

## Advanced Macroeconomics

The course consists of two parts: theoretical (dr Ł. Woźny) and applied (dr Marcin Kolasa) one. The syllabus of each part is presented below.

### Advanced Macroeconomics: Theoretical part

- T1. Introduction to economic methods.** Inductionism, Popper's falsificationism and its critique, Kuhn's paradigms and I. Lakatos, P. Feyerabend anarchism, Friedman's "unimportant" assumptions - instrumentalism, Friedman's "as if", falsificationism in economics, Lucas Critique, Positive and normative economics? Hume's is-ought problem and Ockham's razor.  
**Readings:** Blaug (1995): 1-5 lub Boland (1998).
- T2. Introduction to general equilibrium.** Exchange economy. Feasible and Pareto optimal allocation. Arrow-Debreu competitive equilibrium (ADCE). (Static) production economy and ADCE definition. Discussion on two welfare theorems.  
**Readings:** Varian (1992) 17-19.
- T3. Introduction to dynamic macroeconomic problems. Solow's model.** Stylized facts concerning growth and development (slides). Definitions of dynamic economy (single firm, single household). Assumptions on production function and preferences. Euler theorem. Solow growth model. Capital accumulation path. Definition of steady state, its existence and convergence theorem. Comparative dynamics in savings rate. Dynamic inefficiency. Adding technological progress. Wyznaczenia równania ruchu. Defining balance growth path (BGP), its existence and uniqueness.  
**Readings:** Barro and Sala-i Martin (2004): 1, Parente and Prescott (1993)
- T4. Optimal growth model. Central planners problem.** Writing down optimization problem. Existence, uniqueness, and interiority of solution. Necessary and sufficient conditions for interior solution by Lagrange method. Transversality condition. Steady state for optimal solution vs. optimal steady state (golden rule vs. modified golden rule). Diagram fazowy (wyprowadzenie i rysunek).  
**Readings:** Wickens (2008): 2.1-2.4, 3.1-3.4
- T5. Optimal growth model. Arrow-Debreu competitive equilibrium vs. sequential equilibrium.** Defining ADCE for a dynamic economy. Necessary and sufficient conditions for ADCE. No arbitrage conditions. ADCE in steady state. Defining sequential equilibrium and no-Ponzi game condition. Introducing government and linear taxes. Two methods of using taxes. Necessary and sufficient conditions for ADCE. Tax wedge and non optimality. Methods of analyzing and comparing welfare. Defining economy with elastic labor. Solving central planner problem, defining and characterizing ADCE. Discussing classes of utility functions and BGP existence. Introducing CIES utility function. Model calibration and estimation.  
**Readings:** Wickens (2008): 4
- T6. Endogenous growth.** AK model. Optimal solution. Defining and solving ADCE. BGP, (linear) taxes and role for government. Romer model (small k, large K) with finite number of firms. Optimal and ADCE solution. A role of (linear) taxes. Economies of scale in the aggregate production function and BGP. Romer's model with endogenous R&D. Introduction to models of monopolistic competition and price indexes (finite number of firms). Symmetric equilibrium under monopolistic competition. Endogenous no. of firms. Fixed costs, economies of scale and competitive equilibrium existence. Defining Romer's economy: (R&D sector, intermediary sector (monopolistic competition), final production sector, consumer). Optimal and ADCE solution.  
**Readings:** Wickens (2008): 3.5-3.6, Dixit and Stiglitz (1977), Ljungqvist and Sargent (2005): 14.
- T7. Introduction to recursive methods.** Principle of optimality. Value function for the problem with finite horizon. Limit of a sequence of functions (extending the analysis horizon). Examples. Defining metric space and contraction mapping. Banach theorem (no proof). Writing formally a recursive problem for infinite horizon period. Blackwell's sufficient conditions a contraction mapping (no proof). Studying properties of the value function (continuity, monotonicity, concavity and

differentiability). Benveniste-Scheinkman theorem (no proof). Characterizing optimal solution. Dynamic programming under uncertainty. Problem and discussion.

**Readings:** Stokey, Lucas, and Prescott (1989): 4-5.

T8. **Optimal growth model and recursive competitive equilibrium. Introducing risk and expectations.** Defining recursive competitive equilibrium (RCE) with elastic labor supply. Existence and characterization of a solution. General equilibrium under uncertainty. Exchange economy: defining ADCE and equilibrium with insurance markets, Radner equilibrium. Production under uncertainty. Motivation for using recursive methods. Defining RCE with elastic labor supply under uncertainty.

**Readings:** Stokey, Lucas, and Prescott (1989): 6-10, 15-16, Ljungqvist and Sargent (2005): 7,12, Wickens (2008) 2.5-2.8,9,14, Kydland and Prescott (1982).

