air academy
ASSOCIATES

StataPUTT® MANUAL

A Simple Guide for Using the StataPUTT®

12295 Oracle Blvd; Ste 340
Colorado Springs, CO 80921
719.531.0777
www.airacad.com


DEGREES

Introduction

Meet the newest member of the Air Academy Associates interactive training device family…the StataPUTT! Like its counterpart, the Statapult®, which is used by thousands of companies, organizations, and academic institutions around the world, it can be used to teach and/or practice statistical concepts such as 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 learning how to apply statistical methods to real-world problems. It makes learning fun, interactive, and memorable! Being "memorable" is important because students may not remember what the instructor says, but they will remember what they do! The number of ways this training device can be used is limited only by one's imagination. For example, setting up a 3-hole golf course where individuals compete to win a minimum-number-of-putts contest using the StataPUTT® is highly competitive and exciting. Of course, having prizes for the winners provides additional motivation for learning.

Getting Started

Congratulations on your StataPUTT® purchase! Included in your StatapuTT® shipment, you will find the following (see Figure 1):

- A tower with inserted pin that holds the putting arm. The putting arm is between the two sides of the tower, and it has an embedded inclinometer that is used to measure the pull-back angle
- A stabilizing base assembly with grooves into which the tower will be inserted
- A regular size golf ball

