A Simple Pseudo Random Number Generator
HDR PRNG

\[
= \text{mod}(\text{mod}(\text{mod}(999999999999989, \text{mod}(\text{Trial} \times 2499997 + \text{Var} \times 1800451 + \text{Ent} \times 2000371, 7450589) \times 4658 + 7450581) \times 383, 999991) \times 7440893 + \text{mod}(\text{mod}(999999999999989, \text{mod}(\text{Trial} \times 2246527 + \text{Var} \times 2399993 + \text{Ent} \times 2100869, 7450987) \times 7580 + 7560584) \times 17669, 7440893) \times 1343, 4294967296) + .5) / 4294967296
\]

<table>
<thead>
<tr>
<th></th>
<th>First Term</th>
<th>2nd Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial</td>
<td>2499997</td>
<td>2246527</td>
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<tr>
<td>Var</td>
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<tr>
<td>Agent</td>
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<td>1624729</td>
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Capacity
100 Million Trials
100 Million Variables
100 Million Entities
10+ Million on each of the optional dimensions
How to Use PRNG Dimensions

• The equation is open source
• Entity ID’s will be assigned – but anyone can use Entity ID=0 (which simply cancels out the Entity term)
• Variable IDs should follow a structure – perhaps like a table of accounts
PRNG Requirements

• It has to fit in one cell in Excel and run (meeting Excel constraints) and produce the same results in other environments.

• It has to be a counter-based, that is it behaves like a hash function in which you enter the seed(s) and iteration counter, and the result appears as an output without recursion.

• It has to have a multiple dimensional seed.

• It has to do at least as well on standard statistical tests for randomness as Excel Rand() – but better is nice.
The Dieharder Tests

- The “Dieharder” are a set of 114 statistical tests for Pseudo-Random Number Generators on sets of 65 million numbers.
- We ran full test sets on over 2,000 PRNG formulas and over 10,000 “quick” tests.
- For the best, we rand 10 additional sets of 65 million and compared them to other PRNGs.
New PRNG Performance

- The best HDR PRNG did about as well as Python and AWS.

90% Confidence Intervals for number of non-pass and fails.

*2 sets of 65M instead of 10
New PRNG Performance

• All the non-HDR PRNGs we tested are supposedly based on the Mersenne Twister (MT) which is the benchmark for the best PRNG – but MT is much more complicated, is serial, and could not fit in an Excel cell.

• Even though Excel, R and C are also based on MT, we are not sure why the differences should be so large. They are well outside what could be a random fluke.

90% Confidence Intervals for number of non-pass and fails.