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STATAPULT® MANUAL

A Simple Guide for Using the Statapult® Catapult

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Introduction

The Statapult® is used by thousands of companies, organizations, and academic institutions around the world. It can be used to teach and/or practice Variance Reduction, Cause and Effect, Basic Statistics, Statistical Process Control (SPC), Control Charts, FMEA, and Design of Experiments (DOE). It's a great tool for team exercises and for applying statistical methods to real-world problems. It makes training fun, interactive, and memorable!

Getting Started

Congratulations on your Statapult® purchase! Included in your Statapult® shipment, you will find the following (see Figure 1.0):

- Two smash balls and an extra rubber band
- Base with three metal pins and Measuring Device (protractor) attached
- Arm with ball cup, rubber band hook, rubber band, and rubber stopper attached

Figure 1.0 Statapult Parts

Assembly

The assembly of the Statapult® is simple and straight forward. An assembled Statapult® is shown in Figure 2.0 below. Insert the Statapult® arm into the base crevice and align the hole at the bottom of the Statapult® arm with the hole in the base of it. Insert the metal pin through both holes, securing the arm to the base. The arm's rubber stopper should be able to impact the adjustable metal pin used as a stop. Unwrap the rubber band from the ball cup and stretch the rubber band over the metal pin located on the tower and loop the rubber band around the wooden knob located at the base of the tower. You're now ready to launch balls for distance!

Figure 2.0 Assembled Statapult

Operation

The Statpult® operation begins with the initial setup of the Statapult®. There are four major variables or factors that can be adjusted as shown in Figure 3.0: Ball Cup Position, Tension Pin Setting, Stop Angle Pin Setting, and Rubber Band Hook Setting.

