# REFERENCES


Abraham, B. (1981). Missing Observations in Time Series. Communications in statistics Theory A, 10, 1643-1653.

Beveridge, S. (1992). Least Squares Estimation of Missing Values in Time Series. Communications in statistics Theory A, 21(12), 3479-3496.

Brockwell, P. J., & Davis, R. A. (1991). Time Series: Theory and Methods. New York, USA : Springer-Verlag.

Chatfield, C. (2003). The Analysis of Time Series : An Introduction (6th ed.). New York, USA : John Wiley and Sons.

Damsleth, E. (1979). Interpolating Missing Values in a Time Series. Scand J Statist., 7, 33-39.

Ferreiro, O. (1987). Methodologies for the Estimation of Missing Observations in Time Series. Statistics & Probability Letters, 5(1), 65-69.

Gardner, G., Harvey, A. C., & Phillips, G. D. A. (1980). An Algorithm for Exact Maximum Likelihood Estimation of Autoregressive-Moving Average Models by Means of Kalman. Applied Statistics, 29, 311-322.

Gerald, C. F., & Wheatley, P. O. (1994). Applied Numerical Analysis.

Gomez, I. A., Burton, D. M., & Love, H. A. (1995). Imputing Missing Natural Resource Inventory Data and the Bootstrap. Natural Resource Modelling, 9(4), 299-328.

Hamilton, J. D. (1994). Time Series Analysis. New Jersey, USA : Princeton University Press.

Harvey, A. C. (2001). Forecasting, Structural Time Series Models and the Kalman Filter. Cambridge, UK : Cambridge University Press.

Harvey, A. C., & Pierse, R.G. (1984). Estimating Missing Observations in Economic Time Series. Journal of the American Statistical Association, 79(385), 125-131.

Janacek, G., & Swift, L. (1993). Time Series Forecasting Simulation & Application. West Sussex, England : Ellis Horwood Limited.

Jones, R. H. (1980). Maximum Likelihood Fitting of ARMA Models to Time Series with Missing Observations. Technometrics, 22(3), 389-395.

Kalman, R. E. (1960). A New Approach to Linear Filtering and Prediction Problems. Journal of Basic Energineering, 81, 35-45.

Kohn, R., & Ansley, C. F. (1986). Estimation, Prediction, and Interpolation for ARIMA Models with Missing Data. Journal of the American Statistical Association, 81(395), 751-761.

Ljung, G. M. (1989). A Note on the Estimation of Missing Values in Time Series. Communications in statistics simulation, 18(2), 459-465.

Luceno, A. (1997). Estimation of Missing Values in Possibly Partially Nonstationary Vector Time Series. Biometrika, 84(2), 495-499

Nieto, F. H., & Martfncz, J. (1996). A Recursive Approach for Estimating Missing Observations in An Univariate Time Series. Communications in statistics Theory A, 25(9), 2101-2116.

Pena, D., & Tiao, G. C. (1991). A Note on Likelihood Estimation of Missing Values in Time Series. The American statistician, 45(3), 212-213.

Robinson, P. M. (1985). Testing for Serial Correlation in Regression with Missing Observations. Journal of the Royal Statistical Society B, 47, 429-437.

Robinson, P. M., & Dunsmuir, W. (1981). Estimation of Time Series Models in the Presence of Missing Data. Journal of the American Statistical Association, 76(375), 560-568.

Rosen, Y., & Porat, B. (1989). Optimal ARMA Parameter Estimation Based on The Sample Covariances for Data with Missing Observations. IEEE Transactions on Information Theorey, 35(2), 342-349.

Rosen, Y., & Porat, B. (1989). The Second-Order Moments of The Sample Covariances for Time Series with Missing Observations. IEEE Transactions on Information Theorey, 35(2), 334-341.

Shively, T. S. (1992). Testing for Autoregressive Disturbances in a Time Series Regression with Missing Observations. Journal of econometrics, 57(1), 233-255.
Shumway, R. H. (1982). An Approach to Time Series Smoothing and Forecasting using The EM Algorithm. Journal of Time Series Analysis, 3(4), 253-264.

Tresp, V., & Hofmann, R. (1998). Nonlinear Time-Series Prediction with Missing and Noisy Data. Neural Computation, 10, 731-747.

Wincek, M. A., & Reinsel, G. C. (1986). An Exact Maximum Likelihood Estimation Procedure for Regression ARMA Time Series Models with Possibly Nonconsecutive Data. Journal of the Royal Statistical Society B, 48(3), 303-313.

## Appendix A

During this study, I used macros to help me at different stages for analyzing time series data and examine the effectiveness of different analysis methods.

In this thesis, I have written macros for Microsoft Excel spreadsheet to generate data sets. Also, I used Excel to evaluate the accuracy of various prediction methods such as interpolating with a cubic spline and least squares approximations. The following macros must be used in conjunction with excel_curvefit_analysis_book v4.5 and plugin from XlXtrFunDistribution.

