

2012 Contest Problems

MCM PROBLEMS

PROBLEM A: The Leaves of a Tree

"How much do the leaves on a tree weigh?" How might one estimate the actual weight of the leaves (or for that matter any other parts of the tree)? How might one classify leaves? Build a mathematical model to describe and classify leaves. Consider and answer the following:

- Why do leaves have the various shapes that they have?
- Do the shapes "minimize" overlapping individual shadows that are cast, so as to maximize exposure? Does the distribution of leaves within the "volume" of the tree and its branches effect the shape?
- Speaking of profiles, is leaf shape (general characteristics) related to tree profile/branching structure?
- How would you estimate the leaf mass of a tree? Is there a correlation between the leaf mass and the size characteristics of the tree (height, mass, volume defined by the profile)?

In addition to your one page summary sheet prepare a one page letter to an editor of a scientific journal outlining your key findings.

一棵树的叶子有多重？如何估计一棵树叶子的质量（或者其他部分的质量）如何给叶子分类？建立一个数学模型来给树叶分类，考虑下述问题：

为什么树叶有各自不同的形状

树叶是否使自身的阴影的重叠最小以获得最大的暴露面积，树叶在一棵树体积及分支内的分布是否影响树叶的形状

另一方面，树叶的形状是否和树的分叉结构及表面有关？

你如何估计一棵树树叶的质量？树叶质量是否和树的大小（高度，质量，体积）相关？