Chapter 7

CONCLUSION AND FURTURE WORK

As the aim of this study is to find out optimum strategy for distributing the district-wise paddy production proportional to the district-wise population, it very important to analyse seasonal district-wise production before the model introduced. It was observed that paddy production is harvested in two seasons called 'Maha' and 'Yala' which are the periods from September/October to March/April and from April/May to August/September respectively. Relatively a higher paddy production is obtained in the Maha season than the "Yala' season. According to the concerned period of this study (1989-2000) the average production per year was metric tons 1513987 of the 'Maha' season of the concerned districts whilst that was metric tons 879780.9 of the 'Yala' season.

From both 'Maha' and 'Yala' seasons, Colombo district is the main consumer district. As the main consumer district the average demands of the Colombo district are 144727 Mt. and 154696 Mt. in 'Maha' and 'Yala' seasons respectively. Polonnaruwa district is recorded as the highest supplier in 'Maha' season whilst Ampara district is the highest supplier in 'Yala' season. Badulla, Kurunagala, Matale, Monaragala, Mannar, Anuradhapura, Polonnaruwa, Trincomalee, Batticaloa, Ampara and Hambantota districts are the average suppliers whilest Colombo, Kalutara, Galle, Matara, Kegalle, Ratnapura, Kandy, NuwaraEliya, Puttalum, and Jaffna are the consumer districts in 'Maha' seasons. However, in 'Yala' season, there are only few districts play as suppliers named Polonnaruwa, Trincomalee, Batticaloa, Ampara, and Hambantota and others are consumers. (Jaffna district 'Yala' data are not available)

Colombo is the highest rice consumer district of both seasons in all the years. Kurunagala district is the main supplier for Colombo of all the years in 'Maha' season except for the years 1996 and 1999. However in 1999 81.68 thousand of metric tons of paddy are supplied by Kurunagala while 90.84 thousand of metric tons are supplied by Polonnaruwa district to meet the requirement of 172.52 thousand of metric tons of paddy. In 1996 major supplier to Colombo is Polonnaruwa. 120.08 thousand of metrictons of paddy are supplied to Colombo by Polonnaruwa whilst no paddy is supplied to Colombo or any other district by Kurunagala in this season of the year 1996. As shown in the table 5.1 (a) – (l) Kurunagala and Polonnaruwa are the only suppliers of paddy to the Colombo district in Maha season.

The Highest supplier in the 'Maha' season is the Polonnaruwa district. Averagely it can supply 257.8 thousands of metric tons of paddy. Frequently they are to be supplied from Polonnaruwa to Colombo, Kalutara, Kegalle, Kandy & Jaffna districts and sometimes they are supplied from Polonnaruwa to Puttalum, Vauniya & Mannar. Moreover every year Polonnaruwa supplies a large amount of paddy to the fictitious consumer. It is mean that Polonnaruwa can stored a large amount of paddy of its harvest for the 'Yala' season, which is comparatively low harvest. Second highest supplier in this season is Ampara district. Ampara district frequently supplies its excess productions to kandy and Nuwaraeliya and sometime supply to Ratnapura districts.

In 'Yala' season there is a fewer number of suppliers not like in 'Maha'. Generally these supplies are Polonnaruwa, Trincomalee, Batticaloa Ampara, and Hambantota. Almost all suppliers are the from dry zone of Northeast, East and Southeast areas. However the major consumers are Colombo, Kalutara, Galle, Matara, Kegalle, Ratnapura, Kandy and Nuwaraeliya, same as in the 'Maha' season. Again Colombo is the highest consumer and there is not a fixed supplier but most of the time it meets the requirement from the fictitious supplier. However when Polonnaruwa or Kurunagala play as the

supplier in this season, Colombo district receives its needy by them. Sometime it receives paddy from Anuradhapura and Hambantota.

In this season(Yala), There is not much production like 'Maha' season and most of the consumers especially major consumers get their need from fictitious supplier Moreover they received amount from fictitous supplier are match with the amount store at fictitious consumer in 'Maha' season of the relevant year.. Therefore fictitious supplier may be the same district or fixed supplier of the 'Maha' season.

There is an interesting relationship among the supplier districts and the consumers districts in 'Maha' season. That is shown in table 5.1 all major consumer have regular suppliers. As shown in table 5.1 suppliers of Colombo which is the highest consumer district are Polonnaruwa and Kurunagala. Suppliers of Kalutara district are Hambantota and Polonaruwa. Moreover Hambantota district regularly supplies paddy to Galle, Matara and Ratnapura districts too. Monaragala districts also regularly supply to the Ratnapura district. Suppliers of Kandy district are Matale and Polonnaruwa. Kegalle, Nuwaraeliya, and Jaffna get their need from Polonnaruwa, Ampara and Troncomalee respectively.

In 'Yala' season, There is no clearly shown regular suppliers to the particular consumer as shown in 'Maha' season. However Ampara, Polonnaruwa and Hambantota which are the highest producers in this season have regular consumer districts. Ampara district supplies paddy to Kandy, Nuwaraeliya, Badulla and Monaragala districts while Hambantota supplies to Kalutara and Galle. Sometime Polonnaruwa and Kurunagala play as the suppliers of Colombo district in this season. However most of its needs come from fictitious supplier.

Always 'Maha' season has a fictitious consumer to stock its excess product and Yala season needed fictitious supplier to fulfill the demand its consumers. In 'Maha' season Ampara and Polonnaruwa regularly supply to fictitious

consumer. Further sometimes Batticaloa, Matale, Kurunagala and Anuradapura also supply to the fictitious consumer in this season. Therefore these districts can stock paddy harvest to use next 'Yala' season. However in 'Yala' season almost all consumers such as Colombo, Kalutara, Galle, Matara, Kegalle, Ratnapura receive their needed amounts from fictitious suppliers.

Consumers those who received their needs from fictitious suppliers in 'Yala' season could get their regular supplies in 'Maha' season as shown in transportation strategy. For instance Polonnaruwa supplies large amount of its surplus paddy in 'Maha' season to fictitious consumer in every year. Then the Colombo district gets its additional requirement from fictitious supplier in 'Yala' season in every year. So this requirement could be met from Polonnaruwa district which is the one of the supplier of Colombo. Moreover additional requirement of Colombo and Kalutara districts that taken from fictitious supplier in 'Yala' is nearly equal or less than the amount which is fictitious consumer getting from Polonnaruwa district in 'Maha' season.

When compared 'Maha' there are fewer suppliers in 'Yala' season. However Polonnaruwa, Ampara, Hambantota, Trincomalee and Batticaloa are the suppliers in most of the time in both seasons. Badulla, Matale and Monaragala sometimes play as supplier in 'Maha' and sometimes play as consumer in 'Yala'. Most of the time Anuradapura and Mulative are neither supplier nor consumer.

Annual transportation strategy are find out for the years from 1997 to 2000 considering as balanced deterministic transportation problem. The transportation strategies are shown in the table 5.3 from (a) to (d). Suppliers are same in both annual transportation strategy and 'Maha' season transportation strategy of the above concerned period. But few of them are not play as suppliers in 'Yala' season.