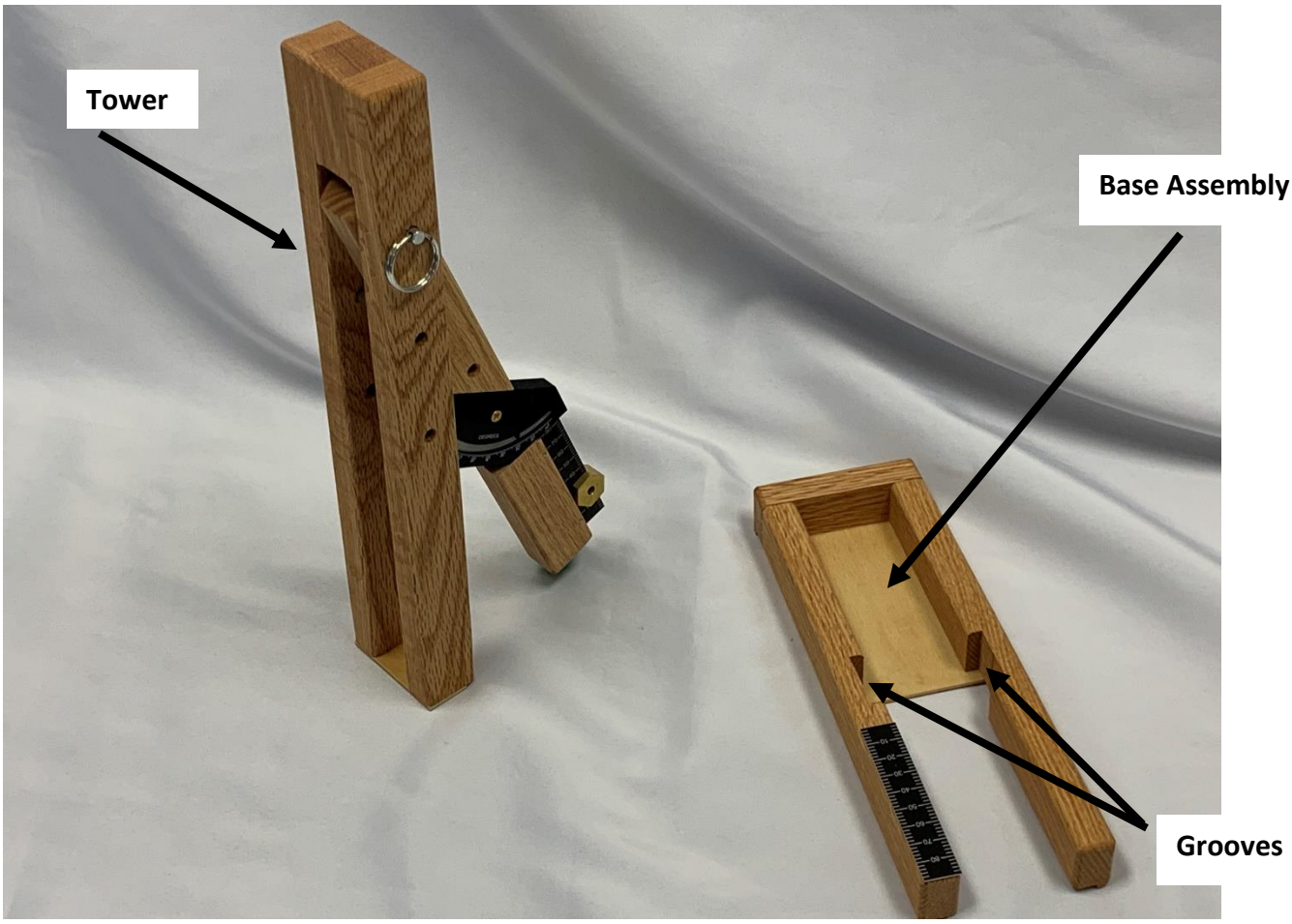


Figure 1. StataPUTT Parts

Assembly

The assembly of the StataPUTT® is simple and straight-forward. Simply insert the tower into the grooves of the base assembly as shown in Figure 2 and you are ready to putt by pulling back on the arm and releasing.

Figure 2. Assembled StataPUTT

Operation

There are several major variables that can be adjusted. Pin Position and Pull Back Angle are shown in