Sports Analytics: Course Description and Syllabus

Time and room

The class meets on Mondays from 5:45 pm–9:00 pm in Warren 208.

Instructor

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Office hours: Mondays 12:30 pm–2:00 pm, or by appointment

FIRST CLASS MANDATORY

Students will not be allowed to add the course unless they attend the first class.

Course work and grading

Grades will be based on the following weights:

- Final project and presentation (groups of 3 or less): 35%
- Class participation (including attendance): 10%
- Homework (groups of 3 or less, lowest score dropped): 40%
- Concept check quizzes (individual): 15%

There will be a homework assignment for almost every class. These may be done individually or in a group of up to three people (which can change from assignment to assignment). If you would like help finding a team, please e-mail the TA. In computing your homework assignment grade, the lowest score will be dropped. There will be one concept check quiz per week. There are to be done individually.

The final project can be on a sports topic of your choosing or one using data and questions that I provide. The final project can be done in groups of three or less. A good level to shoot for would be an article that could be published on

fivethirtyeight.com/sports or sportsanalyticsblog.com.

You could investigate an interesting result from one sport and apply it to another sport. The write-up should be approximately five pages, not including figures, charts, or supporting material in an appendix. Project presentations will be given on the last class session.
Core culture

Core culture (present and on time, prepared and participating) is expected of everyone in the course. It is important for learning the material and for us learning from each other—and is more fun for all of us.

Connection to the core

This course builds on the Business Analytics and Statistics core courses. The course will use the tools of statistical analysis, predictive analytics, optimization and simulation. Issues of risk and return from Corporate Finance will be used in the course, as will game theory concepts from Managerial Economics and Strategy.

Course description

Sports analytics refers to the use of data and quantitative methods to measure performance and make decisions to gain advantage in the competitive sports arena. This course builds on the Business Analytics core course and is designed to help students to develop and apply analytical skills that are useful in business, using sports as the application area. These skills include critical thinking, mathematical modeling, statistical analysis, predictive analytics, game theory, optimization and simulation. These skills will be applied to sports in this course, but are equally useful in many areas of business.

There will be three main topics in the course: (1) measuring and predicting player and team performance, (2) decision-making and strategy in sports, and (3) sports betting and fantasy sports. Typical questions addressed in sports analytics include: How to rank players or teams? How to predict future performance of players or teams? How much is a player on a team worth? How likely are extreme performances, i.e., streaks? Are there hot-hands in sports performances? Which decision is more likely to lead to a win (e.g., attempt a stolen base or not in baseball, punt or go for it on fourth down in football, dump and chase or not in hockey, pull the goalie or not in hockey)? How to form lineups in daily fantasy sports? Are betting markets efficient? How to manage money in sports betting?

The main sports discussed in the course will be baseball, football, basketball, hockey, and golf. Soccer, tennis, and other sports will be briefly discussed. Students are welcome to pursue any sport in more detail (e.g., cricket, rugby, auto racing, horse racing, Australian rules football, skiing, track and field, or even card games such as blackjack, poker, etc.) in a project.

Class sessions will involve a mixture of current events, lecture, discussion, and hands-on analysis with computers in class. Each session will typically address a question from a sport using an important analytical idea (e.g., mean reversion) together with a mathematical technique (e.g., regression). Because of the “laboratory” nature of part of the sessions, students should bring their laptops to each class.
Guest speakers

There will be several guest speakers during the course. Past speakers have included:

- Jason Rosenfeld, Director of Basketball Analytics for the NBA (and formerly with the Charlotte Hornets)
- James Morrow, Fidelity Investments, hockey analytics and investing
- Sarah Rudd, StatDNA, soccer analytics
- Brian Burke, ESPN, football analytics
- Dan Singer, senior partner at McKinsey, head of Sports and Gaming Practice

Prerequisites

The prerequisites for the course are the Managerial Statistics and Business Analytics core courses. Good Excel skills are required and we will use the Business Analytics Excel add-in for analyzing data. Detailed knowledge of sports is not required, but familiarity with the rules of baseball, football, basketball, hockey and golf will be assumed. There are many websites and popular books where you can learn about these sports, if needed. For example, in baseball, you should understand the basic rules and what the terms bunting and base-stealing mean, e.g., as described in https://en.wikipedia.org/wiki/Baseball_rules.


Additional recommended books

- Scorecasting, 2011, Moskowitz and Wertheim, Crown Archetype
- Every Shot Counts, 2014, Mark Broadie, Gotham Books
- Trading Bases, 2013, Joe Peta, Dutton

Software

All assignments are expected to be done in Excel, with some assignments requiring the use of the Business Analytics Excel add-in. There is no requirement to use other software for the assignments (though we might use Visual Basic in class). However, if you are familiar with another statistical package or programming language, you are welcome to use it for the project (e.g., you might want to use R if your project involves analysis of pitch/fx data).
Course outline

Sessions 1-5. Measuring and predicting the performance of players and teams

- Course overview
- Rating field goal kickers in the NFL
- Ratings teams and measuring the strength of schedule
- Predicting future performance of players and teams
- Assessing alternative models of performance
- Streaks, momentum, mean-reversion and hot hands in sports

Sessions 6-8. Decision making in sports

- Markov modeling of games: states, transition probabilities and state values
- Baseball: analysis of bunting, base-stealing and other strategies
- Football: analysis of run versus pass, punt or go-for-it
- Assessing the value of a play using run value added and win probability added
- Decision making with strategic interactions using game theory

Sessions 9-11. Sports betting and fantasy sports

- Overview: betting markets, odds, “prop” bets, setting betting lines
- Investigating the efficiency of betting markets
- Setting betting lines
- Money management and the Kelly criterion
- Analysis of prop bets
- Daily fantasy sports
- Golf analytics: performance measurement, decision making and sports betting

Sessions 12. Project presentations