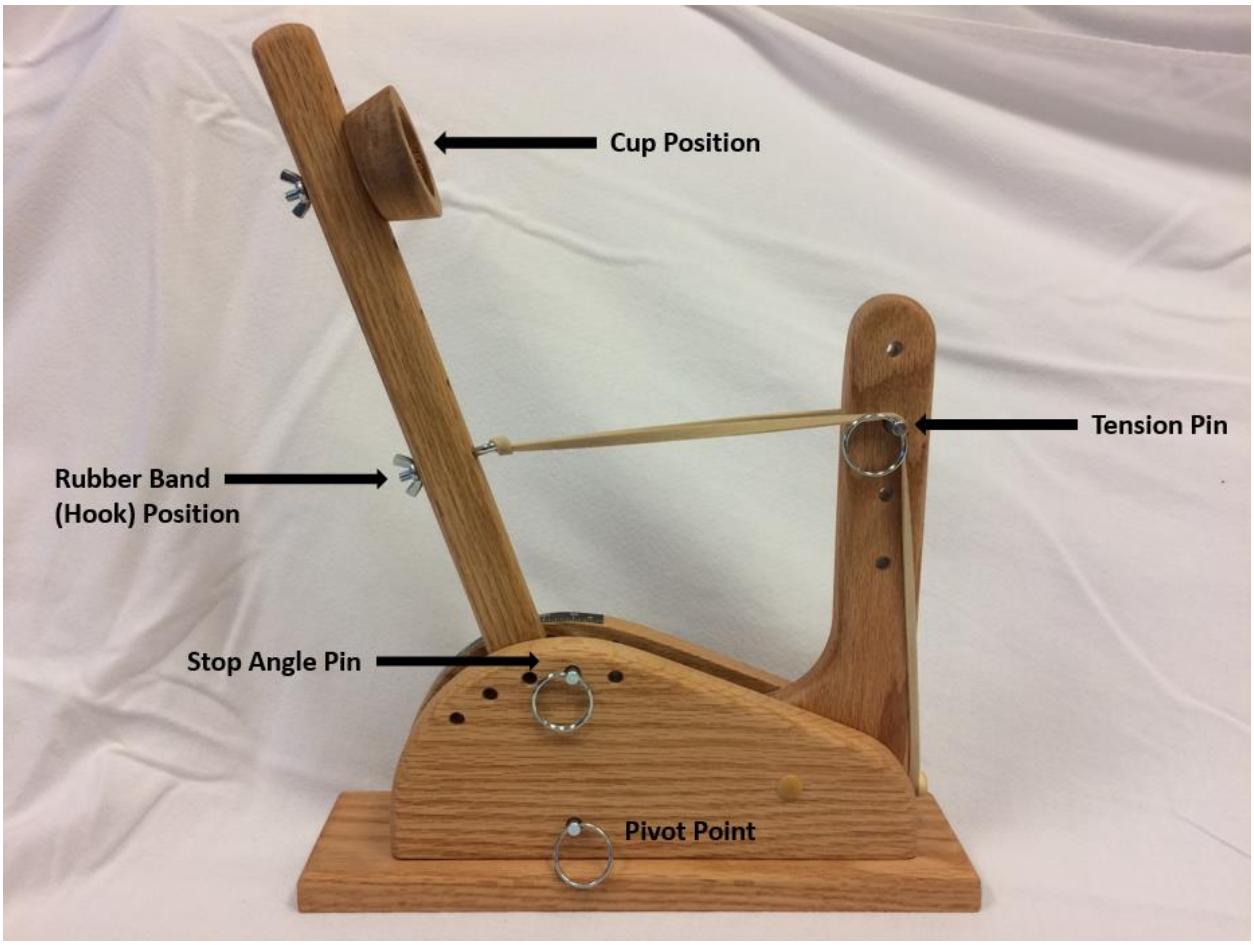


Figure 3.0 Items to Adjust in Setting the Statapult

Once the initial settings have been checked, place the ball in the ball cup and pull back the arm to the desired launch angle (determined by the marker (▼) and the number on the measuring device). Release smoothly and record the distance traveled.

Safety Considerations

- Keep the Statapult® are area clear during a launch.
- The Statapult® will "jump" as the arm impacts the stop pin.
- If you are securing the base with your hand, keep it away from the Statapult® arm and stop pin.
- Be careful where you aim the Statapult®. Injuries may occur if not cautious.

Training Examples

How you use the Statapult® for teaching and practicing is only limited by your imagination. The following examples are exercises that have been successfully taught around the world.

Variance Reduction. This is a two-part exercise that emphasizes the importance of variance reduction in your process. During the first part, students in a team shoot the Statapult® with very little instruction. They pull the Statapult® arm back to a fixed angle (say 177°) and measure the distance. Typically, the results are highly variable! After constructing a process flow diagram, cause and effect diagram (similar to the one shown in Figure 4.0), and building standard operating procedures, the teams shoot the Statapult® again and compare the two results. There are many ways to analyze the data:

- Plot the data in a run chart and compare histograms
- Compute means and standard deviations
- Conduct statistical tests on the means and variances
- Conduct a goodness of fit test for normality on each of the data sets
- Generate box plots for each of the data sets

