Central England Temperature: Analysis and Forecasting

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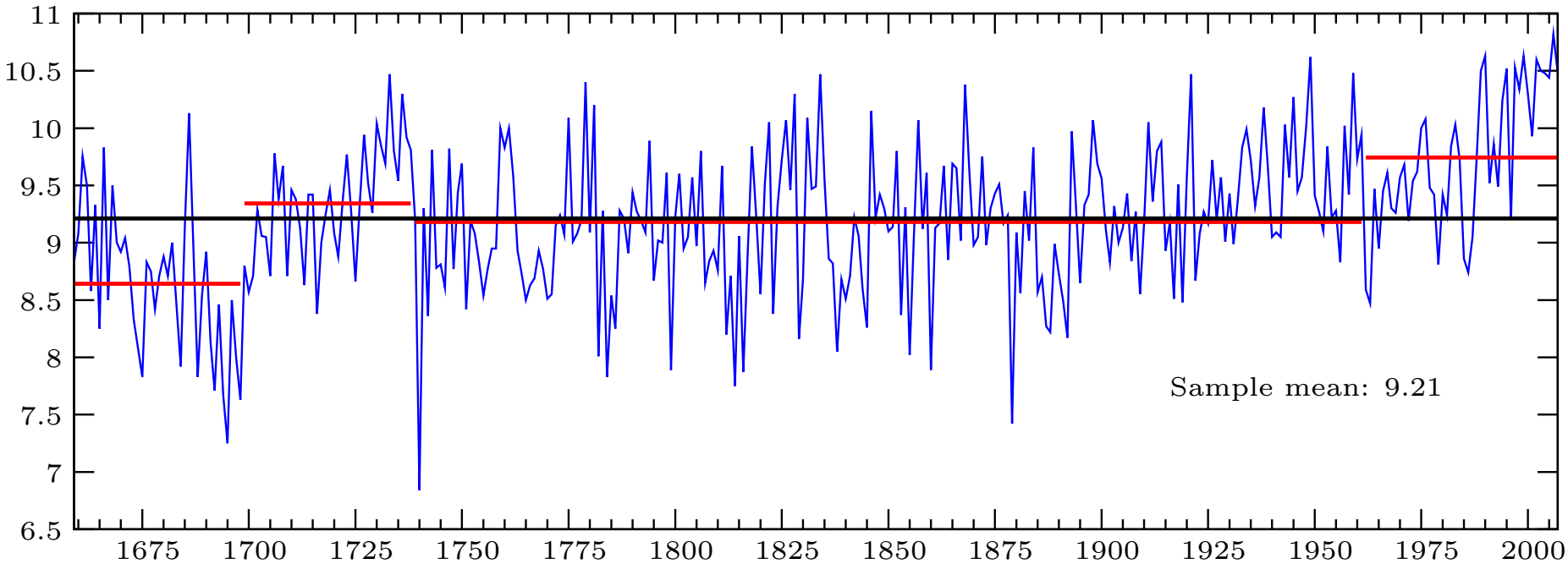

Periods	**1659-2007**	1659-1698	1699-1738	1739-1961	1962-2007
Mean	9.21	8.64	9.34	9.18	9.74
Median	9.21	8.71	9.38	9.18	9.68
Max	10.82	10.13	10.47	10.62	10.82
Min	6.84	7.25	8.38	6.84	8.47
Std. Dev.	0.66	0.64	0.49	0.61	0.62

References

Bujosa, M., García-Ferrer, A., & Young, P. C. (2007). Linear dynamic harmonic regression. *Comput. Stat. Data Anal.*, *52*, 999–1024. 9

García-Ferrer, A., Girón, F. J., & Moreno, E. (2008). A Bayesian approach for detecting multiple turning points in economic time series. Working Paper WP2008/13, Universidad Autónoma de Madrid, Madrid, Spain.

Parker, D. E., Legg, T. P., & Folland, C. K. (1992). A New Daily Central England Temperature Series, 1772–1991. *International Journal of Climatology*, *12*, 317–342.

Thomson, D. J. (1995). The seasons, global temperature and precession. *Science*, *268*, 59–67.

Young, P. C. (2000). Analysis of Nonstationary Climatic Time-Series:Central England and Antarctic Air Temperature Series. CRESearch TR/182, Centre for Research on Environmental Systems and Statistics, Lancaster, UK.

- Data also available on monthly and daily bases. Anual CETs are the least uncertain

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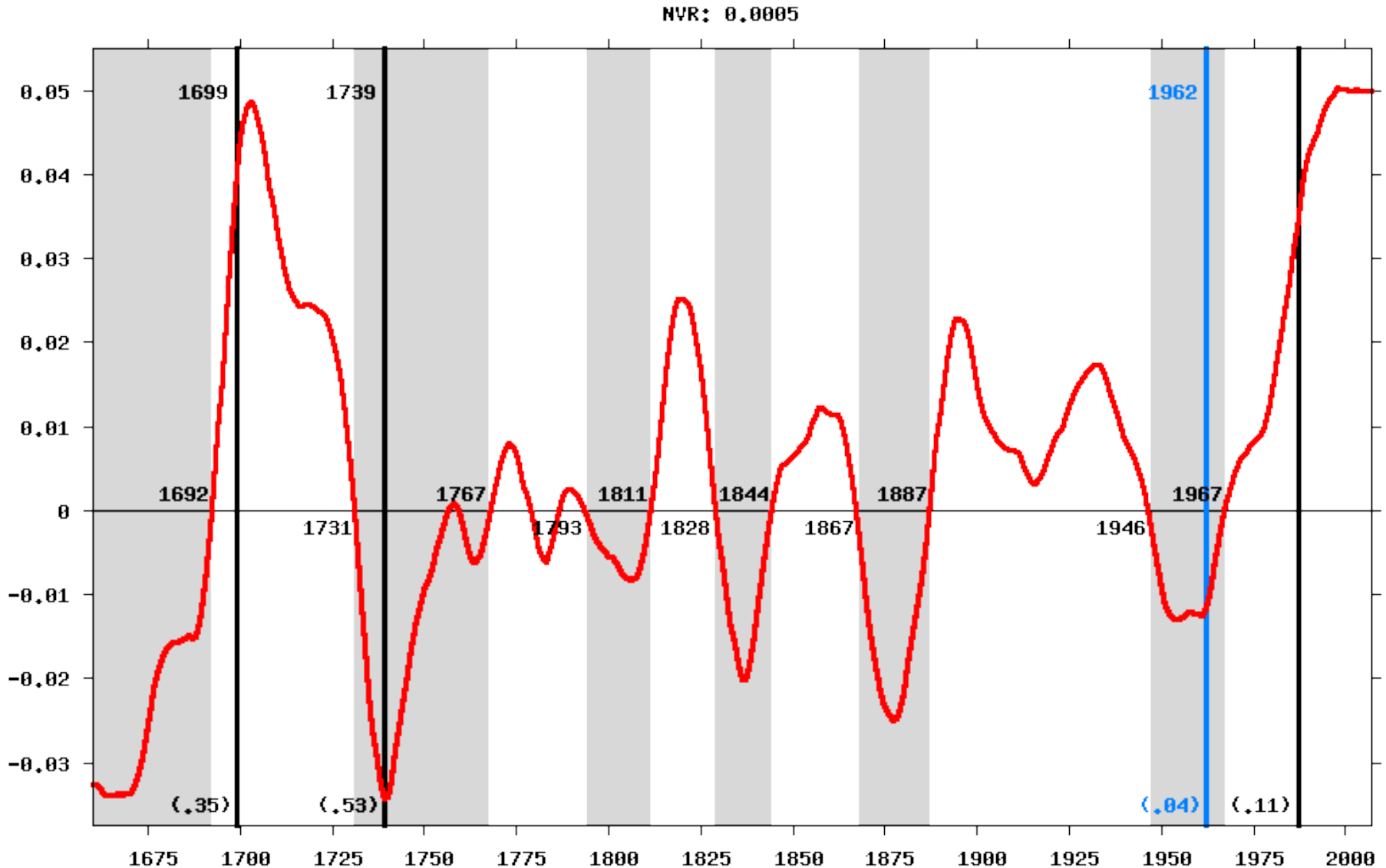
- Over the years data quality have been re-assessed reducing uncertenty due to the:
  - choice of stations
  - calibrations errors
  - reading precision errors
  - random screen errors
  - correction of urbanization bias
  - Changes in instrumentation and exposure
  - etc.

