Problem Set 1

Submit Hard Copy in Class To the TA on the Wednesday of Week 4.

Problems Based on Class Discussions/Readings

a. Why are wages called compensation? How is your answer tied to the concept of scarcity? Would you call right to work a basic human right?

Because wages are compensatory payments to workers for the opportunity cost of working. Time is scarce and that is why working generates opportunity cost in terms of time spent with family or sleeping. On one hand, right to work should be a basic human right if a person does not have any other ways to buy and sell goods and services. On the other hand, if an industry a person is working in goes bust, then that person should have an opportunity to try out other fields. In my opinion, the opportunity to work is perhaps more important.

b. What are some of the desirable properties of an experiment? In what ways do you think economists run experiments? What do you think is identification strategy?

Randomized Control Trial – gold standard for experiments. Economists pose a question, try for a randomized control trial (welfare benefits variations across state to look at outcomes of welfare recipients). Identification strategy is about internal validity of the experiment – where you are making sure that the x variable affects the y variable (there is no reverse causality i.e. y causing x OR some other variable called z affecting y)

c. Name 3 important assumptions behind the typical labor market analysis with a downward sloping labor demand and upward sloping labor supply

Perfect Competition
No Asymmetries in information: Observable effort by workers
No risks/ uncertainty

d. Which properties of the labor equilibrium with downward sloping labor demand and upward sloping labor supply were discussed in class

Equilibrium exists
Equilibrium is stable
Equilibrium is unique

e. Which facts/observations from real life can be easily explained with the labor market equilibrium model? Try to come up with 3 such facts/observations – this answer may vary by student.

Some occupations will have higher earnings than others

To choose an occupation, target occupations with shortages in future for maximum wage growth
Work protection can be counterproductive – think about blockbuster – the entire firm went under so people were let go. If you try to protect these workers, then you will be encouraging inefficiency

f. In class we learned two different reasons why the unemployment from minimum wage (expected from the theoretical model) may not be observed in real life data. What were these two reasons?
Repeated in g

g. In class we also talked about two theoretical reasons why unemployment may not be large (as is expected from theoretical model). What are these two reasons? (Hint: Think in terms of shapes of demand and supply curves and shifts of demand curve)
Workers can go to an unprotected sector
There can be high demand for workers after the min wage legislation is implemented

Problems To test your understanding of causality in Empirical Studies [from PS 1 for Econ 128]

Please consider the following regressions and comment on possible issues (endogeneity, omitted variable, reverse causality, selection etc.). Please justify your conclusions with a story and comment whether there will be upward or downward bias

a. Suppose 178 randomly picked individuals (Men/Women) are asked to throw a baseball as far as they can from a fixed spot on the field. Everyone gets a fresh new baseball to throw made by the same company. The distance of the baseball thrown by a subject is measured in feet. No other characteristics of the subjects are known to the experimenter. The OLS results show that on an average, men indeed throw about 27% father than women.

- **Omitted Variable Bias: Relevant variables Not Included. Example: Did they get the same # of Tries, Was there Practice Times, Were some of them athletes**
- **Endogenity: Omitted variables may be correlated with Gender & How far the ball is thrown. Example: If male experiment subjects were athletes; would perhaps lead to a upward biased (overestimated) coefficient.**

b. Some high school students choose to participate in clubs (drama club, debate club, band, chess club, quiz team, choir, football, basketball etc.). The OLS results show that club participation leads to a 38% increase in SAT scores.

- **Reverse Causality/Selection: Students who participate in clubs may be more academically gifted/motivated to go to college than others; which is why they score more on SAT**
- **Difference between Selection and Endogenity:**

i. **In case of selection the data pertains to a selected sample, it is not a random sample of the entire population.**

ii. **Endogenity is cured using IV, Fixed Effects Estimates, DID, RD etc. but Selection requires Heckman Two Step Procedure (essentially a IV) or Tobit estimators**

c. A recent study using OLS shows that individuals living within 700 ft. of busy highways have a 7% higher probability of Alzheimer's. As a result, policymakers put forward a bill to stop all development near the highways.

Defining Busy Highways (Heterogenities): How busy is busy? Busy every time of the day or specific times of the day

Is the effect big enough? In the population there are about 11% Alzheimer's patients. So an increase in 7% probability of the disease would perhaps not increase the share of Alzheimer's patients in the population

Is the mechanism believable (i.e. presence of other factors correlated with distance from highways)? Looks like the possible mechanism is that noise pollution leads to memory problems.

