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|  | **DSO-562 – Fraud Analytics** |
| **Term: Spring 2020**  **Day(s): Thursdays**  **Times: 3:30 – 6:30 pm; 6:30 – 9:30 pm**  **Location: JKP 104** |
| **Professor: Stephen Coggeshall** |
| **Office: TBD** |
| **Office Hours***:* Thursdays 1:00 – 3:00 pm |
| **E-mail: stevecoggeshall@gmail.com** |

**Course Description**

In this course you will learn how to build the analytics side of fraud detetion model systems. We will cover all algorithmic aspects of solving a fraud problem, in particular how to approach and design the algorithmic solution. The course will cover

* Understanding the fraud problem to be solved
* Understanding the data around the problem
* How to organize the data and create variables
* How to build supervised and unsupervised fraud statistical models
* Measures of model efficacy

The course will focus on the algorithmic development and will not address the software engineering aspects of building and fielding a fraud soltion. The topics covered are the background for building real time fraud detection systems as well as forensic accounting principles.

This is a project-oriented, group-based course in which students are expected to demonstrate mastery of their prior academic coursework to solve real-world problems using data-driven analytical methods. A set of group projects will provide the students experience in working with real and complex data, and build both supervised and unsupervised fraud models. In this course you will be part of a group with diverse skillsets to combine real world data sets with computational, statistical, or analytical technique/tools to produce models to detect potential fraudulent activity.

Fraud detection is an important area of application of data mining techniques given the economic and social consequences that are usually associated with these illegal activities. From the perspective of data analytics, fraud activity is usually associated with unusual observations as these are activities that are supposed to be deviations from the norm. We take a data analytics approach to detect anomalies in data that are indicators of fraud activity.

It is unlikely that any suspicious activity can be proven to be fraud solely based on analyzing data. The decision of how far to go with suspicious activity indicators depends on the company, entity or regulator depending on various factors such as regulatory requirements, possibility of adverse publicity resulting in a loss of consumer confidence, potential lawsuits, violating laws, and the overall impairment to carrying on normal business. Hence analyzing data to identify anomalies or patterns gives the human auditor/inspector a starting point of where to do further analyses.

Some challenges associated with fraud detection are:

* Defining a representative normal region is challenging
* The boundary between normal and outlying behavior is often not precise
* The exact notion of an outlier is different for different application domains
* Lack of availability of quality labeled data for training/validation
* Malicious adversaries leading to novel anomalies
* Data almost always contains errors and noise
* Normal behavior keeps evolving
* Finding a needle in a haystack
* Class imbalance and asymmetric datasets
* Volume, velocity, and variety of massive, streaming, and complex datasets
* Complexity of datasets that are rich and complex in content
* Hard to explain causality (why and how) of an anomaly in post-detection phase

In this course you will learn about fraud detection processes, fraud detection and prediction models using various statistical techniques, data sources to consider, and evaluation metrics of successful fraud analytics models. You will also learn techniques to rank based on probabilities of suspicious activity that helps humans optimize the cost of investigation and confirmation process of fraud. In addition, we may have practitioners from the industry talk about their current processes to detect/investigate/predict/prevent fraud, and career opportunities. In the projects, student teams (5-6 in a group) will be formed to use tools or develop code to deep dive on real world public datasets, detect and predict fraud activity. Please see the course lecture plan (at the end of this syllabus) for more detailed information on the topics covered and course requirements.

The student teams will be expected to use tools or write code and produce models, a software or visualization highlighting the anomalies that indicate potential fraud activity. The student teams will also be expected to make reports and presentations on the projects.

The students are encouraged to work in teams on project assignments, and each student on each team is expected to have full participation and to make meaningful contributions. Each student must turn in all assignments individually even for team-based work.