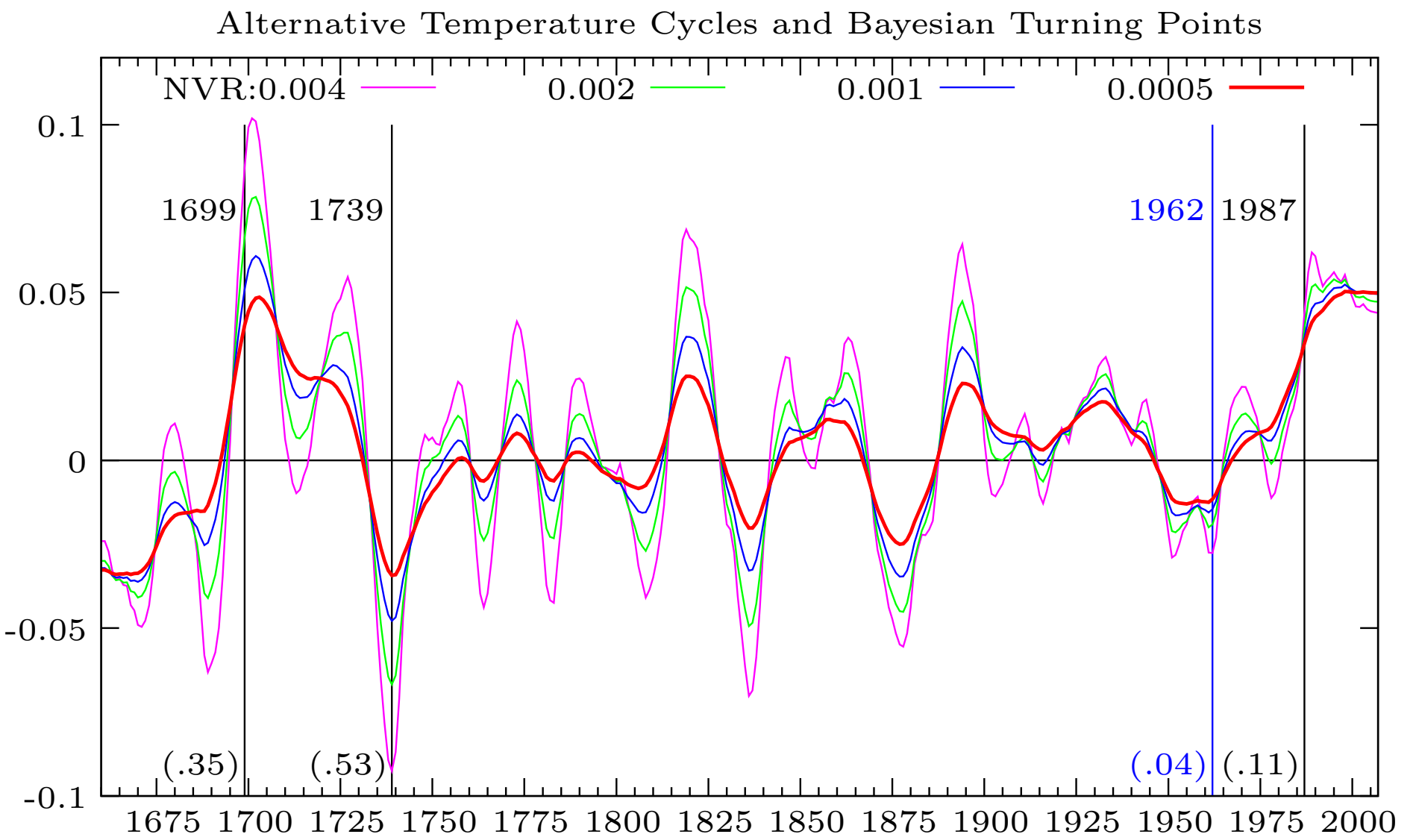
$$y_t \;=\; T_t \;+\; e_t$$

$$(1-\alpha L)(1-L)T_t = \xi_t; \qquad 0 \le \alpha \le 1;$$

where $\begin{cases} e_t & \sim \text{w.n.}\,(0,\sigma_e^2) \\ \xi_t & \sim \text{w.n.}\,(0,\sigma_T^2) \end{cases}$ and $\text{Corr}\,(e_t,\xi_t) = 0.$

$$NVR = \sigma_T^2/\sigma_e^2$$


NVR: 0.0005
0.05
0.04
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
1699
1739
1962
1692
1731
1767
1793
1811
1828
1844
1867
1887
1946
1967
(.35)
(.53)
(.04)
(.11)
1675
1700
1725
1750
1775
1800
1825
1850
1875
1900
1925
1950
1975
2000


Alternative Temperature Cycles and Bayesian Turning Points
NVR:0.004
0.002
0.001
0.0005
0.1
0.05
0
-0.05
-0.1
1699
1739
1962
1987
(.35)
(.53)
(.04)
(.11)
1675 1700 1725 1750 1775 1800 1825 1850 1875 1900 1925 1950 1975 2000

Using LDHR (Bujosa et al., 2007)

Restricted identification: RW

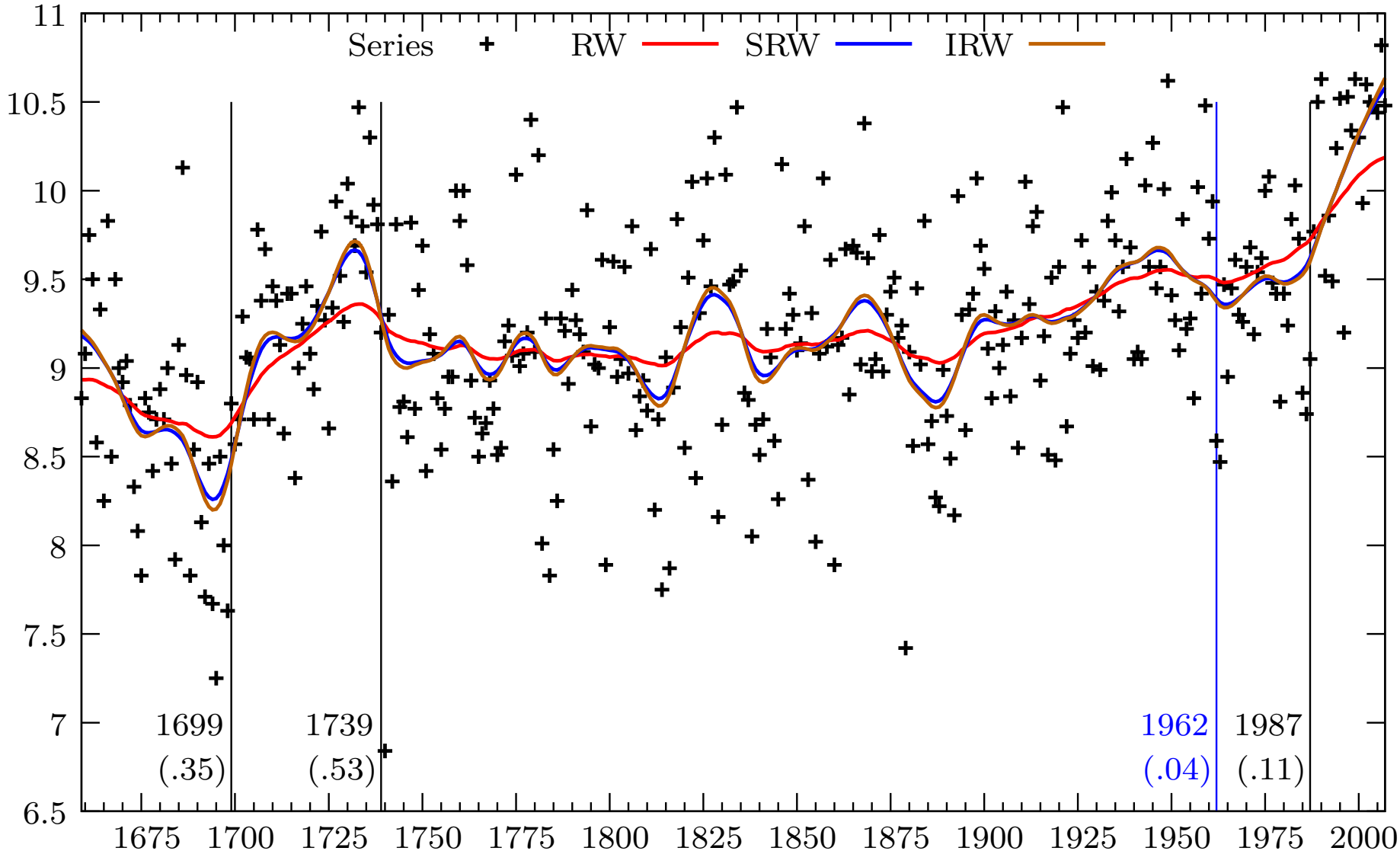
- $NVR = 0.0083$
- Cycles $>$ 116 years
- AR(20)

Free automatic identification: SRW ($\alpha = 0.91$)

- $NVR = 0.00328$
- Cycles $>$ 38,56 years
- AR(20)

forced identification: IRW

- $NVR = 0.00466$
- Cycles $>$ 34,70 years
- AR(11)


