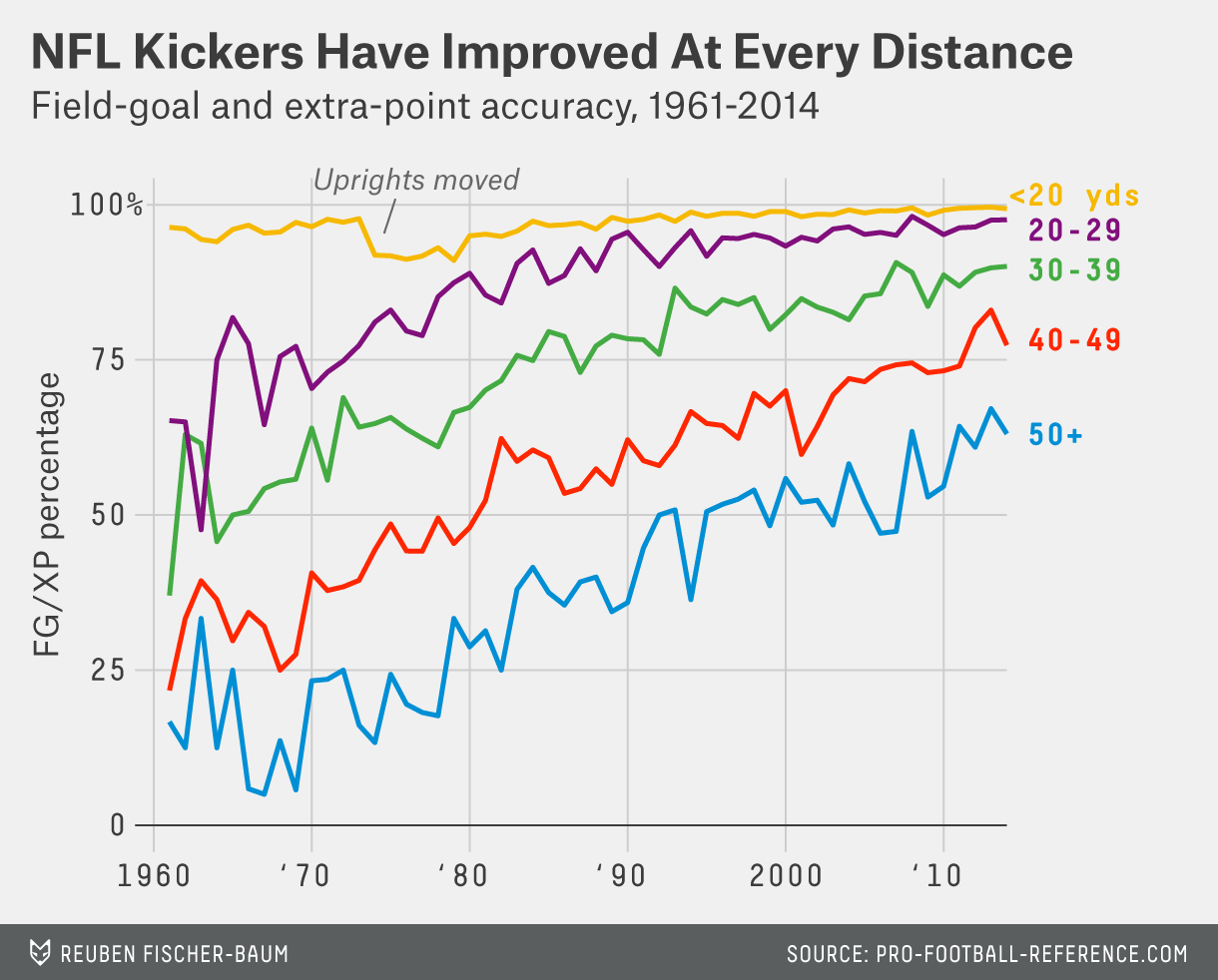
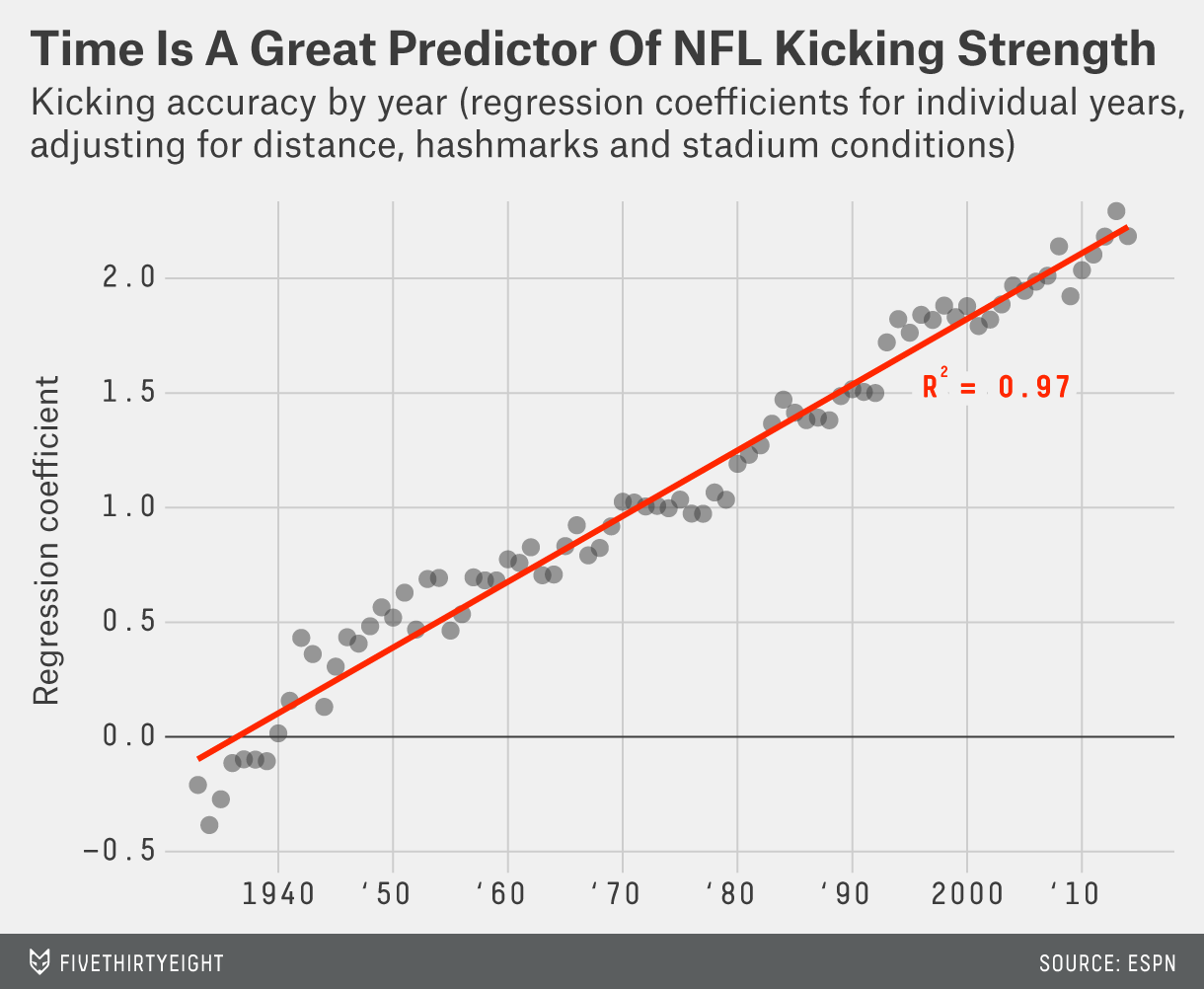
Kickers Are Forever

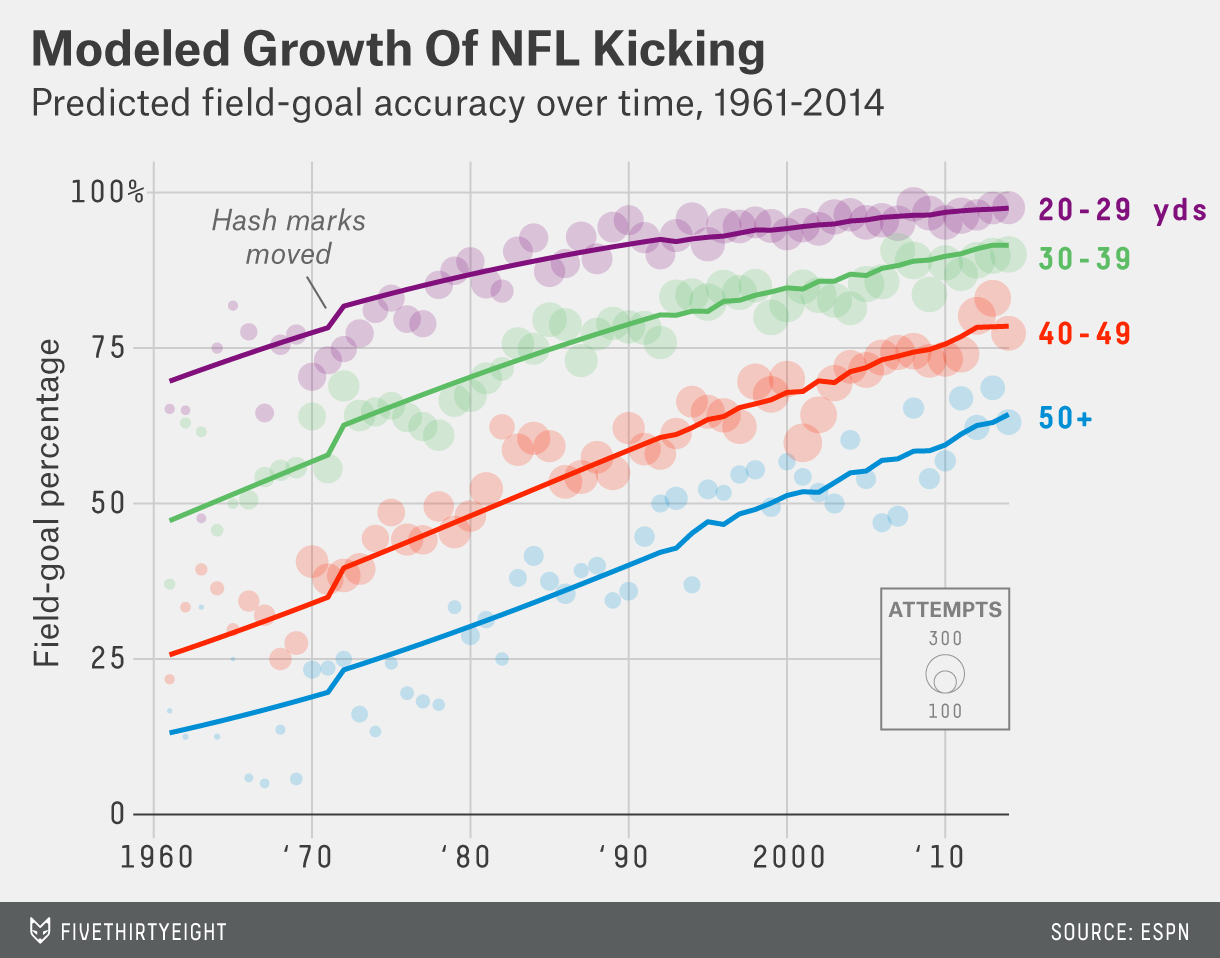
* <https://fivethirtyeight.com/features/kickers-are-forever/>
* Football = constant power struggles, both on + off field: players v. players, offenses v. defenses, passing v. running, coaches v. coaches, new ways of thinking v. old ways
* Kickers = battling no one but [themselves](http://skepticalsports.com/?p=791) (<https://skepticalsports.com/yes-espn-professional-kickers-are-big-fat-chokers/>) + goalposts
* Come on field in moments most mundane + most decisive = take blame when fail + little credit when succeed.
* Year in + year out, just a little bit at a time: get better, + better, + better, until game = completely different, + no one even noticed kickers were 1 of the main reasons why.
* FG from long range made at ever-increasing rate, culminating in 2013 🡺 > 67% from 50+ yards w/ a record 96 such makes.
