**** **Department of Statistical and Actuarial Sciences**

**FM 9528B Banking Analytics**

**1. Course Information**

This course will give students a mixture of knowledge and practice in the use of Python for banking analytics tools, from pricing a bond and calculating credit risk, to advanced deep learning models which will provide tools to tackle sophisticated problems using the latest computational tools. These models will be applied to several business problems within modern financial institutions, covering topics such as credit scoring, LGD and EAD modelling, and advanced models to extract complex non-linear patterns from large amounts of diverse data in topics such as collections, consumer fraud and other applications. The focus will be on the underlying principles, modelling methodologies, and implementation using appropriate software packages.

**Course Information**

Academic Term: Winter 2024/25

Monday, 11.30am – 1.30pm. WSC 248. In-person.

Wednesday 12:30 p.m. – 1:30 p.m. WSC 248. In-person.

**List of Prerequisites**

No courses are required.

**2. Instructor Information**

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| --- | --- | --- | --- | --- |
| **Instructors** | **Email** | **Office** | **Phone** | **Office Hours** |
| Dr. Cristián Bravo  (Course Coordinator) | cbravoro@uwo.ca | WSC 280 | (519) 661-2098 x87565 | Tuesdays 3pm – 4pm |
| TA Team TBD |  |  |  |  |

Students must use their Western (@uwo.ca) email addresses when contacting their instructors. The course will have an active Discord channel for fast communication. Students must use their real name as nicknames, or they will not be accepted/removed from the Discord.

Office hours will be in person unless agreed-to by email.

**3. Course Syllabus, Schedule, Delivery Mode**

The topics covered in this module will include:

* Introduction and overview of banking analytics: CRISP-DM, Analytics problems, designing a data-driven problem-solving strategy in financial institutions.
* Fixed income credit risk: Government bonds, bills, and notes: bond auctions and after-market trading Interest rate conventions (simple, compound, continuous compound), Decomposing bonds into cash flows of coupons. Pricing bonds: day count convention, clean and dirty price. The Yield Curve. The idea of the yield curve and its empirical phenomenology.
* Retail credit risk modelling: Credit Scoring models, LGD and EAD models, basic concepts, working with software, dealing with difficulties.
* Advanced non-linear models: basic principles, ensembles (Random Forest, XGBoosting), data interpretability.
* Introduction to deep learning and alternative data modelling: neural networks, architecture design, advanced models (CNN, LSTM, Large Language Models) and their applications in banking analytics. Use of LLM API and Prompt Engineering.

**Learning Outcomes**

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| --- | --- |
| Bullseye | Having successfully completed the course, you will be able to demonstrate knowledge and understanding of:  A1. The Basic principles of data science in Banking: CRISP-DM and the definition of analytics  A2. The Underlying theory of predictive modelling  A3. Solutions and technologies specifically designed for handling and extracting patterns from big data |

Having successfully completed this course, you will be able to:

B1. Work with relevant software packages to develop banking analytics solutions

B2. Handle various types of data sources

B3. Work with current software packages to create models using complex data sources.

**Table of Contents and Schedule**

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| --- | --- | --- |
| **Week** | **Week Starting** | **Lecture** |
| 1 | Jan 06 | Intro to Banking Regulation |
| 2 | Jan 13 | Bonds and credit instruments |
| 3 | Jan 20 | The yield curve |
| 4 | Jan 27 | Provisions and capital requirements |
| 5 | Feb 03 | Credit scoring and GLM applied in banking I |
| 6 | Feb 10 | Credit scoring and GLM applied in banking II |
| 7 | Feb 17 | Reading Week. No lectures or activities. |
| 8 | Feb 24 | Midterm |
| 9 | Mar 03 | LGD and EAD models –Ensembles I |
| 10 | Mar 10 | LGD and EAD models –Ensembles II |
| 11 | Mar 17 | Model interpretation and transparency |
| 12 | Mar 24 | Introduction to deep learning |
| 13 | Mar 31 | Large Language Models |

Classes begin: January 6, 2025

Spring Reading Week: February 15 – 23, 2025

Classes end: April 4, 2025

Exam period: April 7 – 30, 2025

**4. Course Materials**

The course incorporates multiple sources, publications, and books that can be used as reference.

