



**CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY**

| | |
|--|---|
| Name(s) <p align="center">Peizhu Qian</p> | Project Number <p align="center">S1420</p> |
|--|---|

Project Title
Angle Analysis of Multiple-Line Intersections

Abstract

Objectives/Goals
 (1) To analyze the intersection of 'n' non-parallel lines locating on the same plane, and try to find: A) How many angles (less than 180 degree) that 'n' lines can form; B) What is the value of the smallest angle(s); C) How many right angles, acute angles, and obtuse angles that 'n' lines can be formed.
 (2) To extend the results that obtained in part (1) to the intersection of planes and the intersection of circles.

Methods/Materials
 Begin with the simplest case: the intersection of 2 lines. Summarize the properties of the 2-line intersection including the number of intersecting points, the number of angles, the value of the smallest angle(s), and other findings. Then, gradually add more lines, one by one. Make the new line intersect with all previous lines respectively. Record the properties. When the number of lines is greater than 2, there are many possible ways for the lines to intersect. Now, rearrange the lines so that they intersect in as many ways as possible. Record the number of intersecting points and the number of angles that the lines form in each different case.

Results
 When the number of lines 'n' is fixed: 1.the number of angles is always the same regardless of the number of intersecting points. 2.the value of the smallest angle(s) is also the same regardless of the number of intersecting points. 3.the number of acute angles is always the same as the number of obtuse angles. 4.the maximum number of intersecting points is the same as intersecting axes that formed by 'n' planes.

Conclusions/Discussion
 I. Intersection of lines:
 1)Find the maximum number of intersecting points when n lines intersect at different points, formula: $n(n-1)/2$
 2)Find the number of angles when n lines intersect, formula: $n(n-1)$
 3)The value of the smallest angle, formula:less or equal to $180 \text{ degree}/n$
 4) The number of different types of angles
 When there are two lines perpendicular:
 Right angles: 4; Acute angles=Obtuse angles= $n(n-1)-2$
 When no perpendicular lines:
 Right angles: 0; Acute angles=Obtuse angles= $n(n-1)$
 II.Intersection of Planes

Summary Statement
 When there are 'n' lines intersecting on the same plane, the number of angles, the value of the smallest angle(s), and the number of right angles, acute angles, and obtuse angles can be determined by the formulas found in this project.

Help Received
 1.My math teacher, Juan Gracia, and my grandma helped me go over my summary to make sure that it is understandable. 2.A math professor from Mendocino College, Deborah H. White, came to talk to me about further study of my project after the county science fair. 3.My classmates lent me glue and colored