* Lot of speculation (<https://nypost.com/2013/12/21/improved-placekicking-changing-game/>) about how kickers suddenly became so good @ long kicks, ranging from PEDs (<https://www.washingtonpost.com/sports/redskins/field-goals-is-it-time-to-punt/2012/10/21/ec03fea2-1804-11e2-9855-71f2b202721b_story.html>) to kickers’ special “k-balls” (<http://www.businessinsider.com/why-nfl-kickers-always-squeeze-the-ball-2012-10>) to more kick-friendly stadiums.
* Prior to 2014 season, set out to try to see how recently this improvement had taken place, whether it had been gradual or sudden, + whether specific to very long kicks or reflected improvement in kicking accuracy as a whole.
* What found fundamentally changed understanding of game of football (+ **possibly offered insight into how competitive sports can conceal remarkable changes in human capability**)
* The complete(ish) history of NFL kicking
* Pro Football Reference = kicking data broken down by categories (0-19 yards, 20-29, 30-39, 40-59, 50+ yards) back to 1961.
* W/ this, can see how FG% has changed through years for each range:

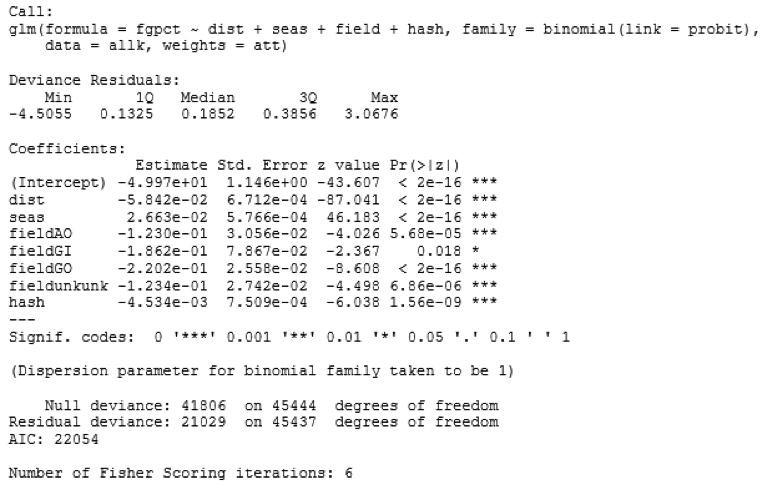


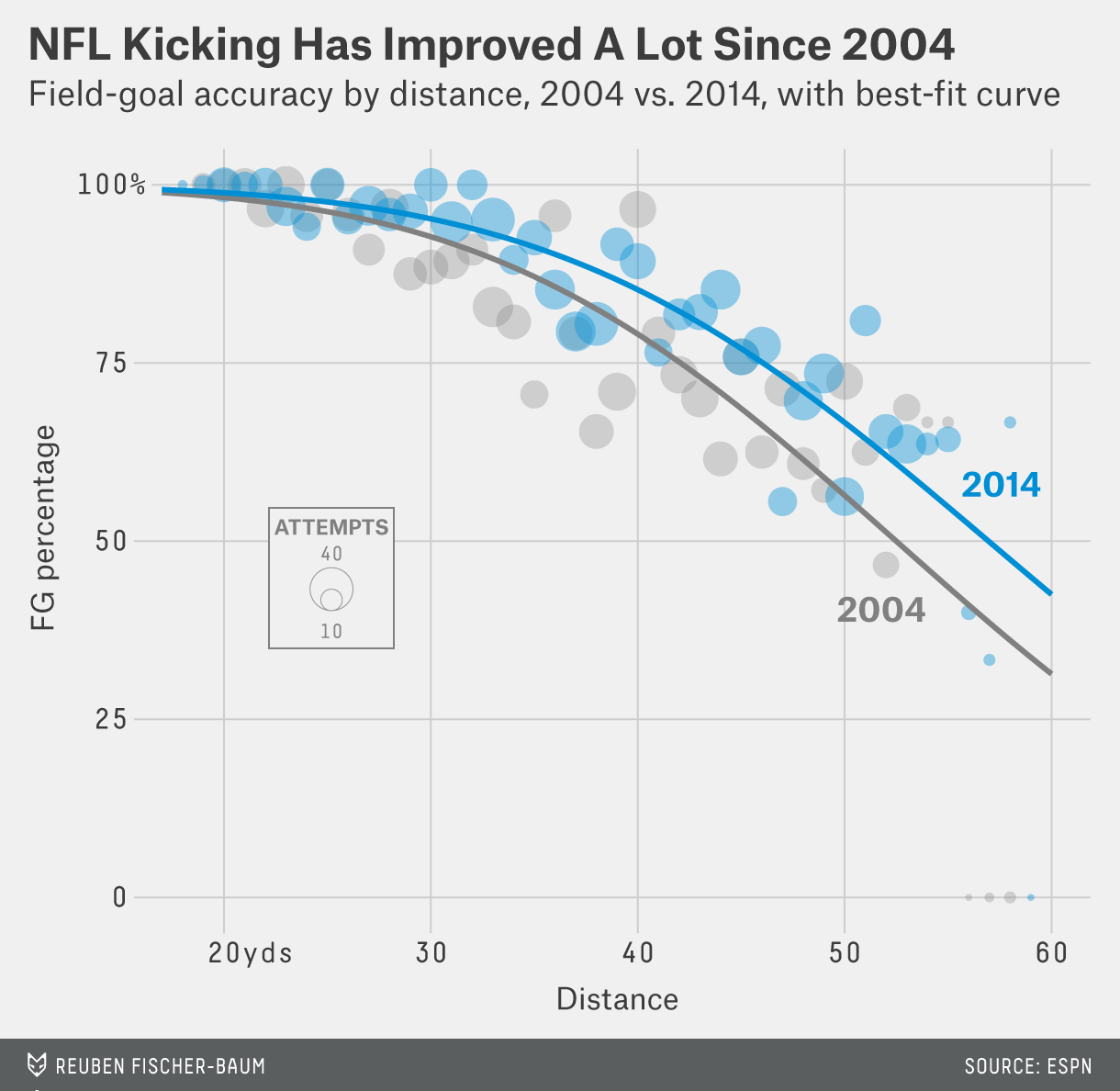
* Distance doesn’t matter; kicking = on a steady upward climb.
* Look back even further 🡺 can see indicators kicking has been on a similar trajectory for entire history of the league.
* Oldest data = 1932 = 8 teams in NFL made just 6 FG (unknown how many attempted) + missed 37/113 XPA, for a conversion rate of 67.3%
* Following year = moved goal posts up to front of EZ 🡪 led to a whopping 36 made FG + skyrocketing XP conversion rate of 79.%.
* W/ uprights @ front of end zone, kickers missed only 30/145 XP
* For comparison, those 30 missed XPA (all w/ goalposts in front of EZ) = more than league’s 28 missed XPA (all coming from 10 yards further out) from 2011-2014, on 4,939 attempts.
* 1938-39 = 1st year we know # of regular FGA 🡪 93/235 FG (39.6%) to go w/ 347/422 XP (82.2%).
* ‘40’s 🡪 made 40.0% of FG (don’t know distances) + 91.3% of XPs
* ’50s 🡪 rose to 48.2% of all FG + 94.8% of XPs
* ’60s 🡪 must’ve seemed like golden era: 56% of FG (breaking 50% barrier for 1st time) + 96.8% of XP
* For comparison, since 2010, NFL kickers have made 61.9% of FGA, *from more than 50 yards.*
* 60s 🡺 start to get data on FGA broken down by distance, allowing for more complete pic above
* 1972 = narrowed hash marks from 18.5 yards from 40 = improved FG% overall by reducing # of attempts taken from awkward angles
* 1974 = moved goal posts to back of EZ = as kick distances are recorded relative to the posts, **main effect** of this move = small (+ temporary) decline in XP conversion rate (in top line of chart above)
* Then we have data on the kicks’ *exact* distance, + field + stadium type, after 1993
* Combine everything: XPA + distances prior to 1961, kicks by category from 1961-1993, kicks’ exact distance after 1993, + changing placement of goal posts + hash marks.
