Homework-3 (Console Output)

```
> install.packages("fpp")
trying URL 'https://cran.rstudio.com/bin/macosx/contrib/4.1/fpp_0.5.tgz'
Content type 'application/x-gzip' length 80322 bytes (78 KB)
==================================================
downloaded 78 KB


The downloaded binary packages are in
        /var/folders/ln/6zltcwbj7cs9vmkqjl9z2llr0000gn/T//Rtmp53hxAf/
downloaded_packages
> library(fpp) #loading the required package
Loading required package: forecast
Registered S3 method overwritten by 'quantmod':
  method            from
  as.zoo.data.frame zoo
This is forecast 8.17.0
  Need help getting started? Try the online textbook FPP:
  http://otexts.com/fpp2/
Loading required package: fma
Loading required package: expsmooth
Loading required package: lmtest
Loading required package: zoo

Attaching package: ‘zoo’

The following objects are masked from ‘package:base’:

    as.Date, as.Date.numeric

Loading required package: tseries

    ‘tseries’ version: 0.10-51

    ‘tseries’ is a package for time series analysis and computational finance.

    See ‘library(help="tseries")’ for details.

Warning messages:
1: package ‘forecast’ was built under R version 4.1.2
2: package ‘lmtest’ was built under R version 4.1.2
3: package ‘zoo’ was built under R version 4.1.2
4: package ‘tseries’ was built under R version 4.1.2
> # choosing a Time Series
>
> usconsumption #choice of data set
        consumption       income
1970 Q1  0.61227692  0.496540045
1970 Q2  0.45492979  1.736459591
```

1970	Q3	0.87467302	1.344880981
1970	Q4	-0.27251439	-0.328145953
1971	Q1	1.89218699	1.965432327
1971	Q2	0.91337819	1.490757133
1971	Q3	0.79285790	0.442927733
1971	Q4	1.64999566	1.050230993
1972	Q1	1.32724825	0.629713564
1972	Q2	1.88990506	0.934207242
1972	Q3	1.53272416	2.024456496
1972	Q4	2.31705777	3.901784825
1973	Q1	1.81385569	1.129195652
1973	Q2	-0.05055772	0.981487307
1973	Q3	0.35966722	0.503626895
1973	Q4	-0.29331546	1.211474571
1974	Q1	-0.87877094	-1.546943855
1974	Q2	0.34672003	-0.860297695
1974	Q3	0.41195356	0.310671244
1974	Q4	-1.47820468	-0.452458059
1975	Q1	0.83735987	-0.393048299
1975	Q2	1.65397369	4.564235521
1975	Q3	1.41431884	-1.359432036
1975	Q4	1.05310993	1.006575406
1976	Q1	1.97774749	1.462092078
1976	Q2	0.91507218	0.819999864
1976	Q3	1.05074607	0.896376224
1976	Q4	1.29519619	0.715996597
1977	Q1	1.13545889	0.082385052
1977	Q2	0.55153240	1.131054305
1977	Q3	0.95015960	1.490114704
1977	Q4	1.49616150	1.995499552
1978	Q1	0.58229978	0.614904129
1978	Q2	2.11467168	1.141343133
1978	Q3	0.41869886	0.808026906
1978	Q4	0.80276430	0.782540078
1979	Q1	0.50412878	1.087249832
1979	Q2	-0.05855113	-0.700631545
1979	Q3	0.97755597	0.568900915
1979	Q4	0.26591209	0.797134552
1980	Q1	-0.17368425	0.279831351
1980	Q2	-2.29656300	-1.409415369
1980	Q3	1.06691983	1.024445050
1980	Q4	1.32441742	2.043130338
1981	Q1	0.54583283	-0.229300048
1981	Q2	0.00000000	0.013772840
