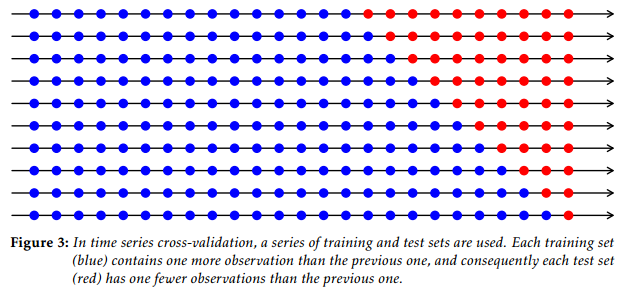
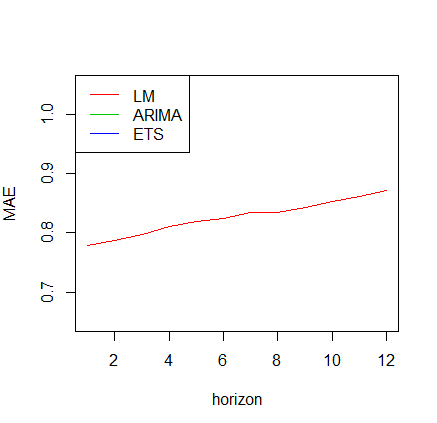
From here <http://www.robjhyndman.com/papers/forecast-accuracy.pdf>

# Example1: add 1 on training set

Training set keeps on growing by 1

Test set for next 12 and then decreases to the last value





LM only shown in graph

> i=1

> window(a10, start=st + (i+1)/12, end=st + (i+12)/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1996 6.486849 6.300569 6.467476 6.828629 6.649078

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716

Dec

1996 8.606937

1997

> n-k

[1] 144

> n

[1] 204

> k

[1] 60

> window(a10, start=st + (i+1)/12, end=st + (i+12)/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1996 6.486849 6.300569 6.467476 6.828629 6.649078

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716

Dec

1996 8.606937

1997

> i=2

> window(a10, start=st + (i+1)/12, end=st + (i+12)/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1996 6.300569 6.467476 6.828629 6.649078

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716 7.050831

Dec

1996 8.606937

1997

> i=3

> window(a10, start=st + (i+1)/12, end=st + (i+12)/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1996 6.467476 6.828629 6.649078

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716 7.050831 6.704919

Dec

1996 8.606937

1997

> i=4

> window(a10, start=st + (i+1)/12, end=st + (i+12)/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1996 6.828629 6.649078

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716 7.050831 6.704919 7.250988

Dec

1996 8.606937

1997

> window(a10, end=st + i/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1991 3.526591 3.180891 3.252221 3.611003 3.565869

1992 5.088335 2.814520 2.985811 3.204780 3.127578 3.270523 3.737851 3.558776 3.777202 3.924490 4.386531

1993 6.192068 3.450857 3.772307 3.734303 3.905399 4.049687 4.315566 4.562185 4.608662 4.667851 5.093841

1994 6.731473 3.841278 4.394076 4.075341 4.540645 4.645615 4.752607 5.350605 5.204455 5.301651 5.773742

1995 6.749484 4.216067 4.949349 4.823045 5.194754 5.170787 5.256742 5.855277 5.490729 6.115293 6.088473

1996 8.329452 5.069796 5.262557 5.597126 6.110296 5.689161 6.486849 6.300569 6.467476

Dec

1991 4.306371

1992 5.810549

1993 7.179962

1994 6.204593

1995 7.416598

1996

> window(a10, start=st + (i+1)/12, end=st + (i+12)/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1996 6.828629 6.649078

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716 7.050831 6.704919 7.250988

Dec

1996 8.606937

1997

> i

[1] 4

> i=5

> window(a10, end=st + i/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1991 3.526591 3.180891 3.252221 3.611003 3.565869

1992 5.088335 2.814520 2.985811 3.204780 3.127578 3.270523 3.737851 3.558776 3.777202 3.924490 4.386531

1993 6.192068 3.450857 3.772307 3.734303 3.905399 4.049687 4.315566 4.562185 4.608662 4.667851 5.093841

1994 6.731473 3.841278 4.394076 4.075341 4.540645 4.645615 4.752607 5.350605 5.204455 5.301651 5.773742

1995 6.749484 4.216067 4.949349 4.823045 5.194754 5.170787 5.256742 5.855277 5.490729 6.115293 6.088473

1996 8.329452 5.069796 5.262557 5.597126 6.110296 5.689161 6.486849 6.300569 6.467476 6.828629

Dec

1991 4.306371

1992 5.810549

1993 7.179962

1994 6.204593

1995 7.416598

1996

> window(a10, start=st + (i+1)/12, end=st + (i+12)/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1996 6.649078

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716 7.050831 6.704919 7.250988 7.819733