* **Using this data, can model the likely success of any kick.**
* W/ those factors held constant, here’s how good kickers have been relative to set of kicks in any given year using a **binomial probit regression** with ALL variables, using “year taken” as a categorical variable, similar to how [SRS](http://www.pro-football-reference.com/blog/?p=37) determines how strong each team is relative to its competition (<https://web.archive.org/web/20080127075333/http://www.pro-football-reference.com/blog/?p=37>)

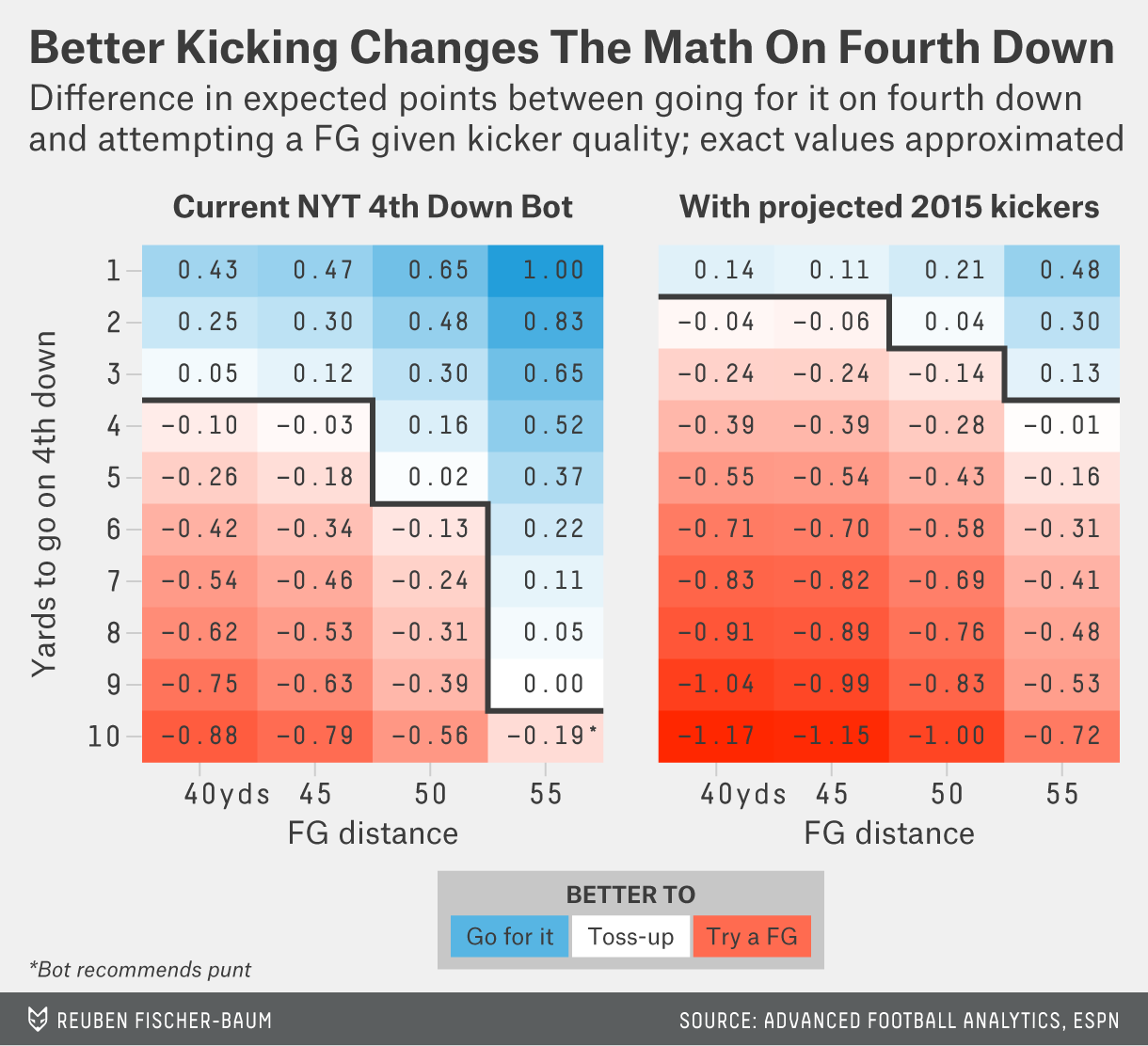
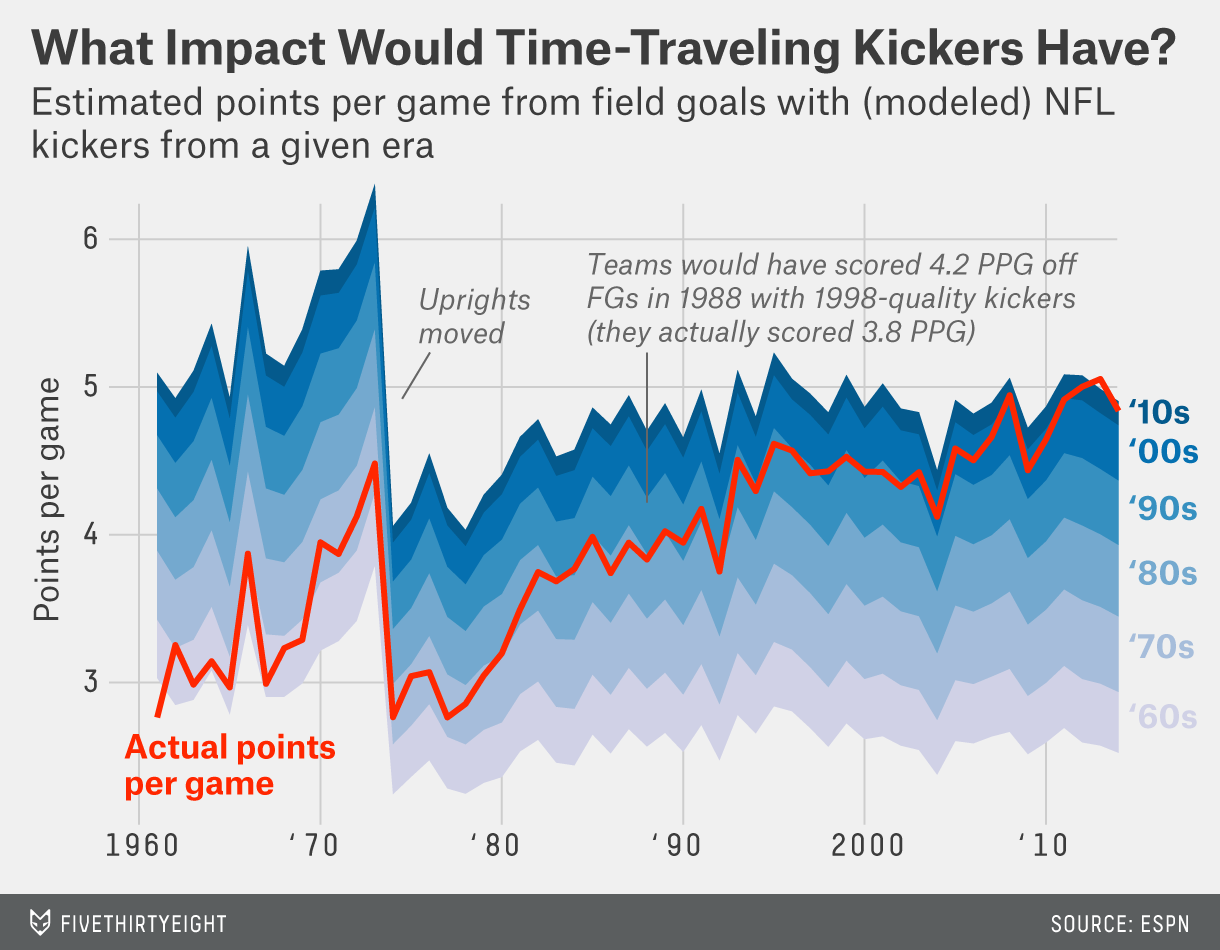
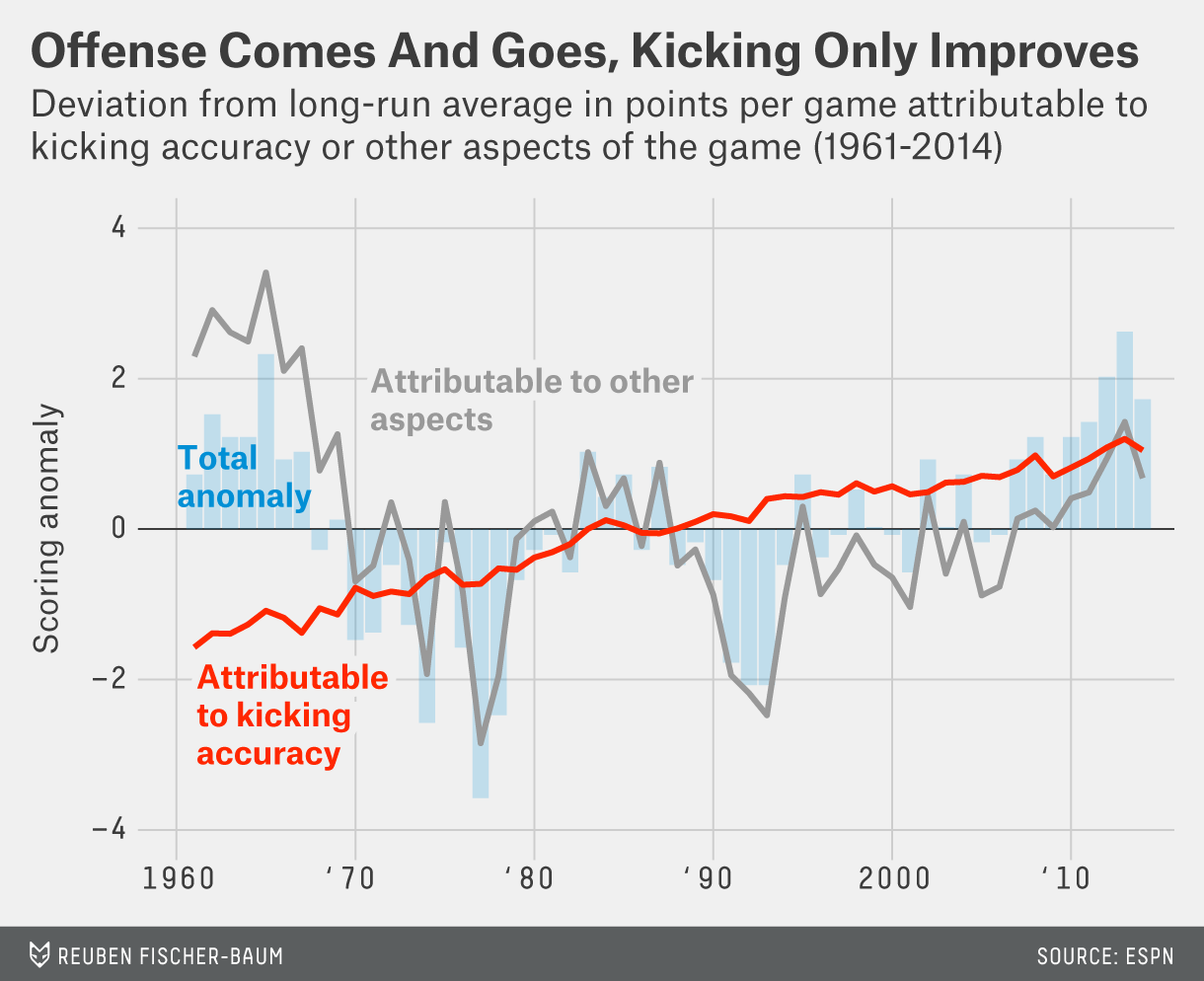


* Like Hacker Gods got lazy + just set a constant Kicker Improvement parameter throughout the universe
* \*\*\*Great thing about this = since improvement in kicking has been almost perfectly linear, can treat “year” as just another continuous variable, **allowing us to generalize the model to any kick in any situation at any point in NFL history\*\*\***
* Applying this year-based model to kicking-distance data, can see just how predictable improvement in kicking has actually been:



* Model may give teams too much credit in early ’60s (an era for which we have a lot less data) but over course of NFL history, it does extremely well (also predicts back to 1932, but not shown)