Kurunagala districts supply only to Colombo district in both annual and 'Maha' season transportation strategies in concerned periods from 1997 to

2000 except 1999. The transported amounts are exactly same in these both transportation solutions. Moreover Kurunagala district does not play as supplier in 'Yala' season in these periods except 1999.

Both seasonal and annual transportation strategies, there are same regular suppliers for each and every consumer district. For instance, suppliers of Colombo districts are Kurunagala and Polonnaruwa and suppliers of Kalutara are Polonnaruwa and Hambantota. Hambantota and Ampara are supplied to Galle districts etc. In 'Yala' season Colombo, Kalutara, Galle, Matara, Kegalle, Ratnapura and Kandy districts are obtained certain amount of their needs from fictitious supplier. Moreover they have other one or two suppliers 'Yala' or 'Maha' season. In annual transportation strategy shown that same supplier or suppliers of seasonal strategy supply all requirements of the above districts. Therefore annual transportation strategy conclude that fictitious supplier of 'Yala' season is the other non fictitious supplier or suppliers of 'Yala' or 'Maha' seasons.

Simulation transportation model is developed for the year 2000 using the previous cultivation seasons data. Simulated supply or demand paddy amount of each and every district are calculated from the simplified deterministic constraint equations(equation 3.6 & 3.7). Three estimated values are calculated for various α_i's and β_j's. These three cases are considered as α_i and $1-\beta j$ equal to 0.85, 0.95 and 0.99. The estimated value are shown on the tables B.5 B.6 of both season. Adjusted* supply and demand values are shown in the table B.7.

According to the simulated results, "Maha' season excess product of Matale, Monaragala, Vauniya, Mannar and Anuradhapura districts are stored for use of 'Yala' season. This is same for all three cases considered in this operation study. However excess products of all those districts except Anuradhapura are

* Supply and demand values are adjusted if a particular district play as the supplier in 'Maha' season and the consumer in 'Yala' season. So as much as 'Yala' season requirement fulfil by the 'Maha' season product by storing rather than transportation.

not enough to completely fulfil the requirement of 'Yala" season. The excess product of Anuradhapura district is sufficient to cover the demand of 'Yala' season and rest are transported.

According to the paddy supply and demand statistics, it has shown that averagely they are highly variation with year to year as well as season to season. Generally most of the supplier districts, their supply amounts vary highly than the consumer districts. Kurunagala, Anurahapura Polonnaruwa, Trincomalee, Baticaloa and Ampara are the main supplier districts and comparatively variation is higher than the other districts. It is show in figure 5.1 and figure 5.2.

As the result of paddy supply or consume amounts variations, the simulated paddy supply or consume amounts of those districts are deviated from the actual values. In Maha season Kurunagala, Anuradhapura, Polonaruwa, Batticaloa and Ampara districts is the most deviate districts. All three simulation cases of 'Yals' season, neither the Anuradhapura district is supplier nor consumer. But in actually it supply 143.38 thousands MT of paddy. However there is a significant deviation of 'Maha' season. In 'Yala' season actual case neither Kurunagalla district play as supplier nor consumer however simulation show that it is the supplier . It supply paddy to Colombo district same as the deterministic transportation problem of each and every year. Kurunagala district simulation results are norticibly deviated from the actual values of both seasons. Moreover supplier and consumers of simulation are the same as deterministic cases.

In 'Maha season Colombo, Kalutara, Galle, Matara, Kegalle, Ratnapura, Kandy, Nuwaraelliya Puttalam and Jaffna districts are always consumer districts in both simulated and actual deterministic transportation problems' solution of all considered years. However in simulation cases Badulla district is consumer district But it is consumer district only the years 1998 and 1999.

Further Badulla is play as supplier in year 1989 and it supplied 8.06 thousand MT of paddy to Nuwaraelliya districts.

In year 2000 'Maha' season actual transportation strategy show that Monaragala district play as supplier and supply 3.02 tousands MT to Ratnapura but both 'Maha' and 'Yala' seasons simulation transportation strategies it is neither play as supplier nor consumer. Moreover the 'Maha' season actual transportation strategy in year 2000, Badulla district neither plays as supplier nor as consumer, However simulation show that It is a consumer district in both 'Maha' and 'Yala' seasons. It should received paddy from Baticaloa in 'Maha' and from Baticaloa and Ampara districts in 'Yala'.

A major consumer, Colombo district all of its requirements are obtained from Kurunagala and Polonnaruwa in 'Maha' season. It is same simulated cases However major supplier of Colombo actual case 'Maha' season is the Polonnaruwa district whilst Kurunagala district play as major supplier in sumulated case. In the 'Yala' season paddy reqirement fullfil by this district in simulation cases somewhat different with actual one. Sumulated strategies shows that most of its needy are obtained from Kurunagala and Polonnaruwa. In actual case supplier of Colombo district in 'Yala' are Polonnaruwa and Anuradhapura. Simulated transportation strategy in 'Maha' season show that supplier in Kandy is Pollonnaruwa but actual situation shows they are Ampara and Batticaloa. In 'Yala' season, supplier of Kandy is Ampara in actual case and simulated cases show that Polonnaruwa also other than the Ampara.

In 'Maha' season, actual transportation strategy shows that Anuradhapura Polonaruwa and Ampara store their excees product by the amounts 59.6 41. 39 and 16.64 thousands MT in fictitious consumer and simulated result show that Ampara, Polonnaruwa Baticaloa, Trincomalee and Anuradhapura store their excees product in fictitious consumer. In 'Yala' season actual case fictitious supplier supply paddy to Kalutara, Galle and Matara by the amounts

21.46, 67.75 and 28.38 thousand MT respectively. Simulated cases of this season show that fictitious supplier supply only Colombo and Galle districts. Further larger amount is supplied to Colombo districts than the Galle. They are 135.52, 107.15 and 76.02 thousand MT in three simulated case of probabilities 0.85 0.95 and 0.99 respectively. Simulated transportation strategies are shown in tables 5.4 and 5.5.

Furture Improvement

Past data shows that some years production do not meet the annual rice requirement of Sri Lanka. Therefore we need to import rice. Some years have excess production than the annual reqirement of rice. So we can export rice in those years. This senario can be included to the model by adding as production of the shipped district if it is import rice. Similarly, if rice can be exported it should be included as consume amount of the shipped district.

This operation study assumed that paddy production is normally distributed. It should be better tried for various probability distributions and varification made for many years. In this way one can deduce very good probability distribution for paddy production as well as cost effective transportation model.