Excel Macros :

```
**********************************************************************
Option Explicit
Option Compare Text

Sub Analysis()
   'declare variables
   Dim Message, Title

   Dim Phi1         As Double
   Dim Phi2         As Double
   Dim Theta1          As Double
   Dim Theta2          As Double
   Dim respond As Integer

   Dim indexNum       As Integer

   Dim var1           As Double

   Dim numberInList    As Integer
   Dim chosenValue     As String

   'unload the form in case it was left in memory
   Unload UserForm1
   'add items to the list box
   With UserForm1.ListBox1
      .AddItem "AR 1"
      .AddItem "AR 2"
      .AddItem "MA 1"
      .AddItem "MA 2"
      .AddItem "ARIMA 011"
      .AddItem "ARIMA 110"
      .AddItem "ARIMA 101"
      .AddItem "ARIMA 111"
      .AddItem "Seasonal"
   End With
   'display the list until an item is selected or cancel pressed
   Do
      UserForm1.Show
```

```
    'check value of bOK that was set by the buttons on the form
    If Not bOK Then Exit Sub
    'if an item is selected, exit the loop
    If UserForm1.ListBox1.ListIndex > -1 Then Exit Do
    'if no item selected, display a message
    MsgBox "No selection was made"
Loop
'store the values of the listbox for later use
indexNum = UserForm1.ListBox1.ListIndex
numberInList = indexNum + 1
chosenValue = UserForm1.ListBox1.Value
'unload the userform
Unload UserForm1
'display a message box of what was selected
MsgBox "List index number* of item picked:  " & indexNum & Chr(13) & _
        Chr(13) & _
       "Number of item in the list:  " & numberInList & Chr(13) & _
       Chr(13) & _
       "list text of item picked:  " & chosenValue & Chr(13) & _
       Chr(13) & _
       Chr(13) & _
       "* Please note that the index number of the first item in a list is 0, not 1"

Message = "Enter the value for the variance ?"
Title = "Information for the random number generator"
var1 = InputBox(Message, Title)

 Select Case indexNum

Case 0
    Message = "Enter the value for the first constant ?"
    Title = "Simulation Data Analysis for AR1 model"
    Phi1 = InputBox(Message, Title)

Case 1
    Message = "Enter the value for the first constant ?"
    Title = "Simulation Data Analysis for AR2 model"
    Phi1 = InputBox(Message, Title)
    Message = "Enter the value for the second constant ?"
    Title = "Simulation Data Analysis for AR2 model"
    Phi2 = InputBox(Message, Title)

Case 2
    Message = "Enter the value for the first constant ?"
    Title = "Simulation Data Analysis for MA1 model"
    Theta1 = InputBox(Message, Title)

Case 3
    Message = "Enter the value for the first constant ?"
    Title = "Simulation Data Analysis for MA2 model"
```

```
    Theta1 = InputBox(Message, Title)
    Message = "Enter the value for the second constant ?"
    Title = "Simulation Data Analysis for MA2 model"
    Theta2 = InputBox(Message, Title)

Case 4
    Message = "Enter the value for the first MA constant ?"
    Title = "Simulation Data Analysis for ARIMA 011 model"
    Theta1 = InputBox(Message, Title)

Case 5
    Message = "Enter the value for the first AR constant ?"
    Title = "Simulation Data Analysis for ARIMA 110 model"
    Phi1 = InputBox(Message, Title)

Case 6
    Message = "Enter the value for the first AR constant ?"
    Title = "Simulation Data Analysis for ARIMA 101 model"
    Phi1 = InputBox(Message, Title)
    Message = "Enter the value for the first MA constant ?"
    Title = "Simulation Data Analysis for ARIMA 101 model"
    Theta1 = InputBox(Message, Title)

Case 7
    Message = "Enter the value for the first AR constant ?"
    Title = "Simulation Data Analysis for ARIMA 111 model"
    Phi1 = InputBox(Message, Title)
    Message = "Enter the value for the first MA constant ?"
    Title = "Simulation Data Analysis for ARIMA 111 model"
    Theta1 = InputBox(Message, Title)

Case 8
    'Seasonal Model
    Message = "Enter the value for the constant ?"
    Title = "Simulation Data Analysis for SARIMA (1,0,0)(0,1,0)12 model"
    Phi1 = InputBox(Message, Title)

Case Else
    'Extra option

End Select

'AddIns("Analysis ToolPak - VBA").Installed = True
Message = "Enter '1' for Excel to simulate data set or '0' for user's data set"
Title = "Information"
respond = InputBox(Message, Title)
If respond = 0 Then
    Processing2 Phi1, Phi2, Theta1, Theta2, indexNum, var1
ElseIf respond = 1 Then
    Processing Phi1, Phi2, Theta1, Theta2, indexNum, var1
```

```
    End If
End Sub

Sub Summary_Analysis()

    Dim row_index1          As Integer
    Dim column_index1       As Integer
    Dim row_index2          As Integer
    Dim column_index2       As Integer
    Dim row_index3          As Integer
    Dim column_index3       As Integer
    Dim countsheet          As Integer
    Dim counter1            As Integer
    Dim counter2            As Integer

    Dim Message, Title

    Dim Phi1          As Double
    Dim Phi2          As Double
    Dim Theta1        As Double
    Dim Theta2        As Double
    Dim model         As String
    Dim respond       As Integer

    Dim indexNum      As Integer

    Dim var1          As Double

    row_index1 = 1
    row_index2 = 1
    respond = 2

    Message = "Enter '1' for Excel to simulate data set or '0' for user's data set"
    Title = "Information"
    respond = InputBox(Message, Title)

    For counter1 = 1 To 20

    column_index1 = 1
    column_index2 = 1
    indexNum = 99
    Sheets("Summary").Select

    model = ActiveSheet.Range("B7").Cells(row_index1, column_index1).Value
    Phi1 = ActiveSheet.Range("B7").Cells(row_index1, column_index1 + 1).Value
    Phi2 = ActiveSheet.Range("B7").Cells(row_index1, column_index1 + 2).Value
    Theta1 = ActiveSheet.Range("B7").Cells(row_index1, column_index1 + 3).Value
    Theta2 = ActiveSheet.Range("B7").Cells(row_index1, column_index1 + 4).Value
    var1 = ActiveSheet.Range("B7").Cells(row_index1, column_index1 + 5).Value
```

```
    If model = "AR 1" Then
       indexNum = 0
    ElseIf model = "AR 2" Then
       indexNum = 1
    ElseIf model = "MA 1" Then
       indexNum = 2
    ElseIf model = "MA 2" Then
       indexNum = 3
    ElseIf model = "ARIMA 011" Then
       indexNum = 4
    ElseIf model = "ARIMA 110" Then
       indexNum = 5
    ElseIf model = "ARIMA 101" Then
       indexNum = 6
    ElseIf model = "ARIMA 111" Then
       indexNum = 7
    ElseIf model = "Seasonal" Then
       indexNum = 8
    End If

If (respond = 0) And (indexNum <> 99) Then

        If counter1 = 1 Then
        Sheets("DataSets (2)").Select
        ElseIf counter1 = 2 Then
        Sheets("DataSets (3)").Select
        ElseIf counter1 = 3 Then
        Sheets("DataSets (4)").Select
        ElseIf counter1 = 4 Then
        Sheets("DataSets (5)").Select
        ElseIf counter1 = 5 Then
        Sheets("DataSets (6)").Select
        ElseIf counter1 = 6 Then
        Sheets("DataSets (7)").Select
        ElseIf counter1 = 7 Then
        Sheets("DataSets (8)").Select
        ElseIf counter1 = 8 Then
        Sheets("DataSets (9)").Select
        ElseIf counter1 = 9 Then
        Sheets("DataSets (10)").Select
        ElseIf counter1 = 10 Then
        Sheets("DataSets (11)").Select
        ElseIf counter1 = 11 Then
        Sheets("DataSets (12)").Select
        ElseIf counter1 = 12 Then
        Sheets("DataSets (13)").Select
        ElseIf counter1 = 13 Then
        Sheets("DataSets (14)").Select
        ElseIf counter1 = 14 Then
        Sheets("DataSets (15)").Select
```

```
        ElseIf counter1 = 15 Then
        Sheets("DataSets (16)").Select
        ElseIf counter1 = 16 Then
        Sheets("DataSets (17)").Select
        ElseIf counter1 = 17 Then
        Sheets("DataSets (18)").Select
        ElseIf counter1 = 18 Then
        Sheets("DataSets (19)").Select
        ElseIf counter1 = 19 Then
        Sheets("DataSets (20)").Select
        ElseIf counter1 = 20 Then
        Sheets("DataSets (21)").Select
        End If

        Range("A3:CV102").Select
        Selection.Copy
        Sheets("DataSets").Select
        Range("A3:CV102").Select
        Selection.PasteSpecial Paste:=xlValues, Operation:=xlNone, SkipBlanks:= _
        False, Transpose:=False
        Application.CutCopyMode = False

        Processing2 Phi1, Phi2, Theta1, Theta2, indexNum, var1
End If

If respond = 1 Then


   If (indexNum = 0) Or (indexNum = 1) Or (indexNum = 2) Or (indexNum = 3) Or
(indexNum = 4) Or (indexNum = 5) Or (indexNum = 6) Or (indexNum = 7) Or
(indexNum = 8) Then
     Processing Phi1, Phi2, Theta1, Theta2, indexNum, var1, counter1
     Sheets("DataSets").Copy Before:=Sheets("Summary")
   End If
End If

      row_index1 = row_index1 + 2

      For counter2 = 1 To 7

      If (indexNum >= 0) And (indexNum <= 8) Then
         Sheets("Summary").Select
         ActiveSheet.Range("H7").Cells(row_index2, counter2).Value =
Sheets("case2").Range("AF104").Cells(1, column_index2).Value
         ActiveSheet.Range("H8").Cells(row_index2, counter2).Value =
Sheets("case2").Range("AF105").Cells(1, column_index2).Value
         ActiveSheet.Range("H52").Cells(row_index2, counter2).Value =
Sheets("case3").Range("AF104").Cells(1, column_index2).Value
         ActiveSheet.Range("H53").Cells(row_index2, counter2).Value =
Sheets("case3").Range("AF105").Cells(1, column_index2).Value
```

```
            ActiveSheet.Range("H97").Cells(row_index2, counter2).Value =
Sheets("case4").Range("AF104").Cells(1, column_index2).Value
            ActiveSheet.Range("H98").Cells(row_index2, counter2).Value =
Sheets("case4").Range("AF105").Cells(1, column_index2).Value
        Else
            Sheets("Summary").Select
            ActiveSheet.Range("H7").Cells(row_index2, counter2).Clear
            ActiveSheet.Range("H8").Cells(row_index2, counter2).Clear
            ActiveSheet.Range("H52").Cells(row_index2, counter2).Clear
            ActiveSheet.Range("H53").Cells(row_index2, counter2).Clear
            ActiveSheet.Range("H97").Cells(row_index2, counter2).Clear
            ActiveSheet.Range("H98").Cells(row_index2, counter2).Clear
        End If

        column_index2 = column_index2 + 4

        Next counter2

        row_index2 = row_index2 + 2

    Next counter1

End Sub
Sub Processing(Phi1, Phi2, Theta1, Theta2, indexNum, var1, counter1)
    'declare variables

    Dim M49, S49_1, S49_2, S49_3, P49_1, P49_2, P49_3 As Double
    Dim M1, S1, P1              As Double
    Dim M99, S99, P99           As Double
    Dim M50, S50, P50           As Double
    Dim M51, S51, P51           As Double

    Dim rwindex         As Integer
    Dim rwindex2        As Integer
    Dim colindex        As Integer
    Dim colindex2       As Integer
    Dim rwindex3        As Integer
    Dim colindex3       As Integer
    Dim rwindex4        As Integer
    Dim colindex4       As Integer
    Dim rwindex5        As Integer
    Dim colindex5       As Integer
    Dim rwindex6        As Integer
    Dim colindex6       As Integer
    Dim rwindex7        As Integer
    Dim colindex7       As Integer
    Dim seed            As Integer
    Dim dcounter        As Integer
    Dim counter         As Integer
```

```
colindex = 1
rwindex = 3
colindex2 = 1
rwindex2 = 4
colindex3 = 1
rwindex3 = 108
colindex6 = 1
rwindex6 = 212
colindex4 = 1
rwindex4 = 4
colindex5 = 1
rwindex5 = 108
colindex7 = 1
rwindex7 = 212

clear_data
Sheets("DataSets").Range("A3:cv102").Clear

AddIns("Analysis ToolPak - VBA").Installed = True

For counter = 0 To 99
seed = counter + counter1
Sheets.Add.Name = "Temp"

Application.Run "ATPVBAEN.XLA!Random", ActiveSheet.Range("$A$5"), 1, 125
_
   , 2, seed, 0, var1

Range("b5:b124").Select
Selection.ClearContents

Select Case indexNum

Case 0
   ActiveSheet.Range("a1").Value = Phi1
   ActiveSheet.Range("b4").Value = ActiveSheet.Range("a5").Value
   ActiveCell.FormulaR1C1 = "=R1C1*R[-1]C+R[1]C[-1]"

Case 1
   ActiveSheet.Range("a1").Value = Phi1
   ActiveSheet.Range("a2").Value = Phi2
   ActiveSheet.Range("b3").Value = ActiveSheet.Range("a5").Value
   ActiveSheet.Range("b4").Value = ActiveSheet.Range("a6").Value
   ActiveCell.FormulaR1C1 = "=r1c1*r[-1]c+r2c1*r[-2]c+r[2]c[-1]"

Case 2
   ActiveSheet.Range("a1").Value = Theta1
   ActiveSheet.Range("b4").Value = ActiveSheet.Range("a5").Value
   ActiveCell.FormulaR1C1 = "=R1C1*RC[-1]+R[1]C[-1]"
```

```
Case 3
   ActiveSheet.Range("a1").Value = Theta1
   ActiveSheet.Range("a2").Value = Theta2
   ActiveSheet.Range("b3").Value = ActiveSheet.Range("a5").Value
   ActiveSheet.Range("b4").Value = ActiveSheet.Range("a6").Value
   ActiveCell.FormulaR1C1 = "=r1c1*rc[-1]+r2c1*r[1]c[-1]+r[2]c[-1]"

Case 4
   ActiveSheet.Range("a1").Value = Theta1
   ActiveSheet.Range("b4").Value = ActiveSheet.Range("a5").Value
   ActiveSheet.Range("c4").Value = ActiveSheet.Range("a5").Value
   ActiveCell.FormulaR1C1 = "=R1C1*RC[-1]+R[1]C[-1]"
   Range("c5").Select
   ActiveCell.FormulaR1C1 = "=R[-1]C+RC[-1]"

Case 5
   ActiveSheet.Range("a1").Value = Phi1
   ActiveSheet.Range("b4").Value = ActiveSheet.Range("a5").Value
   ActiveSheet.Range("c4").Value = ActiveSheet.Range("a5").Value
   ActiveCell.FormulaR1C1 = "=R1C1*R[-1]C+R[1]C[-1]"
   Range("c5").Select
   ActiveCell.FormulaR1C1 = "=R[-1]C+RC[-1]"

Case 6
   ActiveSheet.Range("a1").Value = Phi1
   ActiveSheet.Range("a2").Value = Theta1
   ActiveSheet.Range("b4").Value = ActiveSheet.Range("a5").Value
   ActiveCell.FormulaR1C1 = "=r1c1*r[-1]c+r2c1*rc[-1]+r[1]c[-1]"

Case 7
   ActiveSheet.Range("a1").Value = Phi1
   ActiveSheet.Range("a2").Value = Theta1
   ActiveSheet.Range("b4").Value = ActiveSheet.Range("a5").Value
   ActiveSheet.Range("c4").Value = ActiveSheet.Range("a5").Value
   ActiveCell.FormulaR1C1 = "=r1c1*r[-1]c+r2c1*rc[-1]+r[1]c[-1]"
   Range("c5").Select
   ActiveCell.FormulaR1C1 = "=R[-1]C+RC[-1]"

Case 8
   'Seasonal Model
   ActiveSheet.Range("a1").Value = Phi1
   ActiveSheet.Range("b1").Value = ActiveSheet.Range("a5").Value
   ActiveSheet.Range("b2").Value = ActiveSheet.Range("a6").Value
   ActiveSheet.Range("b3").Value = ActiveSheet.Range("a7").Value
   ActiveSheet.Range("b4").Value = ActiveSheet.Range("a8").Value
   ActiveSheet.Range("b5").Value = ActiveSheet.Range("a9").Value
   ActiveSheet.Range("b6").Value = ActiveSheet.Range("a10").Value
   ActiveSheet.Range("b7").Value = ActiveSheet.Range("a11").Value
   ActiveSheet.Range("b8").Value = ActiveSheet.Range("a12").Value
   ActiveSheet.Range("b9").Value = ActiveSheet.Range("a13").Value
```

```
    ActiveSheet.Range("b10").Value = ActiveSheet.Range("a14").Value
    ActiveSheet.Range("b11").Value = ActiveSheet.Range("a15").Value
    ActiveSheet.Range("b12").Value = ActiveSheet.Range("a16").Value
    ActiveSheet.Range("b13").Value = ActiveSheet.Range("a17").Value
    Range("b14").Select
    ActiveCell.FormulaR1C1 = "=r1c1*r[-1]c-r1c1*r[-13]c+r[-12]c+r[4]c[-1]"

Case Else
    'Extra option

End Select

Select Case indexNum

Case 0, 1, 2, 3, 4, 5, 6, 7

    Range("B5:c5").Select
    Selection.AutoFill Destination:=Range("B5:c108"), Type:=xlFillDefault

Case 8

    Range("B14:c14").Select
    Selection.AutoFill Destination:=Range("B14:c128"), Type:=xlFillDefault

Case Else
    ' extra option

End Select

Select Case indexNum

Case 0, 1, 2, 3, 6
    Range("b5:b104").Select

Case 4, 5, 7
    Range("c5:c104").Select

Case 8
    Range("b14:b113").Select

Case Else
    'Extra option

End Select

Selection.Copy
Sheets("case1").Select
Range("b6").Select
Selection.PasteSpecial Paste:=xlValues, Operation:=xlNone, SkipBlanks:= _
    False, Transpose:=False
```

```
Sheets("DataSets").Select
Range("a1:cv105").Cells(rwindex, colindex).Select
Selection.PasteSpecial Paste:=xlValues, Operation:=xlNone, SkipBlanks:= _
    False, Transpose:=False
Application.CutCopyMode = False
colindex = colindex + 1
Sheets("Temp").Select
Application.CutCopyMode = False
Application.DisplayAlerts = False
ActiveWindow.SelectedSheets.Delete
Sheets("case1").Select
Range("b6").Select

M49 = ActiveSheet.Range("B54").Value
Sheets("case2").Select
S49_1 = ActiveSheet.Range("G54").Value
Range("ad1").Cells(rwindex2, colindex2).Value = M49
Range("ae1").Cells(rwindex2, colindex2).Value = S49_1
Sheets("case1").Select

M1 = ActiveSheet.Range("B12").Value
Sheets("case3").Select
S1 = ActiveSheet.Range("G12").Value
Range("ad1").Cells(rwindex2, colindex2).Value = M1
Range("ae1").Cells(rwindex2, colindex2).Value = S1
Sheets("case1").Select

M99 = ActiveSheet.Range("B96").Value
Sheets("case4").Select
S99 = ActiveSheet.Range("G96").Value
Range("ad1").Cells(rwindex2, colindex2).Value = M99
Range("ae1").Cells(rwindex2, colindex2).Value = S99
Sheets("case1").Select

For dcounter = 2 To 7

Sheets("case1").Range("d3").Value = dcounter

Sheets("case2").Select
P49_1 = ActiveSheet.Range("F54").Value
Range("ai1").Cells(rwindex4, colindex4).Value = P49_1


Sheets("case3").Select
P1 = ActiveSheet.Range("F12").Value
Range("ai1").Cells(rwindex4, colindex4).Value = P1


Sheets("case4").Select
P99 = ActiveSheet.Range("F96").Value
```

```
    Range("ai1").Cells(rwindex4, colindex4).Value = P99

    colindex4 = colindex4 + 4
    colindex5 = colindex5 + 4
    colindex7 = colindex7 + 4

    Next dcounter

    rwindex2 = rwindex2 + 1
    rwindex3 = rwindex3 + 1
    rwindex4 = rwindex4 + 1
    rwindex5 = rwindex5 + 1
    rwindex6 = rwindex6 + 1
    rwindex7 = rwindex7 + 1
    colindex4 = 1
    colindex5 = 1
    colindex6 = 1
    colindex7 = 1

    Next counter

End Sub

Sub clear_data()

Sheets("case2").Range("Ad4:ae103,ai4:ai103,am4:am103,aq4:aq103,au4:au103,ay4:ay1
03,bc4:bc103").Clear
Sheets("case3").Range("Ad4:ae103,ai4:ai103,am4:am103,aq4:aq103,au4:au103,ay4:ay1
03,bc4:bc103").Clear
Sheets("case4").Range("Ad4:ae103,ai4:ai103,am4:am103,aq4:aq103,au4:au103,ay4:ay1
03,bc4:bc103").Clear

End Sub
Sub Processing2(Phi1, Phi2, Theta1, Theta2, indexNum, var1)
    'declare variables

    Dim M49, S49_1, S49_2, S49_3, P49_1, P49_2, P49_3 As Double
    Dim M1, S1, P1              As Double
    Dim M99, S99, P99           As Double
    Dim M50, S50, P50           As Double
    Dim M51, S51, P51           As Double

    Dim rwindex         As Integer
    Dim rwindex2        As Integer
    Dim colindex        As Integer
    Dim colindex2       As Integer
    Dim rwindex3        As Integer
    Dim colindex3       As Integer
    Dim rwindex4        As Integer
    Dim colindex4       As Integer
```

```
Dim rwindex5        As Integer
Dim colindex5       As Integer
Dim rwindex6        As Integer
Dim colindex6       As Integer
Dim rwindex7        As Integer
Dim colindex7       As Integer
Dim dcounter        As Integer
Dim counter         As Integer

colindex = 1
rwindex = 3
colindex2 = 1
rwindex2 = 4
colindex3 = 1
rwindex3 = 108
colindex6 = 1
rwindex6 = 212
colindex4 = 1
rwindex4 = 4
colindex5 = 1
rwindex5 = 108
colindex7 = 1
rwindex7 = 212

clear_data

For counter = 0 To 4

Sheets("DataSets").Select
Range(Cells(3, colindex), Cells(102, colindex)).Select
'Range("a1:cv105").Cells(3, colindex).Select
Selection.Copy

Sheets("case1").Select
Range("b6").Select
Selection.PasteSpecial Paste:=xlValues, Operation:=xlNone, SkipBlanks:= _
   False, Transpose:=False
colindex = colindex + 1

Sheets("case1").Select
Range("b6").Select

M49 = ActiveSheet.Range("B54").Value
Sheets("case2").Select
S49_1 = ActiveSheet.Range("G54").Value
Range("ad1").Cells(rwindex2, colindex2).Value = M49
Range("ae1").Cells(rwindex2, colindex2).Value = S49_1
Sheets("case1").Select

M1 = ActiveSheet.Range("B12").Value
```

```
    Sheets("case3").Select
    S1 = ActiveSheet.Range("G12").Value
    Range("ad1").Cells(rwindex2, colindex2).Value = M1
    Range("ae1").Cells(rwindex2, colindex2).Value = S1
    Sheets("case1").Select

    M99 = ActiveSheet.Range("B96").Value
    Sheets("case4").Select
    S99 = ActiveSheet.Range("G96").Value
    Range("ad1").Cells(rwindex2, colindex2).Value = M99
    Range("ae1").Cells(rwindex2, colindex2).Value = S99
    Sheets("case1").Select

    For dcounter = 2 To 7

    Sheets("case1").Range("d3").Value = dcounter

    Sheets("case2").Select
    P49_1 = ActiveSheet.Range("F54").Value
    Range("ai1").Cells(rwindex4, colindex4).Value = P49_1

    Sheets("case3").Select
    P1 = ActiveSheet.Range("F12").Value
    Range("ai1").Cells(rwindex4, colindex4).Value = P1

    Sheets("case4").Select
    P99 = ActiveSheet.Range("F96").Value
    Range("ai1").Cells(rwindex4, colindex4).Value = P99

    colindex4 = colindex4 + 4
    colindex5 = colindex5 + 4
    colindex7 = colindex7 + 4

    Next dcounter

    rwindex2 = rwindex2 + 1
    rwindex3 = rwindex3 + 1
    rwindex4 = rwindex4 + 1
    rwindex5 = rwindex5 + 1
    rwindex6 = rwindex6 + 1
    rwindex7 = rwindex7 + 1
    colindex4 = 1
    colindex5 = 1
    colindex6 = 1
    colindex7 = 1

    Next counter

End Sub
**************************************************************************
```

In addition, I have also written the following macros for Minitab to examine the accuracy of interpolation method in Box Jenkins approach. During my study, I have made numerous alternations on my macros, sometimes fine tuning is required for the macros to suit different conditions. In this thesis, I have only provided the two macros that I considered as the most common used as references.

