S2_1 Time Series

Carga de librerias

```r
library(ggplot2)
library(tsapp)
```

```
## Loading required package: Matrix

## Loading required package: vars

## Loading required package: MASS

## Loading required package: strucchange

## Loading required package: zoo

##
## Attaching package: 'zoo'

## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric

## Loading required package: sandwich

## Loading required package: urca

## Loading required package: lmtest

## Loading required package: fftwtools
```

```r
library(forecast)
```

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

##
## Attaching package: 'forecast'

## The following object is masked from 'package:tsapp':
##
##     BoxCox
```

```r
library(scales)
library(stats)
library(TTR)
```
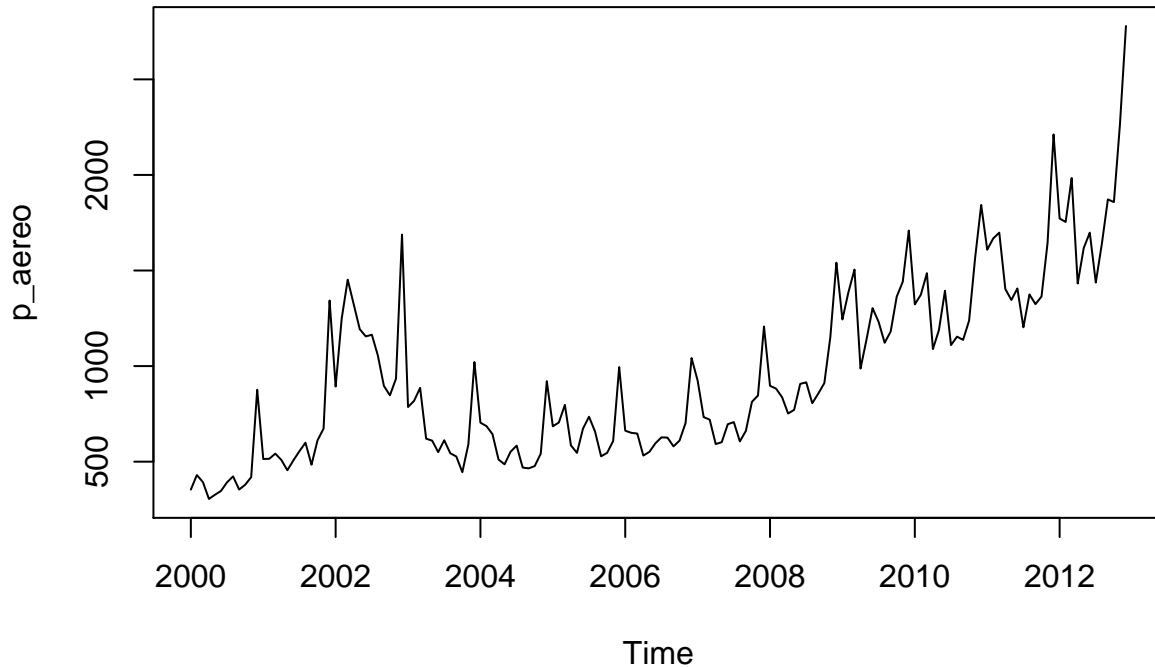
Carga de datos

```r
#Carga de datos
Yt <- read.delim("./datatesisaereo.txt", header=T)
```

```r
#ts para convertir a serie de tiempo
Yt <- ts(Yt, start = c(2000, 1), freq = 12 )
```

Grafico de la seria

```r
plot(Yt)
```


## Agrupacion de meses

```r
cycle(Yt)
```

```
##      Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
## 2000   1   2   3   4   5   6   7   8   9  10  11  12
## 2001   1   2   3   4   5   6   7   8   9  10  11  12
## 2002   1   2   3   4   5   6   7   8   9  10  11  12
## 2003   1   2   3   4   5   6   7   8   9  10  11  12
## 2004   1   2   3   4   5   6   7   8   9  10  11  12
## 2005   1   2   3   4   5   6   7   8   9  10  11  12
## 2006   1   2   3   4   5   6   7   8   9  10  11  12
## 2007   1   2   3   4   5   6   7   8   9  10  11  12
## 2008   1   2   3   4   5   6   7   8   9  10  11  12
## 2009   1   2   3   4   5   6   7   8   9  10  11  12
## 2010   1   2   3   4   5   6   7   8   9  10  11  12
## 2011   1   2   3   4   5   6   7   8   9  10  11  12
## 2012   1   2   3   4   5   6   7   8   9  10  11  12
```

Diagrama de Cajas

