Unemployment Level of different states of the USA. Seasonal adjustment and trend extraction by means of AutoSSA

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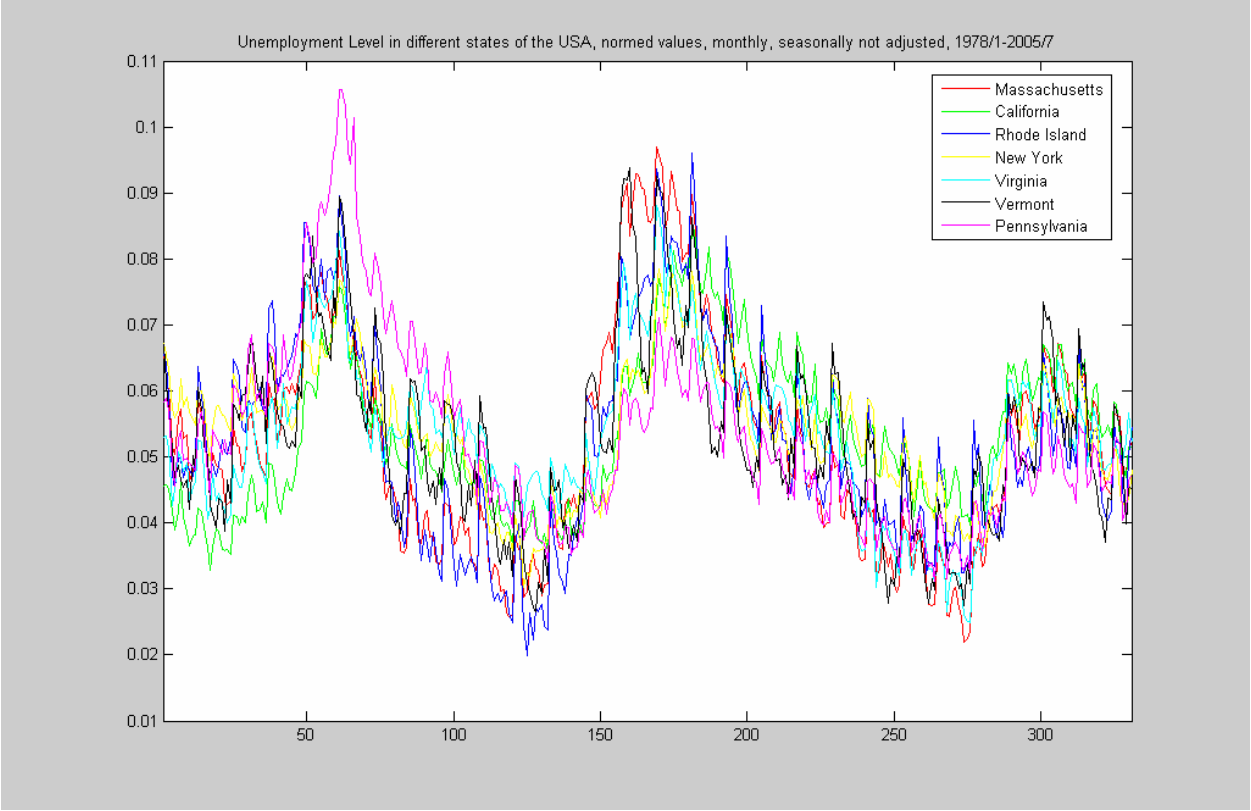
Theodore Alexandrov
www.pdmi.ras.ru/~theo/autossa

Let us take a set of similar time series: *Unemployment level of different states of the USA, thousands, monthly, seasonally not adjusted, 1978/1-2005/7*, downloaded from http://www.economagic.com/em-cgi/find.exe/Unemployment_Level. We consider 7 states: *Massachusetts*, *California*, *Rhode Island*, *New York*, *Virginia*, *Vermont*, *Pennsylvania*.

The plot of their normalized values shows that they have similar behavior:



They are similar and so we expect uniform results of application of the AutoSSA procedure to this set.

All time series are of the same length: **N=331**, they contain monthly data and each time series has evident seasonal component (T=12).

Firstly, we do seasonal adjustment, then we extract trend of adjusted time series.

Threshold for method of trend extraction

The threshold for C-criterion of trend components identification, C0, will be calculated for each time series by consideration of values of the R-measure:

$$C0_{max} = arg\ min_{C0} \left(R(C0+C0_{step}) - R(C0) >= R0 \right), \qquad C0 = C0_{max} - C0_{\varepsilon}.$$

The AutoTrend procedure was applied with default minor parameters:

- we search Cmax in [0.6, 1] with $C0_{step}$=0.02,
- Rdelta threshold R0=0.05,
- $C0_{\varepsilon}$ =0.05.

Threshold for method of seasonality extraction

$$\text{Rho0} = \arg\min_{\text{rho0}} \left(M(\text{rho0}+\text{rho0}_{\text{step}}) - M(\text{rho0}) >= \text{M0} \right)$$

$$M(\text{rho}) = \text{MSE}\left(F - F(\text{rho}) \right),$$

where F is an original time series and F(rho) is a periodical component calculated with rho.

The AutoPeriodicity procedure was applied with default minor parameters:

- we search rho0 in [0.7, 1] with $\text{rho0}_{\text{step}}=0.02$,
- threshold M0=0.05
- we examine only first ETs, max ET number=L/2=78
- limits for the period of seasonal harmonics: [11,13]

Major parameters

Window length L: close to N/2 but divisible by T=12: **L=156**.

Trend frequencies interval [0, omega0] for the method of trend extraction: **[0, 0.07]** in order to distinguish seasonal components (made of harmonics with frequencies > 0.08(3)) from trend components.

