

Math 430 Team Project

Sustainable Tourism

Background

Juneau, Alaska, with a population of about 30,000 residents, set a record in 2023 with 1.6 million cruise passengers, hosting as many as seven large cruise ships on the busiest days, with upwards of around 20,000 visitors [1]. While these tourists bring in substantial revenue for the city, on the order of \$375 million [2], they also bring issues related to overcrowding that have the city working to limit the number of guests [3]. Ironically, Mendenhall Glacier, one of the premier attractions in Juneau, has been receding, primarily due to warming temperatures caused, in part, by overtourism. The glacier has receded the equivalent of eight football fields since 2007, leading many locals to worry that the tourists and associated revenue will eventually disappear with the glacier [4]. Fortunately, Juneau has other attractions, including whale watching and rain forests, and can maintain their status as a tourist destination, provided they can develop and enact a plan for sustainable tourism.

Recent reports [5] have highlighted the hidden costs of tourism at destinations around the world and the growing need to account for and manage these costs to protect natural and cultural resources and build a sustainable tourism industry on which numerous communities depend. These hidden costs include pressure on local infrastructure including drinking water supplies, waste management, and an overall increased carbon footprint in tourist destinations, many of which lie in environmentally sensitive regions. Local populations are also under pressure due to housing supplies and costs, overcrowding, and rowdy tourists. Various measures have been enacted to attempt to ease the burden, including increased hotel taxes, visitor fees, caps on the number of daily visitors, and restrictions on alcohol sales and consumption. Additional revenue from taxes have been used to support conservation, make improvements in infrastructure, and develop community programs. While many locals that depend on tourism are concerned that additional fees might drive tourists away and would rather see the number of visitors, and their businesses grow, many other locals are becoming disgruntled and either leaving or protesting against tourists.

Objectives

- Build a model for a sustainable tourism industry in Juneau, Alaska. You may want to consider factors such as the number of visitors, overall revenue, and measures enacted to stabilize tourism. State clearly which factors you are optimizing, and which factors serve as constraints. Include a plan for expenditures from any additional revenue and show how these expenditures feed back into your model to promote sustainable tourism. Include sensitivity analysis and discuss which factors are most important.

Note: The City and Borough of Juneau has already enacted some measures to stabilize tourism. These measures can be included in your model, or you can ignore these measures, devise your own measures and sustainability plan, and then evaluate the effectiveness of your plan against the existing measures.

- Demonstrate how your model could be adapted to another tourist destination impacted by overtourism. How does the choice of location effect which measures will be most important? How might you use your model to promote attractions and/or locations that have fewer tourists to develop a better balance?

Requirements

- Create a technical report detailing your team's work on this project. Your report should begin with a one-page executive summary written for the tourist council of Juneau outlining your predictions, the effects of various measures, and your advice on how to optimize outcomes.
- Prepare a 30-40 minute presentation detailing your team's work on this project. This is a technical presentation. Assume the audience is familiar with the problem and technically knowledgeable.

Important Notes

1. A highly detailed grading rubric is posted in OneNote for your reference. Generally, your grade on the project is based on the following:
 - the strength of the critical thinking/logical reasoning demonstrated in the creation of your model,
 - your ability to correctly implement your problem-solving methods,
 - your ability to accurately interpret quantitative information,
 - your ability to effectively communicate your work,
 - your ability to function productively as a team, and
 - your personal contribution to the project work.
2. Use of artificial intelligence for modeling, problem solving, coding, and report writing is inappropriate. Use of AI for any of these aspects will constitute an academic integrity violation and will have grade implications.
3. The schedule outlined in the syllabus provides detailed week-by-week activities and assignments, including deadlines, associated with the project. Noteworthy dates:
 - a. **Thursday, March 13:** Your team must have completed a simple model investigating this problem. Try to finish your simple model before this date if possible.
 - b. **Wednesday, March 19:** Complete anonymous team member feedback form.
 - c. **Thursday, April 3:** Your team must have all modeling and problem analysis complete. You will turn your attention to writing your technical report and creating presentation slides.
 - d. **Wednesday, April 16:** Complete anonymous team member feedback form.
 - e. **Wednesday, April 23:** Your team's technical report, presentation slides, task schedule, code and/or spreadsheets are due.
 - f. **TBD:** Your team will make an oral presentation on your work.
4. The purpose of creating a "simple" model as soon as possible is simply to steer your team away from doing large amounts of online research, worrying about all the complicated details and things you don't know, and the fear of "getting it wrong", to **create** a model from scratch that intuitively makes some sense to your team. You'll need to make several simplifying assumptions and have a small number of parameters and variables. That's normal. Remember what you learned in Math 230: Modeling is an iterative process. Start with a simple model and then repeatedly (and systematically) modify it to account for factors you hadn't included previously. So, the simple model is just a starting point. The sooner your team builds it, the more time you'll have to test it, improve it and study interesting questions.
5. In your first week, you'll want to do some research related to Juneau and aspects of tourism. There are a number of resources at the end of this document that will assist you in getting started, and