**Learning Objectives**   
Upon successful completion of this course, student will be able to:

1. *Utilize statistical, data mining techniques to detect and predict fraud*
2. *Explain the data analytics lifecycle that starts from identifying business problem to interpretation and evaluation of fraud models*
3. *Describe different types of anomalies, and utilize techniques to detect and predict such anomalies*
4. *Work with real life datasets to identify and predict anomalies that may be fraud or abuse*
5. *Describe the experiences of industry practitioners in using processes beyond the computational detection and predict, which is focused on investigation and prevention of fraud and abuse*
6. *Discuss career opportunities in different industries armed with knowledge in anomaly detection and prediction*
7. *Work with domain experts, data scientists, data engineers, visualization specialists to solve complex problems*
8. *Use tools and processes that are helpful to succeed and further their career opportunities beyond the course.*

**Required Materials**

1. *Microsoft Office (Excel, PowerPoint, Word) and Internet Access*
2. *Tableau Visualization Public Free Edition*
3. *A machinine learning/statistical modeling environment, such as R, Python, Weka, Matlab,SAS, scikit-learn.*
4. *Community/Student Edition of popular commercial tools*

**Prerequisites and/or Recommended Preparation:**

1. This course is intended for students that have basic statistics & probability knowledge, database management, and basic programming skills.
2. *Anomaly Detection: A Tutorial (*<https://www.siam.org/meetings/sdm08/TS2.ppt>)
3. *Optional reading material:*
   1. Fraud Analytics Using Descriptive, Predictive, and Social Network Techniques, Baesens, Van Vlasselaer, Verbeke. Looks OK.
   2. Bank Fraud, Subramanian. A friend of mine and colleague from HNC. Nice coverage of bank/credit card fraud. Not so technical but practical and good discussions.
   3. Foundations of Predictive Analytics, Wu, Coggeshall. Covers the mathematical fundamentals of popular ML methods. Nice overall description of modeling processes.

**Course Notes:**

*Slides and notes will be posted to blackboard.*

**ASSIGNMENTS AND GRADING DETAIL**

*Your course grade will be based on the following individual and group assignments:*

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| Assignments | | **% of Grade** |
| **Homeworks 1 - 10** 15 points each | | 52% |
| **Mid term exam** 50 points | | 17% |
| **Group projects 1, 2, 3** 30 points each |  | 31% |
|  | |  |
| **TOTAL** | | 100.0% |
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The 10 homework assignments are each worked on individually and turned in individually. The three group projects are worked on in groups and turned in individually, with each member of the group individually turning in the same report as all the other members of their group. Points will be assign according to the above percentile weightings: 15 possible points for each homework, 30 points for each the projects as shown above.

The total possible points across the homework and project assignments is 290. The final letter grade will be derived from scaling the ending percentages so that the average grade is a between a B+ and A-.

**Assignment Submission Policy:**

Assignments must be turned in on the due date/time electronically via Blackboard. Any assignment turned in late may receive no credit. Please do not skip any homework assignments or your grade will definitely suffer.

**Evaluation of Your Work:**

You may regard each of your submissions as an “exam” in which you apply what you’ve learned according to the assignment. I will do my best to make my expectations for the various assignments clear and to evaluate them as fairly and objectively as I can. If you feel that an error has occurred in the grading of any assignment, you may, within one week of the date the assignment is returned to you, write me a memo in which you request that I re-evaluate the assignment. Attach the original assignment to the memo and explain fully and carefully why you think the assignment should be re-graded. Be aware that the re-evaluation process can result in three types of grade adjustments: positive, none, or negative.

**ADDITIONAL INFORMATION**

**Add/Drop Process**

The last days to add the class, withdraw without receiving a “W” or to drop the class are the standard days shown on the 2018 academic calendar.

**Retention of Graded Coursework**

Final exams and all other graded work that affected the course grade will be retained for one year after the end of the course ***if*** the graded work has not been returned to the student (i.e., if I returned a graded paper to you, it is your responsibility to file it, not mine).