Is the mechanism believable (i.e. presence of other factors correlated with distance from highways that causes Alzheimer's)? Looks like the possible mechanism is that noise pollution leads to memory problems.

Reverse Causality (Selection): Did noise pollution cause Alzheimer's or that Alzheimer's patients self selected the location because they had Alzheimer's (or something similar)?

Quantitative Problems: Basic Labor Market Analysis

Suppose a labor demand curve is given by $w = A - Bh^d$ and a labor supply curve is given by $w = C + Dh^s$; where A, B, C and D are positive constants. Suppose there exists a $w = w^*$ such that $h^d = h^s = h^*$.

a. Find the parametric solutions for w^* and h^*

$$w^* = \frac{AD + BC}{B + D} \quad h^* = \frac{A - C}{B + D}$$

b. Use the parametric solutions for w^* and h^* & find the specific solutions in each case using the table below. Please use **Excel** to find out the answers. Include the excel sheet in your answer. Draw a graph comparing baseline to Cases 1-3 individually. Use intuition to justify your results (i.e. which curve(s) shifted & why; what happened to equilibrium wages and hours as a result of the shift(s)).

Parameters	Baseline	Case 1:	Case 2:	Case 3:
A	100	40	100	40
B	1	1	1	1
C	0	0	20	20
D	1	1	1	1

Parameters	Baseline	Case 1:	Case 2:	Case 3:
A	100	40	100	40
B	1	1	1	1
C	0	0	20	20
D	1	1	1	1
h*	**50**	**20**	**40**	**10**
w*	**50**	**20**	**60**	**30**

c. Suppose the government subsidizes the firms ***s*** units to hire **additional workers. Compared to the baseline case,** which equation will be modified? Calculate the parametric equations for equilibrium wage and employment for this case & compare it to the equilibrium. What will happen to wages/employment compared to the baseline?

$w = A - (B - s)h^d \quad w = C + Dh^s$

$$w^*_{new} = \frac{AD + (B - s)C}{(B - s) + D} = \frac{AD + BC - sC}{B + D - s} = w^* \frac{(B + D)}{(B + D - s)} - \frac{sC}{B + D - s} > w^*$$

$$h^*_{new} = \frac{A - C}{(B - s) + D} > h^*$$

Quantitative Problems : Labor Demand

1. Suppose a firm chooses labor **(E)** and capital **(K)** to maximize profits by selling output (***q***) at price (***p)*** subject to a budget constraint $TC = wE + rK$. The production function is given as $q = q(E, K) = E^{\alpha}(AK)^{\beta}$

a. Does this production function exhibit constant returns to scale? When would it do so?

$$q^{new} = q(\lambda E, \lambda K) = (\lambda E)^{\alpha}(A\lambda K)^{\beta} = \lambda^{\alpha+\beta}E^{\alpha}(AK)^{\beta} = \lambda^{\alpha+\beta}q^{old}$$

If $\alpha + \beta = 1$ then CRS

b. Find the parametric equation of **labor demand function** and **elasticity of labor demand**. You need to specify the Lagrangian as done in class and use the first order conditions to find the solutions.

$$\Gamma = pq + \lambda[TC - wE - rK]$$

$$\left.\begin{aligned}\frac{\partial \Gamma}{\partial E} = 0 \rightarrow pMP_E = \lambda w \\ \frac{\partial \Gamma}{\partial K} = 0 \rightarrow pMP_K = \lambda r\end{aligned}\right\} \rightarrow \frac{pMP_E}{pMP_K} = \frac{\lambda w}{\lambda r} \rightarrow \frac{MP_E}{MP_K} = \frac{w}{r}$$

$$\frac{\partial \Gamma}{\partial \lambda} = 0 \rightarrow TC = wE^* + rK^*$$

$$\rightarrow \frac{\alpha E^{\alpha-1}(K)^{\beta}}{\beta E^{\alpha}(K)^{\beta-1}} = \frac{w}{r} \rightarrow \frac{K^*}{E^*} = \frac{\beta w}{\alpha r} \rightarrow K^* = \frac{\beta w}{\alpha r}E^*$$

$$TC = wE^* + r\frac{\beta w}{\alpha r}E^* \rightarrow E^* = \frac{TC}{w\left(1+\frac{\beta}{\alpha}\right)}$$

$$E^* = \frac{TC}{w\left(1+\frac{\beta}{\alpha}\right)} : \textbf{LABOR DEMAND FUNCTION}$$

$$\ln E^* = -\ln w + \ln \frac{TC}{\left(1+\frac{\beta}{\alpha}\right)} \rightarrow \left|\eta^D\right| = 1 \quad \textbf{LABOR DEMAND ELASTICITY}$$