Dec

1996 8.606937

1997

> i=10

> window(a10, end=st + i/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1991 3.526591 3.180891 3.252221 3.611003 3.565869

1992 5.088335 2.814520 2.985811 3.204780 3.127578 3.270523 3.737851 3.558776 3.777202 3.924490 4.386531

1993 6.192068 3.450857 3.772307 3.734303 3.905399 4.049687 4.315566 4.562185 4.608662 4.667851 5.093841

1994 6.731473 3.841278 4.394076 4.075341 4.540645 4.645615 4.752607 5.350605 5.204455 5.301651 5.773742

1995 6.749484 4.216067 4.949349 4.823045 5.194754 5.170787 5.256742 5.855277 5.490729 6.115293 6.088473

1996 8.329452 5.069796 5.262557 5.597126 6.110296 5.689161 6.486849 6.300569 6.467476 6.828629 6.649078

1997 8.524471 5.277918 5.714303

Dec

1991 4.306371

1992 5.810549

1993 7.179962

1994 6.204593

1995 7.416598

1996 8.606937

1997

> window(a10, start=st + (i+1)/12, end=st + (i+12)/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct

1997 6.214529 6.411929 6.667716 7.050831 6.704919 7.250988 7.819733

1998 8.798513 5.918261 6.534493

Nov Dec

1997 7.398101 10.096233

1998

> i=100

> window(a10, end=st + i/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct

1991 3.526591 3.180891 3.252221 3.611003

1992 5.088335 2.814520 2.985811 3.204780 3.127578 3.270523 3.737851 3.558776 3.777202 3.924490

1993 6.192068 3.450857 3.772307 3.734303 3.905399 4.049687 4.315566 4.562185 4.608662 4.667851

1994 6.731473 3.841278 4.394076 4.075341 4.540645 4.645615 4.752607 5.350605 5.204455 5.301651

1995 6.749484 4.216067 4.949349 4.823045 5.194754 5.170787 5.256742 5.855277 5.490729 6.115293

1996 8.329452 5.069796 5.262557 5.597126 6.110296 5.689161 6.486849 6.300569 6.467476 6.828629

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716 7.050831 6.704919 7.250988 7.819733

1998 8.798513 5.918261 6.534493 6.675736 7.064201 7.383381 7.813496 7.431892 8.275117 8.260441

1999 10.391416 6.421535 8.062619 7.297739 7.936916 8.165323 8.717420 9.070964 9.177113 9.251887

2000 12.511462 7.457199 8.591191 8.474000 9.386803 9.560399 10.834295 10.643751 9.908162 11.710041

2001 14.497581 8.049275 10.312891 9.753358 10.850382 9.961719 11.443601 11.659239 10.647060 12.652134

2002 16.300269 9.053485 10.002449 10.788750 12.106705 10.954101 12.844566 12.196500 12.854748 13.542004

2003 16.828350 9.800215 10.816994 10.654223 12.512323 12.161210 12.998046 12.517276 13.268658 14.733622

2004 18.003768 11.938030 12.997900 12.882645 13.943447 13.989472 15.339097 15.370764 16.142005

Nov Dec

1991 3.565869 4.306371

1992 4.386531 5.810549

1993 5.093841 7.179962

1994 5.773742 6.204593

1995 6.088473 7.416598

1996 6.649078 8.606937

1997 7.398101 10.096233

1998 8.596156 10.558939

1999 9.933136 11.532974

2000 11.340151 12.079132

2001 13.674466 12.965735

2002 13.287640 15.134918

2003 13.669382 16.503966

2004

> window(a10, start=st + (i+1)/12, end=st + (i+12)/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

2004 16.68575 17.63673

2005 20.77872 12.15455 13.40239 14.45924 14.79510 15.70525 15.82955 17.55470 18.10086

Dec

2004 18.86932

2005

> i=140

> window(a10, end=st + i/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct

1991 3.526591 3.180891 3.252221 3.611003

1992 5.088335 2.814520 2.985811 3.204780 3.127578 3.270523 3.737851 3.558776 3.777202 3.924490

1993 6.192068 3.450857 3.772307 3.734303 3.905399 4.049687 4.315566 4.562185 4.608662 4.667851

1994 6.731473 3.841278 4.394076 4.075341 4.540645 4.645615 4.752607 5.350605 5.204455 5.301651

1995 6.749484 4.216067 4.949349 4.823045 5.194754 5.170787 5.256742 5.855277 5.490729 6.115293

1996 8.329452 5.069796 5.262557 5.597126 6.110296 5.689161 6.486849 6.300569 6.467476 6.828629

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716 7.050831 6.704919 7.250988 7.819733

1998 8.798513 5.918261 6.534493 6.675736 7.064201 7.383381 7.813496 7.431892 8.275117 8.260441

