

# Why do we do proofs?

Joel Feinstein

School of Mathematical Sciences  
University of Nottingham

2008-2009

- 1 Aren't all mathematical statements either clearly true or clearly false, after checking a few examples and/or doing some calculations?
- 2 Why should we prove anything at all?
- 3 How can we be absolutely sure whether a statement is true or false?
- 4 Why should we prove statements which appear to be intuitively obvious?
- 5 Why are definitions of concepts important?
- 6 Do we need to memorize lots of proofs?

**Problem 1**

For which prime numbers  $p$ , if any, is  $p + 1$  a perfect square?

You should find one example quite quickly. Are there any others? Are you sure? Can you generalize this result?

**Problem 2 (Fermat's Last Theorem!)**

Prove that, whenever  $x, y, z$  and  $n$  are positive integers with  $n > 2$ , then

$$x^n + y^n \neq z^n.$$

That's rather a tricky one. It took over 350 years to find a proof!

Two hospitals (Hospital A and Hospital B) each claim to be better at treating a certain disease than the other.

Hospital A points out that it cured a greater percentage of its male patients last year than Hospital B did, and that it also cured a greater percentage of its female patients last year than Hospital B did.

However, Hospital B points out that, overall, it cured a greater percentage of its patients last year than Hospital A did.

### **Problem 3 (Serious answers please!)**

Given that none of the numbers involved are zero, is it possible that both hospitals have got their calculations right?

If so, which hospital would you rather be treated by?

If you are unclear about the precise definitions of the concepts you are working with, it is very hard to be certain about the answers to questions concerning these concepts.

Often the answers depend on the definitions you are using.

Here are some questions for you to think about which might illustrate this (you may not all agree about the answers!)

#### **Problem 4**

Are squares rectangles?

#### **Problem 5**

Are equilateral triangles isosceles?

#### **Problem 6**

Which of the following numbers are prime? (a) 2 (b) 1 (c)  $-3$ .