```r
boxplot(Yt ~ cycle(Yt), horizontal = FALSE, col = "YELLOW") ## ALT + 126
```
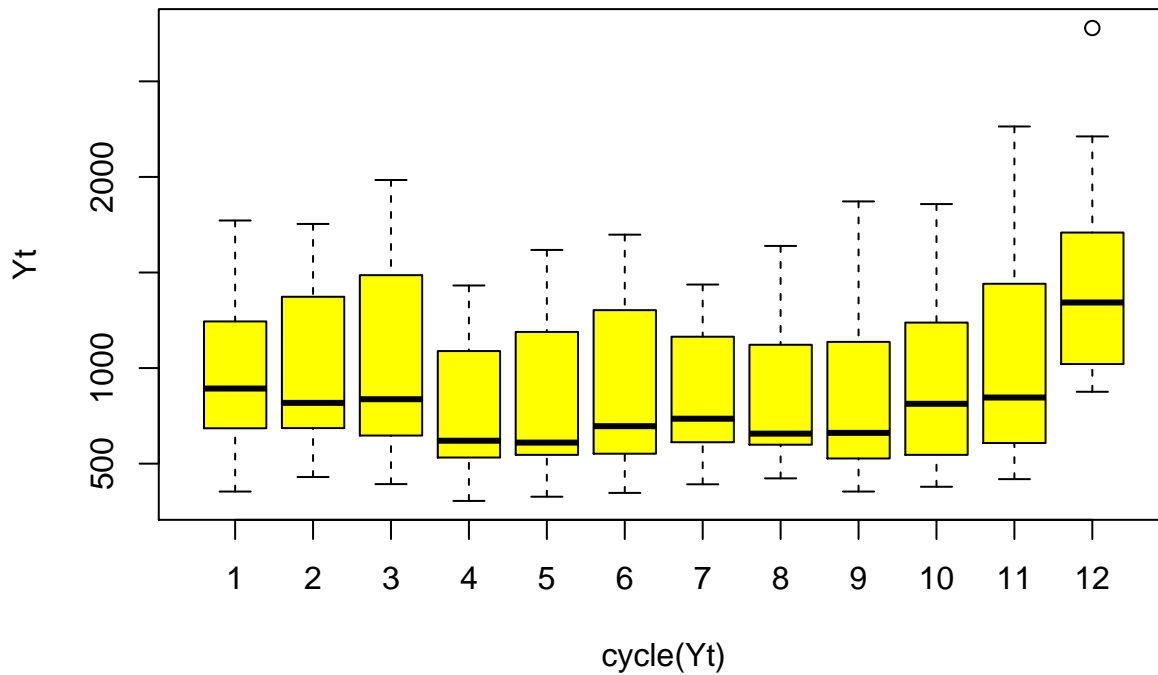


