Syllabus OR 649

Topics in Operations Research: Sports Analytics

Fall 2015, Wed 7:20 pm

Instructor: Mr. Brian Burke

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Office Hours: Before or after class, by appointment

Text: *Mathletics* by Wayne Winston, Princeton, NJ: Princeton University Press, 2012 (paperback edition): ISBN 978-0-691-15458-9.Paper or electronic formats acceptable. Available via Amazon.

Objective: This course will introduce students to topics in the applied analysis of sports, with a focus on supporting team decision-makers. Students will learn to apply modern, practical analytic techniques to sports data in search of actionable insight and a competitive edge. The four major team sports of North America (football, baseball, basketball, and hockey) will be the primary subjects of study, but the course's learning objectives will universally apply to a variety of sports. Students will become familiar with the full analytic life-cycle: asking productive and relevant research questions, finding the right data, applying the appropriate tools, discovering insight, and clearly communicating results.

Planned Topics:

Sep 2: Course introduction and Pythagorean expectation.

Read chapter 1.

Sep 9: General score distribution model. Underdogs and variance. R Studio introduction.

Read chapters 43 and 45.

Sep 16: Baseball weighted on base average (wOBA), Runs Created (RC). Loading and saving data in R.

Read chapters 2 and 3.

Sep 23: Replacement Level, Baseball Wins Above Replacement (WAR). R vectors and data frames.

Read chapters 8 and 9.

Sep 30: Player valuation. With Or Without You (WOWY) stats. Basketball and hockey adjusted plus-minus based on linear programming. R data types.

Read chapters 28, 29, 30.

Oct 7: TBD

Oct 14 : Football Expected Point (EP) model. LOESS regression. Introduction to modeling in R.

Read chapters 20 and 22.

Oct 21: Expected values, decision trees, in-game decision analysis. Introduction to Tableau.

Project proposal due.

Read chapters 21 and 24.

Oct 28: Two-player, zero-sum game theory. Applications in soccer, tennis, football, baseball. 2nd mover advantage. Importing data and data types in Tableau.

Read chapters 23 and 25.

Case study presentations begin.

Nov 4: What makes teams win? Logistic regression. Creating basic visualizations in Tableau.

Read chapter 18.

Nov 11: Simulation and Markov models. Creating dashboards in Tableau.

Project progress report due.

Nov 18: Integer programming and the knapsack model of roster construction.

Nov 25: Thanksgiving Recess

Dec 2: Momentum and the hot hand, Wald–Wolfowitz runs test.

Read chapter 11.

Dec 9: Project presentations.

Grading:

Case Study	15%
Final Exam	40%
Project	30%
Class & Homework	15%
	100%

Case Study:

Each student will present a 15 minute brief on a relevant sports research or analysis article. The brief shall be a review of the article's problem, data, methods, and conclusions. Emphasis shall be on the student's understanding of the concepts and critical evaluation of the research. Articles may include published academic research or deep research published at credible online publications. Topics must be submitted and approved by Oct 21.

Course Projects

Pairs of students will each complete a class project. We will touch on all four major sports to some degree before topics need to be selected. Proposals will be due prior to mid-semester. Progress reports will be due as 5-minute/5-slide presentations at the 10-week mark. Final reports will be due as a 15-20 min scripted brief. Projects must apply one of the major concepts covered in the class and include an interactive visualization of the results plus a final recommendation. Briefs shall be in the form of a report presented to an analytics-savvy major decision maker (coach or general manager).

Student Expectations:

Academic Integrity

Students must be responsible for their own work, and students and faculty must take on the responsibility of dealing explicitly with violations. The tenet must be a foundation of our university culture. [See http://academicintegrity.gmu.edu/distance].

Honor Code

Students must adhere to the guidelines of the George Mason University Honor Code [See http://oai.gmu.edu/honor-code/masons-honor-code/].

MasonLive/Email (GMU Email)

Students are responsible for the content of university communications sent to their George Mason University email account and are required to activate their account and check it regularly. All communication from the university, college, school, and program will be sent to students solely through their Mason email account. [See https://thanatos.gmu.edu/masonlive/login].

Patriot Pass

Once you sign up for your Patriot Pass, your passwords will be synchronized, and you will use your Patriot Pass username and password to log in to the following systems: Blackboard, University Libraries, MasonLive, myMason, Patriot Web, Virtual Computing Lab, and WEMS. [See https://thanatos.gmu.edu/passwordchange/index.jsp].

University Policies

Students must follow the university policies. [See University Policies].

Diversity

George Mason University promotes a living and learning environment for outstanding growth and productivity among its students, faculty and staff. Through its curriculum, programs, policies, procedures, services and resources, Mason strives to maintain a quality environment for work, study and personal growth.

Responsible Use of Computing

Students must follow the university policy for Responsible Use of Computing. [See http://universitypolicy.gmu.edu/1301gen.html].

University Calendar

Students must follow the university policies. [See Catalogue].

Students with Disabilities Students with disabilities who seek accommodations in a course must be registered with the George Mason University Office of Disability Services (ODS) and inform their instructor, in writing, at the beginning of the semester [See http://ods.gmu.edu]. Students are expected to follow courteous Internet etiquette.

Student Services:

University Libraries

University Libraries provides resources for distance students. [See http://library.gmu.edu/distance].

Writing Center

The George Mason University Writing Center staff provides a variety of resources and services (e.g., tutoring, workshops, writing guides, handbooks) intended to support students as they work to construct and share knowledge through writing. [See http://writingcenter.gmu.edu]. You can now sign up for an Online Writing Lab (OWL) session just like you sign up for a face-to-face session in the Writing Center, which means YOU set the date and time of the appointment! Learn more about the Online Writing Lab (OWL) (found under Online Tutoring).

Counseling and Psychological Services

The George Mason University Counseling and Psychological Services (CAPS) staff consists of professional counseling and clinical psychologists, social workers, and counselors who offer a wide range of services (e.g., individual and group counseling, workshops and outreach programs) to enhance students' personal experience and academic performance [See http://caps.gmu.edu].

Family Educational Rights and Privacy Act (FERPA)

The Family Educational Rights and Privacy Act of 1974 (FERPA), also known as the "Buckley Amendment," is a federal law that gives protection to student educational records and provides students with certain rights. [See http://registrar.gmu.edu/privacy].