Microeconomics
The Tale of Cookie Monster, Harvard Class of 2013

NOTE: Each question is worth 25 points and can be completed without completing the other three questions.

PART 1

1. Cookie Monster gets a job as an analyst at Goldman Sachs. He used to like cookies, but now Cookie Monster only likes coffee and leisure. His utility function is $u(C, L) = C^{1/2} \cdot L^{1/4}$ where C is cups of coffee and L is hours of leisure while awake. Coffee costs \$4 a cup. Cookie Monster has H hours of waking time to allocate between work and leisure, and he earns \$40 for each hour he works.

    a. (5 points) Express Cookie Monster's utility maximization problem, including budget constraint.
    b. (10 points) Solve for the optimal consumption of coffee and leisure as a function of hours H.
    c. (5 points) Suppose Cookie Monster suddenly realizes he no longer needs sleep and H increases. What happens to his consumption of coffee? (Assume that the change in the need for sleep and any change in consumption of coffee are unrelated except through the change in H.) Is coffee a normal good, an inferior good, or neither?
    d. (5 points) Are coffee and leisure complements, substitutes, or neither? Explain.

2. Cookie Monster decides to celebrate his Saturday night off by taking his girlfriend, Pie Monster, out for dessert. They can either go out for cookies or for pie. While Cookie Monster and Pie Monster are debating on the phone whether to meet at the cookie store or the pie store, Cookie Monster's cell phone battery dies. Thus, both must decide where to go without having agreed on where to meet. Both Cookie and Pie Monster know that the utility for each from each option is as follows:

		Pie Monster	
		Cookies	Pie
Cookie Monster	Cookies	4,2	0,0
	Pie	0,0	2,4

    a. (5 points) Find all pure strategy Nash equilibria of this game.
    b. (5 points) Are there any mixed strategy Nash equilibria? If so, find them. What is the expected payoff to each player in each mixed strategy Nash equilibrium (if there are any)?
    c. (10 points) Cookie Monster and Pie Monster both remember an agreement they made long ago: if they got in a fight that they could not resolve, Cookie Monster would win if the lights on top of 30 Rockefeller Plaza are blue, and Pie Monster would win if they are red. Both decide independently that if the lights are blue, they will go to the cookie

store and if the lights are red they will go to the pie store. Before they look at 30 Rock, they know that the probability of the lights being blue is ½ and the probability of red is ½. What is the expected payoff of this coordination strategy?

d. (5 points) If a mixed strategy equilibrium exists, is the payoff in c) larger, smaller, or the same as the payoff in b)? Provide intuition why.

PART 2

3. Cookie Monster decides he no longer wants to work in investment banking, so he gets a job as the assistant to the CEO of a private equity firm. The CEO is a very busy person with a lot of money. She is endowed with 5 hours of leisure per week and spends the rest of her time at work. She also has $5000 that she can spend either on consumption or to pay Cookie Monster. An hour of work by Cookie Monster increases the CEO's leisure by an hour. Cookie Monster, on the other hand, has no money and lots of leisure time. He is endowed with $10 to spend on consumption and 20 hours per week that he can spend either on leisure or on working for the CEO. The utility function of the CEO is $U_{CEO}(c,l) = (l-5)^{1/2}c^{1/2}$ and the utility of Cookie Monster is now $U_{CM}(c,l) = 8l^{2/5}c^{3/5}$.
    a. (5 points) Suppose Cookie Monster gets paid hourly wage w. Solve for the CEO's demand for hours of labor from Cookie Monster as a function of w.
    b. (5 points) Solve for the supply of hours of labor by Cookie Monster as a function of w.
    c. (5 points) Solve for the equilibrium wage rate by equating Cookie Monster's supply function with the CEO's demand. How many hours will Cookie Monster supply to the CEO at this wage? How much money will Cookie Monster earn?
    d. (5 points) Sketch an Edgeworth box in consumption-leisure space. Indicate the initial endowments (1 point) and the competitive solution (1 point). Sketch indifference curves for both the CEO and Cookie Monster through the initial endowments (1 point each) and shade the region in which there are gains from trade (1 point).
    e. (5 points) After beginning work for the CEO, Cookie Monster discovers that the CEO's mood is also a function of the performance of her investment portfolio. Her utility is given by $U_{CEO}(c,l) = (l-5)^{1/2}c^{1/2} + \frac{s\&p}{1000}$ where s&p is the S&P 500 at the start of business that day. How does this change the answers to sections a through d?