**Core:**

Kelliher, C. (2022). Quantitative Finance with Python: A Practical Guide to Investment Management, Trading, and Financial Engineering. O’Reilly. Chapters 13 and 14 (up to 14.3). Chapters 1 and 2 recommended if you do not have a background in Finance. [Weeks 1-3] USD $118 ebook. Available at <https://www.routledge.com/Quantitative-Finance-with-Python-A-Practical-Guide-to-Investment-Management-Trading-and-Financial-Engineering/Kelliher/p/book/9781032014432> old editions and second hand copies are allowed]. There is a GitHub for the book that can serve as reference as well <https://github.com/lingyixu/Quant-Finance-With-Python-Code>.

Siddiqi, N. (2017) Intelligent Credit Scoring: Building and Implementing Better Credit Risk Scorecards, Second Edition. Wiley. (Week 4-6) [**Freely available using** Western’s credentials at <https://onlinelibrary-wiley-com.proxy1.lib.uwo.ca/doi/book/10.1002/9781119282396>].

Hastie, Tibshirani and Friedman (2017). The Elements of Statistical Learning. Springer. [**Available for Free Online at** [**https://web.stanford.edu/~hastie/ElemStatLearn/**](https://web.stanford.edu/~hastie/ElemStatLearn/) or with a Western account at <https://link.springer.com/book/10.1007/978-0-387-84858-7>]. Only some chapters are relevant to the course. They will be posted on OWL in each week’s description. (Weeks 4 – 9)

Verbeke, W., Baesens, B. and Bravo, C. (2017) Profit Driven Business Analytics. Wiley and Sons. Chapter 5 (Week 6 and 8). [**Freely available** using Western’s Credentials at <https://onlinelibrary-wiley-com.proxy1.lib.uwo.ca/doi/book/10.1002/9781119443179>]

**Additional Reading**

Goodfellow, I., Bengio, Y. and Courville, A. (2017) Deep Learning. MIT Press. [Freely available online at <http://www.deeplearningbook.org/>]

Thomas, L.C., Crook J.N. and Edelman. (2017) Credit Scoring and Its Applications, 2nd Edition. Philadelphia, PA, USA: SIAM Press. [Not mandatory, $98.10 at

<https://epubs.siam.org/doi/book/10.1137/1.9781611974560>]. Useful for weeks 4 -6.

Students are responsible for checking the course OWL site (http://owl.uwo.ca) on a regular basis for news and updates. This is the primary method by which information will be disseminated to all students in the class.

All course material will be posted to OWL: http://owl.uwo.ca.

If students need assistance with the course OWL site, they can seek support on the OWL Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

[Google Chrome](https://www.google.ca/chrome/?brand=CHBD&gclid=CjwKCAjwxLH3BRApEiwAqX9arfg8JaH6fWGASk9bHTkfW_dyBir93A1-TliP-7u1Kguf-WZsoGAPhBoC9NYQAvD_BwE&gclsrc=aw.ds) or [Mozilla Firefox](https://www.mozilla.org/en-CA/) are the preferred browsers to optimally use OWL; update your browsers frequently. Students interested in evaluating their internet speed, please click [here.](https://www.google.com/search?q=internet+speed+test+google&rlz=1C5CHFA_enCA702CA702&oq=internet+speed+test+google&aqs=chrome..69i57j0l7.3608j0j4&sourceid=chrome&ie=UTF-8)

While self-installation of the software in your own computer is possible, there is also the possibility of using online platforms. Two are available:

* Google Colab: <https://colab.research.google.com>
* Kaggle Kernels: <https://www.kaggle.com/code>

**Technical Requirements**

This is a mostly code-based course so a laptop with internet connection is required. If making your own local installation, a computer with a sufficiently powerful processor (at least two cores @2.2 GHz) with at least 8GB of RAM are recommended. If this were not available, we recommend using an online environment.

**5. Methods of Evaluation**

**Grading Scheme and Assessment Dates**

The overall course grade will be calculated as listed below:

Midterm Test 25%

Term Projects 40%

Final Exam 35%

* The midterm is **a closed-book test** with multiple choice and/or written problems. It will include up to week 7. It will occur in the second slot of the class, after reading week. It will be on the 2-hour lecture on Monday, after reading week.
* The exam is **a closed-book test** that covers all topics of the semester following the same structure as the midterm. Date TBC.
* There are two group term projects (worth 30% and 70% of the project mark) that will challenge teams of 4 students maximum to develop a compliant credit risk system and LGD models using real data. The first project deadline is **February 14th, 2025**. The second one is **April 4th, 2025**. There is a 10-point deduction per day late, starting at 5:05pm the day of the deadline.

