Psychology of Perception
Psychology 4165-100
Spring 2011

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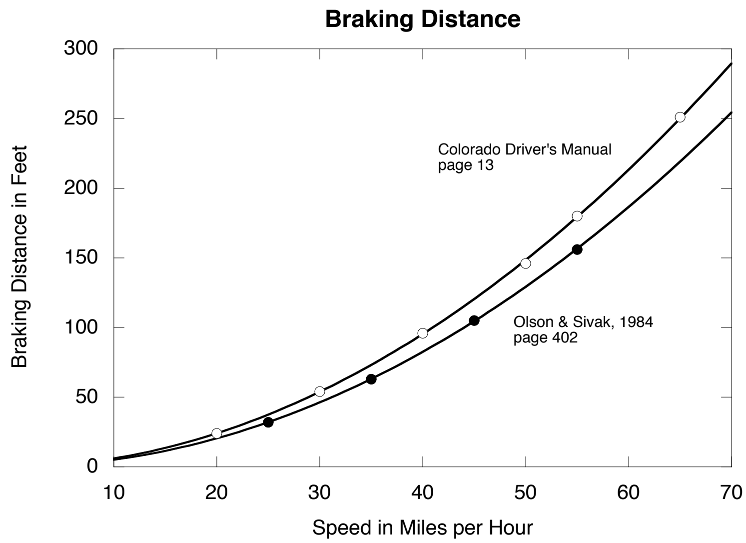
09:30–9:45 TuTh

Homework 5: Perception Reaction Time
10 Points: Due at beginning of class, Thursday, 7 April 2011

There are two parts to this homework assignment. Each part counts 5 points. Late homework will receive a grade of zero.

Part 1: The distances required to bring a car to a stop from various speeds by braking (from the moment that the brake is applied to full stop) are illustrated in the graph.



The two sets of data are from different sources but they are quite similar. The upper set of data, taken from the Colorado Driver's Manuel, is described by the following equation:

$$Feet = 0.062673 \cdot MPH^{1.9862}$$

At 50 miles per hour this equation predicts that an average automobile needs about 148 feet to brake to a complete stop. Assume that the perception reaction time is 2.0 seconds. What is the minimum visibility distance, in feet, needed to be able to bring a car traveling 50 mph to a stop to avoid hitting a pedestrian standing in the roadway? Show your calculations and explain your answer. Hint: for both parts of this homework it will be helpful to write functions in R that evaluate the equations that you need. For example, in R the above braking-distance-equation would be:

```
braking.distance.ft <- function(mph){0.062673*(mph^1.9862)}
```

To then find the braking distance at 10 mph you would type:

```
braking.distance.ft(10)
```

Part 2: If the automobile's low beam headlights provide effective illumination of a darkly-clad pedestrian out to a distance of 100 feet, will the car described in Part I hit the pedestrian at night? What is the maximum speed of a car that will allow it to stop just short of the pedestrian? Show your calculations and explain the basis of your answer. Prepare a plot showing the total stopping distance (PRT + Braking) (y-axis) for speeds ranging from 1 to 50 mph (x-axis), assuming a PRT of 2.0 sec. Mark the speed on the graph that will require 100 feet of stopping distance

Part 1:

