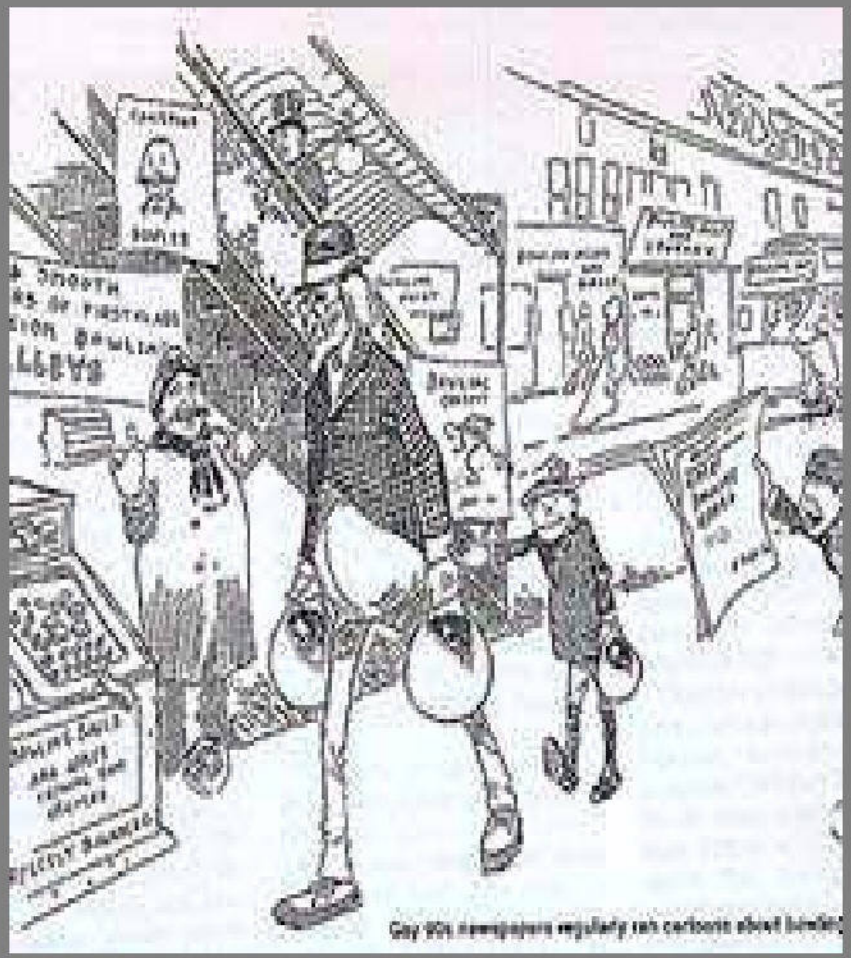
Moments of Interia of Bowling Balls

History of Bowling

- Possible origins as late as 3200 BC with a collection of objects appeared to be an early form of bowling.
- Others assert that bowling began possibly in Germany during 300 AD or England around 1366 under the reign of King Edward III.

History of Bowling (Cont.)

- No one is quite certain when bowling evolved from a nine pin to ten pin game.
- The sport had its ups and downs in America until Joe Thum formed the American Bowling Congress in 1885.



History of Bowling (Cont.)

- Bowling balls were previously made of lignum vitae, a very hard wood.
- First rubber ball was introduced in 1905, called the “Evertrue”.
- In 1914, the Brunswick Corporation produced the Mineralite ball, touting its “mysterious rubber compound”.

The Basic Bowling Ball

- The circumference can be no more than 27.002 inches and no less than 26.704 inches.
- The ball can weigh no more than 16 pounds, but there is no minimum weight.
- The diameter of the ball must be constant.
- No depressions or holes are allowed on the ball save for those caused by wear, used for gripping, and identification purposes.

The Basic Bowling Ball (Cont.)

- The ball can only be made of a non-metallic substance.
- No voids can exist within the interior of the ball.
- One hole allowed to be drilled in the ball for balance purposes of a diameter of no more than 1.25 inches.
- No more than 5 holes or indentations allowed for gripping purposes.

Bowling Ball Cores

- The size, density, and shape of the core effects the radius of gyration (Rg).
- A ball with a low Rg starts to roll earlier than a ball with a high Rg.
- This radius effects how early or late a ball hooks, as well as making it harder for friction to add to the ball's rotation.

