Informator	**2019/2020**
Tytuł oferty	# Advanced Optimization (QEM)
Sygnatura	**221941 - 0999** **7 pkt. ECTS**
Prowadzący	**dr hab., prof. SGH Jakub Marek Growiec oraz zespół: dr Grzegorz Ryszard Koloch**

A. Cel przedmiotu

The goal of this course is to present the key optimization techniques used in modern theoretical economics. The course provides the students with both theoretical and practical aspects of the techniques, from general theorems on existence and uniqueness of extrema in certain important classes of problems, to applications of Lagrange, Karush-Kuhn-Tucker, and dynamic programming methods in typical economic problems. The course comprises both lectures and problem sessions. Students are required to be familiar with advanced calculus of real variables.

B. Program przedmiotu

The course presents the key optimization techniques used in modern theoretical economics, such as the Karush-Kuhn-Tucker method used to find extrema of constrained static problems or dynamic programming used to find optimal time paths of variables in a dynamic setup. The course provides the students with both theoretical and practical aspects of the techniques.

C. Szczegółowe przedmiotowe efekty kształcenia

Wiedza	The applications of calculus and static optimization methods in theoretical economic models (both in micro- and macroeconomics). Foundations of dynamic programming. Techniques of solving and analyzing dynamic programming problems. Theorems on existence and uniqueness of constrained extrema in selected static and dynamic problems.
Umiejętności	Be fluent in using calculus and static optimization methods in economic modeling. Be able to solve and analyze simple dynamic programming problems. Be able to verify assumptions and apply selected theorems on existence and uniqueness of constrained extrema in selected static and dynamic problems.
Kompetencje społeczne	Ability to read (with comprehension) research papers including mathematical models with optimizing agents. Understanding of the concept of an intertemporal trade-off.

D. Semestralny plan zajęć

1	Overview of key optimization techniques and their applications in economics. Static vs. dynamic optimization. Finite vs. infinite planning horizon.
2	Convexity: convex sets, convex cones, convex functions.
3	Topology in Euclidean spaces: norm, distance, continuity, compactness, openness, closedness, boundedness. Heine-Borel theorem. Level curves.
4	Unconstrained optimization. Existence results (Weierstrass theorem, coercivity). First-order and second-order conditions.
5	Constrained optimization with equality constraints. Lagrange multipliers. First-order and second-order conditions. Geometric interpretation.
6	Constrained optimization with inequality constraints. Karush-Kuhn-Tucker. Geometric interpretation.
7	Infinite dimensional normed and metric spaces. Norms and distances in sequence and function spaces. Pointwise and uniform convergence.
8	Compactness in infinite dimensional spaces. Complete spaces. Banach spaces.
9	Banach fixed point theorem. Blackwell theorem.
10	Dynamic programming with a finite planning horizon. Framework: control and state variables, value function, policy function. Bellman equation. Time separability, time consistency.
11	Solving dynamic optimization problems with backward induction.
12	Dynamic programming with an infinite planning horizon. Euler equation. Transversality conditions.
13	Steady state. Dynamics around the steady state. Stability.
14	Correspondences. Upper and lower hemi-continuity. Berge theorem.
15	Economic applications. Detailed elaboration of the Ramsey growth model and the optimal resource extraction model.

E. Literatura podstawowa (obowiązkowe podręczniki)

1. A. de la Fuente (2000), "Mathematical Methods and Models for Economists", Cambridge University Press; 2. Course materials distributed in class

F. Literatura uzupełniająca

1. K.Sydseater, P.Hammond, A.Seierstad, A.Strom, Further mathematics for economic analysis, Prentice Hall, 2008; 2. W.H.Fleming, R.W.Rishel, Deterministic and stochastic optimal control, Springer, 1975.

G. Najważniejsze publikacje autora(ów) dotyczące proponowanych zajęć

1. Growiec, J. "Factor-Specific Technology Choice" (2018), Journal of Mathematical Economics 77, pp. 1-14; 2. Growiec, J., P. McAdam, J. Mućk "Endogenous Labor Share Cycles: Theory and Evidence" (2018), Journal of Economic Dynamics and Control 87, pp. 74-93; 3. Growiec, J. "A Microfoundation for Normalized CES Production Functions with Factor-Augmenting Technical Change" (2013), Journal of Economic Dynamics and Control 37(11), pp. 2336-2350.

H. Sygnatury wymaganych prerekwizytów
nie są wymagane

I. Wymiar i forma zajęć	Stacj.
Ogółem:	60
Wykład	30
Ćwiczenia	30

J. Elementy oceny końcowej	
egzamin tradycyjny-pisemny	40%
kolokwium	30%
inne (Homework and active participation in classes.)	30%

K. Wymagana znajomość języka obcego
angielski

L. Kryteria selekcji
Lista rankingowa

M. Metody prowadzenia zajęć
Wykład Ćwiczenia