

Proof

The number of primes is infinite

Assume the number of primes is finite - say n

So we can list all the prime numbers: $P_1, P_2, P_3, P_4, \dots, P_{n-1}, P_n$

Now consider the number formed by multiplying all the primes together and adding 1

$P_1 P_2 P_3 P_4 \dots P_{n-1} P_n + 1$

None of the n primes are factors of this number so it must be prime itself

But it is not itself included in the list of all primes

This contradicts the assumption that all the primes could be listed in a finite list

Conclusion: The number of primes is infinite