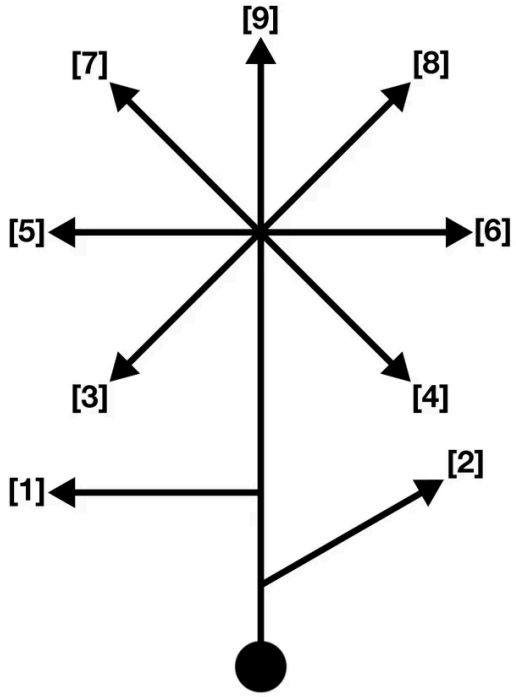


Optimizing Primary Route Targeting: Assessing the Risk-Reward Balance Across Defensive Coverages

---

April 4th, 2025

Nathaniel Wright

Introduction

The modern NFL is defined by high-powered passing offenses, driven by unprecedented levels of arm talent and receiving skill. Crafting an effective passing scheme is more critical than ever, with success hinging on the ability to optimize route selection and execution against various defensive coverages. This study aims to evaluate the success rates of routes across the full route tree, encompassing wide receivers, tight ends, and running backs. By identifying the most effective routes for each position based on anticipated coverage, offensive play callers can minimize schematic inefficiencies and enhance their quarterback's decision-making process, ultimately improving overall offensive performance.

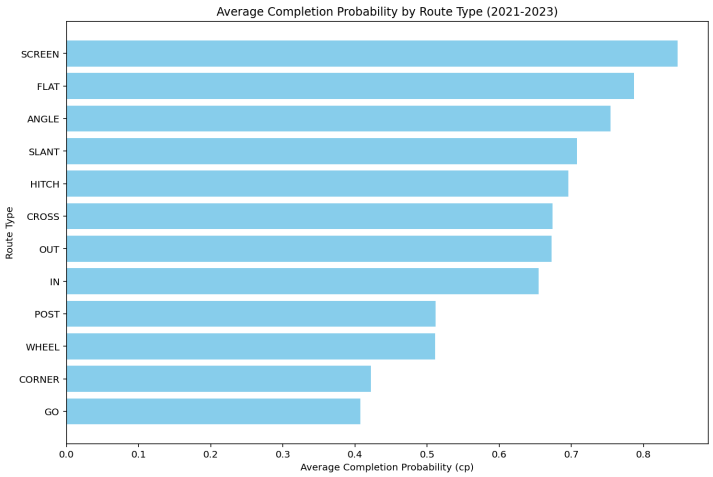
Methodology

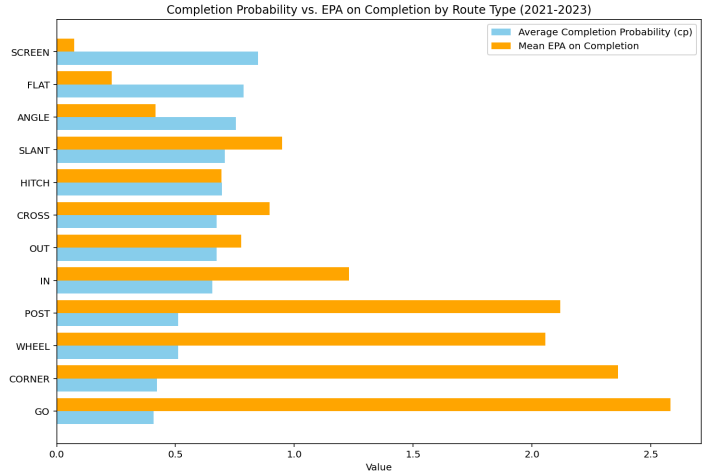
This study leverages the nfl_data_py database, analyzing play-by-play data from the 2021 through 2024 seasons. This time frame ensures a substantial and contemporary sample size while avoiding anomalies from the 2020 season impacted by COVID-19. To maintain relevance to standard game conditions, the dataset was filtered to include only neutral game scripts with a score differential of two possessions or less (≤ 16 points). This approach prevents skewed results from scenarios where teams are forced into pass-heavy play calling to overcome large deficits.

