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>>> Algorithmic and Operation Research  
>>> Project Topic Presentation
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# >>> Conic Duality

## A Briefing

- \* Linear and Conic Duality Problems
- \* Geometry of Primal and Dual Problems
- \* Conic Duality Theorem
- \* Is something Wrong?
- \* Consequences

## >>> Linear and Conic Duality Problems

The most important theoretical result in Linear Programming is the LP Duality Theorem...

- \* can this theorem be extended to conic problems?
- \* What is the extension?

## >>> Linear and Conic Duality Problems Cont/d

Answer:

- \* can this theorem be extended to conic problems? => *Yes!*
- \* What is the extension? => *That is our Presentation Topic;*)

## >>> Geometry of Primal and Dual Problems

The structure of problem (CD) looks quite different from the one of (CP).

BUT

geometrically, the problems are completely similar.

*Note:* Careful analysis shows that the difference in structures comes just from how we represent the data.

## >>> Conic Duality Theorem

### Theorem (Conic Duality Theorem)

*Considering a primal-dual pair of conic problems, we can prove that it is applicable to:*

- \* Weak Duality
- \* Symmetry
- \* Refined Strong Duality

## >>> Conic Duality Theorem Cont/d

The *Refined Conic Duality Theorem* covers the usual *Linear Programming Duality Theorem*. The latter, is the particular case of the former for  $m = 1$ .

>>> Is Something Wrong?

Oh well...

- \* LP duality is stronger than the Conic  $\Rightarrow$  The problem is not always feasible or bounded.
- \* It is possible to get similar results to those of the LP Duality Problem in the general Conic Problem case.



>>> Are There Consequences?

Yes...

...provided that the primal problem (CP) is strictly feasible,  $\exists x$  such that

$$A_x - \beta >_{\kappa} 0$$

or geometrically

$$L \cap \text{int}K \neq \emptyset$$

The End.