> setwd("D:/Documents (Louis Booth)/R/data")

> gdp <- read.csv("GDP.csv", stringsAsFactors = FALSE)

> head(gdp)

DATE GDP

1 1947-01-01 243.080

2 1947-04-01 246.267

3 1947-07-01 250.115

4 1947-10-01 260.309

5 1948-01-01 266.173

6 1948-04-01 272.897

> str(gdp)

'data.frame': 284 obs. of 2 variables:

$ DATE: chr "1947-01-01" "1947-04-01" "1947-07-01" "1947-10-01" ...

$ GDP : num 243 246 250 260 266 ...

> gdp$DATE <- as.Date(gdp$DATE)

> str(gdp)

'data.frame': 284 obs. of 2 variables:

$ DATE: Date, format: "1947-01-01" "1947-04-01" "1947-07-01" "1947-10-01" ...

$ GDP : num 243 246 250 260 266 ...

> gdp$Time <- format(gdp$DATE, format="%y/%m")

> gdp <- gdp[,c(3,2)]

>

> gdp1 <- mean(gdp[gdp$Time > 47/01,2])

>

> gdp <- ts(gdp$GDP, start=c(1947, 01), end=c(2017, 04), frequency=4)

> str(gdp)

Time-Series [1:284] from 1947 to 2018: 243 246 250 260 266 ...

> start(gdp)

[1] 1947 1

> end(gdp)

[1] 2017 4

> frequency(gdp)

[1] 4

> summary(gdp)

Min. 1st Qu. Median Mean 3rd Qu. Max.

243.1 697.0 3349.2 5781.1 10092.9 19754.1

>

> pdf(file="time series.pdf")

>

> plot(gdp, col="blue", lwd=3, ylab="GDP")

> abline(reg=lm(gdp~time(gdp)), lwd=3)

>

> plot(aggregate(gdp, FUN=mean))

>

> boxplot(gdp~cycle(gdp))

>

> plot(gdp, col="blue", lwd=3, ylab="GDP")

>

> legend("topleft", legend="GDP", col="blue", lty=1, lwd=3)

>

> title(main="GDP")

>

> seasDecom <- stl(log(gdp), s.window="periodic")

> plot(seasDecom, lwd=3)

>

> dev.off()

null device

1

>

> summary(seasDecom)

Call:

stl(x = log(gdp), s.window = "periodic")

Time.series components:

seasonal trend remainder

Min. :-0.0015840491 Min. :5.487876 Min. :-0.019727059

1st Qu.:-0.0013675547 1st Qu.:6.551957 1st Qu.:-0.002470281

Median :-0.0001969831 Median :8.116413 Median :-0.000016329

Mean : 0.0000000004 Mean :7.908844 Mean : 0.000023344

3rd Qu.: 0.0011705720 3rd Qu.:9.220832 3rd Qu.: 0.002644171

Max. : 0.0019780168 Max. :9.888819 Max. : 0.014866533

IQR:

STL.seasonal STL.trend STL.remainder data

0.002538 2.668875 0.005114 2.672720

% 0.1 99.9 0.2 100.0

Weights: all == 1

Other components: List of 5

$ win : Named num [1:3] 2841 7 5

$ deg : Named int [1:3] 0 1 1

$ jump : Named num [1:3] 285 1 1

$ inner: int 2

$ outer: int 0

> seasDecom

Call:

stl(x = log(gdp), s.window = "periodic")

