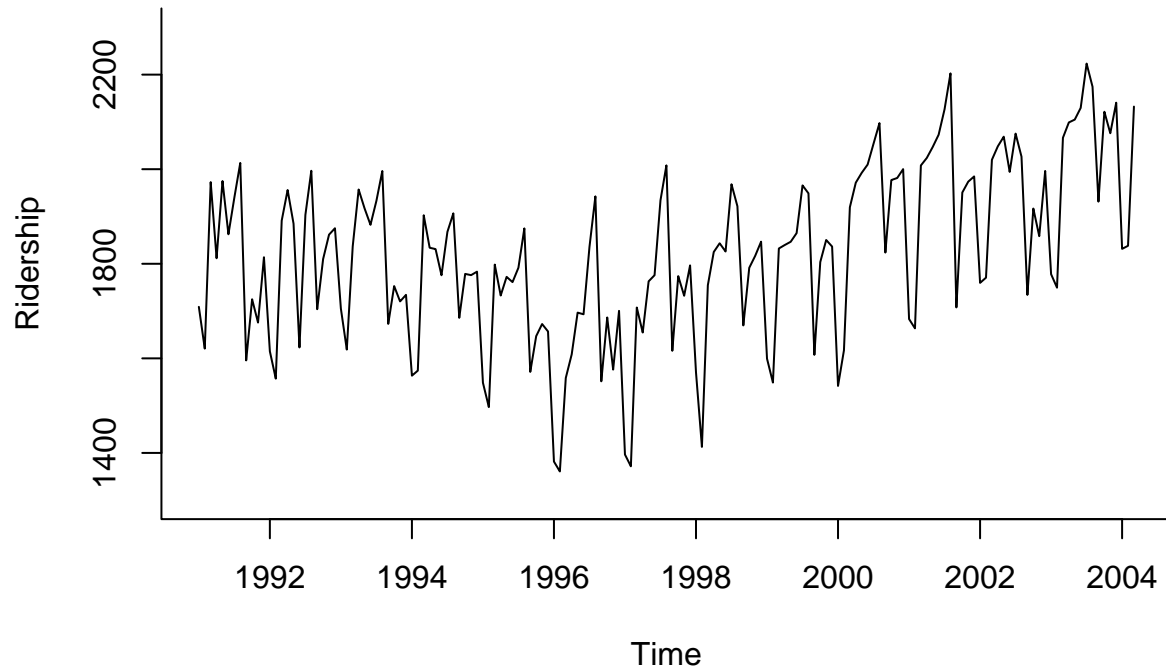
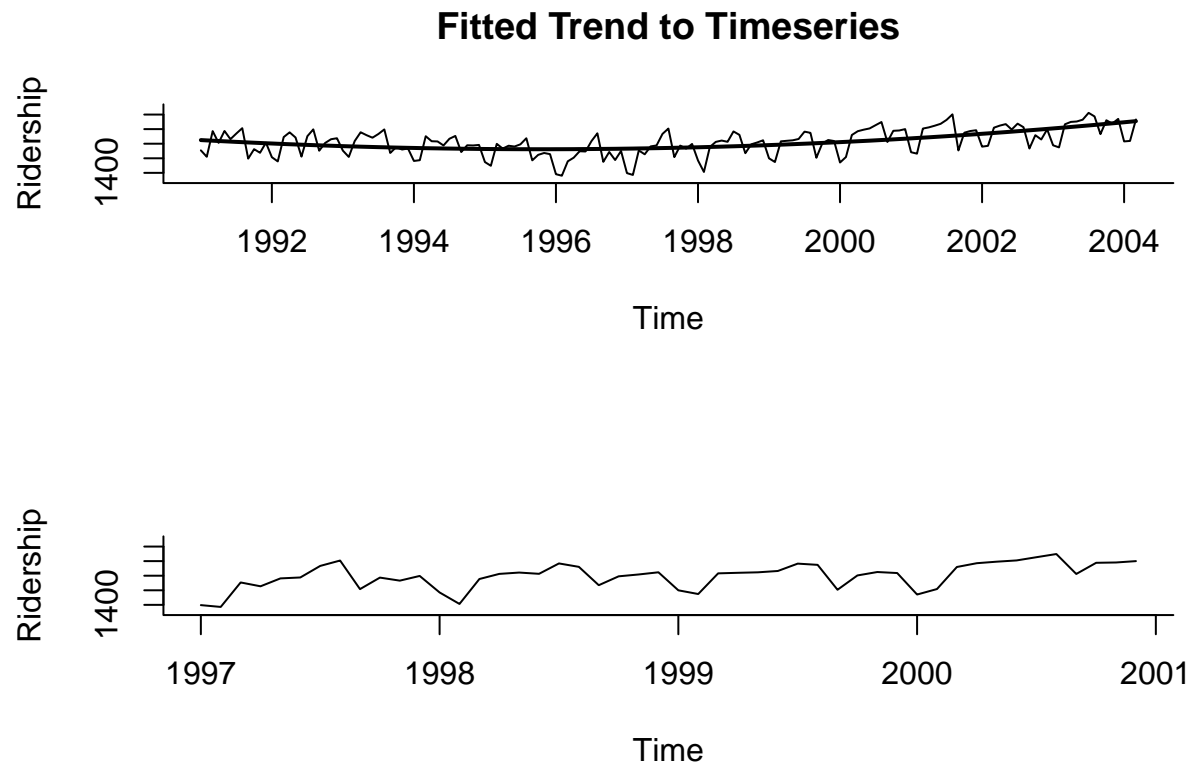


