

**2015 MATH FIELD DAY  
HUDDLE PROBLEMS**

**Problem 1.** Let  $a$  and  $b$  be real numbers not equal to 0, 1, or each other. Let  $x$  and  $y$  be nonzero real numbers such that

$$\frac{x}{a} + \frac{y}{a-1} = 1 \quad \text{and} \quad \frac{x}{b} + \frac{y}{b-1} = 1.$$

Simplify the expression

$$\frac{y}{x} \left( \frac{a}{a-1} \right) \left( \frac{b}{b-1} \right).$$

**Problem 2.** Find the only six-digit number  $861abc$  which is divisible by 210 and has no repeated digit.

**Problem 3.** The function

$$\sin\left(\frac{x}{3} + \frac{1}{4}\right) + \sec\left(\frac{x}{5} + \frac{1}{6}\right) + \tan\left(\frac{x}{7} + \frac{1}{8}\right)$$

is periodic. What is its period?

**Problem 4.** A single-elimination mathball tournament consists of  $3^{10} = 59,049$  teams competing against each other. In each round, the teams are grouped into sets of three and play a round of mathball, with the winning team moving on to the next round, and the losing two teams being eliminated. This continues until only one team remains. How many total matches of mathball are played in the tournament?