Minitab Macros:

a) Generate time series data using minitab

```
**************************************************************************
GMACRO
ARIMA
#

NOTE What is the Autoregressive order p?
SET C91;
        FILE 'TERMINAL';
        NOBS=1.
LET K15=C91(1)
#
IF K15 =0
GOTO 1
ENDIF
NOTE What are the coefficients for the AR component?
SET C92;
        FILE 'TERMINAL';
        NOBS=K15.
MLABEL 1
#
NOTE What is the Moving Average order q?
SET C93;
        FILE 'TERMINAL';
        NOBS=1.
LET K16=C93(1)
IF K16 = 0
GOTO 2
ENDIF
#
NOTE What are the coefficients for the MA component?
SET C94;
        FILE 'TERMINAL';
        NOBS=K16.
MLABEL 2
#
DO k30=1:100
RANDOM 100 C1;
NORMAL 0 1.
COPY K15 K16 C100
MAXIMUM C100 K17
DO K2=1:K17
LET C2(K2)=C1(K2)
```

```
ENDDO
LET K18=K17+1
DO K2=K18:100
LET C2(K2)=C1(K2)
IF K15 = 0
GOTO 3
ENDIF
DO K3=1:K15
LET C2(K2)=C2(K2)+C92(K3)*C2(K2-K3)
ENDDO
MLABEL 3
IF K16=0
GOTO 4
ENDIF
DO K3=1:K16
LET C2(K2)=C2(K2)+C94(K3)*C1(K2-K3)
ENDDO
MLABEL 4
ENDDO
Note TSPLOT C2

Let k991=c91
Let k993=c93

Set c3
 1( 1 : 100 / 1 )1
End.
Copy C2 c4;
 Omit 49:100.
Copy C2 c110;
 Omit 1:49.
Set c111
 1( 1 : 51 / 1 )1
End.
Sort C110 c5;
 By c111;
 Descending c111.
ARIMA k991 0 k993 C4;
 NoConstant;
 Forecast 1 c116.
ARIMA K991 0 k993 c5;
 NoConstant;
 Forecast 1 c117.

If k991=1
   if k993=0
      Let K99=1/(1+c92*c92)
   endif
   if k993=1
      Let k99=(1-c92*c94)/(1+c92*c92-2*c92*c94)
```

```
  endif
endif
If k991=0
  if k993=1
    Let k99=1
  endif
endif

Name c10='Estimate'
Name c12='Actual'
Name c14='Residual'
Name c15='ResiF'
Name c6='Forecast'
Name c7='Backcast'
Let c6(k30)=c116
Let c7(k30)=c117
Let c10(k30)=k99*(c116+c117)
Let c12(k30)=c2(49)
Let c114(k30)=c10(k30)-c12(k30)
Let c115(k30)=c6(k30)-c12(k30)
ENDDO
Let 'Residual'=c114
Let 'ResiF'=c115
Describe c114.
Histogram Residual;
MidPoint;
Bar.
Describe c115.
Histogram ResiF;
MidPoint;
Bar.
ENDMACRO
**************************************************************************
```

b) Import data sets from Excel, forecast and evaluate missing value using different interpolation methods.

```
**************************************************************************
GMACRO
ARIMA

Let k43=1
# Do k42=1:20

Erase C1-C1000
#Erase K1-K1000
Erase M1-M100
Let K998 = '*'
Let K999 = 2.7182818
Let K1000 = 3.14159265
```

```
Let c500(1)=k43

if c500(1)=1
XDGET 'excel' 'DataSets (2)' 'r3c1:r102c100'
endif
if c500(1)=2
XDGET 'excel' 'DataSets (3)' 'r3c1:r102c100'
endif
if c500(1)=3
XDGET 'excel' 'DataSets (4)' 'r3c1:r102c100'
endif
if c500(1)=4
XDGET 'excel' 'DataSets (5)' 'r3c1:r102c100'
endif
if c500(1)=5
XDGET 'excel' 'DataSets (6)' 'r3c1:r102c100'
endif
if c500(1)=6
XDGET 'excel' 'DataSets (7)' 'r3c1:r102c100'
endif
if c500(1)=7
XDGET 'excel' 'DataSets (8)' 'r3c1:r102c100'
endif
if c500(1)=8
XDGET 'excel' 'DataSets (9)' 'r3c1:r102c100'
endif
if c500(1)=9
XDGET 'excel' 'DataSets (10)' 'r3c1:r102c100'
endif
if c500(1)=10
XDGET 'excel' 'DataSets (11)' 'r3c1:r102c100'
endif
if c500(1)=11
XDGET 'excel' 'DataSets (12)' 'r3c1:r102c100'
endif
if c500(1)=12
XDGET 'excel' 'DataSets (13)' 'r3c1:r102c100'
endif
if c500(1)=13
XDGET 'excel' 'DataSets (14)' 'r3c1:r102c100'
endif
if c500(1)=14
XDGET 'excel' 'DataSets (15)' 'r3c1:r102c100'
endif
if c500(1)=15
XDGET 'excel' 'DataSets (16)' 'r3c1:r102c100'
endif
if c500(1)=16
XDGET 'excel' 'DataSets (17)' 'r3c1:r102c100'
```

```
endif
if c500(1)=17
XDGET 'excel' 'DataSets (18)' 'r3c1:r102c100'
endif
if c500(1)=18
XDGET 'excel' 'DataSets (19)' 'r3c1:r102c100'
endif
if c500(1)=19
XDGET 'excel' 'DataSets (20)' 'r3c1:r102c100'
endif
if c500(1)=20
XDGET 'excel' 'DataSets (21)' 'r3c1:r102c100'
endif

# Note What is the position of the missing value?
# SET c495;
#       FILE 'TERMINAL';
#       NOBS=1.

# Let K40=c495(1)


NOTE What is the Autoregressive order p? (1 or 0)
SET C491;
        FILE 'TERMINAL';
        NOBS=1.

#Let c491(1)=1

LET K15=C491(1)
Let c194(1)=c491(1)
IF K15 =0
Let c492(1)=0
GOTO 1
ENDIF

NOTE What are the coefficients for the AR component?
SET C492;
        FILE 'TERMINAL';
        NOBS=K15.

Let c195(1)=c492
MLABEL 1

NOTE What is the Moving Average order q? (1 or 0)
SET C493;
        FILE 'TERMINAL';
        NOBS=1.

#Let c493(1)=0
```

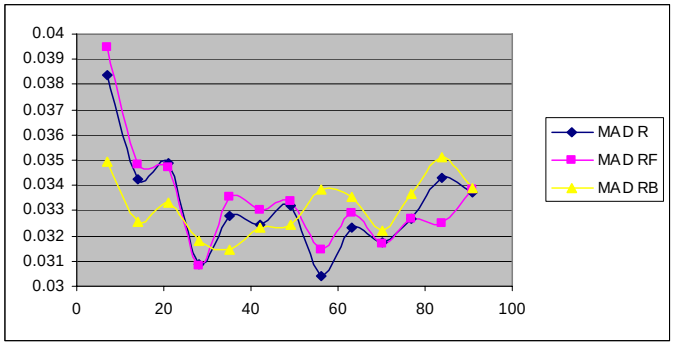
```
LET K16=C493(1)
Let c196(1)=c493(1)
IF K16 = 0
Let c494(1)=0
GOTO 2
ENDIF

NOTE What are the coefficients for the MA component?
SET C494;
        FILE 'TERMINAL';
        NOBS=K16.
Let c197(1)=c494
MLABEL 2

#Note Make sure you have copy data set from Excel
#Note Data set should start from "C2" column

Let k40=7
Do k45=1:13

Let K1 = 1

Do k30=1:100
  Let c102=ck1

  Set c103
  1( 1 : 100 / 1 )1
  End.

  Copy C102 c104;
  Omit k40:100.
  Copy C102 c210;
  Omit 1:k40.

  Let K41=100-k40

  Set c211
  1( 1 : k41 / 1 )1
  End.

  Sort C210 c105;
  By c211;
  Descending c211.

  ARIMA k15 0 k16 C104;
  NoConstant;
  Forecast 1 c218.
  ARIMA k15 0 k16 c105;
  NoConstant;
```

```
  Forecast 1 c219.

  Let c106(k30)=c218
  Let c107(k30)=c219

  Let k97=(1-c492*c494)/(1+c492*c492-2*c492*c494)

  Let c110(k30)=k97*(c106(k30)+c107(k30))
  Let c112(k30)=c102(k40)
  Let c214(k30)=c110(k30)-c112(k30)
  Let c215(k30)=c106(k30)-c112(k30)
  Let c216(k30)=c107(k30)-c112(k30)

  Let k1=k1+1

ENDDO

Let c114=c214
Let c115=c215
Let c116=c216

Absolute c114 c114.
Absolute c115 c115.
Absolute c116 c116.

sum c114 c201
Let c201(1)=c201(1)/100
StDev c114 c199.

sum c115 c202
Let c202(1)=c202(1)/100
StDev c115 c200.

sum c116 c203
Let c203(1)=c203(1)/100
StDev c116 c198.

Let c305(k45)=c201(1)
Let c306(k45)=c199(1)
Let c307(k45)=c202(1)
Let c308(k45)=c200(1)
Let c309(k45)=c203(1)
Let c310(k45)=c198(1)
Let c304(k45)=k40
Let k40=k40+7
enddo

Name c110='Estimate'
Name c112='Actual'
Name c114='Residual'
```

```
Name c115='Resid_F'
Name c106='Forecast'
Name c107='Backcast'
Name c201='C MAD R'
Name c202='C MAD RF'
Name c203='c MAD RB'
Name c305='MAD R'
Name c307='MAD RF'
Name c309='MAD RB'
Name c306='SD R'
Name c308='SD RF'
Name c310='sd RB'
Name c194='AR'
Name c195='Phi'
Name c196='MA'
Name c197='Theta'

# Let k43=k43+1

# Pause
# enddo

ENDMACRO
**********************************************************************
```

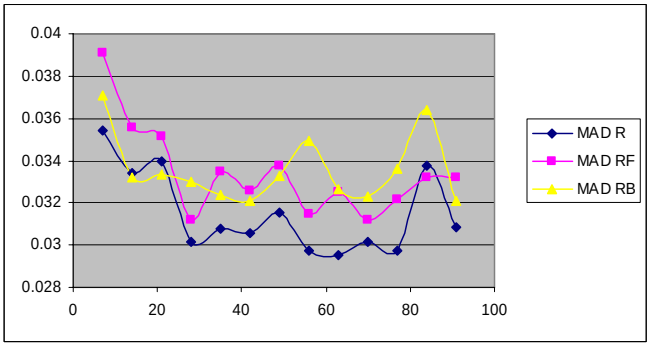
# Appendix B

AR 1 , Phi 0.2 and Var 0.04



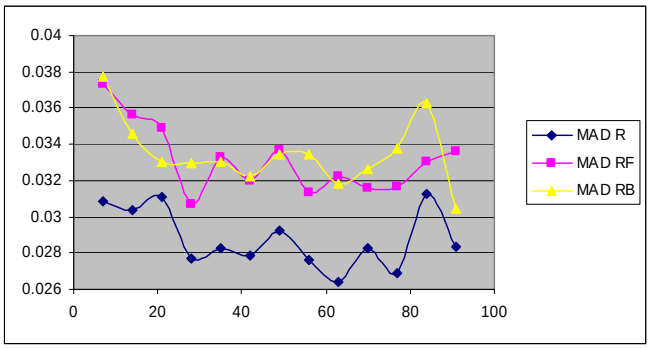

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | sd RB |
|---|---|---|---|---|---|---|
| 7 | 0.0383548 | 0.0300261 | 0.0394706 | 0.0293599 | 0.0349698 | 0.0266808 |
| 14 | 0.0342186 | 0.0261616 | 0.0348106 | 0.0267383 | 0.0325758 | 0.0243101 |
| 21 | 0.0348769 | 0.0258421 | 0.0347216 | 0.0250258 | 0.0333016 | 0.0231421 |
| 28 | 0.0308926 | 0.0247714 | 0.0308156 | 0.0241882 | 0.0317813 | 0.0255378 |
| 35 | 0.0327949 | 0.0253675 | 0.0335549 | 0.025669 | 0.0314575 | 0.0259499 |
| 42 | 0.0324695 | 0.0247884 | 0.0330283 | 0.0240163 | 0.032348 | 0.0258883 |
| 49 | 0.0331776 | 0.0254141 | 0.0333826 | 0.02569 | 0.0324672 | 0.0249714 |
| 56 | 0.0303941 | 0.023799 | 0.03146 | 0.0238795 | 0.0338147 | 0.0227298 |
| 63 | 0.0323239 | 0.0241004 | 0.0328842 | 0.0234854 | 0.0335653 | 0.0238895 |
| 70 | 0.0317275 | 0.0218221 | 0.031692 | 0.0221196 | 0.0321843 | 0.0234915 |
| 77 | 0.0327001 | 0.0241933 | 0.0326502 | 0.0244592 | 0.0336681 | 0.0244235 |
| 84 | 0.0343036 | 0.0269857 | 0.0324897 | 0.0261358 | 0.0351269 | 0.0276911 |
| 91 | 0.0337177 | 0.0266945 | 0.0338195 | 0.0268043 | 0.0338952 | 0.0272599 |

