ALL SELECTIONS PLAYED VERSION

*Two Trials of 100 Million rounds, E1 even distribution $1 to $100, E2 = 2*E1 or E1/2*

Each round: An envelope pair is selected at random from 200 pairs,
from which one envelope is random selected and its value revealed,
keep or swap for the other envelope in the pair.
The envelope pair is replaced after the round.

At each reveal:
for all EVEN values less than $51, SWITCH increase   50.0%
for all ODD values less than $51, SWITCH increase   66.7%
and all HALF dollar values, SWITCH increase   100%
for all EVEN values $51 to $100, STAY increase: 66.7%
for all ODD values $51, to $100 STAY increase   50.0%
and all values between $102 and $200, STAY increase   100%

For a random envelope from a random pair, seems best strategy is to SWITCH under $51 otherwise STAY, but turns out NOT so. STAY for $102 is higher and is the best strategy! Why ??

Always Stay average win: $56.82
Always Switch average win: $56.81

For High equal or greater than $51
Low Switch / High Stay average win: **$63.91**
Low Stay / High Switch average win: $49.72

For High equal or greater than $102:
Low Switch / High Stay average win: **$66.25**
Low Stay / High Switch average win: $47.37

Exact sample space distribution*: 200 E1 and 200 E2 envelopes total $22,725*

*175 envelopes (**56.25%**) from 50 cents to $50 $ 5725 (25%)*
*75 envelopes (**31.25%**) from $51 to $100 $ 9540 (42%)*
*50 envelopes (**12.5%**) from $102 to $200 $ 7550 (33%)*
Envelopes' min: $ 0.50
Envelopes' max: $ 200.00
Envelopes' mean: $ 56.81
Envelopes' median: $ 45.00

From ten million trials
1st quartile $22.5
2nd quartile $45
3rd quartile $80
Top decile $120

Number D values under $51,   **56.2**%
Number D values $51 to $100,   **31.3**%
Number D values $102 to $200,   **12.5**%

Envelope pair selected, but only played if revealed value is 10, 20, 40, 60, 80 or 100 dollars.

Envelopes are generated same as the 'play all selections' version, so relevant info:
for EVEN values less than $51, SWITCH increase   50.0%
for all EVEN values $51 to $100, STAY increase: 66.7%

Five Trials of Ten Million rounds

Always Stay average win: **$47.62**
       win values $5 to $50,   57.1%
       win values $60 to $100,   42.9%
       win values $120 to $200,   0.0%
Always Switch average win: **$50.96**
       win values $5 to $50,   76.2%
       win values $60 to $100,   9.5%
       win values $120 to $200,   14.3%

1. **10 SWITCH / 20, 40, 60, 80, 100 STAY average win: $48.08**
       win values $5 to $50,   57.2%
       win values $60 to $100,   42.8%
       win values $120 to $200,   0.0%

2. **10, 20 SWITCH / 40, 60, 80, 100 STAY average win: $49.05**
       win values $5 to $50,   57.1%
       win values $60 to $100,   42.9%
       win values $120 to $200,   0.0%

3. **10, 20, 40 SWITCH / 60, 80, 100 STAY average win: $50.96**
       win values $5 to $50,   47.6%
       win values $60 to $100,   52.4%
       win values $120 to $200,   0.0%

4. **10, 20, 40, 60 SWITCH / 80, 100 STAY average win: $50.96**
       win values $5 to $50,   57.1%
       win values $60 to $100,   38.1%
       win values $120 to $200,   4.8%

5. **10, 20, 40, 60, 80 SWITCH / 100 STAY average win: $50.95**
       win values $5 to $50,   66.7%
       win values $60 to $100,   23.8%
       win values $120 to $200,   9.5%

for $10.00 chance of Switch increase: 50.0%
for $20.00 chance of Switch increase: 50.0%
for $40.00 chance of Switch increase: 50.0%
for $60.00 chance of Switch increase: 33.3%
for $80.00 chance of Switch increase: 33.3%
for $100.00 chance of Switch increase: 33.3%

Differences to NOTE:

- Best strategy is similar to 'Always Switch'
- Worst strategy similar to 'Always Stay'
- Hence 'Always Switch' & 'Always Stay' not similar as in original
- Original version 'best' strategy is near 40% higher than worst
- Only playing tutorial model values, 'best' strategy is only about 7% higher than worst.
- The more accurate model of the tutorial version (below) has a worst to best increase of just 5% !

Trials 3, 4 and 5 have same average win values, this means 'only 100STAY' is the difference between the best strategy and the worst, "Always Stay".

This version has an asymmetry between the values you can play and the values you can win, you can win values that you cannot play, that is, there are some values you can only win by switching such as: $5, $30, $50, $120, $140, $160 and $200.

Another difference is the sample space, 21 pairs**, to the global sample space of 400, that would be the minimum perfect random sample from the millions of rounds played, so a sample of 21 can't possibly have the same outcomes, right? I'm just guessing about this.

