A Conditional Density Approach to Run Defense Attribution in Football

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The goal: Measure defenders' ability to stop the run in intuitive units with a modular, adaptable approach.

Data

- 2022 NFL Tracking Data
- Plays involving RB handoff only
- Plays with penalties removed

Approach

- Defender's value comes from decreasing value of offense
- First, value offensive player at every frame (points, yards, etc.)
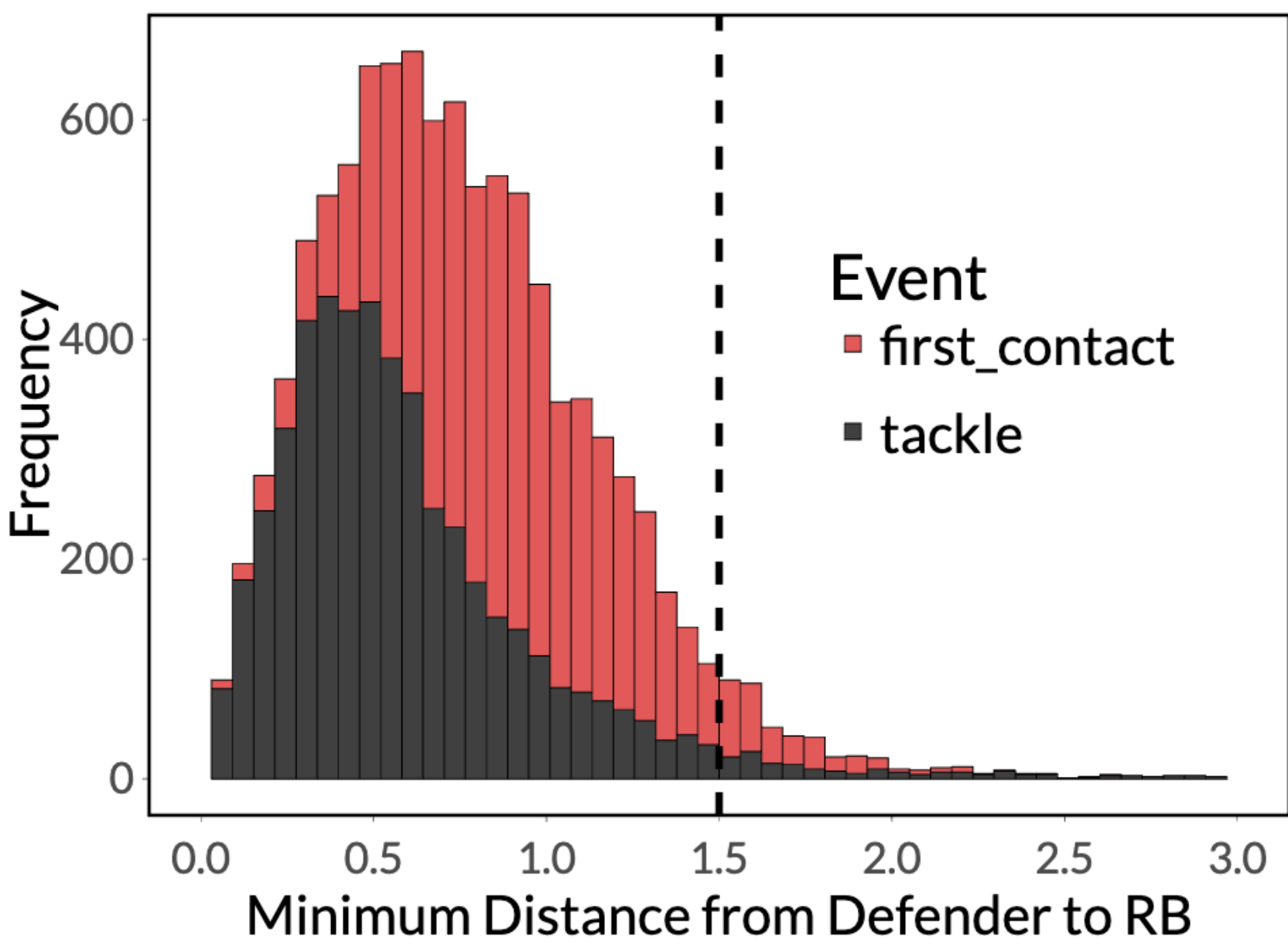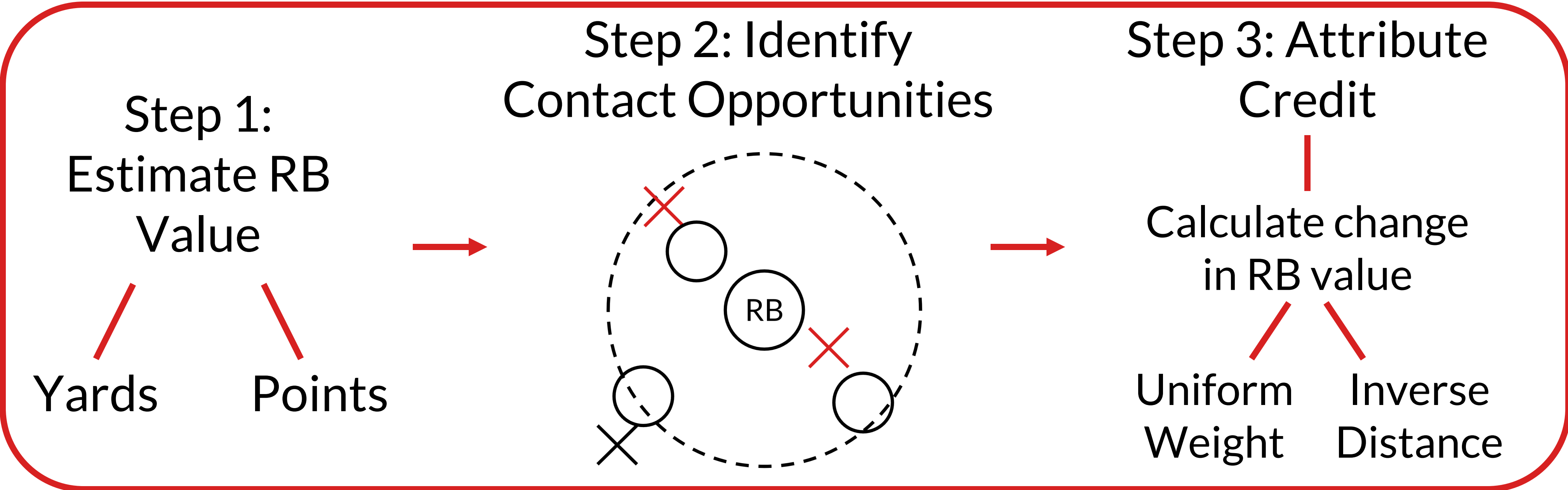- Next, attribute change in offense value at each frame to defenders