APPENDIX A

Spread sheet routine to find out suppliers and consumers and their amount

```
Private Sub workout()
  Dim alpha As Double, alphai As Double
  Dim amountM As Double, amountY As Double
  Dim Cellone As Range, CellTwo As Range, CellThree As Range
  Dim populationi As Double, shname As String
  Dim w As Integer, SumOne As Double, SumTwo As Double
  SumOne = 0
  SumTwo = 0
  shname = "2000E"
  For i = 5 To 26
    Set Cellone = Worksheets(shname).Range("B" & i)
    w = 0
    If (Cellone <> "") Then
        w = w + 1
        SumOne = SumOne + Val(Cellone)
    End If
    Set CellTwo = Worksheets(shname).Range("C" & i)
    If (CellTwo <> "") Then
        w = w + 1
        SumOne = SumOne + Val(CellTwo)
    End If
    Set CellThree = Worksheets(shname).Range("E" & i)
    SumTwo = SumTwo + w * Val(CellThree)

  Next i
  alpha = (SumOne) / SumTwo
  Worksheets(shname).Range("F" & 3) = Str(alpha)
  Worksheets(shname).Range("G" & 3) = Str(alpha)

  For i = 5 To 26
    Set Cellone = Worksheets(shname).Range("B" & i)
    Set CellTwo = Worksheets(shname).Range("E" & i)
    If (CellTwo <> "") Then
        If Cellone <> "" Then
          alphai = Round((Val(Cellone) / Val(CellTwo)), 2)
          Worksheets(shname).Range("F" & i) = Str(alphai)
        End If
        Set Cellone = Worksheets(shname).Range("C" & i)
        If (Cellone <> "") Then
          alphai = Round(Val(Cellone) / Val(CellTwo), 2)
          Worksheets(shname).Range("G" & i) = Str(alphai)
```

```
        End If
    End If

    Set CellTwo = Worksheets(shname).Range("F" & i)
    If (CellTwo <> "") Then
      If (Val(CellTwo) >= alpha) Then
         Worksheets(shname).Range("H" & i) = "S"
      Else
         Worksheets(shname).Range("H" & i) = "D"
      End If
    End If
    Set CellTwo = Worksheets(shname).Range("G" & i)
    If (CellTwo <> "") Then
      If (Val(CellTwo) >= alpha) Then
         Worksheets(shname).Range("I" & i) = "S"
      Else
         Worksheets(shname).Range("I" & i) = "D"
      End If
    End If
    'Calculate the supply/Consume amounts
    Set Cellone = Worksheets(shname).Range("F" & i)
    alphai = Val(Cellone)
    Set CellThree = Worksheets(shname).Range("E" & i)
    If (Cellone <> "") Then
      populationi = Val(CellThree)
      amountM = (alphai - alpha) * populationi
      Worksheets(shname).Range("J" & i) = Str(Round((amountM /
1000), 2))
    End If
    Set CellTwo = Worksheets(shname).Range("G" & i)
    If (CellTwo <> "") Then
      alphai = Val(CellTwo)
      amountY = (alphai - alpha) * populationi
      Worksheets(shname).Range("K" & i) = Str(Round(amountY /
1000, 2))
    End If
  Next i
End Sub
```

Spreadsheet routine to adjust the supplier 'sand consumer's amount according to the seasonal changes

```
Private Sub AdjustAmount()
    Dim Cellone As Range, CellTow As Range
    Dim amountM As Double, amountY As Double
    Dim shname As String
    shname = "2000E"
    For i = 5 To 26
        Set Cellone = Worksheets(shname).Range("J" & i)
        Set CellTwo = Worksheets(shname).Range("K" & i)
        If (Cellone <> "" And CellTwo <> "") Then
            amountM = Val(Cellone)
            amountY = Val(CellTwo)
            If (amountM > 0 And amountY < 0) Then
               If (Abs(amountY) >= amountM) Then
                  amountY = amountY + amountM
                  amountM = 0
               ElseIf (Abs(amountY) < amountM) Then
                  amountM = amountM + amountY
                  amountY = 0
               End If
            End If
            Worksheets(shname).Range("J" & i) =
Str(Round((amountM), 2))
            Worksheets(shname).Range("K" & i) =
Str(Round(amountY, 2))
        End If
    Next i
End Sub
```


Routine to prepare TP problem for the 'Maha' season

```
Private Sub TPMaha()
  Dim shname As String
  Dim Cellone As Range, CellTwo As Range, CellThree As Range
  Dim countD As Integer, countS As Integer
  Dim amount As Double, amountD(20) As Double, amountS(20) As
Double
  Dim kD As Integer, kS As Integer
  Dim col As String, row As Integer

  shname = "2000E"
  countD = 0
  countS = 0
  'Arrange the Consumer and the Supplier districts in Table
```

```
  For i = 5 To 26
     Set Cellone = Worksheets(shname).Range("H" & i)
     Set CellThree = Worksheets(shname).Range("J" & i)
     amount = Val(CellThree)
     If ((Cellone = "D") And (Abs(amount) > 0)) Then
       Set CellTwo = Worksheets(shname).Range("A" & i)
       Worksheets(shname).Range(Chr(66 + countD) & 31) =
CellTwo
       countD = countD + 1
       amountD(countD) = amount
     ElseIf ((Cellone = "S") And (Abs(amount) > 0)) Then
       Set CellTwo = Worksheets(shname).Range("A" & i)
       Worksheets(shname).Range("A" & 32 + countS) = CellTwo
       countS = countS + 1
       amountS(countS) = amount
     End If
  Next i
  nD = countD
  nS = countS
  'Put the Consumer and the Supplier amounts
  kS = 0
  kD = 0
  For i = 1 To nD
    Worksheets(shname).Range(Chr(66 + kD) & 31 + countS + 1) =
amountD(i)
    kD = kD + 1
  Next i
  For i = 1 To nS
    Worksheets(shname).Range(Chr(65 + countD + 1) & 32 + kS) =
amountS(i)
    kS = kS + 1
  Next i
  'Put transport cost
  For i = 1 To countD
    Set cityD = Worksheets(shname).Range(Chr(65 + i) & 31)
    For k = 1 To 21
     If cityD = Worksheets("cost").Range(Chr(65 + k) & 4) Then
           col = Chr(65 + k)
           Exit For
     End If
    Next k
    For j = 32 To (32 + countS - 1)
        Set cityS = Worksheets(shname).Range("A" & j)
        For k = 5 To 26
          If cityS = Worksheets("cost").Range("A" & k) Then
               row = k
               Exit For
          End If
        Next k
        Set cost = Worksheets("cost").Range(col & row)
        Worksheets(shname).Range(Chr(65 + i) & j) = cost
```

```
    Next j
  Next i
End Sub
```

