Math 12: Project Block Stacking
Due Friday December 4, 2009

Introduction

With our understanding of series we are now prepared to apply this knowledge to solving problems. In this project you will examine the stacking of blocks.

Everyone recalls stacking blocks as a child. Typically, one tries to construct as tall a stack as possible without knocking it down. The difficulty lies in placing the blocks carefully one directly on top of the other. In this project, you have a slightly different task. Instead of building a tall stack of blocks, we are interested in building a stack of blocks that spans a certain distance. In particular,

How far can a stack of n identical blocks of length 1 extend over the edge of a table?

The following are the assumptions that you may make:

(1) The blocks are completely uniform 1 unit in length with a mass of 1.
(2) You have as many blocks as you need.
(3) The blocks can be placed perfectly.
(4) No outside forces (other than gravity) can act on the blocks.
(5) You may only place one block per level (i.e. no counterweights).

To help you get started, consider what we can do with one or two blocks. The center of mass of a block is exactly the middle of the block. Then we can place the block with exactly half overhanding the table creating an overhang of 1/2. However, if we try to add another block on top of the first one, any shift further out from the edge of the table would cause the two blocks to fall since their combined center of mass is no longer over the table. In particular, the center of mass of the blocks above a certain block must lie over the block they are stacked on. You will need to determine the optimal placement for any number of blocks.

Assignment

(1) What is the smallest number of blocks needed to produce an overhang of at least 1? (if possible)
(2) What is the smallest number of blocks needed to produce an overhang of at least 2? (if possible)
(3) What is the largest possible overhang?

I expect all written work to be mathematically complete and not simply a numerical answer.

Checklist for Your Writing Projects. Based on checklists by Annalisa Crannell at Franklin & Marshall and Tommy Ratliff at Wheaton College.

Does this paper:

(1) clearly (re)state the problem to be solved?
(2) provide an explanation as to how the problem will be approached?
(3) state the answer in a few complete sentences which stand on their own?
(4) give a precise and well-organized explanation of how the answer was found?
(5) clearly label diagrams, tables, graphs, or other visual representations of the math?
(6) define all variables, terminology, and notation used?
(7) clearly state the assumptions which underlie the formulas and theorems, and explain how each formula or theorem is derived, or where it can be found?
(8) give acknowledgment where it is due?
(9) use correct spelling, grammar, and punctuation?
(10) contain correct mathematics?
(11) solve the questions that were originally asked?