Oil Data Analysis

R Markdown

a time series analysis of the oil data

```
# Load required libraries
library(readxl)
library(imputeTestbench)
```

```
## Registered S3 method overwritten by 'quantmod':
##   method            from
##   as.zoo.data.frame zoo
```

```
library(tidyverse)
```

```
## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v dplyr     1.1.4     v readr     2.1.5
## v forcats   1.0.0     v stringr   1.5.1
## v ggplot2   3.4.4     v tibble    3.2.1
## v lubridate 1.9.3     v tidyr     1.3.1
## v purrr     1.0.2
```

```
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

Read in the dataset and take a look at the first few rows

```
oil <- read.csv("D:/samyak/python/college/R/imputetestbench_tests/First_Test/oil.csv")
View(oil)
glimpse(oil)
```

```
## Rows: 1,218
## Columns: 2
## $ date       <chr> "2013-01-01", "2013-01-02", "2013-01-03", "2013-01-04", "20~
## $ dcoilwtico <dbl> NA, 93.14, 92.97, 93.12, 93.20, 93.21, 93.08, 93.81, 93.60,~
```

Convert 'date' to Date class

```
oil$date <- as.Date(oil$date)
```

Create a time series object

```r
time_series_df <- ts(oil$dcoilwtico, start = c(2013, 1), frequency = 365)
print(time_series_df)
```

```
## Time Series:
## Start = c(2013, 1)
## End = c(2016, 123)
## Frequency = 365
##    [1]     NA  93.14  92.97  93.12  93.20  93.21  93.08  93.81  93.60  94.27
##   [11]  93.26  94.28  95.49  95.61     NA  96.09  95.06  95.35  95.15  95.95
##   [21]  97.62  97.98  97.65  97.46  96.21  96.68  96.44  95.84  95.71  97.01
##   [31]  97.48  97.03  97.30  95.95     NA  96.69  94.92  92.79  93.12  92.74
##   [41]  92.63  92.84  92.03  90.71  90.13  90.88  90.47  91.53  92.01  92.07
##   [51]  92.44  92.47  93.03  93.49  93.71  92.44  93.21  92.46  93.41  94.55
##   [61]  95.99  96.53  97.24     NA  97.10  97.23  95.02  93.26  92.76  93.36
##   [71]  94.18  94.59  93.44  91.23  88.75  88.73  86.65  87.83  88.04  88.81
##   [81]  89.21  91.07  93.27  92.63  94.09  93.22  90.74  93.70  95.25  95.80
##   [91]  95.28  96.24  96.09  95.81  94.76  93.96  93.95  94.85  95.72  96.29
##  [101]  95.55  93.98  94.12  93.84     NA  94.65  93.13  93.57  91.93  93.41
##  [111]  93.36  93.66  94.71  96.11  95.82  95.50  95.98  96.66  97.83  97.86
##  [121]  98.46  98.24  94.89  93.81  95.07  95.25  95.47  97.00  96.36  97.94
##  [131]  99.65 101.92     NA 103.09 103.03 103.46 106.41 104.77 105.85 106.20
##  [141] 105.88 106.39 107.94 108.00 106.61 107.13 105.41 105.47 104.76 104.61
##  [151] 103.14 105.10 107.93 106.94 106.61 105.32 104.41 103.45 106.04 106.19
##  [161] 106.78 106.89 107.43 107.58 107.14 104.90 103.93 104.93 106.48 105.88
##  [171] 109.11 110.17 108.51 107.98     NA 108.67 107.29 108.50 110.62 109.62
##  [181] 107.48 107.65 108.72 108.31 106.54 105.36 108.23 106.26 104.70 103.62
##  [191] 103.22 102.68 103.10 102.86 102.36 102.09 104.15 103.29 103.83 103.07
##  [201] 103.54 101.63 103.08 102.17 102.46 101.15 102.34 100.72 100.87  99.28
##  [211]  97.63  96.90  96.65  97.40  98.74  98.29  96.81  96.29  94.56  94.58
##  [221]  93.40  94.74  94.25  94.56  95.13  93.12  93.91  93.76  93.80  93.03
##  [231]  93.35  93.34  95.35  94.53  93.86  93.41  92.05     NA  92.55  93.61
##  [241]  95.83  96.97  97.14  97.48  97.10  98.32  97.25  97.21  96.27  97.18
##  [251]  96.99  97.59  98.40  99.11  98.62  98.87     NA  99.18  99.94  98.90
##  [261]  98.17     NA  95.14  93.66  93.12  93.31  91.90  91.36  92.39  91.45
##  [271]  92.15  93.78  93.54  93.96     NA  94.51  96.35  97.23  96.66  95.82
##  [281]  97.49  97.34  98.25  97.55  96.44  97.24  97.40  97.84  99.98 100.12
##  [291]  99.96 100.38 100.27 100.31     NA 102.54 103.46 103.20 102.53 103.17
##  [301] 102.20 102.93 102.68 102.88 105.34 103.64 101.75 101.82 102.82 101.39
##  [311] 100.29  98.29  98.57  99.23  98.43 100.08 100.71  99.68  99.97 100.05
##  [321]  99.66 100.61 101.25 101.73 101.57  99.69  99.60 100.29 101.16 100.43
##  [331] 102.57 103.55 103.37 103.68 104.05 103.70 103.71 104.33     NA 104.35
##  [341] 101.69 101.47 102.20 100.85 101.13 101.56 100.07  99.69 100.09  99.74
##  [351]  99.81 101.06 100.52 100.32 100.89 102.01 102.63 101.74 102.31 102.95
##  [361] 102.80 104.31 104.03 105.01     NA 104.78 103.37 104.26 103.40 103.07
##  [371] 103.34 103.27 103.17 103.32 105.09 105.02 105.04 107.20 107.49 107.52
##  [381] 106.95 106.64 107.08 107.95 106.83 106.64 107.04 106.49 106.46 106.07
##  [391] 106.06 105.18 104.76     NA 104.19 104.06 102.93 103.61 101.48 101.73
##  [401] 100.56 101.88 103.84 103.83 105.34 104.59 103.81 102.76 105.23 105.68
##  [411] 104.91 104.29  98.23  97.86  98.26  97.34  96.93  97.34  97.61  98.09
##  [421]  97.36  97.57  95.54  97.30  96.44  94.35  96.40  93.97  93.61  95.39
##  [431]  95.78  95.82  96.44  97.86     NA  92.92  95.50  94.51  93.32  92.64
##  [441]  92.73  91.71  92.89  92.18  92.86  94.91  94.33  93.07  92.43  91.46
##  [451]  91.55  93.60  93.59  95.55  94.53  91.17  90.74  91.02  89.76  90.33
```