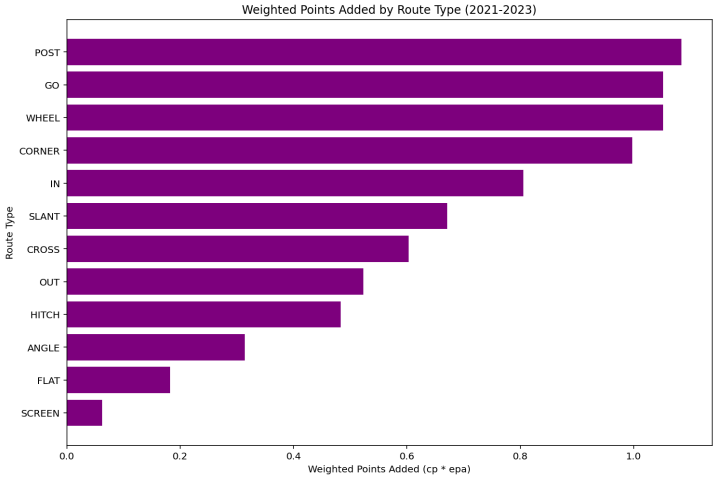
From this refined dataset, completion probabilities were calculated for every route within the route tree, alongside expected points added (EPA) to assess the effectiveness of each route. To further examine the risk-reward tradeoff, Weighted Points Added (WPA) was introduced, calculated by multiplying a pass's completion probability by the expected points added upon completion.

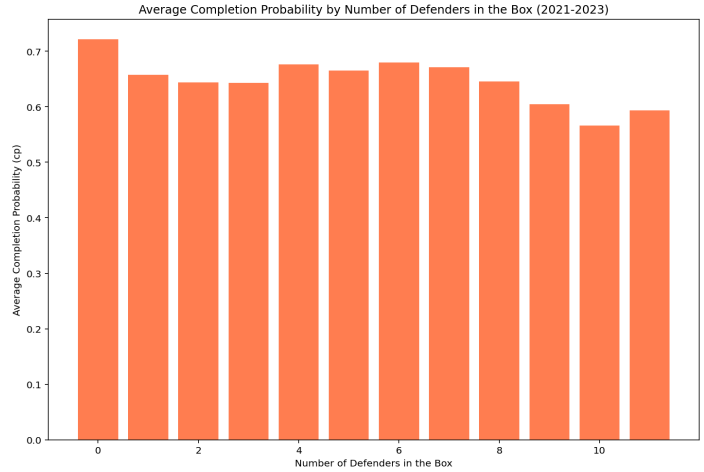
All combinations of routes and defensive coverages were analyzed to identify patterns in success rates against various defensive schemes. This comprehensive approach aims to uncover optimal route scheming for each coverage type, providing actionable insights to enhance offensive play calling.

