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# Introduction

Various theories of the relationship between lecturer and student show that a student’s actions are often influenced by the behaviour of their lecturer ([Conrad, 1983](#ref-power)), ([Conrad, 1991](#ref-comm)), ([Liu & Shi, 2017](#ref-trust)). Identity-based motivation theory posits that a relationship of trust and leniency between student and lecturer causes both to better reach their goals, increases performance, and improves mental health ([Liu & Shi, 2017](#ref-trust)). Lecturers often require students to complete tasks, including essays, before a deadline. Game theoretic models provide a useful framework to analyse the interactions between a student and lecturer ([Osborne, 2004](#ref-book)) since it offers insights into when a student may choose to miss a deadline and when a lecturer will give an extension, in the presence of incomplete information.

The paper considers the strategic interaction of students and lecturers in the context of dynamic games of incomplete information. A student is required to submit an assignment with by a certain deadline, but experiences a crisis and must choose whether to hand in either on time or late. Both players have continuous type spaces and a discrete set of actions.

The remainder of the essay is organised as follows. section discusses the literature on games of incomplete information with applications. Section presents our model of deadline adherence. Section analyses the solutions to the game. Section provides an extension of the game and the final section concludes.

# Games of Incomplete Information

When making decisions, agents often do not have full information ([Trabelsi, 2020](#ref-2020games)). [Von Neumann & Morgenstern](#ref-von) ([1944: 30](#ref-von)) first used the term to describe a model in which parts of the normal form structure was unspecified. However, Von Neumann and Morgenstern deemed further research into such a model unimportant ([Myerson, 2004](#ref-2004com)). [Luce & Adams](#ref-luce1956) ([1956](#ref-luce1956)) disagreed and extended on the incomplete information literature by assuming that each player has a perception of the payoff function of the other player. A player’s perception does not have be a true reflection of the other player’s payoffs, but it forms the basis of the player’s strategy. [Harsanyi](#ref-harsanyi) ([1995](#ref-harsanyi)) developed a general analytical framework for games of incomplete information, which made it practical to solve the games.

Following [Harsanyi](#ref-harsanyi) ([1995](#ref-harsanyi)) approach, players have less than full information about each others payoff functions and, based on Bayesian methodology, both players have expectations in the form of subjective probability distributions. Both players estimate the probability that the other player is of a certain type, subject to the available information. To solve the model, the game of incomplete information will be reinterpreted as a game with complete and imperfect information, through transforming its basic mathematical structure by adding nature as a third player.

# A Model of Deadline Adherence

The model of deadline adherence sheds some light on how students think about assignment submissions, and how lecturers respond when assignments are submitted late. In the model, a student receives an assignment with a due date set by the lecturer. While the student is working on the assignment, she experiences a crisis and therefore spends less time on the assignment. She has two options: she can hand in the assignment on time or she can hand in late. If she hands in on time, she will get a payoff of , where is her potential pre-crisis mark, and is the negative academic impact of the crisis. Submitting late gives the student the opportunity to recover some of the cost of the crisis on her final mark. If the lecturer gives her a penalty for late submission, her payoff is , where is the percentage point penalty subtracted from her final mark. If the lecturer decides the waive the penalty, the student gets a payoff of . The parameter represents the type of the student. A low suggests a strong academic resiliency, whereas a high suggests low resiliency. The student observes her own type but not the lecturer’s type. The lecturer decided whether to give a penalty, , if a student submits late. The lecturer has disutility from giving a penalty since the student submitted late due to a crisis. The magnitude of her disutility depends on the magnitude of the penalty, , , and the lecturer’s degree of empathy. The parameter denotes the lecturer’s penalty, describing her type. A higher implies that a lecturer is more empathetic. The lecturer observes her own type but not the student’s type. If the lecturer does not impose a penalty, he derives benefit from helping a student through a difficult time academically, yielding the payoff . The lecturer knows that by waving the penalty, he may be encouraging this student, and other students to hand in late in the future. The lecturer would rather deter late hand-ins, and receives a negative payoff for not deterring[[1]](#footnote-22) late hand-ins.

The lecturer and student both have continuous type spaces, which are assumed to be independently and randomly chosen by nature at the start of the game from a uniform distribution[[2]](#footnote-23): and . The parameters are all common knowledge. Each player needs to choose her action based on her own type, their beliefs of the other player’s type, and the values of parameters . Figure shows the game in extensive form[[3]](#footnote-24) and figure shows a summary of the game’s parameters.

# Results and Discussion

In order to understand how the lecturer and student will make their decisions given their beliefs, we need to solve for their best responses. A best response for the student would be to hand in on time if the expected payoff from handing in on time is higher than the expected payoff of submitting late. Defining as the probability that the lecturer will give a penalty, a student should hand in on time where: The right hand side is a constant[[4]](#footnote-26). This implies that there is some threshold value of , for which a student should hand in on time. If the student believes that the lecturer will give no penalty (i.e. ), then she should only hand in on time if . Since lies between and , the inequality will never hold and she should always hand in late. From an intuitive stand point, this makes sense: a student can never do worse by handing in late if there is no penalty[[5]](#footnote-27) but she will do better to hand in late if she is resilient in any way () and can partially recover from the crisis.