Series
RW
SRW
IRW
11
10.5
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1800
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(.35)
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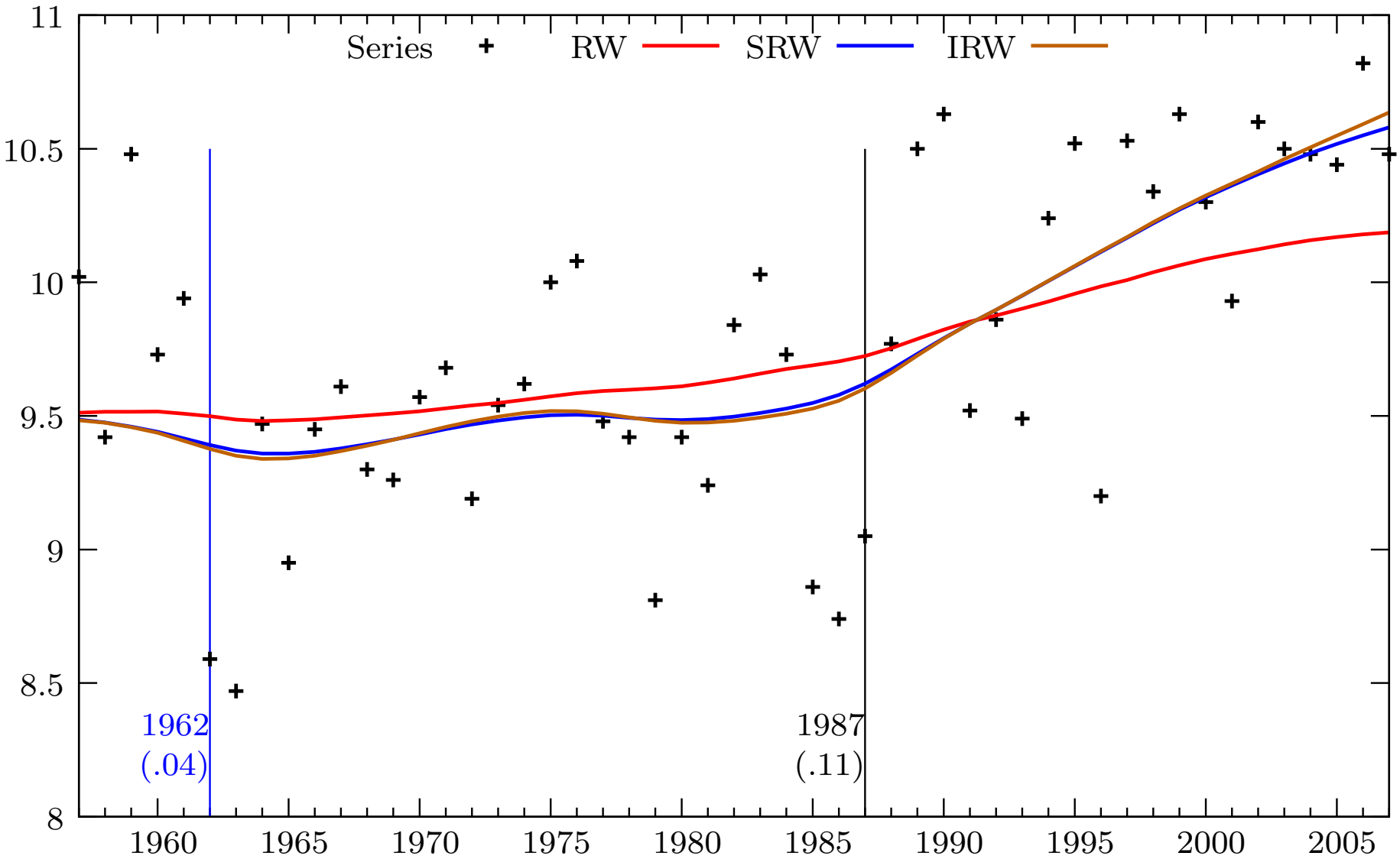
1962
(.04)
1987
(.11)


Series
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IRW
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10.5
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9.5
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8.5
8
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1965
1970
1975
1980
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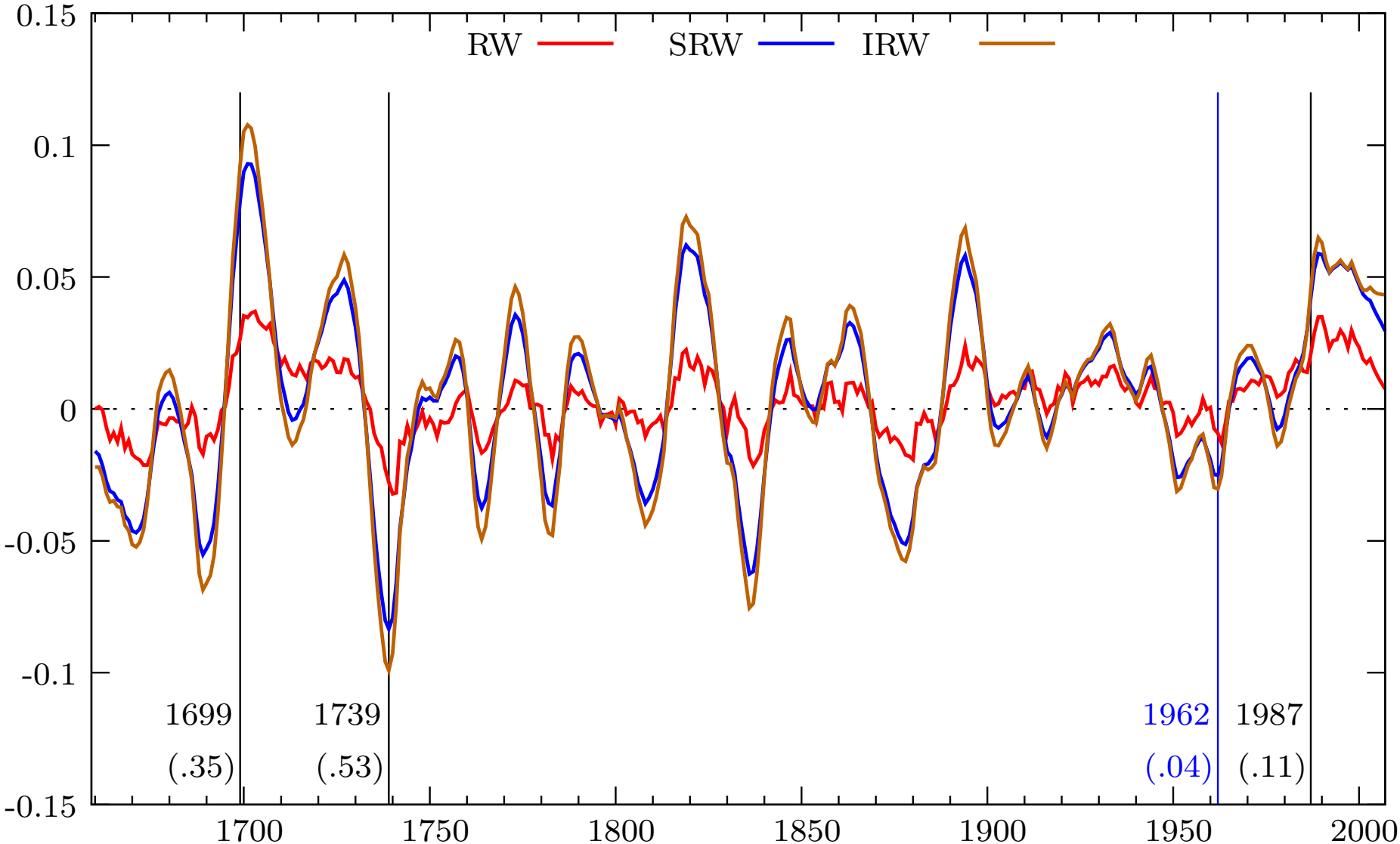
1990
1995
2000
2005
1962
(.04)
1987
(.11)


RW
SRW
IRW
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
1699
(.35)
1739
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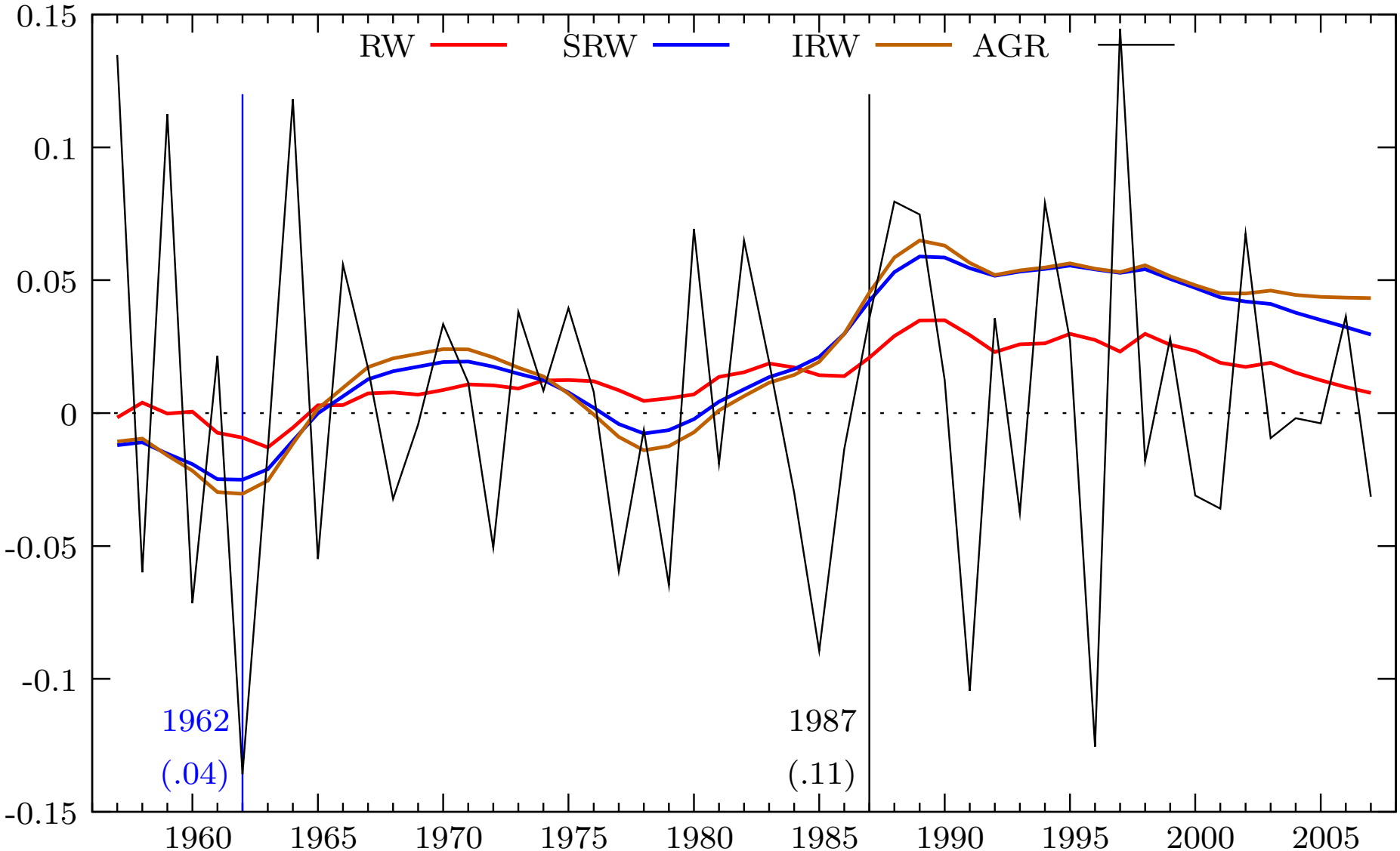
2000


RW
SRW
IRW
AGR
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
1962
(.04)
1987
(.11)
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005

- What can we conclude from this evidence?
  - Is the rise in the mean temperature over the last 50 years significant in statistical terms?

