

NEW COURSE

DATA SCIENCES AND OPERATIONS

FALL 2022

DSO 578 - *Fundamentals of sports*

Performance Analytics

Section(s) – TBD

Professor

Lorena Martin

Email

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When

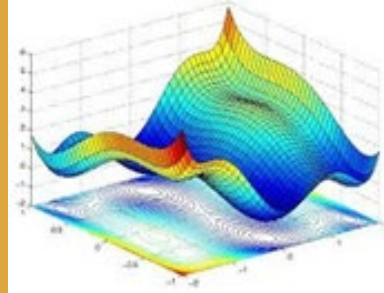
Thursdays, 11:00 AM – 1:50 PM

Office

BRI 400 C

Units

TBD



Will not be open for bidding but should be available during open enrollment May 3, 2022.

WHO SHOULD TAKE THIS COURSE?

Students wanting to learn the fundamentals of sports performance analytics.

COURSE OBJECTIVES

- Learn how to code in R and Rstudio.
- Learn the intricacies of each of the major sports.
- Gain knowledge about the sports science data protocol implemented in pro sports teams.
- Examine how sports analytics are applied to performance, player drafts, injury prevention, and trade value of athletes.
- Meet experts in the sports industry field.

KEY CONCEPTS

- Principles of the measurement model for sports
- Exploratory analysis, correlations, ANOVA, regression models
- Load Management KPIs
- Sports Science Data Collection in Pro Sports

COURSE DESCRIPTION

This course will provide a basic understanding of the different fields within sports analytics including performance, strategy, salary cap, drafting and scouting.

DSO-578 FUNDAMENTALS OF SPORTS PERFORMANCE ANALYTICS

Fall 2022 1.5 Units

Instructor: Lorena Martin, PhD
Class Time: 2nd half of Fall semester, one day per week for a 3hr session.
Office Hours: 1 hr per week, or by appointment
Zoom Meeting ID: 306 401 4243 Passcode: 153045
Email: lmartin1@marshall.usc.edu

COURSE DESCRIPTION

This course is designed to acquire the fundamentals of sports performance analytics. It provides a basic understanding of the different key performance indicators within sports performance analytics including load management, injury prevention, drafting and scouting.

We will examine the process of data collection, the most relevant statistical models implemented in the pro sports industry as well as introduce R and Rstudio as the basic platform to conduct analyses and visualize the data. The course provides an introduction to the most popular sports worldwide as well as provide an understanding of the intricacies of each of the major sports that will enable placing the numbers ascertained through analytics into context. This course begins with a review of the fundamentals of sports performance measurements and the concept of training load. Physical performance measurements such as jumping ability, running speed, agility, strength, as well as the impact of psychological variables, will be examined. The course reviews principles of the sports science data protocol implemented in pro sports teams. Examination of the statistical analyses applied to sports performance, including drafting players, injury prevention, and cost reduction, will also be discussed.

Throughout the course, we will conduct exploratory data analysis, correlations, ANOVA, regression models, as well as non-parametric statistical models commonly implemented in pro sports. The course will culminate by learning how to develop presentation reports using RStudio and effectively communicating it to different audiences, such as coaches and front-office executives. In addition, this course will incorporate expert guest speakers from the world of professional sports, providing insight and behind the scenes look at what a career in sports analytics would entail. This course will provide real-world implications from sports performance analytics.

COURSE OBJECTIVES

Upon successful completion of this course, students will be able to (see Appendix I):

1. Apply data science principles to sports performance, referred to as sports analytics.
2. Apply measurement and statistical modeling to professional athletes in sports.
3. Examine professional athletes' performance and implication of injuries on market value.
4. Present data to different pro sports industry audiences: players, coaches, and front office management.
5. Apply the processes that take place from the inception of a research question, identification of key performance indicators, data collection, statistical analyses, and data visualization, also termed the sports science data protocol.

REQUIRED BOOK

Martin, L. (2016). *Sports Performance Measurement and Analytics: The Science of Assessing Performance, Predicting Future Outcomes, Interpreting Statistical Models, and Evaluating the Market Value of Athletes*. Old Tappan, N.J.: Pearson/FT Press [ISBN-13 978-0-13-419330-4].

No Prerequisites Needed

Structure

Each topic in the course is motivated by a data problem. Some of the data sets we will use are:

- Tennis (ATP/WTA) Tour Data
- Football (NFL/XFL) Data
- Soccer (UEFA/MLS) Data
- Basketball (NBA) Data
- Baseball (MLB) DATA

Topics:

- Data Science Tools: R and Rstudio
- Principles of the measurement model for sports
- Exploratory data analysis
- Sports Science Data Collection in Pro Sports
- Presentation of Graphics to three audiences: Players, Coaches, Front office management

