

Warm-Up: Odd Dice

Prepared by Mark on September 25, 2025

Instructor's Handout

This handout contains solutions and notes.
Recompile without solutions before distributing.

Problem 1:

We say a set of dice $\{A, B, C\}$ is *nontransitive* if, on average, A beats B , B beats C , and C beats A . In other words, we get a counterintuitive “rock - paper - scissors” effect.

Create a set of nontransitive six-sided dice.

Hint: All sides should be numbered with positive integers less than 10.

Solution:

One possible set can be numbered as follows:

- Die A : 2, 2, 4, 4, 9, 9
- Die B : 1, 1, 6, 6, 8, 8
- Die C : 3, 3, 5, 5, 7, 7

Another solution is below:

- Die A : 3, 3, 3, 3, 3, 6
- Die B : 2, 2, 2, 5, 5, 5
- Die C : 1, 4, 4, 4, 4, 4

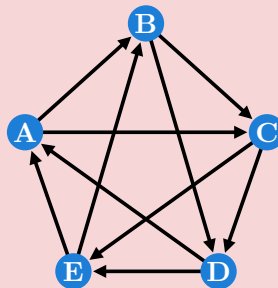
Problem 2:

Now, consider the set of six-sided dice below:

- Die A : 4, 4, 4, 4, 4, 9
- Die B : 3, 3, 3, 3, 8, 8
- Die C : 2, 2, 2, 7, 7, 7
- Die D : 1, 1, 6, 6, 6, 6
- Die E : 0, 5, 5, 5, 5, 5

On average, which die beats each of the others? Draw a diagram.

Solution:



Problem 3:

Now, say we roll each die twice. What happens to the graph from the previous problem?

Solution:

The direction of each edge is reversed!