1981	Q3	0.40482184	2.193050433
1981	Q4	-0.75874883	0.201893379
1982	Q1	0.64399814	0.116463988
1982	Q2	0.35685950	0.698172650
1982	Q3	0.76412375	0.436938581
1982	Q4	1.80788661	0.351269015

1983 Q1	0.97593734	0.784231599
1983 Q2	1.96559809	0.726007440
1983 Q3	1.75134970	1.489909944
1983 Q4	1.57374005	2.042140999
1984 Q1	0.85322727	2.163513516
1984 Q2	1.42002574	1.707008683
1984 Q3	0.76950200	1.545359737
1984 Q4	1.30747803	0.946974902
1985 Q1	1.68128155	-0.246259445
1985 Q2	0.90791081	1.966841071
1985 Q3	1.88085044	-0.620830801
1985 Q4	0.21986403	1.030018787
1986 Q1	0.83153359	1.183355120
1986 Q2	1.05966370	1.128116143
1986 Q3	1.73244172	0.523753063
1986 Q4	0.60006243	0.059897054
1987 Q1	-0.15228800	0.611885129
1987 Q2	1.32935729	-1.090188910
1987 Q3	1.11041685	1.772266694
1987 Q4	0.24012547	1.410476141
1988 Q1	1.65692852	1.248862406
1988 Q2	0.72306031	0.934536046
1988 Q3	0.78681412	0.766858588
1988 Q4	1.17068014	0.896061766
1989 Q1	0.36522624	1.130999186
1989 Q2	0.44694325	-0.411533933
1989 Q3	1.03134287	0.645197097
1989 Q4	0.48794531	0.762948357
1990 Q1	0.78786794	0.750360325
1990 Q2	0.32958888	0.655150176
1990 Q3	0.37909401	0.072718052
1990 Q4	-0.78228237	-0.676795704
1991 Q1	-0.28358087	0.307585359
1991 Q2	0.75819378	0.755588074
1991 Q3	0.38256742	0.211957150
1991 Q4	-0.04493204	0.649885878
1992 Q1	1.70442848	1.497981581
1992 Q2	0.59103346	0.763512573
1992 Q3	1.09931218	0.506330196
1992 Q4	1.21261583	1.412562187
1993 Q1	0.40511535	-1.477541558
1993 Q2	0.95540152	1.543168336
1993 Q3	1.07908089	0.212590891
1993 Q4	0.88609934	1.463027070
1994 Q1	1.10781585	-0.400479849
1994 Q2	0.73801073	1.691849180
1994 Q3	0.79832641	0.732048430
1994 Q4	0.98235581	1.317421015
1995 Q1	0.11670364	0.646210704
1995 Q2	0.81643944	0.009071803

1995	Q3	0.89012327	0.745603285
1995	Q4	0.70025668	0.591013847
1996	Q1	0.90999511	1.059530012
1996	Q2	1.12517415	1.068869375
1996	Q3	0.59749105	0.847813936
1996	Q4	0.81104981	0.547321447
1997	Q1	1.00231479	0.890373141
1997	Q2	0.40370845	0.748012589
1997	Q3	1.68561876	1.138248868
1997	Q4	1.13779625	1.379965421
1998	Q1	0.98935016	2.248544314
1998	Q2	1.70668759	1.417721496
1998	Q3	1.31690105	1.045312610
1998	Q4	1.52238359	0.730112366
1999	Q1	0.98149855	0.675449171
1999	Q2	1.56147049	0.228461748
1999	Q3	1.19479035	0.644917550
1999	Q4	1.40026421	1.555650840
2000	Q1	1.50504064	2.079917327
2000	Q2	0.93588274	1.019653998
2000	Q3	0.97432184	1.055609188
2000	Q4	0.88064976	0.149548646
2001	Q1	0.39868539	0.748024500
2001	Q2	0.37651229	-0.274110069
2001	Q3	0.43918859	2.514669298
2001	Q4	1.55369100	-1.173044414
2002	Q1	0.34382689	2.659477606
2002	Q2	0.50665404	0.549165469
2002	Q3	0.67571194	-0.343744371
2002	Q4	0.35472465	0.236234260
2003	Q1	0.50387273	0.367138124
2003	Q2	0.98555573	1.501775306
2003	Q3	1.33766670	1.390030780
2003	Q4	0.54254673	0.573803177
2004	Q1	0.88074795	0.443164179
2004	Q2	0.44397949	0.983686803
2004	Q3	0.87037870	0.666082163