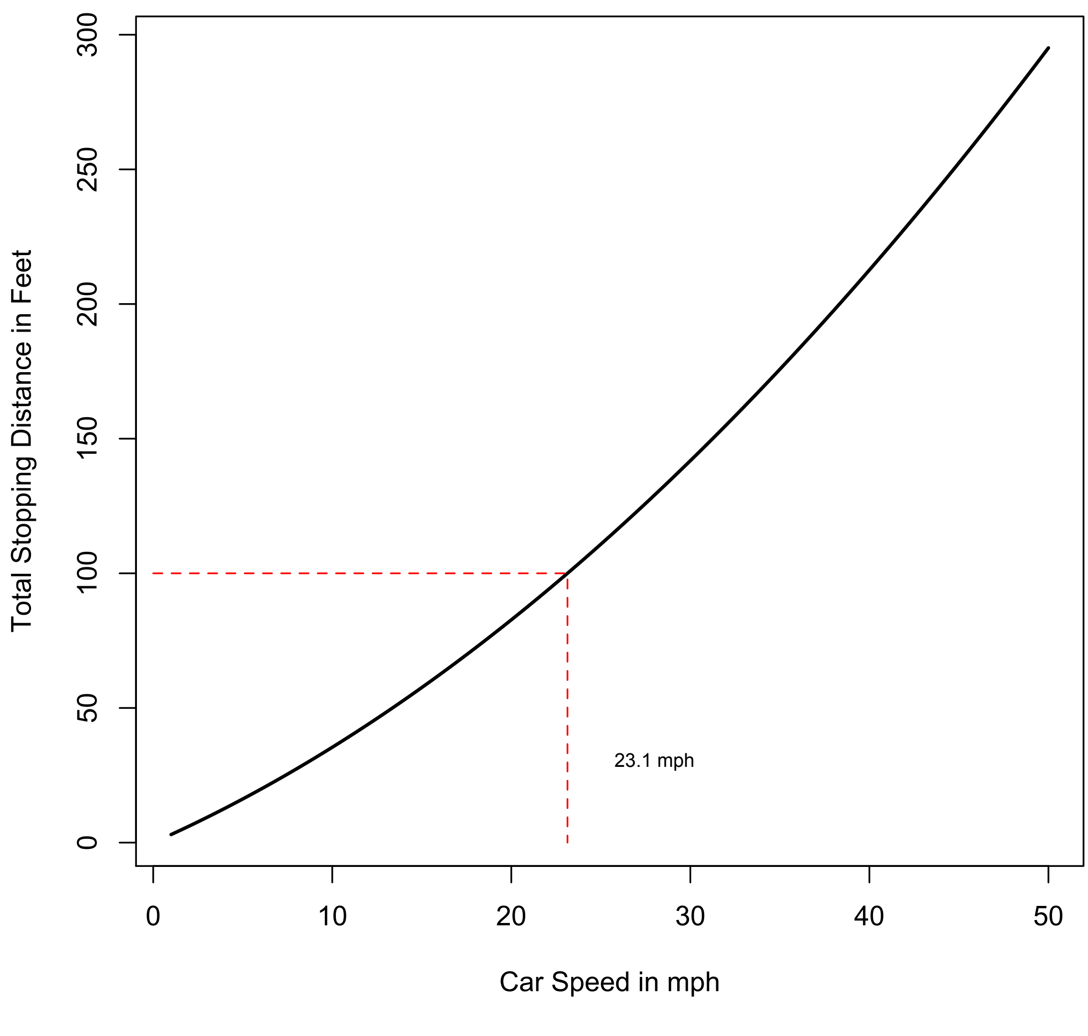
148 + (2*50*1.46667) =

148 + 146.667 =

94.6667 feet

Part 2:

Answer: 23.13782 mph



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```r
# Perception Reaction Time Homework
# PSYC 4165
# Lew Harvey
# 30 March 2011
#
# R code for solving part 2 of the homework
# first define these two equations:

# Equation 1:
# define a function that computes the braking distance in feet
# given the car speed in mph
braking.distance.ft <- function(mph){0.062673*(mph^1.9862)}

# Equation 2:
# define a function that computes the distance traveled in feet
# during the perception reaction time given the prt in seconds
# and the speed in mph
prt.distance.ft <- function(prt, mph) {prt*mph*1.4666667}

# now define a function that uses the two functions above
# so that the actual answer cam be computed.
# The function computes the total stopping distance in feet given the
# speed of the car in mph, the perception reaction time
# (defaults to 2 sec) and the distance of the target (needed so
# the equation can be solved for zero using uniroot(), see below)
total.stopping.distance.ft <- function(mph, prt = 2, feet = 0) {
     braking.distance.ft(mph) + prt.distance.ft(prt, mph) - feet}

# the mph value that gives a 100 feet stopping distance is
# total.stopping.distance.ft(23.13782)

# There are two ways to figure out the answer:
# 1. Trial and Error - try out different speeds in the above
#    equation to find the value that gives 100 feet as the answer;
# 2. Use univariate root finder (uniroot()) to find the speed (mph)
# that will bring the function to zero with an input value of 100 feet.
# The result is saved in object z
z <- uniroot(total.stopping.distance.ft, c(1, 40), prt = 2, feet = 100)
# show the answer by displaying the structure of the uniroot object z.
str(z)

# plot the stopping distance for a range of values.
# Note that I have used the answer (23.13782 mph) to draw
# the horizontal and vertical lines. Of course you need to
# discover what that value is by using uniroot and a distance value
# of 100 feet.
maxspeed <- 23.13782
x <- seq(1,50,0.1)
y <- total.stopping.distance.ft(x)
plot(y ~ x, type="l", lwd=2,
     xlab = "Car Speed in mph",
     ylab = "Total Stopping Distance in Feet")
lines(c(0, maxspeed, maxspeed), c(100, 100, 0), lty="dashed",
col="red")
text(28, 30, paste(round(maxspeed, 1), "mph"), cex=0.7)
```