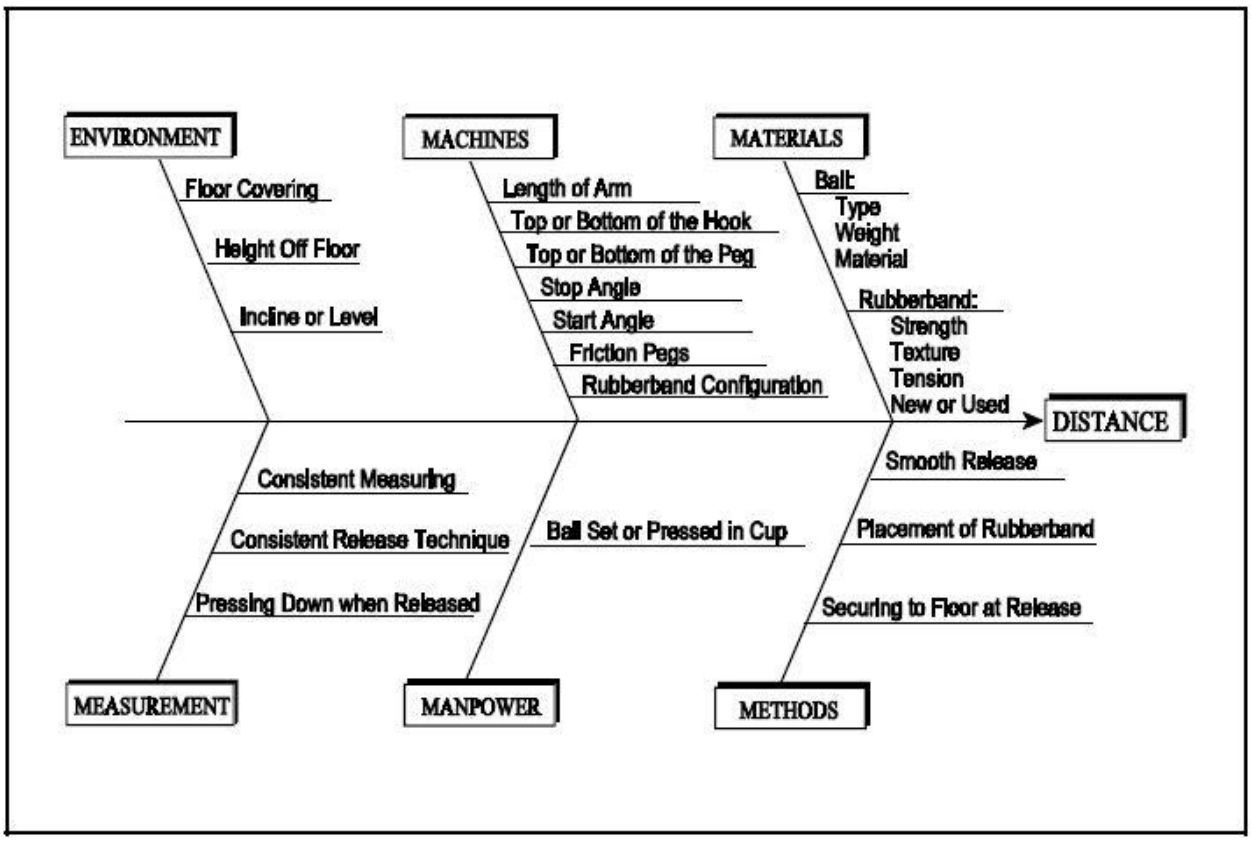


Figure 4.0 Cause and Effect Diagram

Simple Linear/Multiple Regression. Hold all factors constant except pull-back angle and do a simple linear regression analysis. Sometimes, with enough data, a slight quadratic effect will be present (shown on a scatterplot) and this can be modeled as well. Perform confirmation tests on an instructor-chosen target distance.

FMEA. Both process and product FMEAs can be done on the Statapult®. Process FMEA looks at how you could fail to hit the target from the process perspective. Product FMEA identifies failures of the machine's numerous components (e.g., breakage of the Statapult® arm, tear in the rubber band).

Measurement System Analysis (MSA). To conduct a Gage R&R on the Statapult®, shoot the ball at various settings with two or more persons measuring the distance silently and recording the distance on their own. Another approach would be to have 10-20 rubber balls and have 2-3 students measure the circumference of the balls. The teams must decide the measurement method and standard operating procedures to have a consistent measurement.

Control Charts. In a class of 20-25 students, have each student shoot the Statapult® three times. The three distance measures are recorded as one subgroup in an $\bar{x}$-R chart. After 25 points are recorded, the students compute the control charts and analyze the results. After this, have the students build an IMR chart by considering only the first shot of each person and analyze the results. That is, look at the same system as though the second two shots had not been collected.

Screening DOE. Conduct a 12-run 2-level screening design using factors determined from a cause and effect diagram. Some factors could be pull-back angle, stop angle, pin height, cup position, rubber band position, ball type, and operator. Determine the important factors for location and spread using marginal means plots or multiple regression.

2-Level Modeling DOE. Conduct a 2-4 factor, 2-level DOE. The students are typically required to use pull-back angle as one of the factors (at least one continuous variable is needed to hit a target distance). The stop angle position is usually held at position 2 and 3 or position 3 and 4 to avoid its strong quadratic component (the stop angle pin position is numbered from left to right as shown in Figure 5.0).

Figure 5.0 Stop Angle Pin Position

Students can choose the remaining variables in their design. The students build Y and s linear models in a very short time that characterize the Statapult®. Target distances can be chosen inside and outside the range of the data for confirmation.