Cost matrix reduction routine for 'Maha' TP problem

```
Private Sub ReduceCostMatrix_Maha()
  Dim Cellone As Range
  Dim min As Integer
  Dim shname As String
  shname = "2000E"
  'row reduction
  For i = 1 To nS
    min = 600
    For j = 1 To nD
       Set Cellone = Worksheets(shname).Range(Chr(65 + j) & 31
+ i)
       If Val(Cellone) <= min Then
          min = Val(Cellone)
       End If
    Next j
    For j = 1 To nD
       Set Cellone = Worksheets(shname).Range(Chr(65 + j) & 31
+ i)
       Worksheets(shname).Range(Chr(65 + j) & 31 + i) =
Str(Val(Cellone) - min)
    Next j
  Next i
  'colum reduction
  For j = 1 To nD
     min = 600
     For i = 1 To nS
        Set Cellone = Worksheets(shname).Range(Chr(65 + j) &
31 + i)
        If Val(Cellone) < min Then
           min = Val(Cellone)
        End If
     Next i
     For i = 1 To nS
       Set Cellone = Worksheets(shname).Range(Chr(65 + j) & 31
+ i)
       Worksheets(shname).Range(Chr(65 + j) & 31 + i) =
Str(Val(Cellone) - min)
     Next i
  Next j
End Sub
```

Routine to prepare TP problem for the 'Yala' season

```
Private Sub TPYala()
  Dim shname As String
  Dim Cellone As Range, CellTwo As Range, CellThree As Range
  Dim countD As Integer, countS As Integer
  Dim amount As Double, amountD(20) As Double, amountS(20) As
Double
  Dim kD As Integer, kS As Integer
  Dim col As String, row As Integer
  shname = "2000E"
  countD = 0
  countS = 0
  'Arrange the Consumer and the Supplier districts in Table
  For i = 5 To 26
     Set Cellone = Worksheets(shname).Range("I" & i)
     Set CellThree = Worksheets(shname).Range("K" & i)
     amount = Val(CellThree)
     If ((Cellone = "D") And (Abs(amount) > 0)) Then
       Set CellTwo = Worksheets(shname).Range("A" & i)
       Worksheets(shname).Range(Chr(66 + countD) & 51) =
CellTwo
       countD = countD + 1
       amountD(countD) = amount
     ElseIf ((Cellone = "S") And (Abs(amount) > 0)) Then
       Set CellTwo = Worksheets(shname).Range("A" & i)
       Worksheets(shname).Range("A" & 52 + countS) = CellTwo
       countS = countS + 1
       amountS(countS) = amount
     End If
  Next i
  nD = countD
  nS = countS

  'Put the Consumer and the Supplier amounts
  kS = 0
  kD = 0
  For i = 1 To nD
    Worksheets(shname).Range(Chr(66 + kD) & 52 + countS) =
amountD(i)
    kD = kD + 1
  Next i
  For i = 1 To nS
    Worksheets(shname).Range(Chr(66 + countD) & 52 + kS) =
amountS(i)
    kS = kS + 1
  Next i
  'Put transport cost
  For i = 1 To countD
    Set cityD = Worksheets(shname).Range(Chr(65 + i) & 51)
```

```
    For k = 1 To 21
      If cityD = Worksheets("cost").Range(Chr(65 + k) & 4)
Then
           col = Chr(65 + k)
           Exit For
      End If
    Next k
    For j = 52 To (52 + countS - 1)
        Set cityS = Worksheets(shname).Range("A" & j)
        For k = 5 To 26
          If cityS = Worksheets("cost").Range("A" & k) Then
               row = k
               Exit For
          End If
        Next k
        Set cost = Worksheets("cost").Range(col & row)
        Worksheets(shname).Range(Chr(65 + i) & j) = cost
    Next j
  Next i
End Sub
```

Cost matrix reduction routine for 'Yala' TP problem

```
Private Sub ReduceCostMatrix_Yala()
  Dim Cellone As Range
  Dim min As Integer
  Dim shname As String
  shname = "2000E"
  'row reduction
  For i = 1 To nS
    min = 600
    For j = 1 To nD
       Set Cellone = Worksheets(shname).Range(Chr(65 + j) & 51
+ i)
       If Val(Cellone) <= min Then
          min = Val(Cellone)
       End If
    Next j
    For j = 1 To nD
       Set Cellone = Worksheets(shname).Range(Chr(65 + j) & 51
+ i)
       Worksheets(shname).Range(Chr(65 + j) & 51 + i) =
Str(Val(Cellone) - min)
    Next j
  Next i
  'colum reduction
  For j = 1 To nD
     min = 600
```

```
      For i = 1 To nS
         Set Cellone = Worksheets(shname).Range(Chr(65 + j) &
51 + i)
         If Val(Cellone) < min Then
            min = Val(Cellone)
         End If
      Next i
      For i = 1 To nS
        Set Cellone = Worksheets(shname).Range(Chr(65 + j) & 51
+ i)
        Worksheets(shname).Range(Chr(65 + j) & 51 + i) =
Str(Val(Cellone) - min)
      Next i
  Next j
End Sub
```

Routine to calculate simulated supply or demand anoumts

```
Sub EsupplyConsum()
  Dim Cellone As Range, CellTwo As Range
  Dim shname As String
  Dim mean As Double, stddev As Double
  Dim i As Integer
  shname = "Yala"
  For i = 5 To 26
    Set Cellone = Worksheets(shname).Range("N" & i)
    Set CellTwo = Worksheets(shname).Range("O" & i)
    If Cellone <> "" Then
      mean = Val(Cellone)
      stddev = Val(CellTwo)
    End If
    If mean < 0 Then
       Worksheets(shname).Range("Q" & i) = (-1.44) * stddev +
mean
    Else
       Worksheets(shname).Range("Q" & i) = (0.42) * stddev +
mean
    End If
  Next i
End Sub
```

