CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
Eric Ford

Project Number
S1204

Project Title
Optimization of Cell Phone Service in Kern County

Abstract

Objectives/Goals
My objective was to determine the optimal arrangement of cell phone transmission towers in Kern County to generate the best service coverage and the most profit using a mathematical model.

Methods/Materials
I created a list of nodes that were representative of possible tower locations and assigned each a population density value, established points that corresponded to major highways using linear equalities, determined the total population and length of highway that was within the range of each tower, assigned an optimization value to represent the number of potential customers a tower could support, and allotted each highway node a value that represented the average traffic density for that location (2004 project). For my current project, based on the optimization value for a tower, a value was produced to represent the profits that could be generated by that tower#s customers. A representative cost for maintenance that increased with a potential tower#s distance from a city was also created. Using these profit and cost values, three models were generated: one representing the most profitable arrangement of cell phone towers; one representing the maximum service coverage to consumers without causing the service provider to lose money; and one that provided adequate coverage to consumers and also generated profit by using profit values of the first two models. The three models were recalculated with different population density values to represent population growth.

Results
The maximum profit models produced networks with relatively few towers positioned in key locations that would provide service to the most densely populated areas. The maximum coverage models produced networks that provided coverage to most population centers and major highways. The balanced models resembled the maximum service coverage models, but had fewer towers.

Conclusions/Discussion
The maximum profit model would be useful for a cell phone service provider that does not have adequate revenue to construct many towers. The maximum service coverage model would be applicable to a company unconcerned with current profits, but wanting to dominate the market. The average service provider would want to implement the balanced model because it produces profit and also provides enough service coverage to attract customers. All service providers would want to use the data that incorporate predicted population growth to sustain profitability.

Summary Statement
My project is a mathematical model that determines the arrangement of cell phone transmission towers in Kern County that is the most profitable and provides maximum service coverage.

Help Received
My parents assisted in editing and the assembly of my display.