```
> #Homework-5
>
> library(fpp)
> library(fpp2)
>
> cwindow <- window(usconsumption[,"income"], start = 1977) #my chosen window
to use for the forecast
>
> head(cwindow)
           Qtr1       Qtr2       Qtr3       Qtr4
1977 0.08238505 1.13105430 1.49011470 1.99549955
1978 0.61490413 1.14134313
> #          Qtr1       Qtr2       Qtr3       Qtr4
> #1977   0.08238505 1.13105430 1.49011470 1.99549955
> #1978   0.61490413 1.14134313
>
> attributes(cwindow)
$tsp
[1] 1977.00 2010.75    4.00

$class
[1] "ts"

> #$tsp
> #[1] 1977.00 2010.75    4.00
>
> #$class
> #[1] "ts"
>
> plot(cwindow)
> stl_decomp <- stl(cwindow,s.window ="periodic")
> stl_decomp
 Call:
 stl(x = cwindow, s.window = "periodic")

Components
                 seasonal             trend         remainder
1977 Q1 -0.0003766242  0.55739860 -0.474636919
1977 Q2 -0.0063059771  0.87764105  0.259719232
1977 Q3 -0.0449910528  1.14120298  0.393902779
1977 Q4  0.0516727941  1.33806381  0.605762943
1978 Q1 -0.0003766242  1.20821215 -0.592931400
1978 Q2 -0.0063059771  0.97357959  0.174069518
1978 Q3 -0.0449910528  0.89692515 -0.043907194
1978 Q4  0.0516727941  0.75275556 -0.021888279
1979 Q1 -0.0003766242  0.46842025  0.619206206
1979 Q2 -0.0063059771  0.38460305 -1.078928616
1979 Q3 -0.0449910528  0.32622788  0.287664089
1979 Q4  0.0516727941  0.23341361  0.512048145
1980 Q1 -0.0003766242  0.08026679  0.199941186
```

1980 Q2 -0.0063059771 0.21700787 -1.620117260
1980 Q3 -0.0449910528 0.46303155 0.606404549
1980 Q4 0.0516727941 0.64890515 1.342552393
1981 Q1 -0.0003766242 0.78092730 -1.009850722
1981 Q2 -0.0063059771 0.73515826 -0.715079439
1981 Q3 -0.0449910528 0.67503546 1.563006031
1981 Q4 0.0516727941 0.71938263 -0.569162043
1982 Q1 -0.0003766242 0.52482458 -0.407983971
1982 Q2 -0.0063059771 0.40079340 0.303685228
1982 Q3 -0.0449910528 0.48599495 -0.004065320
1982 Q4 0.0516727941 0.55449773 -0.254901513
1983 Q1 -0.0003766242 0.69163674 0.092971488
1983 Q2 -0.0063059771 1.03408200 -0.301768581
1983 Q3 -0.0449910528 1.43379219 0.101108811
1983 Q4 0.0516727941 1.76451523 0.225952971
1984 Q1 -0.0003766242 1.88358901 0.280301131
1984 Q2 -0.0063059771 1.74319514 -0.029880480
1984 Q3 -0.0449910528 1.31733811 0.273012676
1984 Q4 0.0516727941 0.97060608 -0.075303976
1985 Q1 -0.0003766242 0.76633720 -1.012220018
1985 Q2 -0.0063059771 0.54332051 1.429826535
1985 Q3 -0.0449910528 0.68521937 -1.261059120
1985 Q4 0.0516727941 0.74768186 0.230664128
1986 Q1 -0.0003766242 0.88084782 0.302883920
