Fantasy Football:
A Touchdown for Undergraduate Statistics Education

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Abstract: This paper describes a course in introductory statistics and data analysis techniques taught thru the lens of fantasy football. The game's appeal and its natural applicability to empirical analysis sparked strong interest in topics that would otherwise be abstract and are traditionally unattractive; and evidence suggests that the course was a success. Furthermore, there was no correlation between fantasy experience and course achievement, indicating that fantasy football is an accessible avenue toward statistical concept learning. However, issues of the authenticity of learning activities to fantasy football gameplay seemed to arise, and may have dampened initial enthusiasm among students who were already experienced fantasy football managers. Nevertheless, in total, fantasy football is concluded to be an engaging, active, and immersive classroom application of statistical analysis, and a powerful tool toward statistics education reform.

3rd and Long for Statistics Education, Hand-Off to Fantasy Football

Introductory statistics is historically among the most reviled undergraduate courses (Connors et al., 1998; Schultz et al., 1998), commonly taught as mathematical theory, profuse with strange symbols, parametric jargon, and more beans in jars than real-world examples (Cobb & Moore, 1997). The last 20 years have been full with mounting efforts to reform statistics courses with increased emphasis on empirical thinking, relevant practical examples, exploratory data analysis, and active learning (Cobb, 1992; American Statistical Association, 2005). And while the field of statistics education slowly attempts to redefine itself, statistical literacy is among the most urgently desired skills in the modern workforce (McKinsey Global Institute, 2011; PCAST, 2012). There's both a strong need for statistics education to succeed, and it's got a long way to go.

Enter my mother-in-law, a self-proclaimed math-hater. A few years ago, needing one more manager, I invited her to join my fantasy football league. Her drafting strategy was comical (she took players that she "liked," not players who would perform well), and equally entertaining was her growing enthusiasm for fantasy football—including her novice attempts at smack-talk on the league message boards. But in that first season, what surprised me most was her growing appetite for (and appropriate use of) data. By Week 10, the math-hater was scrutinizing weekly running back projections like a seasoned Wall Street analyst might scrutinize an earnings report. She would compare forecasts with past performance, she considered the effects of modulating variables (should the defensive cornerback's stats affect my wide receiver choice?), and she ultimately made smart moves. There's something transformative about fantasy football, something that makes statistics not simply useful, but *attractive* (Halverson & Halverson, 2008). It was suddenly clear to me: I needed to develop a statistics course thru the lens of fantasy football. (1)

My course proposal received immediate support from university administrators, and was approved enthusiastically, on an accelerated schedule to ensure that it'd be listed in the subsequent year's course catalogue. There was a press release that made headlines in campus and regional newspapers, and this upcoming "fantasy football course" was featured on our NBC affiliate's evening newscast. Not a single lecture been given, but the consensus was clear: This course would be a wild success.

And the course ultimately was a success, but in retrospect, these remarkably high hopes that fantasy football would be the panacea of statistics education did not do justice to the complexities of integrating learning goals and fantasy football gameplay. In this paper, I will review my approach to the integration of fantasy football and statistical analysis, my successes and challenges, and conclude with summary insights gleaned from my experience using fantasy sports in education.