AR 1 , Phi 0.4 and Var 0.04



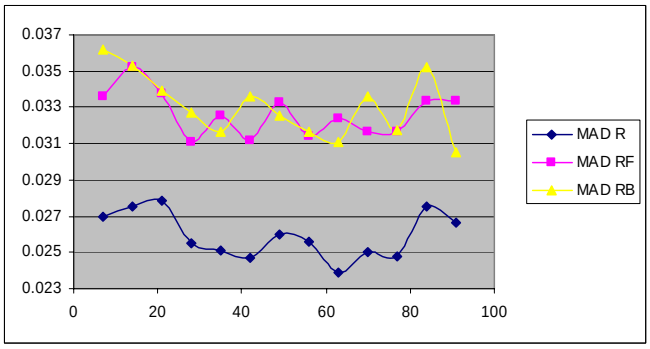

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.0354171 | 0.0297334 | 0.0391116 | 0.0306955 | 0.0370822 | 0.0279217 |
| 14 | 0.0334243 | 0.0240874 | 0.035565 | 0.0263585 | 0.0331941 | 0.0243238 |
| 21 | 0.0339633 | 0.0241433 | 0.0351538 | 0.0255282 | 0.033365 | 0.0228828 |
| 28 | 0.0301497 | 0.0239761 | 0.0311748 | 0.0241983 | 0.0330109 | 0.0251015 |
| 35 | 0.0307671 | 0.0237391 | 0.0334672 | 0.0254874 | 0.0324043 | 0.0253658 |
| 42 | 0.0305512 | 0.0236527 | 0.0326048 | 0.0238531 | 0.0320661 | 0.0258765 |
| 49 | 0.0315432 | 0.0235266 | 0.0337797 | 0.0258524 | 0.0332746 | 0.0228335 |
| 56 | 0.0297035 | 0.0214621 | 0.0314494 | 0.02384 | 0.0349084 | 0.0221234 |
| 63 | 0.0295532 | 0.0228912 | 0.0324862 | 0.0235806 | 0.0326278 | 0.0235692 |
| 70 | 0.0301491 | 0.0210751 | 0.0312146 | 0.0226036 | 0.0322883 | 0.0247577 |
| 77 | 0.0297082 | 0.0224657 | 0.0321325 | 0.0242214 | 0.0336161 | 0.0226056 |
| 84 | 0.0337879 | 0.0257229 | 0.0332094 | 0.0259616 | 0.036365 | 0.0280486 |
| 91 | 0.0308536 | 0.0248005 | 0.0331826 | 0.0262302 | 0.0320738 | 0.0269271 |

AR 1 , Phi 0.6 and Var 0.04



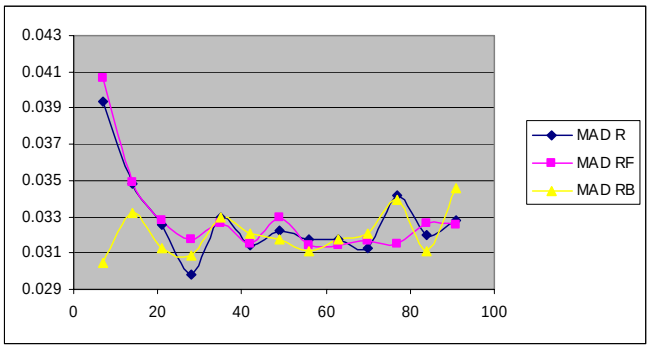

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.0308411 | 0.0260684 | 0.0372982 | 0.0300513 | 0.0377745 | 0.0281719 |
| 14 | 0.0303771 | 0.0225608 | 0.0355961 | 0.0256469 | 0.0345531 | 0.0235791 |
| 21 | 0.0310941 | 0.0215129 | 0.0348632 | 0.0253421 | 0.0330646 | 0.0238015 |
| 28 | 0.0276698 | 0.0221232 | 0.0306791 | 0.024297 | 0.0329367 | 0.0253303 |
| 35 | 0.0282684 | 0.0208651 | 0.0333109 | 0.0250419 | 0.0330475 | 0.0238976 |
| 42 | 0.0278348 | 0.0216977 | 0.0319963 | 0.0241664 | 0.0322576 | 0.0262096 |
| 49 | 0.0292484 | 0.0214444 | 0.0337051 | 0.0256392 | 0.0334359 | 0.0224409 |
| 56 | 0.0275844 | 0.0199176 | 0.0313756 | 0.02376 | 0.0334601 | 0.0239586 |
| 63 | 0.0263725 | 0.0209946 | 0.032266 | 0.0238397 | 0.0318277 | 0.0217346 |
| 70 | 0.0282767 | 0.0199047 | 0.0315978 | 0.023485 | 0.0326364 | 0.0253883 |
| 77 | 0.0269136 | 0.0207659 | 0.0316442 | 0.0242333 | 0.0337613 | 0.0215044 |
| 84 | 0.0312723 | 0.0234993 | 0.0330356 | 0.0259993 | 0.0363139 | 0.0268696 |
| 91 | 0.0283289 | 0.022088 | 0.0336288 | 0.0263108 | 0.0304446 | 0.0255336 |

AR 1 , Phi 0.8 and Var 0.04



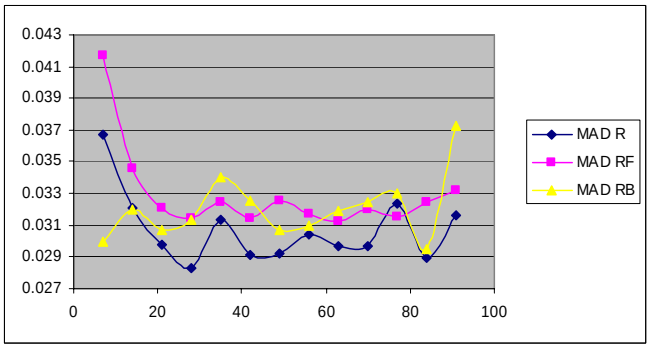

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.0269882 | 0.0222189 | 0.0336106 | 0.0285526 | 0.0362041 | 0.0292764 |
| 14 | 0.0274999 | 0.0206343 | 0.0352364 | 0.0258857 | 0.0353344 | 0.0238631 |
| 21 | 0.0278477 | 0.0185621 | 0.0337556 | 0.0252875 | 0.0338925 | 0.0243914 |
| 28 | 0.0254697 | 0.019544 | 0.0310548 | 0.0242494 | 0.0327125 | 0.0266088 |
| 35 | 0.0251019 | 0.0180902 | 0.0325542 | 0.0246931 | 0.0316466 | 0.0227968 |
| 42 | 0.0246854 | 0.0197351 | 0.031174 | 0.0248393 | 0.0336359 | 0.0264669 |
| 49 | 0.0259562 | 0.0194871 | 0.0333102 | 0.0251805 | 0.0325889 | 0.0249635 |
| 56 | 0.0255703 | 0.0178921 | 0.0313895 | 0.0238622 | 0.0316395 | 0.0246192 |
| 63 | 0.0238685 | 0.0185199 | 0.0323986 | 0.0238678 | 0.0310729 | 0.0210768 |
| 70 | 0.0250436 | 0.0185335 | 0.031691 | 0.0233919 | 0.033619 | 0.0244415 |
| 77 | 0.0247438 | 0.0186809 | 0.0316576 | 0.024699 | 0.0317307 | 0.0244889 |
| 84 | 0.0275294 | 0.0211607 | 0.0333245 | 0.0257529 | 0.0352519 | 0.0256628 |
| 91 | 0.0266075 | 0.0201035 | 0.0333797 | 0.0261817 | 0.0304982 | 0.0261971 |

AR 1 , Phi -0.2 and Var 0.04



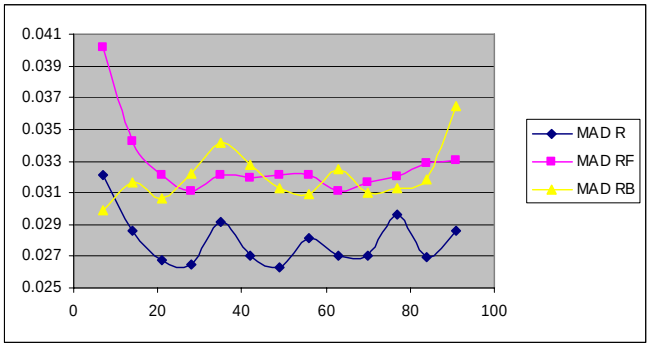

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.0393637 | 0.0290693 | 0.0406404 | 0.0292991 | 0.0304429 | 0.0252375 |
| 14 | 0.0348382 | 0.0266245 | 0.0349406 | 0.0266255 | 0.0331783 | 0.0254741 |
| 21 | 0.0325761 | 0.022485 | 0.0327737 | 0.0232155 | 0.0312844 | 0.0237256 |
| 28 | 0.0298222 | 0.0242613 | 0.0317736 | 0.0248001 | 0.0308372 | 0.0242395 |
| 35 | 0.0329578 | 0.0257039 | 0.0326025 | 0.0261841 | 0.0329743 | 0.0234468 |
| 42 | 0.0314307 | 0.0226177 | 0.0314934 | 0.0241625 | 0.0320543 | 0.0236444 |
| 49 | 0.0322498 | 0.025088 | 0.0329494 | 0.0253438 | 0.0317469 | 0.0255546 |
| 56 | 0.0317826 | 0.0227359 | 0.0314411 | 0.0237394 | 0.0311429 | 0.0238142 |
| 63 | 0.0317711 | 0.0230747 | 0.031427 | 0.0229376 | 0.0317241 | 0.0245613 |
| 70 | 0.0312431 | 0.0215704 | 0.0316544 | 0.0225159 | 0.032103 | 0.0223449 |
| 77 | 0.0341926 | 0.0237252 | 0.0315139 | 0.0240538 | 0.0339225 | 0.0250538 |
| 84 | 0.031955 | 0.0239206 | 0.0326697 | 0.0264244 | 0.031094 | 0.0233598 |
| 91 | 0.0328277 | 0.02468 | 0.0325427 | 0.0245135 | 0.0345711 | 0.0264157 |

AR 1 , Phi -0.4 and Var 0.04



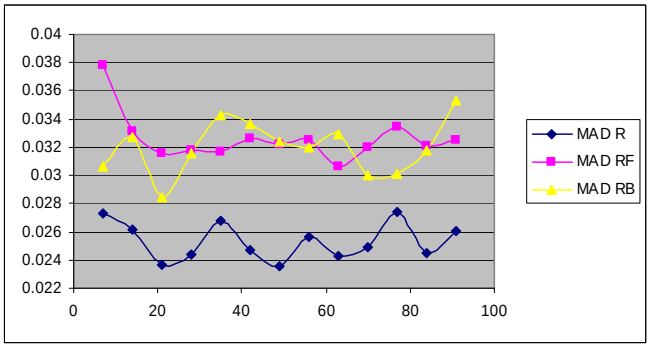

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.0367039 | 0.0277173 | 0.0417334 | 0.0298271 | 0.0299332 | 0.0229485 |
| 14 | 0.0321065 | 0.0244413 | 0.03458 | 0.0258979 | 0.0319514 | 0.0241525 |
| 21 | 0.0297819 | 0.0200817 | 0.0320539 | 0.0224253 | 0.0307124 | 0.0235101 |
| 28 | 0.0282536 | 0.0212684 | 0.0314673 | 0.0247179 | 0.0313055 | 0.0216571 |
| 35 | 0.031381 | 0.0244073 | 0.0324355 | 0.0261273 | 0.0339827 | 0.0229245 |
| 42 | 0.0291552 | 0.0211027 | 0.0314841 | 0.0241835 | 0.0325112 | 0.0226263 |
| 49 | 0.0291798 | 0.0230239 | 0.0325068 | 0.0247367 | 0.0306684 | 0.0252703 |
| 56 | 0.0304406 | 0.0219023 | 0.0316775 | 0.023682 | 0.030964 | 0.0237773 |
| 63 | 0.0296556 | 0.0217812 | 0.0312926 | 0.0230607 | 0.031919 | 0.024703 |
| 70 | 0.0296972 | 0.0205506 | 0.0320261 | 0.0223398 | 0.03248 | 0.0235354 |
| 77 | 0.0323755 | 0.0223382 | 0.0315346 | 0.0237933 | 0.0330472 | 0.0252771 |
| 84 | 0.0289661 | 0.0215249 | 0.0324229 | 0.026474 | 0.0294632 | 0.0217413 |
| 91 | 0.0315949 | 0.0244153 | 0.0331553 | 0.0245652 | 0.0372271 | 0.0271421 |

AR 1 , Phi -0.6 and Var 0.04



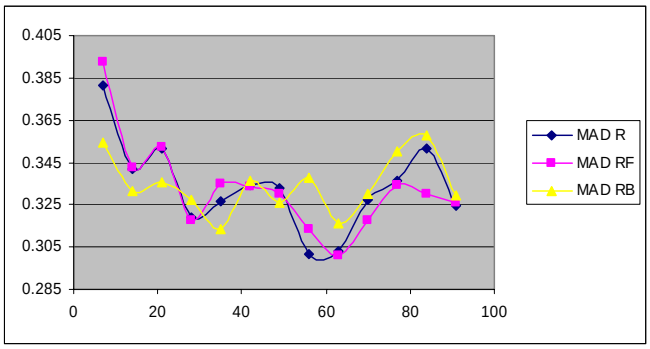

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.03215 | 0.0230155 | 0.0401809 | 0.0286293 | 0.0299092 | 0.0228674 |
| 14 | 0.0286479 | 0.0230971 | 0.034217 | 0.0258879 | 0.0316704 | 0.0246171 |
| 21 | 0.0267589 | 0.0193163 | 0.0321352 | 0.0226373 | 0.0306829 | 0.0229921 |
| 28 | 0.0265205 | 0.0180159 | 0.0311482 | 0.0244511 | 0.0321839 | 0.0199024 |
| 35 | 0.0291452 | 0.022325 | 0.0321507 | 0.0260637 | 0.0341174 | 0.0235595 |
| 42 | 0.0270454 | 0.0194439 | 0.0319063 | 0.024141 | 0.0327339 | 0.0226125 |
| 49 | 0.0262682 | 0.0208842 | 0.0321396 | 0.0246819 | 0.0312858 | 0.0247434 |
| 56 | 0.02818 | 0.0208051 | 0.0321308 | 0.0237188 | 0.0309509 | 0.0239553 |
| 63 | 0.02703 | 0.0203037 | 0.0310643 | 0.0232911 | 0.0325249 | 0.024774 |
| 70 | 0.0270764 | 0.0201432 | 0.031639 | 0.0226081 | 0.0309939 | 0.0256903 |
| 77 | 0.0296191 | 0.0204445 | 0.0320674 | 0.023601 | 0.0313216 | 0.0249268 |
| 84 | 0.0269059 | 0.0205453 | 0.0329022 | 0.026149 | 0.0318393 | 0.0214277 |
| 91 | 0.0286188 | 0.0219232 | 0.0330489 | 0.0245822 | 0.0364775 | 0.0274637 |