Components

seasonal trend remainder

1947 Q1 -0.0012953899 5.487876 6.809868e-03

1947 Q2 -0.0015840491 5.510170 -2.170026e-03

1947 Q3 0.0019780168 5.533062 -1.311882e-02

1947 Q4 0.0009014237 5.556399 4.569391e-03

1948 Q1 -0.0012953899 5.583644 1.798267e-03

1948 Q2 -0.0015840491 5.607004 3.674066e-03

1948 Q3 0.0019780168 5.621416 9.597126e-03

1948 Q4 0.0009014237 5.625024 1.120419e-02

1949 Q1 -0.0012953899 5.620414 -1.002684e-03

1949 Q2 -0.0015840491 5.612680 -6.426906e-03

1949 Q3 0.0019780168 5.610311 -1.857904e-03

1949 Q4 0.0009014237 5.620885 -1.972706e-02

1950 Q1 -0.0012953899 5.644697 -4.303220e-03

1950 Q2 -0.0015840491 5.681842 -7.845596e-03

1950 Q3 0.0019780168 5.725418 4.358281e-03

1950 Q4 0.0009014237 5.769681 -1.261821e-03

1951 Q1 -0.0012953899 5.807749 1.176419e-02

1951 Q2 -0.0015840491 5.837558 5.989195e-03

1951 Q3 0.0019780168 5.858830 2.180546e-03

1951 Q4 0.0009014237 5.873434 2.220467e-03

1952 Q1 -0.0012953899 5.884877 3.064116e-03

1952 Q2 -0.0015840491 5.897942 -6.333774e-03

1952 Q3 0.0019780168 5.915720 -9.386360e-03

1952 Q4 0.0009014237 5.936635 5.895550e-03

1953 Q1 -0.0012953899 5.955475 8.041289e-03

1953 Q2 -0.0015840491 5.964841 8.665149e-03

1953 Q3 0.0019780168 5.964998 3.509608e-03

1953 Q4 0.0009014237 5.961608 -5.323023e-03

1954 Q1 -0.0012953899 5.959659 -2.722835e-03

1954 Q2 -0.0015840491 5.963895 -4.620617e-03

1954 Q3 0.0019780168 5.976596 -8.343237e-03

1954 Q4 0.0009014237 5.996852 -5.418918e-03

1955 Q1 -0.0012953899 6.020735 5.829127e-03

1955 Q2 -0.0015840491 6.043969 3.155800e-03

1955 Q3 0.0019780168 6.062750 1.205648e-03

1955 Q4 0.0009014237 6.077555 3.275886e-03

1956 Q1 -0.0012953899 6.090472 -1.286536e-03

1956 Q2 -0.0015840491 6.102655 9.756654e-04

1956 Q3 0.0019780168 6.117213 -5.546775e-03

1956 Q4 0.0009014237 6.133061 3.813352e-05

1957 Q1 -0.0012953899 6.148237 7.019929e-03

1957 Q2 -0.0015840491 6.159768 5.627147e-04

1957 Q3 0.0019780168 6.163226 9.237882e-03

1957 Q4 0.0009014237 6.161925 1.921496e-03

1958 Q1 -0.0012953899 6.162127 -1.160979e-02

1958 Q2 -0.0015840491 6.170025 -9.798134e-03

1958 Q3 0.0019780168 6.188199 -2.626165e-03

1958 Q4 0.0009014237 6.212521 1.945682e-03

1959 Q1 -0.0012953899 6.235588 2.200651e-03

1959 Q2 -0.0015840491 6.252295 1.124105e-02

1959 Q3 0.0019780168 6.265848 -4.054179e-03

1959 Q4 0.0009014237 6.277710 -7.014745e-03

1960 Q1 -0.0012953899 6.287978 1.106590e-02

1960 Q2 -0.0015840491 6.295720 2.414876e-03

1960 Q3 0.0019780168 6.298110 2.552551e-03

1960 Q4 0.0009014237 6.301342 -8.707322e-03