However, if the student believes that the lecturer will give a penalty with some positive probability () then her decision to hand in on time depends on her level of resiliency, the magnitude of the crisis and the size of the penalty. As the cost of the crisis increases, the threshold value increases (ceteris paribus), and the student becomes more likely to hand in late (unless her she has a very low resiliency). If the mark penalty is high, the threshold value is smaller, and the student is more likely to hand in on time (unless is very resilient: is very low). We can analyse the lecturer’s best response rule similarly. The lecturer should impose a penalty where:  
 The threshold value for the lecturer is the ratio between the deterrent factor and the sum of the crisis cost and the penalty mark. If the deterrent factor is high relative to the cost of crisis and the penalty mark, then the lecturer is more likely to give a penalty (unless he is highly empathetic). If the cost of the crisis large and the mark penalty is high relative to the deterrent factor, the lecturer is more likely to waive the penalty (unless he has very low empathy levels).

While the best response analysis is useful, if we want to understand the outcome of the game and the players’ strategies, we need to solve for the Bayesian Nash Equilibrium (BNE). The full derivations of the solution concepts are given in the appendix ().

After observing her private type, the student chooses the following hand-in pattern:

And the lecturer’s BNE strategy is given by:

When the lecturer and the student play their equilibrium strategies, neither has an incentive to deviate and we get a Bayesian Nash equilibrium. We would interpret the student’s BNE strategy similarly to her best response; however, her strategy profile only depends on her own type and no longer on her beliefs about the lecturer’s type. The lecturer’s best response function and equilibrium strategy profile are the same because the lecturer observes whether the student hands in late or not and therefore has no need to hold beliefs about when the student will hand in.

# Extension

We extend the game explained in section to account for grade inflation. The lecturer has an incentive to inflate a students grades higher grade is associated a more favorable evaluation from the student. Favorable evaluations are linked to an in salary and promotions for the lecturer ([Goswami & Mumit, 2018](#ref-2018grades)). However, inflating a grade is ethically wrong therefore the lecturer incurs cost if he decides to inflate. If the lecturer, then he occurs a empathy cost . A student experiences a cost of for asking the lecturer and the lecturer experiences a cost of of being bothered by the student . If the lecturer decides not to penalize the student, then he will never choose to inflate a students mark. Knowing this, a student that hands in late and receives no penalty will always accept his mark. If a student hands-on time, a lecture will always leave the mark unchanged at the request of the student, therefore the student will always accept the mark. If the lecturer decides to penalize a late student, the lecturer will choose to inflate a student’s mark if the ethical cost is smaller than the empathy cost the lecturer experiences.

If the ethical that the lecturer experiences is bigger than the empathy cost the lecturer experiences for giving a penalty, then the lecturer is strict, otherwise the lecturer is lenient. Therefore, a strict lecturer will not inflate a student mark but a lenient lecture will ([Franz, 2010](#ref-2010grade)).

A summary of the game’s parameter’s and restrictions are shown in table and the game is represented in Figure

# Conclusion

The results of the model are intuitive and provide a useful insight into how student’s think about handing in assignments, and how lecturers respond to late submissions. One shortcoming of the model is its assumption that is common knowledge. Although some lecturers are in touch with their students and would know whether they are experiencing a crisis and how impactful the crisis would be, most lecturers have too many students to know that information.

Extensions, generality Shortcomings

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# Appendix A

# Appendix B

## Payoffs

Student payoffs: Student plays on time if: Student plays late if: Lecturer Payoffs: Lecturer gives a penalty if: Lecturer gives no penalty if:

## Best Responses

Solving for the best responses: Substitute into the student’s best response function - student hands in on time if: Since , cannot be greater than 1. This implies Since , this condition will always hold.

cannot be less than 0: if , otherwise: Best response function for the student: Best response function for the lecturer:

## Bayesian Nash Equilibrium

The Bayesian Nash equilibrium occurs at the point where the best response functions intersect. For the BRFs to cross: BNE strategy for the student BNE strategy for the lecturer

1. This deterrent parameter relates to the literature on games of repeated interaction and reputations ([Clark & Montgomery, 1998](#ref-deter)). [↑](#footnote-ref-22)
2. A uniform distribution puts equal chance on any of the outcomes between 0 and 1 happening. Other more realistic probability distributions have been omitted for ease of interpretation. Assuming a normal distribution would give a similar interpretation of how changes in parameters affect the outcomes but would needlessly complicate the game. [↑](#footnote-ref-23)
3. The simultaneous form game can be found in the appendix [↑](#footnote-ref-24)
4. Since and are known, and is a belief the student holds. [↑](#footnote-ref-26)
5. Handing in late is a weakly dominant strategy. [↑](#footnote-ref-27)