**Technology Policy**

Laptop and Internet usage is not permitted during academic or professional sessions unless otherwise stated by the respective professor and/or staff. Use of other personal communication devices, such as cell phones, is considered unprofessional and is not permitted during academic or professional sessions. ANY e-devices (cell phones, PDAs, I-Phones, Blackberries, other texting devices, laptops, I-pods) must be completely turned off during class time. Upon request, you must comply and put your device on the table in off mode and FACE DOWN. You might also be asked to deposit your devices in a designated area in the classroom. Videotaping faculty lectures is not permitted due to copyright infringement regulations. Audiotaping may be permitted if approved by the professor. Use of any recorded or distributed material is reserved exclusively for the USC students registered in this class.

**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” <https://policy.usc.edu/scampus-part-b/>.  Other forms of academic dishonesty are equally unacceptable.  See additional information in *SCampus*and university policies on scientific misconduct, [http://policy.usc.edu/scientific-misconduct](http://policy.usc.edu/scientific-misconduct/).

**Support Systems:**

*Student Counseling Services (SCS) - (213) 740-7711 – 24/7 on call*

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.<https://engemannshc.usc.edu/counseling/>

*National Suicide Prevention Lifeline - 1-800-273-8255*

Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. [http://www.suicidepreventionlifeline.org](http://www.suicidepreventionlifeline.org/)

*Relationship & Sexual Violence Prevention Services (RSVP) - (213) 740-4900 - 24/7 on call*

Free and confidential therapy services, workshops, and training for situations related to gender-based harm. <https://engemannshc.usc.edu/rsvp/>

*Sexual Assault Resource Center*

For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website:<http://sarc.usc.edu/>

*Office of Equity and Diversity (OED)/Title IX compliance – (213) 740-5086*

Works with faculty, staff, visitors, applicants, and students around issues of protected class.<https://equity.usc.edu/>

*Bias Assessment Response and Support*

Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response.<https://studentaffairs.usc.edu/bias-assessment-response-support/>

*Student Support & Advocacy – (213) 821-4710*

Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic.<https://studentaffairs.usc.edu/ssa/>

*Diversity at USC*

Tabs for Events, Programs and Training, Task Force (including representatives for each school), Chronology, Participate, Resources for Students. [*https://diversity.usc.edu/*](https://diversity.usc.edu/)

*USC Emergency Information*

Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible. [emergency.usc.edu](http://emergency.usc.edu)

*USC Department of Public Safety – UPC: (213) 740-4321 – HSC: (323) 442-1000 – 24-hour emergency or to report a crime.* Provides overall safety to USC community. [dps.usc.edu](http://dps.usc.edu/)

**Students with Disabilities:**

USC is committed to making reasonable accommodations to assist individuals with disabilities in reaching their academic potential. If you have a disability which may impact your performance, attendance, or grades in this course and require accommodations, you must first register with the Office of Disability Services and Programs ([www.usc.edu/disability](http://www.usc.edu/disability)). DSP provides certification for students with disabilities and helps arrange the relevant accommodations.  Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me as early in the semester as possible. DSP is located in GFS (Grace Ford Salvatori Hall) 120 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776. Email: ability@usc.edu.

**Emergency Preparedness/Course Continuity**

In case of a declared emergency if travel to campus is not feasible, the *USC Emergency Information* web site ([*http://emergency.usc.edu/*](http://emergency.usc.edu/)*)* will provide safety and other information, including electronic means by which instructors will conduct class using a combination of Blackboard, teleconferencing, and other technologies.

Please make sure you can access this course in Blackboard and retrieve the course syllabus and other course materials electronically. You should check Blackboard regularly for announcements and new materials. In the event of an emergency, the ability to access Blackboard will be crucial. USC's Blackboard learning management system and support information is available at [blackboard.usc.edu](http://blackboard.usc.edu/).

**Incomplete Grades**

A mark of IN (incomplete) may be assigned when work is not completed because of a documented illness or other “emergency” that occurs after the 12th week of the semester (or the twelfth week equivalent for any course that is scheduled for less than 15 weeks).

