Group Question List:

Your group will be assigned one of the following questions to investigate in detail. Unlike your papers, where a logical argument was considered sufficient to justify your answer, here you are expected to *do* something (measure something) to help you find your answer. If you have a hard time coming up with a technique to figure this out, come see me (as soon as possible).

Your final group presentation will be graded on the same categories as the paper rubric, with additional graded elements being appropriateness of experimental design, ability to answer questions about your answer and method during the presentation, and the quality of the final presentation itself.

Topics:

1. Depending on the arc used by the thrower, the amount of time between when the shooter releases a free throw and when it arrives at the basket can vary by a second or two. For all “standard” trajectories, identify the approximate distribution of times between shooter release and contact with the rim/backboard/net. What is the mean time? What is the median time? What is the bottom quartile and top quartile times?
2. Beach volleyball and indoor gym volleyball are different sports for many reasons; one of them (obviously) is the playing surface. For a group of average athletes, figure out the change in max jump height for someone jumping off of a hard, gym-like floor and jumping off of a beach volleyball-like sand surface.
3. In an effort to gain a competitive advantage, many strategies are used to improve swimming speed including “shaving down” and choice of attire “wet suit vs. speedo vs. jammer vs. recreational swimwear” as well as swimming headgear. Choose one or more of these variables to investigate and try to quantify any advantage attained by using the more advantageous choice.

4. There is a long history of “scuffing” baseballs in order to get more curve/break on pitches. Determining the amount of break one can get is a complicated problem because every pitch is going to be slightly different – even if your release point is identical, small cross-winds can greatly affect the break on the pitch. Therefore, let’s study the effect of scuffing a ball on fastball speed. Although fastballs move faster than terminal velocity, we can learn some about the final speed of a pitch by just studying the terminal velocity of a scuffed vs. unscuffed ball. For this inquiry, determine if scuffing a ball increases or decreases a baseball’s terminal velocity. You may wish to investigate different types of “scuffing”. Make sure you have enough information to make a definitive conclusion.
5. How does the terminal velocity of a volleyball (or soccerball) depend on its inflation pressure? Based on your results, how might inflation pressure influence the speed of the game?
6. Reaction times for professional sprinters are actually a bit better than we measured in class – they can be as short as 0.12 seconds or so. For recreational athletes (as most of us are), reaction times will be much slower. To try and investigate this, choose a race length of 40 yards. (40 yard dash). Compare speeds of athletes that are given a rhythmic “ready,set,go” warning with constant cadence (so that it is in a well predictable rhythm) to athletes who are “surprised” by the start time (either by saying ready,set,go in an uneven rhythm or by just saying, without warning, “go”). Comment, to the extent that you are able, on recreational athlete reaction times in a sprinting setting.
7. They make “anti-slice” golf tees for people who have difficulty hitting a straight drive. These tees are designed to help the ball come off the tee straight, but involve a larger contact area between the tee and the ball. Therefore, the drives likely go a shorter distance. Try and find out how much shorter on average.
8. Racquetballs seem like they never really go completely dead, yet some players swear that you need a fresh ball fairly frequently. Try to determine how the terminal velocity of a racquetball and the coefficient of restitution for a racquetball vary with age / usage.

9. Squash balls have to be “warmed up” before you can use them; before they are sufficiently warmed (by hitting them) they don’t bounce very well. Try to found the coefficient of restitution of recreation squash balls as a function of how many times they have been hit. (A challenging part of this is to determine how long you have to wait after you’ve hit the ball to be able to consider it cooled back down to its initial state).
10. In baseball, the distance between the bases is 90 feet. However, the distance a runner actually travels in moving around the bases is often larger than this because of the sudden direction changes needed when running from home to second on a double, for example. (Rounding first base adds to the total path length). Try to estimate the total distance run on an inside-the-park home-run where the baserunner is running at full speed the entire time. (Multiple trials would make sense here). Use this measurement to determine the actual average velocity of the runner (which will be higher than just 360 ft / X seconds where X is the total running time, since the distance actually run will be larger than 360 feet).
11. When the cue ball interacts with a pool table’s cushions, it is an inelastic collision. Find the coefficient of restitution of the cue ball with the rails. A well-constructed experiment will involve trying a lot of different initial speeds. Calculating velocities here could be tricky.
12. When you take into account air resistance, a dropped ball doesn’t continue to accelerate indefinitely. Since air resistance depends on fall speed, eventually a balance between gravitational force pulling the ball down and air resistance pushing the ball up is reached; the speed this occurs at is known as the terminal velocity of the ball. The ball CAN move at speeds faster than the terminal velocity, but if a ball falls at a speed faster than its terminal velocity, it will actually slow down as it falls further due to a net upward acceleration. In this problem, try to experimentally determine the terminal velocity of a ping-pong ball.