Instructions

This exercise is meant to serve two purposes: First, to act a demonstration of work on a simplified version of the type of problem you'd be asked to solve were you to join Icon. Second, to act as a reference point for concepts related to the needs of the role that we can cover in more detail during a live interview so as to better understand how you approach problems.

You are welcome to use whichever technologies, programming languages, or development environments in which you are most comfortable and think are appropriate. However, you should aim to provide:

- Code used to produce accompanying output and/or detailed descriptions of methods used (e.g. SQL/Python/R files, SQLite instance, Jupyter notebook)
- Any accompanying output which you deem to be relevant (e.g. tables, decks, notebooks)

You will have 7 calendar days from receipt to return final output, though our hope is this will take ~4 hours of focused time in total.

Please note that it is acceptable to submit a partially completed assignment if you're approaching the allotted time. If this is the case, please indicate the next steps you would take with additional time.
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Prompt

In partnership with three new employer based customers, Icon Health has gone live in a new region. These employers have shared information on which providers in the area are in-network for their insurance plan (**employer_in_network**).

In preparation for go-live, Icon obtained data on local orthopedic surgeons (**providers**), including the historical procedures they performed, their associated cost (**encounters_details)**, and whether those (**patients**) experienced a subsequent (**adverse_event**).

The first 200 (**referrals**) have now been received by our team.

Given these new referrals, and accounting for the constraints below, ***please design a solution which will assign each referral to the optimal provider, with the end goal of 1) minimizing cost while 2) maintaining or improving clinical quality outcomes***.

Assumptions / Constraints

1. The expected paid_amount for any procedure is the mean of all historically performed procedures by that provider, as indicated in **encounters_details**
   (e.g. npi = 1063494227 has performed procedure cpt = 29888 four times, for $5,494, $12,722, $5,716, $5,388. The paid_amount for this procedure with this provider should be assumed to be $7,330)
2. Patients can only receive care from a provider who practices in their same zip code. It can be assumed that this is true of the historical record as well
   (i.e. patients have only received care from providers practicing in their same zip code)
3. All providers are able to perform all procedures, even if there is no evidence of their having done so in the historical sample
4. Each provider's capacity is half of the volume seen in their historical record for any particular procedure (rounded up where applicable)
   (e.g. using the example above, it should be assumed that this provider (npi = 1063494227) would be able to perform two procedures, where cpt = 29888. A provider who had performed 5 of these procedures in the historical record, would be eligible to receive referrals for 3 procedures. A provider who had performed 0 of these procedures would be able to receive 1 referral for this procedure)
5. "Clinical quality outcomes" are assumed to be correlated with provider volume, such that sending a patient to a provider who performs a higher than average volume of a particular type of procedure will improve quality/clinical outcomes, and sending a patient a provider with lower than avg volume will result in a worse quality/clinical outcome

Questions

1. How would you go about calculating and explaining the value we provided with this approach (either through cost savings or improved quality outcomes) to these three employer customers?
2. Based on this data, which types of new providers would be most beneficial to have access to?
3. Is provider-procedure volume a good proxy for clinical quality? Is there a better option you could propose?
4. What other data might you ask for to be able to perform better on this task?