1986 Q2 -0.0063059771 0.87373663 0.260685485
1986 Q3 -0.0449910528 0.63595201 -0.067207890
1986 Q4 0.0516727941 0.31020985 -0.301985593
1987 Q1 -0.0003766242 0.13873904 0.473522715
1987 Q2 -0.0063059771 0.44846527 -1.532348204
1987 Q3 -0.0449910528 0.77850831 1.038749442
1987 Q4 0.0516727941 1.16203365 0.196769695
1988 Q1 -0.0003766242 1.21133137 0.037907660
1988 Q2 -0.0063059771 1.01900732 -0.078165301
1988 Q3 -0.0449910528 0.92899595 -0.117146311
1988 Q4 0.0516727941 0.79424619 0.050142784
1989 Q1 -0.0003766242 0.58772115 0.543654660
1989 Q2 -0.0063059771 0.50632399 -0.911551950
1989 Q3 -0.0449910528 0.46494608 0.225242069
1989 Q4 0.0516727941 0.59929041 0.111985153
1990 Q1 -0.0003766242 0.64833422 0.102402730
1990 Q2 -0.0063059771 0.41085491 0.250601239
1990 Q3 -0.0449910528 0.12254244 -0.004833333
1990 Q4 0.0516727941 0.04238859 -0.770857087
1991 Q1 -0.0003766242 0.13447802 0.173483960
1991 Q2 -0.0063059771 0.35055809 0.411335962
1991 Q3 -0.0449910528 0.60321629 -0.346268088
1991 Q4 0.0516727941 0.77504811 -0.176835025
1992 Q1 -0.0003766242 0.86182394 0.636534264
1992 Q2 -0.0063059771 0.94255527 -0.172736721
1992 Q3 -0.0449910528 0.70669891 -0.155377665

1992 Q4	0.0516727941	0.38542086	0.975468533
1993 Q1	-0.0003766242	0.40298402	-1.880148957
1993 Q2	-0.0063059771	0.40957696	1.139897356
1993 Q3	-0.0449910528	0.64524264	-0.387660697
1993 Q4	0.0516727941	0.69362680	0.717727472
1994 Q1	-0.0003766242	0.78587297	-1.185976196
1994 Q2	-0.0063059771	0.85207150	0.846083654
1994 Q3	-0.0449910528	1.00766802	-0.230628541
1994 Q4	0.0516727941	0.89986567	0.365882547
1995 Q1	-0.0003766242	0.67095851	-0.024371178
1995 Q2	-0.0063059771	0.55349408	-0.538116301
1995 Q3	-0.0449910528	0.53995962	0.250634721
1995 Q4	0.0516727941	0.73841185	-0.199070796
1996 Q1	-0.0003766242	0.88669032	0.173216317
1996 Q2	-0.0063059771	0.91290697	0.162268382
1996 Q3	-0.0449910528	0.85425064	0.038554353
1996 Q4	0.0516727941	0.78263686	-0.286988205
1997 Q1	-0.0003766242	0.78394235	0.106807413
1997 Q2	-0.0063059771	0.93081388	-0.176495314
1997 Q3	-0.0449910528	1.18782111	-0.004581190
1997 Q4	0.0516727941	1.47928931	-0.150996681
1998 Q1	-0.0003766242	1.57884374	0.670077202
1998 Q2	-0.0063059771	1.46577817	-0.041750694
1998 Q3	-0.0449910528	1.14472400	-0.054420339
1998 Q4	0.0516727941	0.81357346	-0.135133890
1999 Q1	-0.0003766242	0.60629339	0.069532409
1999 Q2	-0.0063059771	0.63592035	-0.401152629
1999 Q3	-0.0449910528	0.91963760	-0.229728995
