**ORIGINAL COURSE IMPLEMENTATION DATE:** January 2006
**REVISED COURSE IMPLEMENTATION DATE:** September 2021
**COURSE TO BE REVIEWED** (six years after UEC approval)**:** November 2025
Course outline form version: 05/18/2018

# OFFICIAL UNDERGRADUATE COURSE OUTLINE FORM

**Note: The University reserves the right to amend course outlines as needed without notice.**

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| **Course Code and Number:** STAT 430 | **Number of Credits:** 3 Course credit policy (105) |

**Course Full Title:** Time Series and Forecasting
**Course Short Title:**
*(Transcripts only display 30 characters. Departments may recommend a short title if one is needed. If left blank, one will be assigned.)*

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| **Faculty:** Faculty of Science | **Department (or program if no department):** Mathematics & Statistics |

**Calendar Description:**

Introduces the basic ideas of time series analysis and forecasting methods. Topics include stationarity, autocovariance, autocorrelation and partial autocorrelation functions, and the Box-Jenkins classical models. Focuses on the practical implementation of the methods and analysis of real-life time series data using statistical software.

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| **Prerequisites (or NONE):** | STAT 315 or STAT 271. |
| **Corequisites (if applicable, or NONE):** | |
| **Pre/corequisites (if applicable, or NONE):** | |

**Antirequisite Courses** *(Cannot be taken for additional credit.)*
Former course code/number: **MATH 390, MATH 430**
Cross-listed with:
Dual-listed with:
Equivalent course(s):
*(If offered in the previous five years, antirequisite course(s) will be included in the calendar description as a note that students with credit for the antirequisite course(s) cannot take this course for further credit.)*

**Typical Structure of Instructional Hours**

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| Lecture/seminar hours | |
| Tutorials/workshops | |
| Supervised laboratory hours | 50 |
| Experiential (field experience, practicum, internship, etc.) | |
| Supervised online activities | |
| Other contact hours: | |
| **Total hours** | **50** |

Labs to be scheduled independent of lecture hours: ☒ No ☐ Yes

**Special Topics** *(Double-click on boxes to select.)*
This course is offered with different topics:
☒ No ☐ Yes *(If yes, topic will be recorded when offered.)*

**Independent Study**
If offered as an Independent Study course, this course may be repeated for further credit: *(If yes, topic will be recorded.)*
☒ No ☐ Yes, repeat(s) ☐ Yes, no limit

**Transfer Credit**
Transfer credit already exists: *(See **bctransferguide.ca**.)*
☒ No ☐ Yes
Submit outline for (re)articulation:
☒ No ☐ Yes *(If yes, fill in transfer credit form.)*

**Grading System**
☒ Letter Grades ☐ Credit/No Credit

**Maximum enrolment (for information only):** 36

**Expected Frequency of Course Offerings:**
Every two years

| | | |
|---|---|---|
| **Department / Program Head or Director:** Ian Affleck | **Date approved:** | June 15, 2020 |
| **Faculty Council approval** | **Date approved:** | September 11, 2020 |
| **Dean/Associate VP:** Lucy Lee | **Date approved:** | September 11, 2020 |
| **Campus-Wide Consultation (CWC)** | **Date of posting:** | n/a |
| **Undergraduate Education Committee (UEC) approval** | **Date of meeting:** | January 29, 2021 |

**Learning Outcomes:**

Upon successful completion of this course, students will be able to:

1. Show whether a time series is stationary or not.
2. Calculate the autocovariance, autocorrelation and partial autocorrelation functions of an ARMA process.
3. Determine the conditions for the causality and invertibility of an ARMA process.
4. Forecast the future values or estimate a missing value of a given time series based on the criterion of minimum mean squared error.
5. Establish the Yule-Walker equation and find the estimates of the parameters.
6. Use computer software to fit an ARIMA model to a given time series using the AICC criterion, with diagnostic checking and tests for randomness of the residuals.
7. Construct appropriate ARIMA models for non-stationary time series.
8. Formulate and forecast seasonal ARIMA models.

**Prior Learning Assessment and Recognition (PLAR)**

☒ Yes ☐ No, PLAR cannot be awarded for this course because

**Typical Instructional Methods** *(Guest lecturers, presentations, online instruction, field trips, etc.; may vary at department's discretion.)*

Lectures and computer labs using appropriate computer software, e.g., SAS Time Series Studio, MINITAB and spreadsheets.

**NOTE: The following sections may vary by instructor. Please see course syllabus available from the instructor.**

**Typical Text(s) and Resource Materials** *(If more space is required, download Supplemental Texts and Resource Materials form.)*

| | Author (surname, initials) | Title (article, book, journal, etc.) | Current ed. | Publisher | Year |
|---|---|---|---|---|---|
| **1.** | Brockwell, P.J. and Davis, R.A. | Introduction to Time Series and Forecasting. Third edition. | ☐ | Springer | 2016 |
| **2.** | Box, G.E.P. et al. | Time Series Analysis, Forecasting and Control. Fifth edition. | ☐ | Wiley | 2015 |
| **3.** | | | ☐ | | |

**Required Additional Supplies and Materials** *(Software, hardware, tools, specialized clothing, etc.)*

**Typical Evaluation Methods and Weighting**

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|---|---|---|---|---|---|---|---|
| Final exam: | 40% | Assignments: | 20% | Field experience: | % | Portfolio: | % |
| Midterm exam: | 20% | Project: | 20% | Practicum: | % | Other: | % |
| Quizzes/tests: | % | Lab work: | % | Shop work: | % | Total: | 100% |

**Details (if necessary):**

The above percentages may vary among instructors and years. The final exam is comprehensive. Students must achieve at least 40% on the final exam in order to pass this course.

**Typical Course Content and Topics**

First notions: methods of forecasting, differencing, regression, moving averages, Fourier methods, trend, seasonality, classical decomposition model.

Stationary processes: covariance, weakly stationary, strictly stationary, basic properties, white noise, moving-average MA(q) processes, auto-regressive AR(p) processes, linear processes, sample covariance matrix, Bartlett's formula.

ARMA models: auto-regressive moving-average ARMA(p,q) processes, calculations of the autocovariance function, autocorrelation function and partial autocorrelation function, causality, invertibility.

Minimum mean squared error forecasts: the best linear predictor, n-step prediction, prediction of second-order random variables, estimation of a missing value.

Modeling and foresting with ARMA processes: Yule-Walker estimation, Burg's algorithm, innovations algorithm, Hannan-Rissanen algorithm, maximum likelihood estimation, diagnostic checking, tests for randomness of the residuals, forecasting, order selection, FPE criterion, AICC criterion.

Non-stationary and seasonal time series models: auto-regressive integrated moving average ARIMA(p,d,q) models for non-stationary time series, identification techniques, Box-Cox transformation, unit roots in autoregressions, unit roots in moving averages, the forecast function, seasonal ARIMA models, regression with ARMA errors.

Holt-Winter's seasonal and ARIMA forecasting.