CS 325 Report 3

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1 Question 1

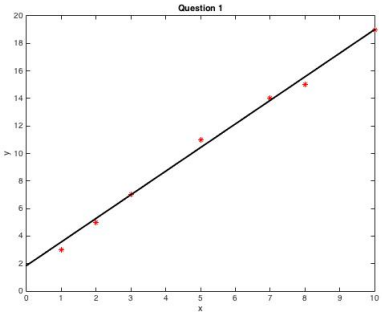
The linear program is

$$
\begin{aligned}
& min_{a,b} r \\
\text{subject to} & \\
& ax_i + b - y_i \leq r \\
& ax_i + b - y_i \geq -r, \quad \text{for} \quad i = 1, \cdots, n
\end{aligned}
$$

The best solution for this specific problem is $a = 1.7143$, $b = 1.8571$, and for the optimal case, the value of objective function is 0.5714.
I use matlab linprog to solve the problem. The screen shot of the output is

```
[xsol, fval, exitflag] = linprog(c, A, a)
Optimization terminated.

xsol =

    1.7143
    1.8571
    0.5714


fval =

    0.5714


exitflag =

     1
```

'xsol' gives the solution for a, b and r, 'fval' gives the optimal value for objective function and 'exitflag = 1' means there is a converged optimal solution. The plot of the points and solution for the instance is



2 Question 2

Set $x = (x_0, x_1, x_2, x_3, x_4, x_5)$, and

$$f(x) = x_0 + x_1 d + x_2 cos(\frac{2\pi d}{365.25}) + x_3 sin(\frac{2\pi d}{365.25}) + x_4 cos(\frac{2\pi d}{365.25 \times 10.7}) + x_5 sin(\frac{2\pi d}{365.25 \times 10.7}),$$

then the linear program is

$$min_x r$$

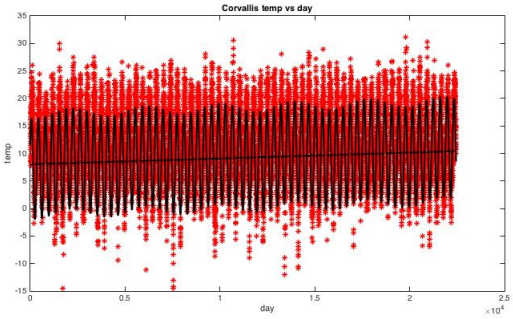
subject to

$$f(x) - r \leq T$$
$$-f(x) - r \leq -T$$

The optimal solution is $x_0 = 8.0214$, $x_1 = 0.0001$, $x_2 = 4.2809$, $x_3 = 8.1869$, $x_4 = -0.7906$ and $x_5 = -0.2954$. The optimal value of objective function is 14.2355. The screenshot of the matlab output is

```
[xsol, fval, exitflag] = linprog(c, A, a)
Optimization terminated.

xsol =

    8.0214
    0.0001
    4.2809
    8.1869
   -0.7906
   -0.2954
   14.2355


fval =

   14.2355


exitflag =

     1
```

The single plot is



Based on value x_1, Corvallis temperature is changing 3.9 degrees Celcius per century and it is a warming trend.

3 Bonus

I extract temperature data for Salem from 1960 to 2016. As previous, set $x = (x_0, x_1, x_2, x_3, x_4, x_5)$, and

$$f(x) = x_0 + x_1 d + x_2 cos(\frac{2\pi d}{365.25}) + x_3 sin(\frac{2\pi d}{365.25}) + x_4 cos(\frac{2\pi d}{365.25 \times 10.7}) + x_5 sin(\frac{2\pi d}{365.25 \times 10.7}),$$

then the linear program is

$$min_x r$$

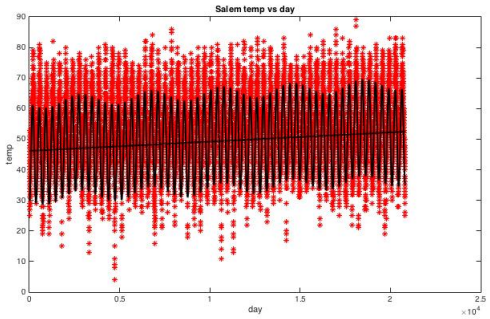
subject to

$$f(x) - r \leq T$$
$$-f(x) - r \leq -T$$

The optimal solution is $x_0 = 46.1595$, $x_1 = 0.0003$, $x_2 = -15.8443$, $x_3 = -0.4847$, $x_4 = -0.2974$ and $x_5 = -2.0159$. The optimal value of objective function is 27.0522. The screenshot of the matlab output is

```
[xsol, fval, exitflag] = linprog(c, A, a)
Optimization terminated.

xsol =

   46.1595
    0.0003
  -15.8443
   -0.4847
   -0.2974
   -2.0159
   27.0522


fval =

   27.0522


exitflag =

     1
```

The single plot is



Based on value x_1, Corvallis temperature is changing 11.1 degrees Celcius per century and it is a warming trend.