Results

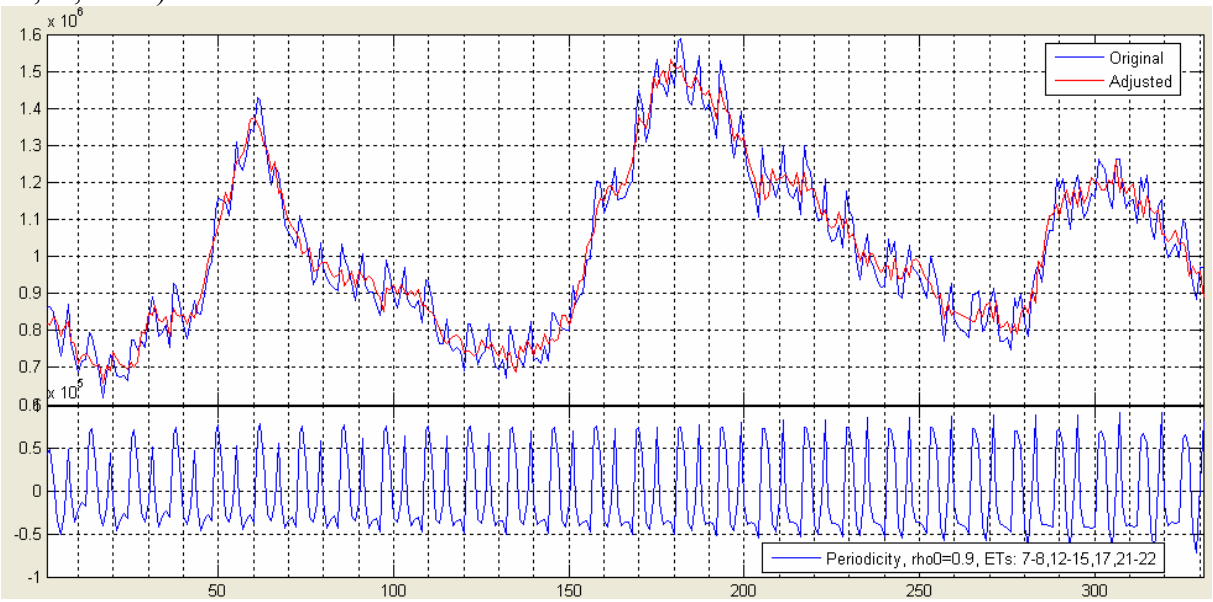
See next pages.

The calculations were made in Matlab using the software package *AutoSSA (Theodore Alexandrov)*.

1) California, seasonal adjustment:

Seasonal ETs:7-8,12-15,17,21-22 (rho0=0.9)

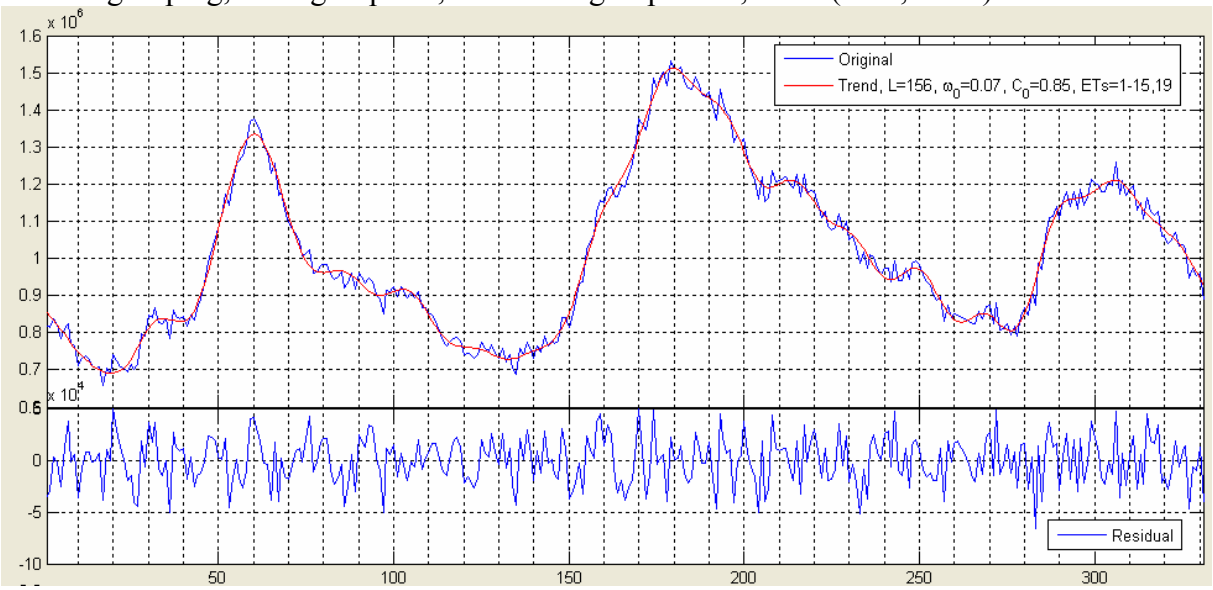
Manual grouping (with period estimation): 7-8(6), 12-13(12), 14-15(4), 17(2), 21-22(3) (7-8,12-15,17,21-23)



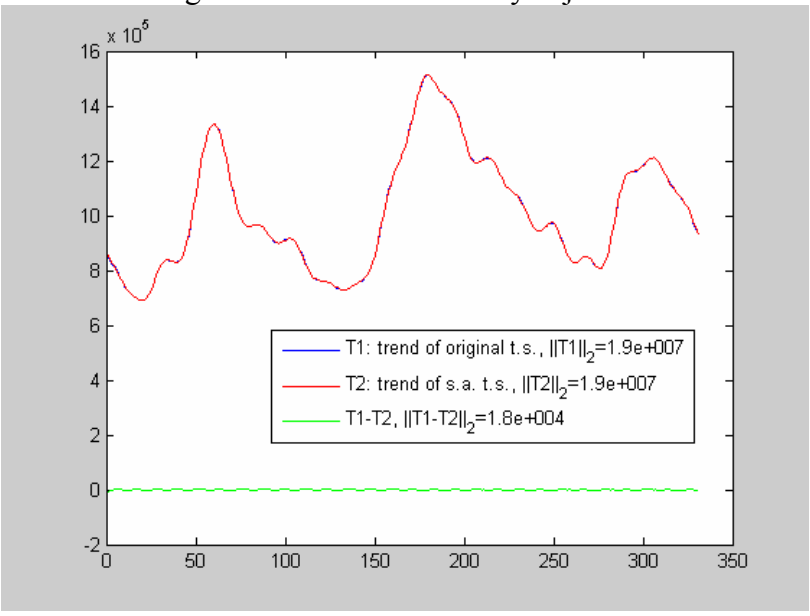
California, trend of seasonally adjusted time series:

Trend ETs (of adjusted time series): 1-15,19 (C0=0.85)