```r
boxplot(Yt ~ cycle(Yt), horizontal = TRUE, col = "YELLOW") ## ALT + 126
```
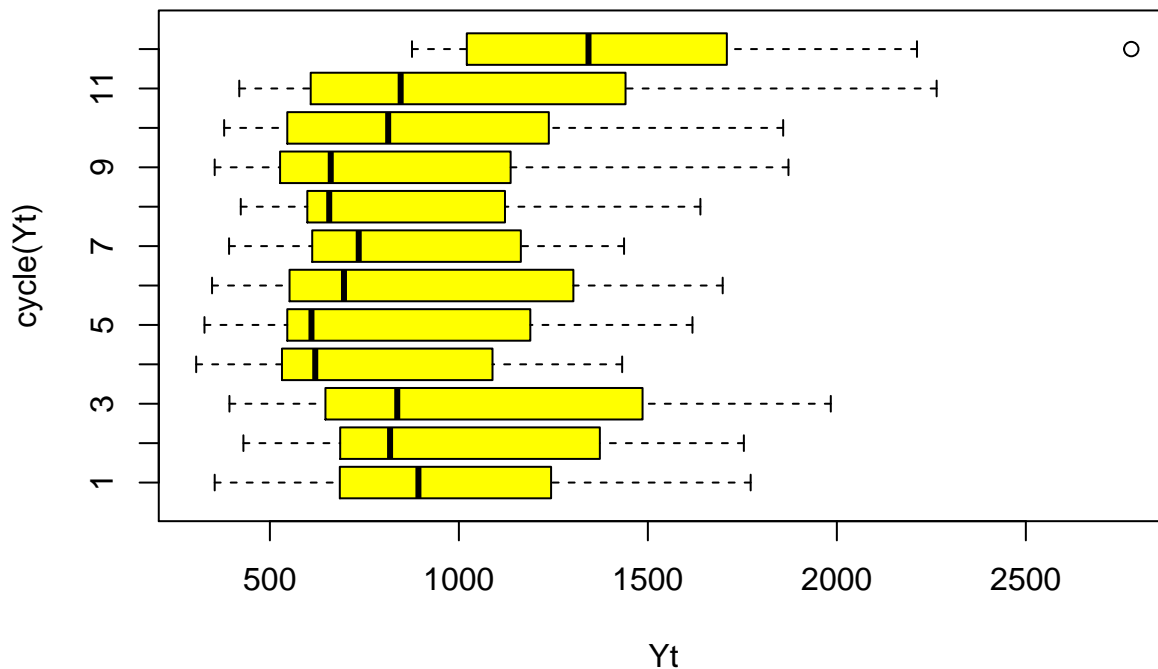

##Descomposición de la serie de tipo multiplicativo

```r
#Aplicamos la sentencia para un enf. de descomposicion
Yt.ts.desc <- decompose(Yt, type = "multiplicative")
Yt.ts.desc
```

```
## $x
##        Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov  Dec
## 2000  354  430  393  305  327  347  392  423  354  379  419  876
## 2001  514  515  542  509  455  507  555  599  484  612  673 1343
## 2002  893 1248 1452 1323 1193 1155 1164 1055  896  847  934 1688
## 2003  786  818  886  620  610  550  612  544  527  445  591 1021
## 2004  704  686  644  511  486  552  584  469  465  477  542  921
## 2005  685  705  797  585  546  673  735  657  528  546  608  995
## 2006  662  651  647  532  551  596  627  626  580  610  702 1042
## 2007  924  733  720  592  602  696  707  606  661  813  846 1207
## 2008  897  882  837  752  771  907  915  806  856  911 1153 1541
## 2009 1244 1387 1505  987 1140 1303 1231 1122 1181 1363 1441 1709
## 2010 1323 1373 1486 1089 1189 1394 1110 1154 1137 1238 1567 1843
## 2011 1609 1668 1698 1403 1346 1406 1203 1375 1324 1364 1643 2212
## 2012 1772 1754 1984 1432 1618 1698 1437 1639 1872 1858 2264 2779
##
## $seasonal
##             Jan       Feb       Mar       Apr       May       Jun       Jul
## 2000 1.0695399 1.0839904 1.1300115 0.8881280 0.8784004 0.9503415 0.9404621
## 2001 1.0695399 1.0839904 1.1300115 0.8881280 0.8784004 0.9503415 0.9404621
## 2002 1.0695399 1.0839904 1.1300115 0.8881280 0.8784004 0.9503415 0.9404621
## 2003 1.0695399 1.0839904 1.1300115 0.8881280 0.8784004 0.9503415 0.9404621
## 2004 1.0695399 1.0839904 1.1300115 0.8881280 0.8784004 0.9503415 0.9404621
## 2005 1.0695399 1.0839904 1.1300115 0.8881280 0.8784004 0.9503415 0.9404621
## 2006 1.0695399 1.0839904 1.1300115 0.8881280 0.8784004 0.9503415 0.9404621
## 2007 1.0695399 1.0839904 1.1300115 0.8881280 0.8784004 0.9503415 0.9404621
## 2008 1.0695399 1.0839904 1.1300115 0.8881280 0.8784004 0.9503415 0.9404621
## 2009 1.0695399 1.0839904 1.1300115 0.8881280 0.8784004 0.9503415 0.9404621
## 2010 1.0695399 1.0839904 1.1300115 0.8881280 0.8784004 0.9503415 0.9404621
## 2011 1.0695399 1.0839904 1.1300115 0.8881280 0.8784004 0.9503415 0.9404621
## 2012 1.0695399 1.0839904 1.1300115 0.8881280 0.8784004 0.9503415 0.9404621
##             Aug       Sep       Oct       Nov       Dec
## 2000 0.8828837 0.8193779 0.8621479 0.9833222 1.5113946
## 2001 0.8828837 0.8193779 0.8621479 0.9833222 1.5113946
## 2002 0.8828837 0.8193779 0.8621479 0.9833222 1.5113946
## 2003 0.8828837 0.8193779 0.8621479 0.9833222 1.5113946
## 2004 0.8828837 0.8193779 0.8621479 0.9833222 1.5113946
## 2005 0.8828837 0.8193779 0.8621479 0.9833222 1.5113946
## 2006 0.8828837 0.8193779 0.8621479 0.9833222 1.5113946
## 2007 0.8828837 0.8193779 0.8621479 0.9833222 1.5113946
## 2008 0.8828837 0.8193779 0.8621479 0.9833222 1.5113946
## 2009 0.8828837 0.8193779 0.8621479 0.9833222 1.5113946
## 2010 0.8828837 0.8193779 0.8621479 0.9833222 1.5113946
## 2011 0.8828837 0.8193779 0.8621479 0.9833222 1.5113946
## 2012 0.8828837 0.8193779 0.8621479 0.9833222 1.5113946
##
## $trend
##             Jan       Feb       Mar       Apr       May       Jun       Jul
## 2000         NA        NA        NA        NA        NA        NA  423.2500
## 2001   497.2083  511.3333  524.0833  539.2083  559.5000  589.5417  624.7917
## 2002   986.2083 1030.5833 1066.7500 1093.7083 1114.3750 1139.6250 1149.5417
## 2003   881.5000  837.2083  800.5417  768.4167  737.3750  695.2917  664.0833
## 2004   609.0833  604.7917  599.0833  597.8333  597.1250  590.9167  585.9583
## 2005   627.0417  641.1667  651.6250  657.1250  662.7500  668.5833  670.7083
```

