

AREA 51 / WORKING PAPER / BETA v0.3

Poker 51

One Card Declared, Five Probabilities Preserved



DECLARED / OUT

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Abstract

Poker 51 is a browser experiment in five-card draw with 2♣ declared outside the deck. Removing that card preserves the exact probabilities of one pair, two pair, three of a kind, full house and four of a kind. A transitive-incidence argument proves the invariance. Exhaustive censuses give the four changes: straight and straight flush probabilities increase by 5.10638% relative to the 52-card values; flush and high card decrease by 0.0399873%. The beta enumerates each possible draw under a stated information model. Version 0.3 offers betting before and after the draw against Riemann, a dealer using published draw rules, sampled hand-strength estimates and fixed betting thresholds. The new pre-draw read projects its own draw through 128 deterministic sample completions. We verify finite accounting paths. Earlier v0.2 strategy simulations do not apply to this two-round game. No equilibrium or optimality is established; neither a player advantage nor a human learning effect is claimed. The name is a name: the dealer uses no zeta data and makes no claim about the Riemann hypothesis.

1. A frozen experiment

The active set is a standard deck without 2♣: 51 distinct identities. The outside marker is I. Poker uses this identity set, freshly shuffled for each hand; it does not retain the Invariant fixture’s card order or decode any stored zero label. Ace is high except in A-2-3-4-5. Suits do not break showdown ties.

Deal and decision order. The player receives five cards, then the House receives five. The player chooses a keep subset and locks it with the opening bet. A pre-draw betting round follows. If neither player folds, the player replaces the chosen cards and the House then draws under the rule below. Discarded cards never return during that hand. The House’s draw count is displayed. A second betting round then follows (§4), unless the player is already all in. Both hands are revealed at the end of every hand, including after a fold.

House rule: first applicable row	Cards kept
Straight or better	All five
Three of a kind / two pair / one pair	All cards in the repeated ranks
Otherwise, four to a flush	Those four
Otherwise, four consecutive ranks, 2-3-4-5 through 10-J-Q-K	Those four; A-2-3-4 and J-Q-K-A do not qualify
Otherwise	The highest card; deterministic suit order ♠♥♦♣ if needed

The House uses its own initial hand only. It does not inspect the player’s cards or stamps. This is a declared deterministic policy, with no optimality claim.

2. Why five probabilities are preserved

Proposition (uniform deletion under transitive incidence). Let E be a class of five-card hands preserved by a permutation group acting transitively on the 52 card identities. If $T = |E|$ and I is the number of its hands containing one specified card, then every card has incidence I. Double-counting card-hand incidences gives $52I = 5T$. Deleting any specified card therefore retains $47T/52$ hands of E.

$$C(51,5) / C(52,5) = 47/52, \text{ so } (T - I) / C(51,5) = T / C(52,5).$$

For each of the five repeated-rank categories, arbitrary rank relabellings and independent suit permutations within each rank preserve the category and act transitively on identities. The proposition applies. It does not apply to the remaining four exclusive poker categories: their definitions depend on rank order, common suit, or exclusions of those events.

Exact census

Exclusive category	52 cards	51 cards	Relative probability change
Straight flush	40	38	+5.10638%
Four of a kind	624	564	0 (exact)
Full house	3,744	3,384	0 (exact)
Flush	5,108	4,615	-0.03999%
Straight	10,200	9,690	+5.10638%
Three of a kind	54,912	49,632	0 (exact)
Two pair	123,552	111,672	0 (exact)
One pair	1,098,240	992,640	0 (exact)
High card	1,302,540	1,176,825	-0.03999%

Denominators: $C(52,5) = 2,598,960$; $C(51,5) = 2,349,060$. Royal flush is included in straight flush. Straight excludes straight flush; flush excludes straight flush; high card excludes both straight and flush. Changes are relative percentages, not percentage points.

