

ECON 102 - Winter 2016
Instructor: François Geerolf

Last Name: _____

First Name: _____

Student ID (UID): _____

Midterm 1
January 27, 2016

Signature: _____

Test A

This exam contains 11 pages (including this cover page). The time limit is 75 minutes. You can earn 100 points.

Instructions:

1. Print your Last name, First Name, Student ID Number and Signature at the top right-hand corner of this page.
2. The only items that should be on your desk are pencils and/or pens, and the calculator **Canon LS-100TS**, described in the syllabus. NO other items are allowed. Place any other item ON THE STAGE.
3. Once the exam begins, you are not allowed to leave the room until you hand in your exam.

Good luck. Budget your time wisely. (skip the question or even the exercise if you get stuck)

Grade Table (FOR TEACHER USE ONLY)

Question	Points	Score
1	20	
2	10	
3	20	
4	20	
5	15	
6	15	
Total:	100	

1 Multiple Choice and Short Answers (20 points)

1. (20 points) These are **multiple choice** questions. Multiple responses may be correct. You get either 0 or 2 points.
- (a) (2 points) In the Solow model, the level of GDP per capita is:
- A parameter.
 - An exogenous variable.
 - An endogenous variable.
 - Constant always.
 - Constant in the long run.
- (b) (2 points) What was per capita GDP growth in the United States over 1870-2012?
- 1%
 - 2%
 - 3%
 - 4%
 - 5%
- (c) (2 points) What was GDP growth in the United States over 1870-2012?
- 1.5%
 - 2.5%
 - 3.5%
 - 4.5%
 - 5.5%
- (d) (2 points) What are the three different approaches for measuring GDP?
- The production approach.
 - The nominal approach.
 - The expenditure approach.
 - The profit approach.
 - The income approach.
- (e) (2 points) In the Solow model, if we assume that capital depreciation rates are the same across all countries, differences in per capita output can be explained by:
- the steady state capital stock.
 - the initial capital stock and saving rates.
 - differences in productivity and saving rates.
 - the labor stock and saving rates.
 - None of these answers are correct.

- (f) (2 points) An implication of the Solow model is that once an economy reaches the steady state:
- per capita consumption is constant.
 - per capita output is constant, but per capita capital is not
 - per capita capital is variable
 - per capita consumption continues to grow
 - per capita consumption is growing.
- (g) (2 points) In the Solow model, if productivity of country A is about three times as large as the productivity in country B, and the savings rate of country A is about twice as large as the savings rate in country B then in the steady state output of country A is approximately:
- 6 times as large as in country B.
 - 2 times as large as in country B.
 - 5 times as large as in country B.
 - 7 times as large as in country B.
 - 9 times as large as in country B.

Assume that production is given by the following production function: $Y_t = A_t K_t^a L_t^b$, and that $A_t = \bar{A}$. Give **short answers**, you won't be penalized if you do not write sentences.

- (h) (1 point) What is the name of this production function?

- (i) (1 point) What is the relationship between a and b in this production function, if returns to scale are constant? (with respect to capital and labor)

- (j) (2 points) Why do macroeconomists use this production function, a power function of the quantity of capital and the quantity of labor? What statistical regularity makes them confident to use this function?

- (k) (1 point) What are a and b equal to typically?

- (l) (1 point) Why are they equal to these numbers?

3 Consumption Maximizing Savings Rate in the Solow Model (20 points)

3. (20 points) Consider the following Solow model. Assume that output Y_t is produced using capital K_t and labor L_t according to the following production function: $Y_t = \bar{A}K_t^{1/5}L_t^{4/5}$. (beware of the exponents !) The amount of labor is fixed $L_t = \bar{L}$, and a fraction of \bar{s} of output is saved by agents in this economy, so that investment is $I_t = \bar{s}Y_t$. Capital depreciates every period at a rate \bar{d} .