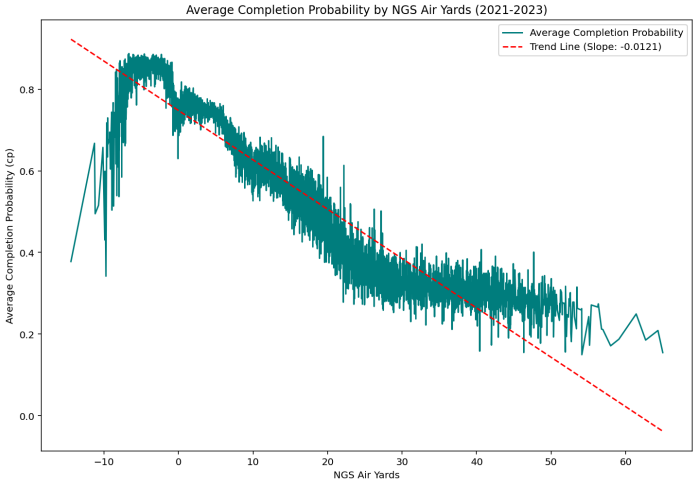
Findings - Exploratory Data Analysis

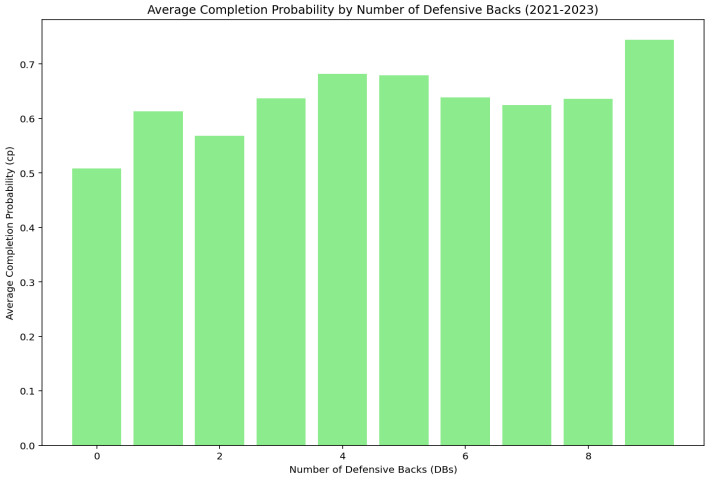






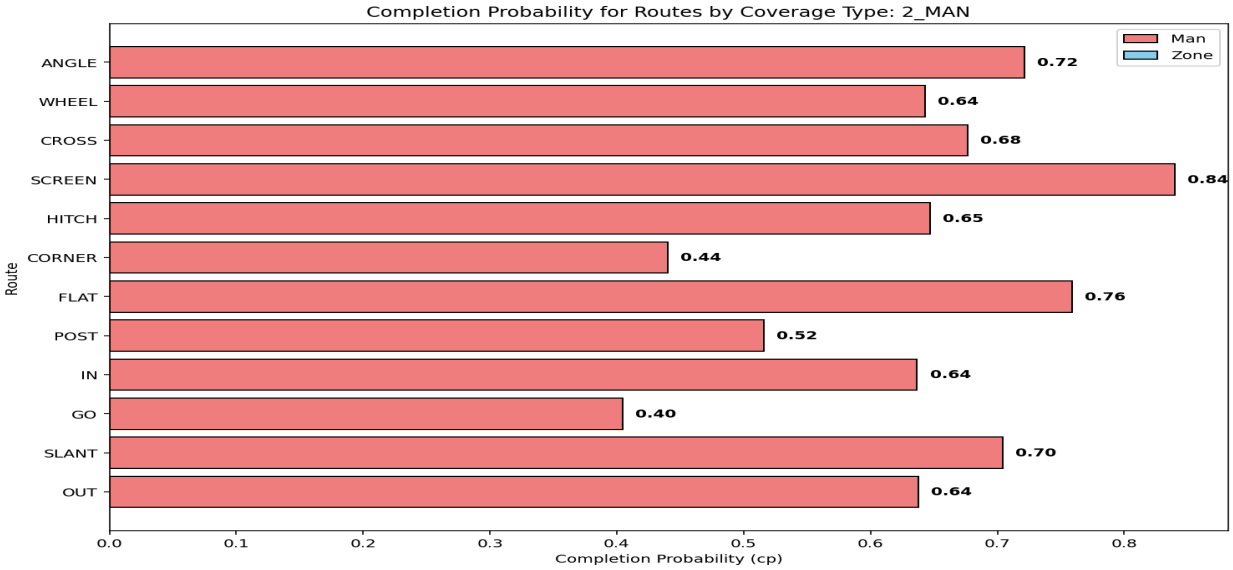


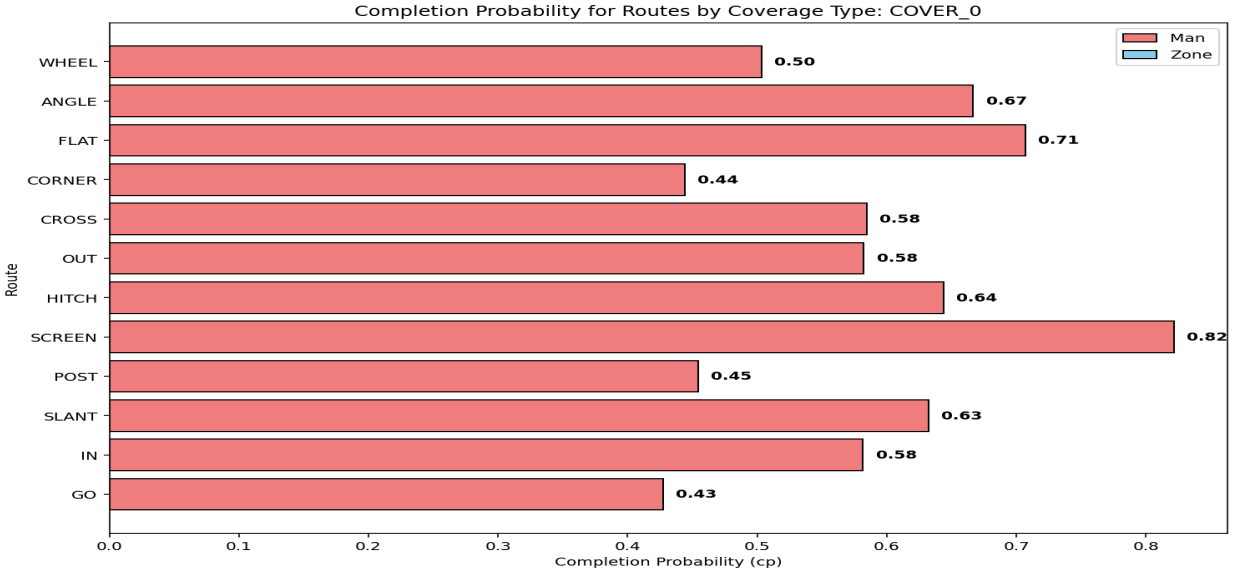


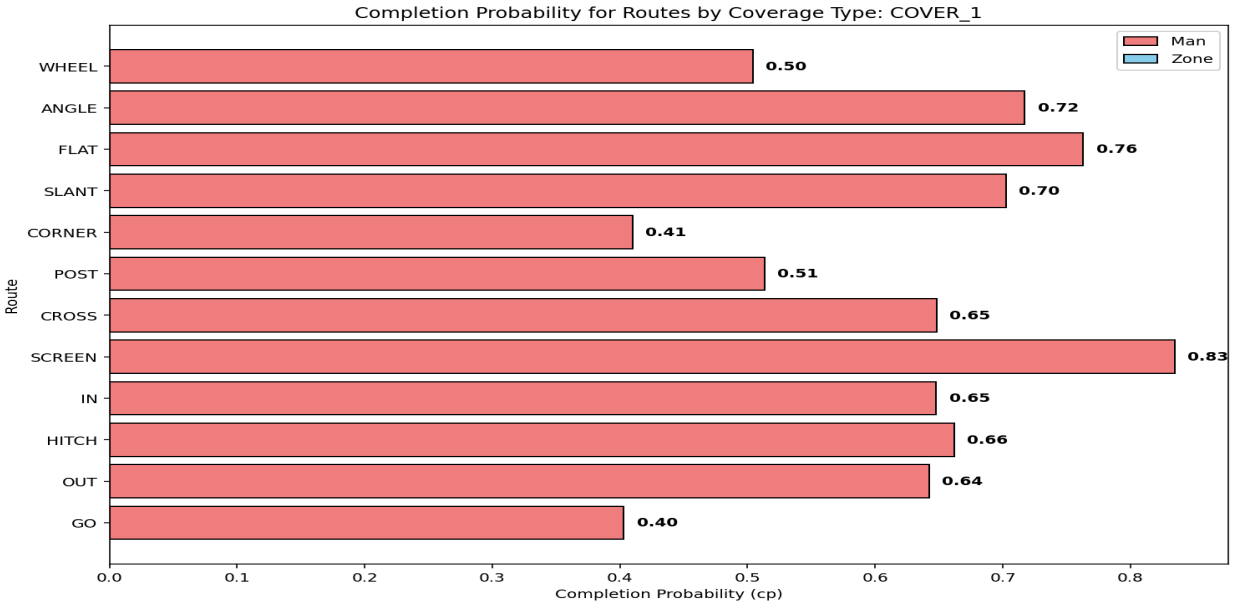


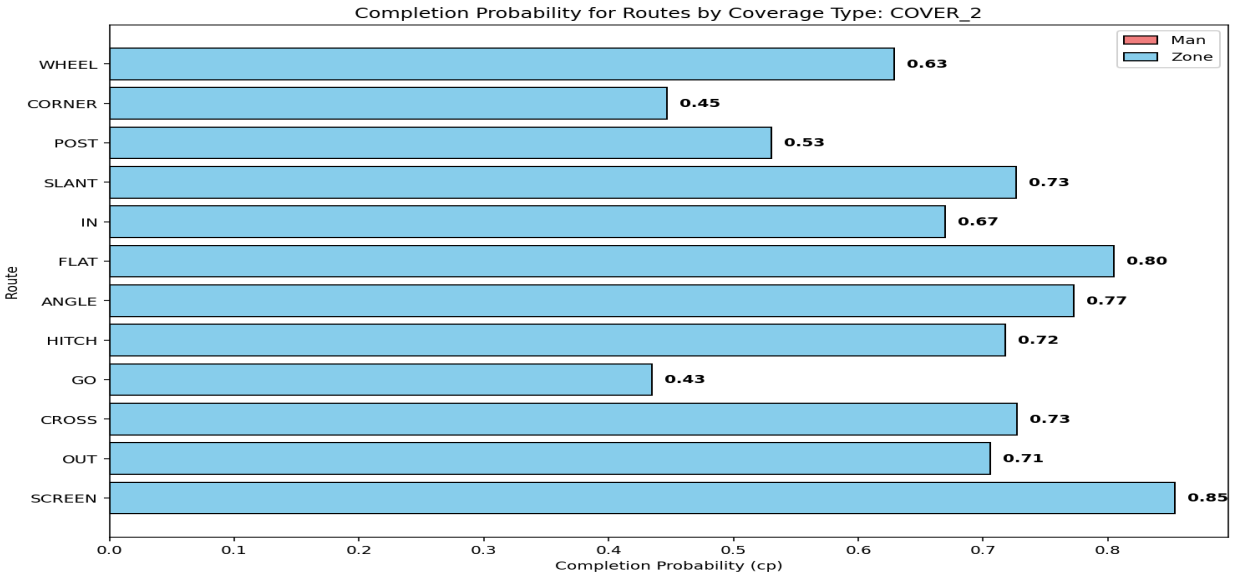
The exploratory data analysis graphs above illustrate how various defensive coverage characteristics impact completion probability, as well as baseline completion probabilities and Weighted Points Added (Completion Probability x Expected Points Added upon completion). The findings suggest that route selection plays a more critical role in completion probability than the specific defensive coverage faced. Effective play design involves diagnosing the expected coverage and aligning routes that are most successful against it. As anticipated, air yards significantly influence completion probability, but the effect plateaus beyond approximately 25 air yards.

