STA457TUT8

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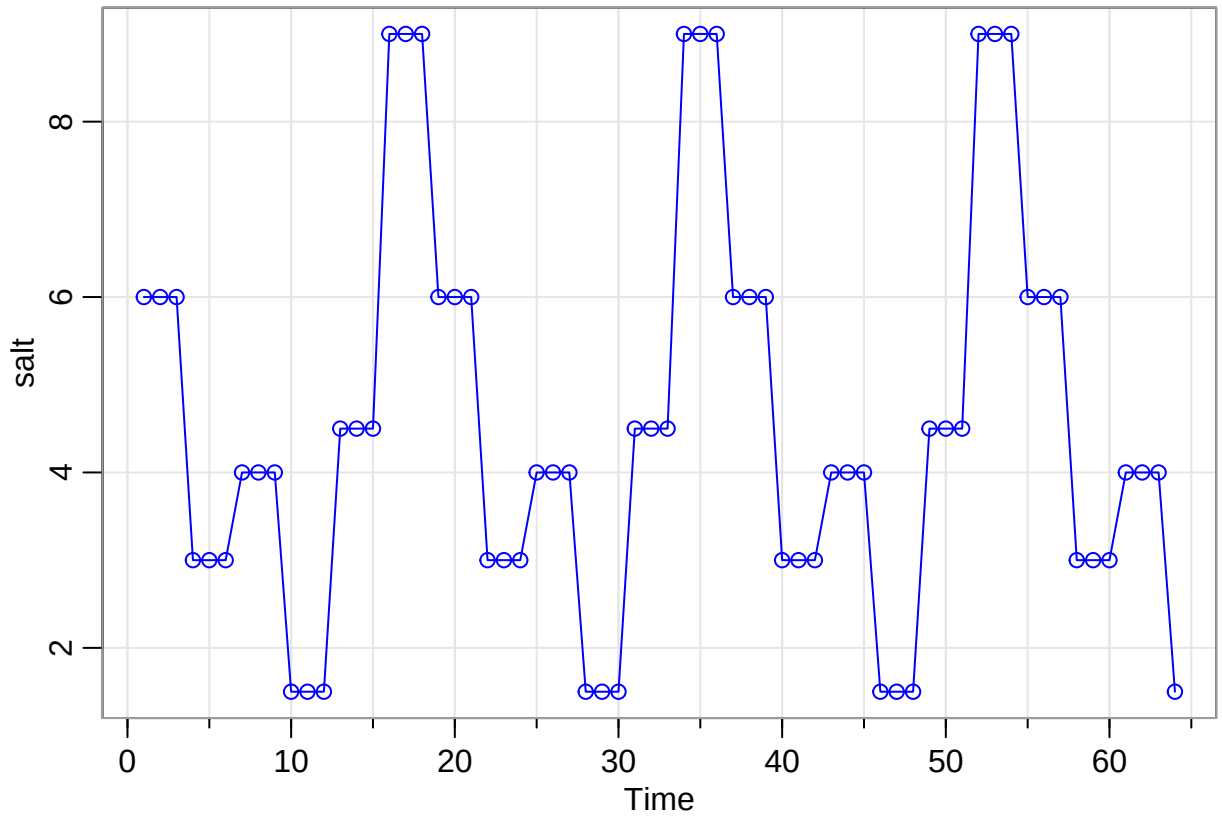
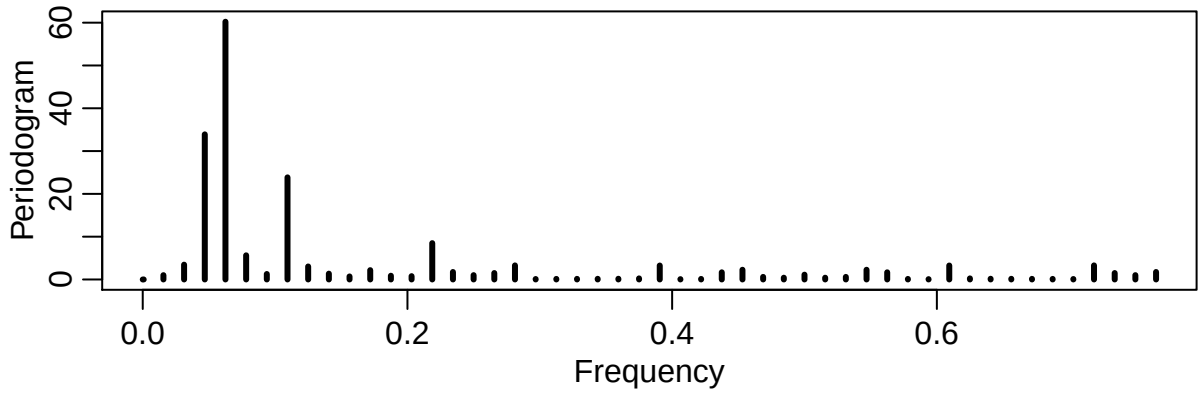
```
library('astsa')
data(salt)
```