4. In his newly-found free time, Cookie Monster decides to start a business making caffeinated cookies to sell to his friends who work at Goldman Sachs in New York City. As the only producer of caffeinated cookies in NYC, Cookie Monster has a monopoly. The total cost of making q cookies is $TC = 50 + 0.5q^2$. The demand for caffeinated cookies is $p = 100 - q$ where p is in dollars.
    a. (5 points) Graph the demand curve for caffeinated cookies. Label both axes.
    b. (5 points) Compute the equilibrium price, quantity, and Cookie Monster's profits.

c. (5 points) Cookie Monster finds cheaper caffeine powder to use in his cookies. His total cost function is now $TC = 50 + 0.25q^2$. Re-do b) with this new cost function. How is Cookie Monster's profit affected by this change in costs?

d. (10 points) To improve public health, Mayor Michael Bloomberg imposes a $25 tax on each cookie sold in New York City. Solve for the new equilibrium price and quantity of cookies using the cost function from parts a and b. How does this tax affect Cookie Monster's profits? What is the tax revenue for the city from Cookie Monster's cookie business? What is the deadweight loss from the tax?

Macroeconomics

2013 Economics Honors Exam

Part 1. (40 minutes) The savings rates of Chinese households are among the highest in the world. This question asks you to analyze the consequences and potential causes of high Chinese saving using some standard macroeconomic models. As you answer the different parts of the question, assume that the Chinese saving rate underwent a large once-and-for all shift upward some time ago (say, around 1978) and that the saving rate has remained at its high level since then.

a.) For this part of the question, assume that China is a *large* open economy with perfect capital mobility. (In reality, China has capital controls, but you can ignore them here.) What is the likely *long-run* impact of an increase in the saving rate on the level of Chinese investment, net exports, real interest rate, and real exchange rate? Assume that the savings rate occurs because of a "level shift" in the consumption function; the marginal propensity to consume MPC, which is greater than zero and less than one, does not change. To get full credit, use a graph (or graphs) to bolster your argument. (Note: this part of the question asks about the long run, in which prices are perfectly flexible but the level of capital and labor are fixed at $\overline{K}$ and $\overline{L}$, respectively. In the *very* long run, investment I is allowed to change the capital stock K. But that's not what we are dealing with here.)

b.) Now think about the effect of higher savings in the very long run. What will happen to the levels of aggregate output Y and output-per-worker $\frac{Y}{L}$ as a consequence of the increase in the saving rate? Be sure to discuss what will happen to Y and $\frac{Y}{L}$ during the immediate period after the savings increase as well as the permanent effects of the savings increase. In this part of the question and in all following parts, assume that China is a *closed* economy. Use graphs.

c.) Now consider China's situation after any adjustments to the new saving rate have taken place. Is there a theoretical possibility that the level of Chinese saving will be "too high," in the sense that the new steady-state level of living standards is lower that it would be with a lower saving rate? What *real-world* data could you use to study whether Chinese saving is higher-than-optimal in this sense? And would a "too high" savings rate be Pareto optimal with respect to different generations in China?

d.) For this part of the question, suppose you are told that the shift toward higher saving occurred at the same time that three other economic changes occurred in China. First, the Chinese welfare state became less generous, in that free housing was no longer offered to young workers. Second, government spending on social programs like unemployment benefits and health care was also reduced. (No more free knee replacements or liver transplants.) Third, employment became more unstable as the right to a lifetime job was ended. How might standard models of consumption link these economic changes to the drop in saving? Given your answer, how might the development of China's *private-sector* financial system—to something that resembles the U.S. *private-sector* financial system—affect Chinese saving rates? (Note: Don't worry about incorporating the effect of the reforms in your answers to the previous parts of this question. The reforms are relevant for this part of the question only.)

Part 2. (20 minutes) For the past several years, Greece, a country that uses the euro, has endured a serious recession. Many people have argued that Greece should undertake a fiscal expansion in order to lower its unemployment rate. The question asks you to evaluate that recommendation. As you answer it, assume that Greece is a small open economy (SOE) with perfect capital mobility and a fixed exchange rate. Use graphs when necessary.

a.) In general, can an SOE with fixed exchange rates raise short-run output with a fiscal expansion? If so, how are the components of output (consumption, investment, government purchases, and net exports) likely to change, if at all? What about the real interest rate and the real exchange rate? Does it matter whether the expansion comes about due to higher government purchases G or lower taxes T?

b.) Now think about Greece's specific situation. One reason many analysts disagree with the benefits of a fiscal expansion in Greece is that they believe such an expansion will undermine the confidence of Greece's international creditors. That is, these analysts believe that if Greece undertakes a fiscal expansion, international creditors will lose confidence in the Greek government's ability to pay its bills, and will therefore require higher compensation to hold Greek debt. If these critics are correct, how would a loss of international confidence in Greece affect your answer above?

c.) In theory, could the effects of the loss of confidence described in part b.) be so severe as to cause total Greek output to *decline* after the fiscal expansion? Explain how your answer affects the debate over whether Greece should choose a fiscal expansion on one hand or fiscal "austerity" on the other.