1999 10.391416 6.421535 8.062619 7.297739 7.936916 8.165323 8.717420 9.070964 9.177113 9.251887

2000 12.511462 7.457199 8.591191 8.474000 9.386803 9.560399 10.834295 10.643751 9.908162 11.710041

2001 14.497581 8.049275 10.312891 9.753358 10.850382 9.961719 11.443601 11.659239 10.647060 12.652134

2002 16.300269 9.053485 10.002449 10.788750 12.106705 10.954101 12.844566 12.196500 12.854748 13.542004

2003 16.828350 9.800215 10.816994 10.654223 12.512323 12.161210 12.998046 12.517276 13.268658 14.733622

2004 18.003768 11.938030 12.997900 12.882645 13.943447 13.989472 15.339097 15.370764 16.142005 16.685754

2005 20.778723 12.154552 13.402392 14.459239 14.795102 15.705248 15.829550 17.554701 18.100864 17.496668

2006 23.486694 12.536987 15.467018 14.233539 17.783058 16.291602 16.980282 18.612189 16.623343 21.430241

2007 28.038383 16.763869 19.792754 16.427305 21.000742 20.681002 21.834890 23.930204 22.930357 23.263340

2008 29.665356

Nov Dec

1991 3.565869 4.306371

1992 4.386531 5.810549

1993 5.093841 7.179962

1994 5.773742 6.204593

1995 6.088473 7.416598

1996 6.649078 8.606937

1997 7.398101 10.096233

1998 8.596156 10.558939

1999 9.933136 11.532974

2000 11.340151 12.079132

2001 13.674466 12.965735

2002 13.287640 15.134918

2003 13.669382 16.503966

2004 17.636728 18.869325

2005 19.347265 20.031291

2006 23.575517 23.334206

2007 25.250030 25.806090

2008

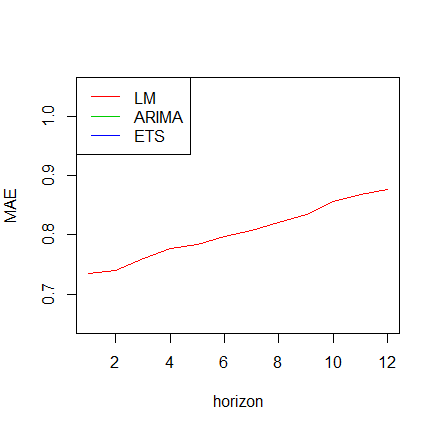
> window(a10, start=st + (i+1)/12, end=st + (i+12)/12)

Feb Mar Apr May Jun

2008 21.65429 18.26495 23.10768 22.91251 19.43174

# Example 2: fixed training window

Training window stays at 60 which is the minimum observations set



LM only shown in graph

> i=1

> window(a10, start=st+(i-k+1)/12, end=st+i/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1991 3.526591 3.180891 3.252221 3.611003 3.565869

1992 5.088335 2.814520 2.985811 3.204780 3.127578 3.270523 3.737851 3.558776 3.777202 3.924490 4.386531

1993 6.192068 3.450857 3.772307 3.734303 3.905399 4.049687 4.315566 4.562185 4.608662 4.667851 5.093841

1994 6.731473 3.841278 4.394076 4.075341 4.540645 4.645615 4.752607 5.350605 5.204455 5.301651 5.773742

1995 6.749484 4.216067 4.949349 4.823045 5.194754 5.170787 5.256742 5.855277 5.490729 6.115293 6.088473

1996 8.329452 5.069796 5.262557 5.597126 6.110296 5.689161

Dec

1991 4.306371

1992 5.810549

1993 7.179962

1994 6.204593

1995 7.416598

1996

> window(a10, start=st + (i+1)/12, end=st + (i+12)/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1996 6.486849 6.300569 6.467476 6.828629 6.649078

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716

Dec

1996 8.606937

1997

> i=2

> window(a10, start=st+(i-k+1)/12, end=st+i/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1991 3.180891 3.252221 3.611003 3.565869

1992 5.088335 2.814520 2.985811 3.204780 3.127578 3.270523 3.737851 3.558776 3.777202 3.924490 4.386531

1993 6.192068 3.450857 3.772307 3.734303 3.905399 4.049687 4.315566 4.562185 4.608662 4.667851 5.093841

1994 6.731473 3.841278 4.394076 4.075341 4.540645 4.645615 4.752607 5.350605 5.204455 5.301651 5.773742

1995 6.749484 4.216067 4.949349 4.823045 5.194754 5.170787 5.256742 5.855277 5.490729 6.115293 6.088473

1996 8.329452 5.069796 5.262557 5.597126 6.110296 5.689161 6.486849

Dec

1991 4.306371

1992 5.810549

1993 7.179962

1994 6.204593

1995 7.416598

1996

> window(a10, start=st + (i+1)/12, end=st + (i+12)/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1996 6.300569 6.467476 6.828629 6.649078

