

GENERALIZING FOOTBALL KEY-NUMBER PRICING AND TEASERS: A DISCRETE-MARGIN FRAMEWORK FOR NFL & NCAA

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ABSTRACT. We develop a unified, push-aware, *discrete-margin* framework for valuing point-spread moves and teaser mechanics at *any* integer n , with particular attention to the football key numbers 3, 6, 7. Leveraging historical margin-of-victory frequencies for the NFL and NCAA, we (i) derive closed-form expressions for the fair price of buying/selling half points across n , (ii) generalize to multi-point moves (including standard t -point teasers) as sums of integer-atom probabilities, (iii) compute teaser break-even thresholds as functions of book pricing and leg count, and (iv) contrast NFL vs. NCAA where key-number mass differs meaningfully. The formulas are model-agnostic (they require only a calibrated discrete PMF over margins) and are plug-and-play for dashboards and backtests. We include league-specific guidance (when to buy the hook, when teasers are viable), and we reconcile our mathematics with empirical push charts and published studies.

1. SETUP: INTEGER MARGINS AND NOTATION

Let $M \in \mathbb{Z}$ denote the final *favorite-minus-underdog* margin and $p_k = \Pr[M = k]$ its probability mass. For a spread s quoted to the half-point,

$$\text{favorite} - s \text{ covers} \iff \begin{cases} M \geq \lceil s + 1 \rceil & \text{if } s \in \mathbb{Z} + \frac{1}{2}, \\ M \geq s + 1 & \text{if } s \in \mathbb{Z}, \end{cases}$$

with a *push* at integer $M = s$ when $s \in \mathbb{Z}$. Define the push atom at integer n by $p_n = \Pr[M = n]$; empirically in the NFL,

$$p_3 \approx 0.145\text{--}0.150, \quad p_7 \approx 0.090\text{--}0.099, \quad p_6 \approx 0.060\text{--}0.073,$$

while in NCAA FBS,

$$p_3 \approx 0.092, \quad p_7 \approx 0.078, \quad p_6 \approx 0.030,$$

based on large-sample tabulations.¹

Throughout, let a unit stake pay net b on a win (e.g. $b = 100/110 \approx 0.909$ at -110) and 0 on a push.

2. HALF-POINT VALUATION AT A GENERAL INTEGER n

Consider moves that cross a single integer n .

Favorite side.

$$\text{(A)} \quad -n \rightarrow -(n - \tfrac{1}{2}) : \quad \text{push} \rightarrow \text{win at } M = n, \quad \Delta\text{EV} = b p_n.$$

$$\text{(B)} \quad -(n + \tfrac{1}{2}) \rightarrow -n : \quad \text{loss} \rightarrow \text{push at } M = n, \quad \Delta\text{EV} = 1 \cdot p_n.$$

Thus the full key move $-(n + \frac{1}{2}) \rightarrow -(n - \frac{1}{2})$ is worth $(1 + b)p_n$ per unit staked.

Underdog side. By symmetry:

$$\text{(C)} \quad +(n - \tfrac{1}{2}) \rightarrow +n : \quad \text{loss} \rightarrow \text{push at } M = n, \quad \Delta\text{EV} = 1 \cdot p_n.$$

$$\text{(D)} \quad +n \rightarrow +(n + \tfrac{1}{2}) : \quad \text{push} \rightarrow \text{win at } M = n, \quad \Delta\text{EV} = b p_n.$$

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¹See [1, 5, 2] for NFL key-number ranges; leaguewide tables from [4] (NFL, 2000–2025) and [3] (FBS vs. FBS, 2005–2025) give exact counts.

Implications. At NFL key numbers, p_3 is so large (§1) that buying the hook on/ off 3 commands the greatest fair premium:²

fair half-point value at $n \propto p_n$, so $n \in \{3, 7\}$ dominate NFL; NCAA values are smaller.

3. MULTI-POINT MOVES AS SUMS OF ATOMS

Any move that shifts the *cover threshold* by $t > 0$ points can be decomposed into half-point steps across the integers it traverses; only the *integers crossed* affect EV. For a favorite,

$$\text{cover set changes from } \{M \geq T_1\} \text{ to } \{M \geq T_2\}, \quad T_2 < T_1.$$

The win-probability increase equals

$$\Delta P_{\text{win}} = \Pr(T_2 \leq M < T_1) = \sum_{k=\lceil T_2 \rceil}^{\lfloor T_1 \rfloor - 1} p_k,$$

i.e. the mass between the old and new thresholds. The EV change (per unit stake) follows:

$$\Delta \text{EV} = b \cdot \underbrace{\sum_{\substack{\text{integers } k \text{ where} \\ \text{push} \rightarrow \text{win}}} p_k}_{\text{Case (A),(D)}} + 1 \cdot \underbrace{\sum_{\substack{\text{integers } k \text{ where} \\ \text{loss} \rightarrow \text{push}}} p_k}_{\text{Case (B),(C)}}.$$

Example (NFL, crossing 7 and 3). $-7.5 \rightarrow -1.5$ increases $P(\text{win})$ by $\sum_{k=2}^7 p_k$; with typical NFL atoms, this is dominated by $p_3 + p_7$ (plus p_6), explaining why 6-point *teaser* legs that cross both 7 and 3 are uniquely powerful.