Figure 3. Weight Position and Ball Position are shown in Figures 4 and 5, respectively.

Pin Position, which determines the height of the fulcrum or, in essence, the length of the arm. There are 3 different pin positions.

Pull Back Angle, as measured by the inclinometer which is embedded in the pull-back arm. Angle shown is approximately 60 degrees.

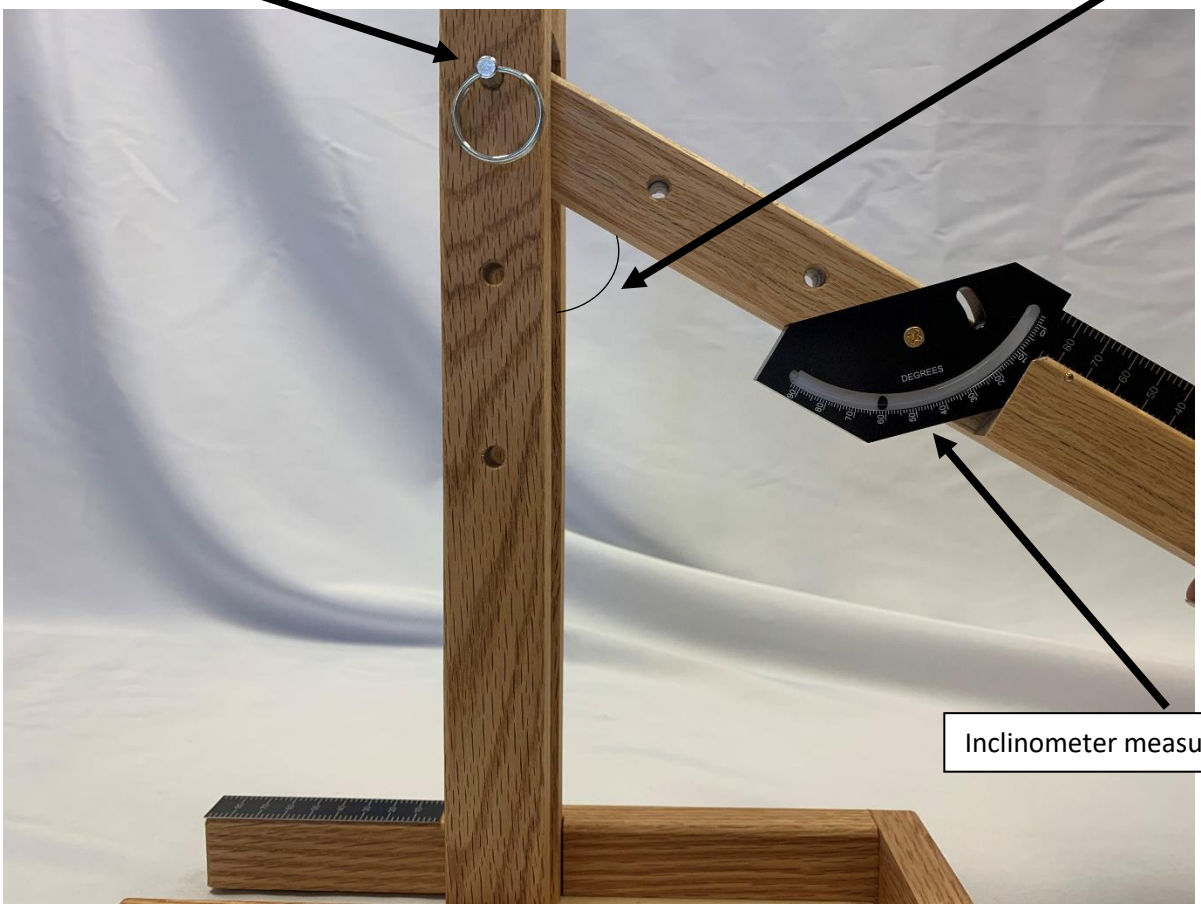
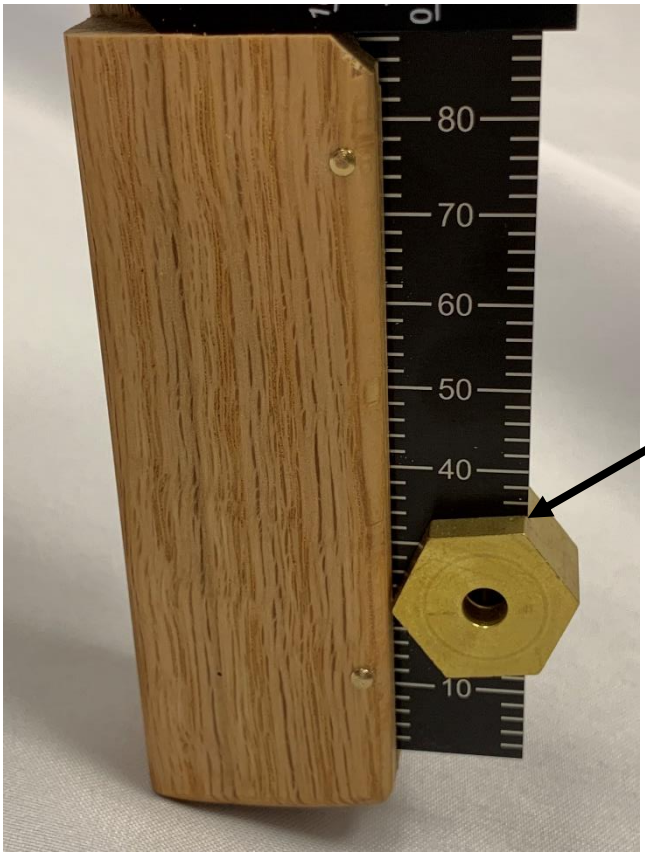