```
## 2006    637.8333    632.0417    632.9167    637.7500    644.3333    650.2083    663.0833
## 2007    707.8333    710.3333    712.8750    724.7083    739.1667    752.0417    757.7917
## 2008    832.5000    849.5000    865.9583    878.1667    895.0417    921.7500    950.1250
## 2009   1158.8333   1185.1667   1211.8750   1244.2500   1275.0833   1294.0833   1304.3750
## 2010   1320.0417   1316.3333   1315.8333   1308.7917   1308.8333   1319.6667   1337.1667
## 2011   1435.4583   1448.5417   1465.5417   1478.5833   1487.0000   1505.5417   1527.7083
## 2012   1624.6667   1645.4167   1679.2500   1722.6667   1769.1250   1818.6250         NA
##              Aug         Sep         Oct         Nov         Dec
## 2000    433.4583    443.2083    457.9167    471.7500    483.7500
## 2001    671.1250    739.5833    811.4167    876.0833    933.8333
## 2002   1127.1667   1085.6667   1032.7917    979.2083    929.7083
## 2003    655.1667    639.5833    624.9583    615.2500    610.1667
## 2004    585.9583    593.1250    602.5833    608.1667    615.7083
## 2005    667.5000    659.0000    650.5417    648.5417    645.5417
## 2006    677.4167    683.8750    689.4167    694.0417    700.3333
## 2007    762.8750    773.9583    785.5000    799.2083    815.0417
## 2008    985.6250   1034.5000   1072.1250   1097.2917   1129.1667
## 2009   1307.0833   1305.7083   1309.1667   1315.4583   1321.2917
## 2010   1361.3750   1382.5000   1404.4167   1424.0417   1431.0833
## 2011   1538.0833   1553.5833   1566.7083   1579.2500   1602.7500
## 2012         NA          NA          NA          NA          NA
##
## $random
##             Jan         Feb         Mar         Apr         May         Jun         Jul
## 2000         NA          NA          NA          NA          NA          NA   0.9847995
## 2001  0.9665576   0.9291326   0.9152001   1.0628835   0.9258034   0.9049274   0.9445316
## 2002  0.8466147   1.1171360   1.2045396   1.3620178   1.2187554   1.0664495   1.0766808
## 2003  0.8336874   0.9013518   0.9794153   0.9084884   0.9417788   0.8323691   0.9799131
## 2004  1.0806846   1.0463884   0.9512962   0.9624213   0.9265706   0.9829538   1.0597534
## 2005  1.0214032   1.0143615   1.0823749   1.0023799   0.9378867   1.0592045   1.1652319
## 2006  0.9704067   0.9501887   0.9046381   0.9392596   0.9735281   0.9645262   1.0054446
## 2007  1.2205174   0.9519549   0.8937915   0.9197778   0.9271748   0.9738400   0.9920380
## 2008  1.0074215   0.9578109   0.8553534   0.9641961   0.9806603   1.0354149   1.0239979
## 2009  1.0036965   1.0796217   1.0989952   0.8931697   1.0178265   1.0595037   1.0034929
## 2010  0.9370769   0.9622308   0.9993901   0.9368754   1.0342011   1.1115239   0.8826655
## 2011  1.0480174   1.0622815   1.0253134   1.0684060   1.0304848   0.9826816   0.8373054
## 2012  1.0197706   0.9833956   1.0455467   0.9359793   1.0411840   0.9824599         NA
##              Aug         Sep         Oct         Nov         Dec
## 2000  1.1053238   0.9747901   0.9599994   0.9032465   1.1981337
## 2001  1.0109273   0.7986822   0.8748341   0.7812208   0.9515438
## 2002  1.0601341   1.0072268   0.9512374   0.9700094   1.2012900
## 2003  0.9404671   1.0056092   0.8258994   0.9768773   1.1071320
## 2004  0.9065726   0.9568029   0.9181623   0.9063185   0.9897072
## 2005  1.1148350   0.9778320   0.9734995   0.9533884   1.0198139
## 2006  1.0466825   1.0350636   1.0262810   1.0286218   0.9844305
## 2007  0.8997373   1.0423165   1.2005011   1.0765012   0.9798275
## 2008  0.9262321   1.0098550   0.9855784   1.0685907   0.9029563
## 2009  0.9722682   1.1038739   1.2075889   1.1140150   0.8557867
## 2010  0.9601178   1.0037165   1.0224519   1.1190525   0.8520843
## 2011  1.0125567   1.0400858   1.0098211   1.0580126   0.9131487
## 2012         NA          NA          NA          NA          NA
##
## $figure
##  [1] 1.0695399 1.0839904 1.1300115 0.8881280 0.8784004 0.9503415 0.9404621
```