$$K^* = \frac{\beta w}{\alpha r}E^* \rightarrow K^* = \frac{\beta}{\alpha r}\frac{TC}{\left(1+\frac{\beta}{\alpha}\right)} = \frac{TC}{r\left(1+\frac{\alpha}{\beta}\right)}$$

$$q^* = A^\beta \left[\frac{TC}{w\left(1+\frac{\beta}{\alpha}\right)} \right]^\alpha \left[\frac{TC}{r\left(1+\frac{\alpha}{\beta}\right)} \right]^\beta$$

c. Use the table below to find out the numerical values of equilibrium labor purchased, equilibrium capital purchased and equilibrium production

Parameters	Baseline	Case 1:	Case 2:	Case 3:
Alpha	0.5	0.5	0.5	0.5
Beta	0.5	0.5	0.5	0.5
A	1	1	1	**50**
TC	100,000	100,000	100,000	100,000
r	1	1	1	1
w	10	**1**	1	10
p	480	480	**600**	480
E*	**5,000**	**50,000**	**50,000**	**5,000**
K*	**50,000**	**50,000**	**50,000**	**50,000**
q*	**15,811.39**	**50,000.00**	**50,000.00**	**111,803.40**

d. Find parametric comparative statics with respect to **w**; **A** and **TC**

$$\ln E^* = -\ln w + \ln TC - \ln\left(1+\frac{\beta}{\alpha}\right)$$

$$\frac{\partial E^*}{\partial w} = -\frac{E^*}{w} < 0$$

$$\frac{\partial E^*}{\partial TC} = \frac{E^*}{TC} > 0$$

$$\frac{1}{E}\frac{\partial E^*}{\partial A} = 0$$

Quantitative Problems: Labor Supply (IGNORE)

1. Suppose utility function is given by $U = U(l,c) = l^{\alpha} \times c^{\beta}$ and the budget constraint is given by $c = \frac{wT+V}{p} + \frac{-w}{p} l$ & $T = h + l$.

a. Please follow the class notes to get the parametric equations and find the equilibrium **consumption, utility, labor and leisure supply** functions. Set up the Lagrangian and follow class notes.

Parameters	Baseline	Case 1:	Case 2:	Case 3:
Alpha	1	1	1	1
Beta	0.5	0.5	0.5	0.5
w	20	40	10	20
p	1	1	1	1
V	0	0	0	100
T	110	110	110	110

2. If Utility function is given by $U = (l - \bar{l})^{\alpha}(c - \bar{c})^{\beta}$; where $\bar{l}$ & $\bar{c}$ represent subsistence leisure and subsistence consumption and α & β are utility weights for leisure and consumption. A higher α would suggest that the person is leisure loving; while a lower α would suggest that the person is work loving. Similarly, higher β suggests a materialistic person & a lower β suggests that the person does not care about material comfort all that much. Suppose p is the price of the consumption good. This person earns w dollars an hour and receives a non-labor income in form of assets worth V. The government taxes hourly wages at a rate of τ As a result, this person's total labor earning is $(w - \tau) \times h$ and non-labor income is V. This person's total expenditure is pc. Assume this person has finite time T to be divided into labor versus leisure.

a. Write the equation for the budget line & find the slope of the budget line. What does it mean?

b. Find the equation for Reservation Wage using the definition $RW = \left|MRS\right|_{l=T, c=\frac{V}{p}}$

c. Mathematically Compute $\frac{\partial RW}{\partial \bar{l}}$; $\frac{\partial RW}{\partial \alpha}$; $\frac{\partial RW}{\partial \bar{c}}$; $\frac{\partial RW}{\partial V}$; $\frac{\partial RW}{\partial \tau}$. Suppose initially $RW = Market\ Wage = w$; and the person involved is indifferent between working and not working. Now, when each of these parameters change individually (i.e. one by one with everything else remaining constant); is this person more likely to work or less likely to work?

d. Find out the tangency condition (i.e. when the slope of Budget Line and Indifference Curve are tangent to one another i.e. $\left|MRS\right| = \left|\text{Real Wage}\right|$)

