QUESTION 1

Use the Matlab `linprog` function to plot the efficient frontier of the Ad Lib Marketing problem with the following data.

Exposure Statistics: Exposures in 1,000's per $1,000 spent

Market Group	1	2	3	4	5	6	7
TVL	0	1	5	50	1	0	13
TVP	0	3	40	1	4	0	0
BLB	30	0	0	0	0	1	40
NEW	4	0	0	0	0	13	2
RAD	0	3	13	60	50	5	0

Minimum Exposures:

Market Group	1	2	3	4	5	6	7
Minimum Number of Exposures Needed (in 1,000's)	19	40	30	10	16	12	17

Saturation Level:

Market Group	1	2	3	4	5	6	7
Saturation Level of Exposures (in 1,000's)	120	90	60	35	100	45	30

Plot the efficient frontier for values of the advertising expenditure **between 15 and 18** thousand dollars.

Within this range of advertising expenditure, give the value for which there is a corner point on the efficient frontier, to the nearest one decimal place.

Decision Variables:

TVL = [0, 1, 5, 50, 1, 0, 13]

TVP = [0, 3, 40, 1, 4, 0, 0]

BLB = [30, 0, 0, 0, 0, 1, 40]

NEW = [4, 0, 0, 0, 0, 13, 2]

RAD = [0, 3, 13, 60, 50, 5, 0]

Min Exposures = [19, 40, 30, 10, 16, 12, 17]

Saturation Level = [120, 90, 60, 35, 100, 45, 30]

UX_i = number of useful excess exposures = min{saturation level, actual exposure} – min required

UX_i = min{$\text{Saturation Level}_i$, ?} – Min Exposures_1

UX_1 = min{120, ?} – 19 = 101

UX_2 = min{90, ?} – 40 = 50

UX_3 = min{60, ?} – 30 = 30

UX_4 = min{35, ?} – 10 = 25

UX_5 = min{100, ?} – 16 = 84

UX_6 = min{45, ?} – 12 = 33

UX_7 = min{30, ?} – 17 = 13

Cost = total amount spent on advertising = 1:1 ratio to number of exposure

USEFULX = total useful exposures = sum of exposures for each exposure between inequality of 2^{nd}last and last row

Constraint Set 1: exposures in a market >= min required + useful excess exposure beyond min

$Exposure_i$ >= Min Exposures[i] + UX_i

Constraint Set 2: useful excess exposure in a market <= saturation level – min required; useful excess exposure in a market <= UX_i ??

UX_1 <= $Saturation\ Level_i$ – Min Exposure[i]

```
value=[];
for i = 15:0.01:18
b = -1*[19;40;30;10;16;12;17];
A = [[0 0 -30 -4 0 1 0 0 0 0 0 0;
   -1 -3 0 0 -3 0 1 0 0 0 0 0;
   -5 -40 0 0 -13 0 0 1 0 0 0 0;
   -50 -1 0 0 -60 0 0 0 1 0 0 0;
   -1 -4 0 0 -50 0 0 0 0 1 0 0;
   0 0 -1 -13 -5 0 0 0 0 0 1 0;
   -13 0 -40 -2 0 0 0 0 0 0 0 1]];
Aeq = [ones(1,5),zeros(1,7)];
beq = i;
lb = zeros(12,1);
ub = [+Inf;+Inf;+Inf;+Inf;+Inf;101;50;30;25;84;33;13];
f = [zeros(5,1);-1*ones(7,1)];
[x,fval] = linprog(f,A,b,Aeq,beq,lb,ub);
value = [value,-1*fval];
end
plot([15:0.01:18], value)
```