```
##   [8] 0.8828837 0.8193779 0.8621479 0.9833222 1.5113946
##
## $type
## [1] "multiplicative"
##
## attr(,"class")
## [1] "decomposed.ts"
```

```
Yt.ts.desc$x
```

```
##       Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov  Dec
## 2000  354  430  393  305  327  347  392  423  354  379  419  876
## 2001  514  515  542  509  455  507  555  599  484  612  673 1343
## 2002  893 1248 1452 1323 1193 1155 1164 1055  896  847  934 1688
## 2003  786  818  886  620  610  550  612  544  527  445  591 1021
## 2004  704  686  644  511  486  552  584  469  465  477  542  921
## 2005  685  705  797  585  546  673  735  657  528  546  608  995
## 2006  662  651  647  532  551  596  627  626  580  610  702 1042
## 2007  924  733  720  592  602  696  707  606  661  813  846 1207
## 2008  897  882  837  752  771  907  915  806  856  911 1153 1541
## 2009 1244 1387 1505  987 1140 1303 1231 1122 1181 1363 1441 1709
## 2010 1323 1373 1486 1089 1189 1394 1110 1154 1137 1238 1567 1843
## 2011 1609 1668 1698 1403 1346 1406 1203 1375 1324 1364 1643 2212
## 2012 1772 1754 1984 1432 1618 1698 1437 1639 1872 1858 2264 2779
```

Ploteo de la descomposion