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  - Is it clear whether, in England at least, we are in the middle of a more permanent increase in annual mean temperatures or whether as in the early part of the CET series, we are encountering a perturbational increase that will be reversed some time in the future?

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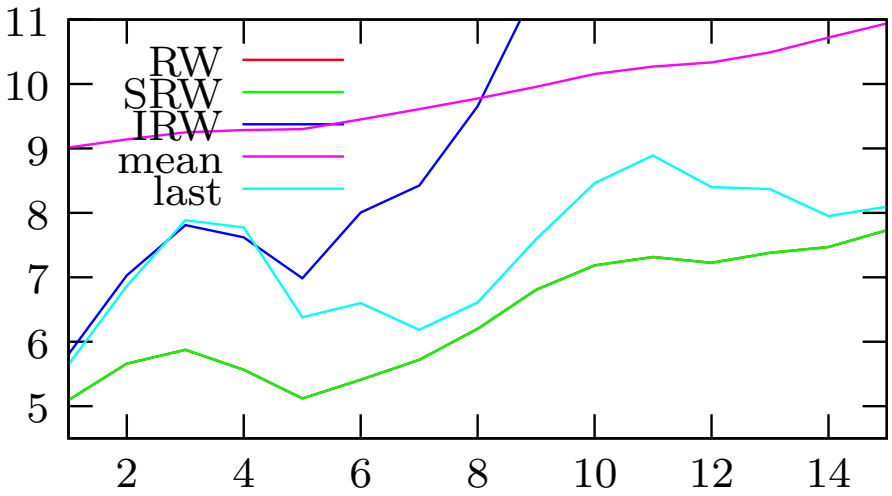
  - What are the relevant forecasting exercises?

1. Using the whole sample

animation

RMSPE



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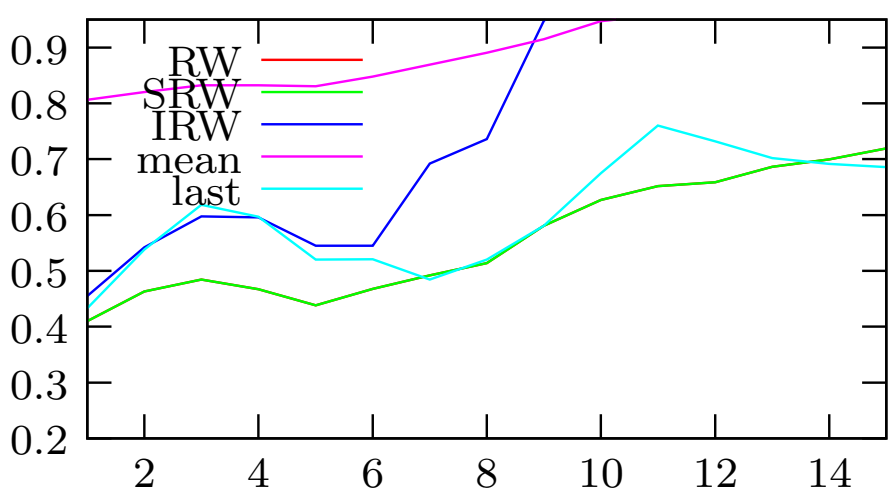

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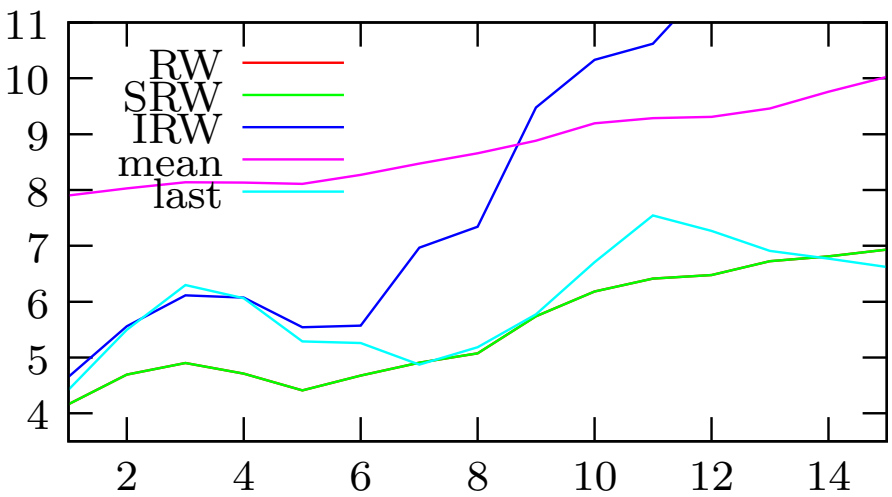

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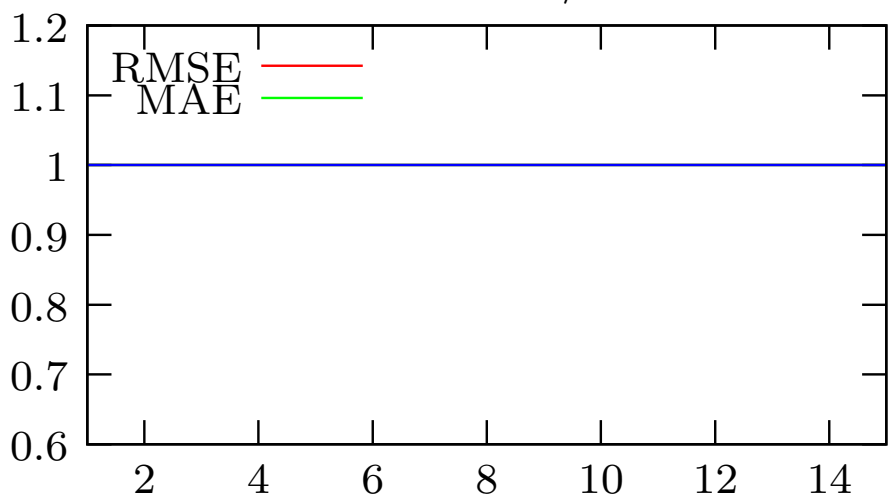
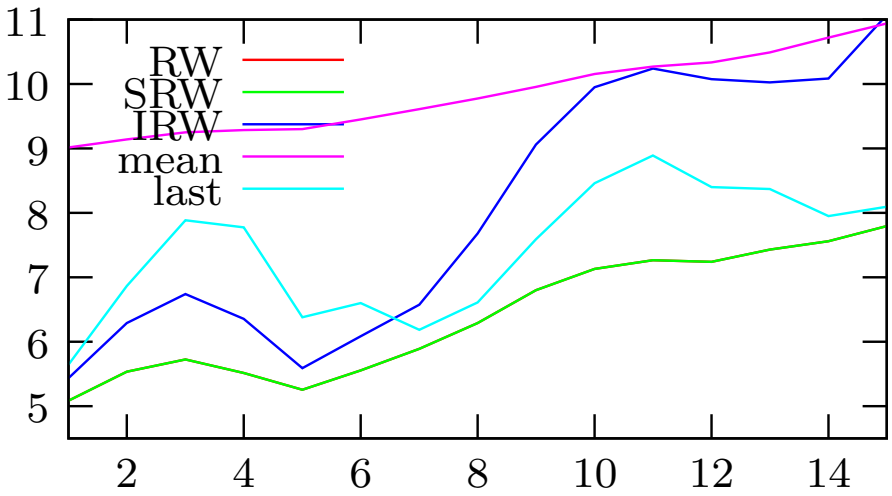


animation

RMSPE



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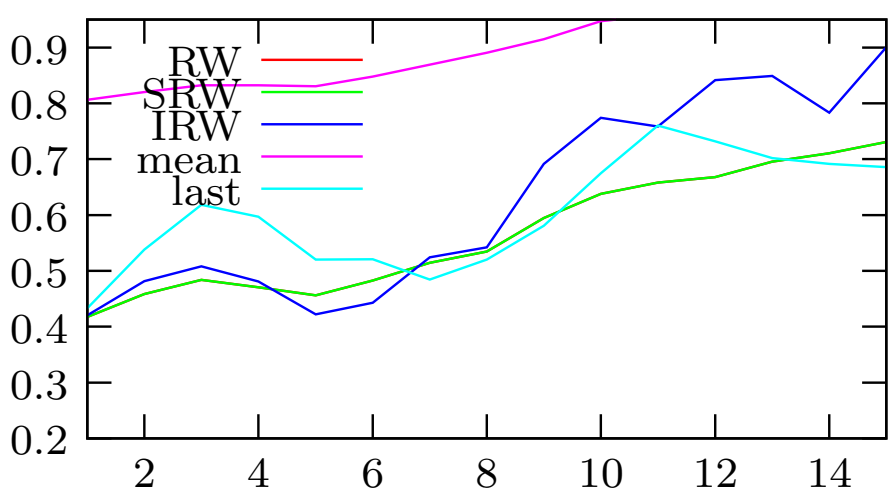