T9. **Permanent income hypothesis and rational expectations.** Random income and self-insurance without insurance markets. Defining permanent income hypothesis using constant Lagrange multiplier. Recursive equilibrium under rational expectations. Bellman equation and credit constraints. Discussion and intuition for results.

**Readings:** Ljungqvist and Sargent (2005): 16.

T10. **Search models (labor market).** Defining economy (risk neutrality). Bellman equation and optimal job acceptance strategy. Comparative statics (discount factor and unemployment benefit). Adding job-exit possibility and calculating unemployment rate in the steady state. Extensions: voluntary job exit, endogenous search intensity, on the job-search.

**Readings:** Cahuc and Zylberberg (2004): 3, Ljungqvist and Sargent (2005): 6.

T11. **Overlapping generations model.** Defining exchange economy and its ADCE. Solving for ADCE and example of no Pareto optimality of ADCE allocation. No efficiently and the role of prices. Defining production economy and its ADCE. Solution and its characterization. Implied capital accumulation path. Example: CIES utility and Cobb-Douglas production. Existence and multiplicity of steady states.

**Readings:** Wickens (2008): 6.3, Blanchard and Fischer (1989): 3, Ljungqvist and Sargent (2005): 9.

T12. **Heterogenous agents economies. Incomplete markets and Bewley models.** Heterogenous of households (Hugget, Aiyagari). Defining measure. RCE: definition and examples. Steady states, invariant distributions and their existence. Incomplete markets models: self insurance from stochastic employment. Bellman equation. Existence of invariant distribution. Credit and solvency constraints. Examples and discussion Aiyagari graph.

**Readings:** Huggett (1993), Aiyagari (1994), Hopenhayn (1992), Ljungqvist and Sargent (2005): 17

T13. **Non-convex economies.** Motivating non-convexities. Example from labor market: indivisible labor (Rogerson, Hansen). Defining ADCE. Labor supply under uncertainty. Randomization. Labor market lotteries: definition and characterization. Labor market lotteries with insurance. Summary and discussion of other non-convexities.

**Readings:** Rogerson (1988), Prescott (2003).

## Advanced macroeconomics: Applied part

- S1. **Real business cycle (RBC) model.** Business cycles - stylized facts. Cycle extraction methods: Hodrick-Prescott filter, band-pass filter. Basic RBC model. Calibration. Technological shock. Stochastic solution: moment matching. Centralized vs. decentralized equilibrium. Time-varying capacity utilization. Indivisible labour.  
**Readings:** Wickens (2008): 14, Romer (2005): 4  
**Additional readings:** Hansen (1985), King and Rebelo (2000)
- S2. **Solving dynamic stochastic general equilibrium (DSGE) models.** Difficulties with analytical solution. Log-linear approximation. Solving linear models with rational expectations. Blanchard-Kahn method. Second-order approximation.  
**Readings:** Canova (2007): 2  
**Additional readings:** Uhlig (1999), Blanchard and Kahn (1980)
- S3. **Money and monetary policy in flexible price models.** Money - stylized facts. Cash-in-advance model. Money in the utility model. Shopping time model. Transaction costs. Inflation costs. Friedman rule.  
**Readings:** Wickens (2008): 8  
**Additional readings:** Walsh (2010): 1-3
- S4. **Monopolistic competition. Sticky price business cycle model.** Price stickiness - stylized facts. Microeconomic sources of price stickiness. Dixit-Stiglitz aggregator and individual demand functions. Price setting with monopolistic competition and no price stickiness. Time-dependent price setting - Taylor and Calvo models. State-dependent price setting - menu cost and Rotemberg models. Price dispersion. Basic New Keynesian (NK) model. IS curve. Phillips curve. Monetary policy rule. Demand and supply shocks.  
**Readings:** Wickens (2008): 9, Gali (2008): 3  
**Additional readings:** Taylor (1980), Calvo (1983), Rotemberg (1982), Golosov and Jr. (2007)
- S5. **Price stickiness and optimal monetary policy.** Natural vs. efficient output. Natural interest rate. Monetary policy trade-offs. Taylor rule. Discretion vs. commitment. Utility-based loss function of benevolent central bank. Ad hoc loss functions.  
**Readings:** Wickens (2008): 13, Gali (2008): 4, 5  
**Additional Readings:** Woodford (2003): 6-8; Clarida, Gali, and Gertler (1999)
- S6. **Open economy. International flow of goods and services** Current account, balance of payments and exchange rates - stylized facts. Consumption basket and households' budget constraint in an open economy. Complete vs. incomplete international financial markets. Uncovered interest rate parity. Closing open economy models with incomplete markets.  
**Readings:** Wickens (2008): 7, Barro and Sala-i Martin (2004): 3.3, 3.4  
**Additional readings:** Obstfeld and Rogoff (1996), Schmitt-Grohe and Uribe (2003)
- S7. **Open economy business cycle model.** Basic two-country model. Small open economy. Price setting in an open economy: law of one price and international price discrimination. Price denomination. Tradable vs. nontradable goods. Distribution costs.  
**Readings:** Wickens (2008): 7,9,12  
**Additional readings:** Obstfeld and Rogoff (1996), Walsh (2010): 9
- S8. **Investment.** Rate of return on capital. Capital adjustment costs. Tobin's Q. Asymmetric information and agency problem as a source of financial frictions. External finance premium. Collateral constraint model.  
**Readings:** Romer (2005): 8  
**Additional readings:** Kiyotaki and Moore (1997), Bernanke, Gertler, and Gilchrist (1999)
- S9. **Consumption and financial markets.** Risky assets. Consumption capital asset pricing model (CCAPM). Asset pricing. Equity premium puzzle.  
**Readings:** Wickens (2008): 10-11, Romer (2005): 7  
**Additional readings:** Mehra and Prescott (1985)
- S10. **Practical methods for macroeconomic analysis. Workshop.** Introduction to Matlab/Octave. Solving numerically dynamic programming problems (e.g. shooting, value function iteration). Solving simple linear rational expectation models.