1961 Q1 -0.0012953899 6.309721 -5.900032e-03

1961 Q2 -0.0015840491 6.324289 6.321146e-04

1961 Q3 0.0019780168 6.344078 -3.533578e-03

1961 Q4 0.0009014237 6.364929 -6.254405e-06

1962 Q1 -0.0012953899 6.384029 6.123983e-03

1962 Q2 -0.0015840491 6.399305 3.499928e-03

1962 Q3 0.0019780168 6.410897 -1.132403e-04

1962 Q4 0.0009014237 6.422203 -4.523748e-03

1963 Q1 -0.0012953899 6.435353 -2.640457e-05

1963 Q2 -0.0015840491 6.450828 -6.159290e-04

1963 Q3 0.0019780168 6.468146 -9.355890e-04

1963 Q4 0.0009014237 6.486989 -3.499330e-03

1964 Q1 -0.0012953899 6.505675 4.611770e-03

1964 Q2 -0.0015840491 6.522839 1.950473e-03

1964 Q3 0.0019780168 6.538759 1.418613e-05

1964 Q4 0.0009014237 6.556357 -8.431747e-03

1965 Q1 -0.0012953899 6.575926 3.575820e-03

1965 Q2 -0.0015840491 6.598578 -7.097952e-04

1965 Q3 0.0019780168 6.623623 -5.282838e-03

1965 Q4 0.0009014237 6.649387 1.247587e-04

1966 Q1 -0.0012953899 6.673452 9.109825e-03

1966 Q2 -0.0015840491 6.693836 1.261530e-03

1966 Q3 0.0019780168 6.710330 -2.031428e-03

1966 Q4 0.0009014237 6.724752 1.615898e-03

1967 Q1 -0.0012953899 6.738200 3.669103e-03

1967 Q2 -0.0015840491 6.751496 -3.432094e-03

1967 Q3 0.0019780168 6.767286 -4.670319e-03

1967 Q4 0.0009014237 6.788690 -6.039013e-03

1968 Q1 -0.0012953899 6.813257 2.729512e-03

1968 Q2 -0.0015840491 6.837116 6.400881e-03

1968 Q3 0.0019780168 6.859181 -2.229223e-03

1968 Q4 0.0009014237 6.879780 -3.252566e-03

1969 Q1 -0.0012953899 6.899977 4.481988e-03

1969 Q2 -0.0015840491 6.918962 1.674222e-03

1969 Q3 0.0019780168 6.934562 2.728994e-03

1969 Q4 0.0009014237 6.948463 -1.676191e-03

1970 Q1 -0.0012953899 6.962124 -9.284570e-04

1970 Q2 -0.0015840491 6.975164 1.936799e-03

1970 Q3 0.0019780168 6.989906 6.363325e-04

1970 Q4 0.0009014237 7.009175 -1.480259e-02

1971 Q1 -0.0012953899 7.030392 7.765537e-03

1971 Q2 -0.0015840491 7.052376 4.826720e-03

1971 Q3 0.0019780168 7.072440 -8.834366e-04

1971 Q4 0.0009014237 7.093538 -9.722343e-03

1972 Q1 -0.0012953899 7.117269 1.885873e-03

1972 Q2 -0.0015840491 7.142816 5.636392e-03

1972 Q3 0.0019780168 7.169695 -6.305329e-03

1972 Q4 0.0009014237 7.197547 -3.994100e-03

1973 Q1 -0.0012953899 7.225536 6.090393e-03

1973 Q2 -0.0015840491 7.251522 6.779379e-03

1973 Q3 0.0019780168 7.273990 -5.784916e-03

1973 Q4 0.0009014237 7.293723 4.543944e-03

1974 Q1 -0.0012953899 7.314363 -3.417145e-03

1974 Q2 -0.0015840491 7.334733 2.628263e-03

1974 Q3 0.0019780168 7.355099 -2.460864e-03

1974 Q4 0.0009014237 7.374630 4.103352e-03

1975 Q1 -0.0012953899 7.395328 -4.126794e-03

