Convex Optimisation Tutorial 6

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February 23, 2022

(a) Assumptions made:

(1) The efficiency stays uniform throughout the week i.e. every day same amount of product is made and proportion of hours devoted to each product stays same.

(2) At the beginning of a week, the inventory is reset i.e. there are no products remaining in the warehouse and the sales team was able to sell all the products the previous week.

(3) No unexpected occurences like some natural disaster or market closure due to a sudden pandemic occurs.

```
area = np.array([40, 45, 210])/1e3
profits = np.array([4, 6, 10])
min_req = np.array([5e3, 0, 4e3])
max_demand = np.array([1e4, 15e3, 8e3])
daily_limit = np.array([6e3, 5e3, 3e3])
```

```
x = cp.Variable(shape=(3))
x_weekly_sold = cp.multiply(x,daily_limit)*5
constraints = [x_weekly_sold <= max_demand, x_weekly_sold >=
    min_req, x_weekly_sold@area <= 6e3, cp.sum(x)==1, x>=0 ]
objective = cp.Maximize(x_weekly_sold@profits)
max_profits_1 = cp.Problem(objective, constraints).solve()
```

(b)

```
y = cp.Variable(shape=(3))
constraints = [y <= max_demand, y >= min_req, y@area <= 6e3, y/5
    <= daily_limit, cp.sum((y/5)/daily_limit) == 1]
objective = cp.Maximize(y@profits)
max_profits_2 = cp.Problem(objective, constraints).solve()
```

(c)

```
z = cp.Variable(shape=(3))
z_weekly_sold = cp.multiply(z/40,daily_limit)*5
constraints = [z_weekly_sold <= max_demand, z_weekly_sold >=
    min_req, z_weekly_sold@area <= 6e3, z>=0, cp.sum(z)<=40 ]
objective = cp.Maximize(z_weekly_sold@profits)
max_profits_3 = cp.Problem(objective, constraints).solve()
```

(d) Number of hours devoted for all products in a week $= 8 * 5 = 40$ hours
Therefore,

$$x = z/40 \tag{1}$$

(e) Proportion hours to be devoted each day for max profit:
$0.167, 0.307, 0.526$ (iPod, iPhone, iPad respectively).

Units sold each week corresponding to max profit:
$5000, 10351, 6290$ (iPod, iPhone, iPad respectively).

Hours devoted each week corresponding to max profit:
$6.667, 13.303, 20.030$ (iPod, iPhone, iPad respectively).

Maximum profit: 145000 dollars