Manual grouping, main group:1-9, additional group: 9-15,18-19 (1-15,18-19)



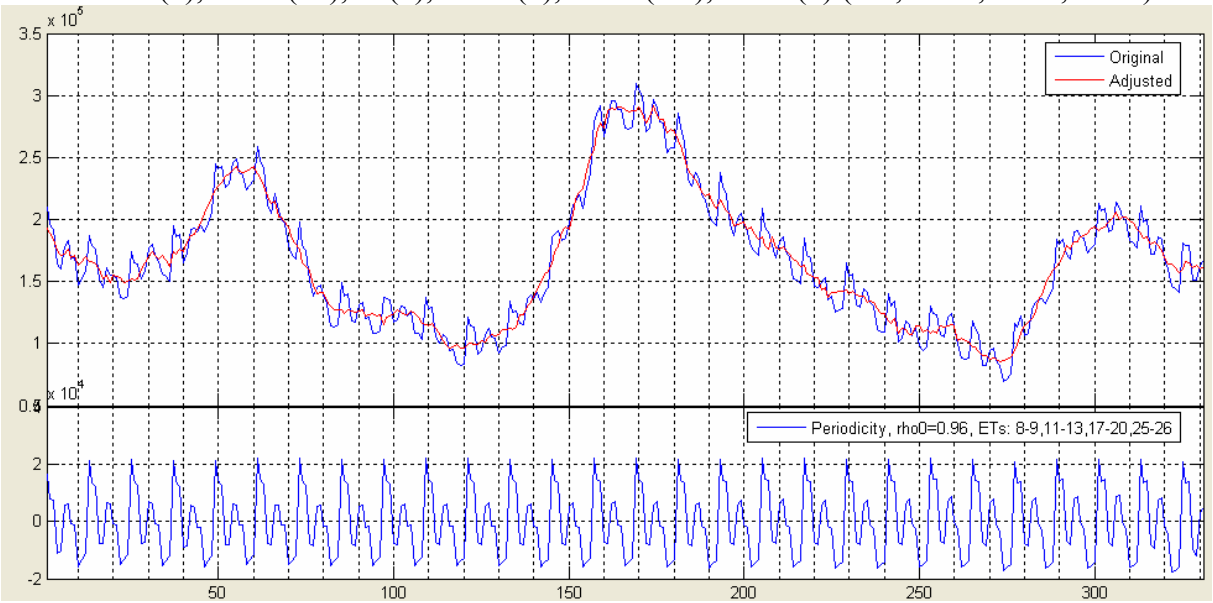
Difference between trend of an original and of the seasonally adjusted time series:



2) Massachusetts, seasonal adjustment:

Seasonal ETs: 8-9,11-13,17-20,25-26 (rho0=0.96)

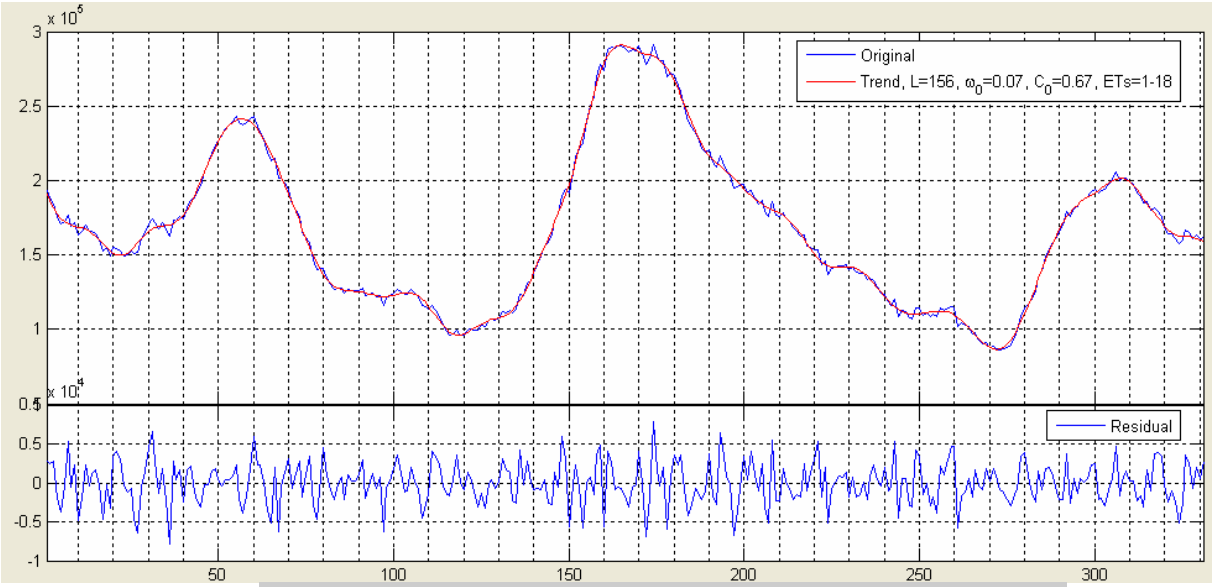
Manual: 8-9(6), 11-12(12), 13(2), 17-18(4), 19-20(2.4), 25-26(3) (8-9,11-13,17-20,25-26)

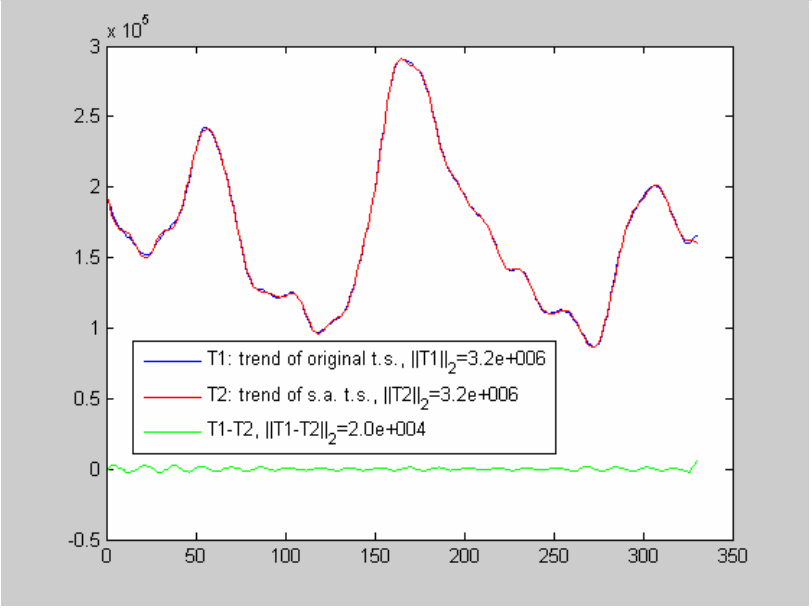


Massachusetts, trend of seasonally adjusted time series:

