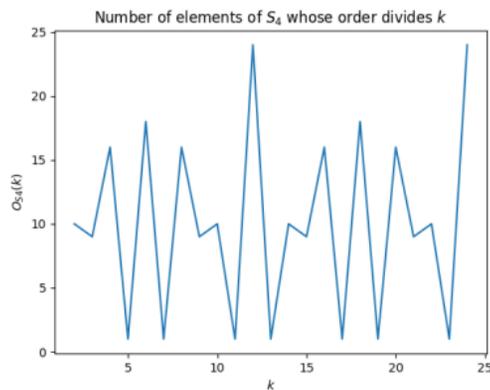


Mathematics Department Student Research Presentations

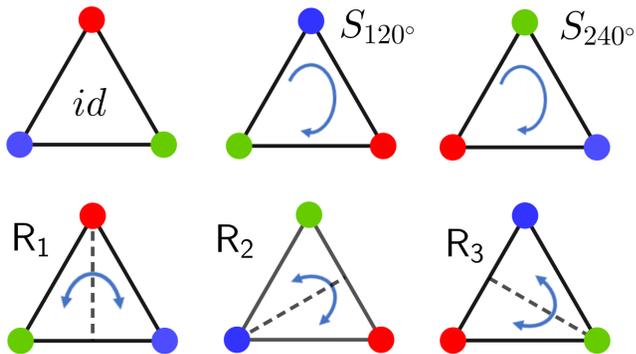
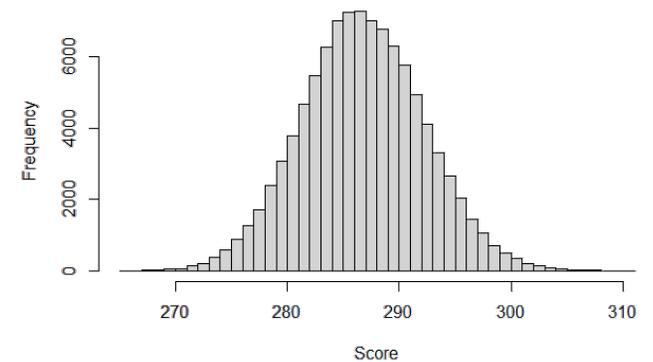
Tuesday, May 3

Swart 127



Joseph Pollari
Counting Group Elements
Whose Order Divides k
4:00-4:25 pm

Watson Simulated Results 09-21



Nicole Kuberra
The Performance Coefficient
in Golf: A Look at the
Masters Tournament
4:30-4:55 pm



Counting Group Elements Whose Order Divides k

Joseph Pollari

Never underestimate a theorem which counts something.

John B. Fraleigh

Groups (see definition below) arise naturally as symmetric actions of a given object. The group structure to combine symmetric actions is to simply perform one action after another. If the order matters, which it often does, then this operation is not commutative.

The study of groups from a purely algebraic point of view has led to many advances. Group theory has applications in diverse areas such as art, biology, geometry, linguistics, music, and physics. The kinds of groups covered in this investigation include permutation, symmetric, alternating, and dihedral groups.

Let k be an integer such that $1 \leq k \leq |G|$. We define a function $O_G(k) : \{1, 2, \dots, |G|\} \rightarrow \mathbb{N}$ to be the number of elements of G whose order divides k . Further, we define a function $H_G(k) : \{1, 2, \dots, |G|\} \rightarrow \mathcal{P}(G)$ be the set of elements whose order divides k . More formally,

$$H_G(k) := \{h \in G : h^k = e\} \text{ and } O_G(k) := |H_G(k)|.$$

For a general abelian G and select examples of nonabelian G , we'll find and compute $O_G(k)$ for arbitrary values of k , either through explicit equations or through algorithmic processes.

Group definition:

Let S be a set and \circ be a binary operation with the following properties:

1. Closure: For every a, b in S , $a \circ b$ is in S .
2. Associativity: For every a, b , and c in S , $a \circ (b \circ c) = (a \circ b) \circ c$.
3. Identity: For some $e \in S$, $e \circ a = a \circ e = a$.
4. Inverses: Every element a in S has a unique element a^{-1} such that $a \circ a^{-1} = a^{-1} \circ a = e$.

Let G denote S equipped with \circ . By the axioms above, G is called a **group**. An optional fifth axiom promotes G to an **abelian group**:

5. Commutativity: For every a, b in G , $a \circ b = b \circ a$.

The Performance Coefficient in Golf: A Look at the Masters Tournament

Nicole Kuberra

Abstract:

Golf is a sport that offers countless opportunities to perform a vast range of statistical analyses. Our research focuses on recent Masters golf tournament performances, addressing the following research questions:

- Who had the best performance at the Masters from 2009 to 2021?
- Who had the worst (winning) performance at the Masters?
- Which year was the most difficult for golfers at the Masters?.

We answer these questions by reproducing Hoegh's work defining a "performance coefficient" for professional golfers. The performance coefficient quantifies a player's performance based on their capabilities. We update Hoegh's work by applying his analysis to 2009-2021 Masters tournaments. This involves aggregating data from these tournaments and simulating thousands of rounds of golf for each player. We then extend Hoegh's research by correcting for course conditions, which can vary significantly from round to round.