you are welcome to utilize other sources as well. But, you MUST resist the urge to constantly look online for answers to all your questions. When teams do this, it takes time away from problem solving and they fall behind. Mathematical modelers are rarely ever experts on the topic they are investigating. If you can't find certain information within a relatively short amount of time, then make assumptions or reasoned guesses, or take a step back and consider why you're looking for that information and whether another option exists to bypass your issue.

6. Reflect carefully on the parameters in your model. Be very clear about their meaning, units of measurement (if they exist), and plausible values (or plausible ranges of values).
7. Recall that sensitivity analysis is an investigation into the impact of problem parameters on a model's outputs. Sensitivity analysis is typically performed by changing the value of a single parameter and observing how the change impacts the outputs of a model. It's used for a variety of purposes:
 - It can reveal which parameters are most important for controlling and shaping the output of a model.
 - It can reveal how model outputs respond to different conditions.
 - In situations, where a parameter's value isn't known with any certainty, sensitivity analysis can be used to gauge the impact on the model outputs caused by limited precision in the parameter value.
8. Pack as much work into each week as you can!
9. Every team member will provide anonymous feedback to each of their teammates about their work on the project. The purpose is to give each team member valuable information about their performance with the intention of helping all team members improve. Feedback is provided twice during the project to give team members an opportunity to see improvement in areas teammates identified for improvement. Note: This activity also supports resume development because you can use the feedback received to objectively highlight areas of strength. This is a required activity. Team members receive completion credit for providing feedback. However, team members are not graded on the feedback received.

References

- [1] <https://abc7.com/post/juneau-alaska-cruise-ship-limits-overtourism/15048713/>
- [2] <https://juneau.org/wp-content/uploads/2024/01/CBJ-Cruise-Impacts-2023-Report-1.22.24.pdf>
- [3] <https://www.seattletimes.com/life/travel/ship-free-saturdays-juneau-votes-against-limiting-large-cruise-ships/>
- [4] <https://alaskapublic.org/2023/08/07/crammed-with-tourists-juneau-wonders-what-will-happen-as-mendenhall-glacier-recedes/>
- [5] <https://www.thetravelfoundation.org.uk/invisible-burden/>

Other Sites

Memorandum of Agreement Between CBJ and Cruise Companies

https://juneau.org/wp-content/uploads/2022/08/CLIAA-CBJ-MOA-1_7.27.22_Signed.pdf

Alaska Cruise Tourism Impacts

<https://www.usatoday.com/story/travel/cruises/2025/02/02/alaska-cruises-environmental-impacts-juneau-ketchikan/77543207007/>

Transportation

<https://alaskapublic.org/news/2023-07-24/as-mendenhall-glacier-hits-tour-capacity-juneau-visitors-are-opting-for-the-city-bus>

Shore Power

<https://www.aelp.com/About-Us/Latest-News/shore-power-milestone-celebrated>

Juneau Air Quality Study

<https://dec.alaska.gov/air/air-monitoring/guidance/data-summaries/cruise-ship-monitoring/>

Solid Waste Management

<https://www.ktoo.org/2024/01/29/cruise-ships-dumped-90-less-trash-in-juneau-last-year/>

<https://juneau.org/wp-content/uploads/2024/02/JCOS-Solid-Waste-Factsheet-March-2021.pdf>

Survey of Juneau Residents

https://juneau.org/wp-content/uploads/2022/12/Juneau-Tourism-Survey-2022-Report-REV-12_1_22.pdf

Economic Indicators

<https://www.jedc.org/wp-content/uploads/2024/11/2024-JEDC-Juneau-SEAK-Economic-Indicators-and-Outlook-Report.pdf>