Trend ETs: 1-18 (C0=0.67)

Manual: 1-18



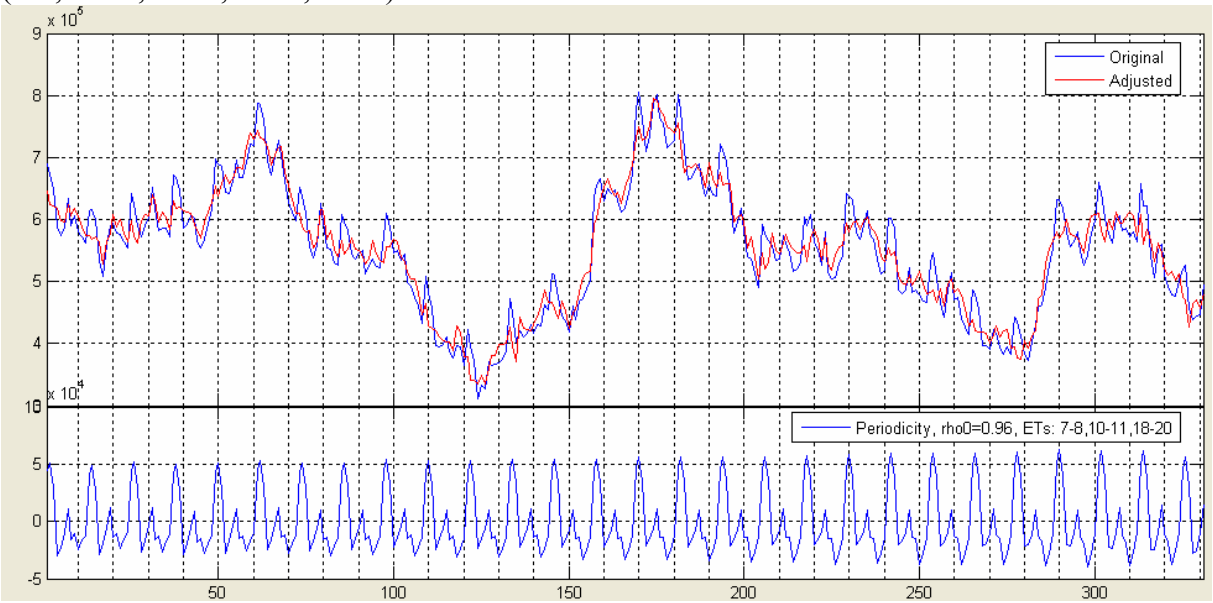


3) NewYork, seasonal adjustment:

Seasonal ETs: 7-8,10-11,18-20 (rho0=0.96)

Manual: 7-8(6), 10-11(12), 18(2), 19-20(4), 27-28(3 – disturbed by harmonic with T=14), 47-48(2.4)

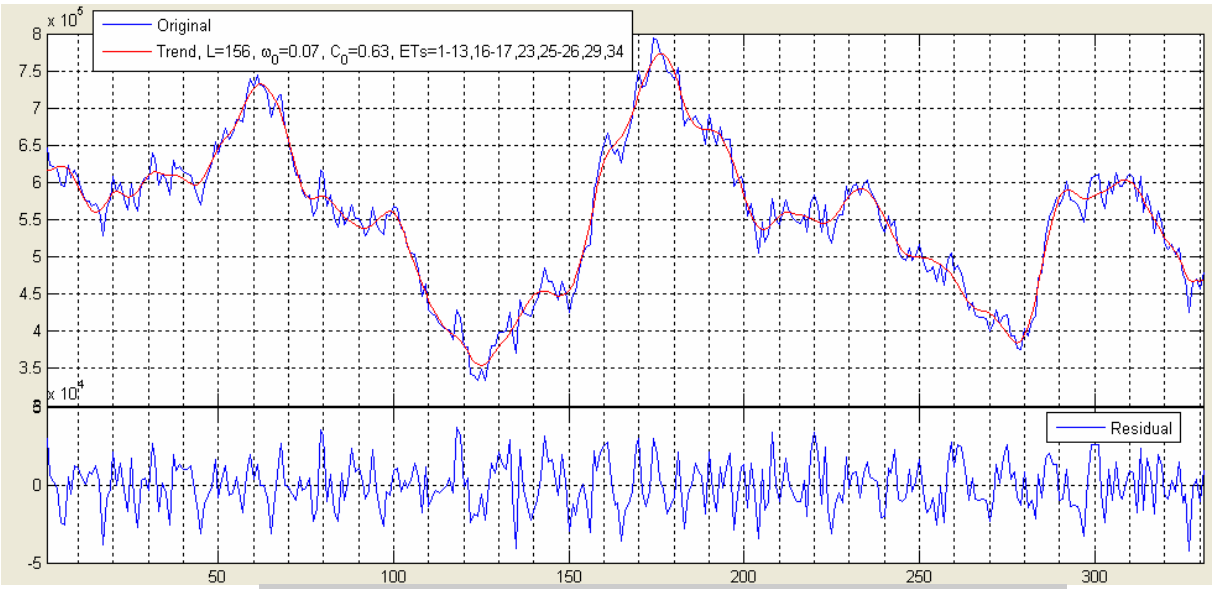
(7-8,10-11,18-20,27-28,47-48)