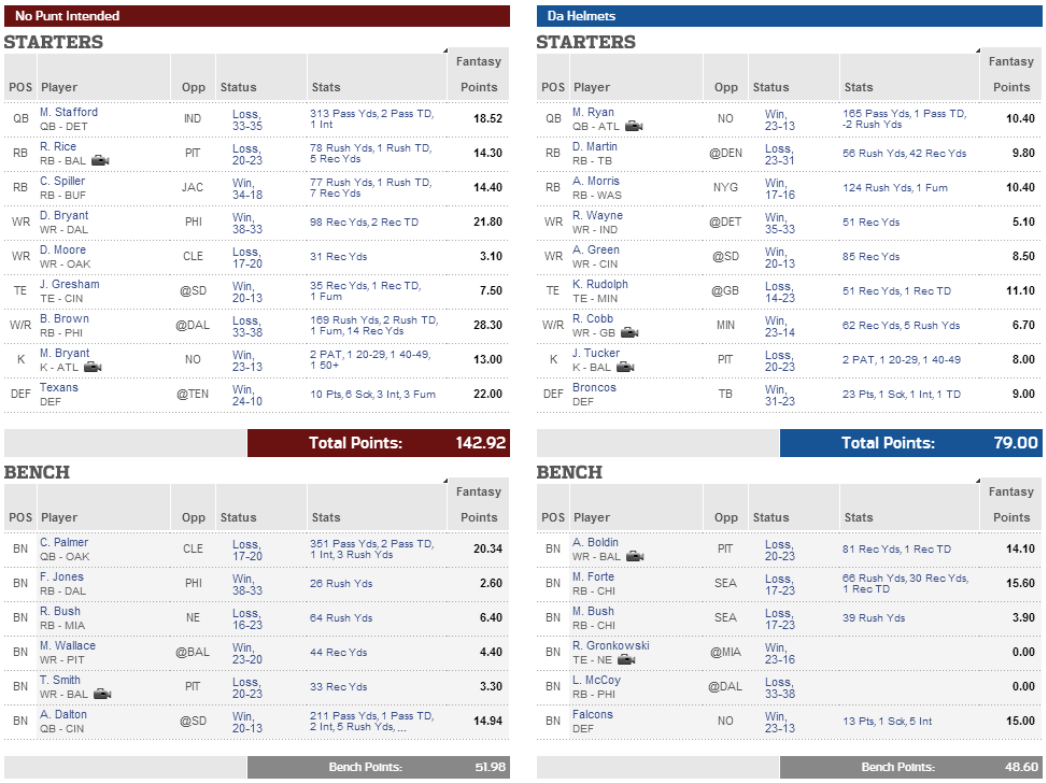
The Fantasy Football Phenomenon

Fantasy football (FF) is an extremely popular, multiplayer, strategic, online game. In the United States, it's estimated that over 30 million people participated in FF leagues last season (about 1 in 7 Americans; Fantasy Sports Trade Association, http://www.fsta.org). That's more than the number of

Americans who visited museums last year (Americans for the Arts, 2012), and three times the number of World of Warcraft players (Olivetti, 2011)!

The standard FF game involves a league of 10 or 12 players, called "managers." Near the start of the National Football League (NFL) season (which coincides conveniently with the start of a Fall semester), these managers participate in an online draft, systematically populating their fantasy football teams, selecting 15 real NFL players who are expected to perform well during real games of the NFL season. Managers will receive points for these players' performances in weekly football games; for instance, 1 point is awarded for every 10 rushing yards gained, 6 points for a rushing touchdown, etc.

But while each manager has 15 players on his/her roster, there are only 9 "starting" positions— that is, only a subset of each manager's roster can accumulate points. For each week of the season, the manager must determine which players to "start" (who will earn points) and which players to "bench" (who will remain on the team, but cannot contribute to that week's point total). Managers can also adjust their rosters, either by trading players with other managers, or by replacing their players with undrafted players. During the season, managers go head-to-head in weekly matchups to see whose fantasy team earns the most points, and the manager with the most "wins" in these weekly matchups is crowned league champion. In this way, FF is a game of predictions and probabilities: Which NFL players will earn the most points each week?