1999 Q4	0.0516727941	1.26820454	0.235773510
2000 Q1	-0.0003766242	1.42508212	0.655211834
2000 Q2	-0.0063059771	1.27038119	-0.244421214
2000 Q3	-0.0449910528	0.88716325	0.213436994
2000 Q4	0.0516727941	0.57801628	-0.480140432
2001 Q1	-0.0003766242	0.53753708	0.210864044
2001 Q2	-0.0063059771	0.65850144	-0.926305535
2001 Q3	-0.0449910528	0.69328109	1.866379261
2001 Q4	0.0516727941	1.01534896	-2.240066164
2002 Q1	-0.0003766242	0.81832646	1.841527770
2002 Q2	-0.0063059771	0.66076720	-0.105295758
2002 Q3	-0.0449910528	0.40685631	-0.705609631
2002 Q4	0.0516727941	0.27708803	-0.092526568
2003 Q1	-0.0003766242	0.65317734	-0.285662595
2003 Q2	-0.0063059771	0.96585254	0.542228745
2003 Q3	-0.0449910528	1.01369175	0.421330085
2003 Q4	0.0516727941	0.88149372	-0.359363341
2004 Q1	-0.0003766242	0.72976046	-0.286219659
2004 Q2	-0.0063059771	0.76630957	0.223683205
2004 Q3	-0.0449910528	0.72262858	-0.011555367
2004 Q4	0.0516727941	0.42203563	0.915195272
2005 Q1	-0.0003766242	0.30775314	-1.532899281

```
2005 Q2 -0.0063059771  0.23637997  0.471599554
2005 Q3 -0.0449910528  0.55489876  0.084870362
2005 Q4  0.0516727941  0.94138185 -0.447726333
2006 Q1 -0.0003766242  1.00376673  0.852288501
2006 Q2 -0.0063059771  1.03992306 -0.151275305
2006 Q3 -0.0449910528  0.92989189 -0.405756160
2006 Q4  0.0516727941  0.71379103  0.536893553
2007 Q1 -0.0003766242  0.58644454 -0.134678086
2007 Q2 -0.0063059771  0.44742418 -0.291783328
2007 Q3 -0.0449910528  0.48118611 -0.044111190
2007 Q4  0.0516727941  0.83535936 -0.338472260
2008 Q1 -0.0003766242  0.86326587  0.567881737
2008 Q2 -0.0063059771  0.39391542  1.586355195
2008 Q3 -0.0449910528 -0.12398885 -2.139624169
2008 Q4  0.0516727941 -0.65502119  0.545641549
2009 Q1 -0.0003766242 -0.64964387 -0.319040383
2009 Q2 -0.0063059771 -0.60446481  0.674060979
2009 Q3 -0.0449910528 -0.39752258 -0.950042580
2009 Q4  0.0516727941  0.04568976 -0.242075958
2010 Q1 -0.0003766242  0.56528901  0.622252746
2010 Q2 -0.0063059771  0.67053516  0.690125533
2010 Q3 -0.0449910528  0.71332220 -0.107161334
2010 Q4  0.0516727941  0.67426232 -0.354877176
>
> plot(stl_decomp)  #Seasonal component no does not increase in magnitude, in
trend -0.6 lowest; 1.8 highest ratio is
>                 #0.6/1.8 = 33%, and seasonality os about 4% therefore total influence
on data of S and T is about 37% and
>                 #rest is remainder,in the worst case. Which makes this a bad model as
it only explains around ~40% of the data.