2004	Q4	1.07395152	1.388903698
2005	Q1	0.79393888	-1.225522766
2005	Q2	0.98477889	0.701673549
2005	Q3	0.75627802	0.594778066
2005	Q4	0.24819787	0.545328307
2006	Q1	1.01902713	1.855678610
2006	Q2	0.60048219	0.882341774
2006	Q3	0.59799998	0.479144681
2006	Q4	0.92584113	1.302357376
2007	Q1	0.55424125	0.451389832
2007	Q2	0.38257957	0.149334878
2007	Q3	0.43929546	0.392083863
2007	Q4	0.29465872	0.548559897

```
2008 Q1 -0.25266521  1.430770981
2008 Q2 -0.03553182  1.973964634
2008 Q3 -0.97177447 -2.308604067
2008 Q4 -1.31350400 -0.057706851
2009 Q1 -0.38748400 -0.969060881
2009 Q2 -0.47008302  0.063290188
2009 Q3  0.57400096 -1.392556217
2009 Q4  0.10932885 -0.144713401
2010 Q1  0.67101795  1.187165135
2010 Q2  0.71771819  1.354354721
2010 Q3  0.65314326  0.561169813
2010 Q4  0.87535215  0.371057940
> mydf <- data.frame(usconsumption) #converting the dataset/time series into a data
frame
> mydf #printing my new data frame
    consumption       income
1    0.61227692  0.496540045
2    0.45492979  1.736459591
3    0.87467302  1.344880981
4   -0.27251439 -0.328145953
5    1.89218699  1.965432327
6    0.91337819  1.490757133
7    0.79285790  0.442927733
8    1.64999566  1.050230993
9    1.32724825  0.629713564
10   1.88990506  0.934207242
11   1.53272416  2.024456496
12   2.31705777  3.901784825
13   1.81385569  1.129195652
14  -0.05055772  0.981487307
15   0.35966722  0.503626895
16  -0.29331546  1.211474571
17  -0.87877094 -1.546943855
18   0.34672003 -0.860297695
19   0.41195356  0.310671244
20  -1.47820468 -0.452458059
21   0.83735987 -0.393048299
22   1.65397369  4.564235521
23   1.41431884 -1.359432036
24   1.05310993  1.006575406
25   1.97774749  1.462092078
26   0.91507218  0.819999864
27   1.05074607  0.896376224
28   1.29519619  0.715996597
29   1.13545889  0.082385052
30   0.55153240  1.131054305
31   0.95015960  1.490114704
32   1.49616150  1.995499552
33   0.58229978  0.614904129
34   2.11467168  1.141343133
```

35	0.41869886	0.808026906
36	0.80276430	0.782540078
37	0.50412878	1.087249832
38	-0.05855113	-0.700631545
39	0.97755597	0.568900915
40	0.26591209	0.797134552
41	-0.17368425	0.279831351
42	-2.29656300	-1.409415369
43	1.06691983	1.024445050
44	1.32441742	2.043130338
45	0.54583283	-0.229300048
46	0.00000000	0.013772840
47	0.40482184	2.193050433
48	-0.75874883	0.201893379
49	0.64399814	0.116463988
50	0.35685950	0.698172650
51	0.76412375	0.436938581
52	1.80788661	0.351269015
53	0.97593734	0.784231599
54	1.96559809	0.726007440
55	1.75134970	1.489909944
56	1.57374005	2.042140999
57	0.85322727	2.163513516
58	1.42002574	1.707008683
59	0.76950200	1.545359737
60	1.30747803	0.946974902
61	1.68128155	-0.246259445
62	0.90791081	1.966841071
63	1.88085044	-0.620830801
64	0.21986403	1.030018787
65	0.83153359	1.183355120
66	1.05966370	1.128116143
67	1.73244172	0.523753063
68	0.60006243	0.059897054
69	-0.15228800	0.611885129
70	1.32935729	-1.090188910