**General information about missed coursework**

You must provide valid documentation for medical-related absences or adequate supporting documentation for non-medical absences to the instructor as soon as possible and no later than 48 hours after the missed assessment.

Documentation for medical illness must include the completion of a Western Student Medical Certificate (SMC) or, where that is not possible, equivalent documentation, by a health care practitioner.

For other types of absences, proper documentation must be provided. The instructor may request additional documentation if necessary.

**Evaluation Scheme for Missed Assessments**

**Exam and/or Midterm**: When a student misses the Final Exam and their Academic Consideration has been granted, they will be allowed to write the Special Examination (the name given by the University to a makeup Final Exam). See the Academic Calendar for details (under [Special Examinations](https://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=5&SelectedCalendar=Live&ArchiveID=#SubHeading_70)), especially for those who miss multiple final exams within one examination period. This Special Examination **will test** **all topics of the semester, independently if the exam or midterm was missed**. The mark in this examination will replace the mark of the missed assignment(s).

**Term Courseworks:** If the deadline for the coursework is missed using Academic Considerations, a one-week extension will be provided. No further extensions will be allowed.

**TO PASS THE COURSE, A 60% MARK IS NECESSARY IN THE WRITTEN PART OF THE COURSE (5/12 \* MIDTERM + 7/12 \* EXAM).**

**6. Additional Statements**

**Religious Accommodation**

When conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request an accommodation for their absence in writing to the course instructor and/or the Academic Advising office of their Faculty of Registration. This notice should be made as early as possible but not later than two weeks prior to the writing or the examination (or one week prior to the writing of the test).

Please visit the Diversity Calendars posted on our university’s EDID website for the recognized religious holidays:

[https://www.edi.uwo.ca](https://www.edi.uwo.ca/).

**Accommodation Policies**

Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at:

[https://www.uwo.ca/univsec/pdf/academic\_policies/appeals/Academic Accommodation\_disabilities.pdf](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic%20Accommodation_disabilities.pdf).

**Academic Policies**

The website for Registrar Services is <https://www.registrar.uwo.ca/>.

In accordance with policy,

<https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf>,

the centrally administered e-mail account provided to students will be considered the individual’s official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at their official university address is attended to in a timely manner.

**No electronic devices will be allowed in the exam, midterm, and special examination. If a student is found using an electronic device, it will be considered a Scholastic Offence (see below).**

**Scholastic offences** are taken seriously, and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

<https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf>.

All required papers (homework, exams, term project, midterm, etc.) may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com ([http://www.turnitin.com](http://www.turnitin.com/)).

Computer-marked multiple-choice tests and exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating.

**Only in case of health lockdowns**, tests and examinations in this course will be conducted using a remote proctoring service. By taking this course, you are consenting to the use of this software and acknowledge that you will be required to provide **personal information** (including some biometric data) and the session will be **recorded**. Completion of this course will require you to have a reliable internet connection and a device that meets the technical requirements for this service. More information about this remote proctoring service, including technical requirements, is available on Western’s Remote Proctoring website at:

[https://remoteproctoring.uwo.ca](https://remoteproctoring.uwo.ca/).

**All lectures will be recorded and made available at the course’s OWL site. Please note your voice may be recorded when attending lectures.**

**Support Services**

Please visit the Science & Basic Medical Sciences Academic Advising webpage for information on adding/dropping courses, academic considerations for absences, appeals, exam conflicts, and many other academic-related matters: <https://www.uwo.ca/sci/counselling/>.

Students who are in emotional/mental distress should refer to Mental Health@Western (<https://uwo.ca/health/>) for a complete list of options about how to obtain help.

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts at

<https://www.uwo.ca/health/student_support/survivor_support/get-help.html>.

To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Accessible Education at

<http://academicsupport.uwo.ca/accessible_education/index.html>

if you have any questions regarding accommodations.

Learning-skills counsellors at Learning Development and Success ([https://learning.uwo.ca](https://learning.uwo.ca/)) are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Western University is committed to a thriving campus as we deliver our courses in the mixed model of both virtual and face-to-face formats. We encourage you to check out the Digital Student Experience website to manage your academics and well-being: <https://www.uwo.ca/se/digital/>.

Additional student-run support services are offered by the USC,  <https://westernusc.ca/services/>.