Computational Assignment

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Codes are available on Github(links here), I also write a readme for them.

Computational Assignment for PPHA44320

Results are reported in response.pdf.

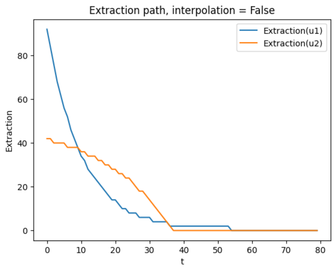
To replicate those figures:

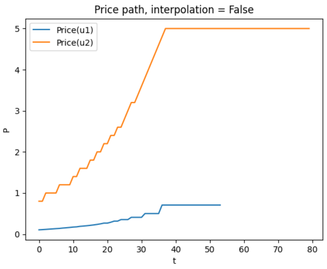
1. Required packages are: numpy, matplotlib, scipy, and numba (making this code slightly faster).
2. Run 44320cc_2.py with python first, then call 44320CA1.py to obtain 4 figures for problem 1 and 2. It should generate figures in the directory of source codes.
3. N could be manually modified in 44320CA1.py to get nice smooth curves. For N no larger than 10000, the performance would be fine.
4. Run 44320CA3 to get results for problem 3.

Since I'm using Windows, I didn't test them on MacOS. In case the scripts won't run, you might delete the savefig lines and location lines and simply use plt.show().

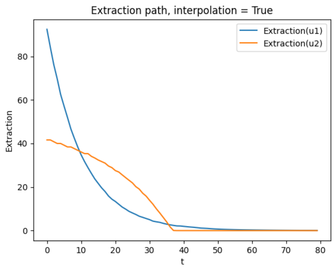
Problem 1 & 2

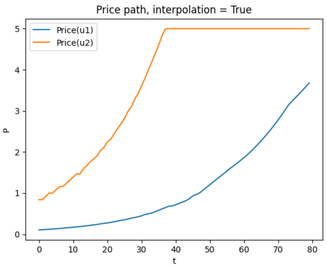
$N = 501$: Without interpolation, the extraction and price paths are not smooth. The price in u1 setup should goes to infinity as extraction goes to zero, but for step size = 2 this won't happen, as extraction is not allowed to be a tiny number. I didn't draw price for periods with 0 extraction (and I am not able to).





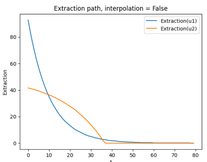
When interpolation is utilized, the extraction and price paths are smoother. We see that extraction is not zero when utility function is u1. This is due to the fact that we have a much smaller step size near zero. Consequently, the price tends to explode(but not obvious since extraction is not too low). In both Q1 and Q2, the price is capped at 5 when utility function is u2 (u' is bounded).

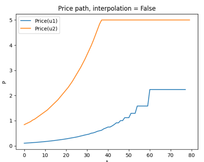


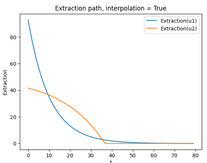


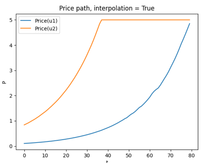
We could use a smaller step size to make the curves smoother!

$N = 5001$, this takes around 160s to run:









And we see that interpolation is useful here, it achieves smoothness with much smaller grid size.

Problem 3

The trigger price is 41 as expected(the first price that control = 1). The drilling option becomes more valuable as price goes higher(intuitively like a opportunity cost). At $p = 41$ and after, it is no longer valuable(or irrelevant?) as you decide to drill today at this price. There's no uncertainty after drilling. So I think both a vertical line(so that no more curves after p=41), and horizontal line on value = 0 make sense here.