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716 7.050831

Dec

1996 8.606937

1997

> i=3

> window(a10, start=st+(i-k+1)/12, end=st+i/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1991 3.252221 3.611003 3.565869

1992 5.088335 2.814520 2.985811 3.204780 3.127578 3.270523 3.737851 3.558776 3.777202 3.924490 4.386531

1993 6.192068 3.450857 3.772307 3.734303 3.905399 4.049687 4.315566 4.562185 4.608662 4.667851 5.093841

1994 6.731473 3.841278 4.394076 4.075341 4.540645 4.645615 4.752607 5.350605 5.204455 5.301651 5.773742

1995 6.749484 4.216067 4.949349 4.823045 5.194754 5.170787 5.256742 5.855277 5.490729 6.115293 6.088473

1996 8.329452 5.069796 5.262557 5.597126 6.110296 5.689161 6.486849 6.300569

Dec

1991 4.306371

1992 5.810549

1993 7.179962

1994 6.204593

1995 7.416598

1996

> window(a10, start=st + (i+1)/12, end=st + (i+12)/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1996 6.467476 6.828629 6.649078

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716 7.050831 6.704919

Dec

1996 8.606937

1997

> i=140

> window(a10, start=st+(i-k+1)/12, end=st+i/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct

2003 9.800215 10.816994 10.654223 12.512323 12.161210 12.998046 12.517276 13.268658 14.733622

2004 18.003768 11.938030 12.997900 12.882645 13.943447 13.989472 15.339097 15.370764 16.142005 16.685754

2005 20.778723 12.154552 13.402392 14.459239 14.795102 15.705248 15.829550 17.554701 18.100864 17.496668

2006 23.486694 12.536987 15.467018 14.233539 17.783058 16.291602 16.980282 18.612189 16.623343 21.430241

2007 28.038383 16.763869 19.792754 16.427305 21.000742 20.681002 21.834890 23.930204 22.930357 23.263340

2008 29.665356

Nov Dec

2003 13.669382 16.503966

2004 17.636728 18.869325

2005 19.347265 20.031291

2006 23.575517 23.334206

2007 25.250030 25.806090

2008

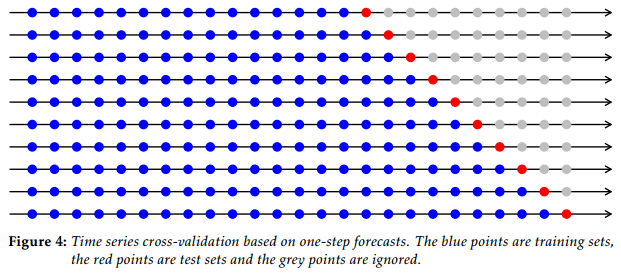
> window(a10, start=st + (i+1)/12, end=st + (i+12)/12)

Feb Mar Apr May Jun

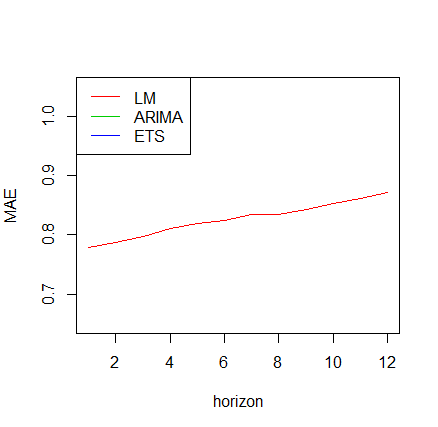
2008 21.65429 18.26495 23.10768 22.91251 19.43174

# Example 3: one step forecast in test

One step on the long set, forecast applied on long set



*Here the models are fitted to the training set (xshort), and then applied to the longer data set (xlong) without re-estimating the parameters. So the fitted values from the latter are one-step forecasts on the whole data set. Therefore, the last part of the fitted values vector are one-step forecasts on the test set.*



LM only shown in graph

> i=1

> window(a10, end=st + i/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1991 3.526591 3.180891 3.252221 3.611003 3.565869

1992 5.088335 2.814520 2.985811 3.204780 3.127578 3.270523 3.737851 3.558776 3.777202 3.924490 4.386531

1993 6.192068 3.450857 3.772307 3.734303 3.905399 4.049687 4.315566 4.562185 4.608662 4.667851 5.093841

1994 6.731473 3.841278 4.394076 4.075341 4.540645 4.645615 4.752607 5.350605 5.204455 5.301651 5.773742

1995 6.749484 4.216067 4.949349 4.823045 5.194754 5.170787 5.256742 5.855277 5.490729 6.115293 6.088473