71	1.11041685	1.772266694
72	0.24012547	1.410476141
73	1.65692852	1.248862406
74	0.72306031	0.934536046
75	0.78681412	0.766858588
76	1.17068014	0.896061766
77	0.36522624	1.130999186
78	0.44694325	-0.411533933
79	1.03134287	0.645197097
80	0.48794531	0.762948357
81	0.78786794	0.750360325
82	0.32958888	0.655150176
83	0.37909401	0.072718052
84	-0.78228237	-0.676795704

85	-0.28358087	0.307585359
86	0.75819378	0.755588074
87	0.38256742	0.211957150
88	-0.04493204	0.649885878
89	1.70442848	1.497981581
90	0.59103346	0.763512573
91	1.09931218	0.506330196
92	1.21261583	1.412562187
93	0.40511535	-1.477541558
94	0.95540152	1.543168336
95	1.07908089	0.212590891
96	0.88609934	1.463027070
97	1.10781585	-0.400479849
98	0.73801073	1.691849180
99	0.79832641	0.732048430
100	0.98235581	1.317421015
101	0.11670364	0.646210704
102	0.81643944	0.009071803
103	0.89012327	0.745603285
104	0.70025668	0.591013847
105	0.90999511	1.059530012
106	1.12517415	1.068869375
107	0.59749105	0.847813936
108	0.81104981	0.547321447
109	1.00231479	0.890373141
110	0.40370845	0.748012589
111	1.68561876	1.138248868
112	1.13779625	1.379965421
113	0.98935016	2.248544314
114	1.70668759	1.417721496
115	1.31690105	1.045312610
116	1.52238359	0.730112366
117	0.98149855	0.675449171
118	1.56147049	0.228461748
119	1.19479035	0.644917550
120	1.40026421	1.555650840
121	1.50504064	2.079917327
122	0.93588274	1.019653998
123	0.97432184	1.055609188
124	0.88064976	0.149548646
125	0.39868539	0.748024500
126	0.37651229	-0.274110069
127	0.43918859	2.514669298
128	1.55369100	-1.173044414
129	0.34382689	2.659477606
130	0.50665404	0.549165469
131	0.67571194	-0.343744371
132	0.35472465	0.236234260
133	0.50387273	0.367138124
134	0.98555573	1.501775306

```
135  1.33766670  1.390030780
136  0.54254673  0.573803177
137  0.88074795  0.443164179
138  0.44397949  0.983686803
139  0.87037870  0.666082163
140  1.07395152  1.388903698
141  0.79393888 -1.225522766
142  0.98477889  0.701673549
143  0.75627802  0.594778066
144  0.24819787  0.545328307
145  1.01902713  1.855678610
146  0.60048219  0.882341774
147  0.59799998  0.479144681
148  0.92584113  1.302357376
149  0.55424125  0.451389832
150  0.38257957  0.149334878
151  0.43929546  0.392083863
152  0.29465872  0.548559897
153 -0.25266521  1.430770981
154 -0.03553182  1.973964634
155 -0.97177447 -2.308604067
156 -1.31350400 -0.057706851
157 -0.38748400 -0.969060881
158 -0.47008302  0.063290188
159  0.57400096 -1.392556217
160  0.10932885 -0.144713401
161  0.67101795  1.187165135
162  0.71771819  1.354354721
163  0.65314326  0.561169813
164  0.87535215  0.371057940
> data("usconsumption")
>
> #Description of the Time Series
>
> #The time series I chose is the US consumption which gives us the percent
change in quarterly personal consumption
> #expenditure and personal disposable income for the US from 1970 to 2010. From
the US consumption TS I chose the income data
> #to forecast.