AR 1 , Phi -0.8 and Var 0.04



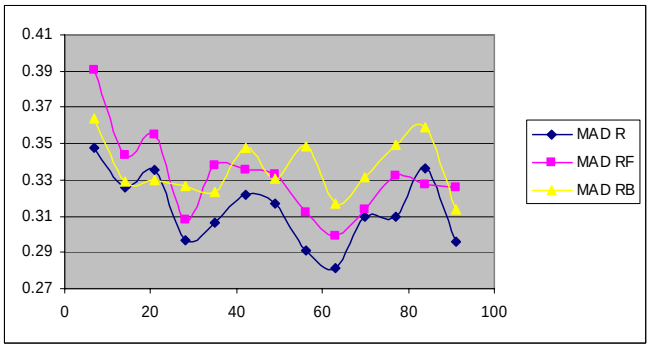

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.0273437 | 0.0201957 | 0.0378197 | 0.0279011 | 0.030672 | 0.0266283 |
| 14 | 0.0261526 | 0.0212997 | 0.0331292 | 0.0259376 | 0.0327643 | 0.025278 |
| 21 | 0.0237121 | 0.0190576 | 0.0316114 | 0.0242461 | 0.0284656 | 0.0225416 |
| 28 | 0.0243595 | 0.0163797 | 0.0317932 | 0.0244646 | 0.0315411 | 0.0226966 |
| 35 | 0.0268144 | 0.0198046 | 0.0316644 | 0.025403 | 0.0342872 | 0.0241655 |
| 42 | 0.0247034 | 0.0176463 | 0.0325757 | 0.0247674 | 0.033676 | 0.0230906 |
| 49 | 0.023533 | 0.0186582 | 0.0322425 | 0.024522 | 0.0323951 | 0.0234074 |
| 56 | 0.0256256 | 0.0192427 | 0.0325035 | 0.0238847 | 0.0320328 | 0.0229931 |
| 63 | 0.0243151 | 0.0186746 | 0.0305981 | 0.0238163 | 0.0329033 | 0.0248569 |
| 70 | 0.0248755 | 0.0183766 | 0.0319791 | 0.0240259 | 0.030027 | 0.0249108 |
| 77 | 0.0273765 | 0.0196273 | 0.0334131 | 0.0258656 | 0.0301672 | 0.0252148 |
| 84 | 0.0245008 | 0.0190813 | 0.0321181 | 0.0254396 | 0.0318123 | 0.024127 |
| 91 | 0.0261095 | 0.0189957 | 0.0324963 | 0.024076 | 0.0352997 | 0.0266595 |

AR 1 , Phi 0.2 and Var 0.4



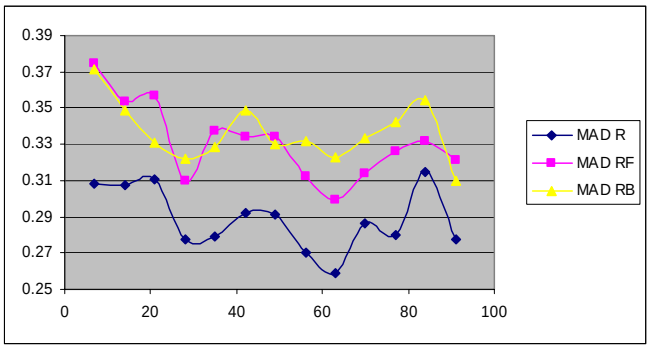

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.38139 | 0.306003 | 0.392677 | 0.29845 | 0.354507 | 0.271464 |
| 14 | 0.342032 | 0.253567 | 0.342878 | 0.257623 | 0.331252 | 0.2424 |
| 21 | 0.35172 | 0.272789 | 0.352419 | 0.264814 | 0.335419 | 0.247718 |
| 28 | 0.319149 | 0.253468 | 0.31756 | 0.250856 | 0.32715 | 0.261323 |
| 35 | 0.326863 | 0.254345 | 0.334778 | 0.256939 | 0.31368 | 0.260513 |
| 42 | 0.333907 | 0.25342 | 0.333702 | 0.243018 | 0.336508 | 0.265347 |
| 49 | 0.333057 | 0.249052 | 0.330219 | 0.250289 | 0.325874 | 0.24334 |
| 56 | 0.301564 | 0.237684 | 0.313363 | 0.238062 | 0.337911 | 0.229339 |
| 63 | 0.302716 | 0.245965 | 0.301037 | 0.237617 | 0.316545 | 0.243187 |
| 70 | 0.327173 | 0.241162 | 0.31764 | 0.233349 | 0.329869 | 0.254341 |
| 77 | 0.336631 | 0.248023 | 0.334287 | 0.260799 | 0.349892 | 0.248119 |
| 84 | 0.351592 | 0.274131 | 0.3299 | 0.262834 | 0.357879 | 0.281081 |
| 91 | 0.32465 | 0.247156 | 0.326182 | 0.245546 | 0.32928 | 0.253065 |

AR 1 , Phi 0.4 and Var 0.4



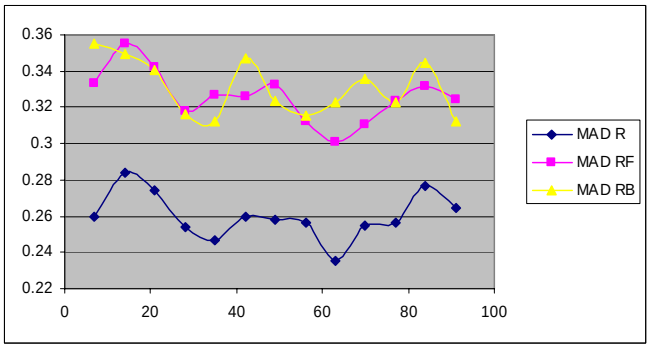

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.347751 | 0.299149 | 0.390727 | 0.306476 | 0.364199 | 0.279019 |
| 14 | 0.325776 | 0.238409 | 0.343638 | 0.255554 | 0.329434 | 0.243461 |
| 21 | 0.335923 | 0.258112 | 0.355247 | 0.269889 | 0.330048 | 0.242528 |
| 28 | 0.296795 | 0.243743 | 0.308151 | 0.250134 | 0.326396 | 0.260502 |
| 35 | 0.306189 | 0.237778 | 0.338347 | 0.252034 | 0.323778 | 0.254907 |
| 42 | 0.322171 | 0.241646 | 0.335509 | 0.241428 | 0.348009 | 0.26687 |
| 49 | 0.316576 | 0.234991 | 0.333048 | 0.251215 | 0.330335 | 0.228512 |
| 56 | 0.291376 | 0.216829 | 0.31243 | 0.237996 | 0.348512 | 0.223573 |
| 63 | 0.281327 | 0.232358 | 0.299327 | 0.241651 | 0.316732 | 0.236971 |
| 70 | 0.309928 | 0.232405 | 0.313543 | 0.236042 | 0.331856 | 0.26139 |
| 77 | 0.310007 | 0.229515 | 0.332554 | 0.259932 | 0.349474 | 0.23041 |
| 84 | 0.336253 | 0.263173 | 0.327152 | 0.262246 | 0.358995 | 0.289287 |
| 91 | 0.296121 | 0.234921 | 0.325865 | 0.247179 | 0.313798 | 0.251826 |

AR 1 , Phi 0.6 and Var 0.4



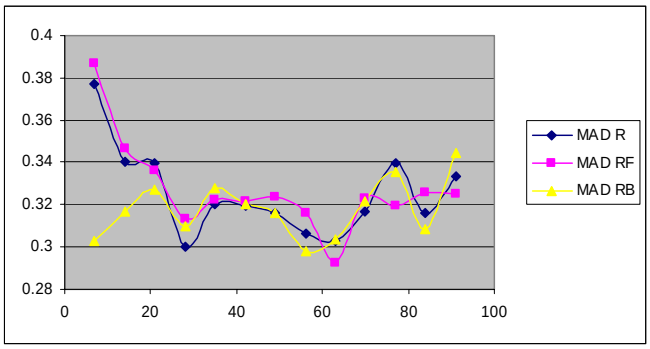

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.307943 | 0.263169 | 0.37496 | 0.301021 | 0.371735 | 0.278125 |
| 14 | 0.307428 | 0.223353 | 0.353835 | 0.251068 | 0.348612 | 0.237905 |
| 21 | 0.310812 | 0.233441 | 0.35712 | 0.269012 | 0.330795 | 0.252261 |
| 28 | 0.277113 | 0.221982 | 0.310103 | 0.248037 | 0.322081 | 0.260747 |
| 35 | 0.279484 | 0.209045 | 0.337314 | 0.247351 | 0.328698 | 0.240144 |
| 42 | 0.292355 | 0.223595 | 0.33452 | 0.24513 | 0.348842 | 0.270071 |
| 49 | 0.29102 | 0.21398 | 0.334398 | 0.250584 | 0.330437 | 0.21899 |
| 56 | 0.270524 | 0.200744 | 0.312004 | 0.237462 | 0.332042 | 0.238403 |
| 63 | 0.258704 | 0.208697 | 0.298976 | 0.245855 | 0.323089 | 0.213562 |
| 70 | 0.286486 | 0.218129 | 0.314066 | 0.236505 | 0.333545 | 0.265274 |
| 77 | 0.279932 | 0.209259 | 0.326321 | 0.255531 | 0.342333 | 0.218732 |
| 84 | 0.314422 | 0.237012 | 0.331568 | 0.26181 | 0.354175 | 0.276431 |
| 91 | 0.277903 | 0.217753 | 0.321006 | 0.242536 | 0.31019 | 0.247713 |

AR 1 , Phi 0.8 and Var 0.4



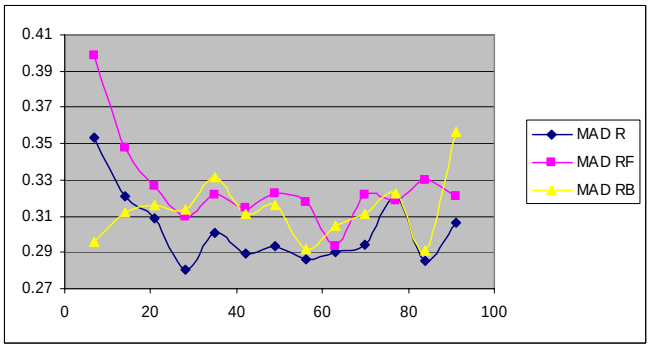

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.259304 | 0.216488 | 0.333315 | 0.277454 | 0.355098 | 0.285448 |
| 14 | 0.283741 | 0.212362 | 0.355396 | 0.255216 | 0.349753 | 0.242503 |
| 21 | 0.273872 | 0.202194 | 0.342586 | 0.265981 | 0.340852 | 0.242832 |
| 28 | 0.254003 | 0.197722 | 0.318236 | 0.244842 | 0.316621 | 0.259313 |
| 35 | 0.246502 | 0.180914 | 0.326819 | 0.243984 | 0.31211 | 0.22833 |
| 42 | 0.259429 | 0.203519 | 0.32567 | 0.249782 | 0.346875 | 0.272505 |
| 49 | 0.258301 | 0.19531 | 0.332153 | 0.249972 | 0.323784 | 0.241 |
| 56 | 0.25604 | 0.180322 | 0.31242 | 0.239142 | 0.315522 | 0.242324 |
| 63 | 0.235476 | 0.186571 | 0.301207 | 0.247027 | 0.322447 | 0.209751 |
| 70 | 0.254925 | 0.202237 | 0.310341 | 0.235972 | 0.335687 | 0.247956 |
| 77 | 0.256408 | 0.194872 | 0.323638 | 0.257339 | 0.322778 | 0.252672 |
| 84 | 0.276271 | 0.211405 | 0.331813 | 0.259193 | 0.344766 | 0.250204 |
| 91 | 0.264841 | 0.20182 | 0.324714 | 0.241684 | 0.312554 | 0.263736 |

AR 1 , Phi -0.2 and Var 0.4



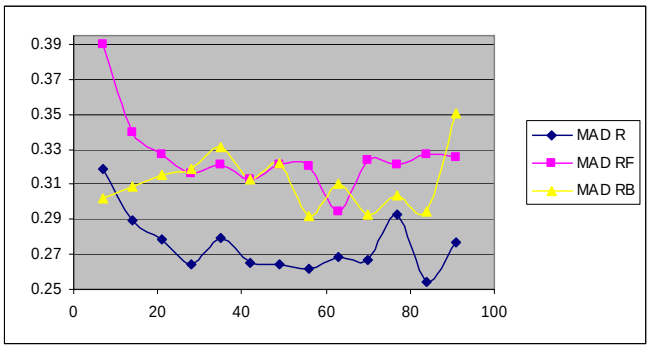

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.376851 | 0.282834 | 0.38709 | 0.284361 | 0.302846 | 0.249494 |
| 14 | 0.340456 | 0.257038 | 0.346351 | 0.254526 | 0.316918 | 0.247548 |
| 21 | 0.339462 | 0.244912 | 0.336157 | 0.258111 | 0.32734 | 0.253803 |
| 28 | 0.300456 | 0.243357 | 0.313297 | 0.247524 | 0.309493 | 0.240488 |
| 35 | 0.320428 | 0.24916 | 0.32259 | 0.250828 | 0.327583 | 0.234496 |
| 42 | 0.319647 | 0.223714 | 0.321378 | 0.236195 | 0.320213 | 0.23148 |
| 49 | 0.31632 | 0.249957 | 0.323948 | 0.253216 | 0.316303 | 0.257331 |
| 56 | 0.306311 | 0.228813 | 0.316163 | 0.238816 | 0.29814 | 0.234448 |
| 63 | 0.303078 | 0.237807 | 0.292594 | 0.240185 | 0.303751 | 0.249762 |
| 70 | 0.316794 | 0.226523 | 0.322805 | 0.228581 | 0.321843 | 0.237338 |
| 77 | 0.339525 | 0.258597 | 0.319507 | 0.256247 | 0.335617 | 0.266224 |
| 84 | 0.316273 | 0.243989 | 0.325609 | 0.266298 | 0.30869 | 0.232996 |
| 91 | 0.333653 | 0.247213 | 0.324851 | 0.239101 | 0.344324 | 0.264374 |