Figure 3. Pin Position and Pull-Back Angle can be adjusted.



Weight Position of the brass weight that is attached to the bottom of the pull-back arm. The top of the weight is shown to be approximately 34 mm from the bottom of the arm.

Ball Position is where the ball is positioned at the time the pull-back arm strikes the ball. The center of the ball is shown to be about 60 mm forward of where the ball would typically be placed. Emulates topping the ball in golf!

Figure 4. Weight Position can be adjusted.

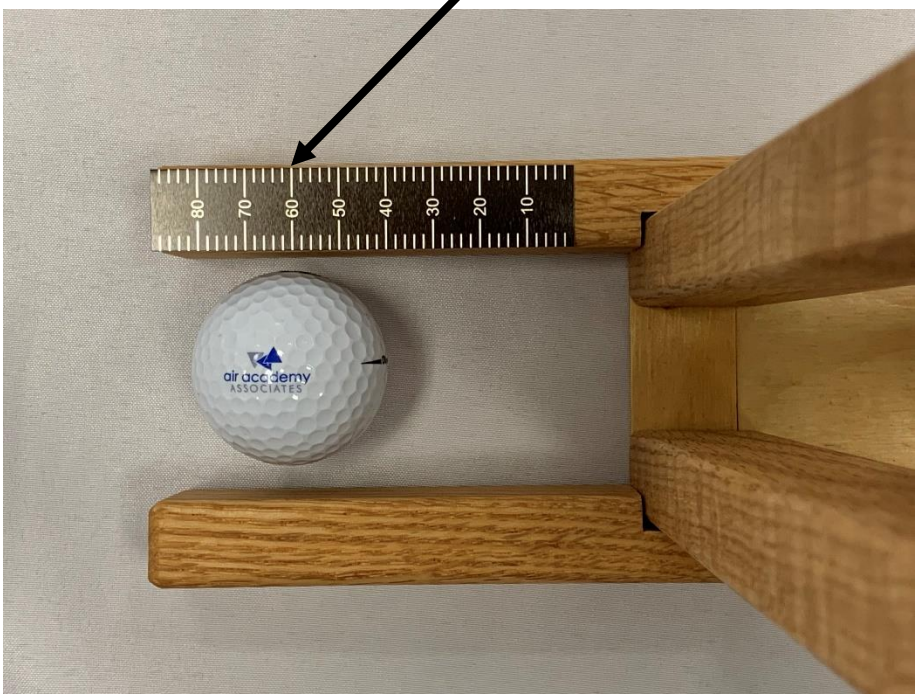


Figure 5. Ball Position can be adjusted.

Safety & Performance Considerations

- Keep your fingers away from the path of the arm as it can come down quickly after it is released.

- If you are securing the base with your hand, keep your hand away from the path of the pull-back arm.

- You can secure the StataPUTT® by pressing down on the top of the tower while pulling the arm back to putt.

- Designate a sufficiently wide pathway in the putting direction and keep it unoccupied while putting is taking place.

- Always watch for bystanders who may or may not be watching the activity. The ball can go farther than one might think and thus injuries could occur to someone who is not aware of what is happening and who could accidentally slip by stepping on the ball or trying to avoid the movement of the ball. Yelling "fore!" is not enough.

Training Examples

How you use the StataPUTT®for teaching and practicing is limited only 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 putt the ball with very little instruction. They are told to pull the arm back to a fixed angle (say 45°), release and then measure the distance the ball traveled. Typically, the results are highly variable! After constructing a process flow diagram, cause and effect diagram (similar to the one shown in Figure 6), and building standard operating procedures, the teams putt the ball 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