> min(usconsumption[,"income"])
[1] -2.308604
> max(usconsumption[,"income"])
[1] 4.564236
>
> plot(usconsumption) #plotting usconsumption to understand it better and choose
which column to use
> plot(usconsumption[,"income"])    #plotting income separately to get a better view
>
> #I chose Income column from the TS
>
```

```
> cwindow <- window(usconsumption[,"income"], start = 1977)
> plot(cwindow)
>
> #choosing the income column from the data set from 1977 to 2010 for forecasting
and future purposes as there was a huge spike
> #in the income around the year 1975 which I would like to disregard so that it does
not hamper my forecast
>
> fit <- stl(cwindow, s.window=5) #using the decomposition method stl to describe
the time series
> plot(fit)
> fit
 Call:
 stl(x = cwindow, s.window = 5)

Components
           seasonal       trend    remainder
1977 Q1 -0.393871331  0.99722835 -0.520971971
1977 Q2 -0.335621393  1.07353698  0.393138713
1977 Q3  0.183946411  1.13491563  0.171252663
1977 Q4  0.527555727  1.18609700  0.281846824
1978 Q1 -0.295156922  1.18164807 -0.271587020
1978 Q2 -0.478822606  1.00699124  0.613174498
1978 Q3  0.184840888  0.86343966 -0.240253646
1978 Q4  0.553903469  0.70429929 -0.475662686
1979 Q1  0.079210369  0.51870102  0.489338438
1979 Q2 -0.938108617  0.40707083 -0.169593757
1979 Q3  0.264516091  0.33026886 -0.025884039
1979 Q4  0.711429949  0.21571952 -0.130014919
1980 Q1 -0.061892538  0.20708955  0.134634334
1980 Q2 -1.251048720  0.32403685 -0.482403496
1980 Q3  0.766353201  0.42976550 -0.171673654
1980 Q4  0.674077154  0.56363093  0.805422256
1981 Q1 -0.510984813  0.72826680 -0.446582032
1981 Q2 -0.733691759  0.74004179  0.007422813
1981 Q3  0.809867665  0.67445185  0.708730916
1981 Q4  0.174297869  0.65642380 -0.628828295
1982 Q1 -0.444204203  0.56389395 -0.003225755
1982 Q2 -0.202782808  0.47394091  0.427014549
1982 Q32010  0.51397815 -0.506818243
1982 Q4 -0.118987477  0.59574356 -0.125487067
1983 Q1 -0.006938292  0.76203538  0.029134513
1983 Q2 -0.079902748  1.08255644 -0.276646254
1983 Q3  0.055687975  1.40835821  0.025863758
1983 Q4  0.059348619  1.62661593  0.356176450
1984 Q1 -0.130313181  1.73629158  0.557535116
1984 Q2  0.286249869  1.62230062 -0.201541808
1984 Q3 -0.288601740  1.32524841  0.508713070
1984 Q4  0.116271919  1.03620452 -0.205501535
1985 Q1 -0.234512163  0.78389369 -0.795640976
```

1985	Q2	0.684732343	0.64782189	0.634286836
1985	Q3	-0.512197434	0.70365345	-0.812286814
1985	Q4	0.002012967	0.80871225	0.219293572
1986	Q1	-0.033700918	0.81256876	0.404487278
1986	Q2	0.104038750	0.75919995	0.264877447
1986	Q3	-0.095218403	0.59765248	0.021318989
1986	Q4	0.052757292	0.39324060	-0.386100839
1987	Q1	0.248166512	0.37190201	-0.008183394
1987	Q2	-0.620731478	0.51552042	-0.984977847
1987	Q3	0.369364359	0.73645780	0.666444540
1987	Q4	0.125534493	0.98622019	0.298721460
1988	Q1	0.275453586	1.11871328	-0.145304457
