Pricing and Revenue Management

ORIE 6154: Syllabus

Fall 2016

Essential Course information:

Lectures and Recitations
Class time: TR 1:25pm-2:40pm
Class location: Phillips 307
Website: http://people.orie.cornell.edu/sbanerjee/ORIE6154/orie6154f16.html

Instructor
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Office hours: Wednesday 2pm-4pm

Course description:

Revenue Management – "*the art and science of selling the right product to the right customer at the right time for the right price*" – is one of the youngest, and yet, most influential disciplines of Operations Research. It combines together probabilistic modeling, optimization techniques and data analytics to determine how different firms should make capacity and price decisions. The field is based on a well-developed body of research, which has proved successful in practice across many industries; simultaneously however, with the advent of online commerce and increased use of smartphones, it is in the process of undergoing rapid transformation.

The goal of this course is to provide an introduction to the theory and practice of revenue management, and also provide a glimpse of the frontiers of the field.

Detailed Course description:

We will first go over the fundamentals of revenue management, in five modules:

1. **Quantity-based RM**: Intro to dynamic programing; capacity allocation and protection levels for a single leg with single and multiple fare classes; overbooking.
2. **Price-based RM**: Basic pricing theory; dynamic pricing
3. **Network RM**: decomposition methods, approximate dynamic programming; stochastic approximation techniques.
4. **Choice-based RM**: Choice models; assortment optimization.
5. **Joint demand estimation and RM**: dynamic pricing with demand learning; the multi-armed bandit paradigm; contextual bandits

In addition, based on time and class interest, we will study some subset of the following topics:

1. **Price discrimination**: Customer segmentation; bundling.
2. **Pricing in Competitive settings**: Pricing under Bertrand and Cournot competition
3. **Pricing under network externalities**: The role of network structure; referral incentives.
4. **Econometric Methods in RM**: Learning customer behavior; A/B testing.

Course Goals

This course aims to provide students with three learning outcomes:

1. A toolbox of RM techniques: The primary goal of the course is to demonstrate how the core OR tools (stochastic modeling, optimization, data analytics) come together in various pricing and revenue management problems. Students will learn a variety of techniques that should prove useful across many diverse application domains.
2. Fundamental methodologies: The course will also expose students to several fundamental OR methodologies, including dynamic programming; approximation techniques; choice modeling; bandit paradigms; models of firm competition; etc.
3. Research Problems: This is an exciting time for pricing and revenue management, with new applications and e-commerce platforms driving a host of new research directions, and providing data and testbeds for validation. The course will expose students to some of these developments, and help them do independent research.

Prerequisites:

This is a graduate course in RM, with a focus on theoretical aspects and proofs. Students should be comfortable with basic graduate probability and optimization (at the level of ORIE 6500 and ORIE 6300, or equivalent). Prior exposure to algorithm design would be helpful, but is not necessary. Send me a mail if you are concerned about having the appropriate prerequisites.

Grading:

The grade will be based on four assignments (40%), one prelim exam (25%) and a project (35%). The assignments will run till the end of October, and the prelims will tentatively be held on the first week of November. Subsequent classes will be devoted to more recent topics, during which time the students should also focus on their project.

For the project, students need to submit a 1 page proposal on **Thursday, October 13, 2016** (right after fall break). The final class (December 1, 2016) will be kept aside for student project presentations, after which a final report is due during the finals period. Timely submission of the project proposal is worth 5%, the final presentation is worth 10%, and the remaining 20% is for the report.

Late homework policy: Assignments will be due in class on Thursdays, and all assignment scores will count towards the grade. Students are allowed a total of 4 days of delay on assignments (a Friday submission counts as 1 day delay, Saturday as 2, and so forth), which they can use as they see fit between assignments. After the 4 days expire, assignments will not be accepted.

Textbook:

There is no required textbook; however, an excellent source for a lot of the topics we will cover is:

- The Theory and Practice of Revenue Management by Talluri and van Ryzin

This book collects most of the main revenue management results as of the mid 2000s, as well as a nice summary of the applications of RM in various industries.

Two other nice references for the material are:

- Pricing and Revenue Optimization by Robert Phillips
- Principles of Pricing by Vohra and Krishnamurthi

Both these books are more suitable for an undergraduate/masters level course, but may be interesting for the students to read. The former covers similar material as the Talluri and van Ryzin book, but at a less formal level, and with more background; the latter is an introduction to pricing from economics and marketing perspectives.

For more recent material, I will maintain a list of papers – some of these we will cover in class, while others can serve as a starting point for projects. The list will be maintained on a shared document, and students are encouraged to contribute to the list.

Any additional material will be posted on the course website.

Academic integrity:

You are expected to abide by the Cornell University Code of Academic Integrity. Any work submitted by you in this course for academic credit should be your own. The complete code is available at http://cuinfo.cornell.edu/Academic/AIC.html.