The four changed categories. The 2 belongs to two of the ten straight rank sets. For each such set, fixing 2♣ leaves $4^4 - 1 = 255$ non-flush suit choices. Thus 510 ordinary straights and two straight flushes disappear: both retain 19/20 of their hands. Their probability ratio is $(19/20)/(47/52) = 247/235$.

The ordinary flush count loses $C(12,4) - 2 = 493$, giving 4,615. For any non-straight five-rank set, non-flush suit assignments are 255 times flush assignments in either deck: 1,020/4 in the full deck or when the 51-card rank set omits the 2, and 765/3 when the 51-card rank set includes the 2. Hence high card equals $255 \times$ flush in both censuses. Their common relative change is exactly -24/60,019. The straight change depends on which rank is removed; the five invariances hold for deletion of any card.

3. What the exact draw panel means

Let H be the player’s initial five-card hand and K a specified subset to keep. Put $k = 5 - |K|$. At the initial deal, before conditioning on stamps or Riemann’s betting actions, the remaining 46 identities are exchangeable from the player’s seat. Five are physically in the House’s initial hand, but those identities are unknown in this baseline model. Marginalizing that unknown hand makes every k-subset of the 46 equally likely as the player’s replacement set. All five initial player cards remain excluded, including discards. Write U for those 46 unseen identities.

For category j: $P(j \mid H, K) = \#\{D \subset U: |D| = k, \text{category}(K \cup D) = j\} / C(46,k)$.

Cards drawn k	0	1	2	3	4	5
Possible draws	1	46	1,035	15,180	163,185	1,370,754

The engine visits every completion; it does not sample. The panel reports the category of the player’s final hand. “Higher category” excludes improvements within one category, such as a better kicker. It is neither a showdown win probability nor an expected-return calculation.

A replayable example

Start with K♠ K♥ 7♦ 4♣ 9♠ and keep the kings. There are $C(46,3) = 15,180$ completions. The exact distribution is:

Final category	Completions	Probability
One pair	10,796	71.119895%
Two pair	2,412	15.889328%
Three of a kind	1,772	11.673254%
Full house	156	1.027668%
Four of a kind	44	0.289855%

All other categories have zero completions in this example. The counts sum to 15,180.

Stamps change the information, not the cards

A House card whose stamp was earned in Memory 51 displays that mark on its back. A player who recalls the mapping may infer the identity; the House ignores marks. The odds panel deliberately ignores all stamp observations, including whether a card is marked. It also ignores betting actions. It is therefore a baseline, not the full posterior distribution after observing the pre-draw round or using stamps.

The House's later draw count is another observation of its fixed policy. A future win-probability model must condition jointly on that policy, the draw order, available marks and unseen discards. Simply maximizing the chance of reaching a higher hand category need not maximize the chance of beating the House. Quantifying the decision value of recall remains an open task for this beta.

4. Two betting rounds and a published dealer

Each player antes 1 jbit. The player chooses keepers, announcing $k = 5 - \text{number kept when the first bet is placed}$. That subset is frozen for the hand. Both rounds begin with the player: bet 1, 2, 4 or 8 jbits, or fold; when the remaining balance is below 8, it is also offered as an all-in opening amount. Riemann may fold, call, or raise by the opening amount B. The player may call, fold, or re-raise by B once. Riemann then calls or folds. A partial all-in call is allowed when the player cannot cover a raise.

After the first round, Draw (or Stand pat) uses the locked subset. The House then draws. The second betting round follows with the accumulated pot. If the player reaches zero available balance before the draw, the draw still occurs, followed directly by showdown. Passive recovery or earnings elsewhere do not reopen betting for an already all-in hand. If the ante took the last jbit, the player locks the keepers and draws for the antes.