Amtrack Ridership Forecasting

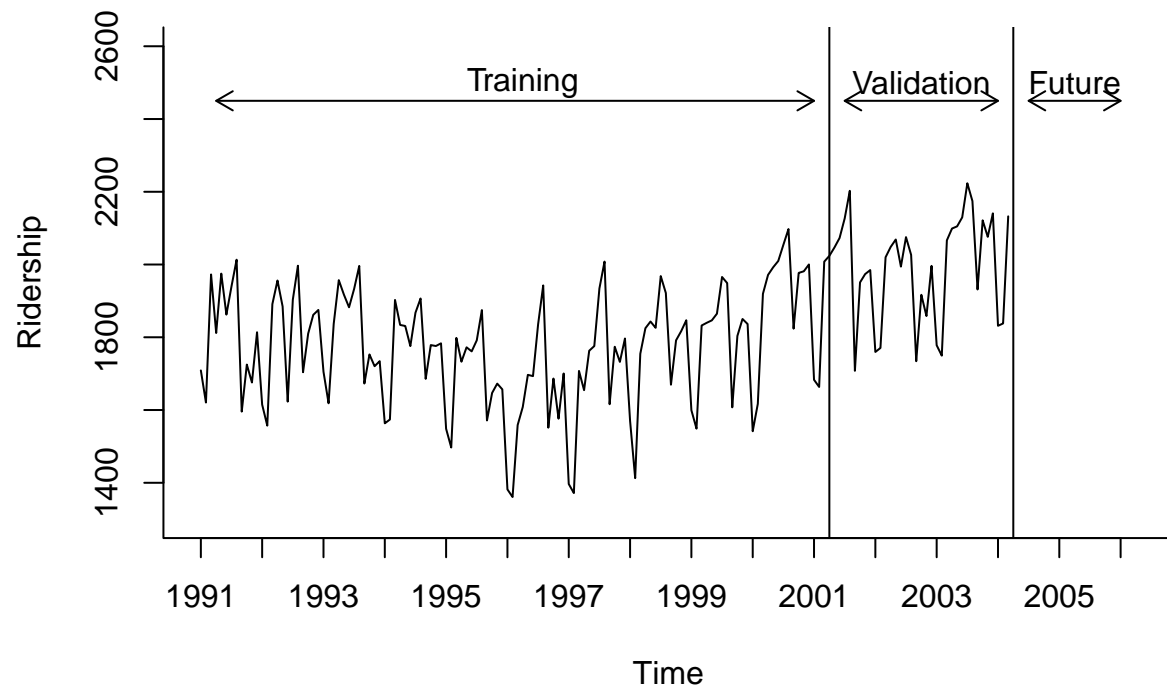


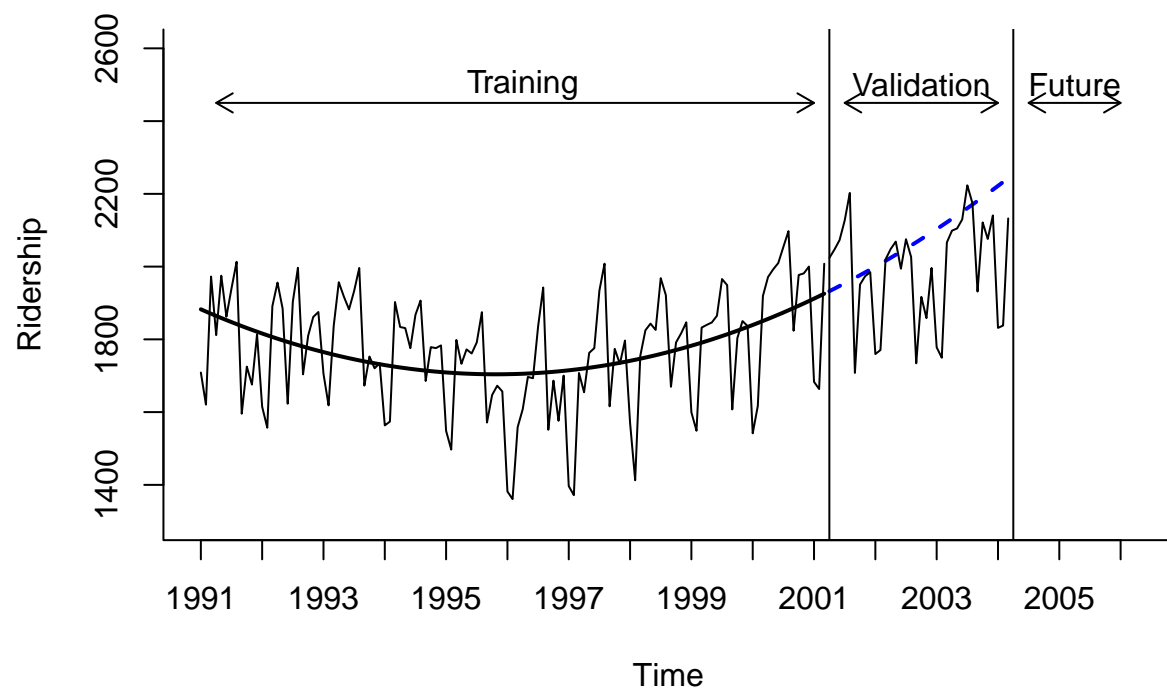
Line plot of Ridership - The dataset

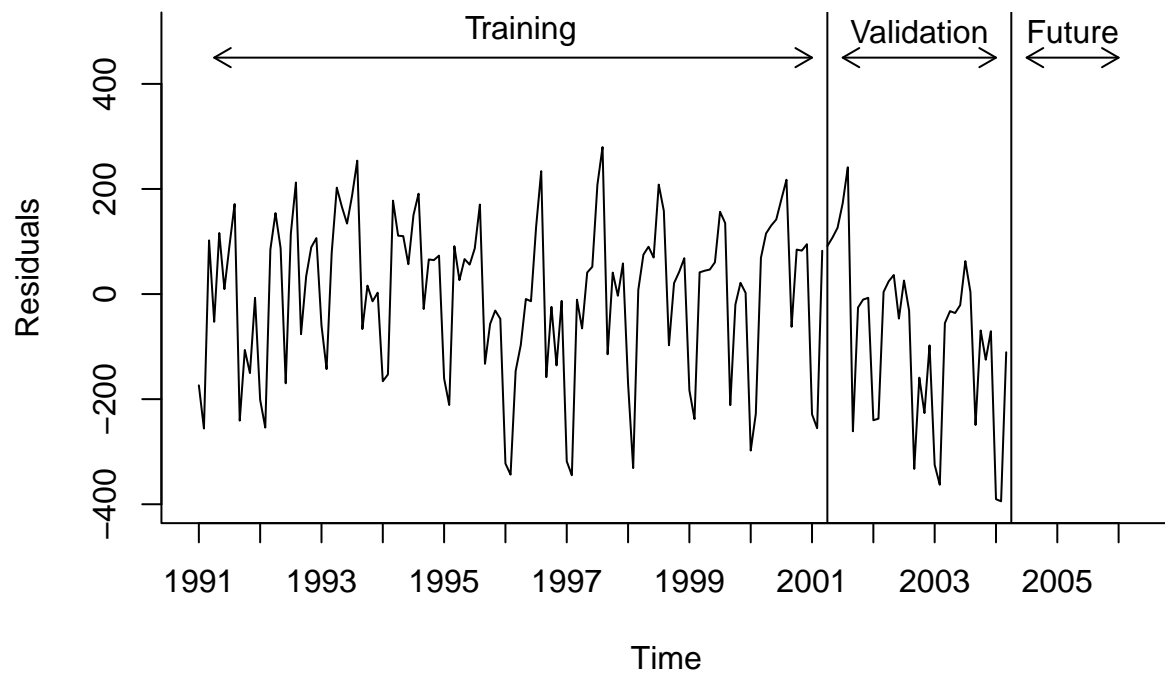
Linear Fitting and Smoothing



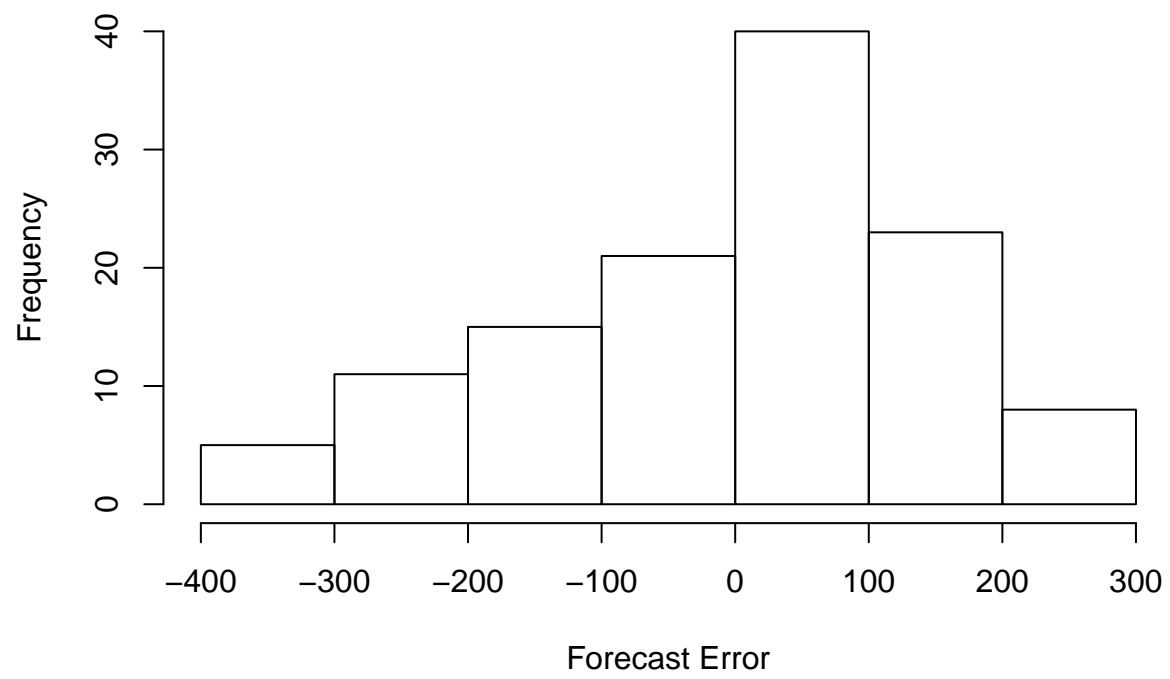
Partitioning

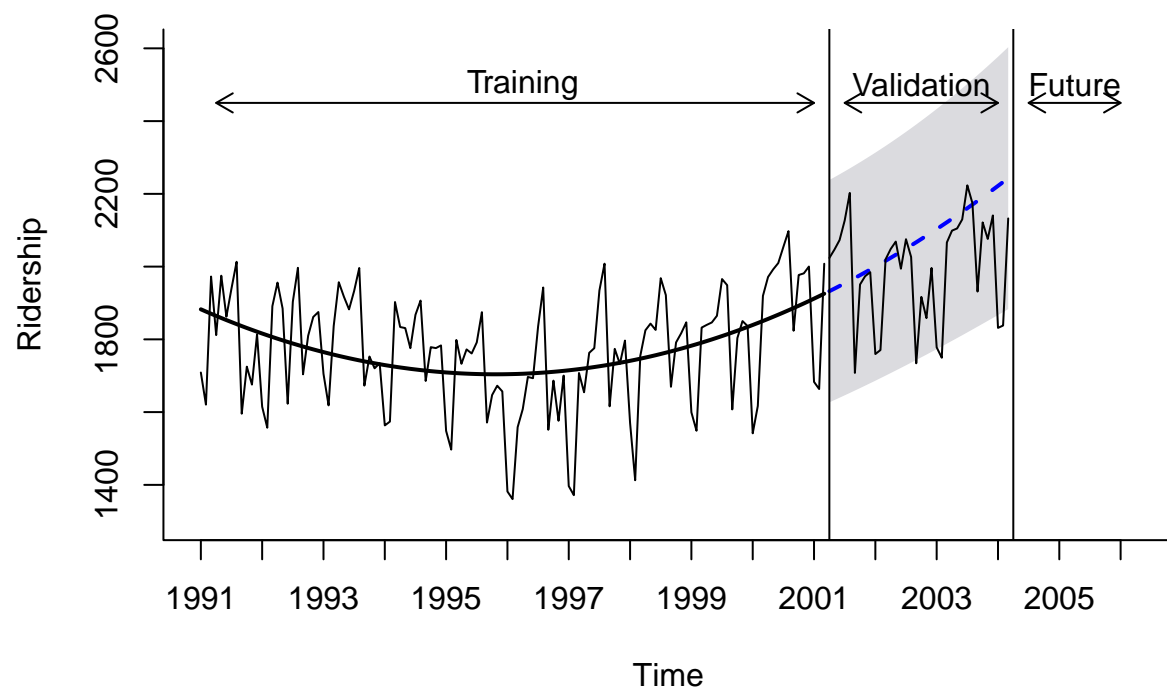


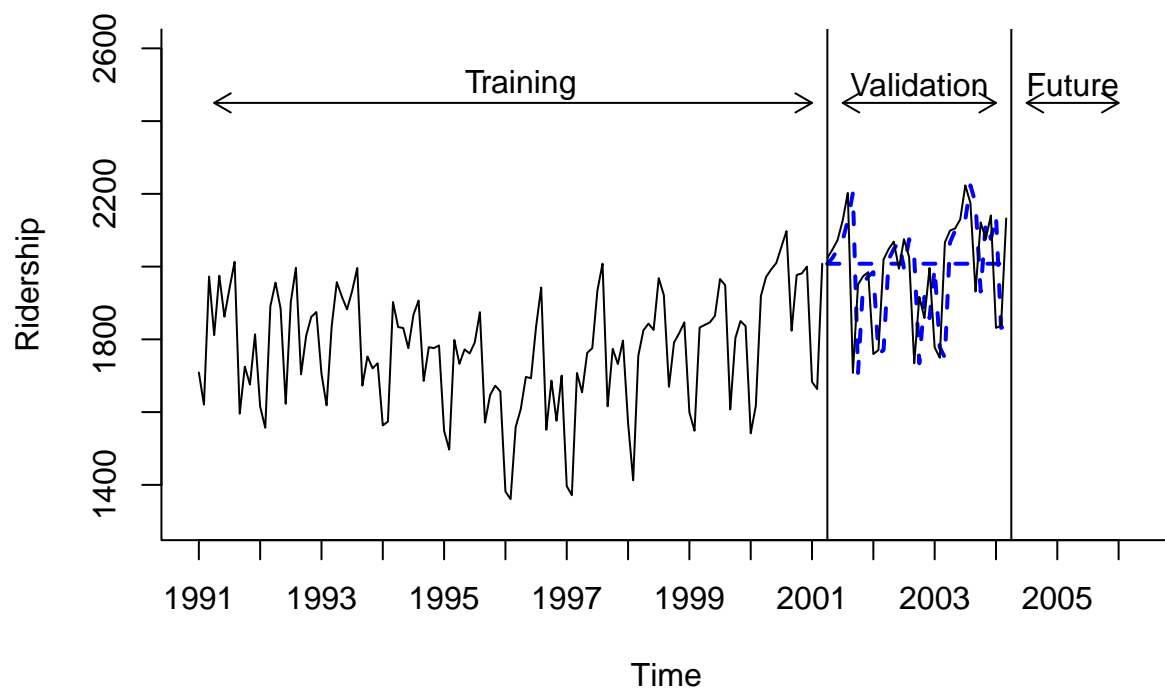




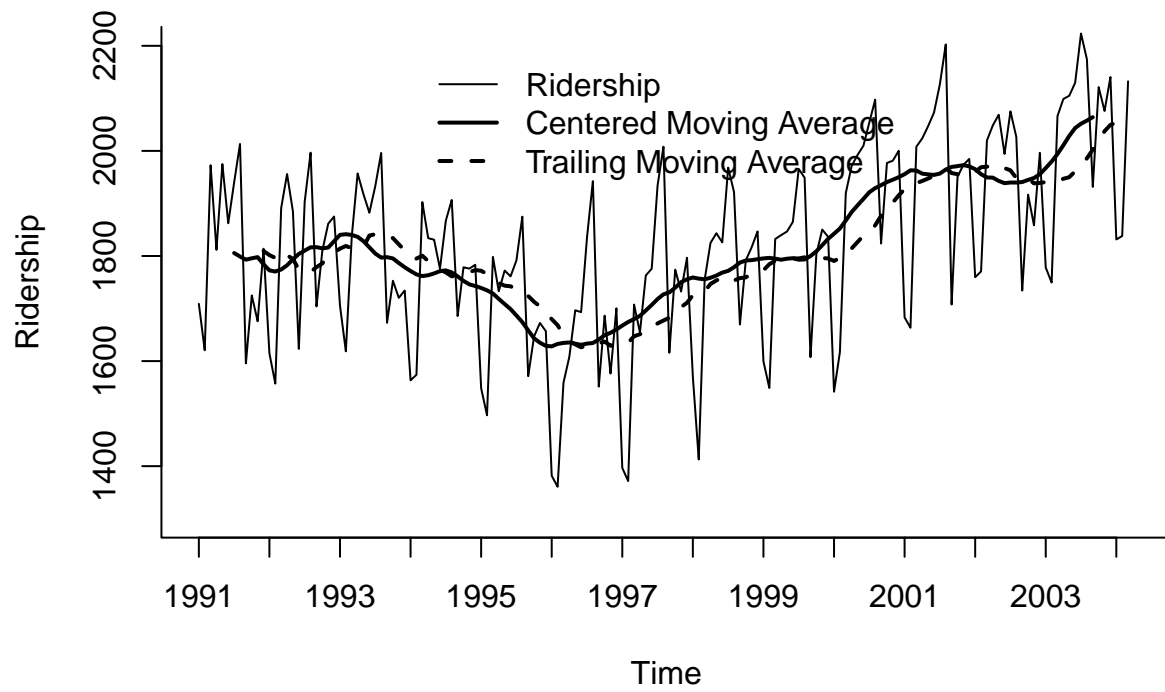
```
## [1] "model"      "mean"      "lower"     "upper"     "level"
## [6] "x"          "series"    "method"    "newdata"   "residuals"
## [11] "fitted"
```