1975 Q2 -0.0015840491 7.418602 -4.587414e-03

1975 Q3 0.0019780168 7.445887 -1.389673e-03

1975 Q4 0.0009014237 7.475616 -1.206535e-04

1976 Q1 -0.0012953899 7.502652 7.709819e-03

1976 Q2 -0.0015840491 7.526125 2.146477e-03

1976 Q3 0.0019780168 7.547993 -5.374000e-03

1976 Q4 0.0009014237 7.571950 -3.226803e-03

1977 Q1 -0.0012953899 7.599869 -1.410768e-03

1977 Q2 -0.0015840491 7.628754 3.370905e-03

1977 Q3 0.0019780168 7.655742 2.577102e-03

1977 Q4 0.0009014237 7.683241 -2.251586e-03

1978 Q1 -0.0012953899 7.714329 -1.287959e-02

1978 Q2 -0.0015840491 7.747442 1.057838e-02

1978 Q3 0.0019780168 7.781744 -9.710894e-04

1978 Q4 0.0009014237 7.811503 4.479278e-03

1979 Q1 -0.0012953899 7.838079 -1.949337e-04

1979 Q2 -0.0015840491 7.863190 8.647250e-05

1979 Q3 0.0019780168 7.887596 4.055162e-04

1979 Q4 0.0009014237 7.910018 1.395663e-03

1980 Q1 -0.0012953899 7.928119 9.308279e-03

1980 Q2 -0.0015840491 7.946769 -7.831978e-03

1980 Q3 0.0019780168 7.971543 -1.492842e-02

1980 Q4 0.0009014237 8.002928 3.777748e-04

1981 Q1 -0.0012953899 8.035792 1.486653e-02

1981 Q2 -0.0015840491 8.063291 -1.087428e-03

1981 Q3 0.0019780168 8.080308 7.565641e-03

1981 Q4 0.0009014237 8.091886 3.889078e-03

1982 Q1 -0.0012953899 8.101507 -6.502642e-03

1982 Q2 -0.0015840491 8.110318 2.378423e-03

1982 Q3 0.0019780168 8.122508 -2.687237e-03

1982 Q4 0.0009014237 8.138790 -5.866118e-03

1983 Q1 -0.0012953899 8.159753 -3.577301e-03

1983 Q2 -0.0015840491 8.185135 6.407156e-04

1983 Q3 0.0019780168 8.213221 -1.205601e-03

1983 Q4 0.0009014237 8.242117 -1.283245e-03

1984 Q1 -0.0012953899 8.269569 3.727787e-03

1984 Q2 -0.0015840491 8.293503 5.873976e-03

1984 Q3 0.0019780168 8.313924 -2.432446e-04

1984 Q4 0.0009014237 8.332300 -2.914682e-03

1985 Q1 -0.0012953899 8.350273 2.635978e-03

1985 Q2 -0.0015840491 8.368307 1.814715e-04

1985 Q3 0.0019780168 8.385024 1.121101e-03

1985 Q4 0.0009014237 8.400284 1.710805e-04

1986 Q1 -0.0012953899 8.413720 3.033326e-03

1986 Q2 -0.0015840491 8.425741 -1.221399e-04

1986 Q3 0.0019780168 8.437316 -1.225185e-03

1986 Q4 0.0009014237 8.450295 -2.410981e-03

1987 Q1 -0.0012953899 8.464994 -7.020833e-04

1987 Q2 -0.0015840491 8.481412 1.003476e-03

1987 Q3 0.0019780168 8.499500 -4.384156e-03

1987 Q4 0.0009014237 8.518261 2.554220e-03

1988 Q1 -0.0012953899 8.537906 -1.456435e-03

1988 Q2 -0.0015840491 8.556886 2.592577e-03

1988 Q3 0.0019780168 8.576361 -2.974248e-03

1988 Q4 0.0009014237 8.596389 -7.847956e-04

1989 Q1 -0.0012953899 8.615956 2.803741e-03

1989 Q2 -0.0015840491 8.633260 3.910160e-03

