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The Problem of the Inside Out Tee Shirts

Introduction

In the lives of mankind, there are many, many questions that arise about man's place in the universe, and what kinds of dark forces lurk therein to do us in. There are issues of disease and plague, war and violence, floods and hurricanes, and there is the mystery of Tee shirts. An undercurrent of concern flows though our societies as we try to understand that phenomenon: do washing machines engage dark forces that turn tee shirts inside out (i.e., tee shirt flipping), or is this human negligence as we forget to keep them outside out when we load the washer. This report will provide ins and outs of The Answer.

Observations

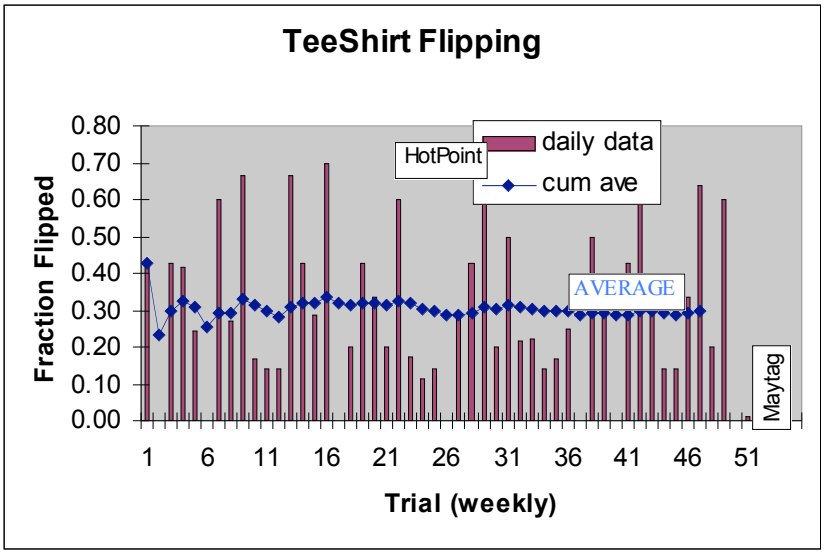
After finally taking note of the considerable incidence of Tee Shirt Flipping (TSF) occurring during the many years of *"doing the warsh",* I began taking careful data in January 2009. The top loading washing machine is a venerable Hotpoint, ca. 1986. When first purchased, we did note that it tended to wind up clothing, sometimes literally tying shirtsleeves in knots and similar feats. That behavior never stopped.

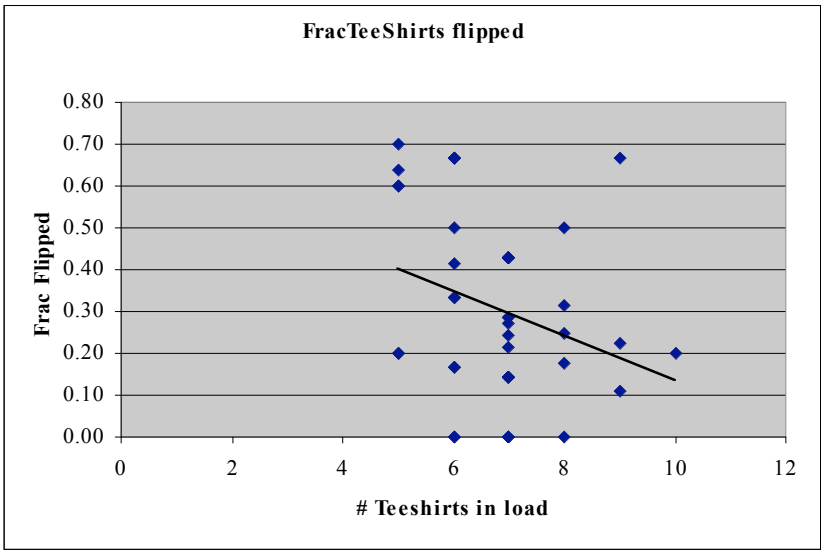
The project period covered all of 2009. Washer loads contained only medium sized male tee shirts (with short sleeves), and occasionally, the addition of a few handkerchiefs. I was careful to verify that all tee shirts went into the machine right side out, i.e., outside side out. Tee shirts were both old (thin) and new. In general, I used a reduced water level and a six-minute cycle for the tee shirt loads. The loads were done approximately once per week, and loads generally had 5-10 tee shirts. Some loads produced tee shirts that were only partially turned inside out, these were counted as 0.5. When the washer load completed processing, the shirts were removed one by one and hung on a line (i.e., not machined dried or tumbled). In December 2009, the Hotpoint washer failed, and the replacement Maytag went into service (see below).

Results

The first graph shows each load in sequence during the project, and each data bar gives the fraction of inside out shirts along with the cumulative average of fraction of tee shirts turned inside out. The reader can see that approximately 1/3 of the shirts engage in flipping behavior. The number of tee shirts each load was 7+/-2.

The second graph shows a plot of fraction of shirts flipped in a load, vs. the number of shirts in that load, i.e., the Flipping Factor. Clearly, there is an apparent decreasing trend--the more tee shirts in a load, the smaller the fraction flipped. Perhaps the Tee Shirts exert some kind of mutual dark force that inhibits Flipping.