1996 8.329452 5.069796 5.262557 5.597126 6.110296 5.689161

Dec

1991 4.306371

1992 5.810549

1993 7.179962

1994 6.204593

1995 7.416598

1996

> window(a10, start=st + (i+1)/12, end=st + (i+12)/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1996 6.486849 6.300569 6.467476 6.828629 6.649078

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716

Dec

1996 8.606937

1997

> window(a10, end=st + (i+12)/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1991 3.526591 3.180891 3.252221 3.611003 3.565869

1992 5.088335 2.814520 2.985811 3.204780 3.127578 3.270523 3.737851 3.558776 3.777202 3.924490 4.386531

1993 6.192068 3.450857 3.772307 3.734303 3.905399 4.049687 4.315566 4.562185 4.608662 4.667851 5.093841

1994 6.731473 3.841278 4.394076 4.075341 4.540645 4.645615 4.752607 5.350605 5.204455 5.301651 5.773742

1995 6.749484 4.216067 4.949349 4.823045 5.194754 5.170787 5.256742 5.855277 5.490729 6.115293 6.088473

1996 8.329452 5.069796 5.262557 5.597126 6.110296 5.689161 6.486849 6.300569 6.467476 6.828629 6.649078

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716

Dec

1991 4.306371

1992 5.810549

1993 7.179962

1994 6.204593

1995 7.416598

1996 8.606937

1997

> i=2

> window(a10, end=st + i/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1991 3.526591 3.180891 3.252221 3.611003 3.565869

1992 5.088335 2.814520 2.985811 3.204780 3.127578 3.270523 3.737851 3.558776 3.777202 3.924490 4.386531

1993 6.192068 3.450857 3.772307 3.734303 3.905399 4.049687 4.315566 4.562185 4.608662 4.667851 5.093841

1994 6.731473 3.841278 4.394076 4.075341 4.540645 4.645615 4.752607 5.350605 5.204455 5.301651 5.773742

1995 6.749484 4.216067 4.949349 4.823045 5.194754 5.170787 5.256742 5.855277 5.490729 6.115293 6.088473

1996 8.329452 5.069796 5.262557 5.597126 6.110296 5.689161 6.486849

Dec

1991 4.306371

1992 5.810549

1993 7.179962

1994 6.204593

1995 7.416598

1996

> window(a10, start=st + (i+1)/12, end=st + (i+12)/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1996 6.300569 6.467476 6.828629 6.649078

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716 7.050831

Dec

1996 8.606937

1997

> window(a10, end=st + (i+12)/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1991 3.526591 3.180891 3.252221 3.611003 3.565869

1992 5.088335 2.814520 2.985811 3.204780 3.127578 3.270523 3.737851 3.558776 3.777202 3.924490 4.386531

1993 6.192068 3.450857 3.772307 3.734303 3.905399 4.049687 4.315566 4.562185 4.608662 4.667851 5.093841

1994 6.731473 3.841278 4.394076 4.075341 4.540645 4.645615 4.752607 5.350605 5.204455 5.301651 5.773742

1995 6.749484 4.216067 4.949349 4.823045 5.194754 5.170787 5.256742 5.855277 5.490729 6.115293 6.088473

1996 8.329452 5.069796 5.262557 5.597126 6.110296 5.689161 6.486849 6.300569 6.467476 6.828629 6.649078

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716 7.050831

Dec

1991 4.306371

1992 5.810549

1993 7.179962

1994 6.204593

1995 7.416598

1996 8.606937

1997

> i=3

> window(a10, end=st + i/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1991 3.526591 3.180891 3.252221 3.611003 3.565869

1992 5.088335 2.814520 2.985811 3.204780 3.127578 3.270523 3.737851 3.558776 3.777202 3.924490 4.386531

1993 6.192068 3.450857 3.772307 3.734303 3.905399 4.049687 4.315566 4.562185 4.608662 4.667851 5.093841

1994 6.731473 3.841278 4.394076 4.075341 4.540645 4.645615 4.752607 5.350605 5.204455 5.301651 5.773742

1995 6.749484 4.216067 4.949349 4.823045 5.194754 5.170787 5.256742 5.855277 5.490729 6.115293 6.088473

1996 8.329452 5.069796 5.262557 5.597126 6.110296 5.689161 6.486849 6.300569

Dec

1991 4.306371

1992 5.810549

1993 7.179962

1994 6.204593

1995 7.416598

1996

> window(a10, start=st + (i+1)/12, end=st + (i+12)/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1996 6.467476 6.828629 6.649078

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716 7.050831 6.704919

Dec

1996 8.606937

1997

> window(a10, end=st + (i+12)/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1991 3.526591 3.180891 3.252221 3.611003 3.565869

1992 5.088335 2.814520 2.985811 3.204780 3.127578 3.270523 3.737851 3.558776 3.777202 3.924490 4.386531