1988	Q2	-0.798368649	1.05848530	0.674419390
1988	Q3	0.239695271	0.92065263	-0.393489316
1988	Q4	0.224070941	0.73838592	-0.066395098
1989	Q1	0.309556242	0.59354749	0.227895455
1989	Q2	-0.383229100	0.56591527	-0.594220106
1989	Q3	-0.044576441	0.55733917	0.132434365
1989	Q4	-0.090875690	0.55284028	0.300983767
1990	Q1	0.309218064	0.52244018	-0.081297920
1990	Q2	-0.016777241	0.37819564	0.293731778
1990	Q3	-0.131241776	0.22842674	-0.024466914
1990	Q4	-0.320948396	0.17156727	-0.527414583
1991	Q1	0.315805604	0.18141185	-0.189632097
1991	Q2	0.248040376	0.32858872	0.178958983
1991	Q3	-0.247543140	0.59013580	-0.130635514
1991	Q4	-0.022296877	0.75142453	-0.079241776
1992	Q1	-0.227190416	0.81895929	0.906212711
1992	Q2	0.409337261	0.81037128	-0.456195967
1992	Q3	-0.271848592	0.65931855	0.118860241
1992	Q4	0.565509105	0.51204615	0.335006930
1993	Q1	-0.994689721	0.47336931	-0.956221146
1993	Q2	0.667671907	0.47199661	0.403499823
1993	Q3	-0.237347039	0.54377955	-0.093841625
1993	Q4	0.727057581	0.71000487	0.025964616
1994	Q1	-1.084997152	0.81402163	-0.129504329
1994	Q2	0.480506464	0.87991147	0.331431249
1994	Q3	-0.134145432	0.89515309	-0.028959229
1994	Q4	0.389303384	0.80918726	0.118930371
1995	Q1	-0.312615089	0.70287819	0.255947599
1995	Q2	0.018924689	0.64044554	-0.650298422
1995	Q3	0.001986667	0.64092940	0.102687218
1995	Q4	0.022179472	0.72046469	-0.151630316
1996	Q1	0.109416823	0.82937795	0.120735234
1996	Q2	-0.147785182	0.86999145	0.346663109
1996	Q3	0.017190766	0.85635956	-0.025736386
1996	Q4	-0.163854484	0.82746773	-0.116291797
1997	Q1	0.294523893	0.84604051	-0.250191257
1997	Q2	-0.045326778	0.97722533	-0.183885967
1997	Q3	-0.065216029	1.19413173	0.009333168

1997 Q4	-0.130433678	1.39172087	0.118678225
1998 Q1	0.333357710	1.46744176	0.447744848
1998 Q2	-0.202662388	1.37082968	0.249554199
1998 Q3	-0.155161760	1.13296241	0.067511964
1998 Q4	0.032024595	0.86739509	-0.169307321
1999 Q1	0.426487189	0.71834565	-0.469383668
1999 Q2	-0.271136325	0.76717994	-0.267581865
1999 Q3	-0.124065714	0.96638211	-0.197398847
1999 Q4	-0.022574274	1.17198724	0.406237870
2000 Q1	0.384333808	1.25310995	0.442473567
2000 Q2	-0.479693510	1.17636807	0.322979434
2000 Q3	0.462066772	0.92164485	-0.328102438
2000 Q4	-0.711912596	0.68841276	0.173048480
2001 Q1	0.823234070	0.62789867	-0.703108239
2001 Q2	-0.455341043	0.64386766	-0.462636684
2001 Q3	0.544204176	0.76643160	1.204033525
2001 Q4	-1.084653067	0.86023817	-0.948629520
2002 Q1	0.785644803	0.76151907	1.112313733
2002 Q2	-0.078244905	0.61526453	0.012145844
2002 Q3	0.273948243	0.53307513	-1.150767742
2002 Q4	-0.796924347	0.50392128	0.529237325
2003 Q1	0.305613292	0.62677797	-0.565253142
2003 Q2	0.339583278	0.79884821	0.363343814
2003 Q3	-0.015318677	0.89090418	0.514445279
2003 Q4	0.056158164	0.91231860	-0.394673585
2004 Q1	-0.700193784	0.84479195	0.298566011
2004 Q2	0.393838344	0.73608643	-0.146237966