Econometrics

Part 1

What is the relative importance of "nature" (genes) vs. "nurture" (social and family environment) in determining economic outcomes? This part examines this question using data from a large adoption agency that placed Korean children in American families between 1964 and 1985.

At this agency, the parents must file an application, pass a criminal background check, and attend adoption classes; if all goes well, they are then deemed eligible. Children are then matched with eligible parents on a first-come, first-serve basis.

The data set contains data on the parents and their children, both adopted and non-adopted (natural), at the time of adoption and also at the end of the study when they are adults. Some households have multiple adoptees; for the purpose of this analysis, assume that the Korean adoptees in the same household are not related by blood. The analysis is restricted to adoptees who are at least 25 years of age at the end of the study.

Variables in the Adoption Data Set

Variable	Definition
Child's characteristics upon adoption	
Adopted	= 1 if adoptee, = 0 if non-adopted
Weight at adoption	Weight of child upon adoption (pounds)
Height at adoption	Height of child upon adoption (inches)
Child's characteristics at end of study (as an adult)	
Child's education	Years of education of adult child
College grad	= 1 if adult child graduates from a 4-year college, = 0 otherwise
Child's income	Income of adult child
Child's BMI	BMI of adult child. The BMI is the Body Mass Index, which is weight (in kilograms) divided by the square of height (in meters), so units are kg/m^2.
Child drinks	= 1 if adult child drinks alcohol, = 0 otherwise
Parent characteristics	
Mother's education	Years of education of mother
Father's education	Years of education of father
Log Parent's Income	natural logarithm of parent's income in dollars
Mother's BMI	BMI of mother (kg/m^2)
Father's BMI	BMI of father (kg/m^2)
Mother drinks	= 1 if mother drinks alcohol, = 0 otherwise
Father drinks	= 1 if father drinks alcohol, = 0 otherwise
Year binary variables	Binary variables indicating the year of adoption (the first year of program is the omitted or "base" year)

Table 1. Regression of adoptee outcome variables on pre-adoption parental characteristics

Dependent variable	(1) Child's Years of Education	(2) Child's Years of Education	(3) College Grad	(4) Log Child's Income	(5) Child's BMI	(6) Child Drinks
Regressors:						
Mother's Education	0.097**	0.084**	0.021*	0.016	-0.081	0.010
	(0.027)	(0.031)	(0.008)	(0.013)	(0.061)	(0.009)
Father's Education	-0.001	-0.041	-0.004	-0.004	-0.037	0.010
	(0.032)	(0.055)	(0.007)	(0.011)	(0.052)	(0.007)
Log parent's income	-0.018	-0.005	0.011	0.024	-0.412	0.015
	(0.113)	(0.032)	(0.027)	(0.040)	(0.219)	(0.028)
Mother's BMI	-0.088**	0.180	-0.017**	-0.004	0.006	-0.001
	(0.024)	(0.183)	(0.004)	(0.006)	(0.028)	(0.004)
Father's BMI	0.007	-0.008	-0.000	-0.000	-0.004	0.004
	(0.020)	(0.112)	(0.004)	(0.007)	(0.038)	(0.004)
(Mother's BMI)^2		-0.091				
		(0.118)				
(Father's BMI)^2		-0.081				
		(0.202)				
(Mother's BMI) x (Father's BMI)		0.274				
		(0.206)				
Mother Drinks	-0.039	-0.715**	-0.043	-0.007	-0.345	0.135**
	(0.205)	(0.175)	(0.046)	(0.066)	(0.392)	(0.045)
Father Drinks	0.263	0.000	0.050	0.030	0.580	0.061
	(0.212)	(0.002)	(0.048)	(0.070)	(0.396)	(0.046)
Child is Male	-0.723**	-0.004	-0.159**	-0.259**	1.927**	0.068
	(0.177)	(0.003)	(0.041)	(0.059)	(0.301)	(0.040)
Constant	16.902**	0.002	0.766**	3.758**	31.183**	0.121
	(1.063)	(0.004)	(0.264)	(0.466)	(2.350)	(0.315)
Year binary variables?	Yes	Yes	Yes	Yes	Yes	Yes
F-statistic testing: (Mother's BMI)^2, (Father's BMI)^2, (Mother's BMI) x (Father's BMI) = 0 (*p*-value)		0.57				
		(0.634)				
Observations	897	897	897	874	878	893
Adjusted R-squared	0.03	0.03	0.01	0.06	0.04	0.04