>
> attributes(stl_decomp)
$names
[1] "time.series" "weights"     "call"        "win"         "deg"         "jump"        "inner"
"outer"

$class
[1] "stl"

> #$names
> #[1] "time.series" "weights"     "call"        "win"         "deg"         "jump"        "inner"
"outer"
>
> #$class
> #[1] "stl"
>
>
> # Lets print out a seasonal adjustment
>
> seasadj(stl_decomp)
```

```
          Qtr1        Qtr2        Qtr3        Qtr4
1977  0.08276168  1.13736028  1.53510576  1.94382676
1978  0.61528075  1.14764911  0.85301796  0.73086728
1979  1.08762646 -0.69432557  0.61389197  0.74546176
1980  0.28020798 -1.40310939  1.06943610  1.99145754
1981 -0.22892342  0.02007882  2.23804149  0.15022058
1982  0.11684061  0.70447863  0.48192963  0.29959622
1983  0.78460822  0.73231342  1.53490100  1.99046820
1984  2.16389014  1.71331466  1.59035079  0.89530211
1985 -0.24588282  1.97314705 -0.57583975  0.97834599
1986  1.18373174  1.13442212  0.56874412  0.00822426
1987  0.61226175 -1.08388293  1.81725775  1.35880335
1988  1.24923903  0.94084202  0.81184964  0.84438897
1989  1.13137581 -0.40522796  0.69018815  0.71127556
1990  0.75073695  0.66145615  0.11770910 -0.72846850
1991  0.30796198  0.76189405  0.25694820  0.59821308
1992  1.49835821  0.76981855  0.55132125  1.36088939
1993 -1.47716493  1.54947431  0.25758194  1.41135428
1994 -0.40010322  1.69815516  0.77703948  1.26574822
1995  0.64658733  0.01537778  0.79059434  0.53934105
1996  1.05990664  1.07517535  0.89280499  0.49564865
1997  0.89074977  0.75431857  1.18323992  1.32829263
1998  2.24892094  1.42402747  1.09030366  0.67843957
1999  0.67582580  0.23476773  0.68990860  1.50397805
2000  2.08029395  1.02595998  1.10060024  0.09787585
2001  0.74840112 -0.26780409  2.55966035 -1.22471721
2002  2.65985423  0.55547145 -0.29875332  0.18456147
2003  0.36751475  1.50808128  1.43502183  0.52213038
2004  0.44354080  0.98999278  0.71107322  1.33723090
2005 -1.22514614  0.70797953  0.63976912  0.49365551
2006  1.85605523  0.88864775  0.52413573  1.25068458
2007  0.45176646  0.15564086  0.43707492  0.49688710
2008  1.43114761  1.98027061 -2.26361301 -0.10937965
2009 -0.96868426  0.06959617 -1.34756516 -0.19638620
2010  1.18754176  1.36066070  0.60616087  0.31938515
>
> # Plot a line on the graph
>
> plot(cwindow)
> lines(seasadj(stl_decomp), col="yellow") #even after taking out the seasonal
component the graph still looks the same this
>                                  #means that all the change that is happening in the time
series is happening due to
>                                  #fundamental changes and are not affected by
seasonality.
>
> # Default period forecast
>
> f_stl <- forecast(stl_decomp)
>
```

```
> # you can pass the # of period
>
> f_stl <- forecast(stl_decomp,h=20) #forecasting for the next 20 periods.
> f_stl
         Point Forecast      Lo 80    Hi 80      Lo 95    Hi 95
2011 Q1      0.7063860 -0.3810965 1.793868 -0.9567749 2.369547
2011 Q2      0.7004566 -0.3870258 1.787939 -0.9627043 2.363618
2011 Q3      0.6617716 -0.4257109 1.749254 -1.0013894 2.324932
2011 Q4      0.7584354 -0.3290471 1.845918 -0.9047255 2.421596
2012 Q1      0.7063860 -0.3810965 1.793868 -0.9567749 2.369547
2012 Q2      0.7004566 -0.3870259 1.787939 -0.9627043 2.363618
2012 Q3      0.6617716 -0.4257109 1.749254 -1.0013894 2.324932
2012 Q4      0.7584354 -0.3290471 1.845918 -0.9047256 2.421596
2013 Q1      0.7063860 -0.3810965 1.793868 -0.9567750 2.369547
2013 Q2      0.7004566 -0.3870259 1.787939 -0.9627043 2.363618
2013 Q3      0.6617716 -0.4257110 1.749254 -1.0013894 2.324933
2013 Q4      0.7584354 -0.3290471 1.845918 -0.9047256 2.421596
2014 Q1      0.7063860 -0.3810965 1.793868 -0.9567750 2.369547
2014 Q2      0.7004566 -0.3870259 1.787939 -0.9627044 2.363618
2014 Q3      0.6617716 -0.4257110 1.749254 -1.0013895 2.324933
2014 Q4      0.7584354 -0.3290471 1.845918 -0.9047256 2.421596
2015 Q1      0.7063860 -0.3810966 1.793869 -0.9567750 2.369547
2015 Q2      0.7004566 -0.3870259 1.787939 -0.9627044 2.363618
2015 Q3      0.6617716 -0.4257110 1.749254 -1.0013895 2.324933
2015 Q4      0.7584354 -0.3290472 1.845918 -0.9047257 2.421596
> plot(f_stl) #as the current model is only explaning 37-40% of the data we get such
a forecast which is not good at all.