No Punt Intended

STARTERS

POS	Player	Opp	Status	Stats	Fantasy Points
QB	M. Stafford QB - DET	IND	Loss, 33-35	313 Pass Yds, 2 Pass TD, 1 Int	18.52
RB	R. Rice RB - BAL	PIT	Loss, 20-23	78 Rush Yds, 1 Rush TD, 5 Rec Yds	14.30
RB	C. Spiller RB - BUF	JAC	Win, 34-18	77 Rush Yds, 1 Rush TD, 7 Rec Yds	14.40
WR	D. Bryant WR - DAL	PHI	Win, 38-33	98 Rec Yds, 2 Rec TD	21.80
WR	D. Moore WR - OAK	CLE	Loss, 17-20	31 Rec Yds	3.10
TE	J. Gresham TE - CIN	@SD	Win, 20-13	35 Rec Yds, 1 Rec TD, 1 Fum	7.50
W/R	B. Brown RB - PHI	@DAL	Loss, 33-38	169 Rush Yds, 2 Rush TD, 1 Fum, 14 Rec Yds	28.30
K	M. Bryant K - ATL	NO	Win, 23-13	2 PAT, 1 20-29, 1 40-49, 1 50+	13.00
DEF	Texans DEF	@TEN	Win, 24-10	10 Pts, 6 Sck, 3 Int, 3 Fum	22.00
				Total Points:	**142.92**

BENCH

POS	Player	Opp	Status	Stats	Fantasy Points
BN	C. Palmer QB - OAK	CLE	Loss, 17-20	351 Pass Yds, 2 Pass TD, 1 Int, 3 Rush Yds	20.34
BN	F. Jones RB - DAL	PHI	Win, 38-33	26 Rush Yds	2.60
BN	R. Bush RB - MIA	NE	Loss, 16-23	64 Rush Yds	6.40
BN	M. Wallace WR - PIT	@BAL	Win, 23-20	44 Rec Yds	4.40
BN	T. Smith WR - BAL	PIT	Loss, 20-23	33 Rec Yds	3.30
BN	A. Dalton QB - CIN	@SD	Win, 20-13	211 Pass Yds, 1 Pass TD, 2 Int, 5 Rush Yds, ...	14.94
				Bench Points:	**51.98**

Da Helmets

STARTERS

POS	Player	Opp	Status	Stats	Fantasy Points
QB	M. Ryan QB - ATL	NO	Win, 23-13	165 Pass Yds, 1 Pass TD, -2 Rush Yds	10.40
RB	D. Martin RB - TB	@DEN	Loss, 23-31	56 Rush Yds, 42 Rec Yds	9.80
RB	A. Morris RB - WAS	NYG	Win, 17-16	124 Rush Yds, 1 Fum	10.40
WR	R. Wayne WR - IND	@DET	Win, 35-33	51 Rec Yds	5.10
WR	A. Green WR - CIN	@SD	Win, 20-13	85 Rec Yds	8.50
TE	K. Rudolph TE - MIN	@GB	Loss, 14-23	51 Rec Yds, 1 Rec TD	11.10
W/R	R. Cobb WR - GB	MIN	Win, 23-14	62 Rec Yds, 5 Rush Yds	6.70
K	J. Tucker K - BAL	PIT	Loss, 20-23	2 PAT, 1 20-29, 1 40-49	8.00
DEF	Broncos DEF	TB	Win, 31-23	23 Pts, 1 Sck, 1 Int, 1 TD	9.00
				Total Points:	**79.00**

BENCH

POS	Player	Opp	Status	Stats	Fantasy Points
BN	A. Boldin WR - BAL	PIT	Loss, 20-23	81 Rec Yds, 1 Rec TD	14.10
BN	M. Forte RB - CHI	SEA	Loss, 17-23	66 Rush Yds, 30 Rec Yds, 1 Rec TD	15.60
BN	M. Bush RB - CHI	SEA	Loss, 17-23	39 Rush Yds	3.90
BN	R. Gronkowski TE - NE	@MIA	Win, 23-16		0.00
BN	L. McCoy RB - PHI	@DAL	Loss, 33-38		0.00
BN	Falcons DEF	NO	Win, 23-13	13 Pts, 1 Sck, 5 Int	15.00
				Bench Points:	**48.60**

Figure 1: Screenshot of a fantasy football matchup during week 13 of the 2012 NFL season, using NFL.com's platform. Reproduced with permission. © 2012 NFL Enterprises LLC.

The Course: Prediction, Probability, and Pigskin

Being a game of predictions and probabilities, FF naturally lends itself to statistical analyses of player performance. An FF manager will routinely devour troves of sports stats (Comeau, 2007), attempting to glean some critical insight about a particular player's odds of a high-scoring week. But how can this appetite for insight become rendered into generalizable, meaningful statistical concept learning in a college course?

