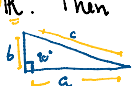


# MAT 108 - Introduction to Abstract Math

**Discrete Mathematics** Combinatorics (MAT 145)  
 ↳  $\mathbb{N}$  natural numbers, 1, 2, 3, ...  
 ↳  $\mathbb{Z}$  integers ... -3, -2, -1, 0, 1, 2, 3 ...  
 ↳ proof by contradiction, PHZ  
 ↳ by induction, by recursion  
 Oct 30: Midterm

**Continuous Mathematics** analysis MAT 127  
 ↳  $\mathbb{R}$  real numbers, functions  $f: \mathbb{R} \rightarrow \mathbb{R}$   
 ↳  $\epsilon$ - $\delta$  proofs & aspects of countability  
 ↳ PSets

## Q 1. Examples of Math. Statements

(A) Let  $T$  be a triangle with a right angle  $90^\circ$  ( $\pi/2$  radians) and sides of length  $a, b, c \in \mathbb{R}$ . Then  $a^2 + b^2 = c^2$ . (Pythagoras)  
geometry  belongs

(B) There exist infinitely many prime numbers. (proof by contradiction)  
number theory (Def:  $p \in \mathbb{N}$  is prime if " $p \mid ab$  implies  $p \mid a$  or  $p \mid b$ ".)  
product divides only  $\forall a, b \in \mathbb{N}$

## 1.2. The REP principle

**Read Experiment Prove**

convincing yourself that statement is true  
techniques developed in 108

once, twice, three ... as many times as needed. definitions, theorems, examples

work out Examples START WITH THE SIMPLEST EXAMPLE YOU DO NOT UNDERSTAND

## Anatomy of a Statement

mean value exists a unique

**Thm.** Let  $a, b \in \mathbb{R}$  s.t.  $a < b$ , and let  $f: [a, b] \rightarrow \mathbb{R}$  be a differentiable function.  
subinterval assumptions / hypothesis "given to us"

**Then**  $\exists c \in [a, b]$  s.t.  
exists  $f'(c) = \frac{f(b) - f(a)}{b - a}$  CONCLUSION

Q 3. **Axioms**: an axiom is a statement that we declare to be true.

- Friday: axiomatics of  $\mathbb{N}$  and  $\mathbb{Z}$ . Euclid "Elements"
- Some axioms are geometric: e.g. "There exists a line between two points." for example
- check Problem Set 1 (due Oct 9).  
 → use us! (Office-mail) → aim for Psets solved by Wed.