# Final Exam
# ECON 4310, Fall 2022

1. Do **not write with pencil**, please use a ball-pen instead.
2. Please answer in **English**. Solutions without traceable outlines, as well as those with unreadable outlines **do not earn points**.
3. Please start a **new page** for **every** short question and for every subquestion of the long questions.

Good Luck!

| | Points | Max |
|---|---|---|
| **Exercise A** | | **100** |
| **Exercise B** | | **100** |
| **Σ** | | **200** |

**Grade: _____**

## Exercise A:

**Ramsey Growth Model (100 points)**

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Consider a consumer who lives for only two periods denoted by $t = 1, 2$. The consumer is born in period 1 without any financial assets. The consumer's labor income is $w_t \geq 0$ in each of the two periods and her preferences over consumption can be represented by the utility function

$$U(c_1, c_2) = u(c_1) + \beta u(c_2), \tag{1}$$

where the momentary utility function is given by

$$u(c) = \log(c)$$

The consumer can borrow and lend consumption across periods at the given real interest rate, $r$.

(a) Write down the consumer's net present value budget constraint, and find the optimal consumption and savings over the life-cycle.

(b) Write down the Lagrangean for the consumer problem (not using the present value budget constraint). Derive the optimality condition and compare to the solution in a)

(c) Derive and discuss the effect of an increase in the gross real interest rate $1 + r$

(d) Assume that $w_1 = w_2$, $\beta = 1$ , $r = 0$. Derive $c_1$ and $c_2$.

(e) Assume that $w_2 = 2 * w_1$, $w_1 = 10$, $\beta = 1$ , $r = 0$. Derive $c_1$ and $c_2$.

(e) Assume that $w_2 = 2 * w_1$, $w_1 = 10$, $\beta = 1$ , $1 + r = 2$. Derive $c_1$ and $c_2$.

## Exercise B:

**Solow Model and climate change (100 points)**

Consider a closed economy with a neoclassical production function, exogenous technological progress, $A_t$, a fixed saving rate, $s$, and a constant labor force, $L$, as described by the following equations (the Solow model):

$$K_{t+1} - K_t = sY_t - \delta K_t \tag{2}$$

$$Y_t = K_t^{\alpha}(A_t L)^{1-\alpha},\ 0 < \alpha < 1, \tag{3}$$

$$A_{t+1} = (1+g)A_t,\ A_0 > 0,$$

where $0 \leq \delta \leq 1$ is the depreciation rate of physical capital

(a) Solve for the steady state capital per efficiency unit labor in this economy.

(b) What is the competitive wage paid to each worker in the steady state? What is the rental rate of capital in the steady state?

(c) Explain what is meant by the Golden Rule savings rate. Find $s_{GR}$ and state the capital per efficiency unit labor that it implies, $k_{GR}$.

(d) A large tropical cyclone hits the steady state economy, destroying a significant portion of installed capital at $t = 0$. What are the impacts on output, the wage and rental rate, and the savings rate in that period? Explain.

(e) After the storm has passed, what is the rate of change of the capital per efficiency unit? That is, find $\frac{k_t+1}{k_t}$. Show that capital is accumulating, i.e. that $\frac{k_t+1}{k_t} > 1$.

(f) Now suppose that the same economy (in its original steady state) is hit by a similar tropical cyclone, but also, at the same time, the world has learned that global warming implies a permanent increase in the depreciation rate of physical capital, $\delta_{CC} > \delta$. What does the new depreciation rate imply for long-run capital per efficiency unit, wage, rental rate, and consumption? Comment on the Golden Rule savings rate, $s_{GR}$, under the new climate-change-induced depreciation rate.

(g) After the cyclone, the stricken economy observes that even though much of their installed capital was destroyed, capital per efficiency unit continues to fall rather than accumulate. Explain why this is happening.