An “emergency” is defined as a serious documented illness, or an unforeseen situation that is beyond the student’s control, that prevents a student from completing the semester. Prior to the 12th week, the student still has the option of dropping the class. Arrangements for completing an IN must be initiated by the student and agreed to by the instructor prior to the final examination. If an Incomplete is assigned as the student’s grade, the instructor is required to fill out an “**Assignment of an Incomplete (IN) and Requirements for Completion”** form (<http://www.usc.edu/dept/ARR/grades/index.html>) which specifies to the student and to the department the work remaining to be done, the procedures for its completion, the grade in the course to date, and the weight to be assigned to work remaining to be done when the final grade is computed. Both the instructor and student must sign the form with a copy of the form filed in the department. Class work to complete the course must be completed within one calendar year from the date the IN was assigned. The IN mark will be converted to an F grade should the course not be completed.

**Information for Faculty Members about Grade Disputes**

All grades assigned by faculty members are final. Students have the right to seek explanation, guidance, counsel and reasons for the assignment of a grade. Students may appeal a grade according to university policy as set forth in *SCampus*. Faculty may initiate a change in grade if there is an error in the calculation of a grade. However, a faculty member may not change a disputed grade outside the formal appeals process. In response to a disputed academic evaluation by an instructor, a student is entitled to two levels of appeal after review by the instructor: first to the chairperson of the department and then to the appropriate dean of the school. The full university policy can be found in *SCampus* under University Governance / Academic Policies at http://scampus.usc.edu/academic-policies/ **PLANNED COURSE CALENDAR/CLASS SESSIONS/ASSIGNMENTS**