AR 1 , Phi -0.4 and Var 0.4



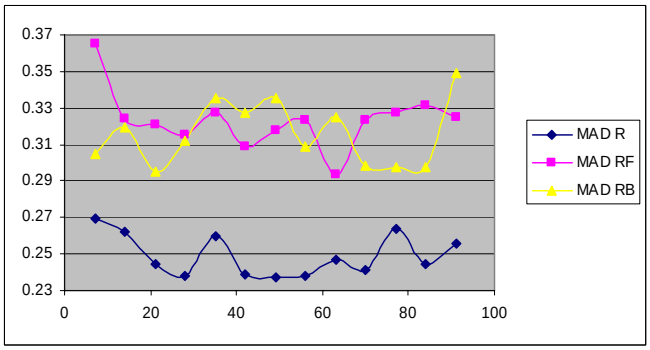

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.353347 | 0.277411 | 0.398411 | 0.296959 | 0.295805 | 0.229466 |
| 14 | 0.321108 | 0.243649 | 0.347624 | 0.25344 | 0.311871 | 0.238452 |
| 21 | 0.308967 | 0.219191 | 0.326622 | 0.251906 | 0.316081 | 0.253699 |
| 28 | 0.280688 | 0.215046 | 0.309531 | 0.246578 | 0.313381 | 0.218947 |
| 35 | 0.300658 | 0.239316 | 0.321524 | 0.252695 | 0.331602 | 0.230981 |
| 42 | 0.289152 | 0.21309 | 0.314798 | 0.238053 | 0.311088 | 0.225711 |
| 49 | 0.293285 | 0.233508 | 0.322981 | 0.249213 | 0.31651 | 0.264321 |
| 56 | 0.286415 | 0.22025 | 0.317877 | 0.238057 | 0.291859 | 0.228057 |
| 63 | 0.290485 | 0.222906 | 0.293477 | 0.240523 | 0.304536 | 0.247413 |
| 70 | 0.29397 | 0.204657 | 0.321919 | 0.230321 | 0.311496 | 0.230369 |
| 77 | 0.320161 | 0.244248 | 0.31846 | 0.254783 | 0.322802 | 0.261699 |
| 84 | 0.285581 | 0.220509 | 0.329712 | 0.266236 | 0.291335 | 0.212617 |
| 91 | 0.3064 | 0.236447 | 0.321163 | 0.23502 | 0.356815 | 0.26816 |

AR 1 , Phi -0.6 and Var 0.4



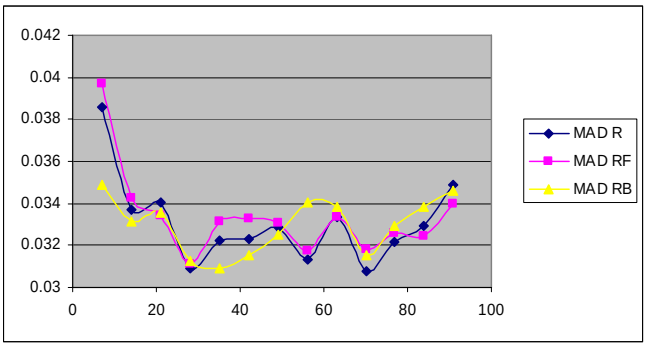

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.318492 | 0.232906 | 0.390068 | 0.281441 | 0.301754 | 0.22885 |
| 14 | 0.289429 | 0.231579 | 0.340076 | 0.255049 | 0.308864 | 0.24586 |
| 21 | 0.278297 | 0.203964 | 0.327399 | 0.250274 | 0.315749 | 0.240975 |
| 28 | 0.26411 | 0.181755 | 0.316572 | 0.24572 | 0.319133 | 0.209282 |
| 35 | 0.279091 | 0.222068 | 0.32115 | 0.255672 | 0.331085 | 0.240164 |
| 42 | 0.26539 | 0.193807 | 0.312565 | 0.236759 | 0.313237 | 0.229651 |
| 49 | 0.264599 | 0.212274 | 0.321298 | 0.245609 | 0.322214 | 0.261174 |
| 56 | 0.262028 | 0.206829 | 0.320558 | 0.237875 | 0.292057 | 0.226194 |
| 63 | 0.268304 | 0.205826 | 0.294576 | 0.241118 | 0.310454 | 0.241307 |
| 70 | 0.266911 | 0.192708 | 0.323777 | 0.233137 | 0.292747 | 0.238368 |
| 77 | 0.292489 | 0.223597 | 0.32155 | 0.253854 | 0.303809 | 0.253525 |
| 84 | 0.254179 | 0.203272 | 0.326972 | 0.263609 | 0.294514 | 0.198106 |
| 91 | 0.276734 | 0.210698 | 0.325343 | 0.236015 | 0.350971 | 0.271477 |

AR 1 , Phi -0.8 and Var 0.4



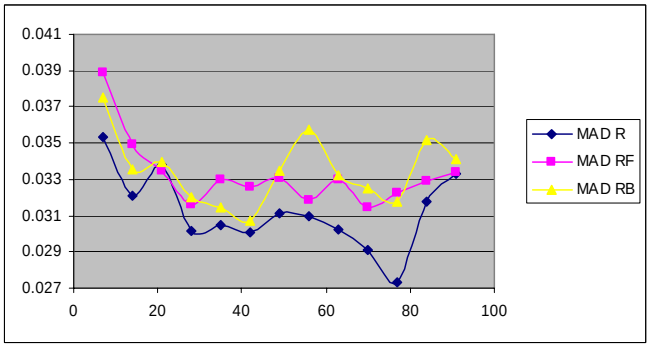

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.269678 | 0.203483 | 0.36523 | 0.271904 | 0.304596 | 0.26233 |
| 14 | 0.262556 | 0.2094 | 0.324071 | 0.256902 | 0.319572 | 0.255121 |
| 21 | 0.244723 | 0.199921 | 0.320987 | 0.26346 | 0.294775 | 0.235084 |
| 28 | 0.23781 | 0.165338 | 0.315206 | 0.246977 | 0.311703 | 0.241057 |
| 35 | 0.260011 | 0.202407 | 0.327296 | 0.279894 | 0.335508 | 0.244695 |
| 42 | 0.238481 | 0.175593 | 0.309183 | 0.238977 | 0.327367 | 0.233924 |
| 49 | 0.237493 | 0.191511 | 0.317936 | 0.2431 | 0.335667 | 0.245734 |
| 56 | 0.237685 | 0.187732 | 0.323484 | 0.238011 | 0.308641 | 0.218936 |
| 63 | 0.246643 | 0.188793 | 0.293679 | 0.244376 | 0.325211 | 0.242987 |
| 70 | 0.24104 | 0.176551 | 0.32349 | 0.237861 | 0.298269 | 0.234203 |
| 77 | 0.263969 | 0.200307 | 0.327019 | 0.256515 | 0.297397 | 0.253414 |
| 84 | 0.244587 | 0.197774 | 0.331663 | 0.264574 | 0.297358 | 0.22662 |
| 91 | 0.255776 | 0.186003 | 0.325213 | 0.238515 | 0.349287 | 0.265774 |

MA 1 , Theta 0.2 and Var 0.04



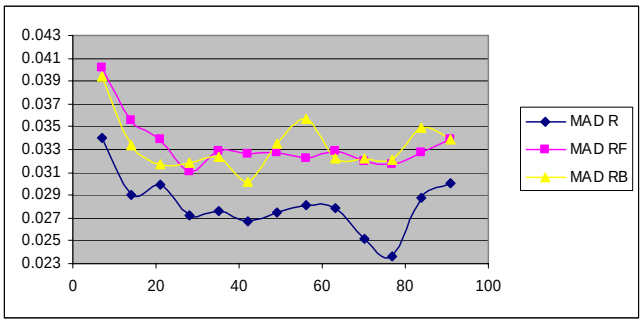

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.0385988 | 0.0308767 | 0.0396807 | 0.0307202 | 0.0348594 | 0.0262824 |
| 14 | 0.0336716 | 0.0270373 | 0.034222 | 0.0270041 | 0.0331728 | 0.0245039 |
| 21 | 0.0340583 | 0.0248417 | 0.0334394 | 0.0244368 | 0.0335632 | 0.0228228 |
| 28 | 0.030936 | 0.0265798 | 0.031131 | 0.0249466 | 0.0312243 | 0.0263726 |
| 35 | 0.0322371 | 0.0254182 | 0.0331353 | 0.025865 | 0.0309033 | 0.0259661 |
| 42 | 0.0322804 | 0.0246727 | 0.0332459 | 0.0247309 | 0.0315449 | 0.0255425 |
| 49 | 0.0328478 | 0.0250577 | 0.0330999 | 0.0250918 | 0.0325235 | 0.0249681 |
| 56 | 0.031343 | 0.0230826 | 0.0317514 | 0.0236345 | 0.034077 | 0.0229055 |
| 63 | 0.0333329 | 0.0240432 | 0.033364 | 0.0234598 | 0.0338565 | 0.0240345 |
| 70 | 0.0307511 | 0.0227241 | 0.0318333 | 0.0218672 | 0.031548 | 0.0241048 |
| 77 | 0.0321622 | 0.0247661 | 0.0325592 | 0.0239951 | 0.0329076 | 0.0256682 |
| 84 | 0.0328968 | 0.0274106 | 0.032408 | 0.02629 | 0.0338359 | 0.0277199 |
| 91 | 0.0348789 | 0.0281762 | 0.0340066 | 0.0267368 | 0.0345848 | 0.028019 |

MA 1 , Theta 0.4 and Var 0.04



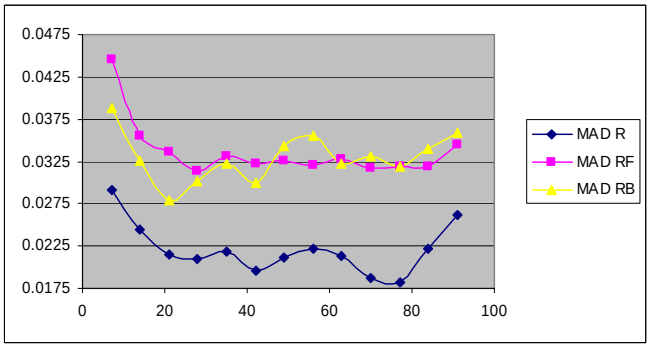

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.0352953 | 0.0289647 | 0.0388875 | 0.0304686 | 0.0375354 | 0.0268733 |
| 14 | 0.0321077 | 0.0242567 | 0.0349263 | 0.0268522 | 0.0335647 | 0.0237625 |
| 21 | 0.0337663 | 0.0235949 | 0.0334864 | 0.0250469 | 0.0339687 | 0.0226985 |
| 28 | 0.030186 | 0.0259466 | 0.0315892 | 0.0247905 | 0.0319964 | 0.025846 |
| 35 | 0.0304925 | 0.0235124 | 0.0329755 | 0.0259252 | 0.0314192 | 0.0254668 |
| 42 | 0.0300947 | 0.0227491 | 0.0325546 | 0.024731 | 0.030746 | 0.0253337 |
| 49 | 0.0311608 | 0.0234025 | 0.0330913 | 0.0247844 | 0.0334705 | 0.0242442 |
| 56 | 0.0309698 | 0.0215449 | 0.0318397 | 0.0236161 | 0.0357144 | 0.023557 |
| 63 | 0.0302474 | 0.0223686 | 0.0330127 | 0.0232125 | 0.0332569 | 0.023073 |
| 70 | 0.0291299 | 0.0220816 | 0.0314902 | 0.0220266 | 0.0325226 | 0.0254594 |
| 77 | 0.027348 | 0.0222405 | 0.0322257 | 0.0235667 | 0.0317965 | 0.0237771 |
| 84 | 0.0317439 | 0.0252918 | 0.0328819 | 0.0259348 | 0.0351574 | 0.0278728 |
| 91 | 0.0332974 | 0.0255416 | 0.0333762 | 0.0259195 | 0.0341139 | 0.026922 |

MA 1 , Theta 0.6 and Var 0.04



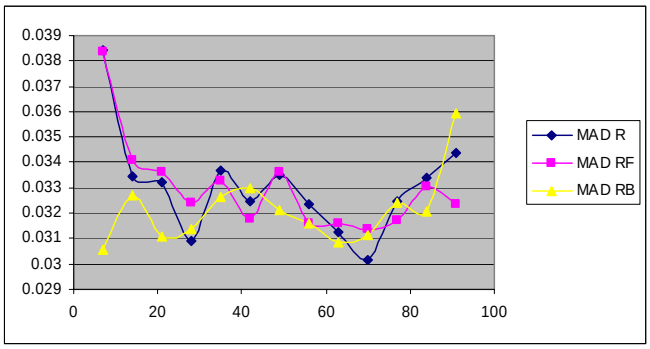

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.0340039 | 0.0271842 | 0.040184 | 0.0306512 | 0.039453 | 0.0272824 |
| 14 | 0.0290054 | 0.0218702 | 0.0355093 | 0.0271114 | 0.0333276 | 0.0213889 |
| 21 | 0.0298882 | 0.0217305 | 0.0338638 | 0.0257619 | 0.0317174 | 0.0232102 |
| 28 | 0.027171 | 0.0226906 | 0.0310661 | 0.0232594 | 0.0318467 | 0.0242996 |
| 35 | 0.0276286 | 0.0213796 | 0.032844 | 0.0261796 | 0.0323987 | 0.0250175 |
| 42 | 0.0267374 | 0.0203918 | 0.0326243 | 0.0244792 | 0.0301565 | 0.0263065 |
| 49 | 0.0275151 | 0.0201343 | 0.0327503 | 0.0243834 | 0.0335085 | 0.0241168 |
| 56 | 0.0280984 | 0.0206939 | 0.0322695 | 0.0235621 | 0.0356729 | 0.0264981 |
| 63 | 0.0278318 | 0.0200042 | 0.0328909 | 0.0234392 | 0.032261 | 0.023216 |
| 70 | 0.025194 | 0.018944 | 0.0319484 | 0.0230057 | 0.0322215 | 0.025216 |
| 77 | 0.0236167 | 0.018012 | 0.031681 | 0.0235896 | 0.0321066 | 0.0243048 |
| 84 | 0.028766 | 0.0210785 | 0.032733 | 0.0256838 | 0.0348732 | 0.0281259 |
| 91 | 0.0300849 | 0.0221525 | 0.0338671 | 0.0262404 | 0.0338975 | 0.0267939 |