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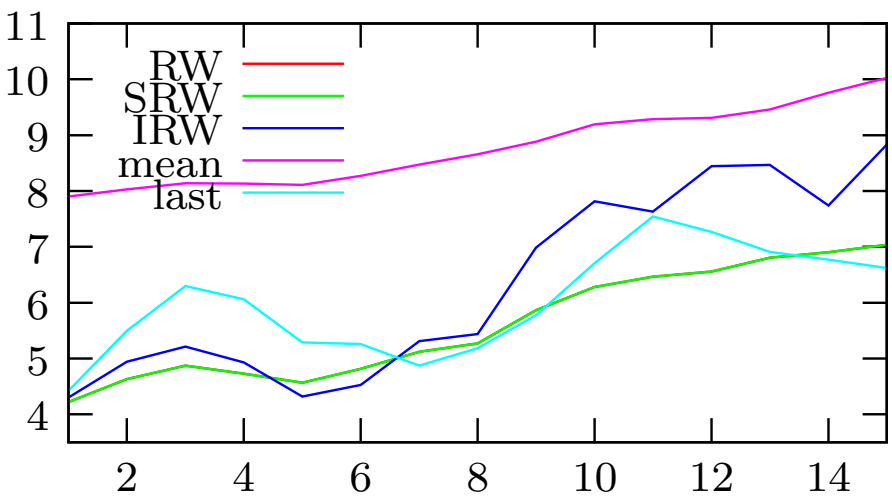

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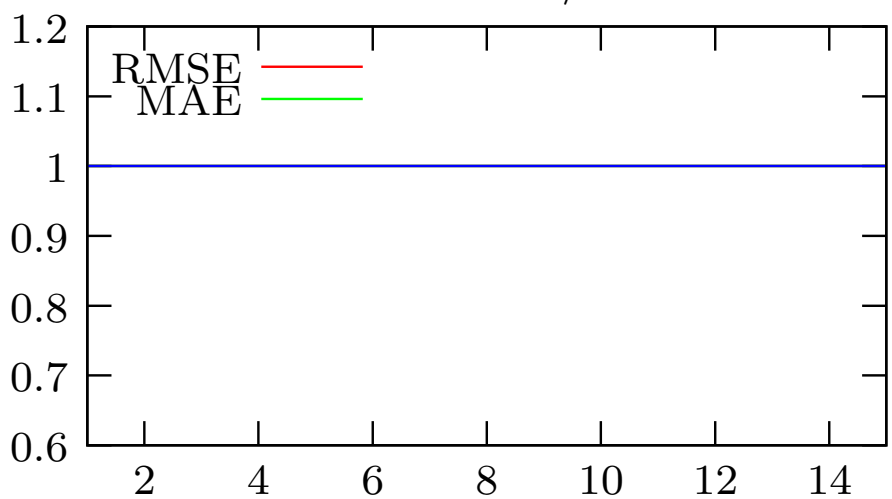

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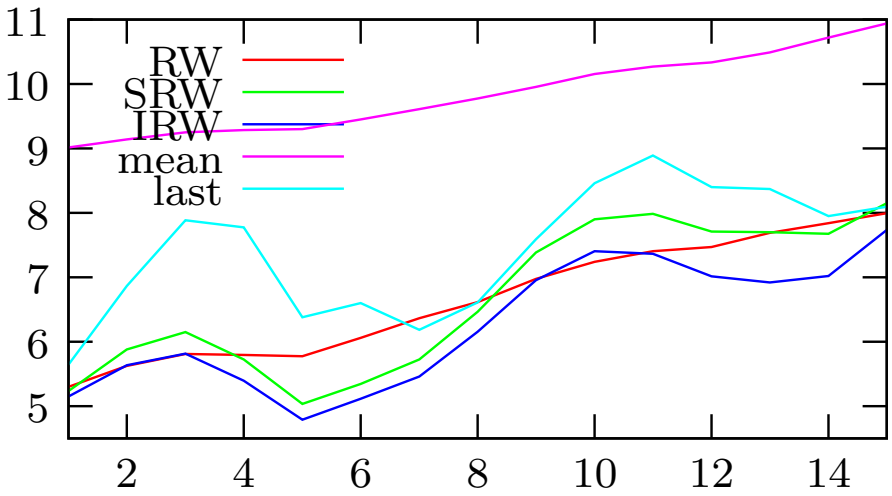

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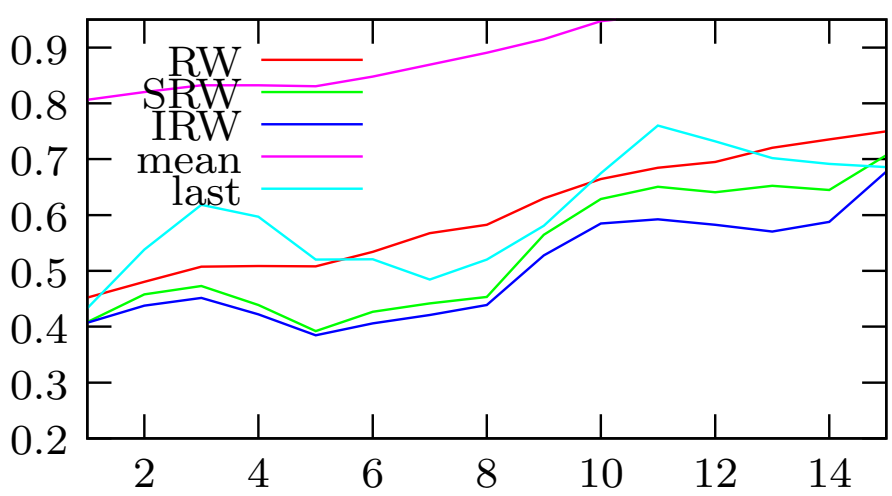

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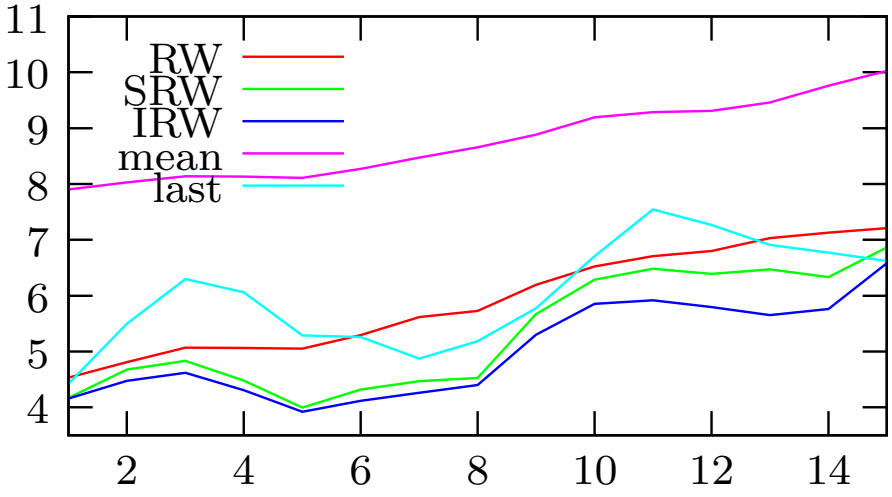

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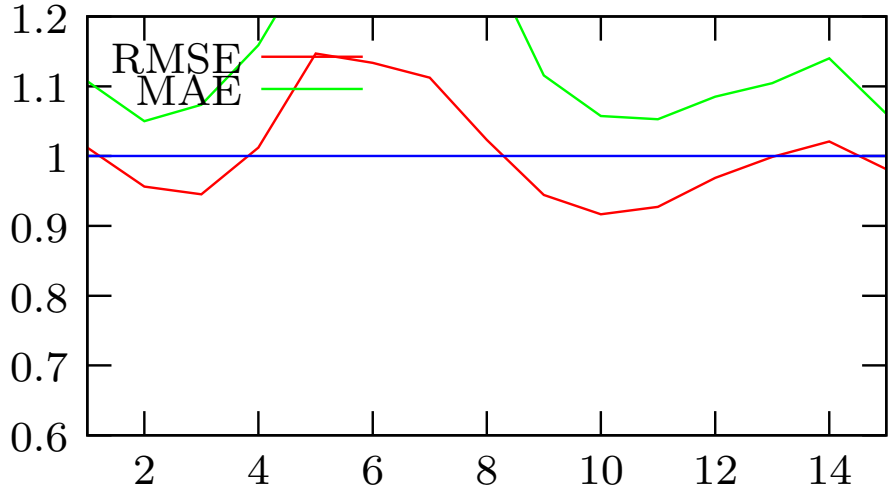

animation

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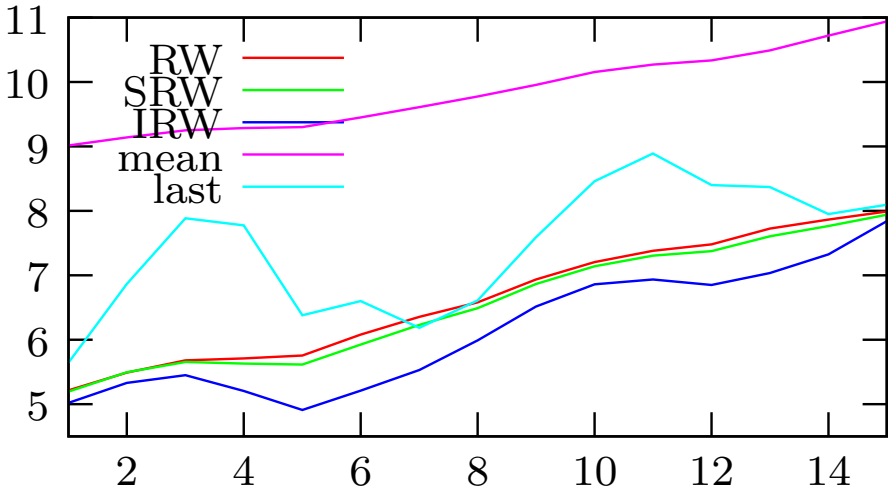

