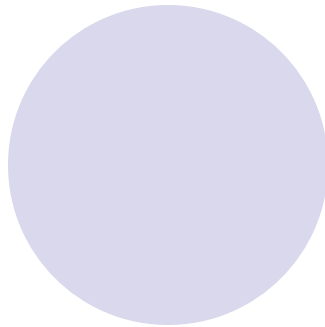
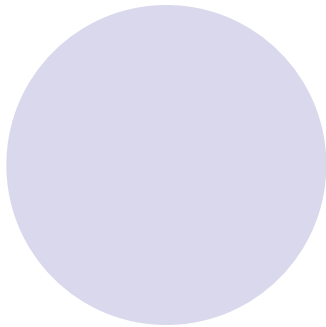


# The Effect of Different Loft Angles of Golf Club on the Distance of the Ball Traveled



Thomas Choi  
Eric Lee

11<sup>th</sup> Grade Woodbridge High School

2/01/09

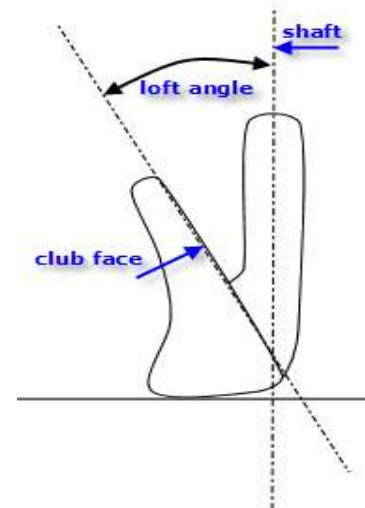
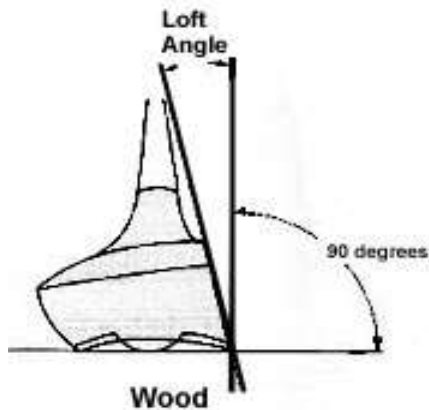
# Purpose/Hypothesis



- Purpose: To find which of the loft angles of the golf clubs is the most effective for the golf ball to reach the farthest distance
- Hypothesis: The golf ball hit by driver with greatest loft angle ( $12.5^\circ$ ) will travel the farthest

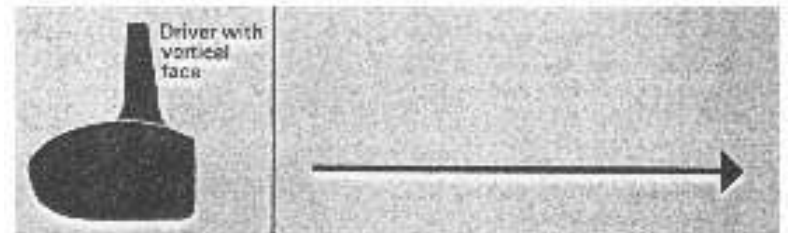
# Background Information

- Loft Angle – an angle formed between a vertical line and clubface when the club is in the address position
- Determines the initial shot trajectory when the ball is struck



# Background Information

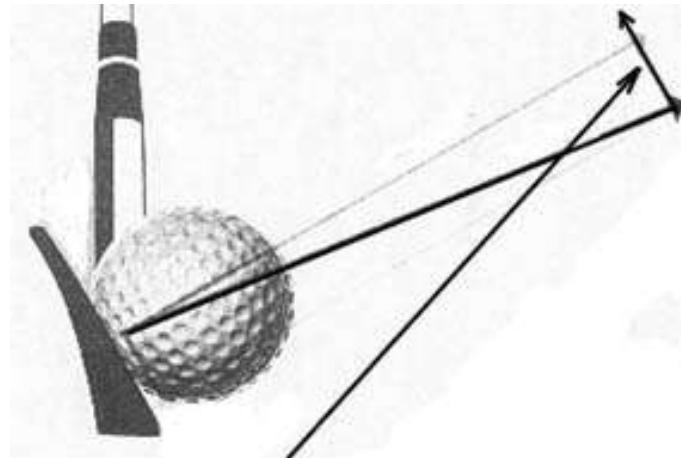
- Higher swing speed generally benefit more from driver with lower loft angle vice versa with slower swing speed
- Angle of attack – angle of clubhead's path as it travels toward and makes contact with the ball
- Zero angle of attack = clubhead level with ground at impact



A zero degree loft club will deliver the maximum energy transfer of your swing. But loft is needed because gravity will pull the ball to the ground too fast.