Students should, at minimum, play the game. At the start of the semester, students took a short survey about their past experience with FF, and were arranged into 10-team leagues with matched

levels of experience (so that fantasy newbies would not be intimated by veterans). At the end of the semester, the top 3 managers in each of these leagues would be rewarded with extra credit in the course.

Additionally, a large database of NFL statistics was compiled, aggregating 6-years' worth of weekly fantasy data from public sports websites. Workstations in computer labs around campus were configured to access this networked data source using Microsoft Excel.

The first half of the course was filled with practical exercises in data analysis using Microsoft Excel, exploring football statistics and using data to make informed predictions. In lectures and in weekly computer lab sections, students actively studied the football database. They calculated quarterback passer ratings and identified the best quarterbacks (while critically evaluating the passer rating equation), they quantified the home-field advantage for different player positions, they investigated differences in performance during rivalry and non-rivalry matchups, and more. All these exercises were intended to train students to employ basic methods for manipulating and analyzing datasets, such as sorting, filtering, summarizing, comparing, and quantifying variance. But rather than learning these methods in abstraction, students were drawn to these skills via active participation in FF problem solving, becoming socialized in the practical value of data analysis to urgent questions in the game system (Squire, 2006).

The second half of the course built on these new analytical skills, and introduced students to more advanced methods of data analysis, each presented as a practical tool for a specific analytical problem in the FF game system. We explored correlation, linear modeling, cluster analysis, factor analysis, and Monte Carlo simulation, each from an applied perspective—students were not taught mathematical foundations of these techniques. We also explored more "meta" issues in data analysis, such as human decision making processes and our propensity to make irrational choices in the face of uncertainty. Declarative knowledge about course topics was assessed in multiple-choice midterm and final exams.

But despite the course's focus on analytical methods, a critical learning goal was for students to be more than just data-jockeys—successful students should be able to translate patterns observed into meaningful, actionable insights. These insights informed the wheeling and dealing efforts involved in FF (e.g., "…and for these reasons, I should activate Cam Newton over Aaron Rogers"), which are issues of great interest (and contention) to managers. Past work had shown that open discourse about gameplay has the ability to facilitate and incentivize empirical reasoning and critical approaches (Steinkuehler & Duncan, 2008). Thus, a substantial portion of the students' grades was determined by their ability to generalize the analyses explored in class, to craft and communicate original insights. A public Wordpress blogging environment was developed (http://pigskin.psych.indiana.edu), and students were required to submit weekly posts and commentary, acting as fantasy football pundits rendering expert predictions and FF advice.

Interest and Achievement

Early in the semester, a reporter for my university's communications office came to interview some of the students. The following quote appeared in the subsequent article:

> "I expected it to be more technical, but it's fun," said Sarah M., a junior from Palm Springs, Calif., who is studying studio art… "It's not the normal sitting in a class falling asleep. It's interesting." (quoted by James, 2012)

Ignoring any symptoms of narcolepsy, Sarah's sentiment about the course was corroborated in end of semester student evaluations: Students' interest in subject matter ranked in the 88th percentile of all university courses. Without question, the crowning success of the course was that I was teaching analytical and statistical concepts (sometimes *hard* statistical concepts), and yet, students were interested. And while "interest" may seem a trite or obvious goal, inspiring student interest pays pedagogical dividends. Research has shown that individuals who are interested will retain significantly more from brief exposure to the material than individuals who are saturated by the same material, but who find the content uninteresting (Hambrick et al., 2008). Moreover, students are much more likely to attend to deep themes, synthesizing and remembering core information, simply when motivated to find interest in the content (McDaniel et al., 2000).