Mathlab program to solve unbalanced transportation problem (TP)

```
clear;
prompt1 = {'First Row ' };
def1={'31', 'hsv'};
dglTitle = ' Read the data sheet ';
lineNo = 1;
ANS =inputdlg(prompt1, dglTitle, lineNo, def1);
NR1 = str2double(ANS);
prompt2 = {'First Column '};
def2 = { '1', 'hsv'};
ANS = inputdlg(prompt2, dglTitle, lineNo, def2);
NC1=str2double(ANS);
prompt3 = {'Data Range '};
def3 = {'B31..O38', 'hsv'};
ANS = inputdlg(prompt3, dglTitle, lineNo, def3);
RNG = char(ANS);
PATHNAME = 'c:\mydocu~1\rama\msc-or\maha\inputs'
[FILENAME,PATHNAME] = uigetfile('*.wk1', 'Open');
A=wk1read(strcat(PATHNAME,FILENAME),NR1, NC1, RNG);
[NR, NC] = size(A);
CC = A(1:NR-1, 1:NC-1);
AA = A(1:NR-1, NC);
AA = AA';
BB = A(NR,1:NC-1);
BB = -BB;
%
% **********************
%
SumAA = 0;
SumBB = 0;
[M, N] = size(CC);
for II = 1 :M
   SumAA = SumAA+AA(II);
end
for JJ = 1 :N
   SumBB = SumBB+BB(JJ);
end
if (SumAA > SumBB)
   amount = SumAA-SumBB;
   BB = [BB, amount];
   for II = 1: M
      CN(II) = 0;
   end
   CC = [CC,CN']; %add column
end
if (SumAA < SumBB)
   amount = SumBB-SumAA;
   AA = [AA, amount];
   for JJ = 1: N
```

```
      RN(JJ) = 0;
   end
   CC = [CC
         RN];  %add row
end

CC

DA=AA;
DB=BB;

C0 = 0;
[M, N] = size(CC);
%IR & IC indicate that (when =1) rows & cols have been deleted
%TR() & TC() count no of basic varables in rows and cols

for II = 1:M
   IR(II) = 0;
   TR(II) = 0;
end
for JJ=1:N
   IC(JJ) = 0;
   TC(JJ) = 0;
end

C=0; CT=0; CR=0;
while(C0<M+N-1)
  RI=0; CJ=0; Y=1E10;
  for II=1:M
     if(IR(II) ~= 1)
        for JJ = 1: N
           if (IC(JJ) ~= 1)
              if (CC(II, JJ)<Y)
                 Y=CC(II, JJ);
                 RI=II;
                 CJ=JJ;
              end
           end
        end
     end
  end
  if (DA(RI)>DB(CJ))
     X(RI, CJ) = DB(CJ);
     IX(RI, CJ) = 1;
     DA(RI) = DA(RI)-DB(CJ);
     DB(CJ)=0;
     IC(CJ)=1;
     C0=C0+1;
     CT=CT+1;
  else
     X(RI, CJ) = DA(RI);
```

```
      IX(RI, CJ) = 1;
      DB(CJ) = DB(CJ)-DA(RI);
      DA(RI) = 0;
      IR(RI) = 1;
      C0=C0+1;
      CR=CR+1;
   end
   TR(RI) = TR(RI)+1;
   TC(CJ) = TC(CJ)+1;
end %end of while loop
CR=CR+1;
X
while(1) %line 1000
   for II = 1:M
      IU(II)=0;
      U(II)=0;
   end
   for JJ=1:N
      IV(JJ)=0;
      V(JJ)=0;
   end
   T=0; L=0;
   for II=1:M
      if(TR(II)>=T)
         T=TR(II);
         L=II;
      end
   end
   U(L)=0;
   IU(L)=1;
   C0=1;
   CR=1;
   CT=0;
   for JJ=1:N
      if (IX(L, JJ) ~= 0)
         V(JJ) = CC(L, JJ);
         IV(JJ) = 1;
         CT=CT+1;
         C0=C0+1;
      end
   end
   C0
   while (C0 < M+N) %line 1200
     for II =1:M
        for JJ =1:N
           if(IX(II, JJ) ~= 0)                    %?
              %if((IU(II) ~= 0) & (IV(JJ) ~= 0))       %?
                 %if ((IU(II) ~= 1) & (IV(JJ) ~= 1))
                  if ((IU(II) == 0) & (IV(JJ) == 1))  %?
                      U(II) = CC(II, JJ)-V(JJ);
                      IU(II) = 1;
```

```
                    CR=CR+1
                    C0=C0+1
                elseif((IU(II) == 1) & (IV(JJ) == 0))
                    V(JJ)=CC(II, JJ)-U(II);
                    IV(JJ) = 1;
                    CT = CT+1;
                    C0 = C0+1;
                end
              %end
            %end
          end
        end
    end
end  % line 1330
disp('Shadow Cost');
U, V
for II = 1: M
  for JJ =1: N
     if (IX(II, JJ) == 0)
        D(II, JJ)=CC(II,JJ)-U(II)-V(JJ);
     else
        D(II, JJ) = CC(II, JJ)-U(II)-V(JJ);
        if (D(II, JJ) ~= 0)
           disp('Fault');
        end
     end
  end %line 1470
end
%Find the smallest D(II, JJ) in cell (K, L) say
T=0; K=0; L=0;
for II = 1:M
  for JJ = 1:N
     if(IX(II, JJ) ~=1)
        if(D(II, JJ) <T)
           T = D(II, JJ); K=II; L=JJ;
        end
     end
  end
end %line 1570

if (T == 0)
  disp('Final solution');
  X  % Print the basic feasible solution
  break ;% exit the whole progtam
end
% Find the next BFS
for II = 1: M % line 2000
  IU(II) = 0;
end
for JJ = 1: N
  IV(JJ) = 0;
```

```
end
for II = 1: M+N
  RTT(II) = 0;
  CTT(II) = 0;
end
for II=1:M
   for JJ=1:N
      if (II==K & JJ ==L)
         D(II, JJ) = 1;
         MM(II, JJ) = 1;
      else
         D(II, JJ) = 0;
         MM(II, JJ) = 0;
      end
  end
end
T = 1;
IP = 0;
RTT(T) = K;
CTT(T) = L;
%D(K, L)=1;
%MM(K, L) = 1;
IU(K) = 1;
T, K, L
while(1) %line 2100
 while(1) %inner loop
   FR = 0; FC = 0; RI = RTT(T); CJ = 0; %line 2100
   for JJ=1:N
       if (FC ~= 1)
         if( IX(RI, JJ) == 1)
            if (IV(JJ) == 0)
               if (MM(RI, JJ) == 0)
               if ((TC(JJ) ~= 1 ) | (TC(JJ) == 1 & JJ == L))
                     FC = 1; CJ = JJ; IV(JJ) = 1; JJ = N;
                  elseif(TC(JJ) == 1)
                     IP = 1;
                  end
               end
            end
         end
       end
   end  %line 2180
   CJ  %debug
   if (CJ ~= 0)
      T=T+1;
      RTT(T) = RI;
      CTT(T) = CJ;
      D(RI, CJ) = -1;
      MM(RI, CJ) = 1;
      if((CTT(T) == L) & (T > 2)) break; end %line 2400
   else
```

```
         if (IP>0)
            IP = 0;
         end
         D(RTT(T), CTT(T))=0;
         T=T-1;
      end
      FR = 0; FC = 0; RI = 0;
      CJ = CTT(T); %line 2500
      for II=1:M
         if (FR ~= 1)
            if (IX(II, CJ) == 1)
               if (IU(II) == 0)
                  if (MM(II, CJ) == 0)
                     if(TR(II) ~= 1 )
                        FR = 1; RI = II; IU(II)=1;
                        II = M;
                     else
                        IP = 1;
                     end
                  end
               end
            end
         end
      end   % line 2580
      if (RI ~= 0 ) break; end
      if (IP>0) IP = 0; end
      D(RTT(T), CTT(T))= 0;
      T=T-1;
    end % end of while (1) inner loop line 2620
    if((CTT(T) == L) & (T > 2)) break; end %line 2400
    T=T+1;
    IP=0;
    RTT(T)=RI;
    CTT(T)=CJ;
    D(RI, CJ) = 1;
    MM(RI, CJ) = 1;
    T, RI, CJ
   end %line 2730 end of the outter loop
   W = 1E10; LL = 0; KK = 0; %line 3000
   for II = 2:2:T
    if(X(RTT(II), CTT(II))<W)
       W=X(RTT(II),CTT(II));
       KK=RTT(II);
       LL=CTT(II);
    end
   end    %line 3040
   for II=1:T
     X(RTT(II), CTT(II))=X(RTT(II), CTT(II))+W*D(RTT(II),
CTT(II));
   end
   IX(K, L) = 1;
```

```
    IX(KK, LL) = 0;
    TR(K)=TR(K)+1;
    TR(KK)=TR(KK)-1;
    TC(L)=TC(L)+1;
    TC(LL)=TC(LL)-1;
    W, KK, LL %line 3220
end %end of while loop line 3250, goto line 1000
disp('Final Solution')
X
%
% ************************************8
%
[NEWWKFILE, PATHNAME]=uiputfile('*.wk1', 'Save As');
wk1write(strcat(PATHNAME,NEWWKFILE), X);
figure
bar3(X);
colormap(gray);
```