# Background Information

- Clubhead speed – measure of how much energy and momentum the clubhead has
- Higher clubhead speed at impact = ball rebound faster and travel further



This component of clubspeed energy is NOT in the forward direction we desire for distance. Luckily it's not a total loss because golf balls are produced with surfaces that facilitate lift when spinning to keep the ball airborne longer



# Background Information

- Less loft = more energy and momentum directed to forward direction
- Also ball launch on lower trajectory and gravity will want to pull the ball down faster
- More loft = ball trajectory higher, swing power wasted on vertical direction but should go in horizontal direction

# Methods



- Manipulated variable: Different loft angles of driver (golf club)
- Units: Degrees of angles ( $^{\circ}$ )
- Responding variable: Distance of the golf ball traveled
- Units: Yards of the distance that the ball traveled -> converted into Meters

# Methods



- Type of golf club: controlled by using same brand drivers and just have different loft angles
- Swing speed: controlled by using the machine to calculate it
- Environment of experiment: controlled by doing it indoors where there would not be outside factors affecting the golf ball's travel
- Person hitting the ball: controlled by having the same person do the same experiment and by doing so, keeps the variables of the swings constant

# Methods



- The research was done at the Club Fitting Center at Golfsmith Golf Shop located in Costa Mesa on December 13th, 2008.
- It was a small driving range, which had a machine that had cameras take photos of the ball at impact and computer to record the swing data

# Methods



- 5 drivers with loft angles ( $8.5^\circ$ ,  $9.5^\circ$ ,  $10.5^\circ$ ,  $11.5^\circ$ ,  $12.5^\circ$ ) were selected and rented
- Each of drivers were swung many times with controlled swing speed and angle of attack calculated by the machine
- While swinging, when the driver head is at impact of the ball, high swing speed camera took a picture of the impact and calculated the data. (Distance of the ball traveled.)

# Methods



- With each balls hit, the ball was replaced at the tee and the data was recorded.
- This procedure was repeated for all other 4 drivers.
- After many trials, 15 best data were collected for each of the drivers.
- Average mean was calculated for each distances
- The data, recorded with yards, were converted to meters.

# Methods

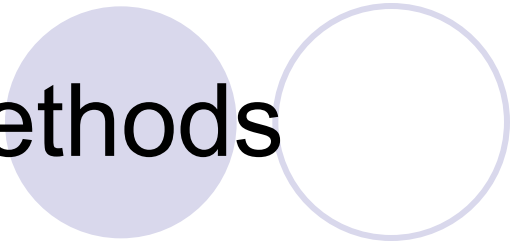


Figure 1



The data shown on the computer screen.

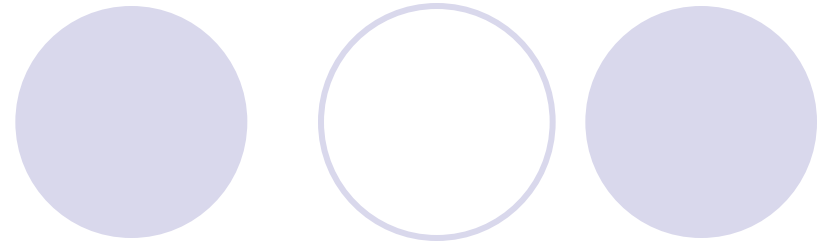


Figure 2



A picture of the ball right after its impact. (Taken by a high speed camera)

# Methods

Figure 3



The computer screen and monitor that recorded the data.

Figure 4



The mini range that was used for the experiment.

# Results

- Golf balls that was hit with  $10.5^\circ$  loft driver traveled the farthest
- Ones hit with  $8.5^\circ$  loft driver traveled the shortest
- Best fit lines of each graph are linear and have very small slopes, not complete horizontal lines
- Balls hit by drivers with  $8.5^\circ$  and  $11.5^\circ$  loft angles had negative slope, the rest had positive slopes

# Results

- Balls hit with  $12.5^\circ$  loft driver had least deviation
- Average deviation for each loft angle all rounded to 0.00% using significant figures
- Order of loft angles that had the ball travel farthest to shortest:  $10.5^\circ$ ,  $11.5^\circ$ ,  $9.5^\circ$ ,  $12.5^\circ$ ,  $8.5^\circ$