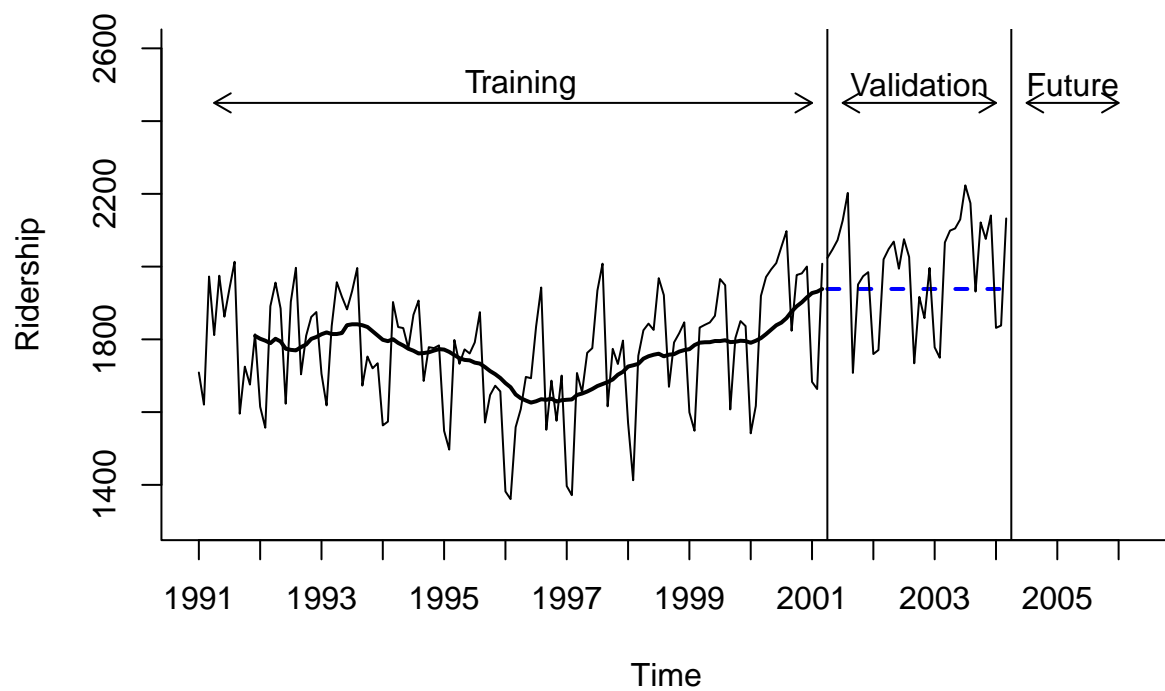


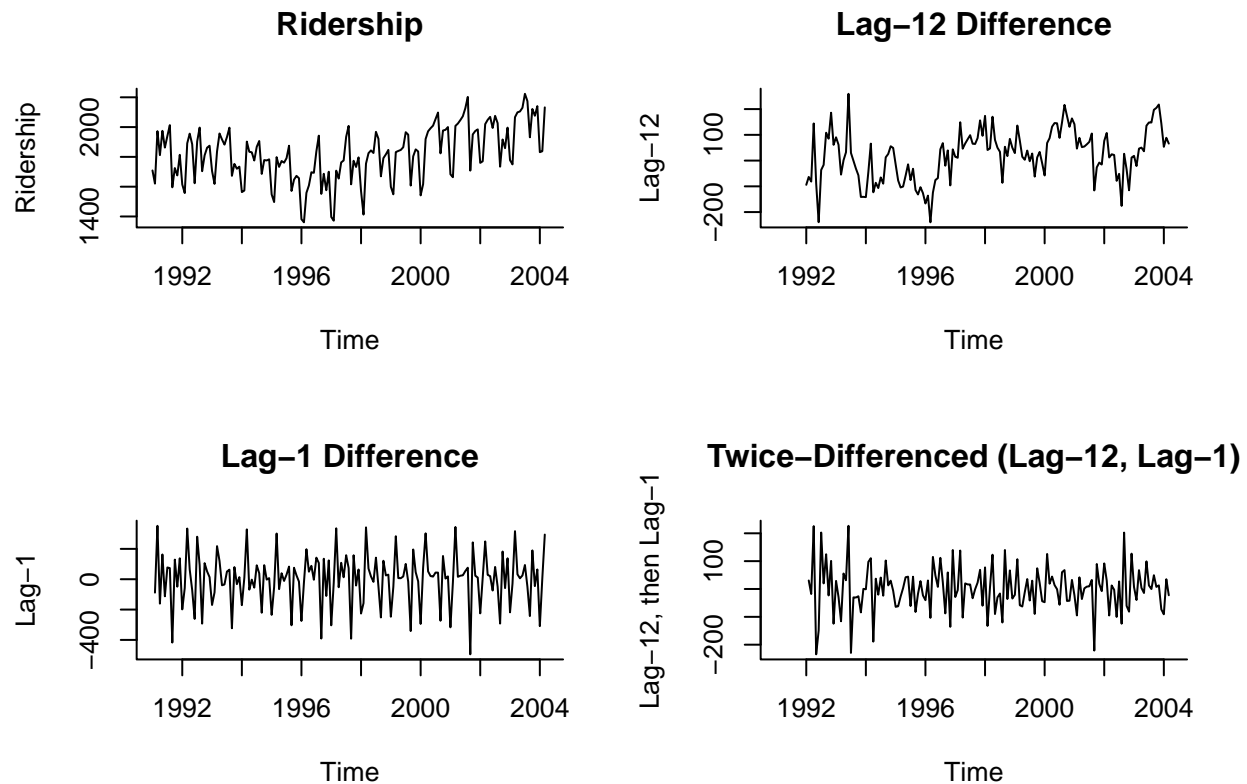




Predictions

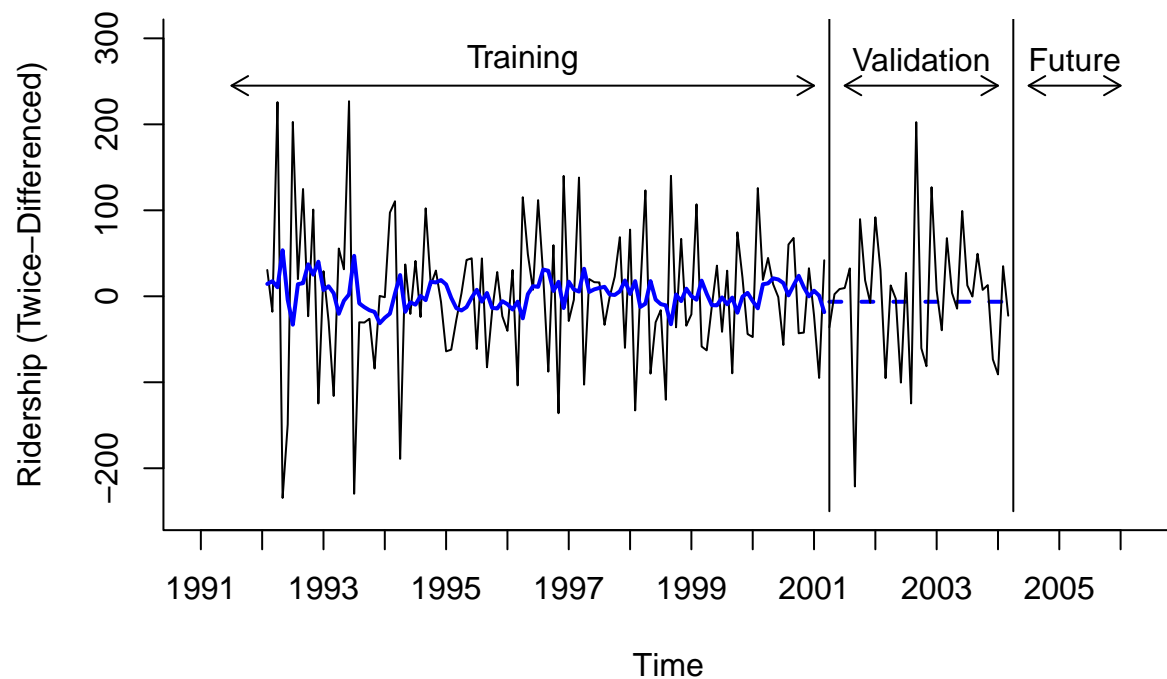






```
## null device
##      1

##
## Call:
## tslm(formula = ridership.deseasonalized ~ trend)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -241.873  -56.022   -0.219   59.150  284.792
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) -40.3641    15.0455  -2.683  0.00815 **
## trend         0.8294     0.1764   4.702 5.93e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 90.74 on 145 degrees of freedom
## Multiple R-squared:  0.1323, Adjusted R-squared:  0.1263
## F-statistic: 22.11 on 1 and 145 DF, p-value: 5.935e-06
```



```
## null device
##      1

## ETS(A,N,N)
##
## Call:
## ets(y = train.ts, model = "ANN")
##
## Smoothing parameters:
##   alpha = 1e-04
##
## Initial states:
##   l = 1.6583
##
## sigma: 82.8209
##
##      AIC      AICc      BIC
## 1494.723 1494.949 1502.824
##
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -0.9407425 90.82254 68.01782 181.35457 225.2854 0.6669040
## Test set      5.7226043 75.99033 54.88964  55.92139 178.3106 0.5381843
##
##           ACF1 Theil's U
## Training set -0.3678952      NA
## Test set      -0.3665235      1.113
##
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -0.001116552 82.82094 62.90416 100.5652 106.3611 0.6167654
```

```

## Test set      -2.280828663 75.80886 53.02528 111.5202 111.5202 0.5199045
##              ACF1 Theil's U
## Training set -0.3398588      NA
## Test set     -0.3665235 0.9627726

## Series: train.ts
## ARIMA(1,0,1)(0,0,1)[12] with non-zero mean
##
## Coefficients:
##          ar1      ma1      sma1      mean
##          0.3850 -0.8181 -0.7545  1.3775
## s.e.  0.1529  0.1032  0.1100  0.7093
##
## sigma^2 estimated as 3894:  log likelihood=-614.1
## AIC=1238.2  AICc=1238.78  BIC=1251.7

## ETS(M,N,A)
##
## Call:
## ets(y = rts)
##
## Smoothing parameters:
##   alpha = 0.5199
##   gamma = 1e-04
##
## Initial states:
##   l = 1811.2158
##   s=30.8814 -12.3074 -2.7332 -120.1579 203.8979 150.6521
##       37.2649 74.1158 47.518 36.5746 -245.4989 -200.2075
##
##   sigma: 0.0328
##
##      AIC      AICc      BIC
## 1437.803 1442.909 1478.310

## [1] 56.89533 72.41222 47.58071 109.40784 105.01269 70.84465 64.63404
## [8] 65.44567 80.81070 134.14835 132.05848 103.71279 106.18907 107.98966
## [15] 109.53008 110.97033 112.37201 113.75885 115.13997 116.51889 117.89696
## [22] 119.27470 120.65232 122.02989 123.40744 124.78498 126.16252 127.54006
## [29] 128.91760 130.29514 131.67268 133.05022 134.42776 135.80530 137.18284
## [36] 138.56038

## [1] 1971.493 1992.301 2009.763 2053.996 2097.471 1823.706 1976.997
## [8] 1981.408 2000.153 1683.148 1663.404 2007.928 2028.388 2064.713
## [15] 2057.344 2163.404 2202.484 1894.551 2041.631 2046.854 2080.964
## [22] 1817.296 1795.462 2111.641 2134.577 2172.703 2166.874 2274.374
## [29] 2314.856 2008.310 2156.771 2163.373 2198.861 1936.571 1916.115
## [36] 2233.671 2257.985 2297.488 2293.036 2401.914 2443.773 2138.605
## [43] 2288.444 2296.423 2333.288 2072.376 2053.298 2372.231

## [1] 2028.388 2064.713 2057.344 2163.404 2202.484 1894.551 2041.631
## [8] 2046.854 2080.964 1817.296 1795.462 2111.641 2134.577 2172.703
## [15] 2166.874 2274.374 2314.856 2008.310 2156.771 2163.373 2198.861
## [22] 1936.571 1916.115 2233.671 2257.985 2297.488 2293.036 2401.914
## [29] 2443.773 2138.605 2288.444 2296.423 2333.288 2072.376 2053.298
## [36] 2372.231

```

##		ME	RMSE	MAE	MPE	MAPE
##	Test set	-152.0855	174.9945	152.959	-7.714254	7.75637

##		l	s1	s2	s3	s4
##	Dec 1990	1813.648	29.568977	-15.787980	-3.331059	-140.301977
##	Jan 1991	1871.621	-208.468368	29.568977	-15.787980	-3.331059
##	Feb 1991	1868.567	-245.569948	-208.468368	29.568977	-15.787980
##	Mar 1991	1898.002	51.477534	-245.569948	-208.468368	29.568977
##	Apr 1991	1812.936	65.880755	51.477534	-245.569948	-208.468368
##	May 1991	1858.762	80.026058	65.880755	51.477534	-245.569948
##	Jun 1991	1832.873	49.919811	80.026058	65.880755	51.477534
##	Jul 1991	1808.081	151.350043	49.919811	80.026058	65.880755
##	Aug 1991	1819.227	185.237516	151.350043	49.919811	80.026058
##	Sep 1991	1772.700	-140.313343	185.237516	151.350043	49.919811
##	Oct 1991	1747.865	-3.337125	-140.313343	185.237516	151.350043
##	Nov 1991	1716.345	-15.795680	-3.337125	-140.313343	185.237516
##	Dec 1991	1754.313	29.578252	-15.795680	-3.337125	-140.313343
##	Jan 1992	1792.858	-208.458951	29.578252	-15.795680	-3.337125
##	Feb 1992	1798.334	-245.568610	-208.458951	29.578252	-15.795680
##	Mar 1992	1821.473	51.483186	-245.568610	-208.458951	29.578252
##	Apr 1992	1859.820	65.890123	51.483186	-245.568610	-208.458951
##	May 1992	1829.014	80.018533	65.890123	51.483186	-245.568610
##	Jun 1992	1686.030	49.884881	80.018533	65.890123	51.483186
##	Jul 1992	1722.869	151.359043	49.884881	80.018533	65.890123
##	Aug 1992	1772.379	185.249611	151.359043	49.884881	80.018533
##	Sep 1992	1812.516	-140.303538	185.249611	151.359043	49.884881
##	Oct 1992	1812.975	-3.337013	-140.303538	185.249611	151.359043
##	Nov 1992	1848.972	-15.786887	-3.337013	-140.303538	185.249611
##	Dec 1992	1847.056	29.577784	-15.786887	-3.337013	-140.303538
##	Jan 1993	1884.305	-208.449852	29.577784	-15.786887	-3.337013
##	Feb 1993	1873.017	-245.571368	-208.449852	29.577784	-15.786887
##	Mar 1993	1823.962	51.471203	-245.571368	-208.449852	29.577784
##	Apr 1993	1861.506	65.899295	51.471203	-245.571368	-208.449852
##	May 1993	1847.906	80.015210	65.899295	51.471203	-245.571368
##	Jun 1993	1839.305	49.882780	80.015210	65.899295	51.471203
##	Jul 1993	1807.089	151.351173	49.882780	80.015210	65.899295
##	Aug 1993	1809.228	185.250134	151.351173	49.882780	80.015210
##	Sep 1993	1811.417	-140.303003	185.250134	151.351173	49.882780
##	Oct 1993	1780.543	-3.344556	-140.303003	185.250134	151.351173
##	Nov 1993	1755.745	-15.792945	-3.344556	-140.303003	185.250134
##	Dec 1993	1727.231	29.570818	-15.792945	-3.344556	-140.303003
##	Jan 1994	1752.143	-208.443766	29.570818	-15.792945	-3.344556
##	Feb 1994	1789.797	-245.562169	-208.443766	29.570818	-15.792945
##	Mar 1994	1824.089	51.479580	-245.562169	-208.443766	29.570818
##	Apr 1994	1792.742	65.891637	51.479580	-245.562169	-208.443766
##	May 1994	1769.437	80.009517	65.891637	51.479580	-245.562169
##	Jun 1994	1745.094	49.876833	80.009517	65.891637	51.479580
##	Jul 1994	1728.925	151.347223	49.876833	80.009517	65.891637
##	Aug 1994	1724.697	185.249101	151.347223	49.876833	80.009517
##	Sep 1994	1781.265	-140.289184	185.249101	151.347223	49.876833
##	Oct 1994	1781.615	-3.344470	-140.289184	185.249101	151.347223
##	Nov 1994	1787.299	-15.791556	-3.344470	-140.289184	185.249101
##	Dec 1994	1768.569	29.566242	-15.791556	-3.344470	-140.289184
##	Jan 1995	1762.026	-208.445365	29.566242	-15.791556	-3.344470