Yards

- Estimate PMF for random variable **G** = yards gained by RB
- Random forest CDE for conditioning, dependence of observations, and multi-modality
- RB speed and distance to defenders are the only features

Points

- Value of a yard depends on context
- Use XGBoost expected points model to include information on score, time, field position, etc.

Attribution

- Defenders with contact opportunity impact value of RB
- Contact opportunity determined by distance + orientation to RB
- Can give equal credit to all defenders with CO or allot credit as inverse of distance to RB

Step 1: Estimate RB Value — Yards, Points

Step 2: Identify Contact Opportunities

Step 3: Attribute Credit — Calculate change in RB value — Uniform Weight, Inverse Distance

Rankings

Player	Position	Uniform	Inverse Dist.
Derion Kendrick	CB	4.541	3.07
Chidobe Awuzie	CB	6.101	2.994
Carlton Davis	CB	6.774	2.692
Mike Hilton	CB	5.784	2.589
Tariq Woolen	CB	5.618	2.541
Bradley Roby	CB	4.357	2.455
Marcus Peters	CB	4.487	2.384
Nate Hobbs	CB	5.94	2.329
Tyson Campbell	CB	5.881	2.309
Derek Stingley	CB	3.531	2.201

Avg. Yards Saved per CO

Player	Position	Uniform	Inverse Dist.
Von Miller	OLB	0.333	0.187
Mike Hilton	CB	0.21	0.174
Marcus Peters	CB	0.281	0.167
Greg Gaines	NT	0.47	0.144
Patrick Peterson	CB	0.127	0.14
Josh Sweat	DE	0.104	0.123
Chris Jones	DT	0.227	0.122
Cameron Sutton	CB	0.134	0.116
Jalen Mills	CB	0.164	0.115
C.J. Henderson	CB	-0.264	0.114

Avg. Points Saved per CO

Player	Position	Uniform	Inverse Dist.
Roquan Smith	ILB	481	171.1
Grover Stewart	DT	488.4	160.8
Alex Anzalone	ILB	396.6	145.8
Drue Tranquill	ILB	512	144.4
Jordyn Brooks	ILB	389.9	135.4
Zaire Franklin	OLB	474.4	133.6
Derrick Brown	DE	454.8	131.3
C.J. Mosley	ILB	443.8	130
Devin White	ILB	475.4	129
Foyesade Oluokun	ILB	466.9	125

Total Yards Saved

Player	Position	Uniform	Inverse Dist.
Pete Werner	OLB	16.31	7.52
Greg Gaines	NT	23.96	7.35
Zach Sieler	DT	15.24	7.21
Derrick Brown	DE	16.83	6.37
DeForest Buckner	DT	9.35	6.24
Davon Godchaux	NT	18.57	5.83
Quinnen Williams	NT	11.68	5.74
Grover Stewart	DT	10.07	5.74
Christian Kirksey	OLB	10.35	5.71
Shaq Thompson	ILB	18.39	5.66

Total Points Saved

Discussion

- Compare within positions
- Secondary in higher leverage positions (on avg.)
- 10 snaps per game
- More runs in short yardage and red zone situations
- "Closers"
- Similar to intuition

What's Next?

- Consider speed or blocking when attributing credit
- Develop notion of "average player"
- Being in position to have a contact opportunity as a skill
- Specialize for each position