GRADING

ASSESSMENT

- Homework – assignments are designed to examine the knowledge acquired in respect to sports performance and R coding ability. There are a total of 5 homework assignments. ’
- Midterm – will consist of material from assigned readings on sports performance, R code, and statistical analyses.
- Team Project and Presentation - It is a group project (self-selected groups of 3-5). There are three deliverables related to the Project; the abstract, final report, and the presentation. For your final project, you'll be expected to find your own dataset by either obtaining sports data from repositories such as Github, Kaggle, or web scraping from sites with publicly available sports data. The report, as well as the presentation, should include a title page, abstract, introduction, methods, results, discussion, and references section, as well as relevant data visualizations such as tables and figures. The presentation has a time limit of 15 minutes and all team members are required to speak to speak. Finally, a peer evaluation form, (see Appendix II) will be used by the faculty member to assess individual contributions to the team work.
- Final Exam - will consist of material from assigned readings, R code, and statistical analyses.

| <u>Assignments</u> | <u>Points</u> | <u>% of Overall Grade</u> |
|-------------------------------|---------------|---------------------------|
| Class Participation | 5 | 5% |
| Homework (5) | 15 | 15% |
| Team Project and Presentation | 25 | 25% |
| Mid-Term Exam | 25 | 25% |
| Final Exam | 30 | 30% |
| TOTAL | 100 | 100% |

CLASS PARTICIPATION

In-class participation is also a critical part of this course's learning experience. In-class participation grading will be based on students' demonstrated willingness to participate and the quality of the comments expressed rather than quantity. While some students are far more comfortable than others with class participation, all students should make an effort to contribute meaningfully.

HOMEWORK

Assignments will consist of the weekly lecture topics and scheduled book chapters. Each homework assignment will consist of R coding, choosing a particular sport and respective dataset, statistical analysis, and data visualization. There are a total of 5 homework assignments each worth 3% of your grade.

TEAM PROJECT

The objective of the Project is to apply statistical models and measurements in order to assess sports performance. Teams will meet outside of class and provide a Team Project Proposal that will identify the sections responsible by each team member. Peer review for the team project will be collected at the end of the team presentation (see Appendix II).

- Sport has to be chosen by each team
- Role of team members (is your team a group of coaches, training staff, or front office)?
- What KPIs will be collected
- What models will be used to analyze the data?
- Who are you presenting to (Coach, Player, or Front Office Management)?
- Peer assessment will be included as a phase of the team project, to assess individual contributions to the team work.

EXAMS

- Midterm and Final Exams will be in class. Exams will consist of material from assigned readings, R code, and statistical analyses. Notes condensed to one page will be allowed to use to check statistical formulas.

Synchronous Sessions

(This is meant for those the students who cannot attend due to visa or medical issues)

In order to earn full participation points, students must actively participate in all synchronous sessions via computer or laptop, with a webcam and headset/speakers. You are expected to be in a location with a reliable internet connection and without distractions. You need to be able to fully engage at all times. Students are expected to be visually present and to ask thought-provoking questions, offer relevant comments, and answer questions from faculty in a clear and concise manner. If the class meets at a time outside of 7:00 AM to 10:00 PM in the time zone, please consider registering for a section that meets then. If you are unable to do this, please contact your professor immediately. As outlined in the student handbook, there are specific expectations of a student attending class online. When attending, present and act appropriately as if you were in a physical classroom.

Please do:

- Attend class from a quiet area, free of distractions.
- Dress respectfully. Video conference business meetings are and will be the norm, so practice your professional telepresence.

- If you use a virtual background, please keep it respectfully professional
- Display both your first and last name during video conferencing and Synchronous class meetings.
- Respectfully minimize distractions by muting and or turning the video off when moving around
- Engage in appropriate tone and language with instructors or classmates
- Disagree respectfully
- Respectfully pay attention to classmates

Please do not:

- Engage in a simultaneous activity (e.g., using a telephone, reading a book, knitting)
- Interact with persons who are not part of the class
- Leave frequently or not be on camera for extended periods of time
- Have other persons or pets in view of the camera
- Behave in an overtly inattentive manner (looking distracted, not participating)

Asynchronous Activities – Discussion Boards and emails Our discussion boards are ways for you to share your ideas and learning with your colleagues in this class. We do this as colleagues in learning, and the Discussion Board is meant to be a safe and respectful environment for us to conduct these discussions.

Some Netiquette Rules:

- Engage in appropriate tone and language with instructors or classmates
- Disagree respectfully
- Do not use all CAPITAL LETTERS in emails or discussion board postings. This is considered "shouting" and is seen as impolite or aggressive.
- Do not use more than one punctuation mark; this is also considered aggressive!!!!
- Begin communications with a professional salutation (Examples: Dr. Name; Ms. Name; Hello Professor Name; Good afternoon Mr. Name). Starting without a salutation or a simple "Hey" is not appropriate.
- When sending an email, please include a detailed subject line. Additionally, make sure you reference the course number (Ex. BUAD101 in the message and sign the mail with your name.
- Use proper grammar, spelling, punctuation, and capitalization. Text messaging language is not acceptable. You are practicing for your role as a business leader.
- Re-Read, think, and edit your message before you click "Send/Submit/Post.". as a check, consider whether you would be comfortable with your email or post or text being widely distributed on the Internet.

Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on [Research and Scholarship Misconduct](#).