During this research, I saw no correlation between age or cleanliness of tee shirts and the Flipping Factor, the depth of water, nor whether there was a handkerchief present in the load.

Some statistical interpretation of the results is required for proper understanding of the results.

For example, an obvious question is whether all the tee shirts are being flipped many times, and at the end of the process, we happen to see the results. A related question is what one would see (i.e., how many tee shirts are flipped) if the wash cycles were

stopped at various times to inspect the results (or if a transparent window were introduced into the washer or if a video camera were used to monitor the washer load).

In, any case, the data show that the tee shirt flipping is simply random at low rates and generally follows Poisson statistics. The data never showed all tee shirts flipped, but frequently showed only a very small fraction flipped. Thus, we know they are not all being flipped back and forth many times, or we would have observed a 50% average (rather than the 30% seen) and we would see as many loads in which nearly all tee shirts flipped as very few flipped. It is, of course, conceivable that there are weird effects occurring (e.g., those that flip do so in the first minute, then no others flip). However, there is no reason and no data to suppose they do, and such action would almost surely show as a different statistical result.

Using simple statistics, because the data show that 1/3 of the Tee Shirts flip, it is almost certain that roughly 1/3 of these have flipped a second time, ending up right side out. That is, of 10 Tee Shirts, approximately 3 will flip once, 1 will flip twice, and the remaining 6 do not flip.

Another question is what would happen with only one Tee Shirt in a load. The graph indicates that perhaps 2/3 of single tee shirt loads would show a flip. However, this was not investigated. Excessive water consumption and cruelty to washing machines would argue against such a line of investigation.

Another question relates to the observed number of partial flips. As noted, we did see occasional cases of a tee shirt partially flipped amounting to about 5% or so of flipped shirts. This small fraction would imply that once a flip starts, it proceeds fairly quickly to completion.

Finally, although not a statistical question, it is clear that we do not know how the tee shirts flip, i.e., through the waist, neck hole, or via an armhole nor the direction of the flip. Nor do we have data on whether sleeveless tee shirts would behave differently. However, many similar loads with long sleeved business shirts almost never showed a flip. Although these were washed with front buttons undone, the sleeves were not turned inside out (though they were frequently tied almost in knots). Video monitoring of loads (or use of *loadus interruptus techniques*) would likely answer this question.

In December 2009, an event occurred that totally changed the universe of TSF research: the Hotpoint washing machine broke. After only 25 years of use, the agitator internal spline sheared off. After repairs were unsuccessful (and a replacement agitator was priced at an outrageous $95-100), we replaced the defunct washing machine with a like-new second hand top loading Maytag washer (found on Craigslist for $50). Continuing to take data, it became clear very quickly that the unique flipping properties of the Hotpoint were no longer present. The new washer does not tie clothing in knots, does not twist sleeves into pretzels, and does not flip tee shirts. The new Maytag is, in fact, very boring (it is also quieter and appears to clean just as well as the Hotpoint). The result is that we cannot pursue additional research in the foreseeable future. Thank goodness.

Agitator Agitation

Many people who have heard of this research (well, one person, anyway) asked about the differences between the Hotpoint and the Maytag. They are both top loading, so-called "heavy duty extra large" washers. The tubs are almost the same size with Hotpoint being 21x14 deep and the Maytag being 21x15deep. The agitators are different. The Hotpoint is 12-in. dia. and the Maytag is 11-in. dia. However, the Hotpoint has three curved blades about three inches high tapering to zero at the full diameter, while the Maytag has four straight radial blades 2-3 inches high (it also has a small second set high on the agitator, but these do not engage during the shallow Tee shirt loads). It also appears that the Maytag agitator oscillates at a higher rate through a smaller arc as compared to the Hotpoint.

While the agitators do not appear radically different, the sloped and curved blades of the Hotpoint as they oscillate back and forth will tend to create a net, repetitive rolling action in the water leading to a net twist in any garment floating in the water. That is, the rolling action of the water will not average out as the agitator rotates back and forth, as compared to the Maytag which is symmetric in its back and forth turbulence. Thus, it is entirely plausible that the Hotpoint will tend to align the clothing around the agitator, and will then tend to wind it into tubes/ropes which will then tangle together--which is exactly what is seen with shirt sleeves and the like. Exactly how this leads to aggressive Tee Shirt flipping is not obvious but is presumably related to the observation that the Hotpoint turbulence does not average out to zero whereas the Maytag does.

Other explanations of Tee Shirt flipping have been proposed (see http://searchwarp.com/Q:4780-Why-Are-Clothes-Always-Inside-Out-When-You-Pull-Them-Out-Of-The-Washing-Machine)
However, no data were supplied to support the various theories discussed.

Conclusion

So the End Of An Era is at hand. The Hotpoint is Dead; Long Live the Maytag. But the Hotpoint survived long enough to help answer the TSF question that has occupied science since Charles Darwin washed his dirty laundry after the gulls following the Beagle messed up his own tee shirts. Some washers DO flip tee shirts.