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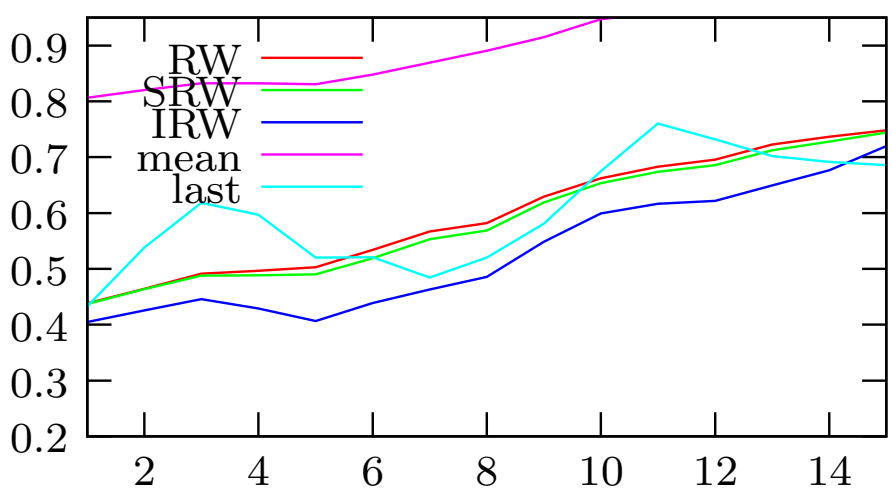

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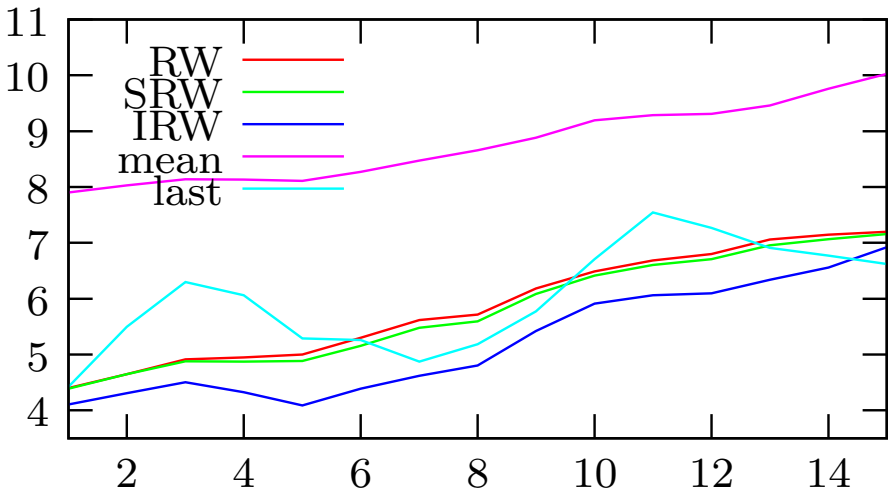

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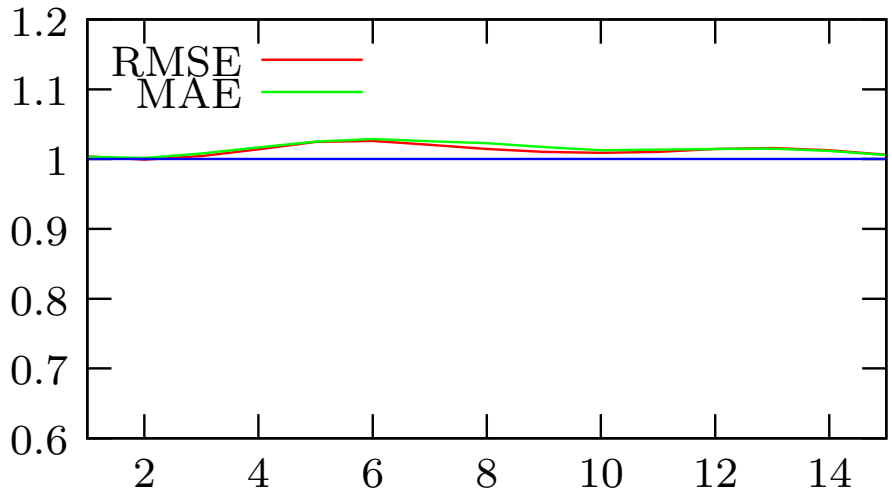
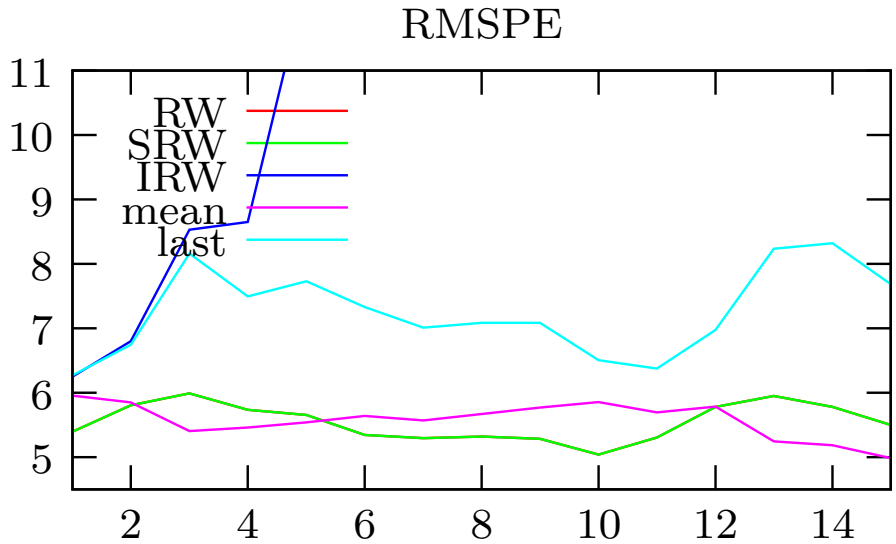


2. Removing the last 25 obsevations

animation


RMSPE
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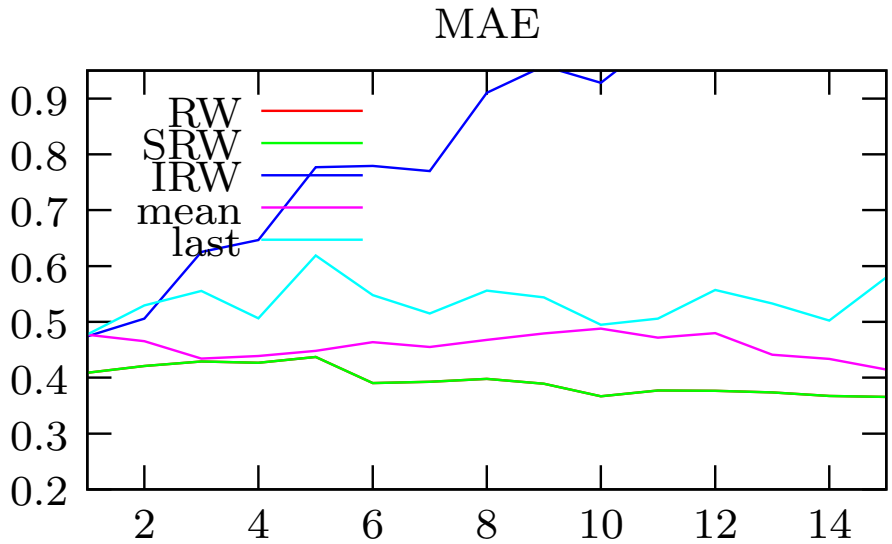
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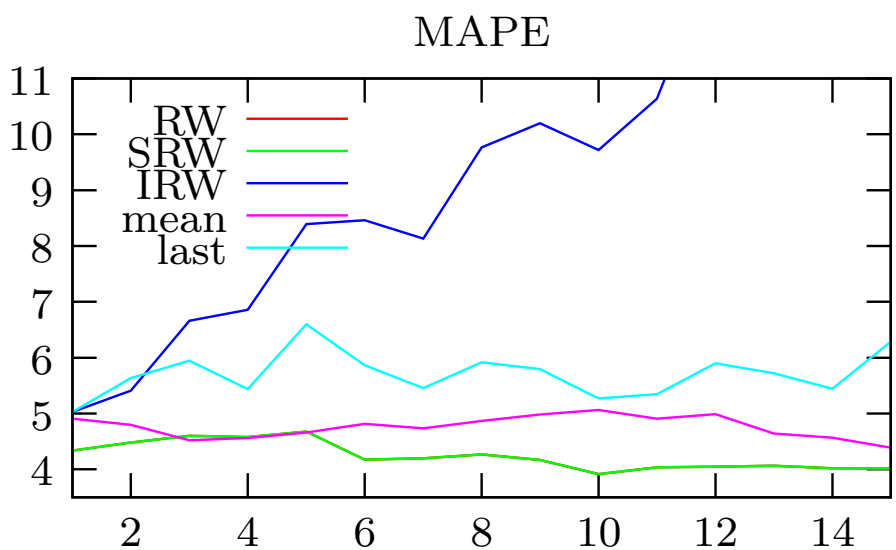
MAPE
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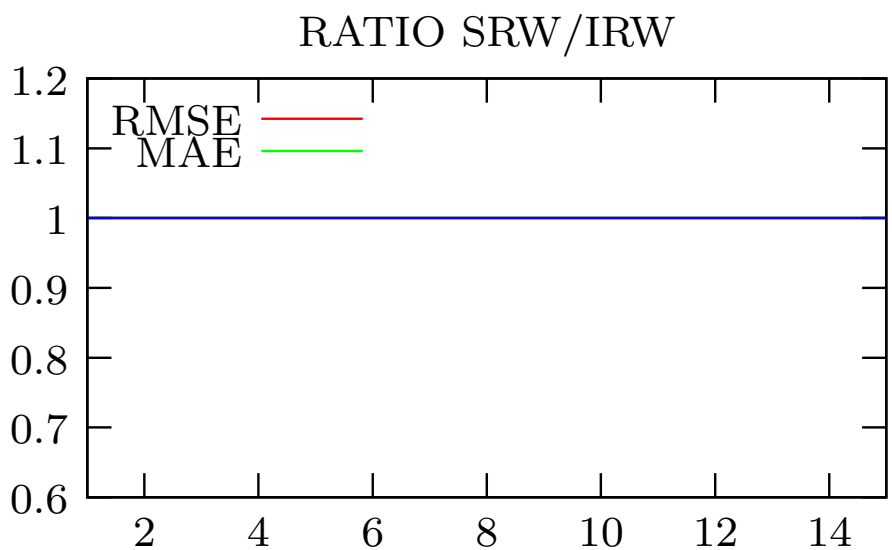
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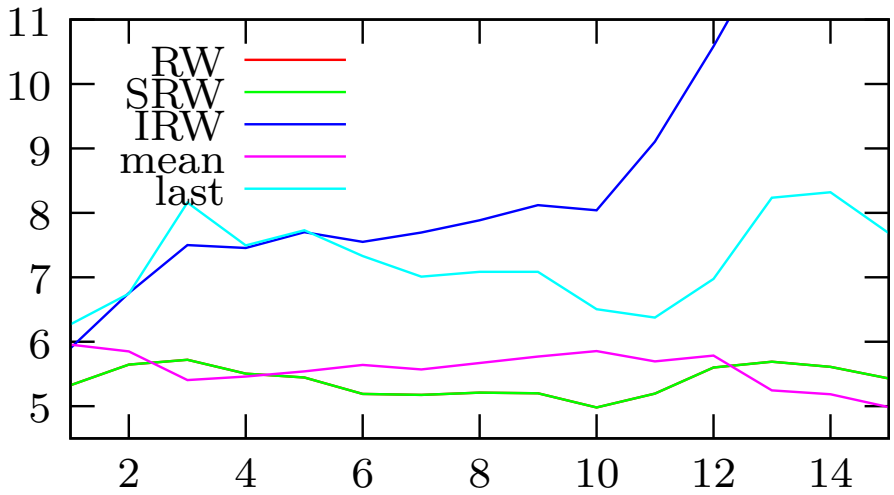
animation