##	Feb	1995	1751.108	-245.564836	-208.445365	29.566242	-15.791556
##	Mar	1995	1748.721	51.478997	-245.564836	-208.445365	29.566242
##	Apr	1995	1703.060	65.880482	51.478997	-245.564836	-208.445365
##	May	1995	1697.067	80.008053	65.880482	51.478997	-245.564836
##	Jun	1995	1705.037	49.878780	80.008053	65.880482	51.478997
##	Jul	1995	1668.868	151.338387	49.878780	80.008053	65.880482
##	Aug	1995	1680.436	185.251927	151.338387	49.878780	80.008053
##	Sep	1995	1697.849	-140.284930	185.251927	151.338387	49.878780
##	Oct	1995	1671.276	-3.350962	-140.284930	185.251927	151.338387
##	Nov	1995	1680.857	-15.789215	-3.350962	-140.284930	185.251927
##	Dec	1995	1650.919	29.558929	-15.789215	-3.350962	-140.284930
##	Jan	1996	1616.993	-208.453652	29.558929	-15.789215	-3.350962
##	Feb	1996	1611.083	-245.566280	-208.453652	29.558929	-15.789215
##	Mar	1996	1552.979	51.464802	-245.566280	-208.453652	29.558929
##	Apr	1996	1547.146	65.879057	51.464802	-245.566280	-208.453652
##	May	1996	1586.004	80.017546	65.879057	51.464802	-245.566280
##	Jun	1996	1618.021	49.886602	80.017546	65.879057	51.464802
##	Jul	1996	1654.987	151.347418	49.886602	80.017546	65.879057
##	Aug	1996	1712.168	185.265895	151.347418	49.886602	80.017546
##	Sep	1996	1700.723	-140.287726	185.265895	151.347418	49.886602
##	Oct	1996	1694.653	-3.352445	-140.287726	185.265895	151.347418
##	Nov	1996	1637.290	-15.803229	-3.352445	-140.287726	185.265895
##	Dec	1996	1656.056	29.563513	-15.803229	-3.352445	-140.287726
##	Jan	1997	1627.551	-208.460616	29.563513	-15.803229	-3.352445
##	Feb	1997	1621.799	-245.567685	-208.460616	29.563513	-15.803229
##	Mar	1997	1640.941	51.469479	-245.567685	-208.460616	29.563513
##	Apr	1997	1611.764	65.871929	51.469479	-245.567685	-208.460616
##	May	1997	1651.505	80.027254	65.871929	51.469479	-245.567685
##	Jun	1997	1693.082	49.896759	80.027254	65.871929	51.469479
##	Jul	1997	1743.253	151.359674	49.896759	80.027254	65.871929
##	Aug	1997	1787.695	185.276752	151.359674	49.896759	80.027254
##	Sep	1997	1770.103	-140.292024	185.276752	151.359674	49.896759
##	Oct	1997	1774.104	-3.351468	-140.292024	185.276752	151.359674
##	Nov	1997	1759.613	-15.806768	-3.351468	-140.292024	185.276752
##	Dec	1997	1763.776	29.564530	-15.806768	-3.351468	-140.292024
##	Jan	1998	1772.166	-208.458566	29.564530	-15.806768	-3.351468
##	Feb	1998	1708.518	-245.583234	-208.458566	29.564530	-15.806768
##	Mar	1998	1705.531	51.468749	-245.583234	-208.458566	29.564530
##	Apr	1998	1735.441	65.879236	51.468749	-245.583234	-208.458566
##	May	1998	1750.986	80.031052	65.879236	51.468749	-245.583234
##	Jun	1998	1765.001	49.900183	80.031052	65.879236	51.468749
##	Jul	1998	1793.951	151.366747	49.900183	80.031052	65.879236
##	Aug	1998	1761.776	185.268892	151.366747	49.900183	80.031052
##	Sep	1998	1788.660	-140.285456	185.268892	151.366747	49.900183
##	Oct	1998	1792.105	-3.350626	-140.285456	185.268892	151.366747
##	Nov	1998	1814.688	-15.801252	-3.350626	-140.285456	185.268892
##	Dec	1998	1816.086	29.564871	-15.801252	-3.350626	-140.285456
##	Jan	1999	1811.504	-208.459686	29.564871	-15.801252	-3.350626
##	Feb	1999	1801.940	-245.585570	-208.459686	29.564871	-15.801252
##	Mar	1999	1790.163	51.465872	-245.585570	-208.459686	29.564871
##	Apr	1999	1781.043	65.877008	51.465872	-245.585570	-208.459686
##	May	1999	1772.898	80.029062	65.877008	51.465872	-245.585570
##	Jun	1999	1796.396	49.905923	80.029062	65.877008	51.465872
##	Jul	1999	1806.443	151.369201	49.905923	80.029062	65.877008

## Aug 1999	1782.578	185.263062	151.369201	49.905923	80.029062
## Sep 1999	1763.066	-140.290223	185.263062	151.369201	49.905923
## Oct 1999	1787.623	-3.344627	-140.290223	185.263062	151.369201
## Nov 1999	1831.479	-15.790538	-3.344627	-140.290223	185.263062
## Dec 1999	1817.728	29.561512	-15.790538	-3.344627	-140.290223
## Jan 2000	1779.951	-208.468915	29.561512	-15.790538	-3.344627
## Feb 2000	1826.084	-245.574300	-208.468915	29.561512	-15.790538
## Mar 2000	1849.546	51.471603	-245.574300	-208.468915	29.561512
## Apr 2000	1880.876	65.884662	51.471603	-245.574300	-208.468915
## May 2000	1898.419	80.033348	65.884662	51.471603	-245.574300
## Jun 2000	1932.749	49.914310	80.033348	65.884662	51.471603
## Jul 2000	1915.918	151.365089	49.914310	80.033348	65.884662
## Aug 2000	1913.845	185.262556	151.365089	49.914310	80.033348
## Sep 2000	1941.868	-140.283377	185.262556	151.365089	49.914310
## Oct 2000	1963.366	-3.339375	-140.283377	185.262556	151.365089
## Nov 2000	1982.270	-15.785920	-3.339375	-140.283377	185.262556
## Dec 2000	1975.745	29.559918	-15.785920	-3.339375	-140.283377
## Jan 2001	1928.737	-208.480398	29.559918	-15.785920	-3.339375
## Feb 2001	1917.696	-245.576997	-208.480398	29.559918	-15.785920
## Mar 2001	1939.354	51.476894	-245.576997	-208.480398	29.559918
## Apr 2001	1949.721	65.887195	51.476894	-245.576997	-208.480398
## May 2001	1959.362	80.035703	65.887195	51.476894	-245.576997
## Jun 2001	1994.920	49.922996	80.035703	65.887195	51.476894
## Jul 2001	1983.986	151.362418	49.922996	80.035703	65.887195
## Aug 2001	2002.643	185.267113	151.362418	49.922996	80.035703
## Sep 2001	1916.220	-140.304490	185.267113	151.362418	49.922996
## Oct 2001	1937.361	-3.334210	-140.304490	185.267113	151.362418
## Nov 2001	1966.439	-15.778816	-3.334210	-140.304490	185.267113
## Dec 2001	1960.142	29.558380	-15.778816	-3.334210	-140.304490
## Jan 2002	1964.594	-208.479311	29.558380	-15.778816	-3.334210
## Feb 2002	1993.414	-245.569957	-208.479311	29.558380	-15.778816
## Mar 2002	1979.457	51.473485	-245.569957	-208.479311	29.558380
## Apr 2002	1981.163	65.887611	51.473485	-245.569957	-208.479311
## May 2002	1985.390	80.036735	65.887611	51.473485	-245.569957
## Jun 2002	1962.455	49.917393	80.036735	65.887611	51.473485
## Jul 2002	1940.909	151.357155	49.917393	80.036735	65.887611
## Aug 2002	1885.247	185.253516	151.357155	49.917393	80.036735
## Sep 2002	1879.219	-140.305962	185.253516	151.357155	49.917393
## Oct 2002	1902.065	-3.328629	-140.305962	185.253516	151.357155
## Nov 2002	1886.452	-15.782630	-3.328629	-140.305962	185.253516
## Dec 2002	1931.344	29.569346	-15.782630	-3.328629	-140.305962
## Jan 2003	1962.170	-208.471780	29.569346	-15.782630	-3.328629
## Feb 2003	1980.547	-245.565467	-208.471780	29.569346	-15.782630
## Mar 2003	1999.794	51.478186	-245.565467	-208.471780	29.569346
## Apr 2003	2018.355	65.892146	51.478186	-245.565467	-208.471780
## May 2003	2021.998	80.037625	65.892146	51.478186	-245.565467
## Jun 2003	2054.270	49.925277	80.037625	65.892146	51.478186
## Jul 2003	2064.172	151.359574	49.925277	80.037625	65.892146
## Aug 2003	2022.228	185.243269	151.359574	49.925277	80.037625
## Sep 2003	2049.878	-140.299207	185.243269	151.359574	49.925277
## Oct 2003	2091.741	-3.318402	-140.299207	185.243269	151.359574
## Nov 2003	2091.795	-15.782617	-3.318402	-140.299207	185.243269
## Dec 2003	2102.586	29.571983	-15.782617	-3.318402	-140.299207
## Jan 2004	2067.604	-208.480326	29.571983	-15.782617	-3.318402

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##			s5	s6	s7	s8	s9
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##	Mar	1991	-15.787980	-3.331059	-140.301977	185.234793	151.356100
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##	Jun	1991	-245.569948	-208.468368	29.568977	-15.787980	-3.331059
##	Jul	1991	51.477534	-245.569948	-208.468368	29.568977	-15.787980
##	Aug	1991	65.880755	51.477534	-245.569948	-208.468368	29.568977
##	Sep	1991	80.026058	65.880755	51.477534	-245.569948	-208.468368
##	Oct	1991	49.919811	80.026058	65.880755	51.477534	-245.569948
##	Nov	1991	151.350043	49.919811	80.026058	65.880755	51.477534
##	Dec	1991	185.237516	151.350043	49.919811	80.026058	65.880755
##	Jan	1992	-140.313343	185.237516	151.350043	49.919811	80.026058
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##	Mar	1992	-15.795680	-3.337125	-140.313343	185.237516	151.350043
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##	May	1992	-208.458951	29.578252	-15.795680	-3.337125	-140.313343
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##	Oct	1992	49.884881	80.018533	65.890123	51.483186	-245.568610
##	Nov	1992	151.359043	49.884881	80.018533	65.890123	51.483186
##	Dec	1992	185.249611	151.359043	49.884881	80.018533	65.890123
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##	Jul	1993	51.471203	-245.571368	-208.449852	29.577784	-15.786887
##	Aug	1993	65.899295	51.471203	-245.571368	-208.449852	29.577784
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##	Feb	1994	-3.344556	-140.303003	185.250134	151.351173	49.882780
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##	May	1994	-208.443766	29.570818	-15.792945	-3.344556	-140.303003
##	Jun	1994	-245.562169	-208.443766	29.570818	-15.792945	-3.344556
##	Jul	1994	51.479580	-245.562169	-208.443766	29.570818	-15.792945
##	Aug	1994	65.891637	51.479580	-245.562169	-208.443766	29.570818
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##	Oct	1994	49.876833	80.009517	65.891637	51.479580	-245.562169
##	Nov	1994	151.347223	49.876833	80.009517	65.891637	51.479580
##	Dec	1994	185.249101	151.347223	49.876833	80.009517	65.891637
##	Jan	1995	-140.289184	185.249101	151.347223	49.876833	80.009517
##	Feb	1995	-3.344470	-140.289184	185.249101	151.347223	49.876833