MA 1 , Theta 0.8 and Var 0.04



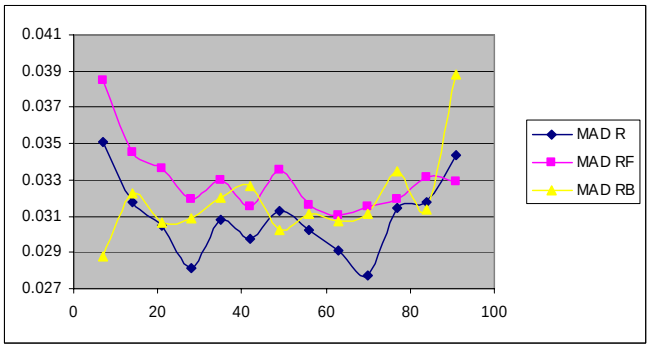

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.0290583 | 0.0273909 | 0.044563 | 0.0309699 | 0.0388214 | 0.028812 |
| 14 | 0.0244912 | 0.0200414 | 0.0354718 | 0.0266229 | 0.0325798 | 0.0230112 |
| 21 | 0.0214376 | 0.0160924 | 0.033697 | 0.0236568 | 0.0279409 | 0.0224326 |
| 28 | 0.0210452 | 0.0168441 | 0.031311 | 0.0234256 | 0.0301271 | 0.0216654 |
| 35 | 0.0218347 | 0.0178179 | 0.0330702 | 0.0262258 | 0.0322516 | 0.0248353 |
| 42 | 0.0194951 | 0.014962 | 0.0322019 | 0.0245005 | 0.0300264 | 0.026784 |
| 49 | 0.0210887 | 0.0155766 | 0.0326344 | 0.0240657 | 0.0342948 | 0.0232509 |
| 56 | 0.0221642 | 0.016528 | 0.0321025 | 0.0242082 | 0.0354868 | 0.0288111 |
| 63 | 0.0212525 | 0.0159207 | 0.032808 | 0.0234319 | 0.0322647 | 0.0219167 |
| 70 | 0.0186874 | 0.0142388 | 0.0316811 | 0.0237323 | 0.0331364 | 0.0253297 |
| 77 | 0.0181389 | 0.0147707 | 0.0318353 | 0.0237466 | 0.0319389 | 0.0242705 |
| 84 | 0.022215 | 0.0179306 | 0.0318199 | 0.0258917 | 0.0339141 | 0.027118 |
| 91 | 0.0260839 | 0.0205974 | 0.0344244 | 0.0270749 | 0.0358881 | 0.0289346 |

MA 1 , Theta -0.2 and Var 0.04



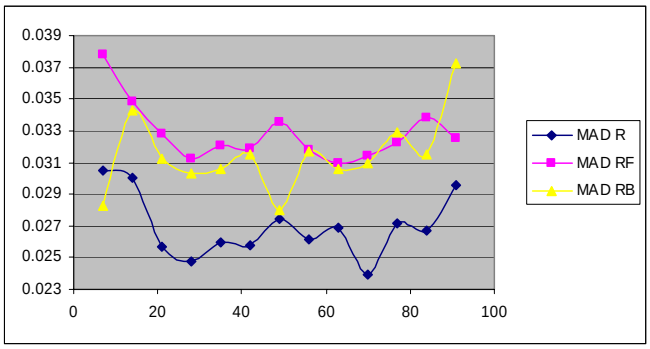

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.0384102 | 0.0257105 | 0.0383725 | 0.02605 | 0.0305345 | 0.0252273 |
| 14 | 0.033431 | 0.0270912 | 0.0340955 | 0.0268442 | 0.032694 | 0.0258565 |
| 21 | 0.0332083 | 0.0232394 | 0.0336205 | 0.0240432 | 0.0310729 | 0.0238828 |
| 28 | 0.0309238 | 0.0249945 | 0.032404 | 0.0253479 | 0.0313696 | 0.0241256 |
| 35 | 0.0336864 | 0.0256003 | 0.0332776 | 0.0258507 | 0.0326537 | 0.023715 |
| 42 | 0.032448 | 0.0235139 | 0.0317703 | 0.0239357 | 0.0329894 | 0.0242658 |
| 49 | 0.0335192 | 0.0255948 | 0.0335996 | 0.0254506 | 0.0321173 | 0.0257044 |
| 56 | 0.0323681 | 0.0229247 | 0.0316245 | 0.0236167 | 0.031603 | 0.0242178 |
| 63 | 0.0312506 | 0.0236646 | 0.0316226 | 0.023145 | 0.0308465 | 0.0245969 |
| 70 | 0.0301567 | 0.02236 | 0.0313841 | 0.0232527 | 0.0311265 | 0.0221162 |
| 77 | 0.0324724 | 0.0243971 | 0.0317101 | 0.0241789 | 0.0323908 | 0.0248439 |
| 84 | 0.0333974 | 0.0247861 | 0.0330342 | 0.0264072 | 0.0320871 | 0.0248244 |
| 91 | 0.034387 | 0.0266744 | 0.0323608 | 0.0250021 | 0.035926 | 0.027474 |

MA 1 , Theta -0.4 and Var 0.04



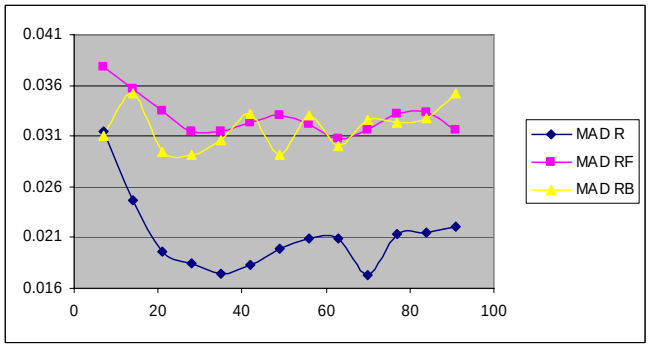

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.0351231 | 0.0246511 | 0.0384694 | 0.026702 | 0.0287566 | 0.02267 |
| 14 | 0.0317687 | 0.0249296 | 0.0345635 | 0.0264959 | 0.0322584 | 0.0246515 |
| 21 | 0.030495 | 0.0212275 | 0.0336648 | 0.0240011 | 0.0306575 | 0.0233688 |
| 28 | 0.0281271 | 0.0217082 | 0.0319492 | 0.0252255 | 0.0309124 | 0.021554 |
| 35 | 0.0307866 | 0.0241351 | 0.0329644 | 0.0257205 | 0.0320268 | 0.0232217 |
| 42 | 0.0297624 | 0.0222733 | 0.0315405 | 0.0240591 | 0.0326454 | 0.0249022 |
| 49 | 0.0313248 | 0.0237694 | 0.033526 | 0.0257553 | 0.0302254 | 0.0253545 |
| 56 | 0.0302298 | 0.0215864 | 0.0315901 | 0.0231043 | 0.0311624 | 0.0240704 |
| 63 | 0.0291269 | 0.0223772 | 0.0310722 | 0.0237061 | 0.0306829 | 0.0237078 |
| 70 | 0.0276998 | 0.0221499 | 0.0315282 | 0.0234094 | 0.0311057 | 0.0240092 |
| 77 | 0.0314844 | 0.0233588 | 0.0319683 | 0.0240053 | 0.0335095 | 0.0249953 |
| 84 | 0.0317838 | 0.0225889 | 0.0331108 | 0.0261882 | 0.0313646 | 0.0254072 |
| 91 | 0.0343653 | 0.0256636 | 0.0328752 | 0.0253194 | 0.0388411 | 0.027594 |

MA 1 , Theta -0.6 and Var 0.04



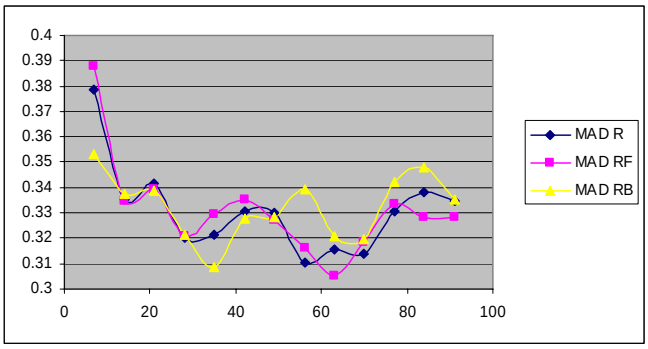

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.030461 | 0.0246031 | 0.0377911 | 0.0289662 | 0.0282651 | 0.0211742 |
| 14 | 0.0300374 | 0.0235605 | 0.034793 | 0.0270875 | 0.034323 | 0.0249579 |
| 21 | 0.0256411 | 0.0186823 | 0.0328074 | 0.0233332 | 0.0312448 | 0.0222147 |
| 28 | 0.0247913 | 0.019029 | 0.0312208 | 0.0255656 | 0.030332 | 0.0198875 |
| 35 | 0.0259724 | 0.0200421 | 0.0320598 | 0.0248516 | 0.0305786 | 0.0249031 |
| 42 | 0.0257339 | 0.0198106 | 0.0318664 | 0.0245488 | 0.0314841 | 0.0268013 |
| 49 | 0.0273979 | 0.0207157 | 0.0335161 | 0.0253331 | 0.0280172 | 0.0254204 |
| 56 | 0.0261856 | 0.0200333 | 0.031799 | 0.0237268 | 0.0317088 | 0.0239972 |
| 63 | 0.0269248 | 0.0206237 | 0.0309529 | 0.0242638 | 0.0305864 | 0.0240163 |
| 70 | 0.0239145 | 0.0196823 | 0.031407 | 0.0235089 | 0.0309078 | 0.0252262 |
| 77 | 0.0271865 | 0.0209445 | 0.0322787 | 0.0240723 | 0.032888 | 0.0261981 |
| 84 | 0.0266601 | 0.019723 | 0.0337867 | 0.026148 | 0.0314832 | 0.0240076 |
| 91 | 0.029576 | 0.0232837 | 0.032559 | 0.0253916 | 0.0372466 | 0.0289345 |

MA 1 , Theta -0.8 and Var 0.04



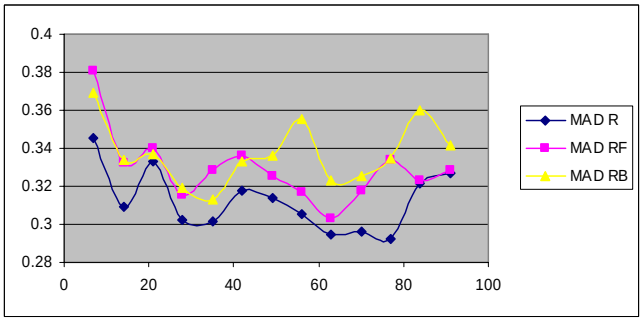

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.0315254 | 0.0274856 | 0.0378521 | 0.0313679 | 0.0310246 | 0.0245616 |
| 14 | 0.0246491 | 0.0186035 | 0.035623 | 0.0252711 | 0.0352744 | 0.0260537 |
| 21 | 0.0196531 | 0.0155102 | 0.0334281 | 0.0242235 | 0.0294615 | 0.0209984 |
| 28 | 0.0184709 | 0.0159549 | 0.0314212 | 0.0245214 | 0.0291153 | 0.0183359 |
| 35 | 0.0173798 | 0.0140527 | 0.0314947 | 0.0244833 | 0.0306144 | 0.0246817 |
| 42 | 0.0183623 | 0.014978 | 0.0323489 | 0.0242187 | 0.0331517 | 0.0261697 |
| 49 | 0.0199387 | 0.015791 | 0.032992 | 0.025279 | 0.0291946 | 0.0242975 |
| 56 | 0.0208561 | 0.0157988 | 0.0322275 | 0.0238391 | 0.0330658 | 0.0232624 |
| 63 | 0.0208799 | 0.0171015 | 0.0307721 | 0.0245566 | 0.0299606 | 0.0239729 |
| 70 | 0.0173334 | 0.0149965 | 0.0315973 | 0.0238362 | 0.0325987 | 0.0246725 |
| 77 | 0.0213724 | 0.0166519 | 0.0332358 | 0.0267882 | 0.0323394 | 0.0259316 |
| 84 | 0.0214994 | 0.0152857 | 0.033381 | 0.0260322 | 0.0326923 | 0.0254503 |
| 91 | 0.0220972 | 0.0171824 | 0.0315524 | 0.0237744 | 0.0351633 | 0.027417 |

MA 1 , Theta 0.2 and Var 0.4



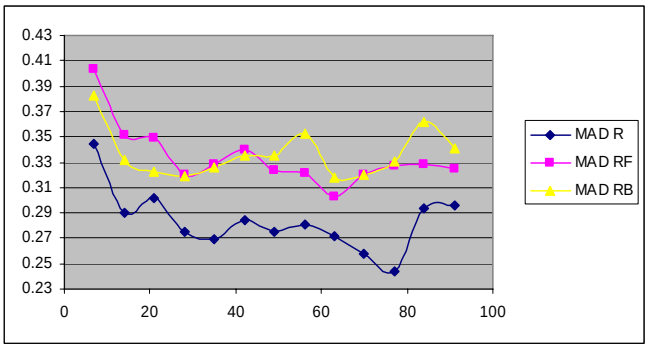

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.378455 | 0.306622 | 0.387695 | 0.302522 | 0.353246 | 0.269399 |
| 14 | 0.335494 | 0.264187 | 0.334643 | 0.261153 | 0.337764 | 0.245631 |
| 21 | 0.341613 | 0.267928 | 0.339255 | 0.263067 | 0.3388 | 0.243107 |
| 28 | 0.320216 | 0.270409 | 0.320961 | 0.256739 | 0.321355 | 0.269537 |
| 35 | 0.321281 | 0.254731 | 0.329256 | 0.259968 | 0.308499 | 0.261105 |
| 42 | 0.330477 | 0.251557 | 0.335319 | 0.248588 | 0.328015 | 0.261315 |
| 49 | 0.330293 | 0.246294 | 0.327108 | 0.245085 | 0.328332 | 0.2428 |
| 56 | 0.310213 | 0.231367 | 0.315908 | 0.235356 | 0.339558 | 0.231349 |
| 63 | 0.315584 | 0.244476 | 0.305062 | 0.236265 | 0.320989 | 0.245478 |
| 70 | 0.313903 | 0.241702 | 0.318592 | 0.231319 | 0.319475 | 0.253616 |
| 77 | 0.330492 | 0.258099 | 0.333377 | 0.256767 | 0.342126 | 0.265274 |
| 84 | 0.338258 | 0.28521 | 0.328155 | 0.265446 | 0.348213 | 0.289361 |
| 91 | 0.33476 | 0.256105 | 0.328037 | 0.244308 | 0.33542 | 0.25678 |