RMSPE



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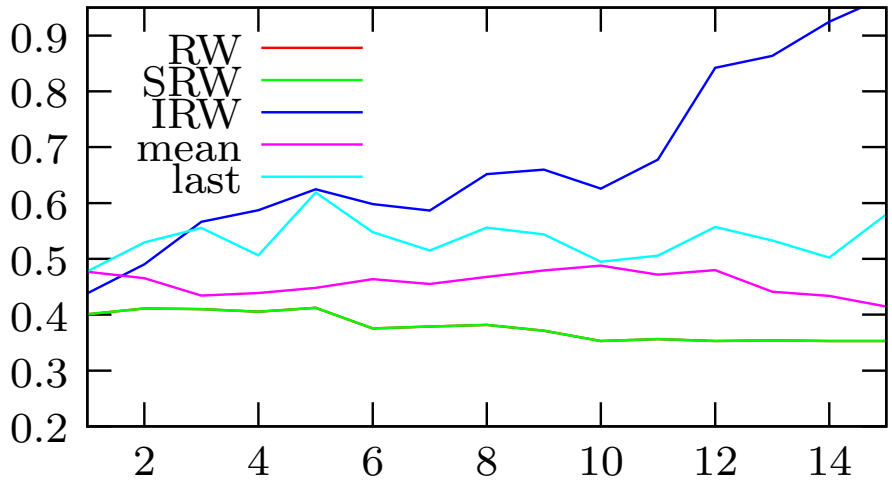

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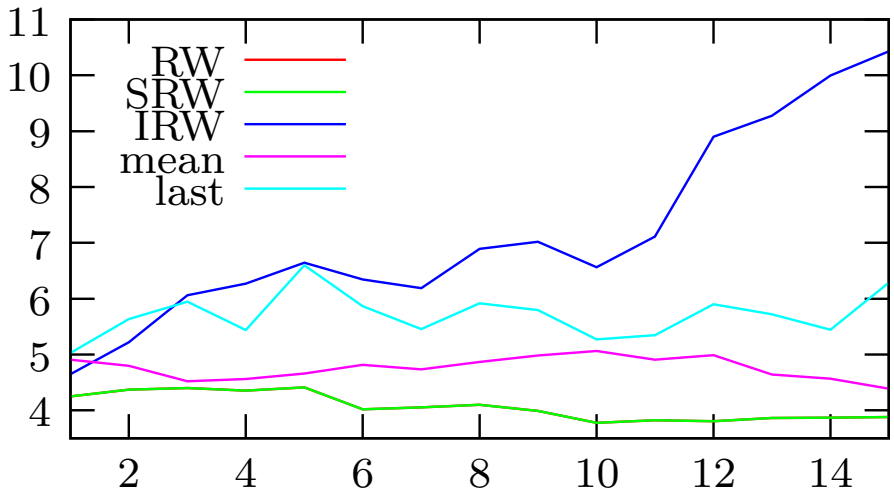

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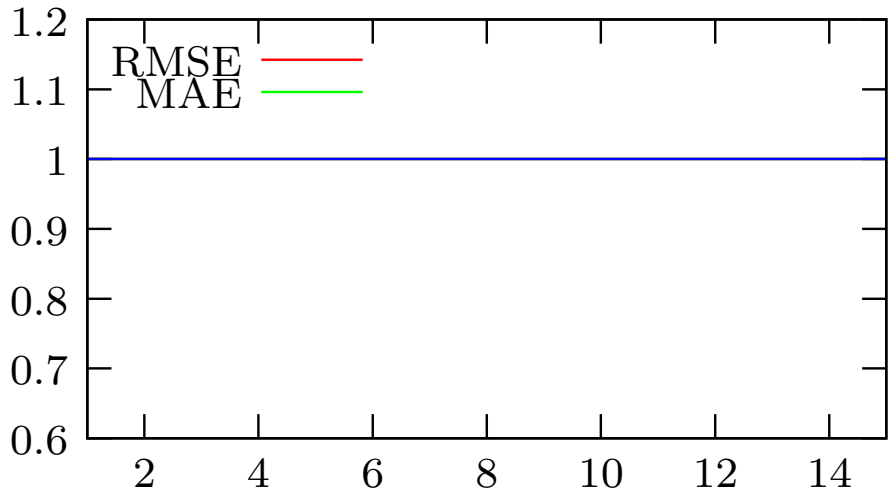