1989 Q3 0.0019780168 8.648485 -2.163587e-04

1989 Q4 0.0009014237 8.663690 -5.300592e-03

1990 Q1 -0.0012953899 8.678557 3.891037e-03

1990 Q2 -0.0015840491 8.691313 5.554438e-03

1990 Q3 0.0019780168 8.699773 2.668747e-03

1990 Q4 0.0009014237 8.706047 -3.552547e-03

1991 Q1 -0.0012953899 8.713407 -3.494336e-03

1991 Q2 -0.0015840491 8.722848 1.904519e-03

1991 Q3 0.0019780168 8.734445 -1.150760e-03

1991 Q4 0.0009014237 8.747662 -3.550286e-03

1992 Q1 -0.0012953899 8.762126 2.176772e-04

1992 Q2 -0.0015840491 8.777502 2.454385e-03

1992 Q3 0.0019780168 8.792491 -1.684396e-03

1992 Q4 0.0009014237 8.805866 2.730427e-03

1993 Q1 -0.0012953899 8.818185 1.389230e-04

1993 Q2 -0.0015840491 8.829813 7.920399e-04

1993 Q3 0.0019780168 8.842721 -4.810444e-03

1993 Q4 0.0009014237 8.857622 -1.768002e-04

1994 Q1 -0.0012953899 8.873784 4.556736e-04

1994 Q2 -0.0015840491 8.889215 3.859346e-03

1994 Q3 0.0019780168 8.903650 -2.866016e-03

1994 Q4 0.0009014237 8.916361 2.279276e-03

1995 Q1 -0.0012953899 8.928028 1.946580e-03

1995 Q2 -0.0015840491 8.938861 -7.258619e-04

1995 Q3 0.0019780168 8.949640 -1.794122e-03

1995 Q4 0.0009014237 8.962462 -1.549245e-03

1996 Q1 -0.0012953899 8.977174 -2.128647e-03

1996 Q2 -0.0015840491 8.992084 4.359703e-03

1996 Q3 0.0019780168 9.007280 -2.375475e-03

1996 Q4 0.0009014237 9.022264 -7.123035e-04

1997 Q1 -0.0012953899 9.037839 -3.111500e-04

1997 Q2 -0.0015840491 9.053218 2.279844e-03

1997 Q3 0.0019780168 9.067533 6.189788e-04

1997 Q4 0.0009014237 9.080766 -4.883321e-04

1998 Q1 -0.0012953899 9.093468 4.793611e-04

1998 Q2 -0.0015840491 9.107066 -1.086964e-03

1998 Q3 0.0019780168 9.122063 -2.912613e-03

1998 Q4 0.0009014237 9.137589 2.033502e-03

1999 Q1 -0.0012953899 9.152797 1.961739e-03

1999 Q2 -0.0015840491 9.167635 -1.021513e-03

1999 Q3 0.0019780168 9.182925 -3.756652e-03

1999 Q4 0.0009014237 9.199617 2.404996e-03

2000 Q1 -0.0012953899 9.217111 -2.377028e-03

2000 Q2 -0.0015840491 9.231996 7.381966e-03

2000 Q3 0.0019780168 9.244430 -9.468441e-04

2000 Q4 0.0009014237 9.254124 1.462526e-03

2001 Q1 -0.0012953899 9.262136 -9.366071e-04

2001 Q2 -0.0015840491 9.268207 5.601142e-03

2001 Q3 0.0019780168 9.274227 -3.877177e-03

2001 Q4 0.0009014237 9.281258 -4.037696e-03

2002 Q1 -0.0012953899 9.289867 1.914367e-03

2002 Q2 -0.0015840491 9.299202 2.083595e-03

2002 Q3 0.0019780168 9.307920 -8.841243e-04

2002 Q4 0.0009014237 9.317121 -2.977088e-03

2003 Q1 -0.0012953899 9.328518 -8.712854e-04

2003 Q2 -0.0015840491 9.342851 -2.475910e-03

2003 Q3 0.0019780168 9.358929 1.799191e-05