* What’s amazing 🡺 While model incorporates things like hashmark location + (more recently) field type, **virtually all work is handled by distance + year alone**.
* Ultimately, it’s an extremely (virtually impossibly) accurate model considering how few variables it relies on
* How accurate is this thing? TBH, in all my years of building models, never seen anything like it
* Model misses a typical year/distance group prediction by average of just 2.5%.
* **Majority of those predictions involve only a couple hundred observations — at most**
* **For comparison, SD for 250 observations of a 75% event = 2.7% 🡺 i.e. model pretty much couldn’t have done any better even if it knew the exact probability of each kick**
* While there is possibly a smidge of overfitting (**usually is**), the risk here = lower than usual, since vast majority of each prediction is driven **solely** by year + distance.
* Regression output: 
* This isn’t just trivia = has real-world implications, from tactical (how to manage clock knowing opponent needs only moderate yardage to get into FG range?) to organizational (maybe good kicker = worth more than league minimum).
* Then there’s the big one = **Fourth down**
* “Dead zone” between roughly the 25-40-yard lines = punts accomplish little + FG = supposedly too long to be good gambles.
* W/ ’90s-quality kickers, settling for FG in the dead zone = practically criminal.
* As of 10 years ago (around when **go-for-it models** rose to prominence), we were still right.
* **But much has changed in 10 years** such that FG Kicking = now good enough that many previous calculations = outdated.
* Comparison between a FG kicking curve from 2004 vs. 2014:



* No 1 universally-agreed-upon system for when you should go for it on 4th down.
* Very popular = NYT’s **4th Down Bot** (<https://twitter.com/NYT4thDownBot>), powered by models built by Brian Burke, founder of Advanced Football Analytics + pioneer in quantitative analysis of football
* Calculates **expected value** (either in points or win %’s) for every 4th-down play in NFL + tweets live results during games.
* 19k+ followers = treated to bot’s particular emphasis on the many, many times coaches fail to go for it on 4th down when they should.
* Very helpful feature of 4th Down Bot = its game logs break down each 4th-down decision into its component parts (<http://nyt4thdownbot.com/game.html?gameid=09072014_MIN@STL>)
* Means we can see **exactly what assumptions bot is making about success rate of each kick**.