Let P and R be total contributions, in integer jbit cents, and $M = \min(P, R)$. At showdown the player receives $P + M$ on a win, $P - M$ on a loss, or P on a tie. Thus unmatched excess returns to its owner. If Riemann folds, the player receives $P + R$; if the player folds, the player receives zero. No additional debit is needed at settlement. The maximum matched contribution with two 8-jbit rounds and both re-raises is $1 + 3 \cdot 8 + 3 \cdot 8 = 49$ jbits per player.

4.1 Information and the read

Riemann receives its own five cards, the announced draw count before the draw (the completed count afterward), the opening wager, the pot before this round, and whether the player retains funds. It never receives the player's card identities, marks or the actual future deck. The fixed v0.2 draw rule and belief table are reused unchanged.

The belief table stores 1,000 strength quantiles per row. Rows 0-4 model final hands under the House draw rule; row 5 is a random-five-card baseline. The House never draws five. The table was generated from 19,257,529 deals with seed 51; the prior verifier reproduced it bit for bit. Let $q_k(x)$ count the fraction below strength x, counting ties half. The mixture score is

$$s(x, k) = 0.6 q_k(x) + 0.4 q_5(x).$$

Before the draw: sort the House hand's card codes, choose its fixed-rule keepers, and sample 128 possible completions from the 46 identities outside that initial hand. Each completion draws without replacement. The independent simulation stream is seeded by the FNV-1a hash of the sorted codes XOR 0x50353103 and uses the published Mulberry32 implementation with rejection-sampled bounded integers. The read is the average of s over these completions. Standing pat uses one exact strength evaluation. These are reproducible model samples; they do not consume or inspect the shuffled game deck.

After the draw: the read is s evaluated at the House's actual final hand. Neither version conditions the belief rows on the House's known cards. The pre-draw projection also does not condition on the unknown player identities. These scores are approximate, quantized model outputs, not exact conditional win probabilities or a game-tree search.

5. Thresholds, presentation and research limits

For opening bet B , retain the modeled top fraction f : 1 for $B < 2$, 0.85 for $2 \leq B < 4$, 0.70 for $4 \leq B < 8$, and 0.55 for $B \geq 8$ (jbit units). Rescale the read r to $n = \max(0, \min(1, (r - (1 - f))/f))$. A player re-raise halves f . The rescaling is a heuristic, not an exact conditional distribution.

Let P_0 be the pot at the beginning of the current betting round, before this round’s player opening wager. Use the same units for P_0 and B . Calling an opening wager costs B and produces a pot $P_0 + 2B$. Calling a player re-raise costs a further B and produces a pot $P_0 + 6B$.

Decision, in priority order	Published rule
Raise for value	$n \geq 0.70$ and the player retains funds
Bluff-raise	$n < 0.10$, own-card FNV-1a hash divisible by 8, and the player retains funds
Call opening bet	$n \geq B / (P_0 + 2B)$, when neither raise applies
Fold opening bet	Otherwise
Facing a re-raise	With f halved, call if $n \geq B / (P_0 + 6B)$; otherwise fold

Example. Before the draw $P_0 = 2$. A 1-jbit call threshold is $1/4$. If that round ended with an opening bet and call, the post-draw pot begins at $P_0 = 4$. A new 1-jbit call then has threshold $1/6$. The second round therefore uses the money already committed, rather than resetting its calculation to the two antes.

Interpretation. When an after-draw call ends the hand, these fractions are break-even equity thresholds for that call. Before the draw, a call normally leaves another betting round, so the same fraction is only an immediate price benchmark. It is not a break-even for the full continuation strategy. Estimated reads, mixture weights, range fractions and raise rules remain design choices. No optimality or equilibrium is established.

Earlier strategy experiments are historical

The v0.2 paper reported 200,000-hand simulations and a search over 480 parameter combinations, with negative means for the reported retests. Those runs used one betting round after the draw. They do not measure v0.3 strategy returns, best responses or finite-bank outcomes. The old source, receipts and PDF are retained without rewriting their results. Profitability in the present two-round game is unmeasured.