```
##  [461]  88.89  87.29  85.76  85.87  85.73  81.72  81.82  82.33  82.80  82.76
##  [471]  83.25  80.52  82.81  81.27  81.26  81.36  82.25  81.06  80.53  78.77
##  [481]  77.15  78.71  77.87  78.71  77.43  77.85  77.16  74.13  75.91  75.64
##  [491]  74.55  74.55  75.63  76.52  75.74  74.04  73.70     NA  65.94  68.98
##  [501]  66.99  67.30  66.73  65.89  63.13  63.74  60.99  60.01  57.81  55.96
##  [511]  55.97  56.43  54.18  56.91  55.25  56.78  55.70     NA  54.59  53.46
##  [521]  54.14  53.45     NA  52.72  50.05  47.98  48.69  48.80  48.35  46.06
##  [531]  45.92  48.49  46.37  48.49     NA  46.79  47.85  45.93  45.26  44.80
##  [541]  45.84  44.08  44.12  47.79  49.25  53.04  48.45  50.48  51.66  52.99
##  [551]  50.06  48.80  51.17  52.66     NA  53.56  52.13  51.12  49.95  49.56
##  [561]  48.48  50.25  47.65  49.84  49.59  50.43  51.53  50.76  49.61  49.95
##  [571]  48.42  48.06  47.12  44.88  43.93  43.39  44.63  44.02  46.00  47.40
##  [581]  47.03  48.75  51.41  48.83  48.66  47.72  50.12  49.13     NA  52.08
##  [591]  53.95  50.44  50.79  51.63  51.95  53.30  56.25  56.69  55.71  56.37
##  [601]  55.58  56.17  56.59  55.98  55.56  57.05  58.55  59.62  59.10  58.92
##  [611]  60.38  60.93  58.99  59.41  59.23  60.72  60.50  59.89  59.73  59.44
##  [621]  57.30  58.96  60.18  58.88     NA  57.29  57.51  57.69  60.25  60.24
##  [631]  61.30  59.67  58.00  59.11  58.15  60.15  61.36  60.74  59.96  59.53
##  [641]  60.01  59.89  60.41  59.62  60.01  61.05  60.01  59.59  59.41  58.34
##  [651]  59.48  56.94  56.93     NA  52.48  52.33  51.61  52.76  52.74  52.19
##  [661]  53.05  51.40  50.90  50.88  50.11  50.59  49.27  48.11  47.98  47.17
##  [671]  47.97  48.77  48.53  47.11  45.25  45.75  45.13  44.69  43.87  44.94
##  [681]  43.11  43.22  42.27  42.45  41.93  42.58  40.75  41.00  40.45  38.22
##  [691]  39.15  38.50  42.47  45.29  49.20  45.38  46.30  46.75  46.02     NA
##  [701]  45.92  44.13  45.85  44.75  44.07  44.58  47.12  46.93  44.71  46.67
##  [711]  46.17  44.53  44.94  45.55  44.40  45.24  45.06  44.75  45.54  46.28
##  [721]  48.53  47.86  49.46  49.67  47.09  46.70  46.63  46.38  47.30  45.91
##  [731]  45.84  45.22  44.90  43.91  43.19  43.21  45.93  46.02  46.60  46.12
##  [741]  47.88  46.32  45.27  44.32  43.87  44.23  42.95  41.74  40.69  41.68
##  [751]  40.73  40.75  40.55  39.39  39.27  40.89  41.22     NA  40.57  40.43
##  [761]  40.58  39.93  41.08  40.00  37.64  37.46  37.16  36.76  35.65  36.31
##  [771]  37.32  35.55  34.98  34.72  34.55  36.12  36.76  37.62     NA  36.36
##  [781]  37.88  36.59  37.13     NA  36.81  35.97  33.97  33.29  33.20  31.42
##  [791]  30.42  30.42  31.22  29.45     NA  28.47  26.68  29.55  32.07  30.31
##  [801]  29.54  32.32  33.21  33.66  31.62  29.90  32.29  31.63  30.86  29.71
##  [811]  27.96  27.54  26.19  29.32     NA  29.05  30.68  30.77  29.59  31.37
##  [821]  31.84  30.35  31.40  31.65  32.74  34.39  34.57  34.56  35.91  37.90
##  [831]  36.67  37.62  37.77  38.51  37.20  36.32  38.43  40.17  39.47  39.91
##  [841]  41.45  38.28  38.14     NA  37.99  36.91  36.91  36.94  35.36  34.30
##  [851]  34.52  37.74  37.30  39.74  40.46  42.12  41.70  41.45  40.40  39.74
##  [861]  40.88  42.72  43.18  42.76  41.67  42.52  45.29  46.03  45.98  44.75
##  [871]  43.65  43.77  44.33  44.58  43.45  44.68  46.21  46.64  46.22  47.72
##  [881]  48.29  48.12  48.16  47.67  48.12  48.04  49.10  49.00  49.36     NA
##  [891]  49.10  49.07  49.14  48.69  49.71  50.37  51.23  50.52  49.09  48.89
##  [901]  48.49  47.92  46.14  48.00  49.40  48.95  49.16  49.34  46.70  45.80
##  [911]  47.93  49.85  48.27  49.02     NA  46.73  47.37  45.22  45.37  44.73
##  [921]  46.82  44.87  45.64  45.93  45.23  44.64  44.96  43.96  43.41  42.40
##  [931]  42.16  41.90  41.13  41.54  40.05  39.50  40.80  41.92  41.83  43.06
##  [941]  42.78  41.75  43.51  44.47  45.72  46.57  46.81  48.20  48.48  46.80
##  [951]  47.54  46.29  46.97  47.64  46.97  46.32  44.68  43.17  44.39     NA
##  [961]  44.85  45.47  47.63  45.88  46.28  44.91  43.62  43.85  43.04  43.34
##  [971]  43.85  45.33  46.10  44.36  45.60  44.65  47.07  47.72  47.72  48.80
##  [981]  48.67  49.75  50.44  49.76  49.76  50.72  50.14  50.47  50.35  49.97
##  [991]  50.30  51.59  50.31  50.61  50.18  49.45  48.75  49.71  48.72  46.83
```

