

Second Midterm

Ec142 – Spring 2017

Please read each question carefully. Start each question on a new bluebook page. The use of calculators and other computational aides is not allowed. Good luck!

[1] **[5 Points]** Please write your full name on this exam sheet and turn it in with your bluebook.

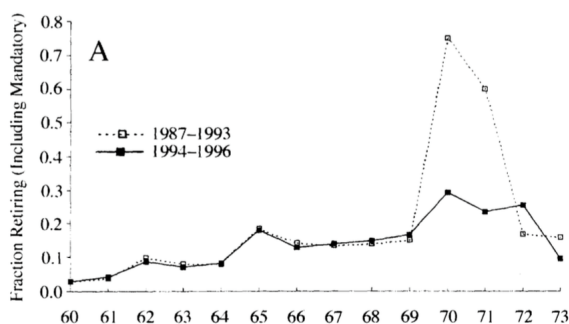
[2] **[65 Points]** Prior to 1994 colleges and universities in the United States were exempt from laws prohibiting mandatory retirement, consequently many institutions forced faculty to retire at age 70. After 1994 mandatory retirement rules were prohibited by Congress. Ashenfelter and Card (*AER*, 2002) study the effects of this exemption expiration on faculty retirement behavior in a sample of 104 colleges and universities. Let Y^* equal age of retirement, let C equal the age at which a faculty-member is lost to follow-up, $D = 1(Y^* \leq C)$ be a censoring indicator, and $Y = \min(Y^*, C)$ be the observed age at exit from the sample. Let T_y (for $y = 60, 61, \dots, 72, 73$) equal the calendar year during which an individual was age y . So, for example, an individual who turned sixty in 1992 would have $T_{60} = 1992$, while one who did so in 1999 would have $T_{60} = 1999$. Let $X = 0$ if $T_{70} < 1994$ and $X = 1$ if $T_{70} \geq 1994$.

[a] **[5 Points]** Assume that

$$\lambda(y; X) = \Pr(Y^* = y | Y^* \geq y, X) = \frac{\exp(\alpha_y + X\beta_0 + X \times \mathbf{1}(y \geq 70)\gamma_0)}{1 + \exp(\alpha_y + X\beta_0 + X \times \mathbf{1}(y \geq 70)\gamma_0)}. \quad (1)$$

In the context of the Ashenfelter and Card (*AER*, 2002) study interpret the hazard function $\lambda(y; X)$ when $X = 0$ and when $X = 1$. Interpret β_0 and γ_0 in terms of the hazard function.

[b] **[10 Points]** Reference the figure below when answering the following questions (justify each of your answers). What signs do you expect β_0 and γ_0 to take? Does the evidence appear consistent with the hypothesis that $\beta_0 = 0$ and $\gamma_0 < 0$?



[c] **[5 Points]** Assume that $D \perp Y^* | X$. Interpret this assumption. Describe how it could be violated.

[d] **[15 Points]** Assume the first four lines of the Ashenfelter and Card (*AER*, 2002) dataset equal

	Y	D	X
1	68	1	0
2	71	0	0
3	65	1	1
4	70	0	1

What are these units' contributions to the corresponding "person-period" dataset (in the sense described in the Singer and Willett book)? Describe, in detail, how you could use this person-period dataset to construct estimates of $\alpha_{60}, \alpha_{61}, \dots, \alpha_{73}, \beta_0$ and γ_0 .

[e] **[10 Points]** Let $S(y; X) = \Pr(Y^* > y | X)$. Does $\Pr(Y > y | X) = S(y; X)$? If not, does $\Pr(Y > y | X) > S(y; X)$ or $\Pr(Y > y | X) < S(y; X)$? Why?

[f] **[10 Points]** Describe a method for constructing an estimate of $S(y; X)$.

[g] **[5 Points]** Describe, in detail, how you could use this estimate to compute the effect of the end of mandatory retirement on median retirement age.

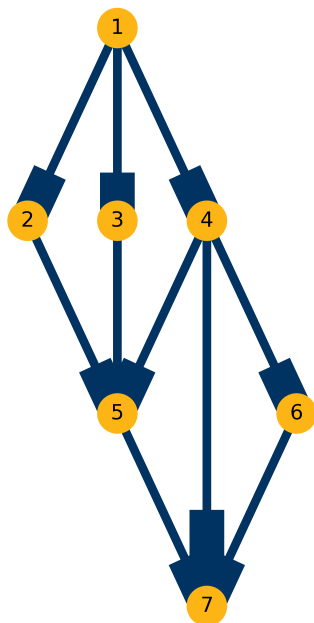
[h] **[5 Points]** Use the information in the table below to implement your procedure (you do not need to numerically evaluate all expressions).