APPENDIX B

Selected initial data sheets with original data and calculated amount of supply or consume by the each district. Year 1989 and year 2000 are presented below (empty cells are data not available)

Year	1989				Alpha		Supplier/Comsumer		Amount ('000 MT)	
	Maha	Yala	Total	Population	Maha	Yala	Maha	Yala	Maha	Yala
Sri Lanka	1261319	604000	1865319	15127	63.97061	63.97061				
Colombo	15627	7000	22627	1915	8.16	3.66	D	D	-106.88	-115.49
Kalutara	38348	36000	74348	925	41.46	38.92	D	D	-20.82	-23.17
Galle	45024	28000	73024	922	48.83	30.37	D	D	-13.96	-30.98
Matara	46297	34000	80297	757	61.16	44.91	D	D	-2.13	-14.43
Kegalle	36073	25000	61073	739	48.81	33.83	D	D	-11.2	-22.27
Ratnapura	41122	25000	66122	913	45.04	27.38	D	D	-17.28	-33.41
Kandy	50657	38000	88657	1227	41.29	30.97	D	D	-27.83	-40.49
Nuwaraeliya	12727	7000	19727	531	23.97	13.18	D	D	-21.24	-26.97
Badulla	61360	36000	97360	698	87.91	51.58	S	D	8.06	0
Puttalam	28959	6000	34959	580	49.93	10.34	D	D	-8.14	-31.11
Kurunagala	193178	67000	260178	1391	138.88	48.17	S	D	82.22	0
Matale	38202	11000	49202	410	93.18	26.83	S	D	0	-3.25
Monaragala	28646	6000	34646	340	84.25	17.65	S	D	0	-8.86
Jaffna	10453		10453	856	12.21		D		-44.31	

Vauniya	6635		6635	112	59.24		D		-0.53	
Mannar	6468		6468	127	50.93		D		-1.66	
Anuradhapura	14646	3000	17646	694	21.1	4.32	D	D	-29.75	-41.4
Polonnaruwa	209493	12000	221493	310	675.78	38.71	S	D	181.83	0
Tincomalee	20259	10000	30259	307	65.99	32.57	S	D	0	-9.02
Batticaloa	61652	41000	102652	401	153.75	102.24	S	S	36	15.35
Ampara	165512	108000	273512	470	352.15	229.79	S	S	135.44	77.94
Hambantota	129981	104000	233981	502	258.93	207.17	S	S	97.87	71.89

Table B.1 Data sheet of the year 1989

Year	2000				Alpha		Supplier/Comsumer		Amount ('000 MT)	
	Maha	Yala	Total	Population	Maha	Yala	Maha	Yala	Maha	Yala
Sri Lanka	1735926	1194104	2930030	17463	86.205243	86.20524				
Colombo	12435	2499	14934	2273	5.47	1.1	D	D	-183.51	-193.44
Kalutara	39946	31434	71380	1031	38.74	30.49	D	D	-48.94	-57.44
Galle	40016	23365	63381	1057	37.86	22.11	D	D	-51.1	-67.75
Matara	46998	47046	94044	875	53.71	53.77	D	D	-28.43	-28.38
Kegalle	34064	14386	48450	800	42.58	17.98	D	D	-34.9	-54.58
Ratnapura	41899	31985	73884	1053	39.79	30.38	D	D	-48.88	-58.78
Kandy	42114	23026	65140	1426	29.53	16.15	D	D	-80.82	-99.9
Nuwaraeliya	11443	3764	15207	607	18.85	6.2	D	D	-40.88	-48.56
Badulla	72371	39849	112220	826	87.62	48.24	S	D	0	-30.19
Puttalam	26322	18137	44459	685	38.43	26.48	D	D	-32.73	-40.91
Kurunagala	237364	55735	293099	1568	151.38	35.55	S	D	22.76	0
Matale	48036	19951	67987	474	101.34	42.09	S	D	0	-13.74

Monaragala	50589	21220	71809	399	126.79	53.18	S	D	3.01	0
Jaffna	21253		21253	937	22.68		D		-59.52	
Vauniya	19136	2790	21926	133	143.88	20.98	S	D	0	-1
Mannar	17203	2037	19240	150	114.69	13.58	S	D	0	-6.62
Anuradhapura	192053	214149	406202	814	235.94	263.08	S	S	121.88	143.98
Polonnaruwa	317000	192012	509012	360	880.56	533.37	S	S	285.97	160.98
Tincomalee	61261	45948	107209	363	168.76	126.58	S	S	29.97	14.66
Batticaloa	89320	48188	137508	499	179	96.57	S	S	46.3	5.17
Ampara	192857	243106	435963	565	341.34	430.28	S	S	144.15	194.4
Hambantota	122246	113477	235723	568	215.22	199.78	S	S	73.28	64.51

Table B.2 Data sheet of the year 2000

Maha	89	90	91	92	93	94	95	96	97	98	99	00
Colombo	-106.88	-139.29	-134.46	-129.24	-143.77	-152.28	-151.79	-120.08	-128.93	-161.97	-172.52	-183.51
Kalutara	-20.82	-32.92	-27.1	-24.78	-38.96	-35.1	-36.18	-26.11	-26.1	-44.86	-41.69	-48.94
Galle	-13.96	-34.76	-32.4	-30.22	-37.92	-37.76	-32.95	-29.65	-28.33	-40.31	-46.79	-51.1
Matara	-2.13	-13.19	-20.5	-5.44	-20.2	-20.55	-22.98	-12.92	-8.55	-24.3	-25.74	-28.43
Kegalle	-11.2	-23.39	-21.28	-21.91	-21.25	-26.49	-23.25	-12.82	-14.84	-50.62	-34.34	-34.9
Ratnapura	-17.28	-22.03	-35.1	-35.48	-41.42	-41.9	-41.49	-27.16	-25.18	-44.33	-47.62	-48.88
Kandy	-27.83	-51.47	-44.7	-50.45	-65.52	-67.36	-62.44	-36.3	-44.81	-68.66	-78.68	-80.82
Nuwaraeliya	-21.24	-30.08	-27.17	-28.62	-29.11	-29.78	-30.63	-19.82	-24.98	-31.51	-36.88	-40.88
Badulla	8.06	0	0	0	0	0	0	0	0	-9.58	-0.14	0
Puttalam	-8.14	-31.88	-16.67	-14.13	-22.14	-17.25	-17.02	-8.45	-22.67	-17.71	-20.26	-32.73
Kurunagala	82.22	93.76	139.94	116.58	100.87	102.27	104.29	0	78.98	86.25	81.68	22.77
Matale	0	2.69	5.85	0	0	0	0	8.27	0	1.3	0	0

