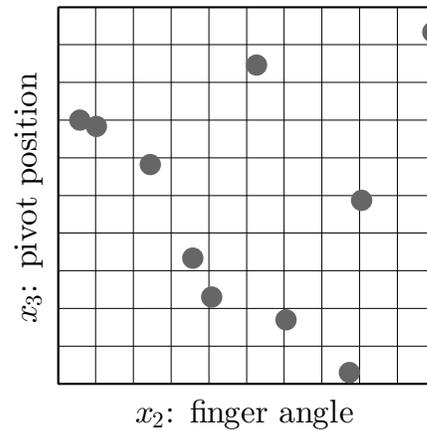
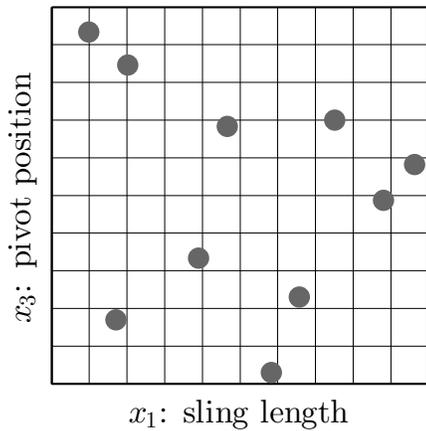
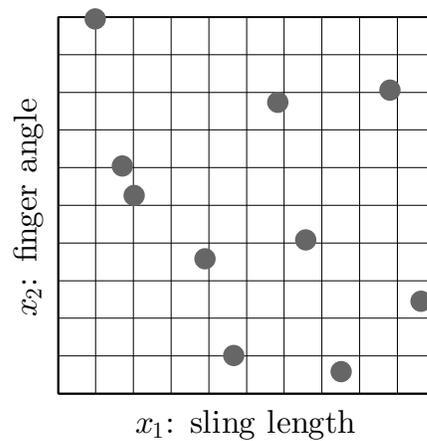
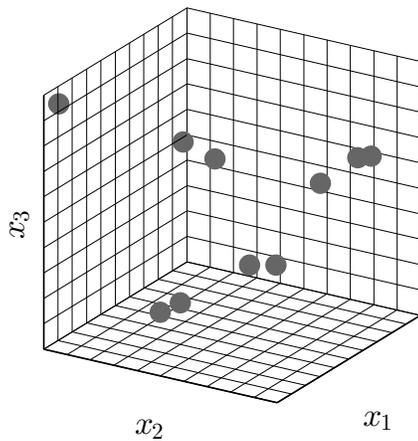




Design of Experiments Activity

GE100 Introduction to ISE

September 12, 2014



Latin hypercube sampling method¹

¹http://en.wikipedia.org/wiki/Latin_hypercube_sampling. For more information on DOE, you can take the elective course IE 400-Design & Anlys of Experiments.

1. Sign In (All Group Members)

Group Number: _____

Name: _____ NetID: _____

2. How to Use this Document

- Red underlines in the digital PDF are hyperlinks to locations in the PDF or website. You can link these to jump to the hyperlinked location. The example here goes to the figure on the first page: [Click Me](#)

3. Rank the Design Variables

Your task today is to plan out the experiments that your group will perform on the first launch day. **Please complete all the tasks on this worksheet** (there are six tasks), and turn it in at the end of class. This plan will be returned to you on the launch day so that you can use it in your tests. Your trebuchet must be fully assembled before completing this activity. If it is not complete, please finish your trebuchet assembly now.