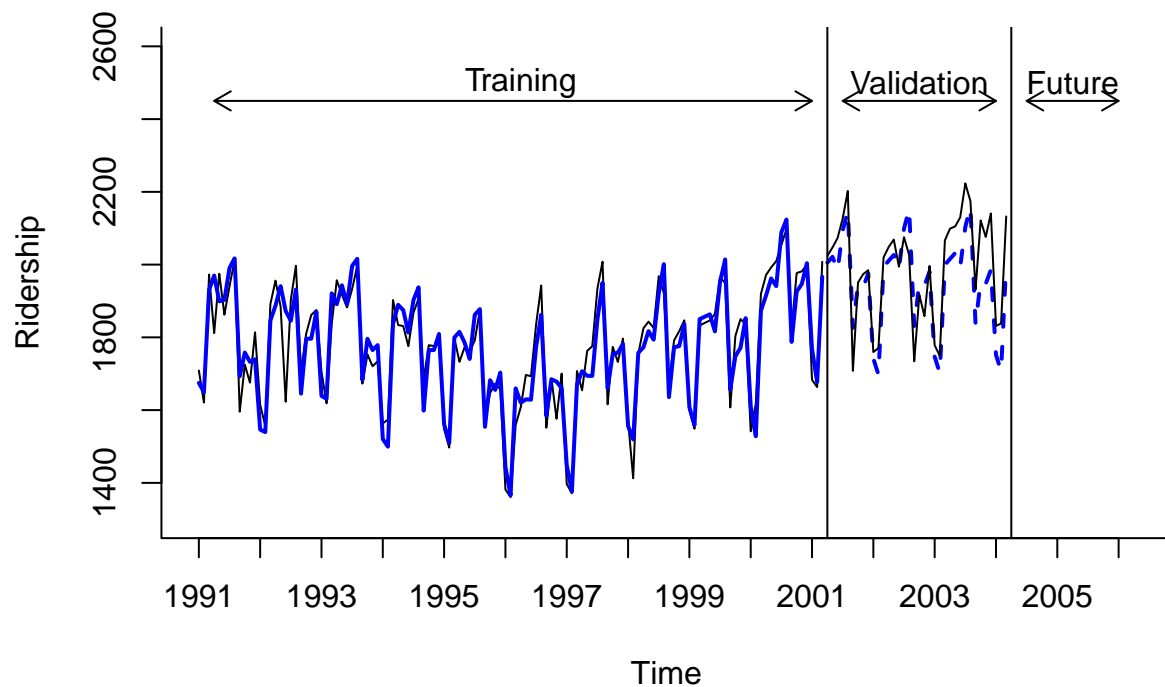
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## Apr 1995	29.566242	-15.791556	-3.344470	-140.289184	185.249101
## May 1995	-208.445365	29.566242	-15.791556	-3.344470	-140.289184
## Jun 1995	-245.564836	-208.445365	29.566242	-15.791556	-3.344470
## Jul 1995	51.478997	-245.564836	-208.445365	29.566242	-15.791556
## Aug 1995	65.880482	51.478997	-245.564836	-208.445365	29.566242
## Sep 1995	80.008053	65.880482	51.478997	-245.564836	-208.445365
## Oct 1995	49.878780	80.008053	65.880482	51.478997	-245.564836
## Nov 1995	151.338387	49.878780	80.008053	65.880482	51.478997
## Dec 1995	185.251927	151.338387	49.878780	80.008053	65.880482
## Jan 1996	-140.284930	185.251927	151.338387	49.878780	80.008053
## Feb 1996	-3.350962	-140.284930	185.251927	151.338387	49.878780
## Mar 1996	-15.789215	-3.350962	-140.284930	185.251927	151.338387
## Apr 1996	29.558929	-15.789215	-3.350962	-140.284930	185.251927
## May 1996	-208.453652	29.558929	-15.789215	-3.350962	-140.284930
## Jun 1996	-245.566280	-208.453652	29.558929	-15.789215	-3.350962
## Jul 1996	51.464802	-245.566280	-208.453652	29.558929	-15.789215
## Aug 1996	65.879057	51.464802	-245.566280	-208.453652	29.558929
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## Oct 1996	49.886602	80.017546	65.879057	51.464802	-245.566280
## Nov 1996	151.347418	49.886602	80.017546	65.879057	51.464802
## Dec 1996	185.265895	151.347418	49.886602	80.017546	65.879057
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## Sep 1997	80.027254	65.871929	51.469479	-245.567685	-208.460616
## Oct 1997	49.896759	80.027254	65.871929	51.469479	-245.567685
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## Jan 1998	-140.292024	185.276752	151.359674	49.896759	80.027254
## Feb 1998	-3.351468	-140.292024	185.276752	151.359674	49.896759
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## Apr 1999	29.564871	-15.801252	-3.350626	-140.285456	185.268892
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##	Feb	1996	80.008053	65.880482	51.478997
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##	Jan	1997	65.879057	51.464802	-245.566280
##	Feb	1997	80.017546	65.879057	51.464802
##	Mar	1997	49.886602	80.017546	65.879057
##	Apr	1997	151.347418	49.886602	80.017546
##	May	1997	185.265895	151.347418	49.886602
##	Jun	1997	-140.287726	185.265895	151.347418
##	Jul	1997	-3.352445	-140.287726	185.265895
##	Aug	1997	-15.803229	-3.352445	-140.287726
##	Sep	1997	29.563513	-15.803229	-3.352445
##	Oct	1997	-208.460616	29.563513	-15.803229
##	Nov	1997	-245.567685	-208.460616	29.563513
##	Dec	1997	51.469479	-245.567685	-208.460616
##	Jan	1998	65.871929	51.469479	-245.567685
##	Feb	1998	80.027254	65.871929	51.469479
##	Mar	1998	49.896759	80.027254	65.871929
##	Apr	1998	151.359674	49.896759	80.027254
##	May	1998	185.276752	151.359674	49.896759
##	Jun	1998	-140.292024	185.276752	151.359674
##	Jul	1998	-3.351468	-140.292024	185.276752
##	Aug	1998	-15.806768	-3.351468	-140.292024
##	Sep	1998	29.564530	-15.806768	-3.351468
##	Oct	1998	-208.458566	29.564530	-15.806768
##	Nov	1998	-245.583234	-208.458566	29.564530
##	Dec	1998	51.468749	-245.583234	-208.458566
##	Jan	1999	65.879236	51.468749	-245.583234
##	Feb	1999	80.031052	65.879236	51.468749
##	Mar	1999	49.900183	80.031052	65.879236
##	Apr	1999	151.366747	49.900183	80.031052
##	May	1999	185.268892	151.366747	49.900183
##	Jun	1999	-140.285456	185.268892	151.366747
##	Jul	1999	-3.350626	-140.285456	185.268892
##	Aug	1999	-15.801252	-3.350626	-140.285456
##	Sep	1999	29.564871	-15.801252	-3.350626

##	Oct	1999	-208.459686	29.564871	-15.801252
##	Nov	1999	-245.585570	-208.459686	29.564871
##	Dec	1999	51.465872	-245.585570	-208.459686
##	Jan	2000	65.877008	51.465872	-245.585570
##	Feb	2000	80.029062	65.877008	51.465872
##	Mar	2000	49.905923	80.029062	65.877008
##	Apr	2000	151.369201	49.905923	80.029062
##	May	2000	185.263062	151.369201	49.905923
##	Jun	2000	-140.290223	185.263062	151.369201
##	Jul	2000	-3.344627	-140.290223	185.263062
##	Aug	2000	-15.790538	-3.344627	-140.290223
##	Sep	2000	29.561512	-15.790538	-3.344627
##	Oct	2000	-208.468915	29.561512	-15.790538
##	Nov	2000	-245.574300	-208.468915	29.561512
##	Dec	2000	51.471603	-245.574300	-208.468915
##	Jan	2001	65.884662	51.471603	-245.574300
##	Feb	2001	80.033348	65.884662	51.471603
##	Mar	2001	49.914310	80.033348	65.884662
##	Apr	2001	151.365089	49.914310	80.033348
##	May	2001	185.262556	151.365089	49.914310
##	Jun	2001	-140.283377	185.262556	151.365089
##	Jul	2001	-3.339375	-140.283377	185.262556
##	Aug	2001	-15.785920	-3.339375	-140.283377
##	Sep	2001	29.559918	-15.785920	-3.339375
##	Oct	2001	-208.480398	29.559918	-15.785920
##	Nov	2001	-245.576997	-208.480398	29.559918
##	Dec	2001	51.476894	-245.576997	-208.480398
##	Jan	2002	65.887195	51.476894	-245.576997
##	Feb	2002	80.035703	65.887195	51.476894
##	Mar	2002	49.922996	80.035703	65.887195
##	Apr	2002	151.362418	49.922996	80.035703
##	May	2002	185.267113	151.362418	49.922996
##	Jun	2002	-140.304490	185.267113	151.362418
##	Jul	2002	-3.334210	-140.304490	185.267113
##	Aug	2002	-15.778816	-3.334210	-140.304490
##	Sep	2002	29.558380	-15.778816	-3.334210
##	Oct	2002	-208.479311	29.558380	-15.778816
##	Nov	2002	-245.569957	-208.479311	29.558380
##	Dec	2002	51.473485	-245.569957	-208.479311
##	Jan	2003	65.887611	51.473485	-245.569957
##	Feb	2003	80.036735	65.887611	51.473485
##	Mar	2003	49.917393	80.036735	65.887611
##	Apr	2003	151.357155	49.917393	80.036735
##	May	2003	185.253516	151.357155	49.917393
##	Jun	2003	-140.305962	185.253516	151.357155
##	Jul	2003	-3.328629	-140.305962	185.253516
##	Aug	2003	-15.782630	-3.328629	-140.305962
##	Sep	2003	29.569346	-15.782630	-3.328629
##	Oct	2003	-208.471780	29.569346	-15.782630
##	Nov	2003	-245.565467	-208.471780	29.569346
##	Dec	2003	51.478186	-245.565467	-208.471780
##	Jan	2004	65.892146	51.478186	-245.565467
##	Feb	2004	80.037625	65.892146	51.478186
##	Mar	2004	49.925277	80.037625	65.892146



```
## ETS(M,A,A)
##
## Call:
## ets(y = train.ts, model = "MAA")
##
## Smoothing parameters:
##   alpha = 0.5483
##   beta  = 1e-04
##   gamma = 1e-04
##
## Initial states:
##   l = 1881.6423
##   b = 0.4164
##   s=27.1143 -10.6847 -2.9465 -121.1763 201.1625 147.3359
##       37.6688 75.8711 60.4021 44.4779 -252.047 -207.1783
##
## sigma: 0.0317
##
##      AIC      AICc      BIC
## 1616.219 1622.048 1664.027
##
##      l      b      s1      s2      s3
## 1881.6422674 0.4164294 27.1143232 -10.6847219 -2.9464535
##      s4      s5      s6      s7      s8
## -121.1762908 201.1625434 147.3359163 37.6688093 75.8711436
##      s9      s10     s11     s12
## 60.4021324 44.4778868 -252.0469570 -207.1783318
```

##	l	b	s1	s2	s3
##	1944.7324008	0.4191293	44.4848339	-252.0480886	-207.1846269
##	s4	s5	s6	s7	s8
##	27.1150410	-10.6828258	-2.9402487	-121.1763500	201.1600763
##	s9	s10	s11	s12	
##	147.3368651	37.6669389	75.8823558	60.3887302	

##		l	b	s1	s2	s3
##	Dec 1990	1881.642	0.4164294	27.114323	-10.684722	-2.946453
##	Jan 1991	1900.721	0.4198334	-207.174926	27.114323	-10.684722
##	Feb 1991	1885.510	0.4169823	-252.049810	-207.174926	27.114323
##	Mar 1991	1909.126	0.4212138	44.482120	-252.049810	-207.174926
##	Apr 1991	1822.760	0.4053837	60.386294	44.482120	-252.049810
##	May 1991	1864.796	0.4129773	75.878741	60.386294	44.482120
##	Jun 1991	1842.991	0.4089247	37.664755	75.878741	60.386294
##	Jul 1991	1815.505	0.4038365	147.330826	37.664755	75.878741
##	Aug 1991	1813.821	0.4034558	201.162162	147.330826	37.664755
##	Sep 1991	1760.825	0.3937156	-121.186036	201.162162	147.330826
##	Oct 1991	1742.934	0.3903804	-2.949790	-121.186036	201.162162
##	Nov 1991	1712.086	0.3846826	-10.690423	-2.949790	-121.186036
##	Dec 1991	1753.197	0.3921111	27.121756	-10.690423	-2.949790
##	Jan 1992	1791.100	0.3989531	-207.168081	27.121756	-10.690423
##	Feb 1992	1801.170	0.4007172	-252.048045	-207.168081	27.121756
##	Mar 1992	1826.338	0.4052346	44.486640	-252.048045	-207.168081
##	Apr 1992	1864.494	0.4121205	60.393184	44.486640	-252.048045
##	May 1992	1834.163	0.4065128	75.873131	60.393184	44.486640
##	Jun 1992	1697.937	0.3815910	37.639820	75.873131	60.393184
##	Jul 1992	1729.933	0.3873576	147.336595	37.639820	75.873131
##	Aug 1992	1766.086	0.3938811	201.168689	147.336595	37.639820
##	Sep 1992	1798.612	0.3997421	-121.180172	201.168689	147.336595
##	Oct 1992	1806.654	0.4011360	-2.948396	-121.180172	201.168689
##	Nov 1992	1842.824	0.4076604	-10.683895	-2.948396	-121.180172
##	Dec 1992	1845.846	0.4081373	27.122233	-10.683895	-2.948396
##	Jan 1993	1882.537	0.4147552	-207.161459	27.122233	-10.683895
##	Feb 1993	1876.170	0.4135182	-252.049282	-207.161459	27.122233
##	Mar 1993	1830.328	0.4050812	44.478199	-252.049282	-207.161459
##	Apr 1993	1866.875	0.4116736	60.399779	44.478199	-252.049282
##	May 1993	1853.045	0.4090758	75.870531	60.399779	44.478199
##	Jun 1993	1848.686	0.4082061	37.638950	75.870531	60.399779
##	Jul 1993	1814.320	0.4018633	147.330249	37.638950	75.870531
##	Aug 1993	1803.908	0.3998907	201.166716	147.330249	37.638950
##	Sep 1993	1798.667	0.3988620	-121.181201	201.166716	147.330249
##	Oct 1993	1775.330	0.3945324	-2.952727	-121.181201	201.166716
##	Nov 1993	1751.235	0.3900656	-10.688364	-2.952727	-121.181201
##	Dec 1993	1727.250	0.3856195	27.117784	-10.688364	-2.952727
##	Jan 1994	1751.153	0.3899090	-207.157168	27.117784	-10.688364
##	Feb 1994	1792.372	0.3973564	-252.041831	-207.157168	27.117784
##	Mar 1994	1828.623	0.4038962	44.484742	-252.041831	-207.157168
##	Apr 1994	1798.575	0.3983417	60.394222	44.484742	-252.041831
##	May 1994	1774.961	0.3939617	75.866149	60.394222	44.484742
##	Jun 1994	1754.937	0.3902374	37.635224	75.866149	60.394222
##	Jul 1994	1736.055	0.3867222	147.326732	37.635224	75.866149
##	Aug 1994	1719.444	0.3836218	201.163614	147.326732	37.635224
##	Sep 1994	1767.522	0.3923213	-121.172497	201.163614	147.326732