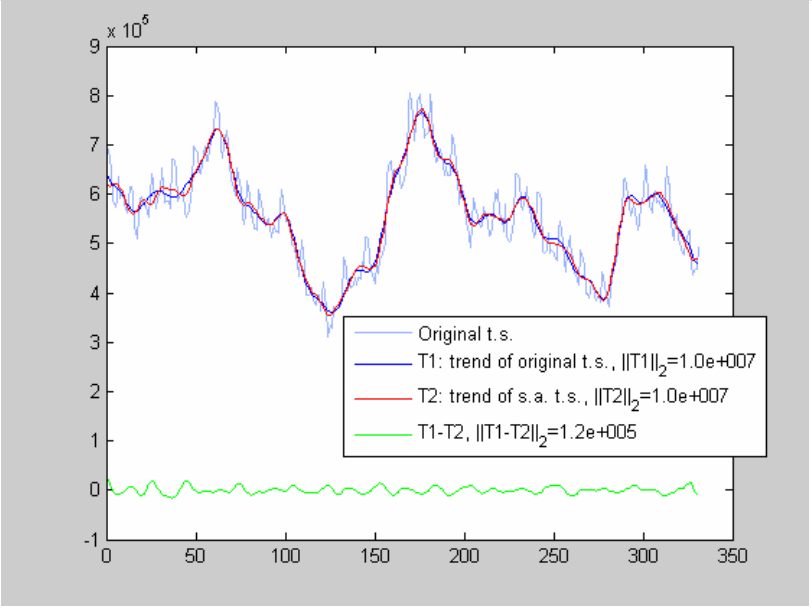


New York, trend of seasonally adjusted time series:

Trend ETs: 1-13,16-17,23,25-26,29,34 (C0=0.63)

Manual: 1-17

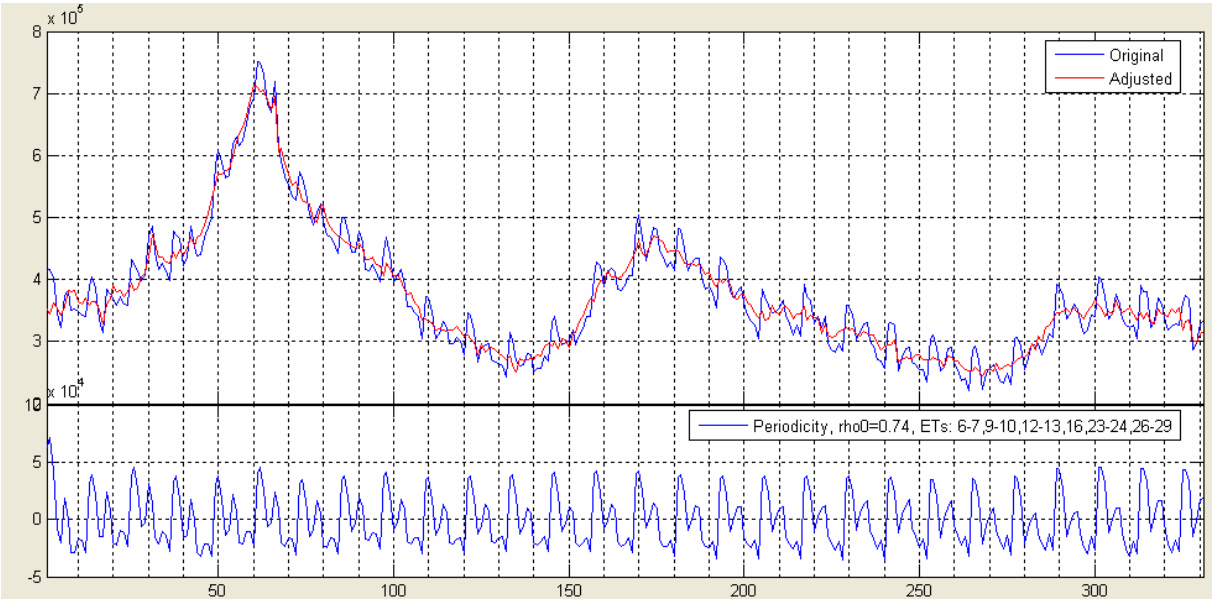




4) Pennsylvania, seasonal adjustment:

Seasonal ETs: 6-7,9-10,12-13,16,23-24,26-29 (rho0=0.74)

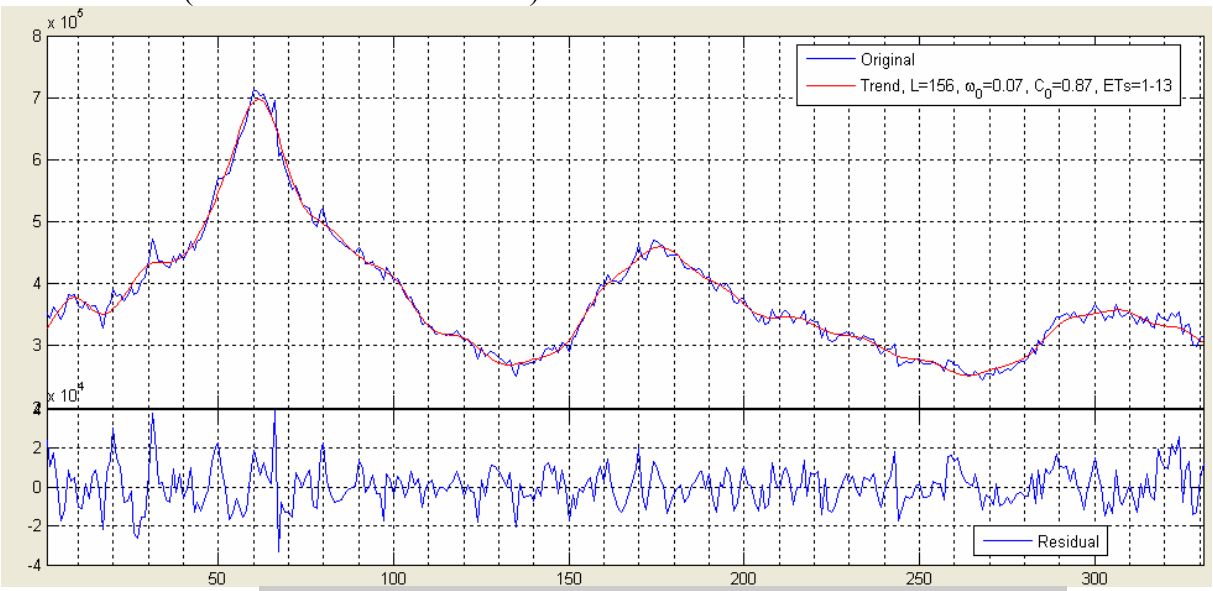
Manual: 6-7(12), 9-10(6), 12-13(4), 16(2), 23-24(2.4), 26-27(3) (6-7,9-10,12-13,16,23-24), big part of 28-29 is a harmonic with T=13

