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**Problem Set 13**

# Advanced Macroeconomics

**Winter 2025/26**

## Midterm Exam Review

In this tutorial, we will review the midterm exams. Due to time constraints, we will look at a sample of questions.

## 1 First date

### 1.1 Optimal Consumption in Solow Model

Which statement about optimal consumption in the Solow growth model is correct?

1. There is an optimal consumption that maximizes the capital stock in the long run.
2. There is an optimal savings rate that maximizes the consumption in the long run.
3. There is an optimal consumption that maximizes the output in the long run.
4. None of the answers is correct.

### 1.2 Sensitivity Analysis in Solow Model

Consider the Solow growth model with population growth and technological progress. Which statement is NOT correct?

1. The larger the distance between production function and savings function, the larger the consumption.
2. The larger the growth rate of technological progress, the smaller the steady state capital intensity.
3. The higher the savings rate, the larger steady state consumption.
4. The larger the depreciation rate, the smaller the steady state capital intensity.

## 1.3 Steady State Consumption in Solow Model

Consider the Solow growth model with variables in labor efficiency units with production $y_t = k_t^{0.3}$, population growth rate $n = 0.01$, growth rate of technological progress $a = 0.1$, savings rate $s = 0.1$, and depreciation rate $\delta = 0.02$. What is the steady-state level of consumption per efficient labor? Round solely your final result. In particular, round it to one decimal.

## 1.4 Productivity Shock in Solow Model

Consider the Solow growth model with capital intensity $k_t = 3$ in period $t$ and $k_{t+1} = 3.5$ in period $t + 1$. Production per efficient unit of labor is given as $y_t = Z_t k_t^{\alpha}$, where $\alpha = 0.3$, and total factor productivity $Z_t = 1$ in normal times. What is the percentage growth rate of output in period $t+1$, if there happens a positive productivity shock in period $t+1$ of a size of 5 percent? Round the result to a whole number.

## 1.5 Solving Dynamic Stochastic General Equilibrium Models

Which statement about solving Dynamic Stochastic General Equilibrium (DSGE) models in Dynare is correct?

1. A DSGE model is simulated using the perfect foresight solver.
2. Dynare is not able to linearize non-linear models.
3. In general, it is assumed that expectations are rational.
4. No statement is correct.

## 1.6 Intertemporal Consumption Decision

Consider a dynamic model with intertemporal consumption decision described by the Euler equation

$$u'(c_t) = \beta E_t(1 + r_{t+1})u'(c_{t+1}).$$

Which statement is correct?

1. The larger the discount rate $\beta$, the smaller present consumption $c_t$.
2. The larger the discount rate $\beta$, the smaller future consumption $c_{t+1}$ and present consumption $c_t$.
3. The larger the expected interest rate $r_{t+1}$, the larger present consumption $c_t$.
4. None of the answers is correct.

## 1.7 Code Analysis 4

The figure shows a snipped from a Dynare file. After running it, Laurel and Hardy are discussing, because they the are not sure about the output they are getting. What would you tell them?

```
// 1. Block: Definition of Variables and Parameters
// Endogenous variables:
var k c y i;
// Exogenous variables:
varexo Z;
// Parameters
parameters alpha, rho, delta, theta, a, n;
alpha = 0.3;
rho = 0.01;
theta = 1;
delta = 0.02;
a = 0.01;
n = 0;

// 2. Model Block
model;
// Consumption Euler Equation:
(c(+1)/c) = (((1+alpha*Z*k^(alpha-1)-delta)/(1+rho))^(1/theta))/(1+a);
// Modified Capital Accumulation Equation:
k = (Z*k(-1)^alpha + (1-delta)*k(-1) - c)/(1+n)/(1+a);
// Production Function:
y = Z*k(-1)^alpha;
// Definition of Investment:
i = y - c;
end;

// Initialization Block
initval;
k = 10;
c = 2;
y = 5;
i = 1;
Z = 1;
end;

// Compute Steady State:
steady;

// check;

// Specify temporary productivity shock
shocks;
var Z;
periods 1:1;
values 1.1;
end;

perfect_foresight_setup(periods=300);
perfect_foresight_solver;

send_endogenous_variables_to_workspace;
```

1. Dynare will only produce time series of the endogenous variables if they add the command `send_endogenous_variables_to_workspace`.
2. The last elements of the resulting time series will be the same steady state values of the variables as before the shock.
3. The values in the block `initval` will be the steady state values of all variables.
4. The command `send_endogenous_variables_to_workspace` will save time series of the endogenous variables as percentage deviation from their steady state.

### 1.8 Insights from RBC Models

Which insights can you take from the basic real business cycle (RBC) model?

1. RBC models show insights into the development of inflation after cost-push shocks.
2. RBC models explain long-run growth as result of aggregate fluctuations.
3. In RBC models, business cycle fluctuations are efficient adjustments to productivity shocks.
4. RBC models allow for analysis with market imperfections and frictions.

## 2 Second date

### 2.1 Growth Rate of GDP

Given national accounts data from Eurostat, calculate the percentage growth rate of nominal GDP in Germany from 2023 to 2024. Round your result to one decimal.

| year | nominal GDP (million Euros) |
|---|---|
| 2023 | 4,219,310 |
| 2024 | 4,328,970 |

### 2.2 Capital Accumulation in Solow Model

Consider the Solow growth model in period $t$ with capital intensity $k_t = 3$ and investments per efficiency unit $i_t = 0.2$. What is the percentage growth rate of capital intensity in period $t + 1$, if the depreciation rate is given as $\delta = 0.02$, the rate of population growth as $n = 0.01$, and the rate of technological progress as $a = 0.02$? Round the result to a whole number.

### 2.3 Steady State Investment in Solow Model

Consider the Solow growth model with variables in efficiency units with production $y_t = k_t^{0.3}$, population growth rate $n = 0.02$, growth rate of technological progress $a = 0.1$, savings rate $s = 0.2$, and depreciation rate $\delta = 0.02$ on capital stock. What is the level of investment per efficient unit of labor? Round solely your final result. In particular, round it to one decimal.

### 2.4 Factor Input Price

Consider a dynamic equilibrium model with real wage given as $w = ZF'(N)$, where $Z$ is the total factor productivity, $N$ is labor input, and $F(N)$ the production function. Which statement is NOT correct?

1. This equation shows price setting under perfect competition.

2. This equation shows that the real wage would increase ceteris paribus in case of a positive productivity shock.
3. With $F(N) = ZN^{\alpha}$, the equation would be $w = \alpha Z N^{\alpha-1}$.
4. The firm pays the increasing marginal product of labor as wage.

## 2.5 Intertemporal Budget Constraint

Consider a two-period model with the budget constraint

$$w_1 n_1 - c_1 = a_2$$

in the first period and

$$c_2 = (1+r)a_2 + w_2 n_2$$

in the second period. Which equation describes the intertemporal budget constraint?

1. $c_1 + c_2(1+r)^{-1} = w_1 n_1 + w_2 n_2 (1+r)^{-1}$
2. $c_1 + c_2(1+r) = w_1 n_1 + w_2 n_2 (1+r)$
3. $c_1(1+r)^{-1} + c_2 = w_1 n_1 (1+r)^{-1} + w_2 n_2$
4. $c_1(1+r) + c_2(1+r)^{-1} = w_1 n_1 + w_2 n_2$