Monaragala	0	0	8.93	0	0	0	0	2.77	-0.98	0	2.22	3.02
Jaffna	-44.31	-47.15		-49.35	-56.21	-57.71	-50.78	-55.59	-45.43	-72.92	-63.53	-59.52
Vauniya	-0.53	-2.27		0	0	0.89	13.58	-6.02	-0.76	-0.34	-0.71	0
Mannar	-1.66	12.05		1.18	-1.36	-1.49	0	-0.12	0	0	0	0
Anuradhapura	-29.75	10.38	11.48	29.82	22.64	124.99	116.61	0	-2.92	145.1	110.57	121.88
Polonnaruwa	181.83	249.48	263.64	245.54	273.54	193.76	286.89	271.75	280	271.27	251.64	285.97
Trincomalee	0	0		10.28	30.46	35.23	14.78	8.46	16.52	22.21	35.45	29.97
Batticaloa	36	60.75		37.81	47.61	25.15	-23.72	7.93	-3.89	44.2	44.99	46.3
Ampara	135.44	138.47	96.8	143.42	128.26	99.18	9.87	154.35	178.6	161.06	184.71	144.15
Hambantota	97.87	76.54	73.52	93.04	95.89	87.08	83.01	79.27	69.02	82.52	79.99	73.28

Table B.3 Adjusted supply and demand(minus values) amount of each year 'Maha' season

Yala	89	90	91	92	93	94	95	96	97	98	99	00
Colombo	-115.49	-147.28	-142.46	-146.25	-156.75	-161.43	-163.76	-132.08	-141.68	-175.69	-180.03	-193.44
Kalutara	-23.17	-39.92	-42.1	-42.78	-50.67	-48.41	-50.36	-38.57	-39.29	-58.57	-56.54	-57.44
Galle	-30.98	-39.75	-46.4	-52.23	-55.24	-52.13	-60.18	-41.83	-51.24	-80.02	-59.27	-67.75
Matara	-14.43	-18.18	-32.49	-28.43	-30.56	-27.16	-30.95	-19.36	-24.28	-39.44	-26.78	-28.38
Kegalle	-22.27	-33.39	-31.28	-26.91	-29.02	-33.82	-35.83	-30	-25.83	-17.81	-40.82	-54.58
Ratnapura	-33.41	-41.02	-44.1	-47.48	-41.82	-46.99	-44.53	-33.75	-37.77	-55.86	-56.89	-58.78
Kandy	-40.49	-59.47	-61.7	-59.45	-78.2	-86.62	-72.45	-59.67	-61.99	-89.87	-86.39	-99.9
Nuwaraeliya	-26.97	-38.08	-34.16	-34.63	-35.88	-37.51	-37.34	-29.01	-32.21	-42.54	-45.2	-48.56
Badulla	0	-15.96	-9.67	-19.46	-14.76	-20.92	-25.87	-13.84	-18.76	-25.81	-37.04	-30.19
Puttalam	-31.11	-37.88	-35.67	-37.13	-41.19	-33.72	-35.78	-37.31	-35.49	-38.53	-37.78	-40.91
Kurunagala	0	0	8.94	27.58	0	0	26.62	-50.14	0	0	14.17	0
Matale	-3.25	0	0	-4.9	-3.46	-16.12	-7.68	0	-6.63	0	-11.9	-13.74

Monaragala	-8.85	-8.92	0	-16.93	-0.27	-5.99	-6.47	0	-15.04	-3.29	0	0
Jaffna												
Vauniya			-11.95		-5.85	0	0		-8.27	-7.56	-7.22	-1
Mannar		0			-10.24	-8.5	-6.35	-7.26	-0.76	-7.86	-4.98	-6.62
Anuradhapura	-41.4	0	0	0	0	3.11	0	-10.18	-41.01	0	0	143.98
Polonnaruwa	0	117.48	126.64	74.54	142.41	167.56	163.55	92.28	127.48	156.36	175.22	160.98
Trincomalee	-9.02	-5.92	0		3.35	7.83	14.84	0	0	1.07	13.21	14.66
Batticaloa	15.35	8.68	0	0	3.99	0	23.3	0	-15.66	0	5.07	5.17
Ampara	77.94	86.36	89.81	107.42	139.02	155.72	148.34	181.87	125.84	179.64	165.87	194.4
Hambantota	71.89	57.55	39.51	2.04	43.73	64.2	65.13	51.05	57.82	58.96	54.96	64.51

Table B.4 Adjusted supply and demand(minus values) amount of each year 'Yala' season

Maha	Mean	std dev	Variance	Alpha = 0.85	alpha = 0.95	Alpha =0.99
				1-beta = 0.85	1-beta = 0.95	1-beta = 0.99
Colombo	-140.11	18.99	360.74	-159.86	-171.444	-184.167
Kalutara	-32.24	7.78	60.57	-40.3312	-45.077	-50.2896
Galle	-33.19	8.35	69.68	-41.874	-46.9675	-52.562
Matara	-16.05	8.05	64.78	-24.422	-29.3325	-34.726
Kegalle	-23.76	11.02	121.41	-35.2208	-41.943	-49.3264
Ratnapura	-34.45	10.07	101.43	-44.9228	-51.0655	-57.8124
Kandy	-54.38	15.47	239.29	-70.4688	-79.9055	-90.2704
Nuwaraeliya	-28.17	4.79	22.93	-33.1516	-36.0735	-39.2828
Badulla	-0.15	3.96	15.65	-4.2684	-6.684	-9.3372

Puttalam	-17.85	6.66	44.32	-24.7764	-28.839	-33.3012
Kurunagala	89.71	34.72	1205.19	125.8188	146.998	170.2604
Matale	1.65	2.86	8.17	4.6244	6.369	8.2852
Monaragala	1.18	2.79	7.81	4.0816	5.7835	7.6528
Jaffna	-54.3	8.92	79.48	-63.5768	-69.018	-74.9944
Vauniya	0.38	5.02	25.18	5.6008	8.663	12.0264
Mannar	0.86	4.03	16.23	5.0512	7.5095	10.2096
Anuradhapura	48.99	62.15	3863.19	113.626	151.5375	193.178
Polonnaruwa	251.76	34.24	1172.55	287.3696	308.256	331.1968
Trincomalee	17.34	13.25	175.68	31.12	39.2025	48.08
Batticaloa	27.68	26.4	696.7	55.136	71.24	88.928
Ampara	130.01	48.66	2368.06	180.6164	210.299	242.9012
Hambantota	83.43	9.24	85.29	93.0396	98.676	104.8668

Table B.5 Simulated supply and demand (minus) amounts for Maha season of the year 2000. The α and $1-\beta$ probabilities are 0.85, 0.95 and 0.99.