1993 6.192068 3.450857 3.772307 3.734303 3.905399 4.049687 4.315566 4.562185 4.608662 4.667851 5.093841

1994 6.731473 3.841278 4.394076 4.075341 4.540645 4.645615 4.752607 5.350605 5.204455 5.301651 5.773742

1995 6.749484 4.216067 4.949349 4.823045 5.194754 5.170787 5.256742 5.855277 5.490729 6.115293 6.088473

1996 8.329452 5.069796 5.262557 5.597126 6.110296 5.689161 6.486849 6.300569 6.467476 6.828629 6.649078

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716 7.050831 6.704919

Dec

1991 4.306371

1992 5.810549

1993 7.179962

1994 6.204593

1995 7.416598

1996 8.606937

1997

> i=140

> window(a10, end=st + i/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct

1991 3.526591 3.180891 3.252221 3.611003

1992 5.088335 2.814520 2.985811 3.204780 3.127578 3.270523 3.737851 3.558776 3.777202 3.924490

1993 6.192068 3.450857 3.772307 3.734303 3.905399 4.049687 4.315566 4.562185 4.608662 4.667851

1994 6.731473 3.841278 4.394076 4.075341 4.540645 4.645615 4.752607 5.350605 5.204455 5.301651

1995 6.749484 4.216067 4.949349 4.823045 5.194754 5.170787 5.256742 5.855277 5.490729 6.115293

1996 8.329452 5.069796 5.262557 5.597126 6.110296 5.689161 6.486849 6.300569 6.467476 6.828629

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716 7.050831 6.704919 7.250988 7.819733

1998 8.798513 5.918261 6.534493 6.675736 7.064201 7.383381 7.813496 7.431892 8.275117 8.260441

1999 10.391416 6.421535 8.062619 7.297739 7.936916 8.165323 8.717420 9.070964 9.177113 9.251887

2000 12.511462 7.457199 8.591191 8.474000 9.386803 9.560399 10.834295 10.643751 9.908162 11.710041

2001 14.497581 8.049275 10.312891 9.753358 10.850382 9.961719 11.443601 11.659239 10.647060 12.652134

2002 16.300269 9.053485 10.002449 10.788750 12.106705 10.954101 12.844566 12.196500 12.854748 13.542004

2003 16.828350 9.800215 10.816994 10.654223 12.512323 12.161210 12.998046 12.517276 13.268658 14.733622

2004 18.003768 11.938030 12.997900 12.882645 13.943447 13.989472 15.339097 15.370764 16.142005 16.685754

2005 20.778723 12.154552 13.402392 14.459239 14.795102 15.705248 15.829550 17.554701 18.100864 17.496668

2006 23.486694 12.536987 15.467018 14.233539 17.783058 16.291602 16.980282 18.612189 16.623343 21.430241

2007 28.038383 16.763869 19.792754 16.427305 21.000742 20.681002 21.834890 23.930204 22.930357 23.263340

2008 29.665356

Nov Dec

1991 3.565869 4.306371

1992 4.386531 5.810549

1993 5.093841 7.179962

1994 5.773742 6.204593

1995 6.088473 7.416598

1996 6.649078 8.606937

1997 7.398101 10.096233

1998 8.596156 10.558939

1999 9.933136 11.532974

2000 11.340151 12.079132

2001 13.674466 12.965735

2002 13.287640 15.134918

2003 13.669382 16.503966

2004 17.636728 18.869325

2005 19.347265 20.031291

2006 23.575517 23.334206

2007 25.250030 25.806090

2008

> window(a10, start=st + (i+1)/12, end=st + (i+12)/12)

Feb Mar Apr May Jun

2008 21.65429 18.26495 23.10768 22.91251 19.43174

Warning message:

In window.default(x, ...) : 'end' value not changed

> window(a10, end=st + (i+12)/12)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct

1991 3.526591 3.180891 3.252221 3.611003

1992 5.088335 2.814520 2.985811 3.204780 3.127578 3.270523 3.737851 3.558776 3.777202 3.924490

1993 6.192068 3.450857 3.772307 3.734303 3.905399 4.049687 4.315566 4.562185 4.608662 4.667851

1994 6.731473 3.841278 4.394076 4.075341 4.540645 4.645615 4.752607 5.350605 5.204455 5.301651

1995 6.749484 4.216067 4.949349 4.823045 5.194754 5.170787 5.256742 5.855277 5.490729 6.115293

1996 8.329452 5.069796 5.262557 5.597126 6.110296 5.689161 6.486849 6.300569 6.467476 6.828629

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716 7.050831 6.704919 7.250988 7.819733

1998 8.798513 5.918261 6.534493 6.675736 7.064201 7.383381 7.813496 7.431892 8.275117 8.260441

1999 10.391416 6.421535 8.062619 7.297739 7.936916 8.165323 8.717420 9.070964 9.177113 9.251887

