Multi-criteria decision making

Optimization models

CASE STUDY OF EQUULEUS CAR SHARING

- Variables

X1	X2	X3	X4	D0	D1	D2	I1	I2
no. of minivan	no. of SUV	no. of Sedan	no. of Econom	Down payment	1st yr payr	2nd yer payr	yr 1 interest	yr 2 interest

- Input data
  - Discount rate = 15
  - %; interest rate = 4%; down payment>= 10% of price
  - Total Budget= $10000,000; payment by the end of year 1>=50% of price

Vehicle type	Minivan	SUV	Sedan	Economy
Purchase Price	$ 27,000.00	$ 22,000.00	$ 18,000.00	$ 14,000.00
Y1 N Rev	$ 15,000.00	$ 10,000.00	$ 9,000.00	$ 7,000.00
Y2 N Rev	$ 28,000.00	$ 19,000.00	$ 21,000.00	$ 15,000.00
PV of Rev	$34,215.50	$23,062.38	$23,705.10	$17,429.11

Linear Programing Model

Object, to maximize,

$NPV = 34.21 X1 + 23.06 X2 + 23.75 X3 + 17.43 X4 - D0 - D1/(1+K) - D2/(1+K)^2 - I1/(1+K) - I2/(1+K)^2$

Subject to,

Budget, $D0 \leq \$10,000$

No. of vehicles, $X1 \geq 0.15(X1+X2+X3)$; $X1 \leq 0.5(X1+X2+X3)$

$X2 \geq 0.15(X1+X2+X3)$; $X2 \leq 0.5(X1+X2+X3)$

$X3 \geq 0.15(X1+X2+X3)$; $X3 \leq 0.5(X1+X2+X3)$

$X4 \geq 0.15(X1+X2+X3)$; $X4 \leq 0.5(X1+X2+X3)$

Payoff, $27X1+22X2+18X3+14X4 = D0+D1+D2$

Linear Programing Model

- Down payment, $D_0 >= .15(27X_1 + 22X_2 + 18X_3 + 14X_4)$
- Payment up to year 1, $D_0 + D_1 >= 0.5(27X_1 + 22X_2 + 18X_3 + 14X_4) + I_1$
- 1st year interest, $I_1 = 0.04(27X_1 + 22X_2 + 18X_3 + 14X_4 - D_0)$
- 2nd year interest, $I_2 = .0.04(27X_1 + 22X_2 + 18X_3 + 14X_4 - D_0 - D_1)$
- 1st year cash flow, $D_1 <= 15X_1 + 10X_2 + 9X_3 + 7X_3$
- 2nd year cash flow, $D_2 <= 28X_1 + 19X_2 + 21X_3 + 15X_4$