IE4211
Intro to Analytics and Modeling
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01. Intro
Mathematical Modeling
- Transforms problems into math for analysis to provide insights
- Building model creatively but choosing model analytically

Analytics
- Use **data** to build model and add value
- Data $\rightarrow$ Prediction $\rightarrow$ Decision

Descriptive "Wht has happened"
- Classification, unsupervised learning

Predictive "Wht could happen"
- Linear/Logistic regression, k-means clustering

Prescriptive "Wht to do"
- Linear and Integer programming

Newsvendor Problem
Problem statement
- Newsvendor sells newspaper everyday
- Vendor buy at \$.5 of y quantity
- Vendor sells min(D_{demand}, y) newspaper @ \$2

Optimal solution
Overage Buying more papers than demand c_o

Underage Buying less paper than demand c_u
- Buying more based on phi inverse
- $y^* = \mu + \sigma\phi^{-1}(\frac{c_u}{c_u + c_o})$
- Out of sample validation

Optimization
- Select a decision that max/min objective
- $Z^* = min(f(x)) \ \mid \ x \in \chi$
- $max(f(x)) = -min(-f(x))$
- Optimization problem can be

Infeasible Sample set is

Unbounded Z^* is continuously decreasing

Exists $f(x) \geq M$ and $x^* \in$sample where $f(x^*) = Z^*$

Multivariable
- Weighted average of variables
- Risk quantified as Variance bounded by expectation

Univariate Optimization
- Bounded by $a \leq x \leq b$ (a, b can be infinite)
- Only one decision variable
- Continuous in [a,b] and derivative $f'(x)$ should exist