##	Oct	1994	1775.363	0.3936799	-2.951368	-121.172497	201.163614
##	Nov	1994	1781.748	0.3947727	-10.687271	-2.951368	-121.172497
##	Dec	1994	1767.936	0.3921814	27.115192	-10.687271	-2.951368
##	Jan	1995	1761.334	0.3909057	-207.158444	27.115192	-10.687271
##	Feb	1995	1754.730	0.3896298	-252.043108	-207.158444	27.115192
##	Mar	1995	1754.413	0.3895009	44.484613	-252.043108	-207.158444
##	Apr	1995	1709.677	0.3812699	60.385987	44.484613	-252.043108
##	May	1995	1702.612	0.3799119	75.864790	60.385987	44.484613
##	Jun	1995	1714.276	0.3819700	37.637283	75.864790	60.385987
##	Jul	1995	1676.096	0.3749363	147.319695	37.637283	75.864790
##	Aug	1995	1674.928	0.3746548	201.163332	147.319695	37.637283
##	Sep	1995	1684.722	0.3763729	-121.170778	201.163332	147.319695
##	Oct	1995	1665.799	0.3728526	-2.954890	-121.170778	201.163332
##	Nov	1995	1675.573	0.3745675	-10.685555	-2.954890	-121.170778
##	Dec	1995	1650.606	0.3699452	27.110567	-10.685555	-2.954890
##	Jan	1996	1616.949	0.3637386	-207.164654	27.110567	-10.685555
##	Feb	1996	1614.891	0.3632968	-252.043550	-207.164654	27.110567
##	Mar	1996	1559.786	0.3531793	44.474491	-252.043550	-207.164654
##	Apr	1996	1553.502	0.3519687	60.384776	44.474491	-252.043550
##	May	1996	1590.578	0.3586671	75.871492	60.384776	44.474491
##	Jun	1996	1626.362	0.3651288	37.643748	75.871492	60.384776
##	Jul	1996	1660.430	0.3712764	147.325845	37.643748	75.871492
##	Aug	1996	1704.999	0.3793380	201.171398	147.325845	37.643748
##	Sep	1996	1687.391	0.3760570	-121.174061	201.171398	147.325845
##	Oct	1996	1688.697	0.3762267	-2.954720	-121.174061	201.171398
##	Nov	1996	1633.046	0.3660073	-10.695780	-2.954720	-121.174061
##	Dec	1996	1655.295	0.3699988	27.114561	-10.695780	-2.954720
##	Jan	1997	1627.201	0.3648070	-207.169848	27.114561	-10.695780
##	Feb	1997	1625.465	0.3644237	-252.043933	-207.169848	27.114561
##	Mar	1997	1646.236	0.3681459	44.478215	-252.043933	-207.169848
##	Apr	1997	1617.882	0.3629069	60.379534	44.478215	-252.043933
##	May	1997	1655.960	0.3697863	75.878375	60.379534	44.478215
##	Jun	1997	1701.195	0.3779698	37.651936	75.878375	60.379534
##	Jul	1997	1748.354	0.3865027	147.334383	37.651936	75.878375
##	Aug	1997	1780.620	0.3923176	201.177216	147.334383	37.651936
##	Sep	1997	1756.934	0.3879256	-121.178455	201.177216	147.334383
##	Oct	1997	1768.037	0.3898801	-2.952765	-121.178455	201.177216
##	Nov	1997	1754.520	0.3873435	-10.698318	-2.952765	-121.178455
##	Dec	1997	1762.915	0.3888040	27.116022	-10.698318	-2.952765
##	Jan	1998	1771.087	0.3902238	-207.168428	27.116022	-10.698318
##	Feb	1998	1712.951	0.3795484	-252.054614	-207.168428	27.116022
##	Mar	1998	1711.594	0.3792316	44.477898	-252.054614	-207.168428
##	Apr	1998	1740.802	0.3844901	60.384795	44.477898	-252.054614
##	May	1998	1755.565	0.3871128	75.880999	60.384795	44.477898
##	Jun	1998	1773.695	0.3903491	37.655173	75.880999	60.384795
##	Jul	1998	1799.720	0.3950248	147.339061	37.655173	75.880999
##	Aug	1998	1756.444	0.3870593	201.169246	147.339061	37.655173
##	Sep	1998	1775.443	0.3904540	-121.175059	201.169246	147.339061
##	Oct	1998	1786.028	0.3923136	-2.950905	-121.175059	201.169246
##	Nov	1998	1808.896	0.3964132	-10.694216	-2.950905	-121.175059
##	Dec	1998	1814.965	0.3974478	27.117057	-10.694216	-2.950905
##	Jan	1999	1810.555	0.3965710	-207.169305	27.117057	-10.694216
##	Feb	1999	1805.418	0.3955616	-252.055624	-207.169305	27.117057
##	Mar	1999	1795.967	0.3937656	44.476101	-252.055624	-207.169305

##	Apr	1999	1787.026	0.3920628	60.383091	44.476101	-252.055624
##	May	1999	1778.206	0.3903826	75.879318	60.383091	44.476101
##	Jun	1999	1805.244	0.3952432	37.660037	75.879318	60.383091
##	Jul	1999	1812.638	0.3965198	147.340338	37.660037	75.879318
##	Aug	1999	1777.284	0.3899989	201.162722	147.340338	37.660037
##	Sep	1999	1750.739	0.3850857	-121.179974	201.162722	147.340338
##	Oct	1999	1781.549	0.3906355	-2.945352	-121.179974	201.162722
##	Nov	1999	1825.290	0.3985426	-10.686305	-2.945352	-121.179974
##	Dec	1999	1816.713	0.3969053	27.115419	-10.686305	-2.945352
##	Jan	2000	1779.672	0.3900766	-207.176137	27.115419	-10.686305
##	Feb	2000	1828.817	0.3989697	-252.046726	-207.176137	27.115419
##	Mar	2000	1854.353	0.4035547	44.480688	-252.046726	-207.176137
##	Apr	2000	1885.655	0.4091906	60.388730	44.480688	-252.046726
##	May	2000	1902.709	0.4122267	75.882356	60.388730	44.480688
##	Jun	2000	1940.944	0.4191255	37.666939	75.882356	60.388730
##	Jul	2000	1922.333	0.4156544	147.336865	37.666939	75.882356
##	Aug	2000	1908.251	0.4130101	201.160076	147.336865	37.666939
##	Sep	2000	1928.525	0.4166326	-121.176350	201.160076	147.336865
##	Oct	2000	1956.905	0.4217333	-2.940249	-121.176350	201.160076
##	Nov	2000	1976.390	0.4252104	-10.682826	-2.940249	-121.176350
##	Dec	2000	1974.744	0.4248326	27.115041	-10.682826	-2.940249
##	Jan	2001	1928.648	0.4163473	-207.184627	27.115041	-10.682826
##	Feb	2001	1921.600	0.4149857	-252.048089	-207.184627	27.115041
##	Mar	2001	1944.732	0.4191293	44.484834	-252.048089	-207.184627
##			s4	s5	s6	s7	s8
##	Dec	1990	-121.176291	201.162543	147.335916	37.668809	75.871144
##	Jan	1991	-2.946453	-121.176291	201.162543	147.335916	37.668809
##	Feb	1991	-10.684722	-2.946453	-121.176291	201.162543	147.335916
##	Mar	1991	27.114323	-10.684722	-2.946453	-121.176291	201.162543
##	Apr	1991	-207.174926	27.114323	-10.684722	-2.946453	-121.176291
##	May	1991	-252.049810	-207.174926	27.114323	-10.684722	-2.946453
##	Jun	1991	44.482120	-252.049810	-207.174926	27.114323	-10.684722
##	Jul	1991	60.386294	44.482120	-252.049810	-207.174926	27.114323
##	Aug	1991	75.878741	60.386294	44.482120	-252.049810	-207.174926
##	Sep	1991	37.664755	75.878741	60.386294	44.482120	-252.049810
##	Oct	1991	147.330826	37.664755	75.878741	60.386294	44.482120
##	Nov	1991	201.162162	147.330826	37.664755	75.878741	60.386294
##	Dec	1991	-121.186036	201.162162	147.330826	37.664755	75.878741
##	Jan	1992	-2.949790	-121.186036	201.162162	147.330826	37.664755
##	Feb	1992	-10.690423	-2.949790	-121.186036	201.162162	147.330826
##	Mar	1992	27.121756	-10.690423	-2.949790	-121.186036	201.162162
##	Apr	1992	-207.168081	27.121756	-10.690423	-2.949790	-121.186036
##	May	1992	-252.048045	-207.168081	27.121756	-10.690423	-2.949790
##	Jun	1992	44.486640	-252.048045	-207.168081	27.121756	-10.690423
##	Jul	1992	60.393184	44.486640	-252.048045	-207.168081	27.121756
##	Aug	1992	75.873131	60.393184	44.486640	-252.048045	-207.168081
##	Sep	1992	37.639820	75.873131	60.393184	44.486640	-252.048045
##	Oct	1992	147.336595	37.639820	75.873131	60.393184	44.486640
##	Nov	1992	201.168689	147.336595	37.639820	75.873131	60.393184
##	Dec	1992	-121.180172	201.168689	147.336595	37.639820	75.873131
##	Jan	1993	-2.948396	-121.180172	201.168689	147.336595	37.639820
##	Feb	1993	-10.683895	-2.948396	-121.180172	201.168689	147.336595
##	Mar	1993	27.122233	-10.683895	-2.948396	-121.180172	201.168689
##	Apr	1993	-207.161459	27.122233	-10.683895	-2.948396	-121.180172

## May 1993	-252.049282	-207.161459	27.122233	-10.683895	-2.948396
## Jun 1993	44.478199	-252.049282	-207.161459	27.122233	-10.683895
## Jul 1993	60.399779	44.478199	-252.049282	-207.161459	27.122233
## Aug 1993	75.870531	60.399779	44.478199	-252.049282	-207.161459
## Sep 1993	37.638950	75.870531	60.399779	44.478199	-252.049282
## Oct 1993	147.330249	37.638950	75.870531	60.399779	44.478199
## Nov 1993	201.166716	147.330249	37.638950	75.870531	60.399779
## Dec 1993	-121.181201	201.166716	147.330249	37.638950	75.870531
## Jan 1994	-2.952727	-121.181201	201.166716	147.330249	37.638950
## Feb 1994	-10.688364	-2.952727	-121.181201	201.166716	147.330249
## Mar 1994	27.117784	-10.688364	-2.952727	-121.181201	201.166716
## Apr 1994	-207.157168	27.117784	-10.688364	-2.952727	-121.181201
## May 1994	-252.041831	-207.157168	27.117784	-10.688364	-2.952727
## Jun 1994	44.484742	-252.041831	-207.157168	27.117784	-10.688364
## Jul 1994	60.394222	44.484742	-252.041831	-207.157168	27.117784
## Aug 1994	75.866149	60.394222	44.484742	-252.041831	-207.157168
## Sep 1994	37.635224	75.866149	60.394222	44.484742	-252.041831
## Oct 1994	147.326732	37.635224	75.866149	60.394222	44.484742
## Nov 1994	201.163614	147.326732	37.635224	75.866149	60.394222
## Dec 1994	-121.172497	201.163614	147.326732	37.635224	75.866149
## Jan 1995	-2.951368	-121.172497	201.163614	147.326732	37.635224
## Feb 1995	-10.687271	-2.951368	-121.172497	201.163614	147.326732
## Mar 1995	27.115192	-10.687271	-2.951368	-121.172497	201.163614
## Apr 1995	-207.158444	27.115192	-10.687271	-2.951368	-121.172497
## May 1995	-252.043108	-207.158444	27.115192	-10.687271	-2.951368
## Jun 1995	44.484613	-252.043108	-207.158444	27.115192	-10.687271
## Jul 1995	60.385987	44.484613	-252.043108	-207.158444	27.115192
## Aug 1995	75.864790	60.385987	44.484613	-252.043108	-207.158444
## Sep 1995	37.637283	75.864790	60.385987	44.484613	-252.043108
## Oct 1995	147.319695	37.637283	75.864790	60.385987	44.484613
## Nov 1995	201.163332	147.319695	37.637283	75.864790	60.385987
## Dec 1995	-121.170778	201.163332	147.319695	37.637283	75.864790
## Jan 1996	-2.954890	-121.170778	201.163332	147.319695	37.637283
## Feb 1996	-10.685555	-2.954890	-121.170778	201.163332	147.319695
## Mar 1996	27.110567	-10.685555	-2.954890	-121.170778	201.163332
## Apr 1996	-207.164654	27.110567	-10.685555	-2.954890	-121.170778
## May 1996	-252.043550	-207.164654	27.110567	-10.685555	-2.954890
## Jun 1996	44.474491	-252.043550	-207.164654	27.110567	-10.685555
## Jul 1996	60.384776	44.474491	-252.043550	-207.164654	27.110567
## Aug 1996	75.871492	60.384776	44.474491	-252.043550	-207.164654
## Sep 1996	37.643748	75.871492	60.384776	44.474491	-252.043550
## Oct 1996	147.325845	37.643748	75.871492	60.384776	44.474491
## Nov 1996	201.171398	147.325845	37.643748	75.871492	60.384776
## Dec 1996	-121.174061	201.171398	147.325845	37.643748	75.871492
## Jan 1997	-2.954720	-121.174061	201.171398	147.325845	37.643748
## Feb 1997	-10.695780	-2.954720	-121.174061	201.171398	147.325845
## Mar 1997	27.114561	-10.695780	-2.954720	-121.174061	201.171398
## Apr 1997	-207.169848	27.114561	-10.695780	-2.954720	-121.174061
## May 1997	-252.043933	-207.169848	27.114561	-10.695780	-2.954720
## Jun 1997	44.478215	-252.043933	-207.169848	27.114561	-10.695780
## Jul 1997	60.379534	44.478215	-252.043933	-207.169848	27.114561
## Aug 1997	75.878375	60.379534	44.478215	-252.043933	-207.169848
## Sep 1997	37.651936	75.878375	60.379534	44.478215	-252.043933
## Oct 1997	147.334383	37.651936	75.878375	60.379534	44.478215