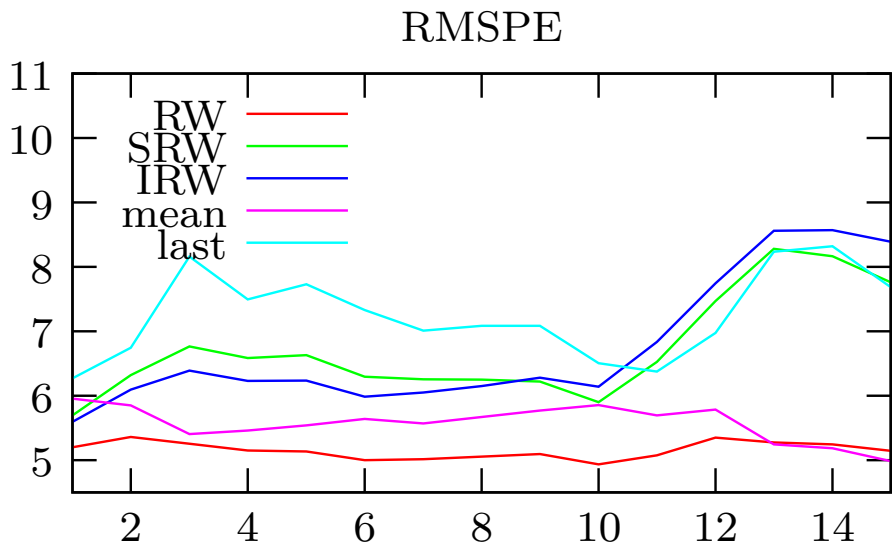
RMSPE
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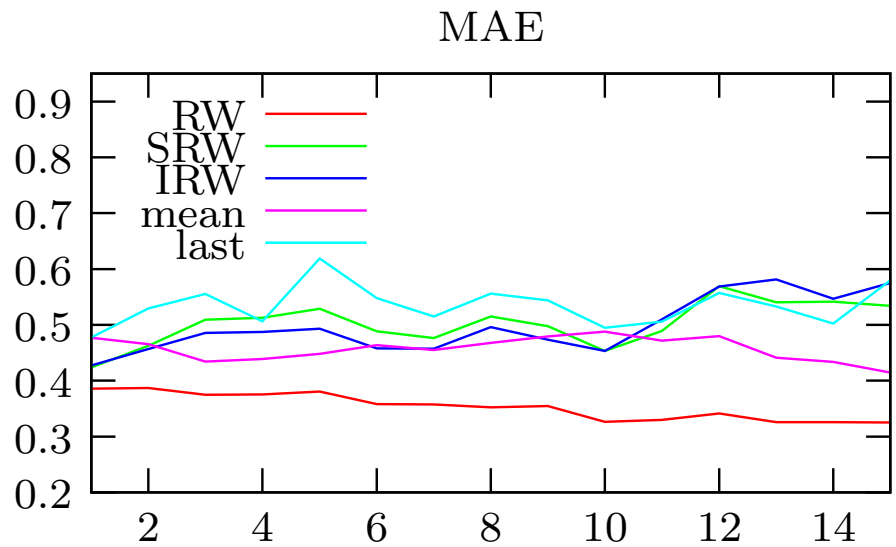
MAE
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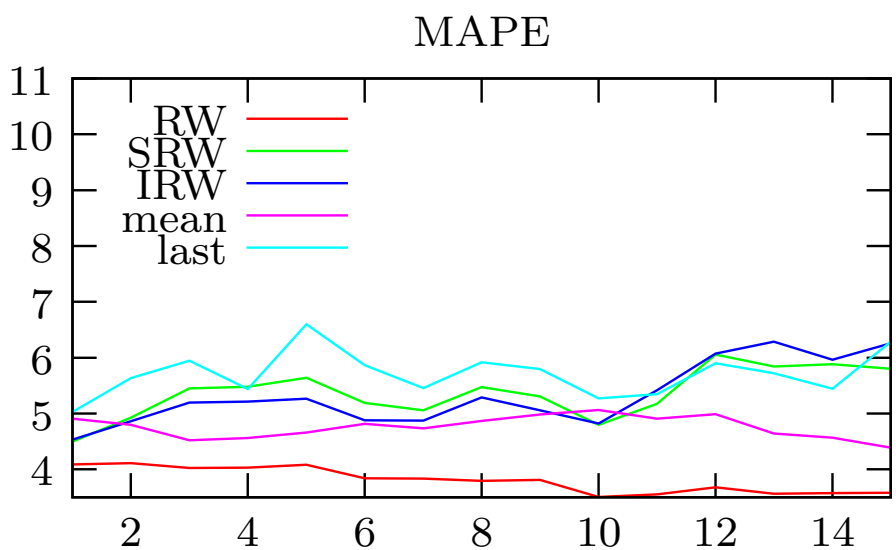
MAPE
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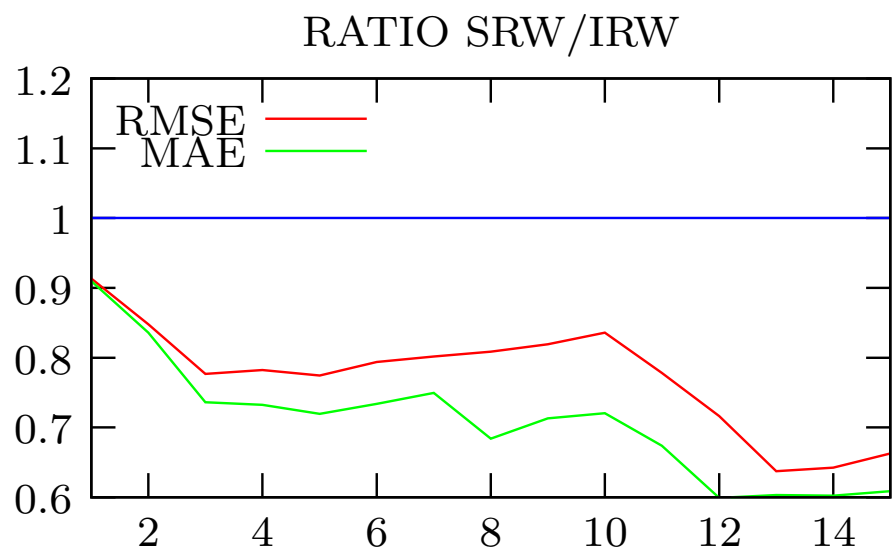
RATIO SRW/IRW
RMSE
MAE
1.2
1.1
1
0.9
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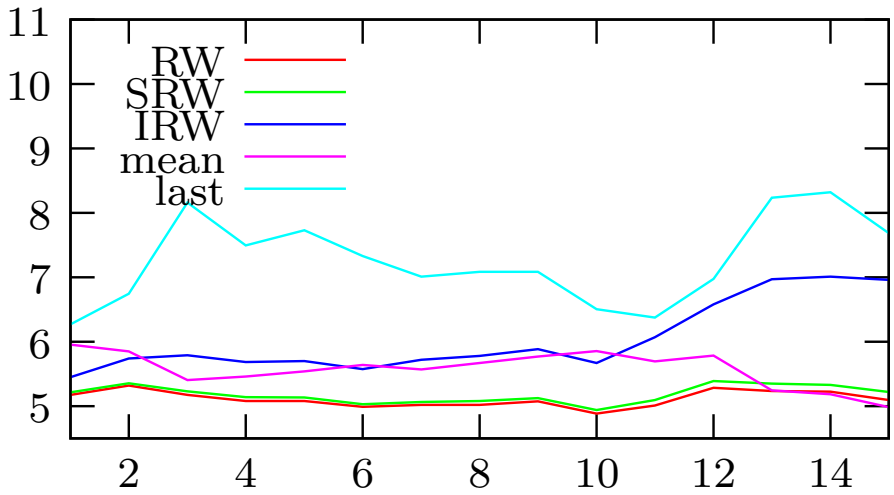
animation

RMSPE



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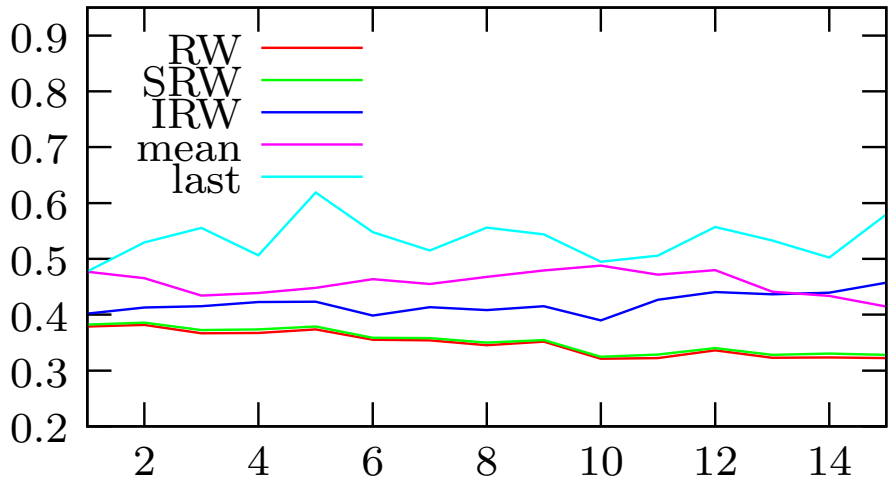

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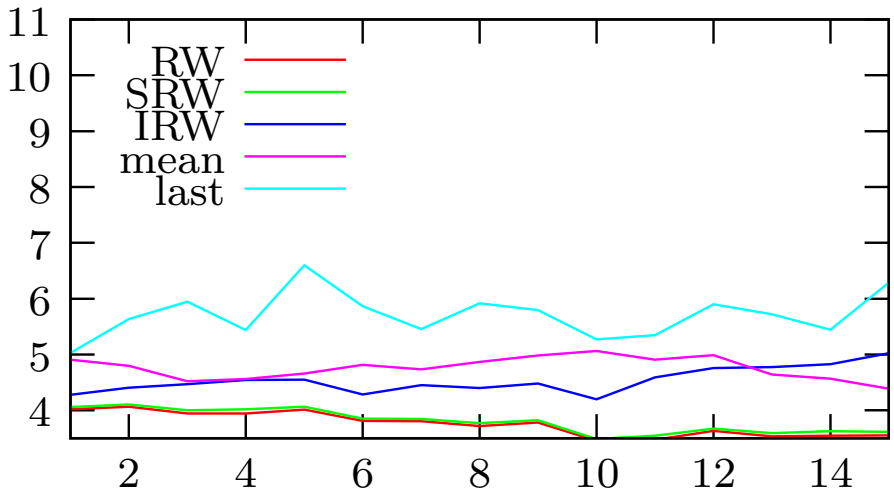
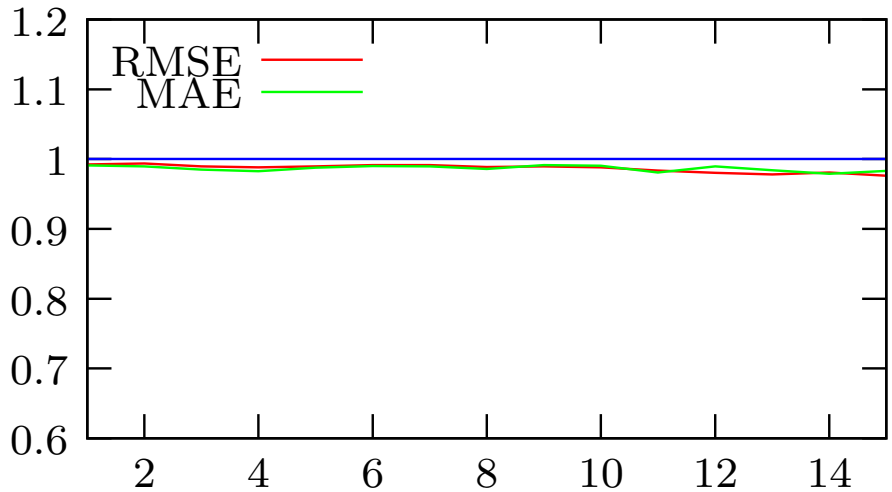


RATIO SRW/IRW



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