(a) (4 points) Write the law of motion for capital. (that is, K_{t+1} as a function of K_t) Solve for the steady state value of capital K^* , and the steady state value of Y^* , in this economy.

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(b) (4 points) Comment the dependence of Y^* with \bar{A} . Compare with the production model. Why is there a difference?

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(c) (4 points) Imagine that the government can enact policies aimed at targeting people's savings rate \bar{s} . Which savings rate would maximize steady-state production ?

4 Solow Model with Land (20 points)

4. (20 points) We consider an economy with the following production function: $Y_t = \bar{A}K_t^{1/3}L_t^{2/3}N_t$, where the amount of land N_t is also entering as an input in the production function. (firms need land to produce, for example because they need offices) Assume that the number of people working is fixed and given by: \bar{L} . Capital depreciates at rate \bar{d} , and the savings rate is constant equal to \bar{s} . It is also assumed that there is a fixed quantity of land in the economy given by \bar{N} .

(a) (4 points) Express K_{t+1} as a function of as a function of Y_t and K_t .

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(b) (6 points) Replace Y_t in the previous expression, to derive the law of motion for the capital stock, where only the capital stock and exogenous variables appear.

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(c) (5 points) What is the marginal product of land?

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(d) (5 points) Imagine the economy starts with an initially too low level of capital (relative to the steady state level). How does the marginal product of land varies over time? Why?

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5 Some Numbers (15 points)

5. (15 points) On Table 1 below you may find some time series for US GDP, as well as for US CPI (indice) and US Population.

(a) (1 point) What does GDP stand for? (that is, what do the initials mean?)

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(b) (1 point) What does CPI stand for? (that is, what do the initials mean?)

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(c) (1 point) In which unit is US GDP expressed on Table 1?

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(d) (1 point) In which unit is US Population expressed on Table 1?

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(e) (1 point) What is US GDP per capita in 2014?

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(f) (1 point) What was average annual US inflation during the period 1973-1975 ?

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(g) (1 point) What was average annual US inflation during the period 2009-2011?

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(h) (1 point) What was average GDP growth during the period 1973-1975 ?

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(i) (1 point) What was average GDP growth during the period 2009-2011?

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(j) (2 points) What was average annual Real Per Capita GDP growth during the period 1973-1975 ?

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(k) (2 points) What was average annual Real Per Capita GDP growth during the period 2009-2011 ?

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(l) (2 points) Your mother tells you she was earning \$10000 annually when she first started working in 1980. How much is this in 2014 dollars?

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Table 1: TIME SERIES OF US GDP, US CPI (INDICE), US POPULATION

year	US GDP	US CPI (indice)	US Population
1962	605.10	30.25	186,475.00
1963	638.60	30.63	189,189.00
1964	685.80	31.04	191,820.00
1965	743.70	31.53	194,250.00
1966	815.00	32.47	196,508.00
1967	861.70	33.38	198,664.00
1968	942.50	34.79	200,664.00
1969	1,019.90	36.68	202,649.00
1970	1,075.90	38.84	204,982.00
1971	1,167.80	40.48	207,589.00
1972	1,282.40	41.81	209,838.00
1973	1,428.50	44.43	211,857.00
1974	1,548.80	49.32	213,815.00
1975	1,688.90	53.83	215,891.00
1976	1,877.60	56.93	217,999.00
1977	2,086.00	60.62	220,193.00
1978	2,356.60	65.24	222,525.00
1979	2,632.10	72.58	225,003.00
1980	2,862.50	82.38	227,622.00
1981	3,211.00	90.93	229,916.00
1982	3,345.00	96.53	232,128.00
1983	3,638.10	99.58	234,247.00
1984	4,040.70	103.93	236,307.00
1985	4,346.70	107.60	238,416.00
1986	4,590.20	109.69	240,593.00
1987	4,870.20	113.62	242,751.00
1988	5,252.60	118.28	244,968.00
1989	5,657.70	123.94	247,286.00
1990	5,979.60	130.66	250,047.00
1991	6,174.00	136.17	253,392.00
1992	6,539.30	140.31	256,777.00
1993	6,878.70	144.48	260,146.00
1994	7,308.80	148.23	263,325.00
1995	7,664.10	152.38	266,458.00
1996	8,100.20	156.86	269,581.00
1997	8,608.50	160.53	272,822.00
1998	9,089.20	163.01	276,022.00
1999	9,660.60	166.58	279,195.00
2000	10,284.80	172.19	282,296.00
2001	10,621.80	177.04	285,216.00
2002	10,977.50	179.87	288,019.00
2003	11,510.70	184.00	290,733.00
2004	12,274.90	188.91	293,389.00
2005	13,093.70	195.27	296,115.00
2006	13,855.90	201.56	298,930.00
2007	14,477.60	207.34	301,903.00
2008	14,718.60	215.25	304,718.00
2009	14,418.70	214.57	307,374.00
2010	14,964.40	218.08	309,761.00
2011	15,517.90	224.93	312,075.00
2012	16,155.30	229.60	314,402.00
2013	16,663.20	232.96	316,742.00
2014	17,348.10	236.71	321,410.00

