

**ISE 535 Data Mining - Section 598**

Units: 3

Spring 2023 - MW 12:30 p.m.

Location: CPA 100**Instructor:** Cesar Acosta**Office:** GER 216**Office Hours:** TBD**Contact Info:** acostame@usc.edu**Teaching Assistant:****Office:** TBD**Office Hours:** TBD**Contact Info:** TBD**IT Help:****Hours of Service:****Contact Info:****Course Description**

This course is about data analytics tools, methods, and applications. It focuses on data mining, Data Visualization, and Unsupervised Learning Methods. The course shows how to do feature engineering and how to reduce data complexity. Data visualization techniques are reviewed to find useful information from spatial data, now available from different online providers.

Unsupervised Learning Methods are used for clustering analysis, anomaly detection, and dimension reduction. The course reviews many unsupervised learning methods and shows how to apply them by means of case studies for model construction and evaluation.

The main computational tool is the R language. Libraries for statistical analysis, data visualization, and statistical learning are reviewed. RStudio is the interface of choice.

Prerequisite(s): None.**Recommended Preparation** Expected to have knowledge of Engineering Statistics at the level of ISE 225 and working knowledge of a programming language.

Learning Objectives and Outcomes

In this course students learn to

- Preprocess dataframes (missing, duplicates, and data types)
- Understand the importance of Dimensionality Reduction.
- Apply Principal Components for Data Reduction.
- Apply clustering methods for unsupervised learning.
- Learn and apply Discriminant Analysis for classification.
- Use statistical learning Classification methods (Naïve Bayes, discriminant analysis)
- Apply Classification methods for unbalanced data.
- Apply data visualization tools on spatial data.
- Use association rules for mining market basket data.

Course Notes

The course material is available on Blackboard.

Technological Proficiency and Hardware/Software Required

The R programming language and the RStudio IDE will be used.

Required Textbook

This course does not require a textbook.

Supplementary Materials (References)

- Tan P., Steinbach M., Kumar V., *Introduction to Data Mining*, Second Edition, Pearson, 2018, ISBN 978-0133128901
- James G., *An Introduction to Statistical Learning*, Springer, 2013 (ISLR) ISBN 978-1-4614-7137-0
- Chapman C., McDonnell Feit E., *R for Marketing Research and Analytics*, Springer 2015, ISBN 978-3-319-14436-8 (RMRA), available from the Science library as an e-book
- Wickham H., *ggplot2*, Second Edition, Springer, 2016. ISBN 978-3319242750
- Kuhn M., Johnson K., *Applied Predictive Modeling*, Springer, 2013, ISBN 978-1-4614-6849-3 (APM)

Description and Assessment of Assignments

- **Midterm** will be in-class based on the schedule and 2 hours length.
- **Final Examination** a two-hour comprehensive exam scheduled by USC.
- **Homework** are assigned every other week. Homework is based on the material of the previous and current week. Must be submitted by the due date, during the class session. No late homework to be accepted.

Grading Policy

Assignment	Points	% of Grade
Homework	100 each (6 homework assignments)	30
Midterm	100	30
Final	100	40
TOTAL		100

Grading Scale (Course final grades will be determined using the following scale)

A	95-100	B-	80-82	D+	67-69
A-	90-94	C+	77-79	D	63-66
B+	87-89	C	73-76	D-	60-62
B	83-86	C-	70-72	F	59 and below

Assignment Submission Policy

Assignments should be typewritten and clean. They should be submitted in class by the due date. Email submissions and late submissions are not allowed. No make-up exams are considered.

Timeline and Rules for submission

Assignments are to be returned the week after submission. Solutions will be released soon after the homework submission date.

Course Schedule: A Weekly Breakdown

	Date	Topics/Daily Activities	Homework	slides	R Files
1	Jan 9 - Jan 11	Introduction to Data Mining for Descriptive and Predictive Analytics. Introduction to R , RStudio, and rmarkdown.	HW1 R base with rmarkdown	Overview DMining Rbase RStudio	intro Cars93 auto
2	Jan 16 - Jan 18	Statistical Analysis with R – Random Variables The Multivariate Normal Distribution. Kernel Density Estimator.	HW1 due HW2 R base plotting	stat1	qq kernels
3	Jan 23 - Jan 25	Statistical Analysis with R – Tests Test vs. Confidence Interval. Hypothesis Testing on k populations.	HW2 due	ht2	simulation 2pop kpop
4	Jan 30 - Feb 1	Unsupervised Learning. Principal Components Analysis (PCA). Dimensionality Reduction, Feature Extraction.	HW3 PCA	slides2 10 largest.r cancer.csv	banknote
5	Feb 6 - Feb 8	Unsupervised Learning. Clustering Methods. K-Means clustering. Hierarchical clustering	HW3 due	unsupervised kmeans hierarchical	simulated kmeans hierarchical usarrests correlationbased
6	Feb 13 - Feb 15	Tidyverse R library (readr, tidyr, dplyr, stringr) Introduction to ggplot2	HW4 clustering	dplyr4 hierarchical	husarrests
7	Feb 20 -- Feb 22	Data Visualization. R libraries ggplot2, and extensions	HW4 due	ggplot	StudyArea ggts2, mpg
8	Feb 27 - Mar 1	Midterm Exam			
9	Mar 6 – Mar 8	Unsupervised Learning. Clustering Methods. Density-based Spatial Clustering (DBSCAN) Model-based Clustering. Mixtures.		db modelbased	simulation2 geyser contourpoints dbscan diabetes
10	Mar 13	Spring Break			
11	Mar 20- Mar 22	Classification – Part 1 KNN, Naïve Bayes.	HW5 Clustering	classification knn, nb	nbayes, tan bostonknn4
12	Mar 27 - Mar 29	Classification – Part 2 Discriminant Analysis (linear, quadratic)	HW5 due	slides	admission wine
13	Apr 3 -- Apr 5	Classification – Part 3 Multinomial regression		slides	
14	Apr 10 - Apr 12	Classifying Unbalanced Data. New metrics, Sensitivity, Specificity, False Positive rate (FPR), Recall, Precision. ROC Curve, and the AUC.	HW6	slides	roc5
15	Apr 17 - Apr 19	Data Visualization. R library ggmap. Spatial and geographical visualization.	HW6 due	slides2	map22, map33 choropleths
16	Apr 24 - Apr 26	Association Rules		rules	fplates groceries
16	TBD	Final Exam 2 p.m.			

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 scientific misconduct, policy.usc.edu/scientific-misconduct.

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 and 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 of Equity and Diversity (OED)- (213) 740-5086 | Title IX – (213) 821-8298
equity.usc.edu, titleix.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. The university prohibits discrimination or harassment based on the following *protected characteristics*: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender expression, sexual orientation, age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations. The university also prohibits sexual assault, non-consensual sexual contact, sexual misconduct, intimate partner violence, stalking, malicious dissuasion, retaliation, and violation of interim measures.

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 of Equity and Diversity | Title IX for appropriate investigation, supportive measures, and response.

The Office of Disability Services and Programs - (213) 740-0776
dsp.usc.edu

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Support and Advocacy - (213) 821-4710

uscса.usc.edu

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

Diversity at USC - (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.