UNIVERSITY OF TORONTO

DEPARTMENT OF ECONOMICS

ECONOMICS 381H1F – SUMMER 2017

MANAGERIAL ECONOMICS II – PERSONNEL ECONOMICS

Midterm 1
Version A

SOLUTION KEY

Instructions

The test is 50 minutes long. Non-programmable calculators are allowed. The test consists of four questions, each worth 5 points. Show all your work in the space provided below the question. If you need additional space, you may write on the back of the page.

LAST NAME ____________________

FIRST NAME ____________________

STUDENT NUMBER ____________________

GOOD LUCK!

Question 1	Question 2	Question 3	Question 4	Total
/5	/5	/5	/5	/20

1. A waiter can serve q customers for each hour of work e. The waiter's disutility of work is given by $\frac{e^2}{2k}$, where k is a positive number that represents years of work experience. The waiter's outside option is 1, while the restaurant owner's outside option is 0. Assume that the restaurant's owner can observe and verify waiter's hours of work and that the number of customers depends only on how many hours the waiter works.

a. (1 point) If the owner decides to hire the waiter, how many hours should the waiter work?
b. (2 points) Show that it is efficient that the owner hires the waiter only if the waiter has at least two years of experience.
c. (2 points) Show that the owner must offer a higher salary to attract waiters with more work experience.

a. (1 point) The efficient number of hours of work equates the marginal benefit and marginal cost. The benefit is equal to q=e, so the marginal benefit is 1. The cost is equal to $0.5e^2/k$, so the marginal cost is e/k. Therefore, the efficient level of e solves 1=e*/k, which implies that e*=k.
b. (2 points) It is efficient that the owner hires the waiter if the social surplus evaluated at the efficient level of hours of work is positive, or q(e*)-c(e*)-R-S≥ 0. Given that e*=k from part (a) and that R=1 and S=0, the social surplus can be expressed as $e^*-0.5e^{*2}/k-1-0=k-0.5k^2/k-1=k-0.5k-1=0.5k-1$. Therefore, the social surplus is non-negative if and only if 0.5k-1≥0, or k≥2.
c. (2 points) The minimum salary that the owner must offer the waiter is given by w*=R+c(e*). Given that R=1 and $c(e^*)=0.5e^{*2}/k=0.5k$ from part (a), we have that w*=1+0.5k. Therefore, $\partial w^*/\partial k=0.5>0$ and the owner must offer a higher salary to attract waiters with more work experience.

2. Consider a relationship between the National Research Council Canada (NRCC) and an archeologist. The archeologist applied for a grant from the NRCC to explore Northern Ontario in search of artifacts left by the Vikings when they first visited Canada in the 10th century. Suppose that the NRCC considers offering a grant that has two parts: (1) a fixed payment (an advance), and (2) a bonus that is paid if the archeologist is successful in finding the artifacts.

a. (1 point) Identify the principal and the agent in this relationship.
b. (2 points) Explain how the risk attitudes of the NRCC and the archeologist can influence the contract that the NRCC offers.
c. (2 points) Explain how the ability of the NRCC to observe and verify the archeologist's effort to uncover the Viking artifacts can influence the contract that the NRCC offers.

a. (1 point) The NRCC could be considered the principal because it 'hires' the archeologist (the agent) to do exploratory work on its behalf.
b. (2 points) If the NRCC is risk neutral while the archeologist is risk-averse, and the NRCC can observe and verify the archeologist's effort, the optimal risk sharing is that the archeologist's pay consists only of the advance and no bonus. In other cases, when the NRCC is risk averse, or both the NRCC and the archeologist are risk averse, it is optimal to share risk through the performance-based bonus.
c. (2 points) If the NRCC cannot observe or verify the agent's effort, then it is always optimal to offer the two-part compensation that includes the bonus. The size of this bonus depends on the risk attitudes of the NRCC and the archeologist and the extent of uncertainty. All else equal, the bonus will be smaller the more risk averse the agent is and the more uncertain the outcome is.

