answer?

Solution

- To calculate $\frac{2}{3}$ of 5280, multiply.



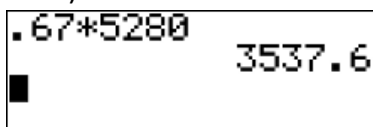
The image shows a calculator screen with the expression $2/3 * 5280$ entered. The result, 3520, is displayed on the right side of the screen.

Answer: 3520 feet.

If we use an exact answer to make another calculation, no error will result from rounding.

b) To calculate 0.67 of 5280, multiply.

c)

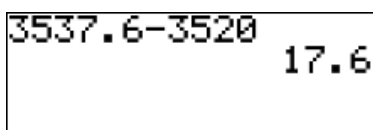


A calculator display showing the calculation $.67 \times 5280$ resulting in 3537.6 . The display is split into two sections: the left section shows the expression $.67 \times 5280$ and the right section shows the result 3537.6 .

Answer: 3537.6 feet

CAUTION: If we use a rounded answer to make another calculation, we can get a different answer, which might be near or far from the correct answer.

d) To find the error, subtract the answers:

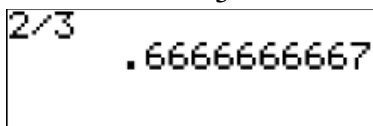


A calculator display showing the calculation $3537.6 - 3520$ resulting in 17.6 . The display is split into two sections: the left section shows the expression $3537.6 - 3520$ and the right section shows the result 17.6 .

Answer: If we use a rounded answer, our rocket would land 17.6 feet away from the intended target!

Observe when the graphing calculator rounds results to fit the screen

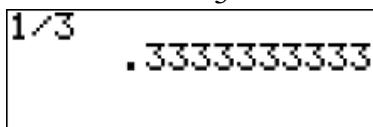
Example 4: Write $\frac{2}{3}$ as a decimal using the graphing calculator. Is the answer exactly $\frac{2}{3}$ or is it approximately $\frac{2}{3}$ (rounded)?



A calculator display showing the fraction $2/3$ on the left and its decimal equivalent $.666666667$ on the right. The display is split into two sections.

Answer: The 7 at the end of the display shows that the calculator has rounded the answer to the nearest ten-billionth. Though this is a very small change from the exact answer, this is approximate (rounded).

Example 5: Write $\frac{1}{3}$ as a decimal using the graphing calculator. Is the answer exactly $\frac{1}{3}$ or is it approximately $\frac{1}{3}$ (rounded)?



A calculator display showing the fraction $1/3$ on the left and its decimal equivalent $.333333333$ on the right. The display is split into two sections.

Answer: As in Example 4, this answer is also rounded to the nearest ten-billionth, only 3 was less than 5, and the remaining digits were chopped off. This is approximate (rounded).

BE AWARE: The calculator has more digits stored in memory than appear on the screen, and it will use those if you save this result to memory or use this result in the next calculation.