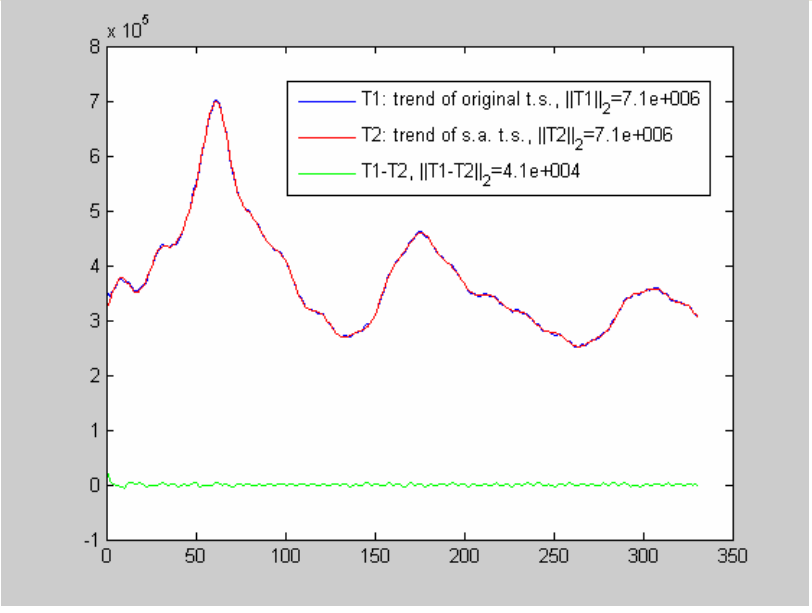


Pennsylvania, trend of seasonally adjusted time series:

Trend ETs: 1-13 (C0=0.87)

Manual: 1-16 (1-13 is better near borders)

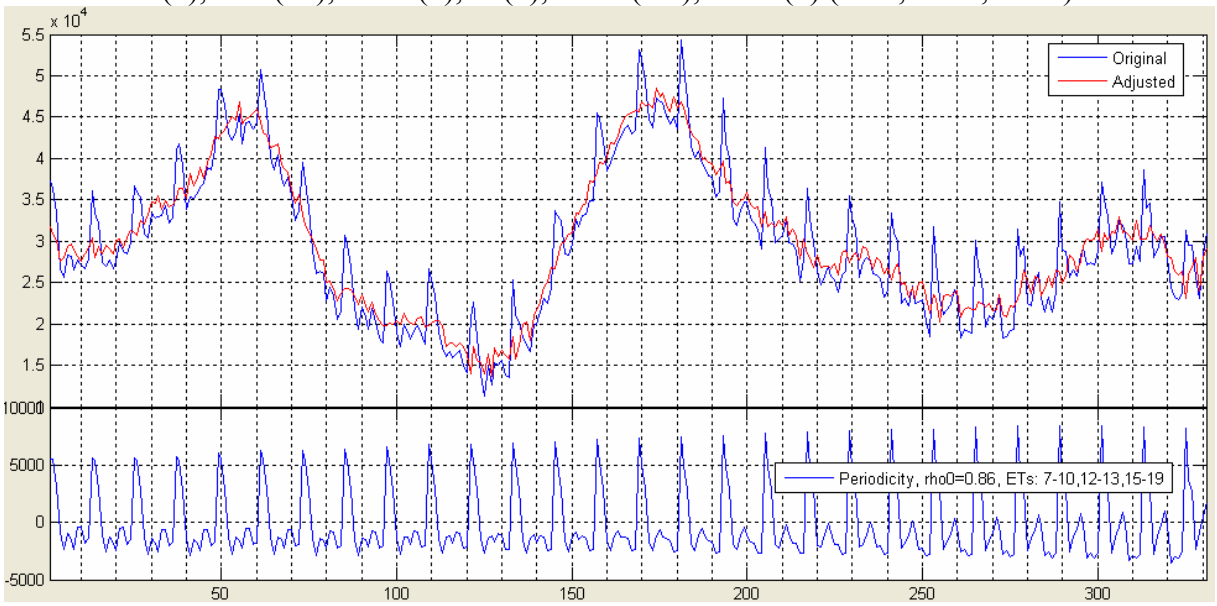




5) Rhode Island, seasonal adjustment:

Seasonal ETs: 7-10,12-13,15-19 (rho0=0.86)

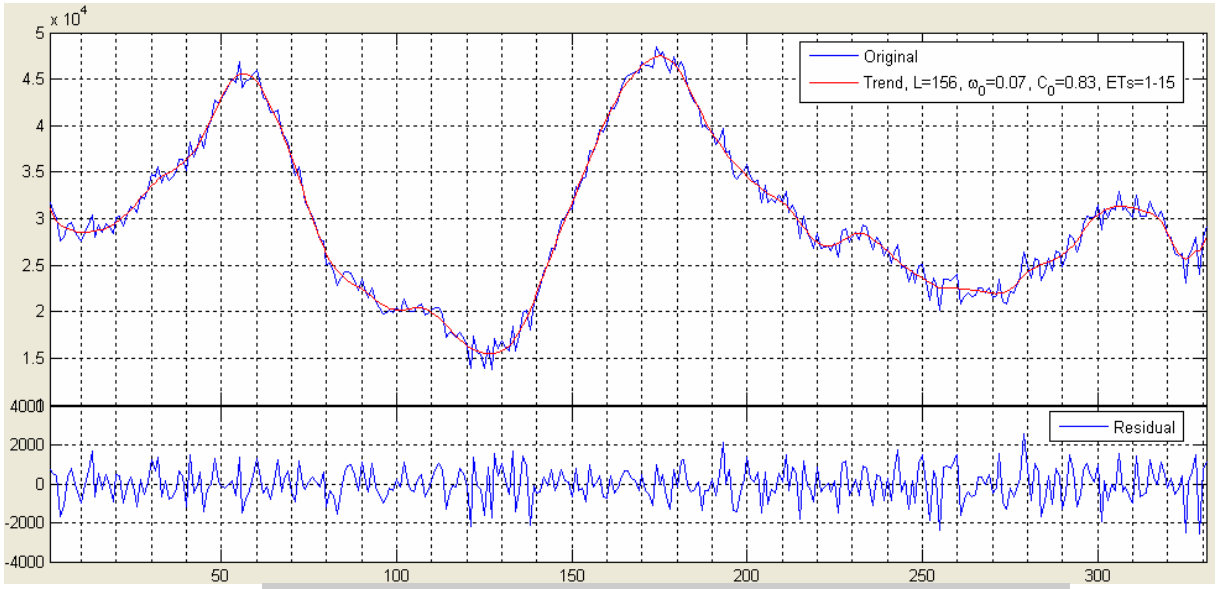
Manual: 7-8(6), 9-10(12), 12-13(4), 15(2), 16-17(2.4), 18-19(3) (7-10,12-13,15-19)