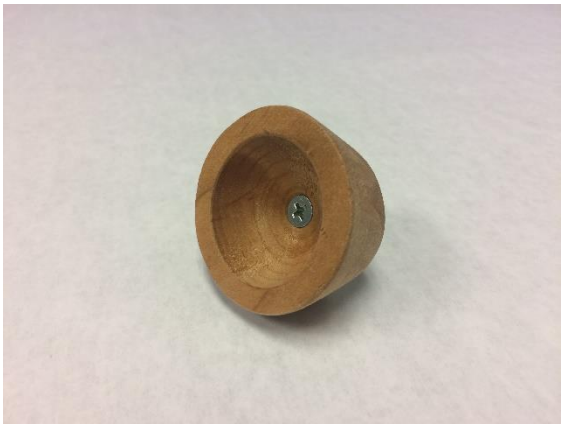
3-Level Modeling DOE. Conduct a 2-4 factor, 3-level DOE such as a Box-Behnken or Central Composite Design. The students will be required to use pull-back angle and stop angle as two of their factors. Stop angle position (Figure 5.0) should vary from position 2 to position 4. The other factors should also be at three levels. The students build Y and s

quadratic models in a very short time that characterize the Statapult®. Target distances can be chosen inside and outside the range of the data for confirmation.

Robust Design. Conduct a robust DOE on the Statapult®. Use an 8-run or 12-run inner array with factors chosen by the students. The factor in the outer array will be ball type. The instructor will provide at least three balls of different composition (i.e., smash, wiffle, foam balls), to shoot in the Statapult®. Once a target has been selected, the students determine the Statapult® settings such that all three balls, when launched at the same settings, will land within 6 inches of the target.

Multiple Output DOE. Conduct a 3-factor, 2-level DOE. Students select three factors and two responses like distance and height. The teams must develop a measurement technique for determining height. Collect the data and analyze the results. Also, the instructor will provide a minimum height and target distance to be achieved simultaneously. The students determine the settings and confirm.

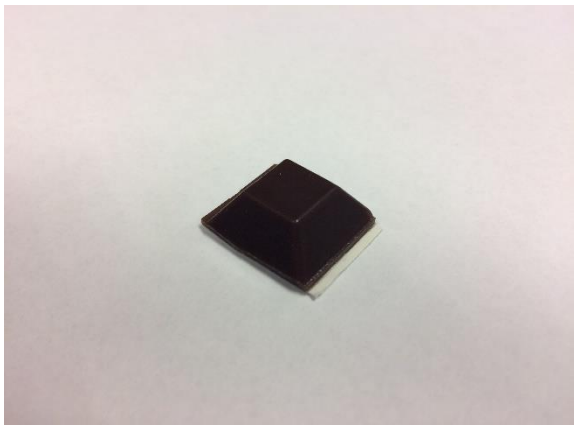
Optional Additional Parts



Single Cup - $15.95

Double Cup - $34.95

Replacement Arm - $29.95



Bumper - $2.95

Eye bolt - $3.95

Pin - $3.95

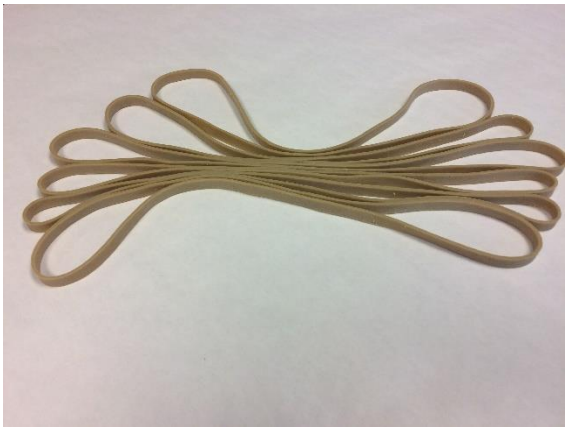
Pointer - $2.95

Wiffle balls - $9.95
(package of 6)

Smash balls - $15.95
(package of 6)

Foam balls - $12.95
(package of 6)

Golden Golf Balls - $24.95
(package of 3)
Complement to decorative Walnut Statapult®



Rubber Bands - $11.95
(package of 6)

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