6 A Simulated Solow Model (15 points)

6. (15 points) On Table 2 below you may find the time series of capital, production, investment, depreciation, generated by a simulation of the Solow growth model. Knowing that population is $\bar{L} = 1$, and that the share of capital in production is $1/3$, you should be able to back out the parameters from the corresponding Solow model as well as guess what the missing values (denoted by dots) are. This is what the questions below ask you to do. (you do NOT need to use power functions for any of these)

(a) (2 points) What is \bar{A} ?

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(b) (2 points) What is \bar{d} ?

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(c) (2 points) What is \bar{s} ?

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(d) (1 point) What is K_0 ?

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(e) (1 point) Now you should be ready to fill in the dots. What is Y_3 ?

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(f) (1 point) What is I_5 ?

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(g) (1 point) What is K_{11} ?

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(h) (1 point) What is D_{11} ?

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(i) (1 point) What is K_{34} ?

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(j) (1 point) What is Y_{49} ?

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(k) (1 point) What is I_{49} ?

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(l) (1 point) What is D_{49} ?

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Table 2: WHAT PARAMETERS GENERATED THIS TABLE?

Time t	Capital K_t	Production Y_t	Investment I_t	Depreciation D_t	Capital K_{t+1}
0	\$1,450.00	\$7,922.96	\$2,376.89	\$72.50	\$3,754.39
1	\$3,754.39	\$10,879.55	\$3,263.87	\$187.72	\$6,830.53
2	\$6,830.53	\$13,281.58	\$3,984.47	\$341.53	\$10,473.48
3	\$10,473.48	.....	\$4,594.62	\$523.67	\$14,544.43
4	\$14,544.43	\$17,086.91	\$5,126.07	\$727.22	\$18,943.28
5	\$18,943.28	\$18,660.21	.....	\$947.16	\$23,594.18
6	\$23,594.18	\$20,077.04	\$6,023.11	\$1,179.71	\$28,437.58
7	\$28,437.58	\$21,366.28	\$6,409.88	\$1,421.88	\$33,425.58
8	\$33,425.58	\$22,548.85	\$6,764.65	\$1,671.28	\$38,518.96
9	\$38,518.96	\$23,640.48	\$7,092.14	\$1,925.95	\$43,685.15
10	\$43,685.15	\$24,653.35	\$7,396.01	\$2,184.26	\$48,896.90
11	.....	\$25,597.16	\$7,679.15	.....	\$54,131.21