**Readings:** Judd (1998)

**Additional readings:** Atkinson and Han (2009)

**Internet sources:** <http://www.gnu.org/software/octave/>,  
<http://www.mathworks.com/products/matlab/>

S11. **Solving DSGE models. Workshop** Introduction to Dynare for Matlab/Octave. MOD-file structure. Impulse response functions. Stochastic simulations.

**Readings:** Griffoli (2008)

**Internet sources:** <http://www.dynare.org/>,  
<http://www.dynare.org/DynareWiki/DynareOctave>

**To pass the course** you need to collect at least 60 points. The maximum score is 100 points (50p for the exam, 50 points for homework). Those that succeed obtain the grade that is rescaled to the score of the best student.

The **exam** is based on topics and problems discussed during the course and posted on the web pages of the instructors. The **homework** lists (6 in total) will be posted consecutively on the web. It is your responsibility to get it from there. Homework is due in class on the due date. Remember that homework is the most valuable part of the course. Always write correct English with complete sentences. You may talk about the problems with other students, but you must write up your own solutions in your own words.

We welcome questions at any time. Please do not hesitate to ask us during class if there is something that you do not understand or that you want to discuss. (The only exception is a question about the grading of your homework or exam paper. Please ask these questions before or after class, or in office hours.) You may also ask questions in office hours, or any other time that you catch us in our offices. You may also ask questions by email.

**The main textbook** of the course is Wickens (2008). More on economic growth can be found in Acemoglu (2009), OLG models are extensively covered in De la Croix and Michel (2002). For those interested in monetary theory we recommend Walsh (2010), Gali (2008) and Woodford (2003). Suggested reading for topics in international economics is Obstfeld and Rogoff (1996), while for labour economics we recommend Cahuc and Zylberberg (2004).

Alternatively, you can use textbooks presenting macroeconomic theory in continuous time: Barro and Sala-i Martin (2004), Blanchard and Fischer (1989) and Romer (2005). In Chiang (2002) you will find an intuitive introduction to optimization in continuous time.

Recursive methods for economists are covered in Stokey, Lucas, and Prescott (1989). An introduction to numerical methods and their implementation is offered by Canova (2007), Judd (1998), and (more formally) by Atkinson and Han (2009).

**Computer codes** discussed during workshops: Matlab/Octave ([www.gnu.org/software/octave/](http://www.gnu.org/software/octave/), [www.mathworks.com/products/matlab/](http://www.mathworks.com/products/matlab/)) and Dynare ([www.dynare.org/](http://www.dynare.org/)). Please note that this course features no computer classes - you are expected to implement the computer codes yourself at home.

While studying you may find useful to use various scientific paper browsers like e.g.: [econpapers.repec.org](http://econpapers.repec.org), [ideas.repec.org](http://ideas.repec.org) and [scholar.google.com](http://scholar.google.com); article databases, e.g. [www.jstor.org](http://www.jstor.org), [www.sciencedirect.com](http://www.sciencedirect.com) and [www.nber.org](http://www.nber.org). For students trying to write their own papers we recommend H. Varian *How to build an economic model in your spare time*.

We invite all interested in economic theory to participate in **Seminarium Ekonomiczne SGH** ([akson.sgh.waw.pl/se/](http://akson.sgh.waw.pl/se/)).

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