These positive learning outcomes were not limited to those students who entered the course with FF expertise. The number of years students had previously played FF (reported on a survey at the start of the semester) were uncorrelated with end of semester course grades, r = -.012, *ns*. Students with absolutely no FF experience found the game, and the course, to be accessible and engaging. Moreover, despite some speculative claims that FF statistical savvy is an expressly masculine activity (Davis & Duncan, 2006), male and female students' course grades were at parity, $t(57)$ = .709, *ns*, and anecdotally, some of the most enthusiastic players and engaged students were females that had not previously played FF. We had spectacular in-class discussions about FF strategy and applications of analytical tools, and I was constantly impressed by the enthusiasm of FF newbies.

While I assert that student performance was generally impressive and high quality, I don't have a valid basis for quantitative comparison. The average cumulative percent score in the course was 83% (excluding extra credit for FF standings), which is relatively high for introductory statistics. Scores on blogging activities were highly correlated with scores on midterm and final exams, r = .656, $p < .001$, and neither blog scores (worth 40% of grade) nor exam scores (worth 30% of grade) were significantly more predictive of cumulative final class standing, $F(1, 57)$ = .015, *ns*, suggestive that students were learning generalizable skills and transferrable concepts using FF. A handful of students proudly reported that they were spontaneously applying course concepts beyond the required classwork, digging deeper into the football data to satisfy curiosities, and compiling datasets and running analyses for other extra-curricular interests. But not all students were so impressive, and course grades took the form of the canonical bell-shaped curve; some students produced work that was phenomenal, while some others were mediocre, as readers might observe on the blogging platform.

Experience and Engagement

A course about FF is, as one might expect, exceptionally attractive to experienced FF players. In that way, some students may have signed-up with a mindset that mismatched the course's learning objectives: enrolling because of strong interest in FF, not because of any interest in applying statistical analyses to FF. While these are not mutually exclusive, it was apparent that some students found the coursework to be unauthentic distortions of their original reasons for enrolling, and some of the most vocal class participants during discussions of FF, sage FF veterans, would noticeably "tune out" when the discussion turned more squarely toward analytical methods. There is some empirical support for the theory that experienced FF players, in particular, became less engaged: students were asked in the beginning of the semester how much time they *planned* to invest in the course, and at the end of the semester, how much time they had *previously* invested in the course. By the end of the semester, students with more FF experience had invested significantly less time in their coursework than originally planned, and there was no such difference between planned/actual time investments for FF novices, $F(1, 51)$ = 10.773, p = .002 (see Figure 2).

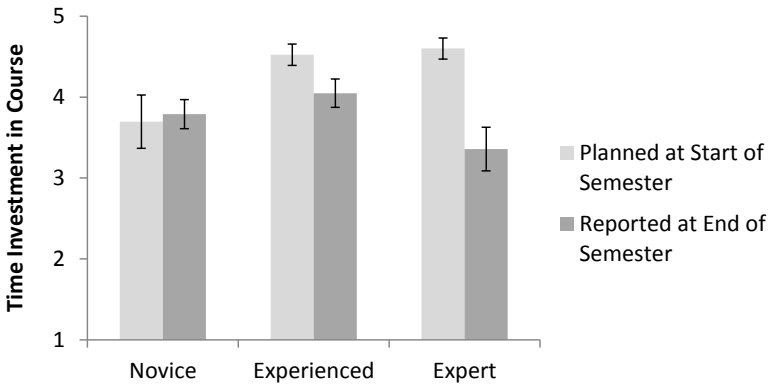


Figure 2: Students' planned time investment in course at start of semester, and reported time investment at the end of the semester. "Novice" indicates students who had no experience in fantasy football prior to the course (19 students), "Experienced" had 1-4 years (21 students), and "Expert" had 5 or more years of experience (14 students). Larger numbers indicate increased self-reported time investment on a 5-point scale. Error bars indicate +/- one standard error.