12	\$54,131.21	\$26,479.75	\$7,943.93	\$2,706.56	\$59,368.57
13	\$59,368.57	\$27,307.60	\$8,192.28	\$2,968.43	\$64,592.42
14	\$64,592.42	\$28,086.13	\$8,425.84	\$3,229.62	\$69,788.64
15	\$69,788.64	\$28,819.93	\$8,645.98	\$3,489.43	\$74,945.19
16	\$74,945.19	\$29,512.95	\$8,853.89	\$3,747.26	\$80,051.82
17	\$80,051.82	\$30,168.60	\$9,050.58	\$4,002.59	\$85,099.80
18	\$85,099.80	\$30,789.85	\$9,236.95	\$4,254.99	\$90,081.77
19	\$90,081.77	\$31,379.33	\$9,413.80	\$4,504.09	\$94,991.48
20	\$94,991.48	\$31,939.36	\$9,581.81	\$4,749.57	\$99,823.71
21	\$99,823.71	\$32,472.02	\$9,741.61	\$4,991.19	\$104,574.13
22	\$104,574.13	\$32,979.15	\$9,893.75	\$5,228.71	\$109,239.17
23	\$109,239.17	\$33,462.43	\$10,038.73	\$5,461.96	\$113,815.94
24	\$113,815.94	\$33,923.38	\$10,177.01	\$5,690.80	\$118,302.16
25	\$118,302.16	\$34,363.36	\$10,309.01	\$5,915.11	\$122,696.06
26	\$122,696.06	\$34,783.63	\$10,435.09	\$6,134.80	\$126,996.34
27	\$126,996.34	\$35,185.34	\$10,555.60	\$6,349.82	\$131,202.13
28	\$131,202.13	\$35,569.55	\$10,670.86	\$6,560.11	\$135,312.89
29	\$135,312.89	\$35,937.22	\$10,781.16	\$6,765.64	\$139,328.41
30	\$139,328.41	\$36,289.24	\$10,886.77	\$6,966.42	\$143,248.76
31	\$143,248.76	\$36,626.46	\$10,987.94	\$7,162.44	\$147,074.26
32	\$147,074.26	\$36,949.64	\$11,084.89	\$7,353.71	\$150,805.44
33	\$150,805.44	\$37,259.50	\$11,177.85	\$7,540.27	\$154,443.02
34	\$154,443.02	\$37,556.70	\$11,267.01	\$7,722.15	.....
35	\$157,987.88	\$37,841.87	\$11,352.56	\$7,899.39	\$161,441.05
36	\$161,441.05	\$38,115.59	\$11,434.68	\$8,072.05	\$164,803.68
37	\$164,803.68	\$38,378.41	\$11,513.52	\$8,240.18	\$168,077.02
38	\$168,077.02	\$38,630.84	\$11,589.25	\$8,403.85	\$171,262.42
39	\$171,262.42	\$38,873.36	\$11,662.01	\$8,563.12	\$174,361.30
40	\$174,361.30	\$39,106.42	\$11,731.93	\$8,718.07	\$177,375.16
41	\$177,375.16	\$39,330.46	\$11,799.14	\$8,868.76	\$180,305.54
42	\$180,305.54	\$39,545.86	\$11,863.76	\$9,015.28	\$183,154.02
43	\$183,154.02	\$39,753.03	\$11,925.91	\$9,157.70	\$185,922.23
44	\$185,922.23	\$39,952.30	\$11,985.69	\$9,296.11	\$188,611.81
45	\$188,611.81	\$40,144.03	\$12,043.21	\$9,430.59	\$191,224.43
46	\$191,224.43	\$40,328.54	\$12,098.56	\$9,561.22	\$193,761.77
47	\$193,761.77	\$40,506.13	\$12,151.84	\$9,688.09	\$196,225.52
48	\$196,225.52	\$40,677.09	\$12,203.13	\$9,811.28	\$198,617.37
49	\$198,617.37	.....	.....	.....	\$200,939.01
50	\$200,939.01	\$41,000.21	\$12,300.06	\$10,046.95	\$203,192.13