```
## [1001]  46.66  45.32  44.66  44.07  44.88  44.96  45.20  44.62  43.39  43.29
## [1011]  45.86  45.56  45.37  45.69  47.48  48.07  46.72     NA  46.72  45.66
## [1021]  45.29  49.41  51.08  51.70  51.72  50.95  49.85  50.84  51.51  52.74
## [1031]  52.99  51.01  50.90  51.93  52.13  52.22  51.44  51.98  52.01     NA
## [1041]  52.82  54.01  53.80  53.75     NA  52.36  53.26  53.77  53.98  51.95
## [1051]  50.82  52.19  53.01  52.36     NA  52.45  51.12  51.39  52.33  52.77
## [1061]  52.38  52.14  53.24  53.18  52.63  52.75  53.90  53.55  53.81  53.01
## [1071]  52.19  52.37  52.99  53.84  52.96  53.21  53.11  53.41  53.41     NA
## [1081]  54.02  53.61  54.48  53.99  54.04  54.00  53.82  52.63  53.33  53.19
## [1091]  52.68  49.83  48.75  48.05  47.95  47.24  48.34  48.30  48.34  47.79
## [1101]  47.02  47.29  47.00  47.30  47.02  48.36  49.47  50.30  50.54  50.25
## [1111]  50.99  51.14  51.69  52.25  53.06  53.38  53.12  53.19     NA  52.62
## [1121]  52.46  50.49  50.26  49.64  48.90  49.22  49.22  48.96  49.31  48.83
## [1131]  47.65  47.79  45.55  46.23  46.46  45.84  47.28  47.81  47.83  48.86
## [1141]  48.64  49.04  49.36  50.32  50.81  51.12  50.99  48.57  49.58     NA
## [1151]  49.63  48.29  48.32  47.68  47.40  48.13  45.80  45.68  45.82  46.10
## [1161]  46.41  44.79  44.47  44.73  44.24  43.34  42.48  42.53  42.86  43.24
## [1171]  44.25  44.74  44.88  46.02     NA     NA  45.11  45.52  44.25  44.40
## [1181]  45.06  45.48  46.06  46.53  46.02  46.40  47.10  46.73  45.78  46.21
## [1191]  47.77  48.58  49.05  49.72  50.21  49.19  49.60  49.03  49.57  49.37
## [1201]  49.07  49.59  48.54  48.81  47.59  47.57  46.80  47.07  48.59  47.39
## [1211]  47.65  48.45  47.24  47.65  46.40  46.46  45.96  47.26
```

Use imputeTestbench to impute missing values

```
imputation_results <- impute_errors(errorParameter = 'mape' ,data = time_series_df)
imputation_results
```

```
## $Parameter
## [1] "mape"
##
## $MissingPercent
## [1] 10 20 30 40 50 60 70 80 90
##
## $na.approx
## [1] 0.1155952 0.2503434 0.4016898 0.5448995 0.7170281 0.9461750 1.1891243
## [8] 1.5929378 2.4739084
##
## $na.interp
## [1] 0.3487617 0.7677324 1.1849888 0.5447039 0.7163887 0.9454024 1.1877563
## [8] 1.5908125 2.4680005
##
## $na_interpolation
## [1] 0.1155952 0.2503197 0.4016567 0.5447039 0.7163887 0.9454024 1.1877563
## [8] 1.5908125 2.4680005
##
## $na.locf
## [1] 0.1645991 0.3511071 0.5746344 0.7851061 1.0588830 1.4138246 1.9377715
## [8] 2.6902841 4.1217117
##
## $na_mean
## [1]  3.961701  8.085894 12.279098 16.143299 20.061145 24.390514 28.035686
## [8] 31.557080 36.046388
```

Plot imputed values

```
plot_errors(imputation_results, plotType = 'line')
```