(a)

```
tsplot(salt,type = 'o',col = 'blue')
```




```
n = length(salt)
par(mfrow = c(2,1),mar = c(3,3,1,1),mgp = c(1.6,0.6,0))
Per = Mod(fft(salt-mean(salt)))^2/n
Freq = (1:n -1)/n
plot(Freq[1:50],Per[1:50],type = 'h',lwd = 3,ylab = 'Periodogram',xlab = 'Frequency')
```




```
y = cbind(1:50,Freq[1:50],Per[1:50])
y<-y[order(y[,3]),]
y
```

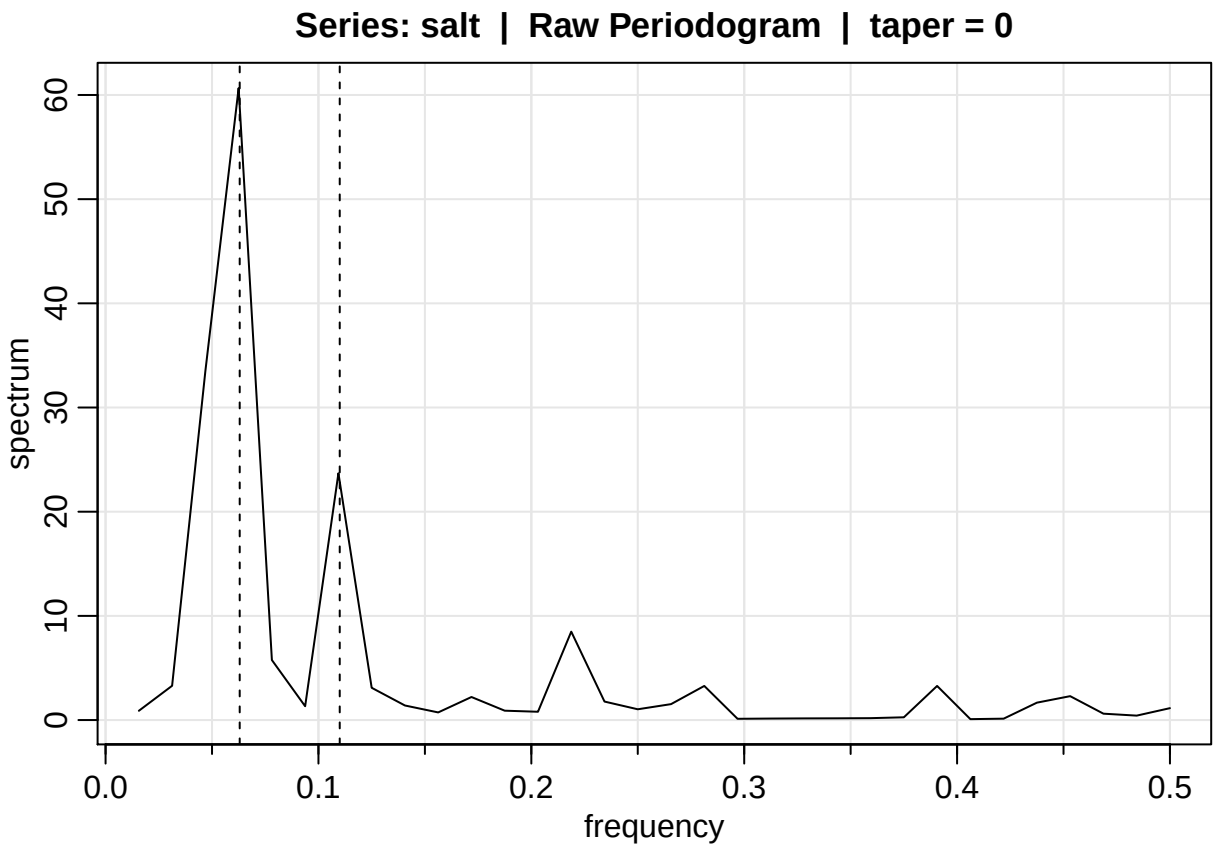
```
##       [,1]     [,2]        [,3]
##  [1,]    1 0.000000  0.00000000
##  [2,]   39 0.593750  0.08338736
##  [3,]   27 0.406250  0.08338736
##  [4,]   46 0.703125  0.11727946
##  [5,]   20 0.296875  0.11727946
##  [6,]   28 0.421875  0.13119655
##  [7,]   38 0.578125  0.13119655
##  [8,]   21 0.312500  0.13964862
##  [9,]   45 0.687500  0.13964862
## [10,]   44 0.671875  0.15370542
## [11,]   22 0.328125  0.15370542
## [12,]   43 0.656250  0.16236430
## [13,]   23 0.343750  0.16236430
## [14,]   42 0.640625  0.17830990
## [15,]   24 0.359375  0.17830990
## [16,]   25 0.375000  0.26022727
## [17,]   41 0.625000  0.26022727
## [18,]   34 0.515625  0.41846381
## [19,]   32 0.484375  0.41846381
## [20,]   31 0.468750  0.60356992
## [21,]   35 0.531250  0.60356992
```

```
## [22,]   11 0.156250  0.71207264
## [23,]   14 0.203125  0.78348395
## [24,]   13 0.187500  0.88255166
## [25,]    2 0.015625  1.00877873
## [26,]   17 0.250000  1.01953125
## [27,]   49 0.750000  1.01953125
## [28,]   33 0.500000  1.12890625
## [29,]    7 0.093750  1.28314793
## [30,]   10 0.140625  1.36492664
## [31,]   18 0.265625  1.51076064
## [32,]   48 0.734375  1.51076064
## [33,]   29 0.437500  1.67615967
## [34,]   37 0.562500  1.67615967
## [35,]   50 0.765625  1.75506058
## [36,]   16 0.234375  1.75506058
## [37,]   12 0.171875  2.18375456
## [38,]   30 0.453125  2.27829254
## [39,]   36 0.546875  2.27829254
## [40,]    9 0.125000  3.04446023
## [41,]   26 0.390625  3.26710055
## [42,]   40 0.609375  3.26710055
## [43,]   19 0.281250  3.29197105
## [44,]   47 0.718750  3.29197105
## [45,]    3 0.031250  3.46635412
## [46,]    6 0.078125  5.64873550
## [47,]   15 0.218750  8.49088269
## [48,]    8 0.109375 23.85582985
## [49,]    4 0.046875 33.90682131
## [50,]    5 0.062500 60.22351505
```