3. The worker's expected output is E[q]=*e*+*n,* where *e* is worker's effort and *n* is worker's ability. Each worker is either of low ability (*n*=0) or high ability (*n*=1). The worker's cost of effort is given by $0.5e^2$, while his outside option is 0. The worker can work for a salary firm that pays w=0 or a piece rate firm that pays w=-1+q. Assume that the worker's effort cannot be observed or verified and that the worker is risk neutral.

    a. (1 point) What is the expected effort level for workers who decide to join the salary firm and for those who decide to join the piece rate firm?
    b. (1 point) Will the high ability workers decide to join the salary or the piece rate firm? What about the low ability workers?
    c. (3 points) What is the expected difference in productivity of salary and piece rate workers? How much of this difference is the treatment effect and how much is the selection effect?

a. (1 point) The worker in the salary firm would choose e=0 since his pay does not depend on his effort. The worker in the piece rate firm would choose the efficient level of effort, given by the first-order condition 1=e*, or e*=1.
b. (1 point) The worker will choose which firm to work for by comparing his expected utility in each firm. In the salary firm, the utility is a-c(e)=0. In the piece rate firm, the expected utility is -1+E[e*+n]-c(e*)=-1+1+n-0.5(1^2)=n-0.5. Therefore, the expected utility in the piece rate firm is 1-0.5=0.5 for the high ability worker and 0-0.5=-0.5 for the low ability worker. Therefore, the high ability worker will choose to work for the piece rate firm, while the low ability worker will choose to work for the salary firm.
c. The expected productivity, E[q]=e+n, is then 0 for the salary workers and 1+1=2 for the piece rate workers. Therefore, the observed difference is 2 (1 point). The incentive effect is the difference in productivity for the high ability workers between their productivity as the piece rate workers, e+n=1+1=2, and their productivity as the salary workers, e+n=0+1=1. Therefore, it is equal to 1. A similar argument shows that the incentive effect is 1 for the low ability workers as well. (1 point) The selection effect is the difference between the observed productivity and the incentive effect, or 2-1=1. Alternatively, it is the difference in productivity between high and low ability workers, independently of how they are paid. This is equal to 1 as well. (1 point)

4. An investor considers designing a contract for a prospective portfolio manager. The value of portfolio is given by $q=e+u$, where e is the manager's effort and u is a random variable with a mean of zero and a variance of one. The coefficient of absolute risk aversion is one for the manager and two for the investor. The manager's cost of effort is given by $0.5e^2$. The outside options are zero for both the manager and the investor. The compensation consists of a base salary plus a percentage of the portfolio value.

a. (1 point) What is the efficient level of effort for the portfolio manager?

b. (2 points) What is the social surplus from this relationship when the manager's effort can be observed by the investor?

c. (2 points) What is the social surplus from this relationship when the manager's effort cannot be observed by the investor?

a. (1 point) The efficient level of effort maximizes the expected benefit net of cost of effort, i.e. max $E[q]-c(e)=e-0.5e^2$. The first-order condition for e is then $1-e^*=0$ or $e^*=1$.

b. (2 points) The social surplus from this relationship is equal to $E[q]-c(e)-RP_A-RP_P-R-S=e-0.5e^2 - 0.5rb^2\theta - 0.5s(1-b)^2\theta$. The first-order condition for e is then $1-e^*=0$, so $e^*=1$. The first-order condition for b is $-rb\theta+s(1-b)\theta=0$. Substituting for $r=1$, $s=2$, and $\theta=1$, this simplifies to $-b+2(1-b)=0$, which yields $b^*=2/3$. The social surplus is then $1-0.5-0.5(1)(2/3)2(1) - 0.5(2)(1-2/3)2(1)=1/6$.

c. (2 points) The social surplus in its general form is again $E[q]-c(e)-RP_A-RP_P-R-S=e - 0.5e^2 - 0.5rb^2\theta - 0.5s(1-b)^2\theta$. Further, from the incentive compatibility constraint, the manager chooses e to maximize $a+bE[q]-c(e)-RP_A=a+be-0.5e^2 - 0.5rb^2\theta$, which yields $e=b$. Substituting back into the social surplus function, we have $b-0.5b^2 - 0.5rb^2\theta - 0.5s(1-b)^2\theta= b-0.5b^2 - 0.5b^2 - (1-b)^2= b-b^2 - (1-b)^2$. The first-order condition for b is then $1-2b+2(1-b)=0$, or $b=3/4$. Therefore, the social surplus is $3/4-(3/4)^2-(1-3/4)^2=1/8$.