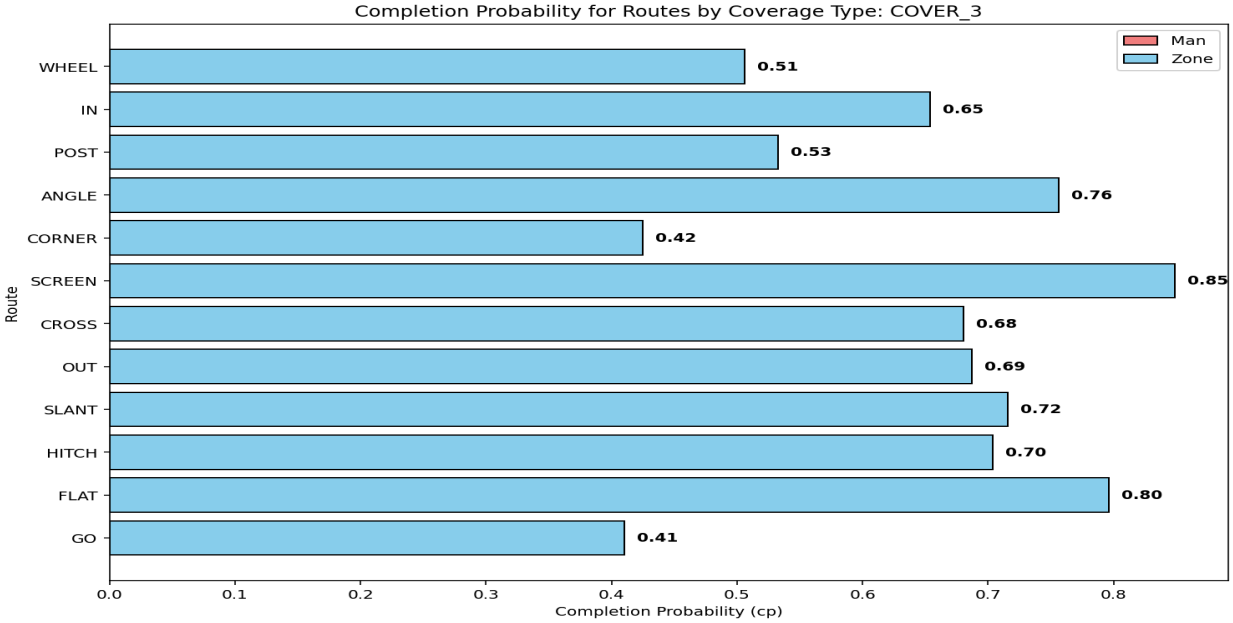
Findings - Routes v Coverages

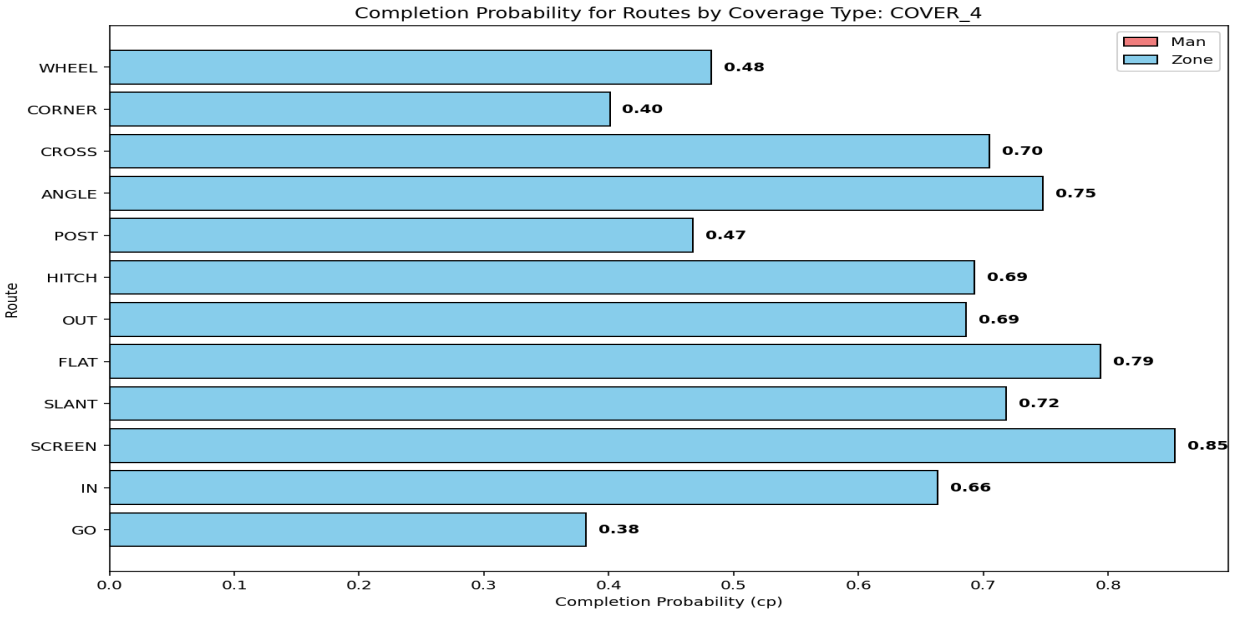


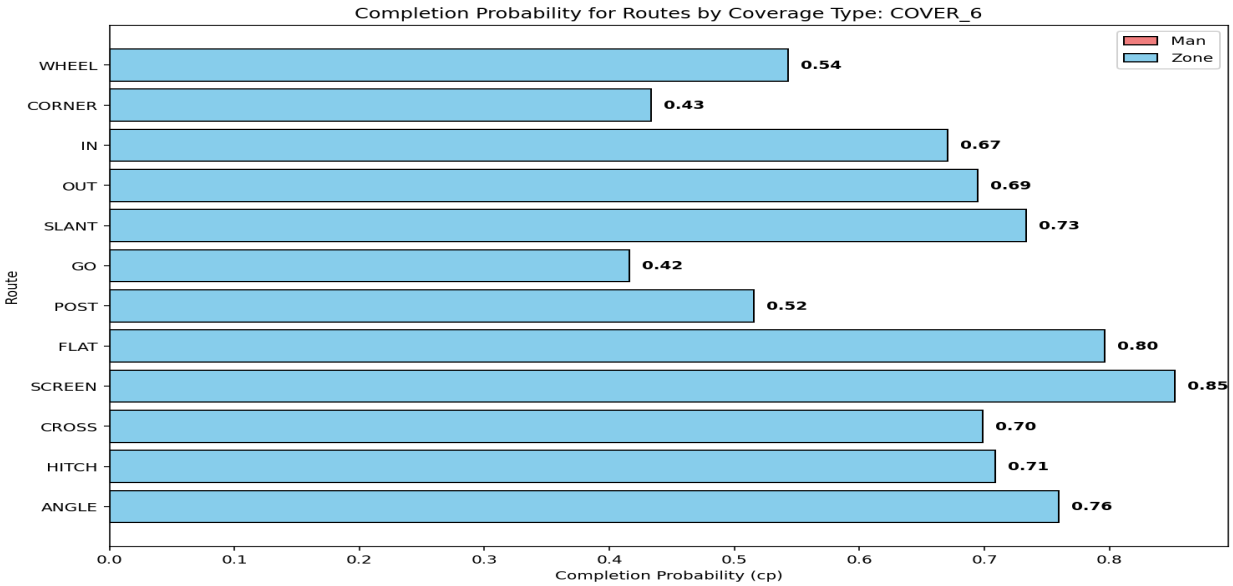


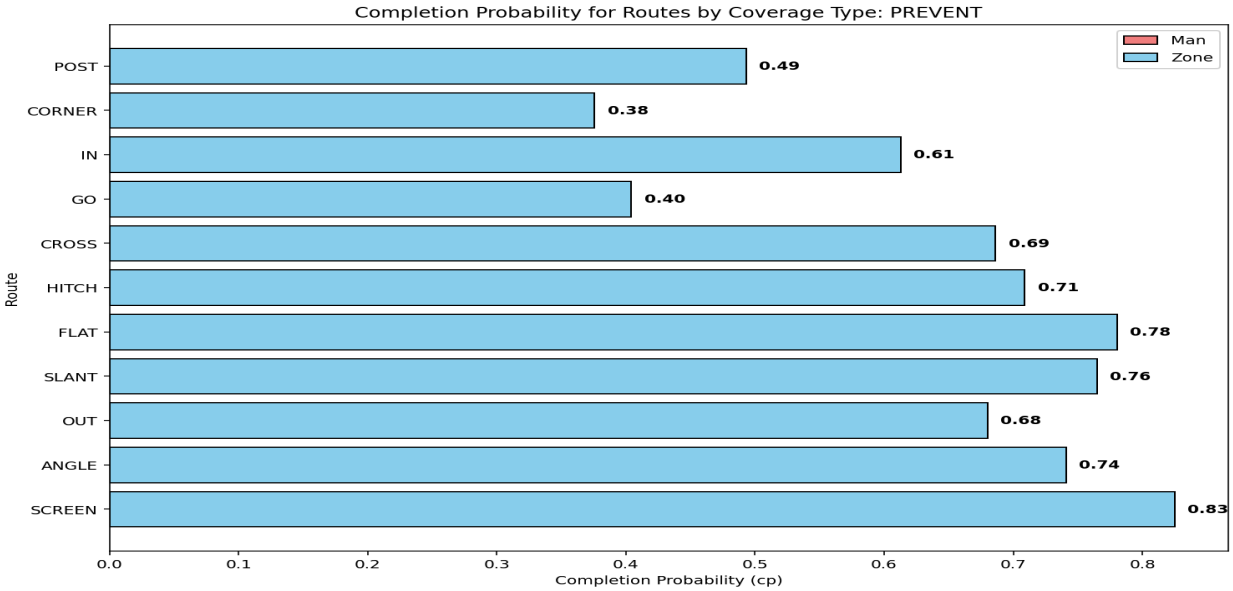



Completion Probability for Routes by Coverage Type: COVER_2
Man
Zone
WHEEL
CORNER
POST
SLANT
IN
FLAT
ANGLE
HITCH
GO
CROSS
OUT
SCREEN
0.63
0.45
0.53
0.73
0.67
0.80
0.77
0.72
0.43
0.73
0.71
0.85
Route
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Completion Probability (cp)


Completion Probability for Routes by Coverage Type: COVER_3
Man
Zone
WHEEL
IN
POST
ANGLE
CORNER
SCREEN
CROSS
OUT
SLANT
HITCH
FLAT
GO
0.51
0.65
0.53
0.76
0.42
0.85
0.68
0.69
0.72
0.70
0.80
0.41
Route
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Completion Probability (cp)

