

Assignment III, FYSE 130
Fall 2014
Due 9/5/14 at start of class

1. As mentioned in the last homework, Usain Bolt set the world record for the 100 meter dash at 9.58 seconds. Here's how that record-breaking run breaks down into 20 meter increments:

Position	Time for Interval (s)
0-20 m	2.89
20-40 m	1.75
40-60 m	1.67
60-80 m	1.61
80-100 m	1.66

- a) Based on this data, what was Usain's average velocity in the first 20 meters of the race?
- b) Based on this data, what was Usain's acceleration in the first 20 meters of the race? (We'll assume it was constant, even though it probably wasn't).
- c) Human reaction time is somewhere in the neighborhood of a tenth of a second, even for the best sprinters. If you subtract a tenth of a second off of the first 20 meter interval for Usain due to reaction time, what was his average velocity in the first 20 meters of the race?
- d) Based on our revised data for average velocity as calculated in part (c), what was Usain's true acceleration in the first 20 meters of the race? (We'll again assume it was constant, even though it probably wasn't). (It might be a good idea to keep this acceleration in mind as a good approximate maximal acceleration for a human running; this number could come in handy in the future).
- e) From splits like these, it is impossible to tell exactly what the highest speed reached was, but the average velocity in the 60-80 m interval will give a decent approximation. What was Usain's average speed in the 60-80 m part of the race (in m/s)?
- f) Convert your answer in part (e) to miles per hour.

MORE ON BACK!

2. A quarterback throws a screen pass to his halfback. The throw is released perfectly horizontally at 30 miles per hour. (Ignore any air resistance on the ball or any other effects associated with the shape of the football).
 - a) How fast was the throw made in meters per second?
 - b) The halfback caught the ball 0.4 seconds after the ball was released. How far away from the quarterback was he when he caught the ball? (Since this is football, leave your answer in yards).
 - c) How far did the football drop between when the quarterback let it go and the halfback caught it? (Leave your answer in feet).
3. The giant video board at Cowboys stadium is 90 feet above the playing surface. Many punters enjoy trying to hit it in pregame warmups. What would the minimum hang-time on a punt have to be for a punt that hits the bottom of the video board?
4. In the absence of air resistance, the optimal angle to launch a projectile a maximal distance with the least speed is 45 degrees. On a soccer pitch, the distance from the halfway line to the endline is 50 meters.
 - a) What is the minimum speed (in meters/second) one would have to kick a soccer ball to hit the endline in the air (neglecting air resistance)?
 - b) How long would such a kick stay airborne?
 - c) How high would such a kick reach?