Math 140
Fall 08

Study Group Homework: Sept 17/18 and 19

Note that I will be away on Friday September 19. Please work on the Cuisinaire Rod Train problems below in your study groups on Wednesday or Thursday, and then come to class on Friday. Chris Redford will be there to help you get going. On Friday, groups will share their results and then keep working on the problem. You have several options for sharing results; we will discuss them on Wednesday and hopefully decide in advance.

- You can have the reporters present, similar to what we did last Friday. For this problem, it would be good to make some representations in advance. You can email a file to yourself to project it on the board or you can make an overhead transparency (I can give you supplies)
- You can make four or five "hybrid" groups that include one or two members of each study group and share your work this way.
- Groups can prepare handouts to distribute to the other groups, and then study groups can read the handouts, sending emissaries when there are questions.

Reporters should send me a report after the class on Friday; you don't need to send a report after the study group. Include at least one paragraph describing your mathematical results in detail; one paragraph describing places where you struggled or got stuck, again with mathematical detail; and one paragraph describing the dynamics of your group and especially the dynamics of class on Friday. Include whatever else you like. The report should be a summary with mathematical detail, but not a play-by-play.

Be sure to clean up your work a bit for Monday. Make sure there are descriptions of the problems included, that results are clearly highlighted, and there is enough included so that five years from now you will be able to tell what you did.

Cuisinaire Rod Trains

If all goes well, in class we will watch a video that shows children doing a simpler version of this activity. You can borrow Cuisinaire Rods from the Resource Center and there is also an online version of them available at http://arcytech.org/java/ (Chose "Integer Bars;" I had trouble loading this applet in Firefox, but it worked fine in Explorer; you can make nice illustrations of your work). You can also use graph paper and colored pencils or the formatting commands in Excel (first select all cells and change the row height and width from the format menu so the cells are approximately square; then change the background color of various cells).

The colors of the Cuisinaire Rods are as follows:

Length (centimeters)	Color	Length (centimeters)	Color
1	White	6	Dark Green
2	Red	7	Black
3	Light Green	8	Brown
4	Purple	9	Blue
5	Yellow	10	Orange

In the video, the children's class together finds that there are four "Rod Trains" of length 3 centimeters: Light Green, Red-White, White-White-White, and White-Red, and then the children work individually and in groups to find trains of length 4 and 5. Note that the Red-White train is considered different from the White-Red train, and for most of this problem, trains that contain the same rods in different orders will be considered different.

For this activity, you will explore the same problem as the children, but in more depth and at a more adult level. Focus especially on the following:

- Getting organized
- Looking for patterns
- Justifying why your patterns will continue
- Asking (and answering!) new questions about the problem

Note that for some questions you will want to assume that there are new Cuisinaire Rods that are longer than 10 cm.

Here are some questions to explore:

1. How many rod trains are there of length 4? How can you be sure you've found them all? Can you use the results of smaller cases to help you get organized and to help justify your reasoning? Don't ignore very small cases – solve the problem for rods of length 1 and 2 also, and see if you can use these results to strengthen your reasoning.

2. Can you find any patterns in the number of trains? Can you predict how many trains of length 5 there will be? Test your prediction.

3. How many trains do you think there will be of length 6? Of length 10? What if there were more bars (e.g. of length 11, 12, etc…. the online applet has some options that allow these). How many trains would there be of length 20? Of length n? Justify your reasoning (although, past a certain point, it's too much work to try to build them all). If you wish, use Excel to help you.

4. Now classify your previous results by the number of rods you used in each rod train. For example, there are 3 ways to make a train of length 4 using exactly 2 rods (white-light green, red-red, and light green-white). Find a way to organize your information and look for patterns.

5. There are many more patterns embedded in this problem and many variations. Explore. Select from the list below or ask and try to answer your own questions (your group can pick whichever looks most interesting to you). Your results from previous problems will be helpful, and spreadsheets might be too. Look for connections with problems we've already done in class.

    - Explore the number of trains of each length made with exactly two rods. Look for patterns. Can you predict how many trains of length 20 can be made from exactly two rods? Of length n? Justify your reasoning. (Assume that there are rods longer than 10 cm).
    - Explore the number of trains of each length made with exactly three rods.
    - Continue the above, generalize.
    - Explore the number of trains of each length made with only White and Red Rods.
    - Explore some other problems like the one above.
    - Suppose we consider trains that have the same rods to be the same, no matter the order of the rods (e.g. Red-White is the same as White-Red). How many trains of each length are there now?
    - How many trains are there of each length if we are not allowed to use White rods?
    - How many trains are there of each length if we are not allowed to use the same color of rod more than once in a train?