

Eastern Oregon University
Mini-Project #1
MATH 323 - Math Modeling

Name: _____

Major: _____

In the 100 *m* sprint, Usain Bolt's top speed in 2009 was 12.42 *m/s*. In that race he ran 100 *m* in 9.58 *s*. Assume that his velocity as a function of time can appropriately be modeled as

$$v(t) = \frac{a_0 t}{\sqrt{1 + \left(\frac{a_0^2 t^2}{v_{max}^2}\right)^2}} \quad (1)$$

1. Usain Bolt Record 100 m dash Analysis

- (a) What was his average speed?
- (b) Using the data above, determine his average velocity quantitatively.
- (c) Using the mathematical definition of average, write an integral expression for the average velocity where you equate the integral expression to the average velocity you just calculated.
- (d) Perform the integral, obtaining a (probably transcendental) equation for a_0 .
- (e) Use Maple or some other computer algebra system to determine his initial acceleration.
- (f) Express the initial acceleration in "g's".
- (g) What assumptions have you made in this analysis?

2. Model Comparison

- (a) Make a plot of $v(t)$ from your model along with the data points from <http://datagenetics.com/blog/july32013/index.html>
- (b) Find the rms error.