# Results

● Table 1. Landing Distances

Loft Angle (°)	8.5	9.5	10.5	11.5	12.5
Distance (m) (Trial 1)	203.2	216.7	233.1	224.6	206.8
Distance (m) (Trial 2)	193.7	217.3	241.7	227.4	205.1
Distance (m) (Trial 3)	192.3	221.1	238.6	230.1	208.9
Distance (m) (Trial 4)	201.7	218.9	234.9	229.5	207.2
Distance (m) (Trial 5)	192.5	215.9	239.2	223.7	211.3
Distance (m) (Trial 6)	193.5	219.0	241.0	227.8	209.5
Distance (m) (Trial 7)	190.0	222.4	237.5	232.8	213.3
Distance (m) (Trial 8)	200.5	215.6	238.4	224.9	206.4
Distance (m) (Trial 9)	194.6	217.7	235.8	225.1	204.6
Distance (m) (Trial 10)	197.3	217.9	239.2	228.2	208.7
Distance (m) (Trial 11)	192.6	220.8	242.6	227.0	210.7
Distance (m) (Trial 12)	193.8	218.2	237.0	224.3	206.1
Distance (m) (Trial 13)	195.6	219.4	236.9	229.0	207.0
Distance (m) (Trial 14)	192.4	218.5	239.8	234.6	212.0
Distance (m) (Trial 15)	194.9	219.8	237.5	221.7	205.4
<b>Total Distance (m)</b>	2928.6	3279.2	3573.2	3410.7	3123.0
<b>Mean (m)</b>	195.24	218.61	238.21	227.38	208.20

# Results

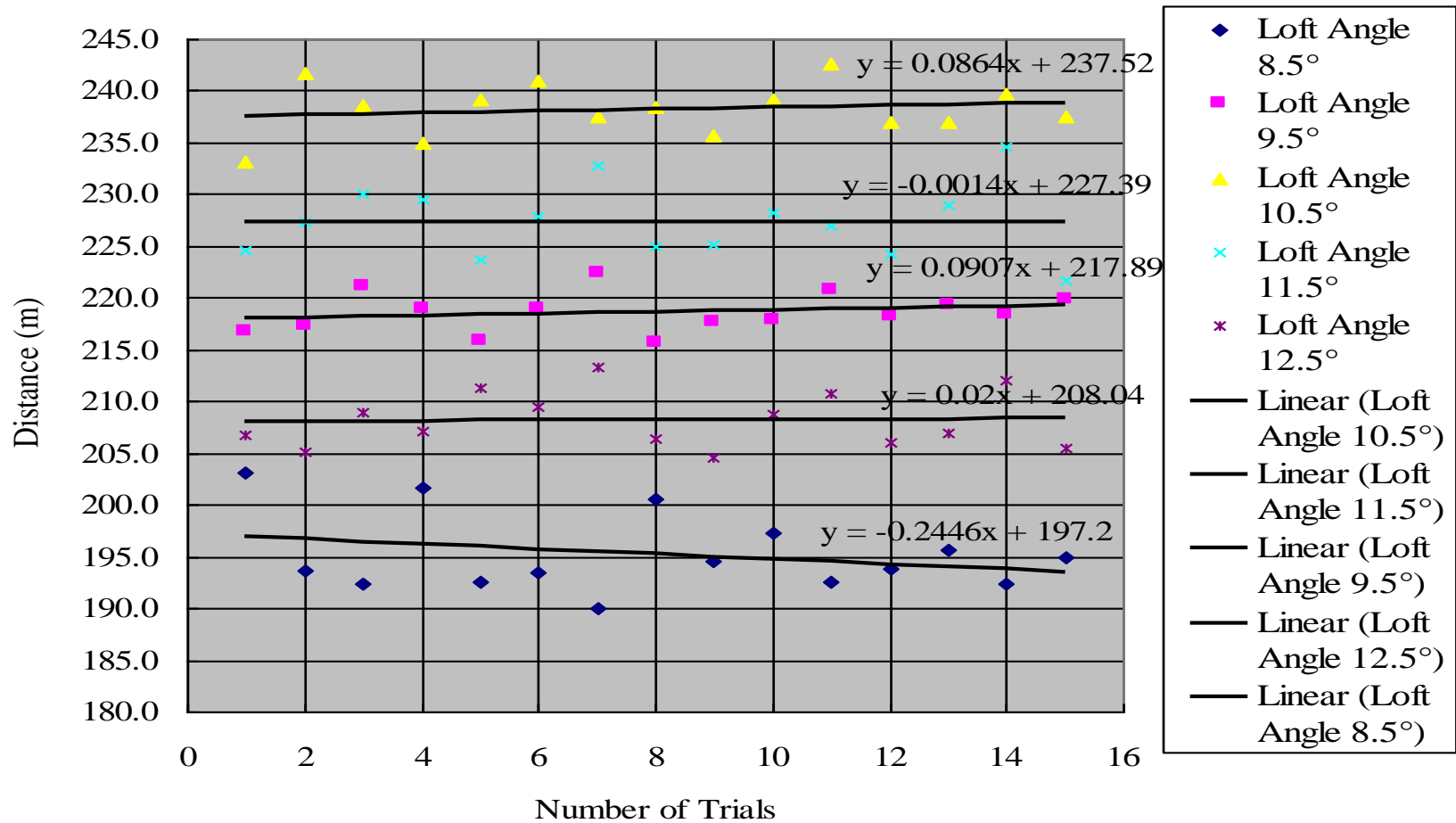
- Table 2. Deviations of the Data Collected