TABLE 2—AGE-SPECIFIC RETIREMENT RATES, BEFORE AND AFTER 1994

Age	Number of observations	Percentage post-1994	Average retirement rate		Change in retirement rate	
			1987–1993	1994–1996	Unadjusted	Adjusted from logit
60	7,343	31.8	3.3 (0.3)	3.0 (0.4)	–0.3 (0.4)	–0.2 (0.5)
61	7,027	32.4	4.1 (0.3)	4.4 (0.4)	0.3 (0.5)	0.3 (0.5)
62	6,665	32.9	10.3 (0.5)	8.9 (0.6)	–1.4 (0.8)	–1.4 (0.8)
63	5,838	34.5	8.5 (0.5)	7.3 (0.6)	–1.3 (0.7)	–1.1 (0.8)
64	5,222	35.4	8.4 (0.5)	8.5 (0.7)	0.1 (0.8)	0.1 (0.8)
65	4,650	35.1	19.3 (0.7)	18.1 (1.0)	–1.2 (1.2)	–1.4 (1.3)
66	3,653	35.1	14.7 (0.7)	13.0 (0.9)	–1.7 (1.2)	–1.9 (1.3)
67	2,969	34.2	13.8 (0.8)	14.0 (1.1)	0.1 (1.3)	–0.1 (1.4)
68	2,453	34.2	14.3 (0.9)	14.6 (1.2)	0.4 (1.5)	0.7 (1.5)
69	2,004	33.7	15.4 (1.0)	16.7 (1.4)	1.3 (1.7)	0.6 (1.7)
70	1,598	35.1	75.6 (1.3)	29.1 (2.0)	–46.5 (2.4)	–43.7 (2.5)
71	502	58.6	60.6 (3.4)	23.8 (2.5)	–36.8 (4.2)	–32.2 (4.0)
72	182	67.0	16.7 (4.9)	25.4 (4.0)	8.7 (6.3)	–3.7 (7.2)

Notes: Retirement rates expressed as percent per year. Estimated standard errors are in parentheses. An individual's retirement age is measured as of September 1 following the date of retirement. The adjusted change in retirement rates is the normalized regression coefficient from a logit model for the event of retirement, fit by age and including a total of 19 covariates: gender, Ph.D., nonwhite race, region (three dummies), Carnegie classification and public/private status of institution, and six department dummies.

[3] **[30 Points]** The figure below depicts a (hypothetical) supply chain. For example firm 1 sells inputs to firms 2, 3 and 4; firm 6 sells inputs to firm 7 and so on.



[a] **[5 Points]** Let $\mathbf{D} = [D_{ij}]$ where

$$D_{ij} = \begin{cases} 1, & \{i, j\} \in \mathcal{E}(G) \\ 0, & \text{otherwise} \end{cases} . \quad (2)$$

That is $D_{ij} = 1$ if firm i “sells” to firm j (and zero otherwise). Fill in the table below to construct the adjacency matrix \mathbf{D} for the depicted supplier-buyer network.

		<i>Buyers</i>						
		1	2	3	4	5	6	7
<i>Suppliers</i>	1	0						
	2		0					
	3			0				
	4				0			
	5					0		
	6						0	
	7							0

[b] **[5 Points]** Let A_i equal the productivity of firm i . Assume that

$$A_i = \alpha_0 + \beta_0 \left\{ \frac{\sum_{j=1}^N D_{ji}}{\max\left(1, \sum_{j=1}^N D_{ji}\right)} \right\} A_j + V_i \quad (3)$$

with V_i independently and identically distributed across agents with mean zero and variance σ^2 . Interpret, in words, equation (3). Why might the productivity of a firm vary with that of its suppliers?

[c] **[5 Points]** Assume firm 1 experiences a shock to V_1 of σ . What is the effect of this shock on the productivity of firm 1's direct customers, firms 2, 3, and 4?

[d] **[5 Points]** What is the effect of the shock on the productivity of the customers of firm 1's customers? On the customers of those firms customers?

[e] **[5 Points]** What is the social multiplier associated with this shock to firm 1's productivity?

[f] **[5 Points]** What is the social multiplier associated with a one standard deviation shock to V_6 ? How does your answer differ from the one given in [e] above? Why?