Game Theory Analysis on College Student Cheating*

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***Abstract*- Honesty education is a very important part in higher education, but the status of college students' cheating in examination is widespread and is highly concerned nowadays. Game theory in economics is used to study and research college students' cheating in examination in this paper. By deep analysis on the reason of the behavior, a mathematic model is established, according to which the problem can be solved, by some corresponding solutions, such as, to effort to increase the incentive proctor, to reduce the punishment for cheating students appropriately , to increase the cost of student cheating, and etc.**

***Key words*- student cheat; game theory; rational man;**

I. INTRODUCTION

Graduates from colleges are facing to fierce competition when they are seeking jobs. Good jobs are prepared for the outstanding ones among the employees, who have good scores in the transcripts, even the career certifications and various certificates of grades examinations. Some of the students in colleges do everything possible to improve their curriculum scores, even cheating in examination at last. Higher education should teach the students a lot of qualities, which should contain honesty. Honesty is not only the needs of the colleges and community, but also the needs of the students themselves.

II. GAME THEORY TO STUDENT CHEATING

A. Model Establish

This model is made to analyze the underlying causes of cheating; Game participants are student A and student B, who are participating in the same examination. Both of the two students, who are not conspirers, know the costs and benefits of cheating and not cheating clearly. The game between them is a complete information, non-cooperative and static one.

As both of them have the choice of cheating and not cheating, they have the same strategy space, which is {not cheat, cheat}, and the two ones' strategy portfolio set is {(A cheats, B cheats), (A cheats, B not), (B cheats, A not) , (A not cheat, B not cheat)}.

Their cost-benefit analysis is followed below. If they want to pass the examination without cheating, both A and B need to spend some time in the course, which is concerned in the examination. The amounts of time they pay to learn the course to pass the test is the cost of not cheating are their costs, which are a1, a2 respectively.

If they do not spend time in the course, and want to pass examination by cheating, the costs of cheating exist, too. Psychological burden is concerned here, set b1 and b2 for student A and B respectively. The conclusion is obvious, a1>b1, a2> b2.

The benefits of not cheating are set to c1 and c2 for A and B. And the receipts of cheating are set to d1 and d2. If one of them is not cheating, the other one gains an extra receipt, e1 for A, e2 for B. where a1, a2, b1, b2, c1, c2, d1, d2, e1, e2>0.

The analysis above is showed in the test game payoff matrix of student A and B, in table 1 below.

table 1 test game payoff matrix of student A and B

		Student B	
		Not cheat	cheat
Student A	Not cheat	c_1-a_1, c_2-a_2	c_1-a_1, $d_2+e_2-b_2$
	cheat	$d_1+e_1-b_1$, c_2-a_2	d_1-b_1, d_2-b_2

B. Model analysis

It is found in the strategies of the two students easily that A will cheat when $c1-a_1<d_1-b_1$; B will cheat when $c_2-a_2<d_2-b_2$; both will cheat when $c_1-a_1<d_1-b_1$ and $c_2-a_2<d_2-b_2$; In one word, when they gain less from not cheating than from cheating, the students choose to cheat.

The formation of the inequality $c_i-a_i<d_i-b_i$ transform into the form below,

$$d_i-c_i>b_i-a_i \qquad (1)$$

Because $a_i>b_i$, namely $b_i-a_i<0$, as long as

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$d_i - c_i \geq 0$,Eq.(1) is perpetually correct.

For the students, cheating helps them pass examination easily or brings higher scores than not cheating, that is $d_i \geq c_i$. So we can see that both A and B have their best ways, both of which are cheating. And the strategy combination is (cheat, cheat).

Colleges students are taken as rational man, who know to choose their decision-making for maximize efficiency. Therefore, the internal factors of prevalence of cheating are that the net proceeds of cheating are greater than not cheating under normal circumstances.

III. GAME BETWEEN THE PROCTOR AND STUDENTS

A. Model Establish

The model studies the situation of proctor and student in one examination, who are the two sides in the game. The proctor and student understand the information completely. And both of them know their benefits and costs clearly. They do not know the choice of the other, while they must choose at the same time. That is a complete information static game.

For the student, the strategy space is {cheat, not cheat}, while for the proctor the strategy space is {poor invigilation, effective invigilation}. The strategy combination of proctor and student is {(not cheat, poor invigilation), (not cheat, effective invigilation), (cheat, poor invigilation), (cheat, effective invigilation)}

In the model, when not cheating, the cost is A1, the benefit is B1; when cheating, the cost is A2, the benefit is B2, according to the analysis above, we know that A1>A2, B2≥B1. If the student is caught while cheating, he will be punished severely, which bring him benefit by –B3, which is much great bigger than B2. That is $B_3 >> B_2$.