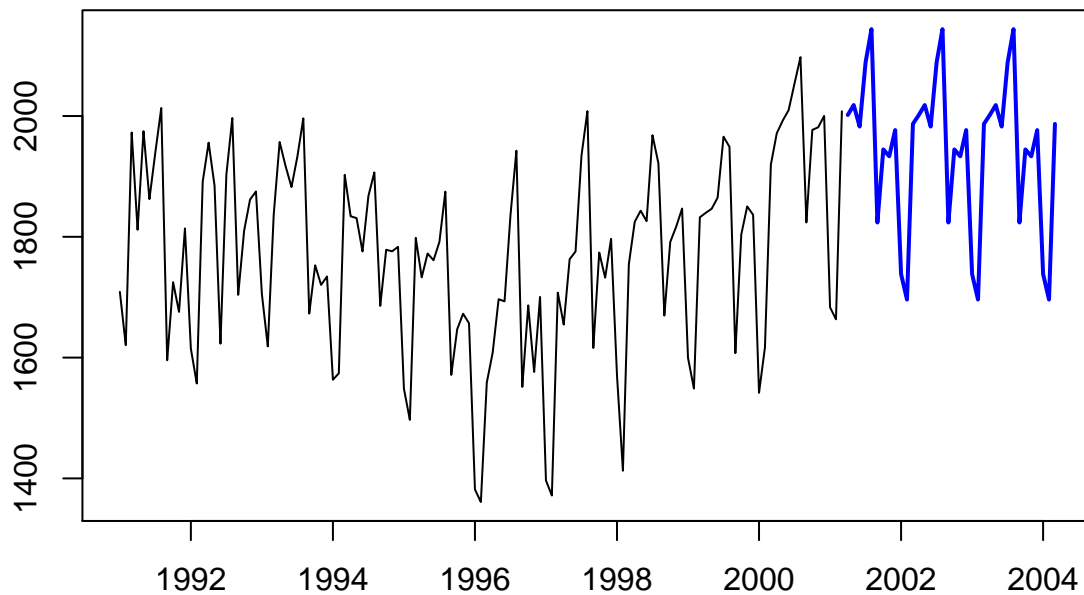
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##	Dec	1997	-121.178455	201.177216	147.334383	37.651936	75.878375
##	Jan	1998	-2.952765	-121.178455	201.177216	147.334383	37.651936
##	Feb	1998	-10.698318	-2.952765	-121.178455	201.177216	147.334383
##	Mar	1998	27.116022	-10.698318	-2.952765	-121.178455	201.177216
##	Apr	1998	-207.168428	27.116022	-10.698318	-2.952765	-121.178455
##	May	1998	-252.054614	-207.168428	27.116022	-10.698318	-2.952765
##	Jun	1998	44.477898	-252.054614	-207.168428	27.116022	-10.698318
##	Jul	1998	60.384795	44.477898	-252.054614	-207.168428	27.116022
##	Aug	1998	75.880999	60.384795	44.477898	-252.054614	-207.168428
##	Sep	1998	37.655173	75.880999	60.384795	44.477898	-252.054614
##	Oct	1998	147.339061	37.655173	75.880999	60.384795	44.477898
##	Nov	1998	201.169246	147.339061	37.655173	75.880999	60.384795
##	Dec	1998	-121.175059	201.169246	147.339061	37.655173	75.880999
##	Jan	1999	-2.950905	-121.175059	201.169246	147.339061	37.655173
##	Feb	1999	-10.694216	-2.950905	-121.175059	201.169246	147.339061
##	Mar	1999	27.117057	-10.694216	-2.950905	-121.175059	201.169246
##	Apr	1999	-207.169305	27.117057	-10.694216	-2.950905	-121.175059
##	May	1999	-252.055624	-207.169305	27.117057	-10.694216	-2.950905
##	Jun	1999	44.476101	-252.055624	-207.169305	27.117057	-10.694216
##	Jul	1999	60.383091	44.476101	-252.055624	-207.169305	27.117057
##	Aug	1999	75.879318	60.383091	44.476101	-252.055624	-207.169305
##	Sep	1999	37.660037	75.879318	60.383091	44.476101	-252.055624
##	Oct	1999	147.340338	37.660037	75.879318	60.383091	44.476101
##	Nov	1999	201.162722	147.340338	37.660037	75.879318	60.383091
##	Dec	1999	-121.179974	201.162722	147.340338	37.660037	75.879318
##	Jan	2000	-2.945352	-121.179974	201.162722	147.340338	37.660037
##	Feb	2000	-10.686305	-2.945352	-121.179974	201.162722	147.340338
##	Mar	2000	27.115419	-10.686305	-2.945352	-121.179974	201.162722
##	Apr	2000	-207.176137	27.115419	-10.686305	-2.945352	-121.179974
##	May	2000	-252.046726	-207.176137	27.115419	-10.686305	-2.945352
##	Jun	2000	44.480688	-252.046726	-207.176137	27.115419	-10.686305
##	Jul	2000	60.388730	44.480688	-252.046726	-207.176137	27.115419
##	Aug	2000	75.882356	60.388730	44.480688	-252.046726	-207.176137
##	Sep	2000	37.666939	75.882356	60.388730	44.480688	-252.046726
##	Oct	2000	147.336865	37.666939	75.882356	60.388730	44.480688
##	Nov	2000	201.160076	147.336865	37.666939	75.882356	60.388730
##	Dec	2000	-121.176350	201.160076	147.336865	37.666939	75.882356
##	Jan	2001	-2.940249	-121.176350	201.160076	147.336865	37.666939
##	Feb	2001	-10.682826	-2.940249	-121.176350	201.160076	147.336865
##	Mar	2001	27.115041	-10.682826	-2.940249	-121.176350	201.160076
##			s9	s10	s11	s12	
##	Dec	1990	60.402132	44.477887	-252.046957	-207.178332	
##	Jan	1991	75.871144	60.402132	44.477887	-252.046957	
##	Feb	1991	37.668809	75.871144	60.402132	44.477887	
##	Mar	1991	147.335916	37.668809	75.871144	60.402132	
##	Apr	1991	201.162543	147.335916	37.668809	75.871144	
##	May	1991	-121.176291	201.162543	147.335916	37.668809	
##	Jun	1991	-2.946453	-121.176291	201.162543	147.335916	
##	Jul	1991	-10.684722	-2.946453	-121.176291	201.162543	
##	Aug	1991	27.114323	-10.684722	-2.946453	-121.176291	
##	Sep	1991	-207.174926	27.114323	-10.684722	-2.946453	
##	Oct	1991	-252.049810	-207.174926	27.114323	-10.684722	
##	Nov	1991	44.482120	-252.049810	-207.174926	27.114323	

## Dec 1991	60.386294	44.482120	-252.049810	-207.174926
## Jan 1992	75.878741	60.386294	44.482120	-252.049810
## Feb 1992	37.664755	75.878741	60.386294	44.482120
## Mar 1992	147.330826	37.664755	75.878741	60.386294
## Apr 1992	201.162162	147.330826	37.664755	75.878741
## May 1992	-121.186036	201.162162	147.330826	37.664755
## Jun 1992	-2.949790	-121.186036	201.162162	147.330826
## Jul 1992	-10.690423	-2.949790	-121.186036	201.162162
## Aug 1992	27.121756	-10.690423	-2.949790	-121.186036
## Sep 1992	-207.168081	27.121756	-10.690423	-2.949790
## Oct 1992	-252.048045	-207.168081	27.121756	-10.690423
## Nov 1992	44.486640	-252.048045	-207.168081	27.121756
## Dec 1992	60.393184	44.486640	-252.048045	-207.168081
## Jan 1993	75.873131	60.393184	44.486640	-252.048045
## Feb 1993	37.639820	75.873131	60.393184	44.486640
## Mar 1993	147.336595	37.639820	75.873131	60.393184
## Apr 1993	201.168689	147.336595	37.639820	75.873131
## May 1993	-121.180172	201.168689	147.336595	37.639820
## Jun 1993	-2.948396	-121.180172	201.168689	147.336595
## Jul 1993	-10.683895	-2.948396	-121.180172	201.168689
## Aug 1993	27.122233	-10.683895	-2.948396	-121.180172
## Sep 1993	-207.161459	27.122233	-10.683895	-2.948396
## Oct 1993	-252.049282	-207.161459	27.122233	-10.683895
## Nov 1993	44.478199	-252.049282	-207.161459	27.122233
## Dec 1993	60.399779	44.478199	-252.049282	-207.161459
## Jan 1994	75.870531	60.399779	44.478199	-252.049282
## Feb 1994	37.638950	75.870531	60.399779	44.478199
## Mar 1994	147.330249	37.638950	75.870531	60.399779
## Apr 1994	201.166716	147.330249	37.638950	75.870531
## May 1994	-121.181201	201.166716	147.330249	37.638950
## Jun 1994	-2.952727	-121.181201	201.166716	147.330249
## Jul 1994	-10.688364	-2.952727	-121.181201	201.166716
## Aug 1994	27.117784	-10.688364	-2.952727	-121.181201
## Sep 1994	-207.157168	27.117784	-10.688364	-2.952727
## Oct 1994	-252.041831	-207.157168	27.117784	-10.688364
## Nov 1994	44.484742	-252.041831	-207.157168	27.117784
## Dec 1994	60.394222	44.484742	-252.041831	-207.157168
## Jan 1995	75.866149	60.394222	44.484742	-252.041831
## Feb 1995	37.635224	75.866149	60.394222	44.484742
## Mar 1995	147.326732	37.635224	75.866149	60.394222
## Apr 1995	201.163614	147.326732	37.635224	75.866149
## May 1995	-121.172497	201.163614	147.326732	37.635224
## Jun 1995	-2.951368	-121.172497	201.163614	147.326732
## Jul 1995	-10.687271	-2.951368	-121.172497	201.163614
## Aug 1995	27.115192	-10.687271	-2.951368	-121.172497
## Sep 1995	-207.158444	27.115192	-10.687271	-2.951368
## Oct 1995	-252.043108	-207.158444	27.115192	-10.687271
## Nov 1995	44.484613	-252.043108	-207.158444	27.115192
## Dec 1995	60.385987	44.484613	-252.043108	-207.158444
## Jan 1996	75.864790	60.385987	44.484613	-252.043108
## Feb 1996	37.637283	75.864790	60.385987	44.484613
## Mar 1996	147.319695	37.637283	75.864790	60.385987
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## May 1996	-121.170778	201.163332	147.319695	37.637283

## Jun 1996	-2.954890	-121.170778	201.163332	147.319695
## Jul 1996	-10.685555	-2.954890	-121.170778	201.163332
## Aug 1996	27.110567	-10.685555	-2.954890	-121.170778
## Sep 1996	-207.164654	27.110567	-10.685555	-2.954890
## Oct 1996	-252.043550	-207.164654	27.110567	-10.685555
## Nov 1996	44.474491	-252.043550	-207.164654	27.110567
## Dec 1996	60.384776	44.474491	-252.043550	-207.164654
## Jan 1997	75.871492	60.384776	44.474491	-252.043550
## Feb 1997	37.643748	75.871492	60.384776	44.474491
## Mar 1997	147.325845	37.643748	75.871492	60.384776
## Apr 1997	201.171398	147.325845	37.643748	75.871492
## May 1997	-121.174061	201.171398	147.325845	37.643748
## Jun 1997	-2.954720	-121.174061	201.171398	147.325845
## Jul 1997	-10.695780	-2.954720	-121.174061	201.171398
## Aug 1997	27.114561	-10.695780	-2.954720	-121.174061
## Sep 1997	-207.169848	27.114561	-10.695780	-2.954720
## Oct 1997	-252.043933	-207.169848	27.114561	-10.695780
## Nov 1997	44.478215	-252.043933	-207.169848	27.114561
## Dec 1997	60.379534	44.478215	-252.043933	-207.169848
## Jan 1998	75.878375	60.379534	44.478215	-252.043933
## Feb 1998	37.651936	75.878375	60.379534	44.478215
## Mar 1998	147.334383	37.651936	75.878375	60.379534
## Apr 1998	201.177216	147.334383	37.651936	75.878375
## May 1998	-121.178455	201.177216	147.334383	37.651936
## Jun 1998	-2.952765	-121.178455	201.177216	147.334383
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## Sep 1998	-207.168428	27.116022	-10.698318	-2.952765
## Oct 1998	-252.054614	-207.168428	27.116022	-10.698318
## Nov 1998	44.477898	-252.054614	-207.168428	27.116022
## Dec 1998	60.384795	44.477898	-252.054614	-207.168428
## Jan 1999	75.880999	60.384795	44.477898	-252.054614
## Feb 1999	37.655173	75.880999	60.384795	44.477898
## Mar 1999	147.339061	37.655173	75.880999	60.384795
## Apr 1999	201.169246	147.339061	37.655173	75.880999
## May 1999	-121.175059	201.169246	147.339061	37.655173
## Jun 1999	-2.950905	-121.175059	201.169246	147.339061
## Jul 1999	-10.694216	-2.950905	-121.175059	201.169246
## Aug 1999	27.117057	-10.694216	-2.950905	-121.175059
## Sep 1999	-207.169305	27.117057	-10.694216	-2.950905
## Oct 1999	-252.055624	-207.169305	27.117057	-10.694216
## Nov 1999	44.476101	-252.055624	-207.169305	27.117057
## Dec 1999	60.383091	44.476101	-252.055624	-207.169305
## Jan 2000	75.879318	60.383091	44.476101	-252.055624
## Feb 2000	37.660037	75.879318	60.383091	44.476101
## Mar 2000	147.340338	37.660037	75.879318	60.383091
## Apr 2000	201.162722	147.340338	37.660037	75.879318
## May 2000	-121.179974	201.162722	147.340338	37.660037
## Jun 2000	-2.945352	-121.179974	201.162722	147.340338
## Jul 2000	-10.686305	-2.945352	-121.179974	201.162722
## Aug 2000	27.115419	-10.686305	-2.945352	-121.179974
## Sep 2000	-207.176137	27.115419	-10.686305	-2.945352
## Oct 2000	-252.046726	-207.176137	27.115419	-10.686305
## Nov 2000	44.480688	-252.046726	-207.176137	27.115419

