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Dear Mr. Fred “Twinkle Toes” Flintstone,

Congratulations on being hired as a fruit tester by the Geode Orange Juice Company. We understand that your job is to determine whether the oranges available in different locations are sweet enough for Geode’s orange juice, and that you need make this determination via sampling a subset of the total orange population in any given location. We were dismayed to hear of your lack of success in your new position, and feel you have come to the right place for advice. As your trusted algebra advisors, we will do our best to clearly explain the reasoning behind your lack of success to date and our proposed solution. We assure you that you will be on your yabba-dabba-way to retirement in no time!

We have analyzed your initial sampling procedure of oranges from the Agate Orange Farm in order to determine why the oranges from Agate resulted in overly tart juice. While you were absolutely correct in your assessment that a sample size of 1,000 oranges could adequately predict the behavior of the larger population of 25,000 oranges, we have concluded that the problem was that your fruit testing instructions did not accurately select a representative sample of oranges.

Before we continue with our analysis and recommendations, it is important to understand several basic ideas of sampling. As you know, a sample is some part of a population, or a subset of the whole. A sample is only considered *random* if every element of the population is equally likely to be chosen as part of that sample. In your case, every orange/tree should be equally likely to be chosen as part of your tasting sample. While your selection of which tree to taste may have been random, you also need to consider whether your sample will be representative of entire population when you select it. A *representative* sample is one in which the sample accurately predicts or reflects the observed behavior or characteristic of the entire population. When you chose 1,000 oranges to taste from the same tree, those oranges were only useful to predict the performance of that particular tree, not the entire grove.

When sampling oranges from different trees in any orange farm, it is important to remember that different sections of the farm may be exposed to different conditions, influenced by factors such as light exposure, watering, types of soil, air quality, bugs/pesticides, and weather. These varying conditions can and do result in oranges of different levels of sweetness, and it is necessary to keep this in mind when selecting a sample of oranges to taste. It is not possible to test oranges from every tree, but a truly representative sample in this scenario needs to include oranges from different trees in various sections of the farm. We have some ideas on how you can make sure this occurs in your selection of future orange samples.

Moving forward with sampling next year’s crop, we would like to suggest the following:

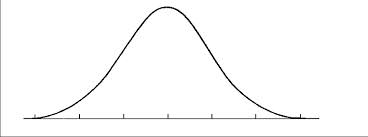
* Divide the orange farm into 250 sections with 100 trees each (note that this creates intentionally non-random sections of trees to ensure appropriate representation of the orange farm as a whole ) .
* Randomly select four different trees from each of the sections, and then select one orange from each of the selected trees within each section.
* [](http://www.crystalgraphics.com/powerpictures/Image.Search.Details.asp?product=cg3p30323c&title=a-sour-orange)Make sure to choose oranges from different parts of the selected trees.
* You should randomly select the trees within each section.

One strategy to ensure this happens is to use the following strategy:

Assign each tree a number from 1 to 100; use a random number generator to select 4 trees to be sampled from each of the 250 sections. The random number generator will need to be used for each section (250 times).

*It is important to sample the trees selected by the random number generator to keep the sampling random and valid.*

When you follow the suggestions we have recommended for random and representative sampling, we expect to see that the sweetness level of the sampled oranges will create a normal distribution curve similar to the one pictured below. In order to confidently recommend an orange farm to your employer, the Geode Orange Juice Company, we recommend that at least 70% of the oranges sampled should be at or above the appropriate sweetness level for juicing.



**sour**

**sweet**

**Percentage of Oranges**

Shaded region represents that approximately 70% of the whole population are quality juicing oranges.

**Sweetness Scale**

Fred, regarding your medical exam involving your blood test, it is unnecessary for your doctor to test numerous sites throughout your body. The body is a single organism, much different than the orange grove previously addressed. The orange grove has independent trees within the grove that can vary from tree to tree depending on growing conditions. However, your blood stream continuously cycles throughout your entire body. The blood that cycles through your cheeks is the exactly same blood that cycles through your toes! There would be no need to test multiple sites since the result of one blood test would be representative of your blood make-up as a whole.

You wish you the best in your future orange sampling and hope we’ve helped set you on the right path to retirement. Save a lane for us at Bedrock’s Quartzside Bowling Alley!

Sincerely,

Santan Junior High School Algebra Advisors