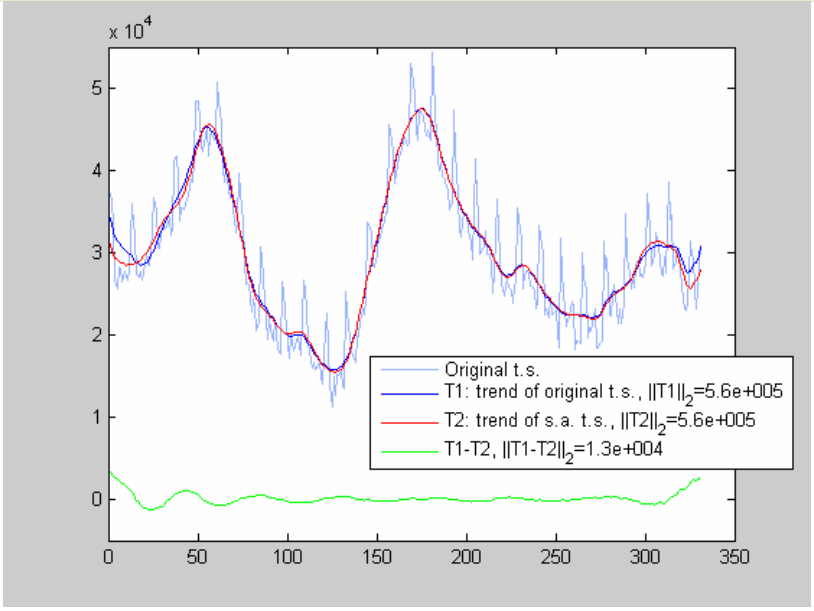


Rhode Island, trend of seasonally adjusted time series:

Trend ETs: 1-15 (C0=0.83)

Manual: 1-15



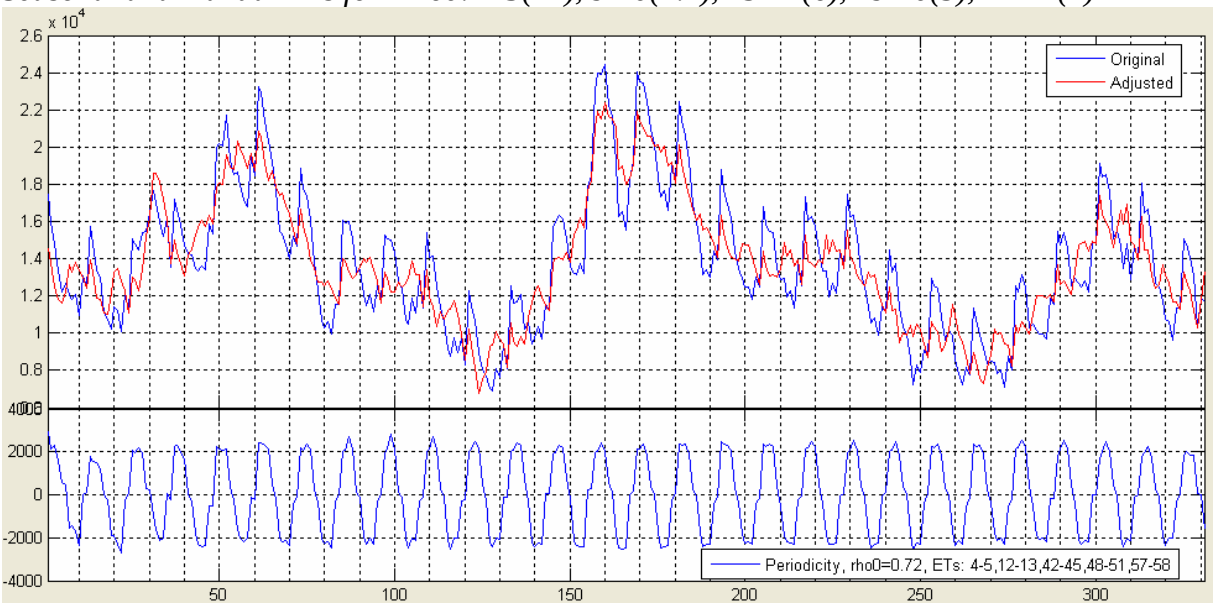


6) Vermont, seasonal adjustment:

Seasonal ETs: 4-5,12-13,42-45,48-51,57-58 (rho0=0.72)

Manual: 4-5(6), 11-13(2, 2.4, compound), part of harm with T=2.4 is in ET14, 16-17(6, compound), 29-31(3, compound) (4-5,11-13,16-17,29-31)

