

(Some) Types of Mathematical Proof

Mathematical Proof Vs Scientific Proof

Science is operated according to the judicial system. A theory is assumed to be true if there is enough evidence to prove it 'beyond all reasonable doubt'. On the other hand mathematics does not rely on evidence from fallible experimentation, but it is built on infallible logic.

Direct proof

To prove that a statement is true using this method you must prove that the statement is true for *all* possible scenarios or values. In most cases you will use algebra to achieve this.

- <http://www.mathcentre.ac.uk/resources/uploaded/mathcentre-direct.pdf>
- <http://people.oregonstate.edu/~maischf/M232N2.pdf>
- <http://math.berkeley.edu/~hutching/teach/proofs.pdf>

Proof by contradiction

To prove that a statement is true using this method;

1. Assume first that it is not true and then
2. Find an example to contradict and hence disprove this
3. Therefore the statement is true.

To prove that a statement is false using this method;

1. Find just one example that contradicts, and hence disproves, the statement. (Compare this with the requirement to prove all possible scenarios or values to prove a statement true via direct proof). A common example of this is the proof that not all prime numbers are odd.

- http://en.wikipedia.org/wiki/Proof_by_contradiction
- <http://nrich.maths.org/4717>
- <http://zimmer.csufresno.edu/~larryc/proofs/proofs.contradict.html>

Geometric proof

...is any proof involving diagrams and logic reasoning to prove a statement.

- <http://www.benjamin-mills.com/math/Year11/circle-theorems-proof.pdf>

Proof by induction



To prove a statement is true using this method;

1. Prove that the statement is true in one possible scenario, usually the first (u_1)
2. Prove that the statement is also true for the next, or subsequent, scenario (u_{n+1})
3. Therefore true for all possible scenarios.

- <http://www.mathsisfun.com/algebra/mathematical-induction.html>
- <http://m.youtube.com/watch?v=IFqna5F0kW8>
- http://www.khanacademy.org/math/trigonometry/seq_induction/proof_by_induction/v/proof-by-induction
- <http://www.mathcentre.ac.uk/resources/uploaded/mathcentre-proof2.pdf>
- <http://www.cs.dartmouth.edu/~ac/Teach/CS19-Winter06/SlidesAndNotes/lec12induction.pdf>

Some Popular Proofs

- Pythagoras' theorem
- There are infinitely many sets of Pythagorean Triples (different integer values satisfying Pythagoras' theorem, excluding enlargements of smaller sets)
- $\sqrt{2}$ is irrational
- There are infinitely many prime numbers
- The angle on the circumference subtended from either end of the diameter in a semi-circle is 90° .
- SAS, ASA, SSS proofs of congruent triangles
- Euler's formula for polyhedral
- $\sum_1^n r = \frac{n(n+1)}{2}$



CHAPTER THREE

But . . . that's Absurd . . .

At the end of *The Adventure of the Beryl Coronet*, Sherlock Holmes explains his methods of deduction, as usual, and remarks:

It is an old maxim of mine that when you have excluded the impossible, whatever remains, however improbable, must be the truth.

This is, in a way, like *proof by contradiction*, which is one of the most elegant and powerful techniques in the whole of mathematics.

Proof Website Links

- http://en.wikibooks.org/wiki/High_School_Mathematics_Extensions/Mathematical_Proofs
- <http://www.cut-the-knot.org/proofs/index.shtml>
- http://en.wikipedia.org/wiki/Mathematical_proof
- <http://www.people.vcu.edu/~rhammack/BookOfProof/>

- Other types of proof...
<http://jwilson.coe.edu/EMT668/EMAT6680.F99/Challen/proof/proof.html>