MA 1 , Theta 0.4 and Var 0.4



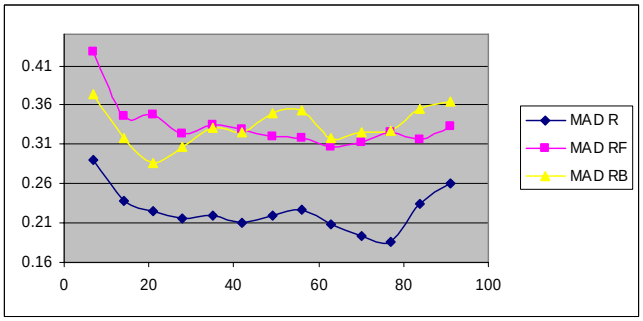

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.345273 | 0.284047 | 0.380909 | 0.293155 | 0.36909 | 0.27244 |
| 14 | 0.30906 | 0.241297 | 0.332621 | 0.26237 | 0.33389 | 0.240825 |
| 21 | 0.332783 | 0.257762 | 0.339825 | 0.270305 | 0.336622 | 0.236887 |
| 28 | 0.302616 | 0.262311 | 0.315625 | 0.253746 | 0.319131 | 0.267601 |
| 35 | 0.301443 | 0.23569 | 0.328226 | 0.261055 | 0.312752 | 0.256576 |
| 42 | 0.31761 | 0.232771 | 0.335891 | 0.24887 | 0.332896 | 0.266169 |
| 49 | 0.314172 | 0.234731 | 0.325225 | 0.242923 | 0.336326 | 0.242194 |
| 56 | 0.305298 | 0.217173 | 0.3168 | 0.235665 | 0.355045 | 0.237537 |
| 63 | 0.294716 | 0.224357 | 0.303218 | 0.239061 | 0.323329 | 0.231519 |
| 70 | 0.295959 | 0.234904 | 0.317597 | 0.231564 | 0.32509 | 0.26279 |
| 77 | 0.291985 | 0.232233 | 0.334195 | 0.25455 | 0.334949 | 0.249539 |
| 84 | 0.321646 | 0.270443 | 0.3234 | 0.262498 | 0.360186 | 0.298086 |
| 91 | 0.326635 | 0.24707 | 0.328822 | 0.244268 | 0.341656 | 0.260441 |

MA 1 , Theta 0.6 and Var 0.4



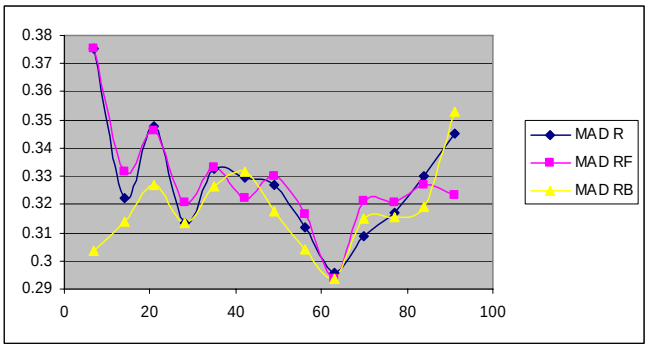

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.344216 | 0.272764 | 0.402938 | 0.306485 | 0.382658 | 0.277612 |
| 14 | 0.290161 | 0.211781 | 0.351347 | 0.259535 | 0.331317 | 0.218736 |
| 21 | 0.301543 | 0.237762 | 0.349069 | 0.281757 | 0.32275 | 0.245123 |
| 28 | 0.275408 | 0.229044 | 0.320107 | 0.240317 | 0.318805 | 0.251184 |
| 35 | 0.268765 | 0.211835 | 0.328646 | 0.262827 | 0.32573 | 0.253261 |
| 42 | 0.284223 | 0.215195 | 0.339304 | 0.249828 | 0.334627 | 0.283254 |
| 49 | 0.274653 | 0.205375 | 0.323187 | 0.24004 | 0.334966 | 0.246097 |
| 56 | 0.280337 | 0.205834 | 0.320877 | 0.2372 | 0.352512 | 0.267633 |
| 63 | 0.271855 | 0.191418 | 0.302611 | 0.240438 | 0.317746 | 0.233542 |
| 70 | 0.2577 | 0.199469 | 0.319828 | 0.233452 | 0.320111 | 0.256721 |
| 77 | 0.243765 | 0.190448 | 0.327593 | 0.251761 | 0.331028 | 0.252811 |
| 84 | 0.294136 | 0.230261 | 0.328347 | 0.258232 | 0.361337 | 0.295354 |
| 91 | 0.29593 | 0.220513 | 0.324867 | 0.240718 | 0.340759 | 0.258081 |

MA 1 , Theta 0.8 and Var 0.4



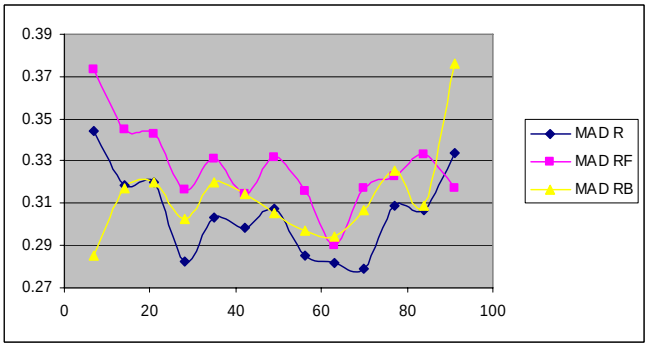

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.29041 | 0.274609 | 0.427648 | 0.30683 | 0.374506 | 0.289892 |
| 14 | 0.239003 | 0.182175 | 0.345714 | 0.251832 | 0.318086 | 0.222204 |
| 21 | 0.225036 | 0.171178 | 0.34839 | 0.261518 | 0.285822 | 0.228055 |
| 28 | 0.216327 | 0.167834 | 0.324095 | 0.241853 | 0.306212 | 0.215094 |
| 35 | 0.219071 | 0.170427 | 0.333893 | 0.262895 | 0.330387 | 0.252601 |
| 42 | 0.210357 | 0.161065 | 0.328377 | 0.251578 | 0.325274 | 0.294969 |
| 49 | 0.220122 | 0.165862 | 0.32073 | 0.241082 | 0.350069 | 0.241291 |
| 56 | 0.227681 | 0.164311 | 0.317471 | 0.243121 | 0.353227 | 0.2901 |
| 63 | 0.209156 | 0.153698 | 0.306184 | 0.239928 | 0.317578 | 0.22066 |
| 70 | 0.193118 | 0.148944 | 0.311852 | 0.241089 | 0.324846 | 0.254643 |
| 77 | 0.185647 | 0.152152 | 0.324577 | 0.250436 | 0.326919 | 0.254325 |
| 84 | 0.234461 | 0.191539 | 0.31599 | 0.257026 | 0.355076 | 0.282387 |
| 91 | 0.260783 | 0.205792 | 0.333215 | 0.246248 | 0.363858 | 0.275858 |

MA 1 , Theta -0.2 and Var 0.4



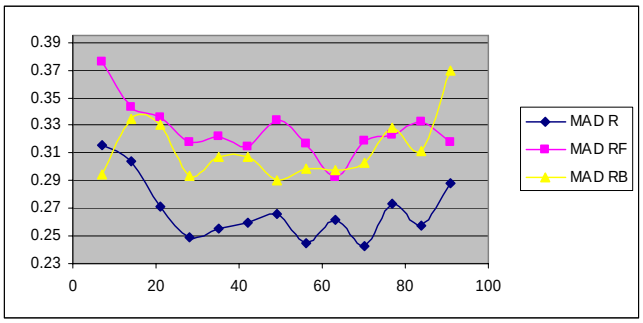

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.375456 | 0.244439 | 0.375168 | 0.24417 | 0.303383 | 0.250009 |
| 14 | 0.322415 | 0.260832 | 0.331555 | 0.257844 | 0.314095 | 0.25134 |
| 21 | 0.347552 | 0.24947 | 0.346393 | 0.261585 | 0.326732 | 0.254292 |
| 28 | 0.31329 | 0.25053 | 0.320794 | 0.252953 | 0.313455 | 0.238291 |
| 35 | 0.332687 | 0.25245 | 0.332987 | 0.252747 | 0.326512 | 0.236987 |
| 42 | 0.329451 | 0.232314 | 0.322074 | 0.231751 | 0.331394 | 0.238268 |
| 49 | 0.327088 | 0.250538 | 0.329921 | 0.251298 | 0.317728 | 0.256758 |
| 56 | 0.311843 | 0.227686 | 0.316329 | 0.237058 | 0.304199 | 0.237023 |
| 63 | 0.295632 | 0.244839 | 0.293447 | 0.243313 | 0.293821 | 0.25204 |
| 70 | 0.308504 | 0.231837 | 0.321316 | 0.234936 | 0.314723 | 0.234522 |
| 77 | 0.316936 | 0.259217 | 0.320688 | 0.256237 | 0.315346 | 0.261297 |
| 84 | 0.329951 | 0.251283 | 0.327155 | 0.266218 | 0.319178 | 0.247616 |
| 91 | 0.345233 | 0.265668 | 0.32341 | 0.243586 | 0.352874 | 0.272725 |

MA 1 , Theta -0.4 and Var 0.4



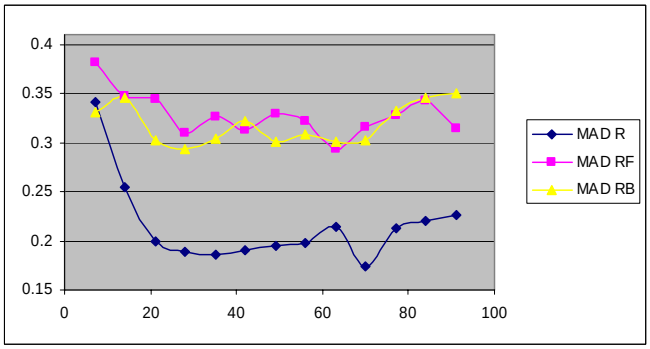

| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.344096 | 0.245427 | 0.373023 | 0.261789 | 0.285203 | 0.232029 |
| 14 | 0.318402 | 0.24233 | 0.345176 | 0.257974 | 0.317053 | 0.244637 |
| 21 | 0.320233 | 0.224038 | 0.342921 | 0.25958 | 0.319901 | 0.250569 |
| 28 | 0.282587 | 0.221127 | 0.316255 | 0.251738 | 0.302903 | 0.214332 |
| 35 | 0.303357 | 0.238117 | 0.330929 | 0.253157 | 0.320014 | 0.232313 |
| 42 | 0.298518 | 0.223935 | 0.314461 | 0.23501 | 0.314685 | 0.246377 |
| 49 | 0.30763 | 0.238691 | 0.331571 | 0.254952 | 0.305457 | 0.264706 |
| 56 | 0.285048 | 0.216938 | 0.315507 | 0.231738 | 0.297279 | 0.233441 |
| 63 | 0.281742 | 0.228525 | 0.290257 | 0.247786 | 0.294496 | 0.241085 |
| 70 | 0.279031 | 0.220752 | 0.317242 | 0.240655 | 0.307019 | 0.235199 |
| 77 | 0.30898 | 0.252904 | 0.322582 | 0.254289 | 0.325677 | 0.264413 |
| 84 | 0.30689 | 0.220392 | 0.332878 | 0.263671 | 0.308928 | 0.247843 |
| 91 | 0.333814 | 0.247985 | 0.317341 | 0.240451 | 0.375892 | 0.266331 |

MA 1 , Theta -0.6 and Var 0.4




| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.315328 | 0.258954 | 0.375947 | 0.294683 | 0.294188 | 0.222028 |
| 14 | 0.30432 | 0.228233 | 0.342832 | 0.259866 | 0.334481 | 0.249902 |
| 21 | 0.271156 | 0.1942 | 0.335578 | 0.252336 | 0.330231 | 0.2317 |
| 28 | 0.24858 | 0.194375 | 0.317915 | 0.255043 | 0.293467 | 0.200928 |
| 35 | 0.255353 | 0.199661 | 0.321597 | 0.246514 | 0.307645 | 0.249149 |
| 42 | 0.259222 | 0.204616 | 0.314691 | 0.242897 | 0.307433 | 0.26392 |
| 49 | 0.265699 | 0.209304 | 0.334024 | 0.254018 | 0.289889 | 0.265718 |
| 56 | 0.244545 | 0.191858 | 0.317228 | 0.236948 | 0.298807 | 0.229903 |
| 63 | 0.261604 | 0.209193 | 0.292367 | 0.250771 | 0.297351 | 0.242128 |
| 70 | 0.242282 | 0.190489 | 0.318631 | 0.241138 | 0.303264 | 0.233574 |
| 77 | 0.273429 | 0.228763 | 0.322946 | 0.255396 | 0.327962 | 0.269785 |
| 84 | 0.257431 | 0.192889 | 0.332658 | 0.262735 | 0.31134 | 0.23746 |
| 91 | 0.288064 | 0.221178 | 0.318 | 0.24245 | 0.369448 | 0.273836 |

MA 1 , Theta -0.8 and Var 0.4




| Position | MAD R | SD R | MAD RF | SD RF | MAD RB | SD RB |
|---|---|---|---|---|---|---|
| 7 | 0.340851 | 0.281864 | 0.381003 | 0.315096 | 0.33118 | 0.256379 |
| 14 | 0.254114 | 0.187364 | 0.346643 | 0.254348 | 0.34585 | 0.257446 |
| 21 | 0.19874 | 0.162586 | 0.344719 | 0.256388 | 0.302306 | 0.21614 |
| 28 | 0.18957 | 0.160901 | 0.31005 | 0.245833 | 0.293874 | 0.181866 |
| 35 | 0.18517 | 0.144938 | 0.326239 | 0.278479 | 0.304074 | 0.253179 |
| 42 | 0.190175 | 0.153621 | 0.31301 | 0.237991 | 0.321941 | 0.255233 |
| 49 | 0.195208 | 0.154468 | 0.32982 | 0.253911 | 0.300794 | 0.249364 |
| 56 | 0.197138 | 0.15786 | 0.32194 | 0.23852 | 0.308494 | 0.233854 |
| 63 | 0.214619 | 0.172694 | 0.292953 | 0.251665 | 0.300516 | 0.249827 |
| 70 | 0.174406 | 0.146451 | 0.316203 | 0.239624 | 0.30197 | 0.23589 |
| 77 | 0.213287 | 0.170897 | 0.327076 | 0.265134 | 0.332153 | 0.261977 |
| 84 | 0.22023 | 0.163007 | 0.343387 | 0.266193 | 0.345173 | 0.257615 |
| 91 | 0.226075 | 0.163026 | 0.314155 | 0.234695 | 0.350704 | 0.264876 |