>
> # There is more than one way to do things
>
> decomp_cwindow <- decompose(cwindow)
>
> # Each one shows different attributes
>
> attributes(decomp_cwindow)
$names
[1] "x"        "seasonal" "trend"    "random"   "figure"   "type"

$class
[1] "decomposed.ts"

> #$names
> #[1] "x"        "seasonal" "trend"    "random"   "figure"   "type"
>
> #$class
> #[1] "decomposed.ts"
>
> seasadj(decomp_cwindow)
                Qtr1                Qtr2                Qtr3                Qtr4
1977  0.0702040256  1.1540900801  1.5399052790  1.9348542283
```

1978	0.6027231026	1.1643789081	0.8578174810	0.7218947543
1979	1.0750688056	-0.6775957699	0.6186914900	0.7364892283
1980	0.2676503246	-1.3863795939	1.0742356250	1.9824850143
1981	-0.2414810744	0.0368086151	2.2428410080	0.1412480553
1982	0.1042829616	0.7212084251	0.4867291560	0.2906236913
1983	0.7720505726	0.7490432151	1.5397005190	1.9814956753
1984	2.1513324896	1.7300444581	1.5951503120	0.8863295783
1985	-0.2584404714	1.9898768461	-0.5710402260	0.9693734633
1986	1.1711740936	1.1511519181	0.5735436380	-0.0007482697
1987	0.5997041026	-1.0671531349	1.8220572690	1.3498308173
1988	1.2366813796	0.9575718211	0.8166491630	0.8354164423
1989	1.1188181596	-0.3884981579	0.6949876720	0.7023030333
1990	0.7381792986	0.6781859511	0.1225086270	-0.7374410277
1991	0.2954043326	0.7786238491	0.2617477250	0.5892405543
1992	1.4858005546	0.7865483481	0.5561207710	1.3519168633
1993	-1.4897225844	1.5662041111	0.2623814660	1.4023817463
1994	-0.4126608754	1.7148849551	0.7818390050	1.2567756913
1995	0.6340296776	0.0321075781	0.7953938600	0.5303685233
1996	1.0473489856	1.0919051501	0.8976045110	0.4866761233
1997	0.8781921146	0.7710483641	1.1880394430	1.3193200973
1998	2.2363632876	1.4407572711	1.0951031850	0.6694670423
1999	0.6632681446	0.2514975231	0.6947081250	1.4950055163
2000	2.0677363006	1.0426897731	1.1053997630	0.0889033223
2001	0.7358434736	-0.2510742939	2.5644598730	-1.2336897377
2002	2.6472965796	0.5722012441	-0.2939537960	0.1755889363
2003	0.3549570976	1.5248110811	1.4398213550	0.5131578533
2004	0.4309831526	1.0067225781	0.7158727380	1.3282583743
2005	-1.2377037924	0.7247093241	0.6445686410	0.4846829833
2006	1.8434975836	0.9053775491	0.5289352560	1.2417120523
2007	0.4392088056	0.1723706531	0.4418744380	0.4879145733
2008	1.4185899546	1.9970004091	-2.2588134920	-0.1183521747
2009	-0.9812419074	0.0863259631	-1.3427656420	-0.2053587247
2010	1.1749841086	1.3773904961	0.6109603880	0.3104126163