2000 12.511462 7.457199 8.591191 8.474000 9.386803 9.560399 10.834295 10.643751 9.908162 11.710041

2001 14.497581 8.049275 10.312891 9.753358 10.850382 9.961719 11.443601 11.659239 10.647060 12.652134

2002 16.300269 9.053485 10.002449 10.788750 12.106705 10.954101 12.844566 12.196500 12.854748 13.542004

2003 16.828350 9.800215 10.816994 10.654223 12.512323 12.161210 12.998046 12.517276 13.268658 14.733622

2004 18.003768 11.938030 12.997900 12.882645 13.943447 13.989472 15.339097 15.370764 16.142005 16.685754

2005 20.778723 12.154552 13.402392 14.459239 14.795102 15.705248 15.829550 17.554701 18.100864 17.496668

2006 23.486694 12.536987 15.467018 14.233539 17.783058 16.291602 16.980282 18.612189 16.623343 21.430241

2007 28.038383 16.763869 19.792754 16.427305 21.000742 20.681002 21.834890 23.930204 22.930357 23.263340

2008 29.665356 21.654285 18.264945 23.107677 22.912510 19.431740

Nov Dec

1991 3.565869 4.306371

1992 4.386531 5.810549

1993 5.093841 7.179962

1994 5.773742 6.204593

1995 6.088473 7.416598

1996 6.649078 8.606937

1997 7.398101 10.096233

1998 8.596156 10.558939

1999 9.933136 11.532974

2000 11.340151 12.079132

2001 13.674466 12.965735

2002 13.287640 15.134918

2003 13.669382 16.503966

2004 17.636728 18.869325

2005 19.347265 20.031291

2006 23.575517 23.334206

2007 25.250030 25.806090

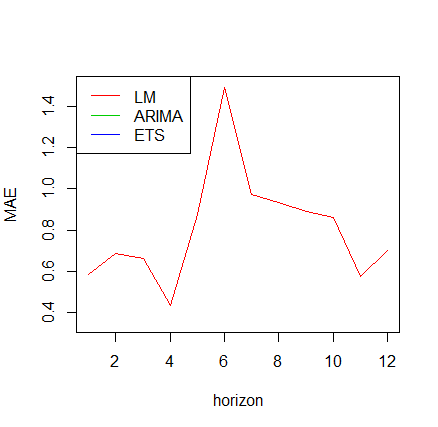
2008

# Example 4: k-fold cross-validation (for large data sets)

Adding 12 at a time

Yet another variation which is useful for large data sets is to use a form of k-fold cross-validation where the training sets increment by several values at a time. For example, instead of incrementing by one observation in each iteration, we could shift the training set forward by 12 observations.

However, because this is based on fewer estimation steps, the results are much more volatile. It may be best to average over the forecast horizon as well:



LM only shown in graph

> i=1

> window(a10, end=st + (i-1))

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1991 3.526591 3.180891 3.252221 3.611003 3.565869

1992 5.088335 2.814520 2.985811 3.204780 3.127578 3.270523 3.737851 3.558776 3.777202 3.924490 4.386531

1993 6.192068 3.450857 3.772307 3.734303 3.905399 4.049687 4.315566 4.562185 4.608662 4.667851 5.093841

1994 6.731473 3.841278 4.394076 4.075341 4.540645 4.645615 4.752607 5.350605 5.204455 5.301651 5.773742

1995 6.749484 4.216067 4.949349 4.823045 5.194754 5.170787 5.256742 5.855277 5.490729 6.115293 6.088473

1996 8.329452 5.069796 5.262557 5.597126 6.110296 5.689161

Dec

1991 4.306371

1992 5.810549

1993 7.179962

1994 6.204593

1995 7.416598

1996

> window(a10, start=st + (i-1) + 1/12, end=st + i)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1996 6.486849 6.300569 6.467476 6.828629 6.649078

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716

Dec

1996 8.606937

1997

> i=2

> window(a10, end=st + (i-1))

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

1991 3.526591 3.180891 3.252221 3.611003 3.565869

1992 5.088335 2.814520 2.985811 3.204780 3.127578 3.270523 3.737851 3.558776 3.777202 3.924490 4.386531

1993 6.192068 3.450857 3.772307 3.734303 3.905399 4.049687 4.315566 4.562185 4.608662 4.667851 5.093841

1994 6.731473 3.841278 4.394076 4.075341 4.540645 4.645615 4.752607 5.350605 5.204455 5.301651 5.773742

1995 6.749484 4.216067 4.949349 4.823045 5.194754 5.170787 5.256742 5.855277 5.490729 6.115293 6.088473

1996 8.329452 5.069796 5.262557 5.597126 6.110296 5.689161 6.486849 6.300569 6.467476 6.828629 6.649078