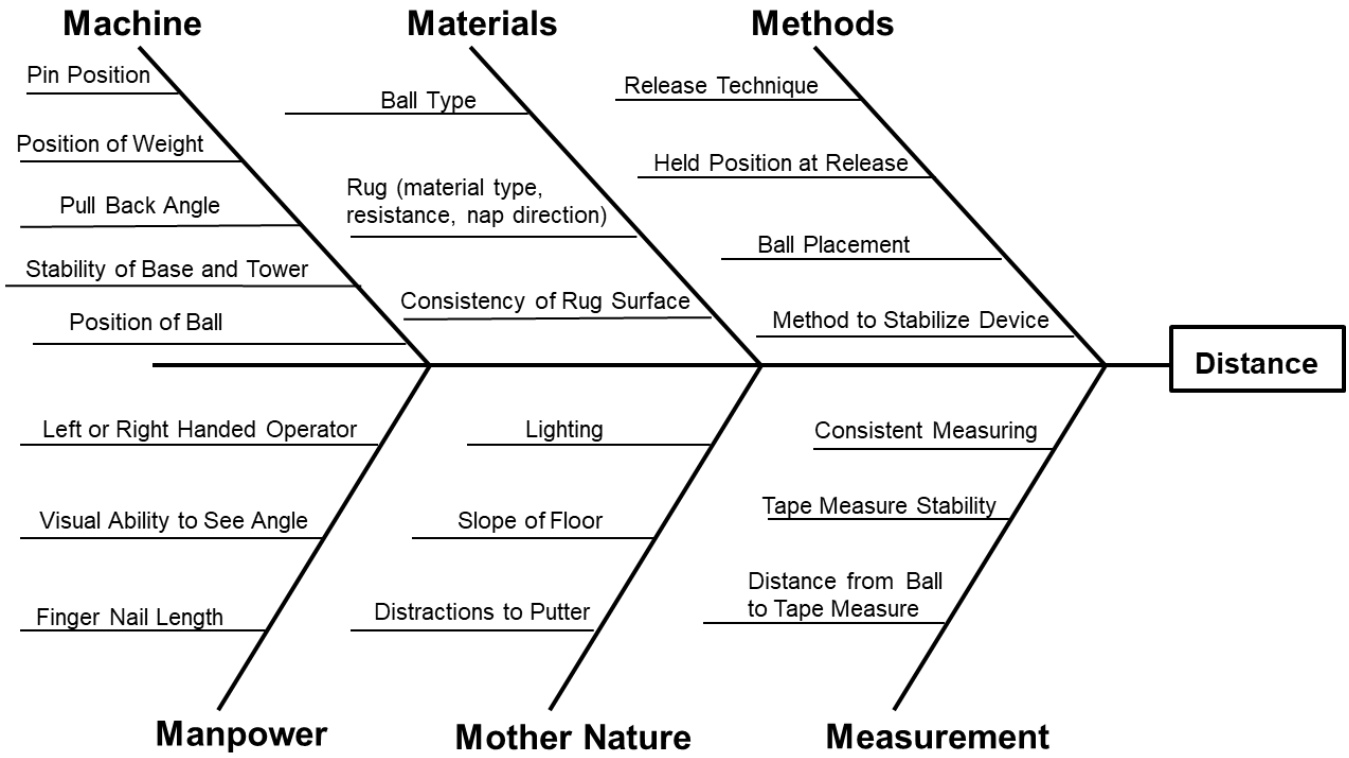


Figure 6. Cause and Effect Diagram

Simple Linear/Multiple Regression. Hold all factors constant except pull-back angle and do a simple linear regression analysis. Sometimes, with enough data, a quadratic effect can be seen (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 StataPUTT®. Process FMEA looks at how one could fail to hit the target from the process perspective. Product FMEA identifies failures of the machine's numerous components (e.g., spacing between the pull-back arm and the tower, placement of the weight, etc.).

Measurement System Analysis (MSA). To conduct a Gage R&R on the StataPUTT®, putt the ball at various settings with two or more persons measuring the distance silently and

recording the distance on their own. Another approach might be to use different types of balls (golf, nerf, plastic, etc.) as the different parts of an MSA. 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 putt the ball three times. The three distance measures from each student are recorded as one subgroup in an $\bar{x}$-R chart. The students can then develop the control charts and analyze the results. One can also have the students build an IMR chart by considering only the first putt of each person. Further, superimposing three 25-point run charts (one for each of the 3 ordered putts) can be used to show differences between the putt order.

Screening DOE. Conduct a Taguchi or Plackett-Burman12-run, 2-level screening design using factors determined from a cause and effect diagram. Some factors could be pull-back angle, pin height, weight position, ball position, type of ball (Nike vs Titleist??), direction of putt, putting surface, 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 full factorial DOE. The students typically use pull-back angle (continuous), pin height (discrete), weight position (continuous), ball position (continuous) or putting direction (continuous) as factors in their DOEs. The pin height position is usually held at positions 2 and 3 (or 1 and 2) to avoid its strong nonlinear effect on distance. See Figure 7.