For the proctor, no matter he invigilates poorly or efficiently, he has to spend the corresponding time for invigilation as the cost, which is not considered in the model for simplicity. But as a rational man in the model, he can choose to be lazy or seriously. So we take the attention focused on the examination as the cost of the proctor's. The cost of effective invigilation is C, and poor invigilation needs no cost.

If the student cheats, the proctor will be punished for his lax job, which brings him a negative return –D1. On the contrary, he could get a reward D2 when catching a cheating student if he works seriously. Where A1, A2, B1, B2, B3, C, D1, D2>0.

By the analysis above the payoff matrix of proctor and student is here now.

Table 2 payoff matrix of proctor and student

		proctor	
		poor invigilation	effective invigilation
student	No cheat	$B_1 - A_1$, 0	$B_1 - A_1$, $-C$
	cheat	$B_2 - A_2$, $-D_1$	$-B_3 - A_2$, $D_2 - C$

B. Model analysis

It is can be seen that for both sides of the payment matrix there is no Nash balance in model. It is a mixed strategy game. In fact, if the student cheats, the invigilator should take some measures to stop them cheating, otherwise, if the invigilators do their deed well, students will choose cheat, otherwise they will not.

1) If t is fixed, expectations of earnings of the proctor who invigilate poorly.

$$EJ\big|_{r=0} = (1-t)\times 0 + t\times(-D_1) = -tD_1 \quad (2)$$

The expectations of earnings of the proctor, who works effectively is,

$$EJ\big|_{r=1} = (1-t)(-C) + t(D_2 - C) = tD_2 - C \quad (3)$$

Make $EJ\big|_{r=0} = EJ\big|_{r=1}$

The best probability of cheating to students is

$$t^* = C/(D_1 + D_2)$$

2) If r is fixed, the expected return of students for not to cheat is

$$EX\big|_{t=0} = (1-r)(B_1 - A_1) + r(B_1 - A_1) = B_1 - A_1 \quad (4)$$

Expected return of students who cheat is

$$EX\big|_{t=1} = (1-r)(B_2 - A_2) + r(-B_3 - A_2) = B_2 - A_2 - r(B_2 + B_3) \quad (5)$$

Make $EX\big|_{t=0} = EX\big|_{t=1}$,

The best probability for proctor who supplies effective supervision is,

$$r^* = (B_2 - A_2 - (B_1 - A_1))/(B_2 + B_3) \quad (6)$$

3) The best probability of student cheating is *t**,

$$t^* = C/(D_1 + D_2) , \quad (7)$$

Which shows that, C is an approximate constant, which means the proctor pays similar energy while effectively invigilating. So the value of *t** depends on *D*1 and *D*2. When the proctor can take more reward from school for his effective job in examination, the probability of student cheating *t** reduces, while D1 and D2 increase.

4) The best probability of proctor effective invigilation is *r**,

$$r^* = (B_2 - A_2 - (B_1 - A_1))/(B_2 + B_3) \quad (8)$$

Which shows that A1, A2, B1, B2 are approximate constants, while the costs and returns of cheating and not cheating are almost unchanged for the student himself. When punishment for cheating B3 decreases, *r** increases.

In other words school turn low the punishment for the student who cheating Proctor's supervision will increase, Thereby reducing student cheating, in fact, If the school punished the students for cheating too heavy ,such as Cancel Degree, Then the proctor found the student cheating, he will consider the results of students were arrested, Could not bear to punish, Just take a verbal warning, But the use of morality, warning and other soft constraints to limit the cheating students often are not binding,

5) Schools reduce the punishment of students is not unlimited, it has a scope. If the punishment is too light cheating students, while reducing the risk of students cheating, it also reduces the cost of student cheating, so that the net proceeds of cheating than students not to cheat net, so that students choose to cheat, When r is constant, if $EX\big|_{t=0} > EX\big|_{t=1}$

That $$B_1 - A_1 > B_2 - A_2 - r(B_2 + B_3)$$

$$B_3 > \frac{B_2 - A_2 - (B_1 - A_1)}{r} - B_2$$

The students choose not to cheat.

Make $1/r = s$, $B_2 - A_2 - (B_1 - A_1) = \alpha$, $-B_2 = \beta$, that

$B_3 > \alpha s + \beta$

So $B_3 = \alpha s + \beta$ (9)

Linear regression model can be derived the relationship between B3 and s, and to determine the lower limit of B3.

IV CONCLUSIONS AND RECOMMENDATIONS

From the analysis above, we can draw the conclusions:

A. The underlying causes of students cheating in exams is the net income of cheating is bigger than not in resent examination environment. College students will choose to cheat as a rational man. In response, schools should step up publicity; you can also set up a reporting system, increase mutual supervision among students themselves.

B. The way to stop students cheating is to increase the level of awards and punishment to proctors to incent them to effective job.

C. Schools reduce appropriately the penalty for cheating, which help proctors increase intensity within a certain range, thereby to reduce student cheating.

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