**[(10, 5), (10, 5.0), (10, 20), (10.0, 20),
          (20, 40), (20.0, 40), (20, 10.0), (20, 10),
          (40, 80), (40.0, 80), (40, 20), (40, 20.0),
          (60, 30.0), (60, 120), (60, 30)
          (80, 40), (80, 40.0), (80.0, 160),
          (100, 50.0), (100, 50), (100, 200)   ]

THIS IS NOT QUITE TRUE TO THE TUTORIAL VERSION where each round played consists of six hands, one each of the 10, 20, 40, 60, 80 and 100 values. That means an equal distribution of values are played. You can see from the tuples above, my model played 10, 20 and 40 $\frac{4}{21}$ of the time and 60, 80, and 100 $\frac{3}{21}$.

But adjusting so all values are played $\frac{1}{6}$ of the time, there are similar differences to the original.

The new model selects hands from the same global sample space of 400 tuples, playing each value the same number of times. Instead of playing 100 rounds of 6 values as in the tutorial, we play 100 rounds at each value. The following results for a 100 million rounds at each value:

Stay for equal or greater than $20:   **$52.08**
     win values $5 to $50   50.0%
     win values $60 to $100   50.0%
     win values $120 to $200   0.0%

Stay for equal or greater than $40:   **$52.92**
     win values $5 to $50   50.0%
     win values $60 to $100   50.0%
     win values $120 to $200   0.0%

Stay for equal or greater than $60:   **$54.58**
    win values $5 to $50   41.7%
    win values $60 to $100   58.3%
    win values $120 to $200   0.0%

Stay for equal or greater than $80:   **$54.58**
    win values $5 to $50   52.8%
    win values $60 to $100   41.7%
    win values $120 to $200   5.6%

Stay at equal to $100:   **$54.58**
    win values $5 to $50   63.9%
    win values $60 to $100   25.0%
    win values $120 to $200   11.1%

Always Switch average win: $54.58
    win values $5 to $50   75.0%
    win values $60 to $100   8.3%
    win values $120 to $200   16.7%

Always Stay average win: $51.67
    win values $5 to $50   50.0%
    win values $60 to $100   50.0%
    win values $120 to $200   0.0%

chance of switch increase for new model:
for $10.00 chance of Switch increase: 50.0%
for $20.00 chance of Switch increase: 50.0%
for $40.00 chance of Switch increase: 50.0%
for $60.00 chance of Switch increase: 33.3%
for $80.00 chance of Switch increase: 33.3%
for $100.00 chance of Switch increase: 33.3%

Probability of increase for every value in global sample space.
<u>Ten Million rounds E1 even distribution $1 to $100</u>

for $0.50 chance of Switch increase: 100.0%	for $8.50 chance of Switch increase: 100.0%
for $1.00 chance of Switch increase: 66.6%	for $9.00 chance of Switch increase: 66.5%
for $1.50 chance of Switch increase: 100.0%	for $9.50 chance of Switch increase: 100.0%
for $2.00 chance of Switch increase: 50.0%	for $10.00 chance of Switch increase: 50.0%
for $2.50 chance of Switch increase: 100.0%	for $10.50 chance of Switch increase: 100.0%
for $3.00 chance of Switch increase: 66.7%	for $11.00 chance of Switch increase: 66.5%
for $3.50 chance of Switch increase: 100.0%	for $11.50 chance of Switch increase: 100.0%
for $4.00 chance of Switch increase: 50.1%	for $12.00 chance of Switch increase: 50.1%
for $4.50 chance of Switch increase: 100.0%	for $12.50 chance of Switch increase: 100.0%
for $5.00 chance of Switch increase: 66.8%	for $13.00 chance of Switch increase: 66.4%
for $5.50 chance of Switch increase: 100.0%	for $13.50 chance of Switch increase: 100.0%
for $6.00 chance of Switch increase: 50.0%	for $14.00 chance of Switch increase: 50.1%
for $6.50 chance of Switch increase: 100.0%	for $14.50 chance of Switch increase: 100.0%
for $7.00 chance of Switch increase: 66.6%	for $15.00 chance of Switch increase: 66.9%
for $7.50 chance of Switch increase: 100.0%	for $15.50 chance of Switch increase: 100.0%
for $8.00 chance of Switch increase: 49.8%	for $16.00 chance of Switch increase: 50.1%