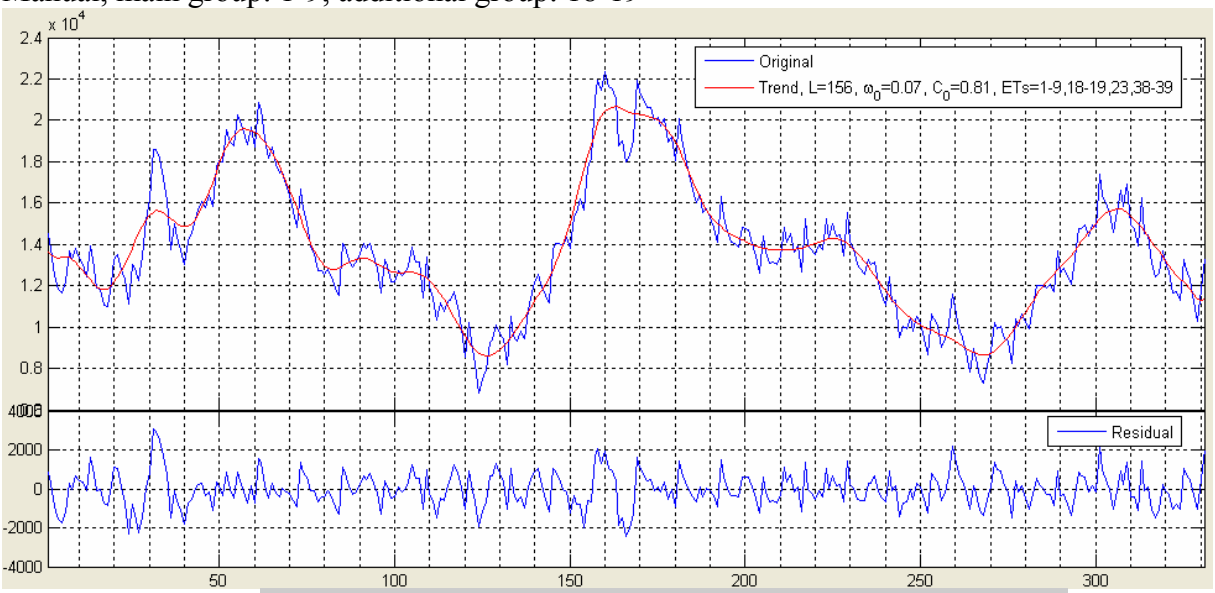
Seasonal and manual ETs for L=60: 4-5(12), 9-10(2.4), 13-14(6), 19-20(3), 21-22(4)

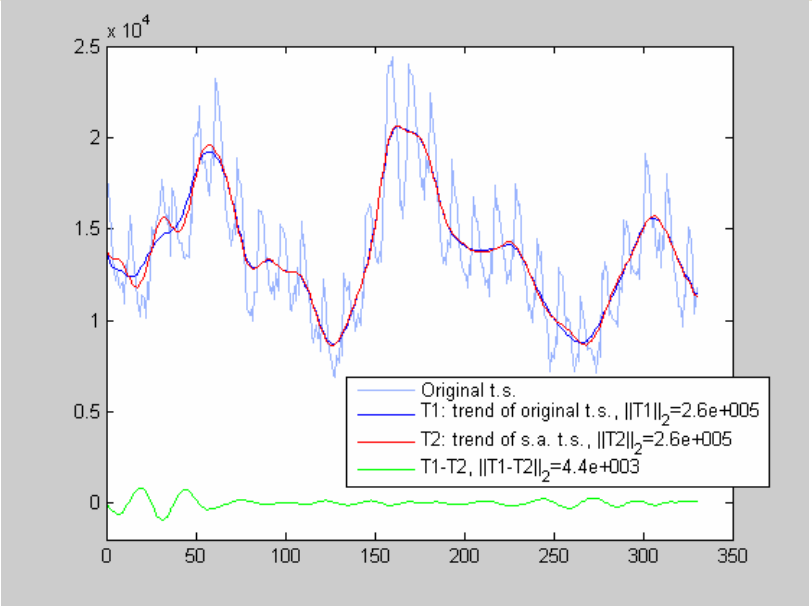


Vermont, trend of seasonally adjusted time series:

Trend ETs: 1-9,18-19,23,38-39 (C0=0.81)

Manual, main group: 1-9, additional group: 18-19

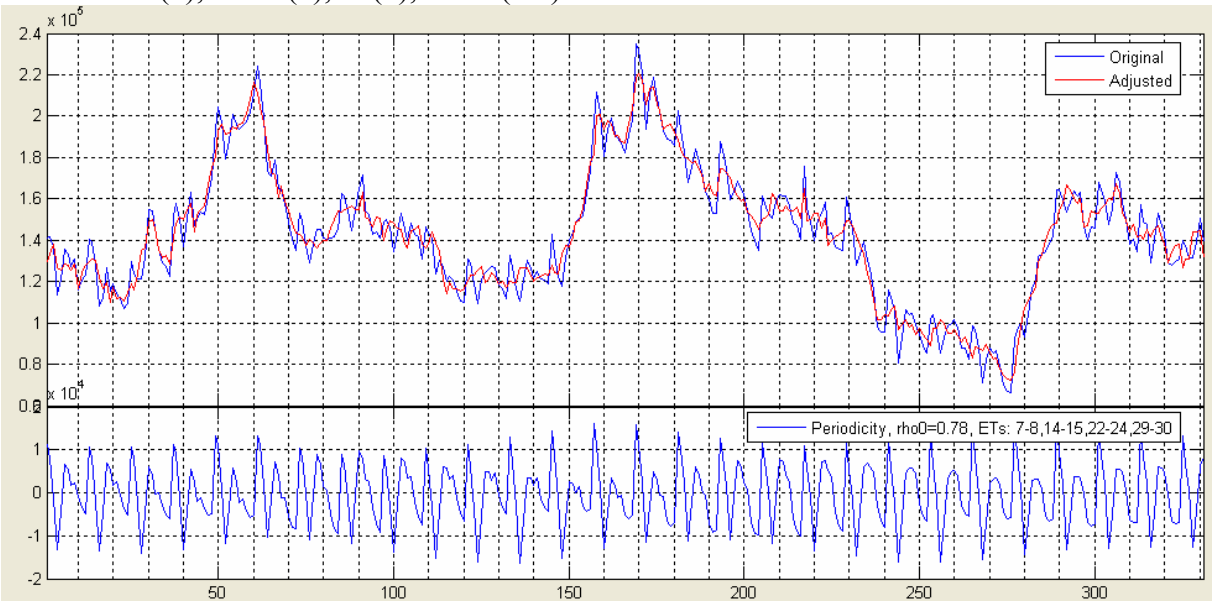




7) Virginia, seasonal adjustment:

Seasonal ETs: 7-8,14-15,22-24,29-30 (rho0=0.78). *ET22-23 isn't identified if est.period limits are [11.5,12.5].*

Manual: 7-8(6), 14-15(4), 24(2), 29-30(2.4).



Virginia, trend of seasonally adjusted time series:

Trend ETs: 1-11,14-19,22-23,26-27 (C0=0.61)

Manual: 1-11