Loft Angles (°)	8.5	9.5	10.5	11.5	12.5
Deviation (m)	8.0	-1.9	-5.1	-2.8	-1.4
	-1.5	-1.3	3.5	0.0	-3.1
	-2.9	2.5	0.4	2.7	0.7
	6.5	0.3	-3.3	2.1	-1.0
	-2.7	-2.7	1.0	-3.7	3.1
	-1.7	0.4	2.8	0.4	1.3
	-5.2	3.8	-0.7	5.4	5.1
	5.3	-3.0	0.2	-2.5	-1.8
	-0.6	-0.9	-2.4	-2.3	-3.6
	2.1	-0.7	1.0	0.8	0.5
	-2.6	2.2	4.4	-0.4	2.5
	-1.4	-0.4	-1.2	-3.1	-2.1
	0.4	0.8	-1.3	1.6	-1.2
	-2.8	-0.1	1.6	7.2	3.8
	-0.3	1.2	-0.7	-5.7	-2.8
<b>Average Deviation (m)</b>	0.07	0.01	0.01	0.02	0.00
<b>% Deviation (%)</b>	0.00	0.00	0.00	0.00	0.00

# Results

● Figure. 9

## Distance of Ball Traveled in Each Trial Using Different Loft Angles



# Discussion/Analysis



- Hypothesis that driver with greatest loft angle ( $12.5^\circ$ ) would travel farthest was not supported
- Driver with  $10.5^\circ$  loft angle hit the ball farthest because this degree was best for experimenter's angle of attack

# Discussion/Analysis



- Swing speed & launch angle necessary to have consistent distances without too much variance
- More trials need to be done for more precision of swing speed & launch angle
- One error: driver did not hit the sweet spot during impact

# Discussion/Analysis



- Experiment can be improved by having more people experimented instead of just one person
- To see different outcomes for everyone according to their own swing speed and angle of attack

# Conclusions

The word 'Conclusions' is positioned at the top left of the slide. To its right, there are two circles: a solid light purple one and an outlined light purple one. Further to the right, there are three more circles: a solid light purple one, an outlined light purple one, and another solid light purple one.

- According to the result, the ball that was hit by driver with  $10.5^\circ$  loft traveled the farthest distance.
- Loft angles were not the only factors that affect the distance ball travel when it is hit.
- Controlled swing speed and angle of attack were also necessary to get the best result.

# Further Research & Application

- This experiment could enhance by experimenting with a high technology swing machine where the machine hits the ball instead of a experimenter.
- This way, less trials is needed and is more accurate. (regards human errors)
- This project is useful to determine each person's own best golf club for the best game performance.

# Literature



- “Loft Angle and Lie Angle of a Golf Club.” 2004-2008 PatentStorm LLC. 20 Oct. 2008  
<<http://www.patentstorm.us/patents/6363620/claims.html>>.
- “Loft Angle and Lie Angle of a Golf Club.” 2004-2008 PatentStorm LLC. 20 Oct. 2008  
<<http://www.patentstorm.us/patents/6363620/claims.html>>.
- Pinemeadow Golf Products, Inc., 2007. "Golf Lesson #1: The Basics of Golf Clubs," 21 Oct. 2008  
<[http://www.pinemeadowgolf.com/clubs101\\_1.html](http://www.pinemeadowgolf.com/clubs101_1.html)>.

# Credits/Acknowledgements



- Acknowledgements our parents for giving rides to the experimenting site
- Also acknowledgements to Mr. Antrim for the guidance of the research, and Coach Tracy Roberts for help to find the experimenting site and lending the golf clubs that were needed