Note: this plan is subject to modification as the need arises



**Appendix VI**

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| **How [YOUR COURSE] Contributes to Student Achievement of USC Marshall’s Six Graduate Programs Learning Goals** | | |
| **Marshall Graduate Programs Learning Goals** | **Degree of Emphasis**  **(1=Low, 2=Moderate, 3=High)** | **[YOUR COURSE] Objectives that support this goal** |
| **Learning goal #1: Our graduates will develop a strategic level of understanding of the key functions of business and be able to comprehend the relationships between the core business disciplines in order to *make holistic judgments and decisions in analyzing business situations.*** |  |  |
| 1.1. Students will demonstrate foundational knowledge of core business disciplines, including their interrelationships. |  |  |
| 1.2 Students will analyze business scenarios, such as cases, with a firm grounding of how each of the core fields play into decisions made. |  |  |
| 1.3 Students will apply theories, models, and frameworks to analyze relevant markets (e.g. product, capital, commodity, factor and labor markets). |  |  |
| 1.4 Students will show the ability to utilize technologies (e.g., spreadsheets, databases, software) relevant to contemporary business practices in a variety of disciplines and industries. |  |  |
| 1.5 Students will demonstrate the ability to utilize interdisciplinary business skills in case analyses, exams, presentations and projects, including capstone projects. |  |  |
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| **Learning goal # 2: Our graduates will develop a global mindset and a competitive edge in this interdependent, fast-changing, diverse and volatile world through structured educational opportunities. They will acquire knowledge, both theoretical and practical as well as experiential, about America and the rest of the world, and the economic/financial interdependencies that signify current geopolitical, economic and financial relationships that impact business decisions *so as to make a difference in the world.*** |  |  |
| 2.1 Students will understand how local, regional and global markets interact and are impacted by economic, social and cultural factors. |  |  |
| 2.2 Students will understand that stakeholders, stakeholder interests, business environments (legal, regulatory, competitor) and business practices vary across regions of the world. |  |  |
| 2.3 Students will demonstrate the ability to evaluate global business challenges and opportunities through experiential learning, immersion international trips, case studies, international business consulting projects and exams. |  |  |
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| **Learning goal 3: Our graduates will demonstrate critical thinking skills by making the intellectual connection between quantitative and qualitative tools, theories and context to provide the basis *for proper and effective problem solving and decision making as well as the development of new and innovative business opportunities to strategically navigate the complex demands of the current and dynamic national and international business environments.*** |  |  |
| 3.1 Students will understand the concepts of critical thinking, entrepreneurial thinking and creative thinking as drivers of innovative ideas. |  |  |
| 3.2 Students will critically analyze concepts, theories and processes by stating them in their own words, understanding key components, identifying assumptions, indicating how they are similar to and different from others and translating them to the real world. |  |  |
| 3.3 Students will be effective at gathering, storing, and using qualitative and quantitative data and at using analytical tools and frameworks to understand and solve business problems. |  |  |
| 3.4 Students will demonstrate the ability to anticipate, identify and solve business problems. They will be able to identify and assess central problems, identify and evaluate potential solutions, and translate a chosen solution to an implementation plan that considers future contingencies. |  |  |
| 3.5 Students will demonstrate the ability to be accurate, clear, expansive (thorough, detailed) and fair-minded in their thinking. |  |  |
| 3.6 Students will demonstrate their ability to apply critical thinking tools and the USC-CT Framework in designated exercises, cases, projects and exams. |  |  |
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| **Learning Goal 4: Our graduates will develop people and leadership skills by demonstrating self-awareness, emotional intelligence, curiosity, visionary and strategic thinking, teamwork, refection and knowledge transfer skills to promote their effectiveness as *business managers and leaders.*** |  |  |
| 4.1 Students will recognize, understand, and analyze the motivations and behaviors of stakeholders inside and outside organizations (e.g., teams, departments, consumers, investors, auditors). |  |  |
| 4.2 Students will be able to demonstrate various emotional intelligences and leadership skills such as self-awareness, self-management, teamwork and collaboration to better understand the potential complexities in organizations in papers, exercises, cases, exams and projects. |  |  |
| 4.2 Students will recognize, understand and analyze the roles, responsibilities and behaviors of effective managers and leaders in diverse business contexts (e.g., marketing, finance, accounting, etc.) |  |  |
| 4.3 Students will be able to demonstrate the understanding of visions and values of world-class companies and the impact it has had on financial results. |  |  |
| 4.4 Students will understand factors that contribute to effective teamwork. |  |  |
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| **Learning goal 5: Our graduates will demonstrate ethical reasoning skills, understand social, civic, and professional responsibilities *and aspire to add value to society*** |  |  |
| 5.1 Students will understand professional codes of conduct. |  |  |
| 5.2 Students will recognize ethical challenges in business situations and assess appropriate courses of action. |  |  |
| 5.3 Students will be able to apply ethical principles and professional standards in analyzing situations and making informed decisions. |  |  |
| 5.4 Students will demonstrate an understanding of and consistently apply the ethical principles and professional standards related to the business world and show the ability to express and follow results of independence and the highest sense of professional ethics. |  |  |
| 5.5 Students will demonstrate the ability to research, critically analyze, synthesize, and evaluate information, including professional standards for decision making, in the local, regional and global business environment. |  |  |
| 5.6 Students will enhance their appreciation of values of social responsibility, legal and ethical principles and corporate governance through the analysis and discussion of pertinent articles and real business cases, seminars and summits. |  |  |
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| **Learning Goal #6: Our graduates will be effective communicators *to facilitate information flow in organizational, social, and intercultural contexts*** |  |  |
| 6.1 Students will identify and assess diverse personal and organizational communication goals and audience information needs. |  |  |
| 6.2 Students will understand individual and group communications patterns and dynamics in organizations and other professional contexts. |  |  |
| 6.3 Students will demonstrate an ability to gather and disseminate information and communicate it clearly, logically, and persuasively in professional contexts. |  |  |
| 6.4 Students will be able to clearly communicate in oral and written formats the solutions to business issues and problems accurately and effectively. |  |  |