for $16.50 chance of Switch increase: 100.0%
for $17.00 chance of Switch increase: 66.7%
for $17.50 chance of Switch increase: 100.0%
for $18.00 chance of Switch increase: 49.8%
for $18.50 chance of Switch increase: 100.0%
for $19.00 chance of Switch increase: 66.6%
for $19.50 chance of Switch increase: 100.0%
for $20.00 chance of Switch increase: 50.1%
for $20.50 chance of Switch increase: 100.0%
for $21.00 chance of Switch increase: 66.3%
for $21.50 chance of Switch increase: 100.0%
for $22.00 chance of Switch increase: 50.3%
for $22.50 chance of Switch increase: 100.0%
for $23.00 chance of Switch increase: 66.6%
for $23.50 chance of Switch increase: 100.0%
for $24.00 chance of Switch increase: 50.1%
for $24.50 chance of Switch increase: 100.0%
for $25.00 chance of Switch increase: 66.7%
for $25.50 chance of Switch increase: 100.0%
for $26.00 chance of Switch increase: 49.6%
for $26.50 chance of Switch increase: 100.0%
for $27.00 chance of Switch increase: 66.8%
for $27.50 chance of Switch increase: 100.0%
for $28.00 chance of Switch increase: 50.2%
for $28.50 chance of Switch increase: 100.0%
for $29.00 chance of Switch increase: 66.8%
for $29.50 chance of Switch increase: 100.0%
for $30.00 chance of Switch increase: 49.8%
for $30.50 chance of Switch increase: 100.0%
for $31.00 chance of Switch increase: 66.3%
for $31.50 chance of Switch increase: 100.0%
for $32.00 chance of Switch increase: 49.9%
for $32.50 chance of Switch increase: 100.0%
for $33.00 chance of Switch increase: 66.6%
for $33.50 chance of Switch increase: 100.0%
for $34.00 chance of Switch increase: 50.1%
for $34.50 chance of Switch increase: 100.0%
for $35.00 chance of Switch increase: 66.9%
for $35.50 chance of Switch increase: 100.0%
for $36.00 chance of Switch increase: 50.1%
for $36.50 chance of Switch increase: 100.0%
for $37.00 chance of Switch increase: 66.5%
for $37.50 chance of Switch increase: 100.0%
for $38.00 chance of Switch increase: 49.8%
for $38.50 chance of Switch increase: 100.0%
for $39.00 chance of Switch increase: 66.9%
for $39.50 chance of Switch increase: 100.0%
for $40.00 chance of Switch increase: 49.9%
for $40.50 chance of Switch increase: 100.0%
for $41.00 chance of Switch increase: 66.8%
for $41.50 chance of Switch increase: 100.0%

for $42.00 chance of Switch increase: 49.9%
for $42.50 chance of Switch increase: 100.0%
for $43.00 chance of Switch increase: 66.5%
for $43.50 chance of Switch increase: 100.0%
for $44.00 chance of Switch increase: 49.6%
for $44.50 chance of Switch increase: 100.0%
for $45.00 chance of Switch increase: 66.6%
for $45.50 chance of Switch increase: 100.0%
for $46.00 chance of Switch increase: 50.2%
for $46.50 chance of Switch increase: 100.0%
for $47.00 chance of Switch increase: 66.5%
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for $48.00 chance of Switch increase: 50.0%
for $48.50 chance of Switch increase: 100.0%
for $49.00 chance of Switch increase: 66.9%
for $49.50 chance of Switch increase: 100.0%
for $50.00 chance of Switch increase: 50.4%
for $51.00 chance of Switch increase: 50.2%
for $52.00 chance of Switch increase: 33.3%
for $53.00 chance of Switch increase: 49.8%
for $54.00 chance of Switch increase: 33.4%
for $55.00 chance of Switch increase: 49.7%
for $56.00 chance of Switch increase: 33.5%
for $57.00 chance of Switch increase: 49.5%
for $58.00 chance of Switch increase: 33.3%
for $59.00 chance of Switch increase: 50.2%
for $60.00 chance of Switch increase: 33.6%
for $61.00 chance of Switch increase: 50.2%
for $62.00 chance of Switch increase: 33.6%
for $63.00 chance of Switch increase: 50.0%
for $64.00 chance of Switch increase: 33.1%
for $65.00 chance of Switch increase: 49.7%
for $66.00 chance of Switch increase: 33.5%
for $67.00 chance of Switch increase: 50.3%
for $68.00 chance of Switch increase: 33.2%
for $69.00 chance of Switch increase: 49.9%
for $70.00 chance of Switch increase: 33.3%
for $71.00 chance of Switch increase: 49.9%
for $72.00 chance of Switch increase: 33.2%
for $73.00 chance of Switch increase: 50.4%
for $74.00 chance of Switch increase: 33.3%
for $75.00 chance of Switch increase: 50.2%
for $76.00 chance of Switch increase: 33.2%
for $77.00 chance of Switch increase: 49.8%
for $78.00 chance of Switch increase: 33.2%
for $79.00 chance of Switch increase: 50.1%
for $80.00 chance of Switch increase: 33.5%
for $81.00 chance of Switch increase: 50.0%
for $82.00 chance of Switch increase: 32.8%
for $83.00 chance of Switch increase: 49.5%
for $84.00 chance of Switch increase: 33.1%

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for $86.00 chance of Switch increase: 33.3%
for $87.00 chance of Switch increase: 50.2%
for $88.00 chance of Switch increase: 33.2%
for $89.00 chance of Switch increase: 50.2%
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for $98.00 chance of Switch increase: 33.2%
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