2004 Q3	0.183074279	0.57797451	-0.094966622
2004 Q4	0.222361483	0.45227027	0.714271948
2005 Q1	-0.552938663	0.40792276	-1.080506861
2005 Q2	0.160421779	0.41973290	0.121518872
2005 Q3	-0.085422128	0.57828350	0.101916694
2005 Q4	0.334790778	0.81233930	-0.601801773
2006 Q1	-0.114355365	0.94527223	1.024761742
2006 Q2	-0.089960732	0.99924456	-0.026942054
2006 Q3	-0.255265709	0.90037784	-0.165967448
2006 Q4	0.112861086	0.68104045	0.508455844
2007 Q1	0.403725888	0.58197040	-0.534306460
2007 Q2	0.234612897	0.55405885	-0.639336866
2007 Q3	-0.878780836	0.60522049	0.665644208
2007 Q4	0.213851813	0.70091282	-0.366204734
2008 Q1	0.229586171	0.60353597	0.597648838
2008 Q2	0.787082258	0.32549586	0.861386513
2008 Q3	-1.315733298	-0.03562969	-0.957241079
2008 Q4	0.074409742	-0.41252341	0.280406814
2009 Q1	0.368850960	-0.61397036	-0.723941480
2009 Q2	0.846866906	-0.52996837	-0.253608350
2009 Q3	-1.089409252	-0.28272932	-0.020417650
2009 Q4	-0.171123780	0.07852242	-0.052112039
2010 Q1	0.381398493	0.40213936	0.403627284

```
2010 Q2  0.851169198  0.67245254 -0.169267017
2010 Q3 -1.014170499  0.93295295  0.642387363
2010 Q4 -0.236591675  1.18221290 -0.574563288
>
> # Plotting the Time Series
>
> plot(cwindow)   #the value of the seasonal change is somewhat constant hence we can say that these components are additive
>               #the plot has a mixture of cyclicl movement and seasonal pattern
>
> #ACF Plot
>
> Acf(cwindow) #since all the values that we got from the Acf plot are within the blue zone (threshold areas) it means that
>             #none of the values are dependent on the previous value hence they are independent.
>
> #forecasting using Holt-Winters and checking the accuracy
>
> tmp <- HoltWinters(cwindow)
> attributes(tmp)
$names
[1] "fitted"       "x"            "alpha"        "beta"         "gamma"        "coefficients"
"seasonal"     "SSE"
[9] "call"

$class
[1] "HoltWinters"

> #$names
> #[1] "fitted"       "x"            "alpha"        "beta"         "gamma"        "coefficients"
"seasonal"     "SSE"  "call"
>
> #$class
> #[1] "HoltWinters"
>
>
> plot(tmp)
>
> tmp_f <- forecast(tmp)
> attributes(tmp_f)
$names
 [1] "method"    "model"     "level"     "mean"      "lower"     "upper"     "x"         "series"
"fitted"    "residuals"

$class
[1] "forecast"

> #$names
> # [1] "method"    "model"     "level"     "mean"      "lower"     "upper"     "x"
```

```
"series"    "fitted"    "residuals"
> #$class
> #[1] "forecast"
>
> plot(tmp_f)
>
> plot(tmp_f$residuals)
>
> hist(tmp_f$residuals)
>
> Acf(tmp_f$residuals)
>
> accuracy(tmp_f)
                     ME      RMSE       MAE       MPE    MAPE      MASE      ACF1
Training set 0.07083846 0.9383384 0.7201747 -41.16379 206.858 0.7791495
-0.095718
>
> #                    ME     RMSE       MAE       MPE     MAPE      MASE       ACF1
> #Training set 0.07083846 0.9383384 0.7201747 -41.16379 206.858 0.7791495
-0.095718
```