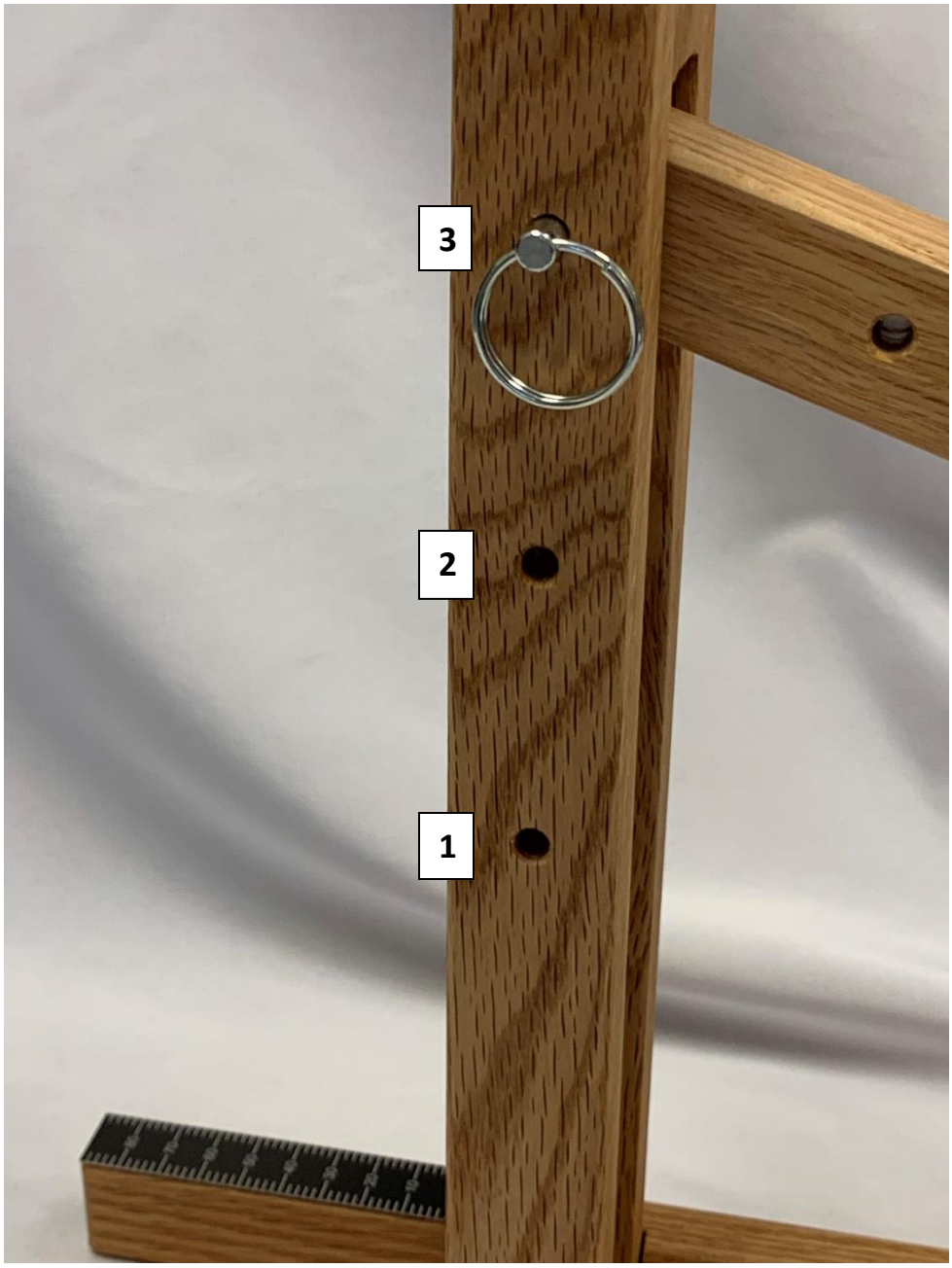


Figure 7. Pin Position

After collecting the data students build linear models for the mean and standard deviation that are used to characterize the StataPUTT®. 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. Note that pull-back angle and pin height will have strong non-linear effects, especially if the low and high settings are far apart. You can also expect a strong pull-back angle vs pin height interaction effect. Other 2-way and 3-way interactions are also possible. The students build Y and S quadratic models in a very short time that characterize the StataPUTT®. Target distances can be chosen inside and outside the range of the data for confirmation.

Robust Design. The variable that we would like to make putting distance robust to could be a variety of things, such as putting surface or direction of putt. When competing on an in-class golf course on the same carpet, the putting direction could influence the distance of the putt, so we may want to make the putting process robust (or insensitive) to putting direction. For this purpose, one could conduct an 8-run factorial design inner array with factors chosen by the students. The factor in the outer array (replications) will be putting direction (e.g., 0, 45, and 90 degrees). After collecting the data, models can be developed to determine the settings on the StataPUTT® that will achieve a given distance, no matter what the angle of direction the putt is.

Multiple Output DOE. Conduct a 3-factor, 2-level factorial DOE. Students select three factors and two responses like distance and lateral dispersion. The teams must develop a consistent technique for measuring lateral dispersion as well as distance. Collect the data and analyze the results, building models for both distance and lateral dispersion. The instructor then provides a target hole (see additional parts below) at a specified distance. The students are then

challenged to use their models to determine the settings on the StataPUTT® that will put the ball in the hole. This confirmation or validation testing can be accomplished at different distances. These results could then be compared with a human putter using such tests as a t-test to see if the mean miss distances are significantly different. It is desirable for the optimized machine to perform better than a human.

Optional Additional Parts

Putting Cup - $12.95
(Multi-directional)

Putting Cup w/ Flag - $12.95

Replacement Arm - $69.95

Variable Height Tees - $9.95
(set of 3)

Pin - $3.95

Replacement weight – $4.95

Air Academy Branded Golf Balls - $14.95
(package of 3)

Golden Golf Balls - $24.95
(package of 3)

Foam balls - $12.95
(package of 6)

Putting turf - $29.95
(approximately 12'x 18")

StataPUTT Starter Kit - $72.95
(15% discount from individual component parts)