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,

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

while in NCAA FBS,

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

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.

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

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

Underdog side. By symmetry:

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

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[1] See [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]

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

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

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

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

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

Example (NFL, crossing 7 and 3). $-7.5 \to -1.5$ 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 $b^\star$ at $-n$ solves

$$0 = b^\star P_{>n} - P_{<n} \quad \Longrightarrow \quad b^\star = \frac{P_{<n}}{P_{>n}}.$$

A half-point buy $-n \to -(n - \frac{1}{2})$ has *fair* surcharge $\Delta b_{\text{fair}} = b\, p_n$ (Case A). Conversely, selling the hook $-n \to -(n + \frac{1}{2})$ 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 is[3]

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

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]

[2] Rule-of-thumb conversions align with journalism and sharp market studies: converting -3 to -2.5 often prices near $\sim$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).

[3] Assuming 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.

[4] Classic 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) $-3 \to -2.5$ if the extra juice $\lesssim b\,p_3$; buy (dog) $+3 \to +3.5$ 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 $f^\star = (bq - \ell)/b$; 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.

References

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[5] Totals 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].

[6] Empirical 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].

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

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