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University’s educational programs. The Office of Student Accessibility Services (OSAS) is responsible for determining appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call

studenthealth.usc.edu/counseling

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call

suicidepreventionlifeline.org

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press “0” after hours – 24/7 on call

studenthealth.usc.edu/sexual-assault

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - (213) 740-5086

eeotix.usc.edu

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298

usc-advocate.symplicity.com/care_report

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

The Office of Student Accessibility Services (OSAS) - (213) 740-0776

osas.usc.edu

OSAS ensures equal access for students with disabilities through providing academic accommodations and

auxiliary aids in accordance with federal laws and university policy.

USC Campus Support and Intervention - (213) 821-4710

campussupport.usc.edu

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity, Equity and Inclusion - (213) 740-2101

diversity.usc.edu

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

dps.usc.edu, emergency.usc.edu

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call

dps.usc.edu

Non-emergency assistance or information.

Office of the Ombuds - (213) 821-9556 (UPC) / (323) 442-0382 (HSC)

ombuds.usc.edu

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

Occupational Therapy Faculty Practice - (323) 442-3340 or otfp@med.usc.edu

chan.usc.edu/otfp

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.

COURSE OUTLINE AND ASSIGNMENTS

| | Topics/ Daily Activities | Readings | Deliverables |
|---------------|--|---|---------------------------------------|
| <i>Week 1</i> | <p>Topics: Chapters 2 and 3 Descriptives of Physical and Psychological Variables</p> <p>Importing Data in R</p> <p><i>Guest Speaker – Pro Sports Team Owner</i></p> | <p>Readings: Introduction to R</p> <p>Key Performance Indicators in Pro Sports Physical and Psychological</p> <p>Assignment: Identify Topic for Team Project</p> | |
| <i>Week 2</i> | <p>Topics: Working in Professional Sports Organizations</p> <p>Role of Analytics in Pro Sports</p> <p><i>Guest Speaker – Director of Sports Analytics for the Las Vegas Raiders</i></p> | <p>Readings: McDuff, D. R., & Garvin, M. (2016). Working with sports organizations and teams. <i>International review of psychiatry</i>, 28(6), 595-605.</p> <p>Wagstaff, C. R. D., Gilmore, S., & Thelwell, R. C. (2015). Sport medicine and sport science practitioners' experiences of organizational change. <i>Scandinavian Journal of Medicine & Science in Sports</i>, 25(5), 685-698.</p> <p>Assignment: Project Abstract</p> | HW1: DUE Basic R HW |
| <i>Week 3</i> | <p>Topics: Chapters 4 and 5</p> <p>Data Wrangling</p> | <p>Readings: Selecting Statistical Models</p> <p>Sports Science Data Protocol</p> <p>Touchdown Analytics</p> <p>Assignment: Analysis of Variance on Football NFL or XFL data.</p> | HW2: DUE Project Abstract |
| <i>Week 4</i> | <p>Topics: Chapter 6</p> <p><i>Guest Speaker – Director of Sports Analytics for the Miami Heat</i></p> | <p>Readings: NBA Bubble</p> <p>Assignment: ANCOVA on NBA data</p> | HW3: DUE ANOVA NFL Analysis |

| | | | |
|---------------|---|--|--|
| <i>Week 5</i> | <p>Topics: Midterm</p> <p>Chapter 7 - Baseball Linear Regression</p> | <p>Readings: Homerun Analytics</p> <p>Assignment: Correlation and Linear Regression on MLB data.</p> | <p>HW3: DUE ANCOVA on NBA data</p> |
| <i>Week 6</i> | <p>Topics: Chapter 8 – Soccer</p> <p><i>Guest Speaker – Co-President of LAFC</i></p> | <p>Readings: Golden Goal Analytics</p> <p>Assignment: Finalize Team Project</p> | <p>HW4: DUE Linear Regression on MLB data</p> |
| <i>Week 7</i> | <p>Topics: Chapter 9 – Tennis</p> <p>Project Presentations</p> | <p>Readings: Game, Set, Match Analytics</p> | <p>Team Project Due</p> |
| <i>Week 8</i> | <p>Final Exam</p> | <p>Discuss future internship opportunities and research collaboration in sports</p> | |

Appendix II

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|------------------------------------|
| SAMPLE PEER EVALUATION FORM |
|------------------------------------|

Please identify your team and team members for the ____ Project(s) that you worked on. Then rate all your team members, *including yourself*, based on the **contributions** of each team member for the selected assignment according to the criteria listed below. On a scale of 0 – 2, with 0 indicating doesnot meet expectations, 1 meets expectations, and 2 exceeds expectations, rate each person on each of the five criteria. Lastly, add up the points for each person, with the maximum number of points for each person being 10. In the box below, describe the exact contributions of each team member, including yourself.

| Team Members/ Assessment Criteria of Team Contributions | Team Member 1 | Team Member 2 | Team Member 3 | Yourself |
|--|--------------------------|--------------------------|--------------------------|-----------------|
| 1. Role Performance | | | | |
| 2. Assists Team Members | | | | |
| 3. Listening and Discussing | | | | |
| 4. Research and Information Sharing | | | | |
| 5. Time Management | | | | |
| Total | | | | |

| |
|-----------------------|
| Contribution details: |
|-----------------------|