

The Deming Funnel Experiment (rev 4_16)

Objectives

- Understand the impact of tampering on processes
- Become aware of common practices in industry that increase variation

Background on the Deming Funnel Experiment

The funnel experiment as described in Deming's book, Out of the Crisis, (1986), shows the impact of "tampering" with a process in an attempt to improve product output.

Tampering refers to the process of adjusting the equipment/process based on some sample measurement that has been taken. Too often, the sample measurement's deviation from some nominal value is merely common cause variation. Only improving the process itself, to reduce the variation, will bring about improvements. Tampering often makes the problem worse.

In the Deming Funnel Experiment, marbles are dropped from a funnel onto a piece of paper. A mark is made where the marble rolls to after it hits the paper. Observations are collected under four adjustment rules. As described by Deming, the rules are

1. "Leave the funnel fixed, aimed at the target, no adjustment.
2. "At drop k ($k = 1, 2, 3, \dots$) the marble will come to rest at point zk , measured from the target. (In other words, zk is the error at drop k .) Move the funnel the distance $-zk$ from the last position. Memory 1.
3. "Set the funnel at each drop right over the spot zk , measured from the target. No memory.
4. "Set the funnel at each drop right over the spot (zk) where it last came to rest. No memory."

Part 1. Understanding the rules

Open the funnel simulation at <http://www.symphonytech.com/dfunnel.htm>

Rule 1) The funnel is fixed, aimed at the target with no adjustments made. (All marbles dropped from same funnel location.)

We are not reacting to the data we collect here, so intuitively, we may think that this will not give us the best results. We do know that we can use this data to compare to the other methods.

Set the simulation to Rule 1 and the drop height to High.

Enter the number of drops: 150

Click on the run simulation button ►.

What is the standard deviation for this process? 94.96

Look at the pattern of the drops. Which of the following appear to be true about this process?

- T / F** The points appear to be random about the center (similar number of drops in every direction from center).
- T / F** Looking at the deviation from target over time, this appears to be a stable process.
- T / F** The funnel never moved.

Rule 2) After a marble is dropped, the distance from the target is measured. The funnel is moved that distance (in the opposite direction) from its last position. For example, if the marble hits $\frac{1}{2}$ inch to the left of the target, the funnel is moved $\frac{1}{2}$ inch to the right of its current location.

To see Rule #2 demonstrated, you can click on the Explain, then Rule #2 to watch a slow motion demo.

Is it not reasonable to assume that if the funnel drops the ball off the target by a certain amount, moving the funnel the opposite direction by the same amount will improve the results? Let's try it.

Run the Rule 2 (high level) simulation for 50, 100 and 150 drops. (Be sure to reset between runs.) Record the standard deviations

Drops	Standard deviation
50	63.28
100	120.3
150	142.22

Which of the following appear to be true about this process?

- T / F** The points appear to be random about the center (similar number of drops in every direction from center).
- T / F** The more drops made, the larger the spread of the drops.
- T / F** This appears to be a stable process. The pattern and standard deviation are similar for all number of drops
- T / F** The new location of the funnel was calculated based on the last location of the funnel.

Rule 3.) After a marble is dropped, the distance from the target is measured. The funnel is moved that distance from the initial target position. For example, if the marble hits $\frac{1}{2}$ inch to the left of the target, the funnel is moved $\frac{1}{2}$ inch to the right of the initial target position.

If we weren't keeping track of where our funnel was, as in Rule #2, this might be a good tactic. We are reacting to the data we collect by making the adjustment based on the initial target position.

To see Rule #3 demonstrated, you can click on the Explain, then Rule #3 to watch a slow motion demo.

Run the Rule 3 simulation (high level) for 50, 100 and 150 drops. (Be sure to reset between runs.) Record the standard deviations

Drops	Standard deviation
50	171.18
100	238.66
150	475.38

Which of the following appear to be true about this process?

- T / F** The points appear to be random about the center (similar number of drops in every direction from center).
- T / F** The more drops made, the larger the spread of the drops.
- T / F** This appears to be a stable process. The pattern and standard deviation are similar for all number of drops
- T / F** The new location of the funnel was calculated based on the last location of the funnel.

Rule 4.) The funnel is reset over the spot where it last came to rest. If the marble hits $\frac{1}{2}$ inch to the left of the target, the funnel is moved to $\frac{1}{2}$ inch left of the target.

As long as the funnel is dropping at a given point, it might make sense to set the funnel to that point. That way, the setting and last drop are consistent.

To see Rule #4 demonstrated, you can click on the Explain, then Rule #4 to watch a slow motion demo.