Bowling Ball Cores (Cont.)

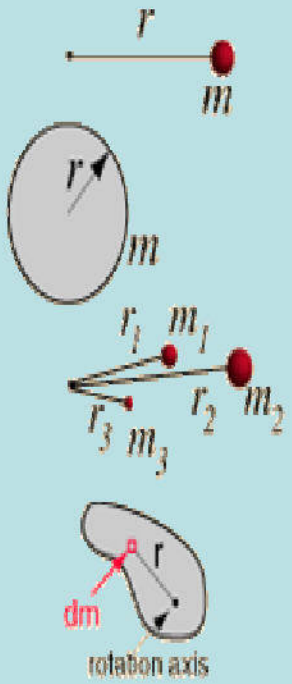
Rg Value (in inches)	Rg Rating	Typical Reaction
2.43 – 2.48	Very low	Very early arcing break point
2.49 – 2.51	Low	Early and strong arcing break point
2.52 – 2.54	Medium – Low	Medium length with snapping break point
2.55 -2.58	Medium	Gets down lane easily with snapping backend reaction
2.59 – 2.66	Medium – high	Late break point with sharp or arcing break point depending on carrydown
2.67 – 2.80	High	Extremely late break point

Bowling Ball Cores Shapes

- Possible Core shapes
- Cylinder
- Sphere
- Two right triangular cones attached to each other at their bases
- Can be off the rotational axis

Moment of Interia

- Moment of interia is rotational analog of mass for linear motion.
- Theoretical calculations will be done for the various core shapes.



$I = mr^2$

For a point mass the moment of inertia is just the mass times the radius from the axis squared. For a collection of point masses (below) the moment of inertia is just the sum for the masses.

$I = kmr^2$

For an object with an axis of symmetry, the moment of inertia is some fraction of that which it would have if all the mass were at the radius r.

$I = \sum_i m_i r_i^2 = m_1 r_1^2 + m_2 r_2^2 + m_3 r_3^2 + \ldots$

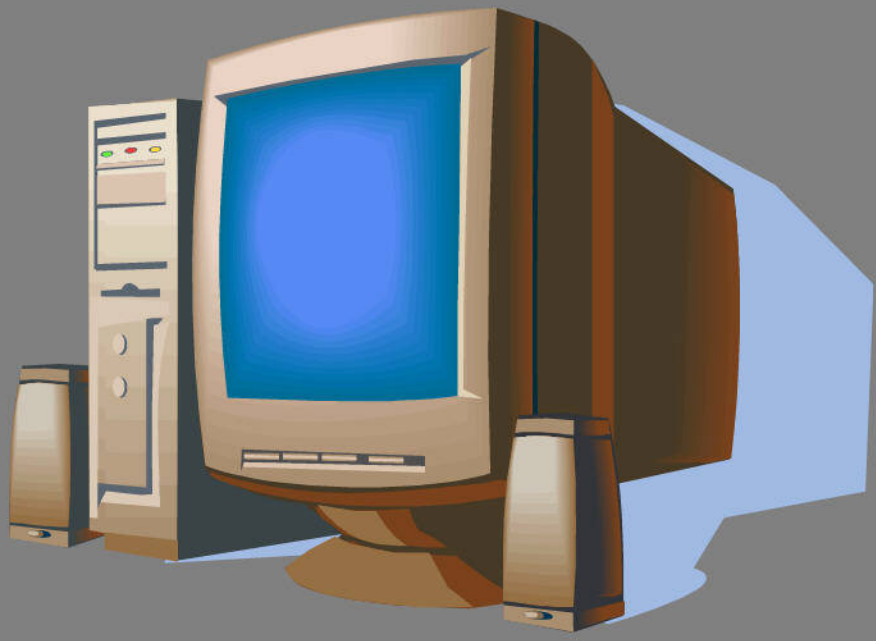
Sum of the point mass moments of inertia.

$I = \int_0^M r^2 dm$

Continuous mass distributions require an infinite sum of all the point mass moments which make up the whole. This is accomplished by an integration over all the mass.

Tools

- DirectMath as a front end for Mathematica
- Maple



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