4. FAIR PRICING: SPREADS AND POINT-BUYS

For a favorite at integer n with $(P_{>n}, P_{=n}, P_{<n}) = (\Pr[M \geq n+1], p_n, \Pr[M \leq n-1])$, the no-vig fair net payoff b^* at $-n$ solves

$$0 = b^* P_{>n} - P_{<n} \implies b^* = \frac{P_{<n}}{P_{>n}}.$$

A half-point buy $-n \rightarrow -(n - \frac{1}{2})$ has *fair* surcharge $\Delta b_{\text{fair}} = b p_n$ (Case A). Conversely, selling the hook $-n \rightarrow -(n + \frac{1}{2})$ requires a *rebate* matching the value lost, $\approx b p_n$ in EV terms. These statements hold verbatim for dogs via (C)–(D).

5. TEASERS: GENERAL t -POINT, k -LEG MECHANICS

A t -point teaser shifts each leg's threshold by t , converting the leg's cover probability from q to $q_t = q + \sum p_k$ across the integers traversed. If a k -leg teaser pays decimal odds O_k , the *break-even* per-leg win probability is³

$$q_{\text{req}}(k, O_k) = (O_k^{-1})^{1/k}.$$

For two-leg NFL teasers at -110 ($O_2 = 1.909$), $q_{\text{req}} \approx 0.724$; at -120 ($O_2 = 1.833$), $q_{\text{req}} \approx 0.738$.⁴

²Rule-of-thumb conversions align with journalism and sharp market studies: converting -3 to -2.5 often prices near ~ 20 – 35 cents in fair odds, and converting $+3$ to $+3.5$ similarly [7, 1]. Books frequently *overcharge* relative to fairness; use a push chart or calculator to avoid paying above $b p_3$ (favorite) or p_3 (dog).

³Assuming independence and the house rule that a push reduces leg count (the industry standard for NFL; always verify rules). If pushes *lose*, adjust q_t downward by the push mass.

⁴Classic references give the same $\sim 72.5\%$ rule-of-thumb per leg for two-team, 6-point teasers priced near -110 ; see [10, 6, 8]. Empirical hit rates for *Wong* legs (crossing 3 and 7) are historically in the low-/mid-70s% per leg [9].

Wong strategy (NFL) vs. NCAA. NFL: teasing favorites from -7.5 to -1.5 and dogs from $+1.5$ to $+7.5$ traverses $\{2, 3, 4, 5, 6, 7\}$, capturing $p_3 + p_7$ and typically achieving $q_t \gtrsim 0.72$ in low-total games—hence *potentially* +EV at -110 but marginal at -120 .⁵ NCAA: because p_3, p_7 are materially smaller (§1), q_t gains less; multiple studies find college teasers broadly -EV even under low totals, with only small, noisy pockets near pick'em spreads showing near-breakeven legs [11, 12]. *Default guidance: do not tease college sides.*

6. STRATEGY PLAYBOOK (LEAGUE-SPECIFIC)

- (1) **NFL — buy/sell the right hooks.** Pay for 3 (and to a lesser extent 7) if the price \leq fair value: buy (favorite) $-3 \rightarrow -2.5$ if the extra juice $\lesssim b p_3$; buy (dog) $+3 \rightarrow +3.5$ if $\lesssim p_3$.⁶ Avoid paying for non-key numbers (e.g. 4, 5, 8) where p_n is small.
- (2) **NFL — teasers only if they cross 7 and 3 and are fairly priced.** Two-leg, 6-pt at -110 can be viable; at -120 the margin is thin or negative unless legs are very strong (low totals, efficient spreads).⁷
- (3) **NCAA — rarely buy, almost never tease.** Lower key-number masses (p_3, p_7) and higher scoring variance shrink t -point value; buying hooks is only justified at unusually cheap prices, and teasers are generally -EV [11].
- (4) **Line shopping.** Because value scales with p_n , a *free* hook (rogue ± 3.5 or ∓ 2.5 at standard juice) is worth substantially more than the same hook on 5; aggregate multiple books and prefer alternate lines that cross $\{3, 7\}$ at modest juice [7].

7. IMPLEMENTATION IN DASHBOARDS/BACKTESTS

1. **Calibrate p_k by league, era, and (optionally) total.** Start from league tables [4, 3]; optionally condition on total bins (low totals \Rightarrow higher p_3).
2. **Compute fair moves as additive over integers crossed.** Use (A)–(D) and sum of p_k across intervals to convert spreads \leftrightarrow alternate lines & teasers.
3. **Teaser logic.** Given book teaser price O_k , require $q_t \geq q_{\text{req}}(k, O_k)$ for *each* leg; prefer legs that cross both 7 and 3, and filter by total.
4. **Kelly sizing.** With push probability r and win/loss (q, ℓ) (so $q + \ell + r = 1$), fractional Kelly is $f^* = (bq - \ell)/b$; set $q = q_t$ for teased legs or adjusted spreads.

CONCLUSION

Key-number pricing is nothing more than *counting lattice mass*: the fair value of a point (or teaser) move equals the sum of the p_k it captures, with push vs. win weights $(1, b)$. Because p_3 (and p_7) are large in the NFL and smaller in NCAA, the same hook or teaser has very different economics across leagues. The discrete framework here turns that insight into one-line computations suited for live decisioning, auditing sportsbook prices, and principled bankroll deployment.

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⁵Totals matter: lower totals concentrate distributions, increasing the value of t points; most practitioners filter Wong legs by total (e.g. ≤ 49). Books reacted by repricing to -120 or worse and by limiting teaser eligibility, eroding edge [10, 9].

⁶Empirical push rates at 3 near 9–10% on the *favorite's* side imply ~ 20 –35 cent fair moves in common markets; media primers concur [7, 1].

⁷Wizard-of-Odds' long-horizon estimates show basic-strategy teasers roughly breakeven at contemporary pricing without additional filters [9].

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