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716

Dec

1991 4.306371

1992 5.810549

1993 7.179962

1994 6.204593

1995 7.416598

1996 8.606937

1997

> window(a10, start=st + (i-1) + 1/12, end=st + i)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct

1997 7.050831 6.704919 7.250988 7.819733

1998 8.798513 5.918261 6.534493 6.675736 7.064201 7.383381

Nov Dec

1997 7.398101 10.096233

1998

> i=3

> window(a10, end=st + (i-1))

Jan Feb Mar Apr May Jun Jul Aug Sep Oct

1991 3.526591 3.180891 3.252221 3.611003

1992 5.088335 2.814520 2.985811 3.204780 3.127578 3.270523 3.737851 3.558776 3.777202 3.924490

1993 6.192068 3.450857 3.772307 3.734303 3.905399 4.049687 4.315566 4.562185 4.608662 4.667851

1994 6.731473 3.841278 4.394076 4.075341 4.540645 4.645615 4.752607 5.350605 5.204455 5.301651

1995 6.749484 4.216067 4.949349 4.823045 5.194754 5.170787 5.256742 5.855277 5.490729 6.115293

1996 8.329452 5.069796 5.262557 5.597126 6.110296 5.689161 6.486849 6.300569 6.467476 6.828629

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716 7.050831 6.704919 7.250988 7.819733

1998 8.798513 5.918261 6.534493 6.675736 7.064201 7.383381

Nov Dec

1991 3.565869 4.306371

1992 4.386531 5.810549

1993 5.093841 7.179962

1994 5.773742 6.204593

1995 6.088473 7.416598

1996 6.649078 8.606937

1997 7.398101 10.096233

1998

> window(a10, start=st + (i-1) + 1/12, end=st + i)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct

1998 7.813496 7.431892 8.275117 8.260441

1999 10.391416 6.421535 8.062619 7.297739 7.936916 8.165323

Nov Dec

1998 8.596156 10.558939

1999

> i=11

> window(a10, end=st + (i-1))

Jan Feb Mar Apr May Jun Jul Aug Sep Oct

1991 3.526591 3.180891 3.252221 3.611003

1992 5.088335 2.814520 2.985811 3.204780 3.127578 3.270523 3.737851 3.558776 3.777202 3.924490

1993 6.192068 3.450857 3.772307 3.734303 3.905399 4.049687 4.315566 4.562185 4.608662 4.667851

1994 6.731473 3.841278 4.394076 4.075341 4.540645 4.645615 4.752607 5.350605 5.204455 5.301651

1995 6.749484 4.216067 4.949349 4.823045 5.194754 5.170787 5.256742 5.855277 5.490729 6.115293

1996 8.329452 5.069796 5.262557 5.597126 6.110296 5.689161 6.486849 6.300569 6.467476 6.828629

1997 8.524471 5.277918 5.714303 6.214529 6.411929 6.667716 7.050831 6.704919 7.250988 7.819733

1998 8.798513 5.918261 6.534493 6.675736 7.064201 7.383381 7.813496 7.431892 8.275117 8.260441

1999 10.391416 6.421535 8.062619 7.297739 7.936916 8.165323 8.717420 9.070964 9.177113 9.251887

2000 12.511462 7.457199 8.591191 8.474000 9.386803 9.560399 10.834295 10.643751 9.908162 11.710041

2001 14.497581 8.049275 10.312891 9.753358 10.850382 9.961719 11.443601 11.659239 10.647060 12.652134

2002 16.300269 9.053485 10.002449 10.788750 12.106705 10.954101 12.844566 12.196500 12.854748 13.542004

2003 16.828350 9.800215 10.816994 10.654223 12.512323 12.161210 12.998046 12.517276 13.268658 14.733622

2004 18.003768 11.938030 12.997900 12.882645 13.943447 13.989472 15.339097 15.370764 16.142005 16.685754

2005 20.778723 12.154552 13.402392 14.459239 14.795102 15.705248 15.829550 17.554701 18.100864 17.496668

2006 23.486694 12.536987 15.467018 14.233539 17.783058 16.291602

Nov Dec

1991 3.565869 4.306371

1992 4.386531 5.810549

1993 5.093841 7.179962

1994 5.773742 6.204593

1995 6.088473 7.416598

1996 6.649078 8.606937

1997 7.398101 10.096233

1998 8.596156 10.558939

1999 9.933136 11.532974

2000 11.340151 12.079132

2001 13.674466 12.965735

2002 13.287640 15.134918

2003 13.669382 16.503966

2004 17.636728 18.869325

2005 19.347265 20.031291

2006

> window(a10, start=st + (i-1) + 1/12, end=st + i)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

2006 16.98028 18.61219 16.62334 21.43024 23.57552

2007 28.03838 16.76387 19.79275 16.42731 21.00074 20.68100

Dec

2006 23.33421

2007