Run the Rule #4 simulation (high level) five times: 50, 100, 100, 150, and 150 drops. (Be sure to reset between runs.) Record the standard deviations

Drops	Standard deviation
50	131.32
100	585.16
100	380.72
150	745.94
150	664.88

How would you describe these patterns?

These patterns are irregular and disorder, like a drunk man walk randomly.

Which of the following appear to be true about this process?

- T / F The points appear to be random about the center (similar number of drops in every direction from center).
- T / F The more drops made, the larger the spread of the drops.
- T / F This appears to be a stable process. The pattern and standard deviation are similar for all number of drops
- T / F The new location of the funnel was calculated based on the last location of the funnel.

Part 2. How does this apply?

Consider each of the following situations. In each case, state which rule is being followed and why you think the practice follows that rule. Discuss whether the practice is good or not.

- a. A company relies on its management hierarchy to inform its employees of upcoming policy changes. So the President informs the vice presidents in a meeting. In their weekly staff meetings, the vice presidents tell their managers. The managers will then meet with the supervisors. Then the supervisors tell the line employees. (Think about the game where one person whispers to another on down a line of players, and the last one tells what they heard. What typically would happen?)

In this case, rule 4 is being followed. The message transmit person by person just like the funnel reset over the spot where it last came to rest. This is not good, this way is inefficiency and may probably cause the last one get wrong message.

- b. Because a company was hiring fewer employees than in the past, it introduced the on-the-job training to replace its standardized classroom training. Under the new system, each machine operator trains his or her successor.

In this case, rule 4 is being followed. The junior employees training next new employees just like the funnel reset over the spot where it last came to rest. It is not good, because if there were something wrong happened recently, the new workers may probably still making the same mistakes.

- c. An automatic gage is used to check the size of a diameter produced on a turning machine. If a part is too large, a compensating adjustment is made by moving the cutting tool closer to the part by the amount that it was too large.

In this case, rule 2 is being followed. The compensating adjustment is made moving the cutting tool closer when a part is too large just like the funnel move in the opposite direction from last position. It is good way to check the size automatically.

- d. A chemical solution must be prepared in small batches, but then several batches go into the same holding tank. After each batch, a measurement is taken and an adjustment is made. If the first batch is 5 units over, the next batch will be set at 5 units under the target setting. The desired result is that the average is equal to the target. (Think about the output from the process itself here.)

In this case, rule 4 is being followed. The units are setting by the last batch, which is similar to the funnel reset over the spot where it last came to rest. It is not good, if a batch has wrong units, the next batch will still has wrong number of units.

- e. A supervisor notices that a machine operator is just sitting by the machine and does not appear to be making appropriate adjustments. This machine historically has output which requires some rework. The supervisor scolds the operator for not adjusting the machine more often to improve quality.

In this case, rule 1 is being followed. The operator not adjusting the machine more often just like the funnel is fixed. It is good that the supervisor require the operator making appropriate adjustment. The rework is very important for adjusting machine work well.

- f. Describe an additional situation that illustrates a concept in the funnel experiment. The situation may describe an actual one you have experienced or are aware of. (If you cannot think of one, you can do an internet search on Deming Funnel Experiment and find one. Do not plagiarize: Paraphrase the situation and appropriately cite the source.)

It is very popular to eat watermelon in China one year, and the price of watermelon kept sustainable growth. A lot farmer found it is easy to make money by farming watermelon, but the output of watermelon in the next year was too much. The price of watermelon slippery slope. Then the farmer gave up farming watermelon. This case is just apply the Deming's Funnel Experiment rule 3. The farmers' behavior just like the funnel is moved that distance from the initial target position.

Part 3. Deliverables

Complete this handout and submit to the dropbox.

Post 1 response to the discussion board. Choose out of these three options:

1. Post your response to one of the situations in Part 2 a-e (that has not yet been addressed)
2. Respond to another students posting, offering a different perspective or expanding upon the discussion.
3. Describe an additional situation that illustrates a concept in the funnel experiment from your own experience (not one from internet).

Grading criteria –

1. All requirements of Part 1 completed with mostly correct answers.
2. Part 2: a-e
 - a. Correct “rule” identified for each situation
 - b. Clear explanation provided as to why the practice follows the rule.
 - c. Reasons for the practice being good or not are reasonable.
3. Part 2 f: Situation described clearly illustrates one of the rules.
(Source appropriately cited if not from own experience.)
4. Response posted in discussion board as required meeting one of these requirements.
 - Posting is the first in the thread and provides sufficient information (see 2b&c) to allow students to make a reasonable response.
 - Responses after initial situation posting offers different perspective or expands the discussion
 - Situation from own experience clearly illustrates one of the rules. (May not submit an internet example.)