Example 19.03 Refinery Optimization
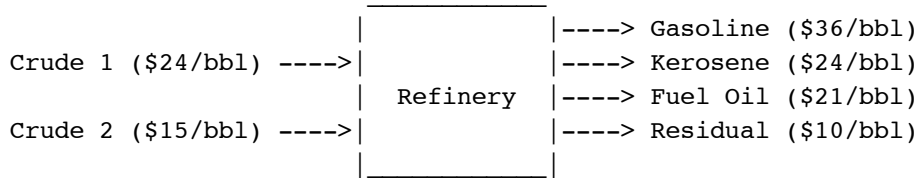
File: `Ch19_E03_cvx.m`

Determine the optimal production schedule for the following process.

```
             _____
            |               |----> Gasoline ($36/bbl)
 Crude 1 ($24/bbl) ---->|               |----> Kerosene ($24/bbl)
            |   Refinery    |----> Fuel Oil ($21/bbl)
 Crude 2 ($15/bbl) ---->|               |----> Residual ($10/bbl)
            |_____|
```

	Volumetric Yield		Capacity
	Crude #1	Crude #2	bbl/day
Gasoline	80%	44%	24,000
Kerosine	5%	10%	2,000
Fuel Oil	10%	36%	6,000

Processing Cost	$0.50/bbl	$1.00/bbl

Contents

Script Requirments

- `displaytable.m`
- CVX

```
addpath('utilities');
```

Decision Variables

```
clabels = {'Crude 1','Crude 2'};
plabels = {'Gasoline','Kerosene','Fuel Oil','Residual'};
```

CVX Optimization Model

```
cvx_begin
```

```
    % Decision Variables

    variables c(2) p(4)
    c >= 0; p <= 100000;
    p >= 0; p <= 100000;

    % Objective Function

    revenue = 36*p(1) + 24*p(2) + 21*p(3) + 10*p(4);
    rawmaterials = 24*c(1) + 15*c(2);
    processing = 0.5*c(1) + 1.0*c(2);
    profit = revenue - rawmaterials - processing;

    maximize(profit)

    % Refinery Yield Model

    Y = [0.80 0.44; 0.05 0.10; 0.10 0.36; 0.05 0.10];
    p == Y*c;

    % Refinery Production Capacity

    dual variable z
    Capacity = [24000; 2000; 6000; 100000];
    z : p <= Capacity;

cvx_end
```

Crude Utilization

```
displaytable(c,clabels,'bbl/day','%6.1f');
```

```
          bbl/day
Crude 1   26206.9
Crude 2    6896.6
```

Production

```
displaytable(p,plabels,'bbl/day','%6.1f');
```

```
            bbl/day
Gasoline    24000.0
Kerosene     2000.0
Fuel Oil     5103.4
Residual     2000.0
```

Process Utilization

```
displaytable( ...
    [p, Capacity, Capacity - p, z], plabels, ...
    {'Production','Capacity','Slack','Sensitivity'},'%6.1f');
```

	Production	Capacity	Slack	Sensitivity
Gasoline	24000.0	24000.0	0.0	4.7
Kerosene	2000.0	2000.0	0.0	87.5
Fuel Oil	5103.4	6000.0	896.6	0.0
Residual	2000.0	100000.0	98000.0	0.0

Questions to Explore

1. Why is the sensitivity so high for Kerosene?

2. You're considering expanding the Kerosene and Fuel Oil capacities for the plant. Each bbl of additional capacity has the same cost. Plot the additional profit as a function of additional capacity.

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