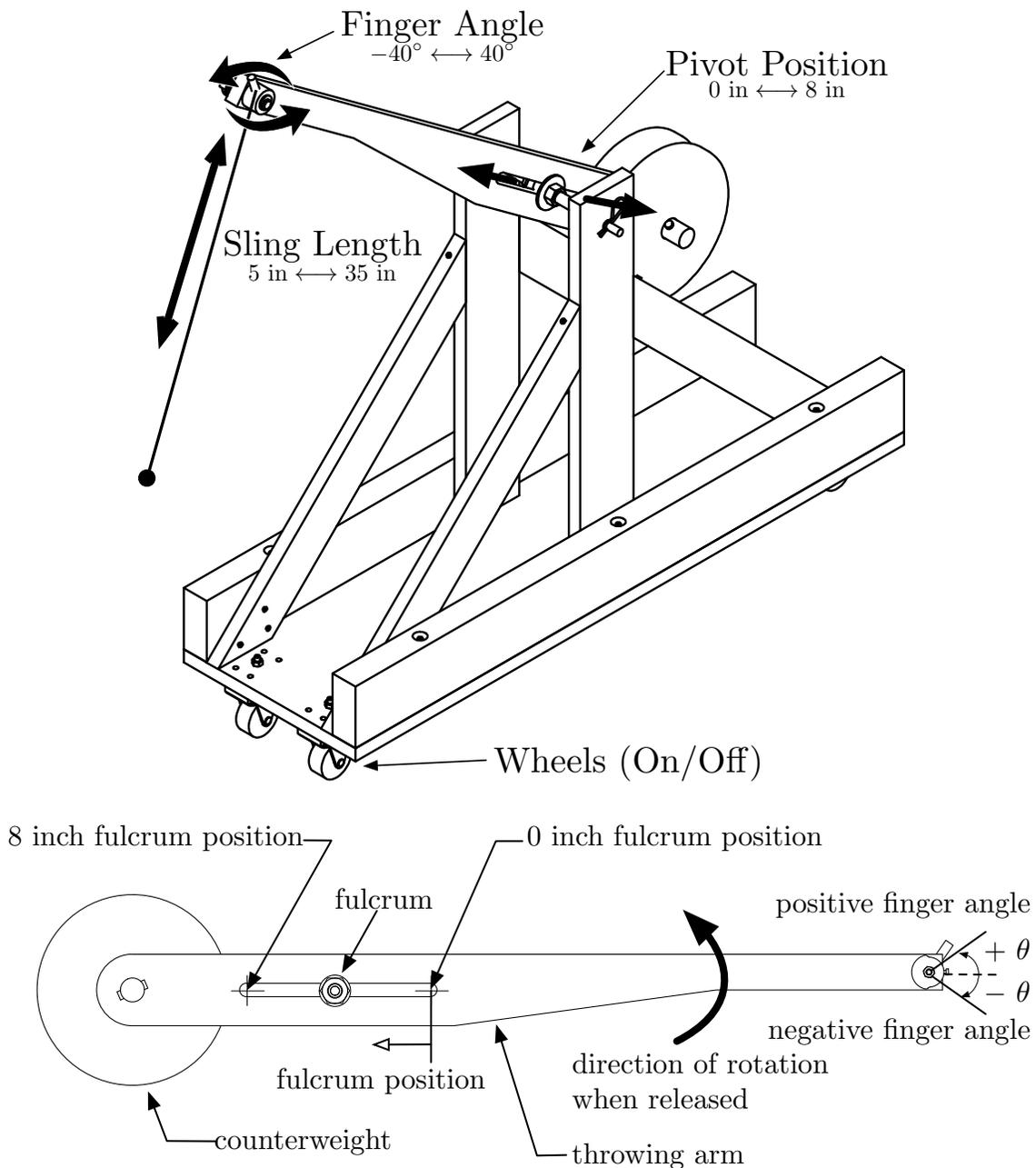
Rank the design variables according to what you predict their influence on projectile range is. The variables are fulcrum position, sling length, finger angle, and wheel use. Variable #1 is what you consider to be the most important variable. You are encouraged to move and manipulate the parts of the trebuchet to get some intuition for the trebuchet design.

#1: _____

#2: _____

#3: _____

#4: _____



Note the fulcrum position and finger angle are measured as indicated in the figure above. When the fulcrum is as close as possible to the counterweight, it is in the 0 inch position, and when it is as close as possible to the finger it is in the 8 inch position. The finger angle is positive if the finger is pointed in the direction that the throwing arm rotates upon release, and the finger angle is negative if the finger is pointed opposite the direction that the throwing arm rotates upon release. The angle is measured from the dotted line shown in the figure.

4. Identify Variable Ranges

Identify variable ranges that you think will be important to test. The maximum and minimum values for all of the variables are given in the table below.

Variable #	Range
Fulcrum Position	0 to 8 inches
Finger Angle	-30 to 40 degrees
Sling Length	10 to 30 inches
Wheels	Yes or no

Try to develop some intuition for ranges within these maximum and minimum values that will be important to test. For example, you can move the throwing arm slowly while holding the pouch to get a sense for when the projectile will release. What range of finer angles do you think are likely to release the projectile at a good angle? In the table below, please record the ranges that you think are most important to test. This will help you in planning out your experiments.

Variable	Min	Max
Fulcrum Position		
Finger Angle		
Sling Length		
Wheels		

5. Plan for a Budget of 8 Total Experiments

If all goes smoothly, you will have time for two rounds of launches, each with four launches for a total of eight experiments. Please plan out the design for each of your tests, and record your experimental plan in the table below.

Variable	Launch Round 1				Launch Round 2			
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8
Fulcrum Pos.								
Finger Angle								
Sling Length								
Wheels								

Please note that the wheel variable (yes or no) must be the same for the first four tests and for the last four tests. This is because you will not have time to install or remove the wheels during the same launch round. You must be able to switch between designs during the same launch round very quickly (ideally less than a minute). If you want to test your trebuchet both with and without wheels, you may make the switch between launch rounds while you are waiting in the staging area. You will need to make this change fast to be ready for your second round of launching in time.

6. Practice Your Design Configurations

Strategize with your group members how you make the changes as quickly as possible between tests. Have your ELA initial below that you have practiced making design changes, at least with the three continuous variables (everything but wheels).

ELA Initials: _____

Safety

Make sure that you **understand the safety rules**. They will be spelled out in greater detail as the launch day approaches. Also, make sure that you understand the logistics of how your group will move around on the field during launch day. **Now is your opportunity to ask questions** so that you can help make everything go smoothly on launch day.

Finally, keep in mind that there is a **competition** for the longest range. Be sure to plan out your experiments well, and good luck!