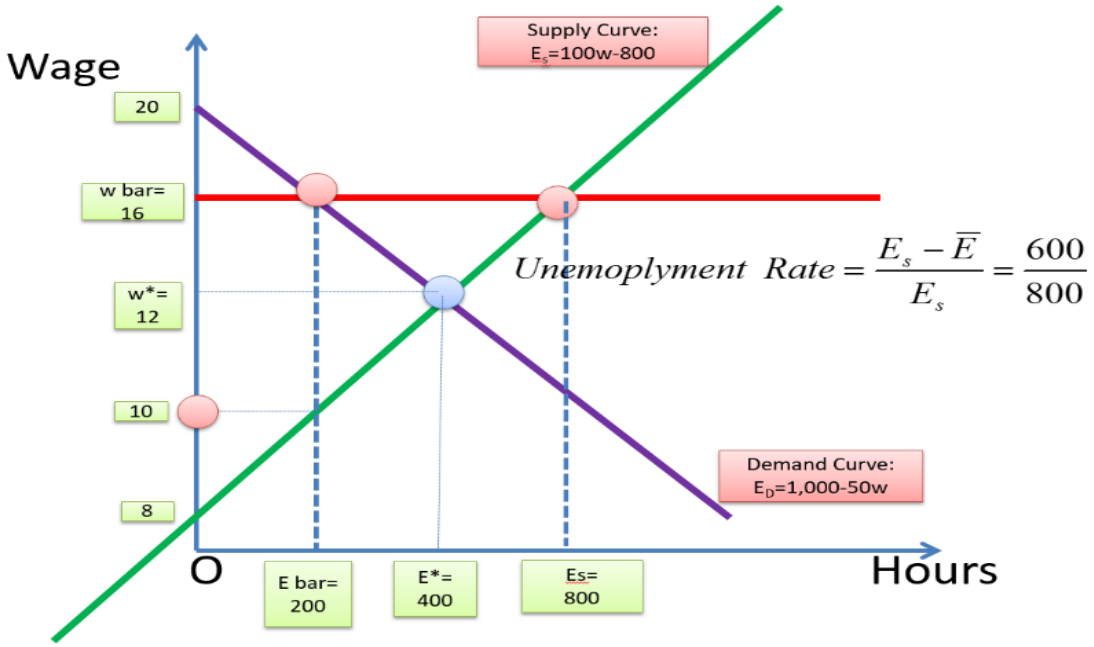
e. Suppose a person thinks that the causes of poverty are: Laziness, Having too many kids, getting welfare handouts from the government, not having a stable family, being sick. As an economics

major, you want to relate these causes to each of the parameters of your model: $\{\bar{l}, \alpha, \bar{c}, \beta, V, T, p, w, \tau\}$

f. Are these causes or correlations? How would you disprove each claim as a cause and show that it may be a symptom of poverty itself?

Quantitative Problem: Minimum Wage

1. Find Worker Surplus (measured by the area under the labor supply curve to the equilibrium wage) & Firm Surplus (measured by the area under labor demand curve to the equilibrium wage) – example is done in class (using a table for Firm Surplus & Worker Surplus before and after the minimum wage change). You have to utilize the equation of the labor demand and supply curves – given on the graph



	Before Min Wage	After Min Wage	Changes (After - Before)
Firm Surplus	$\frac{1}{2} \times 400 \times (20-12) = 1{,}600$	$\frac{1}{2} \times 200 \times (20-16) = 400$	$400 - 1{,}600 = -1{,}200$
Worker Surplus	$\frac{1}{2} \times 400 \times (12-8) = 800$	$\frac{1}{2} \times 200 \times (10-8) + 2 \times 200 + 4 \times 200 = 1{,}400$	$1{,}400 - 800 = +600$
Total Social Surplus	$1{,}600 + 800 = 2{,}400$	$400 + 1{,}400 = 1{,}800$	$1{,}800 - 2{,}400 = -600$

Problems To test your understanding of the papers

1. **Properties of Good RCT**

Imagine a Randomized Control to find out the effectiveness of memory books for dementia patients. Please look at each study below and comment (using bullet points) which desirable properties of RCT may be are violated

a. In a study of memory books (books with pictures of family members) for dementia patients, some caregivers of control group force the experimenter to give treatment to specific members of the control group

One desirable property of a good RCT is that Treatment and Control groups should be separate. In this question, T and C groups are mixed up. Therefore getting estimates of the effectiveness of treatment will be hard.

b. In a study of effectiveness of malaria drug, the treatment and control group of malaria patients is assigned based on the participant's knowledge about malaria

One desirable property of a good RCT is that Treatment and Control groups should be randomly selected from same distribution (of observables and unobservables). In this question, random picking of T&C from the same distribution are violated. This is because individuals with more knowledge about malaria can be systematically different (they can have different socio-economic background, different locations) from those who do not know about malaria

2. **Women and War Paper**

a. What is the author's IV strategy to find causal effects of labor force participation on female wages? What makes you think it is a strong IV? What makes you think that it is a valid IV? What is the limitation of the paper?

b. Use the dataset given below to

i. Give the descriptive/summary statistics of the three variables?