Yala	Mean	Std dev	Variance	Alpha = 0.85	alpha = 0.95	Alpha =0.99
				beta = 0.15	beta = 0.05	beta = 0.01
Colombo	-151.17	18.90	357.18	-170.825	-182.354	-195.016
Kalutara	-44.58	9.89	97.75	-54.8625	-60.8935	-67.5178
Galle	-51.75	12.81	164.20	-65.0768	-72.8935	-81.479
Matara	-26.55	7.17	51.46	-34.0108	-38.3868	-43.1932
Kegalle	-29.73	6.44	41.42	-36.4233	-40.3492	-44.6612
Ratnapura	-43.97	7.73	59.78	-52.011	-56.7274	-61.9076
Kandy	-68.75	15.26	232.86	-84.6203	-93.9288	-104.153
Nuwaraeliya	-35.78	5.34	28.53	-41.335	-44.5932	-48.172
Badulla	-18.37	9.59	92.05	-28.3482	-34.2007	-40.629
Puttalam	-36.51	2.64	6.97	-39.2561	-40.8667	-42.6359
Kurunagala	2.47	20.49	419.69	23.7758	36.27247	49.99832
Matale	-4.9	5.35	28.64	-10.4661	-13.7309	-17.3168
Monaragala	-5.98	6.05	36.62	-12.2737	-15.9653	-20.0199
Jaffna						
Vauniya	-5.84	4.40	19.39	-10.419	-13.1047	-16.0546
Mannar	-5.74	3.65	13.34	-9.53829	-11.7661	-14.2131
Anuradhapura	-8.13	16.68	278.12	-25.474	-35.647	-46.8205
Polonnaruwa	122.14	51.31	2632.32	175.4984	206.7951	241.1702
Trincomalee	2.54	7.60	57.83	10.44901	15.08796	20.18319
Batticaloa	3.7	9.95	98.99	14.04736	20.11649	26.78258
Ampara	132.53	37.69	1420.72	171.7301	194.7225	219.9765
Hambantota	51.53	18.86	355.76	71.14608	82.65166	95.28894

Table B.6 Simulated supply and demand (minus) amounts for Yala season of the year 2000. The α and 1-β probabilities are 0.85, 0.95 and 0.99.

	alpha=0.85, 1-beta=0.85		alpha=0.95, 1-beta=0.95		alpha=0.99, 1-beta=0.99	
District	Maha	Yala	Maha	Yala	Maha	Yala
Colombo	-159.86	-170.83	-171.44	-182.35	-184.17	-195.02
Kalutara	-40.33	-54.86	-45.08	-60.89	-50.29	-67.52
Galle	-41.87	-65.08	-46.97	-72.89	-52.56	-81.48
Matara	-24.42	-34.01	-29.33	-38.39	-34.73	-43.19
Kegalle	-35.22	-36.42	-41.94	-40.35	-49.33	-44.66
Ratnapura	-44.92	-52.01	-51.07	-56.73	-57.81	-61.91
Kandy	-70.47	-84.62	-79.91	-93.93	-90.27	-104.15
Nuwaraeliya	-33.15	-41.34	-36.07	-44.59	-39.28	-48.17
Badulla	-4.27	-28.35	-6.68	-34.2	-9.34	-40.63
Puttalam	-24.78	-39.26	-28.84	-40.87	-33.3	-42.64
Kurunagala	125.82	23.78	147	36.27	170.26	50
Matale	0	-5.84	0	-7.36	0	-9.03
Monaragala	0	-8.19	0	-10.18	0	-12.37
Jaffna	-63.5768		-69.018		-74.9944	
Vauniya	0	-4.82	0	-4.44	0	-4.03
Mannar	0	-4.49	0	-4.26	0	-4
Anuradhapura	88.15	0	115.89	0	146.36	0
Polonnaruwa	287.37	175.5	308.26	206.8	331.2	241.17
Trincomalee	31.12	10.45	39.2	15.09	48.08	20.18
Batticaloa	55.14	14.05	71.24	20.12	88.93	26.78
Ampara	180.62	171.73	210.3	194.72	242.9	219.98
Hambantota	93.04	71.15	98.68	82.65	104.87	95.29

Table B.7 Adjusted supply and demand(minus values) amount of the year 2000 simulated values for the α and 1-β probabilities are 0.85, 0.95 and 0.99.

Colombo	Kalutara	Galle	Matara	Kegalle	Ratnapura	Kandy	Nuwaraeliya	Badulla	Puttalam	Kurunagala	Matale	Monaragala	Jaffna	Vauniya	Mannar	Anuradhapura	Polonnaruwa	Tincomalee	Batticaloa	Ampara	Hambantota
	43	116	160	77	101	116	180	230	142	93	142	254	396	254	312	206	216	257	303	350	238
43		72	116	121	77	159	192	206	175	137	185	240	439	298	356	249	259	301	346	335	193
116	72		45	192	150	232	290	256	248	209	257	285	512	370	428	322	332	373	381	332	124
160	116	45		238	169	277	245	211	293	254	303	191	557	415	473	367	377	418	336	288	77
77	121	192	238		103	39	103	159	119	32	64	253	335	193	251	153	154	196	225	224	227
101	77	150	169	103		142	148	129	206	119	168	149	422	280	338	240	241	283	296	245	124
116	159	232	277	39	142		77	134	129	42	26	204	320	179	237	138	140	182	187	185	245
180	192	290	245	103	148	77		56	128	119	103	126	398	256	314	216	217	259	224	222	167
230	206	256	211	159	129	134	56		262	175	159	89	454	312	370	272	233	277	167	172	134
142	175	248	293	119	206	129	128	262		87	154	368	269	127	185	74	175	180	270	311	330
93	137	209	254	32	119	42	119	175	87		68	246	303	161	219	121	122	164	217	227	243
142	185	257	303	64	168	26	103	159	154	68		228	295	153	211	113	144	156	212	206	270
254	240	285	191	253	149	204	126	89	368	246	228		476	321	450	215	387	261	159	92	113
396	439	512	557	335	422	320	398	454	269	303	295	476		142	219	195	283	238	378	469	546
254	298	370	415	193	280	179	256	312	127	161	153	321	142		77	53	142	97	237	308	404
312	356	428	473	251	338	237	314	370	185	219	211	450	219	77		111	200	174	295	381	462
206	249	322	367	153	240	138	216	272	74	121	113	215	195	53	111		101	106	196	269	364
216	259	332	377	154	241	140	217	233	175	122	144	387	283	142	200	101		129	95	185	323
257	301	373	418	196	283	182	259	277	180	164	156	261	238	97	174	106	129		138	206	367
303	346	381	336	225	296	187	224	167	270	217	212	159	378	237	295	196	95	138		70	261
350	335	332	288	224	245	185	222	172	311	227	206	92	469	308	381	269	185	206	70		209
238	193	124	77	227	124	245	167	134	330	243	270	113	546	404	462	364	323	367	261	209	

Table B.8 Cost matrix ; Distances among the administrative capitals of districts (Km)

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