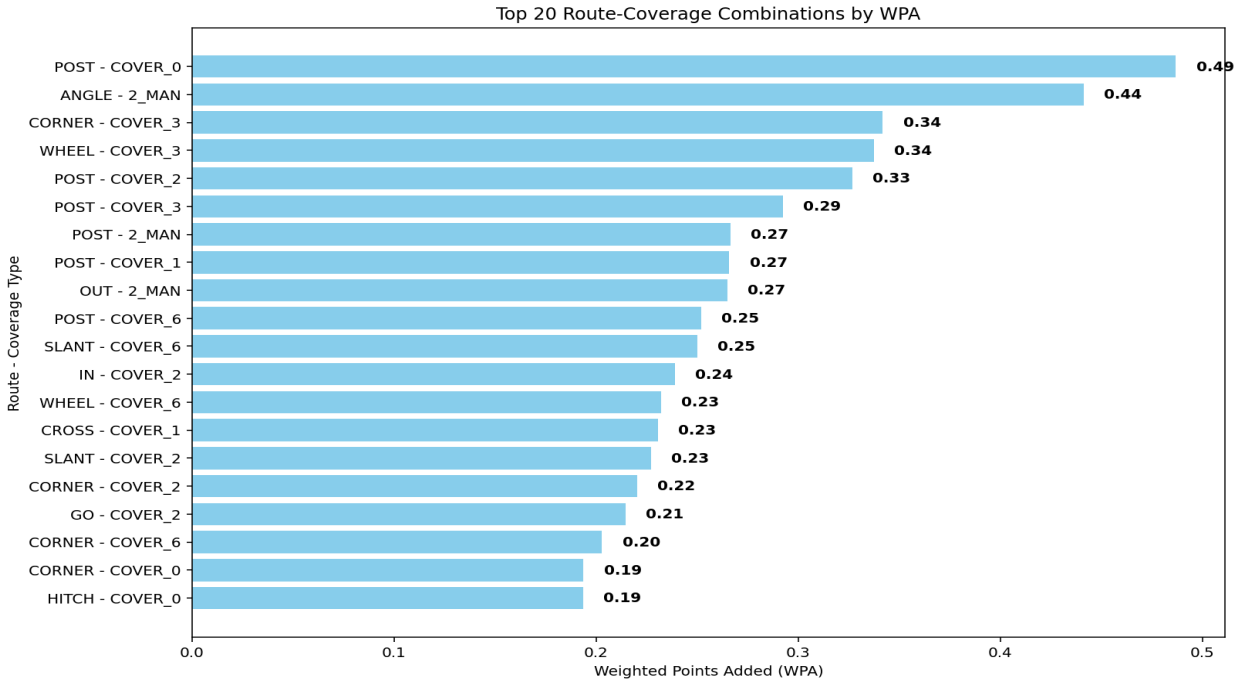

Completion Probability for Routes by Coverage Type: COVER_4
Man
Zone
WHEEL
CORNER
CROSS
ANGLE
POST
HITCH
OUT
FLAT
SLANT
SCREEN
IN
GO
0.48
0.40
0.70
0.75
0.47
0.69
0.69
0.79
0.72
0.85
0.66
0.38
Route
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Completion Probability (cp)





Building on the analysis, each route's completion probability was evaluated against every defensive back-end coverage type. The results reveal that coverage type significantly influences individual routes' success rates, highlighting the importance of tailoring offensive schemes to anticipated defensive looks. Across most coverage types, short, quick-hitting routes targeting running backs, slot receivers, and tight ends are consistently the most effective. As expected from the relationship between completion probability and air yards, prioritizing routes closer to the line of scrimmage yields the highest success rates. Designing plays that provide high-success touches to players excelling after the catch is a particularly effective strategy for sustaining drives.

While quick-hitting routes are effective, defenses will inevitably adjust by pressing and tightening their coverage. To counter this, strategically incorporating deep shots is essential to keep defenses honest. When dialing up a downfield attempt, the expected coverage type significantly influences which route to target. The Weighted Points Added (Completion Probability x Expected Points Added upon completion) for various route-coverage pairings underscores this relationship.



Reviewing the graphic reveals a consistent presence of corner and post routes among the most successful combinations. This highlights the value of deep shots with breaks in the route—such as corners and posts—to stretch the field and manipulate defensive backs, rather than relying solely on simple go routes. Additionally, the prominence of angle and wheel routes speaks to the importance of a versatile running back who can contribute as a receiver, reinforcing the value of split backfields in the modern game.

An optimal passing scheme features a receiving-capable running back who can read linebacker coverage and choose between angle, flat, and wheel routes based on defensive tendencies. Complementing this, a deep threat utilizing corner, post, or crossing routes to influence safety positioning creates openings for an intermediate or short YAC-focused receiver to capitalize on in-breaking or out-breaking routes.

Application and Conclusion

While this analysis does not encompass every facet of offensive strategy, it provides a valuable framework for play callers aiming to optimize their schemes. Understanding which routes have historically succeeded against specific coverages offers a foundational guide that can be refined and expanded upon. By integrating these findings with other critical aspects of offensive strategy—such as run game efficiency, the impact of pre-snap motion, and down-and-distance decision-making—teams can develop a more comprehensive, statistically informed offensive approach.

The ultimate goal is to craft a dynamic, adaptable scheme that keeps defenses off balance by strategically deviating from tendencies while leveraging concepts proven to be effective against the anticipated coverages. This approach allows teams to make more informed, data-driven decisions that enhance overall efficiency and explosiveness.