We see that 1/freq(5) = 16 day cycle and 1/freq(4) = 21.333 day cycle and 1/freq(8) = 9.143 day cycle are the most prominent periodic components of the data.

(b)

```
salt.per = mvspec(salt,log = 'no')
abline(v = 0.063,lty = 2)
abline(v = 0.11,lty = 2)
```



We notice a narrow-band peak at $\omega = 0.063\Delta = 5.25 * 10^{-3}$,The occurring years is $1/0.063 = 15.87$ years.

```
nextn(length(salt))
```

```
## [1] 64
```

(c)

```
P2<-salt.per$details[order(salt.per$details[,3],decreasing = TRUE),]
P2[1,];P2[2,];P2[3,]
```

```
## frequency    period  spectrum
##    0.0625   16.0000   60.6665
```

```
## frequency    period  spectrum
##    0.0469   21.3333   33.4859
```

```
## frequency    period  spectrum
##    0.1094    9.1429   23.6903
```

```
U =qchisq(0.05,2)
L =qchisq(0.95,2)

##90% CIs for the dominant frequencies for saltemp series in part(a)
salt.u1 = 2*P2[1,3]/U
salt.l1 = 2*P2[1,3]/L
salt.u2 = 2*P2[2,3]/U
salt.l2 = 2*P2[2,3]/L
```

```
salt.u3 = 2*P2[3,3]/U
salt.l3 = 2*P2[3,3]/L
##Create a data frame for the CIs
Result <- data.frame(Series=c(rep("salt",3)),
Dominant.Freq=c(P2[1,1],P2[2,1],P2[3,1]), Spec=c(P2[1,3],P2[2,3],
P2[3,3]),
Lower=c(salt.l1,salt.l2,salt.l3),
Upper=c(salt.u1,salt.u2,salt.u3))
Result[1:2,3:5] = round(Result[1:2,3:5], 4)
Result
```

```
##   Series Dominant.Freq    Spec     Lower     Upper
## 1   salt        0.0625 60.6665 20.251000 1182.7374
## 2   salt        0.0469 33.4859 11.177900  652.8319
## 3   salt        0.1094 23.6903  7.908016  461.8596
```

We cannot establish the significance of the first peak since the periodogram ordinate is 60.67, which lies in the confidence intervals of the second and third peak.

We cannot establish the significance of the second peak since the periodogram ordinate is 33.49, which lies in the confidence interval of the first and third peak.

We cannot establish the significance of the third peak since the periodogram ordinate is 23.69, which lies in the confidence interval of the first and second peak.