```
plot(Yt.ts.desc, xlab = 'Anho')
```


6
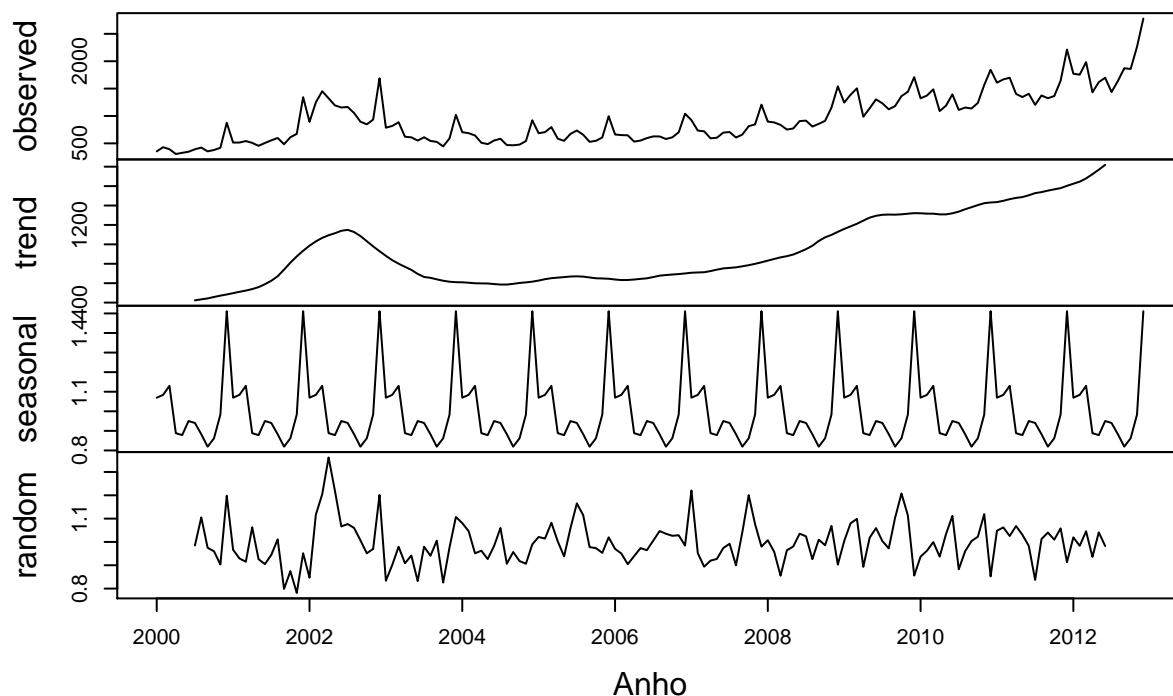
Resumen de la tendencia

```
tendencia <- data.frame(Yt.ts.desc$trend)
tendencia
```

```
##      Yt.ts.desc.trend
## 1                  NA
## 2                  NA
## 3                  NA
## 4                  NA
## 5                  NA
## 6                  NA
## 7            423.2500
## 8            433.4583
## 9            443.2083
## 10           457.9167
## 11           471.7500
## 12           483.7500
## 13           497.2083
## 14           511.3333
## 15           524.0833
## 16           539.2083
## 17           559.5000
## 18           589.5417
## 19           624.7917
## 20           671.1250
## 21           739.5833
## 22           811.4167
## 23           876.0833
## 24           933.8333
## 25           986.2083
## 26          1030.5833
## 27          1066.7500
## 28          1093.7083
## 29          1114.3750
## 30          1139.6250
## 31          1149.5417
## 32          1127.1667
## 33          1085.6667
## 34          1032.7917
## 35           979.2083
## 36           929.7083
## 37           881.5000
## 38           837.2083
## 39           800.5417
## 40           768.4167
## 41           737.3750
## 42           695.2917
## 43           664.0833
## 44           655.1667
## 45           639.5833
## 46           624.9583
## 47           615.2500
## 48           610.1667
```