Notes: All regressions are estimated by OLS. Clustered standard errors are given in parentheses, where the clustering occurs at the level of the family. * significant at 5%; ** significant at 1%.

Table 2. Probit regressions of outcome variables on pre-adoption parental characteristics for adoptee and non-adoptee children

Dependent variable	(1) College Grad	(2) Child Drinks	(3) College Grad	(4) Child Drinks
Data are for:	**Adoptees**	**Adoptees**	**Non-adoptees**	**Non-adoptees**
Regressors:				
Mother's Education	0.057**	0.013	0.097**	0.032
	(0.019)	(0.021)	(0.025)	(0.025)
Father's Education	-0.010	0.022	0.105**	0.021
	(0.017)	(0.018)	(0.020)	(0.022)
Log Parent's Income	0.008	0.079	0.108	-0.067
	(0.064)	(0.066)	(0.076)	(0.077)
Mother's BMI	-0.086**	0.000	-0.108**	0.000
	(0.019)	(0.009)	(0.022)	(0.013)
Father's BMI	-0.003	0.000	-0.030*	0.010
	(0.010)	(0.010)	(0.012)	(0.015)
Mother Drinks	-0.054	0.374**	0.039	0.489**
	(0.109)	(0.106)	(0.128)	(0.131)
Father Drinks	0.042	0.211	0.134	0.611**
	(0.112)	(0.110)	(0.132)	(0.132)
Child is Male	-0.397**	0.203*	-0.063	0.355**
	(0.090)	(0.097)	(0.098)	(0.100)
Constant	0.142	-1.300*	-1.680**	-1.396*
	(0.566)	(0.570)	(0.607)	(0.669)
Year binary variables?	Yes	Yes	Yes	Yes
Observations	1088	1083	943	933

Notes: All regressions are probit. Clustered standard errors are given in parentheses, where the clustering occurs at the level of the family.
* significant at 5%; ** significant at 1%

Part I (24 points)
Please answer these questions in Blue Book I
The questions in Part I refer to the results in Tables 1 and 2.

1) Using regression (1) in Table 1:
    a. (3 points) Compute the estimated effect on the child's years of education of a mother who drinks compared to a mother who does not drink.
    b. (2 points) Compute a 95% confidence interval for your estimated effect in (a).

2) Consider the relationship between the child's years of education and parental income, holding constant the regressors in Table 1, column (1) other than parental income.
    a. (2 points) Suggest a reason why this effect might be nonlinear; that is, why should income be included in logs rather than levels.
    b. (2 points) Specify both the appropriate word and the correct number: An (increase / decrease) in parental income of ___% (holding all other factors constant) has the same estimated effect on the child's years of education as having a mother who drinks compared to a mother who does not drink (holding all other factors constant; the effect from question 1, part a).

3) The standard errors reported in Table 1 are "clustered" standard errors, clustered at the level of the household.
    a. (3 points) The author of the paper is not sure whether to use clustered or conventional heteroskedasticity-robust standard errors. Which should she use, and why?
    b. (3 points) How will the clustered standard errors reported in Table 1 compare in size to conventional heteroskedasticity-robust standard errors? Explain.

4) Consider a female adoptee whose adoptive mother and father both have 16 years of education, whose parents' income is $100,000, mother's BMI is 23, father's BMI is 24, the mother does not drink, and the father does not drink. Also suppose that the child was adopted in the initial program year (so all binary year variables equal zero).
    a. (3 points) Using regression (1) in Table 2, compute the probability that the child graduates from college.
    b. (2 points) What is the difference in the predicted probabilities of graduating from college for the adoptee in (a), compared with a male adoptee with all other characteristics identical?
    c. (2 points) Now use the linear probability model from Table 1, regression 3 to estimate the change in predicted probabilities for the comparison in 4 b) (that is, male vs. a female adoptee, with the values of the other regressors given at the beginning of this question).

