002

1. In order to safeguard the public health, environment, public beaches, water quality, and economy of south San Diego County, California, and Tijuana, Mexico, federal agencies in the United States and Mexico developed four alternatives for treating wastewater prior to discharge into the ocean. The project will minimize untreated wastewater flows that have caused chronic and substantial pollution in the Tijuana River Valley, the Tijuana River National Estuarine Research Reserve, coastal areas used for agriculture and public recreation, and areas designated as critical habitat for federal- and state-listed endangered species. For the costs and benefits estimated, which alternative should be selected on the basis of a B/C analysis at 6% per year and a 40-year project period?

	Pond System	Expand Plant	Advanced Primary	Partial Secondary
Capital cost,	$ 58	76	2	48
M&O cost, $/year	5.5	5.3	2.1	4.4
Benefits, $/year	11.1	12.0	2.7	8.3

In[36]:=
```
ToAnnualPaymentFromPresent[P_, i_, n_] := P * (i - 1) i^n / (i^n - 1)
```

In[37]:=
```
CalculateFunction[{initialCost_, MAndO_, Benefits_, Disbenefits_, life_}, interest_] :=
  (Benefits - Disbenefits) / (ToAnnualPaymentFromPresent[initialCost, interest, life] + MAndO)
```

In[106]:=
```
data = <|"pond system" → {58, 5.5, 11.1, 0, 40}, "expand plant" → {76, 5.3, 12, 0, 40},
   "advanced primary" → {2, 2.1, 2.7, 0, 40}, "partial secondary" → {48, 4.4, 8.3, 0, 40}|>;
```

In[107]:=
```
dataset = Dataset[data]
```

Out[107]=

pond system	58	5.5	11.1	0	40
expand plant	76	5.3	12	0	40
advanced primary	2	2.1	2.7	0	40
partial secondary	48	4.4	8.3	0	40

Sort by capital cost. Change the data to be in order. The order is 2, 48, 58, 76.

In[109]:=
```
dataset = dataset[SortBy[1]]
```

Out[109]=

advanced primary	2	2.1	2.7	0	40
partial secondary	48	4.4	8.3	0	40
pond system	58	5.5	11.1	0	40
expand plant	76	5.3	12	0	40

In[113]:=
```
dataset[All, CalculateFunction[#, 1.06] &]
```

Out[113]=

advanced primary	1.20918
partial secondary	1.09352
pond system	1.18656
expand plant	1.1593

In[114]:=
```
AnnualWorthOfVector[a1_, interest_] := ToAnnualPaymentFromPresent[
   a1[[1]](*320k, first cost*), interest, a1[[5]](*10, years, life*)] + a1[[2]]
```

In[115]:=
```
Select1Of2Alternatives[input_, interest_] :=
 Module[{a1, a2, deltaB, deltaC, deltaD}, {a1, a2} = Values[input];
   deltaB = a2[[3]] - a1[[3]]; ×
   deltaD = a2[[4]] - a1[[4]]; ×
   deltaC = AnnualWorthOfVector[a2, interest] - AnnualWorthOfVector[a1, interest];
  (deltaB - deltaD)/deltaC
 ]
```

This is our data, sorted by the value.

In[122]:=
```
interest = 1.06;
```

In[123]:=
```
Select1Of2Alternatives[Normal@dataset[{1, 2}], interest]
```

Out[123]=
```
1.04532
```

We compared partial secondary-advanced primary and got BC of 1.04532. Since BCC is greater than 1, we choose partial secondary.

Now we do pond system - partial secondary.

In[125]:=
```
Select1Of2Alternatives[Normal@dataset[{"pond system", "partial secondary"}], interest]
```
Out[125]=
```
1.58675
```

In[79]:=
```
Keys[data]
```
Out[79]=
```
{advanced primary, partial secondary, pond system, expand plant}
```

In[94]:=
```
Extract[Keys[data], {{3}, {2}}]
```
Out[94]=
```
{pond system, partial secondary}
```

We use this.

In[126]:=
```
dataset[{"pond system", "partial secondary"}]
```
Out[126]=

pond system	58	5.5	11.1	0	40
partial secondary	48	4.4	8.3	0	40

Since we get 1.58675, we select pond system.

In[127]:=
```
dataset
```
Out[127]=

advanced primary	2	2.1	2.7	0	40
partial secondary	48	4.4	8.3	0	40
pond system	58	5.5	11.1	0	40
expand plant	76	5.3	12	0	40

do expand plant - pond system.

In[128]:=
```
dataset[{"expand plant", "pond system"}]
```
Out[128]=

expand plant	76	5.3	12	0	40
pond system	58	5.5	11.1	0	40

In[132]:=
```
Select1Of2Alternatives[Normal@dataset[{"expand plant", "pond system"}], interest]
```
Out[132]=
```
0.903335
```

Stick with pond system because 0.903335<1.

003

```
CalculateFunction[{initialCost_, MAndO_, Benefits_, Disbenefits_, life_}, interest_] :=
                        Benefits - Disbenefits
 ToAnnualPaymentFromPresent[initialCost, interest, life] + MAndO
```

In[133]:=

```
data = <|"A" → {50, 3, 20, 0, 5}, "B" → {90, 4, 29, 0, 5}, "C" → {200, 6, 61, 0, 5}|>;
```

In[134]:=

```
dataset = Dataset[data]
```

Out[134]=

A	50
	3
	20
	0
	5
B	90
	4
	29
	0
	5
C	200
	6
	61
	0
	5

Sort the data.

In[135]:=

```
dataset = dataset[SortBy[1]]
```

Out[135]=

A	50
	3
	20
	0
	5
B	90
	4
	29
	0
	5
C	200
	6
	61
	0
	5

50, 90, 200 is ordered.

In[136]:=

```
interest = 1.1;
```

In[137]:=

```
dataset[All, CalculateFunction[#, interest] &]
```

Out[137]=

A	1.23534
B	1.04535
C	1.03813

Select A.