```
## 49             609.0833
## 50             604.7917
## 51             599.0833
## 52             597.8333
## 53             597.1250
## 54             590.9167
## 55             585.9583
## 56             585.9583
## 57             593.1250
## 58             602.5833
## 59             608.1667
## 60             615.7083
## 61             627.0417
## 62             641.1667
## 63             651.6250
## 64             657.1250
## 65             662.7500
## 66             668.5833
## 67             670.7083
## 68             667.5000
## 69             659.0000
## 70             650.5417
## 71             648.5417
## 72             645.5417
## 73             637.8333
## 74             632.0417
## 75             632.9167
## 76             637.7500
## 77             644.3333
## 78             650.2083
## 79             663.0833
## 80             677.4167
## 81             683.8750
## 82             689.4167
## 83             694.0417
## 84             700.3333
## 85             707.8333
## 86             710.3333
## 87             712.8750
## 88             724.7083
## 89             739.1667
## 90             752.0417
## 91             757.7917
## 92             762.8750
## 93             773.9583
## 94             785.5000
## 95             799.2083
## 96             815.0417
## 97             832.5000
## 98             849.5000
## 99             865.9583
## 100            878.1667
## 101            895.0417
## 102            921.7500
```

```
## 103          950.1250
## 104          985.6250
## 105         1034.5000
## 106         1072.1250
## 107         1097.2917
## 108         1129.1667
## 109         1158.8333
## 110         1185.1667
## 111         1211.8750
## 112         1244.2500
## 113         1275.0833
## 114         1294.0833
## 115         1304.3750
## 116         1307.0833
## 117         1305.7083
## 118         1309.1667
## 119         1315.4583
## 120         1321.2917
## 121         1320.0417
## 122         1316.3333
## 123         1315.8333
## 124         1308.7917
## 125         1308.8333
## 126         1319.6667
## 127         1337.1667
## 128         1361.3750
## 129         1382.5000
## 130         1404.4167
## 131         1424.0417
## 132         1431.0833
## 133         1435.4583
## 134         1448.5417
## 135         1465.5417
## 136         1478.5833
## 137         1487.0000
## 138         1505.5417
## 139         1527.7083
## 140         1538.0833
## 141         1553.5833
## 142         1566.7083
## 143         1579.2500
## 144         1602.7500
## 145         1624.6667
## 146         1645.4167
## 147         1679.2500
## 148         1722.6667
## 149         1769.1250
## 150         1818.6250
## 151               NA
## 152               NA
## 153               NA
## 154               NA
## 155               NA
## 156               NA
```

```r
summary(tendencia)
```

```
##  Yt.ts.desc.trend
##  Min.   : 423.2
##  1st Qu.: 645.2
##  Median : 806.0
##  Mean   : 939.6
##  3rd Qu.:1296.7
##  Max.   :1818.6
##  NA's   :12
```

Remplazar valores nulos por 0

```r
tendencia$Yt.ts.desc.trend[is.na(tendencia$Yt.ts.desc.trend)]=0
```

Modelamiento de la tendencia

```r
tendencia$x <- seq(1:nrow(tendencia))
tendencia$x
```

```
##   [1]   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18
##  [19]  19  20  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35  36
##  [37]  37  38  39  40  41  42  43  44  45  46  47  48  49  50  51  52  53  54
##  [55]  55  56  57  58  59  60  61  62  63  64  65  66  67  68  69  70  71  72
##  [73]  73  74  75  76  77  78  79  80  81  82  83  84  85  86  87  88  89  90
##  [91]  91  92  93  94  95  96  97  98  99 100 101 102 103 104 105 106 107 108
## [109] 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126
## [127] 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144
## [145] 145 146 147 148 149 150 151 152 153 154 155 156
```

```r
modelo <- lm(Yt.ts.desc.trend ~x, data= tendencia)
tendencia_estimada <- modelo$fitted.values
head(tendencia_estimada)
```

```
##        1        2        3        4        5        6
## 455.4575 460.7720 466.0865 471.4010 476.7155 482.0300
```

Estacionalidad

```r
estacional <- data.frame(Yt.ts.desc$seasonal)
head(estacional)
```

```
##   Yt.ts.desc.seasonal
## 1           1.0695399
## 2           1.0839904
## 3           1.1300115
## 4           0.8881280
## 5           0.8784004
## 6           0.9503415
```

Estimacion de la serie en base a un modelo multiplicativo

```
dataf <- data.frame(tendencia_estimada,estacional)
colnames(dataf) <- c('tend_est','estacionalidad')

dataf$Yt_est <- dataf$tend_est*dataf$estacionalidad
```

Grafico del modelo final

```
plot(Yt, col = "red")
points(dataf$Yt_est, type = 'l', col = 'blue' )
```