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Exploring Planes in Mathematics: From Euclidean Geometry to Projective Spaces

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Opinion Article

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ABOUT THE STUDY

A plane is a two-dimensional space or flat surface that extends indefinitely in mathematics. A plane is the two-dimensional equivalent of a point, a line, and space. The definite article is used when dealing entirely in two-dimensional Euclidean space consequently the Euclidean plane refers to the entire space. In mathematics, geometry, trigonometry, graph theory, and graphing, many significant duties are accomplished in a two-dimensional or flat domain.

Euclidean plane

A Euclidean plane is a Euclidean space of dimension two, called E2 in mathematics. It is a geometric space in which each point's position is determined by two real numbers. It is an affine space, which incorporates the concept of parallel lines in particular. It also contains metrical qualities caused by distance, allowing it to define circles and measure angles. A Cartesian plane is a Euclidean plane with a selected Cartesian coordinate system. Because every Euclidean plane is isomorphic to it, the set R2 of pairs of real numbers equipped with the dot product is often referred to as the Euclidean plane.

Embedding in three-dimensional space

A plane is a flat two-dimensional surface that extends constantly in Euclidean geometry. Euclidean planes are frequently encountered as subspaces of three-dimensional space R3. One of a room's walls, infinitely extended and deemed infinitesimally thin, is a classic example. While a pair of real numbers R2 suffices to describe points on a plane, their embedding in the ambient space R3 necessitates particular treatment.

Elliptic plane

The elliptic plane is the true projective plane given a metric. Kepler and Desargues utilised the gnomonic projection to connect points on a hemisphere that were tangent to a plane. With O as the hemisphere's centre, any point P defines a line OP intersecting the hemisphere, and any line L determines a plane OL intersecting the hemisphere in half of a great circle. A plane through O and parallel to bounds the hemisphere. This plane has no conventional line; instead, a line at infinity is attached it. Because any line in this extension corresponds to a plane through O, and any pair of such planes intersects in a line through O, one can conclude that any pair of lines in the extension intersect: the point of intersection is where the plane intersection meets, or the line at infinity. As a result, the projective geometry postulate that all pairs of lines in a plane must intersect is proven. The elliptic distance between P and Q in is the measure of the angle POQ, which is commonly measured in radians. When he wrote "On the Definition of Distance," Arthur Cayley sparked interest in elliptic geometry. This foray into geometric abstraction was followed by Felix Klein and Bernhard Riemann, who pioneered non-Euclidean geometry and Riemannian geometry.

Projective plane

A projective plane is a geometric construction that expands the concept of a plane in mathematics. Two lines in the ordinary Euclidean plane normally cross at a single point, although some pairs of lines do not intersect. A projective plane is analogous to an ordinary plane with extra "points at infinity" where parallel lines intersect. Thus, in a projective plane, any two different lines intersect at exactly one point. Renaissance artists established the groundwork for this mathematical topic by establishing perspective drawing techniques. The real projective plane, often known as the extended Euclidean plane, is the archetypal example. This example is essential in algebraic geometry, topology, and projective geometry, where it may be indicated as PG (2, R), RP2, or P2(R), among other notations. There are numerous more projective planes, both infinite and finite, such as the complex projective plane. A projective plane is a two-dimensional projective space, however not all projective planes can be embedded in three dimensions. This embeddability is due to a property known as Desargues' theorem, which is not shared by all projective planes.