2003 Q4 0.0009014237 9.375855 5.234702e-04

2004 Q1 -0.0012953899 9.392283 7.073464e-04

2004 Q2 -0.0015840491 9.407602 1.647391e-03

2004 Q3 0.0019780168 9.423248 -2.378490e-03

2004 Q4 0.0009014237 9.439561 -2.017734e-03

2005 Q1 -0.0012953899 9.455997 3.570880e-03

2005 Q2 -0.0015840491 9.472018 2.750570e-04

2005 Q3 0.0019780168 9.487409 -1.002543e-03

2005 Q4 0.0009014237 9.503178 -2.441118e-03

2006 Q1 -0.0012953899 9.517894 4.815515e-03

2006 Q2 -0.0015840491 9.530537 3.456152e-03

2006 Q3 0.0019780168 9.541428 -3.150458e-03

2006 Q4 0.0009014237 9.552141 -1.500123e-03

2007 Q1 -0.0012953899 9.563874 7.555560e-04

2007 Q2 -0.0015840491 9.575162 2.953990e-03

2007 Q3 0.0019780168 9.584323 3.964682e-04

2007 Q4 0.0009014237 9.591223 2.479877e-03

2008 Q1 -0.0012953899 9.596921 -2.172031e-03

2008 Q2 -0.0015840491 9.598705 6.138039e-03

2008 Q3 0.0019780168 9.595191 8.113894e-03

2008 Q4 0.0009014237 9.587736 -3.295002e-03

2009 Q1 -0.0012953899 9.579327 -4.168207e-03

2009 Q2 -0.0015840491 9.575510 -3.088445e-03

2009 Q3 0.0019780168 9.578240 -6.336286e-03

2009 Q4 0.0009014237 9.585765 -1.859120e-04

2010 Q1 -0.0012953899 9.596545 -9.362993e-04

2010 Q2 -0.0015840491 9.607828 2.107288e-03

2010 Q3 0.0019780168 9.618194 -5.301372e-04

2010 Q4 0.0009014237 9.627370 2.764705e-03

2011 Q1 -0.0012953899 9.636374 -3.506228e-03

2011 Q2 -0.0015840491 9.645111 2.544607e-03

2011 Q3 0.0019780168 9.655410 -3.187626e-03

2011 Q4 0.0009014237 9.666557 -6.230195e-04

2012 Q1 -0.0012953899 9.677307 2.698317e-03

2012 Q2 -0.0015840491 9.686320 3.194504e-03

2012 Q3 0.0019780168 9.693704 -1.192659e-03

2012 Q4 0.0009014237 9.700737 -2.880639e-03

2013 Q1 -0.0012953899 9.708150 2.771200e-03

2013 Q2 -0.0015840491 9.717148 -1.942770e-03

2013 Q3 0.0019780168 9.726605 -2.468404e-03

2013 Q4 0.0009014237 9.736648 3.412147e-03

2014 Q1 -0.0012953899 9.748552 -4.447257e-03

2014 Q2 -0.0015840491 9.760366 8.882672e-04

2014 Q3 0.0019780168 9.772021 2.918648e-03

2014 Q4 0.0009014237 9.783207 -7.609184e-04

2015 Q1 -0.0012953899 9.792944 -5.058485e-04

2015 Q2 -0.0015840491 9.801247 3.629905e-03

2015 Q3 0.0019780168 9.808078 6.407471e-04

2015 Q4 0.0009014237 9.813833 -7.759971e-04

2016 Q1 -0.0012953899 9.820260 -2.932699e-03

2016 Q2 -0.0015840491 9.827949 1.214978e-03

2016 Q3 0.0019780168 9.837035 -1.177216e-03

2016 Q4 0.0009014237 9.846588 -2.786423e-04

2017 Q1 -0.0012953899 9.856455 6.682805e-05

2017 Q2 -0.0015840491 9.867110 -2.592321e-04

2017 Q3 0.0019780168 9.877948 -1.725188e-03

2017 Q4 0.0009014237 9.888819 1.396362e-03