Riemann AI: the table character

The shared illustrated avatar has a beard, round spectacles and a bow tie. In Poker, the thinking pause is 1–2.4 seconds and increases with the public pot, not hidden hand strength. Dialogue is selected from public actions and revealed results. Original lines and short adapted historical excerpts are distinguished and sourced on the Rule Card. This is a rule-based simulated opponent, not a language model, and the presentation does not change a deal, decision or payment.

At Blackjack 51 the same character is a narrator: after a card leaves a player decision open, it prompts “Your move”, “Your turn”, “Over to you” or “Take your time”, and names the legal choices. It adds no thinking delay and does not alter the Blackjack dealer engine. Riemann is a name, not a claim about the Riemann hypothesis.

6. Verification and reproducibility

Current or retained evidence	Scope and limits
Retained exact census and independent replay	The v0.1 engine is unchanged. Prior checks enumerate all 52-card and 51-card five-card hands, compare independent category counts, enumerate all 32 keep masks of one fixture and independently replay 200,000 sampled showdown rankings. This edition does not claim a new census.
v0.3: 5,000 seeded paths	Seed 3102; varying balances, both betting rounds, folds, calls, raises, re-raises, stand-pat, five-card draws and partial all-ins. Exact integer accounting, nonnegative available balances, unique movement IDs and frozen keepers are asserted.
v0.3: 1,000 recalculated decisions	A separate quantile scan, range adjustment, threshold and action calculation matches the policy. It reuses the projected keys and evaluator; this is not an independent validation of the projection sampler.
Targeted v0.3 cases	A tied showdown returns both 8-jbit rounds with maximum re-raises; an ante-only all-in draws before settlement; pre-draw choices ignore future deck and player identities; saved v0.2 hands keep their original rules.

Finite checks do not exhaust all starting hands, betting paths or strategies. The seeded path sample contains no random tie; a separate constructed royal-flush tie tests that outcome. Verifier receipts are included beside the game. The browser-integration receipts describe their separate storage and UI scope.

Reproduce from the site root

`node area-51/poker-51/verify-poker51-v0-3.mjs`

Current rules: `poker51-table-v0-3.js` and `poker51-riemann-v0-3.js`. Earlier evaluators and belief data stay versioned. For UI and wallet tests, follow `tests/v3_2/README.md` and install its pinned dependencies. Those tests use an in-memory DOM, not a rendered browser.

Saved hands and limits

Each movement is posted atomically with the saved hand. Receipt steps include pre- or post-draw so the rounds cannot collide. A stale tab’s phase and action count are checked before a wager commits. An unfinished v0.2 hand continues under its original one-round rules; the next deal uses v0.3 and preserves the record. Close or reload older tabs after installing the update. The most recent 100 completed hands are retained for export.

The browser’s cryptographic source, bounded rejection sampler and Fisher-Yates shuffle are unchanged. Uniformity relies on uniform random words, not on the finite tests. Hidden cards exist in client memory and can be inspected. Jbits are browser-local play units with no monetary value. No measured memory advantage, human-learning effect, optimal draw rule, strategy-profit bound or claim concerning zeta zeros follows from this release.

References and draft citation

[1] Huckstead, Jeffery Lyn. Project 51: Reading the Record Across Rules. Zenodo record 23004789. Intended collection destination; this existing DOI does not identify the Poker draft.

[2] Huckstead, Jeffery Lyn / Cerebral Graphix. Poker 51: One Card Declared, Five Probabilities Preserved. v0.1 and v0.2 unpublished drafts, 28 September 2026. Earlier PDFs, census and verification sources remain under `research/project-51/poker-51/` and `area-51/poker-51/`. The inherited mathematical results are unchanged.

[3] Game and sourced dialogue: `cerebralgraphix.com/area-51/poker-51/`. The Rule Card distinguishes Riemann’s 1859 zeta-paper and 1854 geometry-lecture excerpts from original game dialogue.

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