This issue of a perceived mismatch between "games for fun" and "games for learning" has been previously observed (Steinkuehler et al., 2011), and current results suggest this may be particularly pronounced for students with extensive gameplay experience. These results cannot be explained by the experts feeling unchallenged by an uncompetitive classroom gameplay environment, since student leagues were organized to match FF experience levels; even the seats in lecture and laboratory were assigned specifically to group experts with one another. The experts were very much involved in their leagues, there was no shortage of competitiveness; engagement hurdles are unlikely due to lessened competition in these classroom leagues. Fortunately for their GPAs, years of FF experience were not correlated with course performance, and these experts were at no disadvantage. However, students with more fantasy football experience reported significantly less learned proficiency in data analysis as a result of their coursework, $r = -.288$, $p = .037$. This negative correlation between FF experience and self-reported learning outcomes may result from FF experts entering the course with data analysis proficiency *a priori*, as previous FF gameplay would have implicitly incentivized data consumption. But whether due to perceived incongruities between learning and gameplay, or due to extant familiarity with data analysis, there was a measurable engagement hurdle with students who were experienced FF managers.

Another symptom of this mismatch between "games for fun" and "games for learning" became apparent earlier in the semester. I had originally provided weekly analytical puzzles, short explorations of the football database which, if answered correctly, would yield 5 "bonus points" toward the student's FF matchup that week (e.g., "What is the correlation coefficient that describes the relationship between fantasy points for a team's starting quarterback and place kicker?"). Despite the attractiveness of these bonus points, and repeated reminders in class and via email, only 10% of the students would complete these puzzles. When asked outright, "Why aren't more of you completing the puzzle?" a strange consensus emerged among the students: "If I won/lost my matchup because of those bonus points, that'd be cheating." There was something fundamentally illegitimate about changing the rules of the game to incentivize coursework, and as one might expect, these claims of illegitimacy came primarily from students who were experienced FF managers.

Case Summary

Fantasy Football was observed sparking interest and achievement in introductory statistics, and leading to broad learning outcomes including new declarative knowledge about statistics (measured by multiple choice exams) as well as improved analytical reasoning skills (measured by blog posts). It provided an engaging and immersive example application of otherwise abstract material, creating a learning experience whereby analytical techniques were made relevant, accessible, and useful—exactly the type of approach advocated by statistics education reform. And anecdotally, I was thoroughly impressed by the new skills (both reasoning ability and technical proficiency) demonstrated by the students.

However, the authenticity of learning activities to FF gameplay is an issue that may disproportionately inhibit students who are more experienced in FF. Future efforts might be made to advertise the course to FF novices specifically, as FF experts may already demonstrate reasonable aptitude with some data analysis techniques and/or may be less inclined to "colonize" their gaming activities with coursework. However, armed with the knowledge that more FF experience may obstruct engagement, an effective instructional strategy might be to focus increased attention on the veterans, rather than allow them to become sidelined. Experts might be engaged by asking them to recount anecdotes about FF scenarios that might lead necessarily toward analytical solutions, having them provide informal constructive tutelage to novices on FF strategy, or otherwise make them feel like their expertise plays an important role in the class discourse beyond the issues of gameplay.

Why do people play fantasy football? Factor analysis suggests that most FF engagement is mediated by competitiveness and social identification (Curry, 2009; Lewis, 2012; see also Haverson & Haverson, 2008), and a successful learning application of FF will not marginalize these. Efforts should be made to incentivize competitiveness in a student league (in this case, by offering extra credit for FF success), with classmates who are at similar skill levels, and class time should be dedicated to open discussion of FF news and league outcomes to facilitate interpersonal connections. Oftentimes these discussions would lead logically toward issues that are conducive to empirical analysis ("Could anyone have predicted that Anquan Boldin would do better than Reggie Wayne?"), which is exactly the "hook" that makes FF such an effective educational activity in statistics.

Endnote

(1) Others have previously used fantasy football to achieve similar learning objectives. John Hagen's remedial algebra class at Foothill High School (featured at http://sports.espn.go.com/espn/news/story?id=2680335), Dan Flockhart's (2007) middle school textbook, and a popular New York Times blog post (Honner & Ojalvo, 2011) are noteworthy examples. Additionally, Blake Scott recently conducted a course on fantasy football rhetoric at the University of Central Florida.

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