Lexicographic Preferences Workouts

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A car can have any integer number of cup holders $\{0, 1, 2, ...\}$ and any horsepower in $[0, 1000]$.

A consumer has lexicographic preferences over these cars and prefers more cup holders regardless of the horsepower, but prefers more horsepower if two cars have the same number of cup holders.

A. Prove these preferences are transitive and complete.

B. Pick a point on the cup holder / horsepower plane. Label it x. Sketch and label the better than and no-better-than sets $\succsim (x)$ and $\precsim (x)$. Are either of these sets open?

C. Write down a continuous utility function that represents these preferences.

Another consumer has lexicographic preferences over these cars and prefers more horsepower regardless of the cup holders, but prefers more cup holders if two cars have the same amount of horsepower.

A. Prove these preferences are transitive and complete.

B. Pick a point on the cup holder / horsepower plane. Label it x. Sketch and label the better than and no-better-than sets $\succsim (x)$ and $\precsim (x)$. Are either of these sets open?

C. Prove no utility function represents these preferences.