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BADGES



TOILET SEAT PROBLEM



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The toilet seat problem has been the subject of much controversy. In this paper we consider a simplified model of the toilet seat problem. We shall show that for this model there is an inherent conflict of interest which can be resolved by an equitable solution.

Consider a bathroom with one omnipurpose toilet (also known as a WC) which is used for two toilet operations which we shall designate as #1 and #2. The toilet has an attachment which we shall refer to as the seat (but see remark 1 below) which may be in either of two positions which we shall designate as up and down.

Toilet operations are performed by members of the human species (see remark 2 below) who fall into two categories, popularly designated as male and female. For convenience we shall use the name John to refer to the typical male and Marsha to refer to the typical female.

The performance of toilet operations by John and Marsha differ in a number of respects. The costs of these operations are peculiar to the respective sexes and are fixed except with respect to the position of the toilet seat. In particular:

Marsha performs toilet operations #1 and #2 with the seat in the down position. John performs toilet operation #1 with the seat in the up position and toilet operation #2 with the seat in the down position. If the seat is in the wrong position before performing a toilet operation the position must be changed at an average cost C . Optionally the position may be changed after performing the toilet operation, also at an average cost C . (Changing the position of the seat during the performance of a toilet operation is beyond the scope of this note and is definitely not recommended.)

Consider the scenario where John and Marsha each use a separate toilet. It should be obvious to the most casual observer that each minimizes the seat position transfer cost by not altering the seat position after performing a toilet operation.

For Marsha the seat position transfer cost is 0 since all operations are performed with the seat in the down position. For John the cost is greater than 0 since seat position transfers must be performed.

Let p be the probability that John will perform a #1 operation vs a #2 operation. Assume that John optimizes his seat position transfer cost (see remark 3 below.) Then it is easy to determine that John's average cost of seat position transfer per toilet operation is

$$B = 2p(1-p)C$$

where B is the bachelor cost of toilet seat position transfers per toilet operation.

Now let us consider the scenario where John and Marsha cohabit and both use the same toilet. In our analysis we shall assume that John and Marsha perform toilet operations with the same frequency (see remark 4 below) and that the order in which they perform them is random. They discover to their mutual displeasure that their cohabitation adversely alters the toilet seat position transfer cost function for each of them. What is more there is an inherent conflict of interest. Attempts to resolve the problem typically revolve around two strategies which we shall designate as J and M

Strategy J

Each person retains the default strategy that they used before cohabiting. This strategy is proposed by John with the argument "Why does it matter if the seat is up or down?". As we see below this strategy benefits John.

Strategy M

Each person leaves the seat down. This strategy is proposed by Marsha with the argument "It ought to be down." As we see below this strategy benefits Marsha.

Consequences of strategy J:

Under strategy J the toilet seat is in the up position with probability $p/2$. The respective average cost of toilet seat transfer operations for John and Marsha are:

$$\text{John: } p(3/2-p)C$$

$$\text{Marsha: } pC/2$$

The incremental costs (difference between pre and post habitation costs) are:

$$\text{John: } (p - 1/2)pC$$

$$\text{Marsha: } pC/2$$

$$\text{Total: } (p^2)C$$

John's incremental cost would actually be negative if p were less than $1/2$. This is not the case; $p > 1/2$. Note that Marsha's incremental cost is greater than John's for $p < 1$. Marsha objects.

Consequences of strategy M:

In strategy M the seat is always left down. When John performs operation #1 he lifts the seat before the operation and lowers it after the operation. The respective average cost of toilet seat transfer operations is:

$$\text{John: } 2pC$$

$$\text{Marsha: } 0$$

The incremental costs are:

$$\text{John: } 2(p^2)C$$

$$\text{Marsha: } 0$$

$$\text{Total: } 2(p^2)C$$

In these strategy Marsha bears no cost; all of the incremental costs are borne by John. John objects. Note also that the combined incremental cost of strategy M is greater than that of strategy J.

It is notable that John and Marsha each advocates a strategy that benefits them. This is predictable under game theory. However the conflict over strategies has a cost M in marital discord that is greater than the cumulative cost of toilet seat transfers. It behooves John and Marsha, therefore, to adopt a strategy that minimizes M.

This is not simple. A common reaction is to advance sundry arguments to justify adopting strategy M or J. All such arguments are suspect because they are self serving (and often accompanied with the “If you loved me” ploy.) A sound strategy is one that is equitable and is seen to be equitable. In this regard there are three candidate criteria:

- (1) Minimize the joint total cost
- (2) Equalize the respective total costs
- (3) Equalize the respective incremental costs

The argument for (1) is that John and Marsha are now as one and it is the joint costs and benefits of the union that should be considered. This principle is not universally accepted. It is readily seen that (see remark 5) that the joint total cost is optimized by strategy J which has already been seen to be suspect.

Criterion (2) seems plausible. It requires, however, that Marsha put the seat in the up position after performing a toilet operation some percentage of the time. No instance of this behaviour has ever been observed in recorded history; ergo this criterion can be ruled out. (But see remark 6.)

Criterion (3) argues that the mutual increased cost of toilet seat operations should be shared equitably, i.e., neither party should bear a disproportionate share of the costs of cohabitation. A short calculation reveals that criterion (3) can be achieved if John leaves the seat up after performing toilet operation #1 with a frequency

$$f = (2p-1)/p$$

Since the value of p is seldom precisely measured and is variable in any event it suffices to use an approximate value of f. If we assume that $p=2/3$ then $f=1/2$. This suggests the following convenient rule of thumb:

In the morning John leaves the seat up after performing #1.
In the evening he puts it down.

This rule may not be precise but it is simple and approximately equitable; moreover the use of a definite rule sets expectations. The seat is put down in the evening to avoid the notorious “middle of the night surprise”.

I expect that this analysis should settle the toilet seat controversy for once and for all – if John and Marsha are mathematicians.

* * *

Remark 1: The toilet has an additional attachment called the toilet seat lid which can only be down if the toilet seat is down. When the lid is down the toilet is (or should be) non-functional for toilet operations. Some persons maintain the toilet seat lid in the down position when the toilet is not use. For these

persons the analysis in this note is moot. Such persons pay a fixed cost in seat movement for all toilet operations.

Remark 2: Toilets are also used by domestic animals as a convenient source of drinking water unless the lid is down. (See remark 1)

Remark 3: Experimental evidence suggests that almost all bachelors optimize the seat transfer cost, the exception being those who put the seat up after performing a #2 operation.

Remark 4: Folklore has it that Marsha performs more toilet operations than John, hypothetically because of a smaller bladder. John, however, drinks more beer. We shall not discuss his prostate problem.

Remark 5: “Readily seen” in this context means “It looks obvious but I don’t know how to prove it; you figure it out.”

Remark 6: The toilet lid solution is to put the toilet lid down after all toilet operations. This solution imposes a cost of $2C$ on each party and is accordingly more expensive. It is, however, more esthetic. It also eliminates the “doggy drinking” problem.

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