Part 2

Childhood obesity is a health problem of significant concern. In the 1960s, approximately 4 percent of American children ages 6 to 11 were overweight; by 1999, 13 percent of American children were overweight. Measured in terms of BMI, the average BMI for children rose from 16.63 in the 1960s to 17.37 in 1999, an increase of almost 5%; this is a large increase in historical and medical terms. [The BMI is the body mass index, which is weight (in kilograms) divided by the square of height (in meters), so the units of the BMI are kg/m^2.]

A shift to a high-fat, high-calorie childhood diet – the sort of food found at fast-food restaurants – is one possible reason for the increase in childhood BMI. This section considers whether exposure to fast-food advertising on TV plays a role in this increase.

The data set is a cross-sectional data set on children aged 6-11 in the U.S. in 1997. It contains data on children's characteristics, family characteristics, TV viewing by the child, and characteristics of the child's county.

Variables in the Childhood BMI Data Set

Variable	Definition
Child characteristics	
BMI	Child's BMI (kilograms/meter^2)
TV Exposure	Number of hours per week of fast-food TV ads seen by the child
Age	Child's age (years)
Other individual variables	Child's race and sex, family income, mother's BMI, and mother employed/not employed
County characteristics	
Price of TV advertising	Average price of TV advertising in the child's county in 1997 ($/second)
Number of households with TV	Number of households in the child's county with a TV (hundreds of thousands)
Temperature	Average annual temperature in child's county (degrees Fahrenheit)
Other county variables	Number of fast-food restaurants per capita, number of full-service restaurants per capita, and price indexes for fast-food restaurant meals, full-service restaurant meals, and at-home restaurant meals

Table 3. Children's BMI and Fast-Food TV Advertising

Dependent variable	(1) BMI	(2) TV exposure	(3) BMI
Estimation method	OLS	OLS	Two Stage Least Squares[a]
Regressors:			
TV exposure	.315** (.111)	--	.336* (.150)
Age	.429** (.028)	.021* (.010)	.388** (.048)
Price of TV advertising	--	-.148** (.013)	--
Number of households with TV	--	.100+ (.064)	--
Temperature	--	4.711 (5.50)	--
Other individual variables?	Yes	Yes	Yes
Other county variables?	Yes	Yes	Yes
F-statistic testing: coefficients on Price of TV advertising, no. households with TV, and Temperature = 0	--	41.92	--
J-statistic	--	--	.308
Number of observations	6,818	6,818	6,818

Notes: Heteroskedasticity-robust standard errors appear in parentheses under regression coefficients, and *p*-values appear in parentheses under *F*-statistics. All regressions contain the other individual variables (child's race, male/female, family income, mother's BMI, mother employed/not employed) and the other county variables (number of fast-food restaurants per capita, number of full-service restaurants per capita, price indexes for fast-food restaurant meals, full-service restaurant meals, and at-home restaurant meals).

[a]Instruments for the TSLS regression are the *Price of TV Advertising*, *Number of households with TV*, and *Temperature*.

Significant at the: **1%, *5%, +10% significance level.

Questions for Part II (34 points)
Please answer these questions in Blue Book II

The questions in Part II refer to Table 3, which report results of regressions from your senior thesis.

1) (3 points) Suggest a reason why TV exposure might be endogenous in regression (1).

2) Regression (3) instruments for TV exposure using three variables: the price of TV advertising, the number of households with TV, and temperature. Assume for this question that these instruments are exogenous.
   a) (3 points) Suppose the instruments in regression (3) are weak. How will the estimated coefficient compare to i) the OLS estimate from regression (1) and ii) the true value of the coefficient?
   b) (3 points) Is there evidence in Table 3 that this set of instruments is weak? Explain.

3) (5 points) After seeing the results of your study, Mayor of New York City Michael Bloomberg calls you and tells you he's decided to ban all televisions in order to reduce childhood obesity in NYC. Is this a reasonable conclusion given the results of Table 3? Explain.

4) (3 points) To control for unobserved local characteristics, the author of the paper considers including county-level fixed effects in regression (3). What will be the effect on the first stage in regression (2)?

5) Your thesis advisor suggests including the number of households with TV and temperature as controls rather than instruments in all three regressions in Table 3, leaving the price of TV advertising as the only instrument for TV exposure.
   a) (3 points) Is the price of TV advertising an exogenous instrument in this new regression? Explain.
   b) (5 points) Given a choice between regression 3 and the specification described here, which would you prefer? Why?