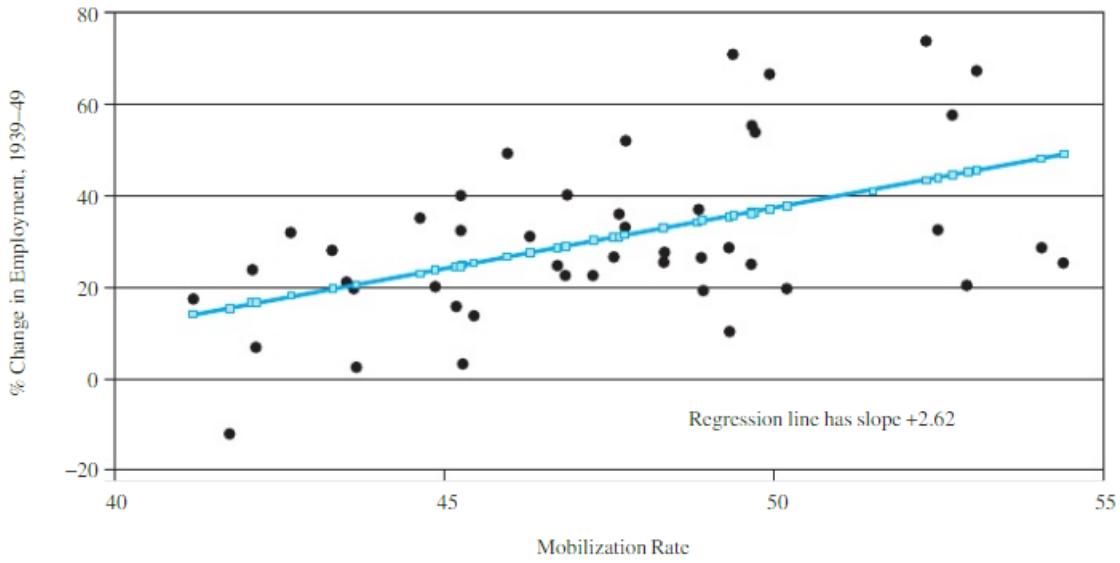
ii. Draw a graph relating % mobilization (horizontal axis) to % change in labor force participation of women (vertical axis), clearly marking the states on the graph

iii. Regress % Change in Labor Force Participation on % Mobilization – show the results

iv. Draw a graph relating %mobilization rate (horizontal axis) to % change in female wages (vertical axis)

v. Regress % change in female wages on % mobilization and show the results

State Abbreviations	Mobilization Rate (%)	Change in Female Employment (%)	Change in Female Wage (%)
AL	43.3	20.3	81
AR	43.6	19.2	79.5
AZ	49.4	70.2	38.4
CA	50	65.7	31.3
CO	49.7	54.5	50.2
CT	49.4	27.9	34.5
DE	46.9	39.4	24.6
FL	47.7	35.2	69.9
GA	41.2	16.7	65.2
ID	49.8	53.3	58.1
IL	47.6	26.2	42
IN	45.3	31.6	48.3
IA	45.3	2.9	51.2
KS	49	18.8	55.6
KY	45.2	15.1	51.1
LA	43.5	19.5	69.4
ME	50.3	19.1	38.4
MD	46.9	22.1	48.9
MA	54.5	24.8	26.9
MI	45.3	39.1	48.6
MN	46.8	23.9	47.5
MS	43.7	2.2	73
MO	45.5	13.2	48.2
MT	49.4	10.1	44.2
NE	46.3	30.4	49
NH	53	20.1	41.8
NJ	49.7	24.3	35.7
NM	47.8	51.1	50.6
NY	48.4	24.9	33.7
NC	42.1	23.3	51.6
ND	41.8	-12.5	51.8
OH	47.8	24.9	33.7
OK	49	25.9	55.1
OR	53.1	66.5	42.3
PA	52.6	31.9	37.9
RI	54.1	27.8	28.6
SC	42.7	31.1	80
SD	42.2	6.5	52.5
TN	44.9	19.5	52.4
TX	46	48.5	66.8
UT	52.8	56.9	35.3
VT	47.3	21.9	62.6
VA	44.7	34.5	56.1
WA	52.4	72.8	39.2
WV	48.4	27.3	47.5
WI	43.3	27.3	44.4
WY	48.9	36.2	39.6



(*b*) Mobilization Rate and Changes in Female Wages, by State