* Comparing those to above model, looks like bot’s kickers = approximately 2004-quality. (Burke agrees bot is probably at least a few years behind + says its kicking assumptions = based on a fitted model of the most recent 8 years of kicking data)
* Full statement: “Bot = ~3-4 years behind trends in FG accuracy, which have been improving at longer distances. It uses a kicking model fitted to the average of the recent 8-year period of data. AFA’s more advanced model for team clients is on the current ‘frontier’ of kick probabilities, + can be tuned for specific variables like kicker range, conditions, etc. Please keep in mind bot is intended to be a good first-cut on analysis + a demonstration of what is possible w/ real-time analytics**. It’s not intended as the final analysis.**”
* don’t blame Burke or others for not updating models based on last few years b/c it’s good to be prudent + not assume temporary shifts 1 way or the other will hold.
* Normally = *is* better to go w/ weight of history rather than w/ recent trends.
* **But in this case, recent trends = backed by the weight of history**
* More importantly, these breakdowns allow us to essentially recalculate bot’s recommendations **given a different set of assumptions.**
* The improvement in kicking dramatically changes calculus of whether to go for it on 4th in the dead zone
* Following table compares “Go or No” charts from 4th Down Bot as it stands right now, vs, w/ projected 2015 kickers[8](https://fivethirtyeight.com/features/kickers-are-forever/#fn-8)
* 
* exact values in chart may differ slightly from reports on NYT’s site b/c we had to reverse-engineer bot’s decision-making process.
* Basically = assuming this model gets everything exactly right, as far as expected value, from various field locations, chances of converting a 4th-down attempt, etc., then recalculating final expected value comparison using 2015 kickers
* Having better kickers = big difference, seen from the blue sea on left vs. red sea on the right.
* Complete “Go or No” table  = <https://www.nytimes.com/2014/09/05/upshot/4th-down-when-to-go-for-it-and-why.html?abt=0002&abg=1>
* Getting 4th-down calls wrong = potentially big problem for the model.
* As a test case, tried applying 4th Down Bot’s model to a selection of most relevant kicks from between 25-55 yards in 2013, then looked at what coaches actually did in those scenarios.
* Graded both against kicking-adjusted results for 2013.
* While updated version still concluded coaches = too conservative (particularly on 4th + short), it found coaches were (very slightly) making more correct decisions than 4th Down Bot.
* Differences = small (coaches beat bot by only a few points over entire season), but even being just as successful as the bot would be a drastic result considering how absolutely terrible coaches’ go-for-it strategy has been for decades.
* **In other words, maybe it’s not that NFL coaches were wrong, they were just ahead of their time!**
* Time-traveling kickers
* Having such an accurate model also allows us to see the overall impact kicking improvement has had on football. For example, we can calculate how kickers from different eras would have performed on a common set of attempts. In the following chart, we can see how many more or fewer points per game the typical team would have scored if kickers from a different era had taken its kicks (the red line is the actual points per game from field goals that year):
* 
* The last time kickers were as big a part of the game as they are today, the league had to move the posts back! Since the rule change, the amount of scoring from field goals has increased by more than 2 points per game. A small part of the overall increase (the overall movement of the red line) is a result of taking more field goals, but most of it comes from the improvement in accuracy alone (the width of the “ribbon”).
* How does this compare to broader scoring trends? As a baseline for comparison, I’ve taken the average points scored in every NFL game since 1961, and then seen how much league scoring deviated from that at any given point in time (the “scoring anomaly”). Then I looked at how much of that anomaly was a result of kicking accuracy.[9](https://fivethirtyeight.com/features/kickers-are-forever/#fn-9):
* 
* Amid wild fluctuations in scoring, kicking has remained a steady, driving force.
* For all the talk of [West Coast offenses](http://en.wikipedia.org/wiki/West_Coast_offense), the invention of the pro formation, the [wildcat](http://www.nfl.com/videos/nfl-network-playbook/09000d5d80b1831e/WK-3-Anatomy-Wildcat-formation), [5-wide sets](http://en.wikipedia.org/wiki/Spread_offense), the rise of [the pass-catching tight-end](http://en.wikipedia.org/wiki/Rob_Gronkowski), [Bill Walsh](https://www.google.com/search?q=bill+walsh+coaching+tree&rlz=1C1CHFX_enUS603US604&espv=2&biw=585&bih=572&tbm=isch&tbo=u&source=univ&sa=X&ei=Sx3IVNrdA8GMyASc2oDICw&ved=0CB0QsAQ), the [Greatest Show On Turf](https://fivethirtyeight.com/features/revisiting-the-greatest-show-on-turf/), and the general recognition that passing, passing and more passing is the best way to score in football, half the improvement in scoring in the past 50-plus years of NFL history has come solely from field-goal kickers kicking more accurately.[10](https://fivethirtyeight.com/features/kickers-are-forever/#fn-10)
* The past half-century has seen an era of defensive innovation — running roughly from the mid-’60s to the mid-’70s — a chaotic scoring epoch with wild swings until the early ’90s, and then an era of offensive improvement. But the era of kickers is forever.
* Reuben Fischer-Baum contributed graphics.
* **CORRECTION (Jan. 28, 2:22 p.m.):**An earlier version of this article incorrectly gave the distances from which extra-point kicks were taken in 1933 and in recent years. Actual extra-point distances aren’t recorded.