## Dec 2000	60.388730	44.480688	-252.046726	-207.176137
## Jan 2001	75.882356	60.388730	44.480688	-252.046726
## Feb 2001	37.666939	75.882356	60.388730	44.480688
## Mar 2001	147.336865	37.666939	75.882356	60.388730

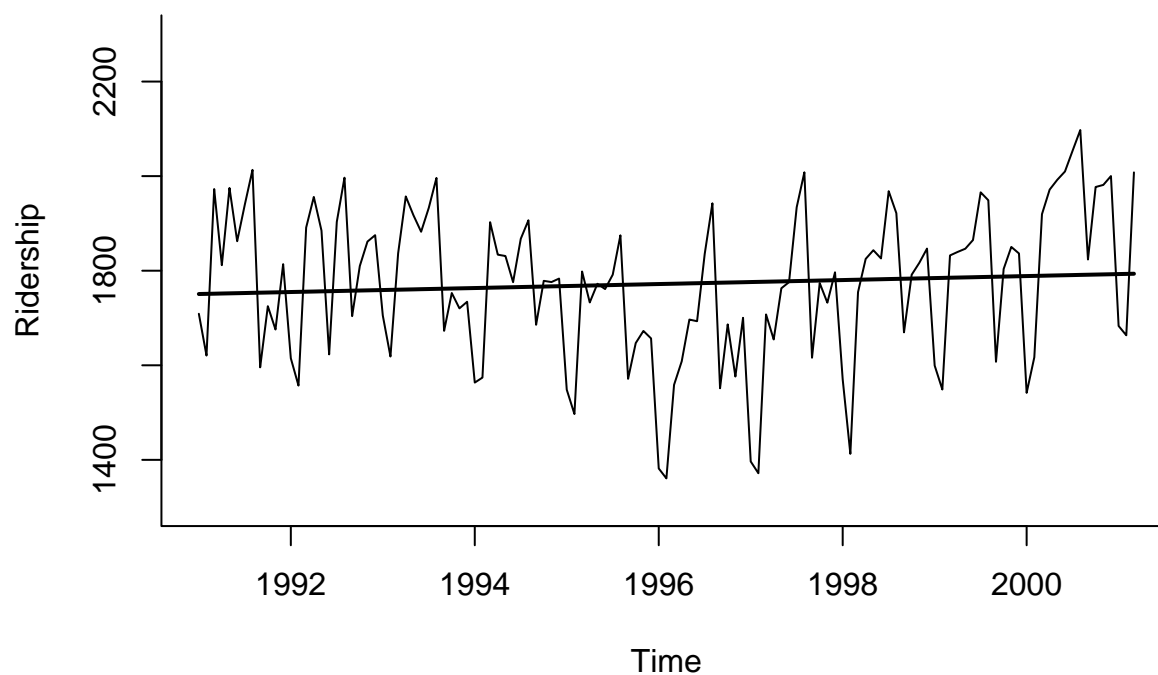
Forecasts from ETS(M,N,A)



##		ME	RMSE	MAE	MPE	MAPE	MASE
## Training set		0.219486	56.24056	44.98047	-0.07430418	2.564691	0.5452709
## Test set		40.723759	82.11922	67.52209	1.93604797	3.388343	0.8185293
##	ACF1 Theil's U						
## Training set		0.06506553		NA			
## Test set		0.62663295	0.4755131				

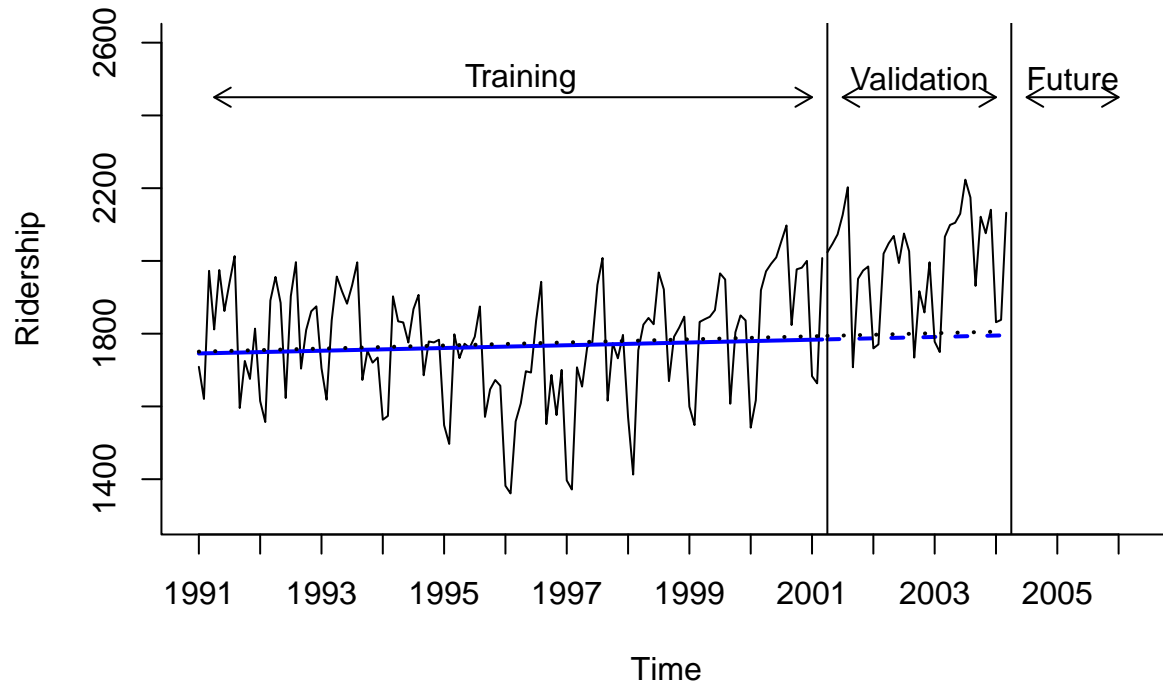
##		ME	RMSE	MAE	MPE	MAPE	MASE
## Training set		1.947578	56.88865	45.33644	0.02337148	2.582187	0.5495861
## Test set		48.667558	88.01624	73.05445	2.33048701	3.656759	0.8855948
##	ACF1 Theil's U						
## Training set		0.05514443		NA			
## Test set		0.65275454	0.5098143				

Smoothing



```
##
## Call:
## tslm(formula = train.ts ~ trend)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -411.29 -114.02   16.06  129.28  306.35
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 1750.3595    29.0729   60.206  <2e-16 ***
## trend         0.3514     0.4069    0.864    0.39
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 160.2 on 121 degrees of freedom
## Multiple R-squared:  0.006125,    Adjusted R-squared:  -0.002089
## F-statistic: 0.7456 on 1 and 121 DF,  p-value: 0.3896
```


Box-Cox Transformation

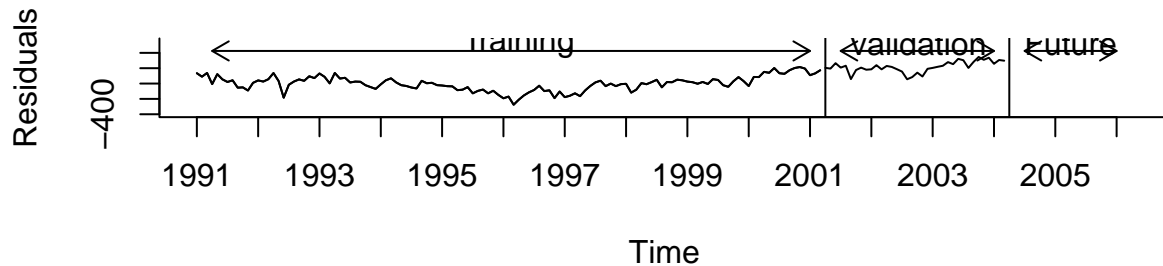
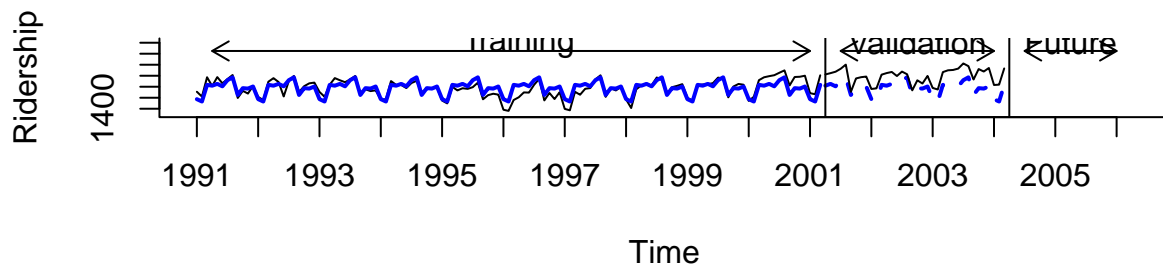


##	Jan	Feb	Mar	Apr	May	Jun	Jul
## 1991	7.443615	7.390543	7.587166	7.502002	7.588305	7.529598	7.570371
## 1992	7.386983	7.350573	7.544979	7.578647	7.541531	7.392057	7.551349
## 1993	7.441472	7.389277	7.515731	7.579190	7.558613	7.540302	7.566833
## 1994	7.354596	7.361349	7.550997	7.514194	7.512644	7.481981	7.532360
## 1995	7.344987	7.311168	7.494606	7.457549	7.480059	7.473755	7.490895
## 1996	7.231112	7.215866	7.351527	7.383008	7.436438	7.434365	7.515081
## 1997	7.241787	7.223799	7.442798	7.411317	7.474717	7.482006	7.567459
## 1998	7.359041	7.253252	7.470020	7.509298	7.519307	7.509863	7.584860
## 1999	7.377401	7.345238	7.513345	7.517369	7.521046	7.530937	7.583626
## 2000	7.340615	7.388283	7.559840	7.586546	7.597046	7.605772	7.627542
## 2001	7.428421	7.416621	7.604859				
##	Aug	Sep	Oct	Nov	Dec		
## 1991	7.607513	7.375041	7.452938	7.423967	7.503214		
## 1992	7.599257	7.440673	7.501082	7.529192	7.536429		
## 1993	7.598984	7.422279	7.468985	7.450299	7.458355		
## 1994	7.553081	7.429896	7.483551	7.482116	7.486249		
## 1995	7.536268	7.359664	7.406679	7.422153	7.412670		
## 1996	7.571769	7.346914	7.430415	7.362775	7.438638		
## 1997	7.604922	7.387662	7.480941	7.457245	7.493666		
## 1998	7.560937	7.420338	7.490794	7.504785	7.521185		
## 1999	7.575073	7.382356	7.497575	7.523108	7.515581		
## 2000	7.648488	7.508626	7.589334	7.591563	7.600979		
## 2001							

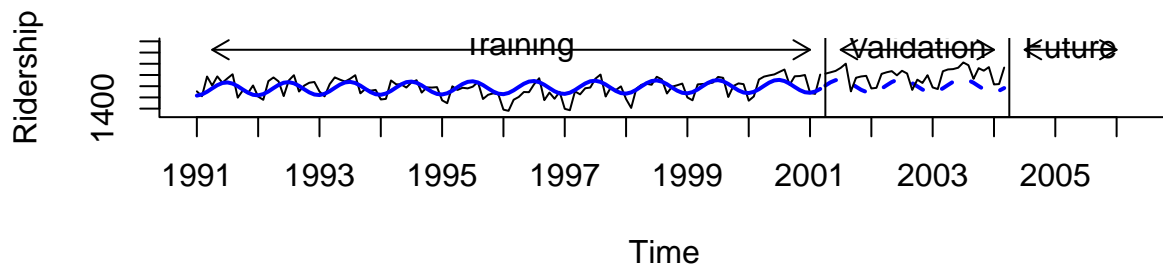
Smoothing with various Permutations of Interaction Terms

```
##
## Call:
## tslm(formula = train.ts ~ trend + I(trend^2))
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -344.79 -101.86   40.89   98.54  279.81
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 1888.88401   40.91521  46.166 < 2e-16 ***
## trend        -6.29780    1.52327  -4.134 6.63e-05 ***
## I(trend^2)     0.05362    0.01190   4.506 1.55e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 148.8 on 120 degrees of freedom
## Multiple R-squared:  0.1499, Adjusted R-squared:  0.1358
## F-statistic: 10.58 on 2 and 120 DF,  p-value: 5.844e-05

##
## Call:
## tslm(formula = train.ts ~ season)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -276.165  -52.934    5.868   54.544  215.081
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  1573.97      30.58  51.475 < 2e-16 ***
## season2       -42.93      43.24  -0.993  0.3230
## season3       260.77      43.24   6.030 2.19e-08 ***
## season4       245.09      44.31   5.531 2.14e-07 ***
## season5       278.22      44.31   6.279 6.81e-09 ***
## season6       233.46      44.31   5.269 6.82e-07 ***
## season7       345.33      44.31   7.793 3.79e-12 ***
## season8       396.66      44.31   8.952 9.19e-15 ***
## season9        75.76      44.31   1.710  0.0901 .
## season10      200.61      44.31   4.527 1.51e-05 ***
## season11      192.36      44.31   4.341 3.14e-05 ***
## season12      230.42      44.31   5.200 9.18e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 101.4 on 111 degrees of freedom
## Multiple R-squared:  0.6348, Adjusted R-squared:  0.5986
## F-statistic: 17.54 on 11 and 111 DF,  p-value: < 2.2e-16
```

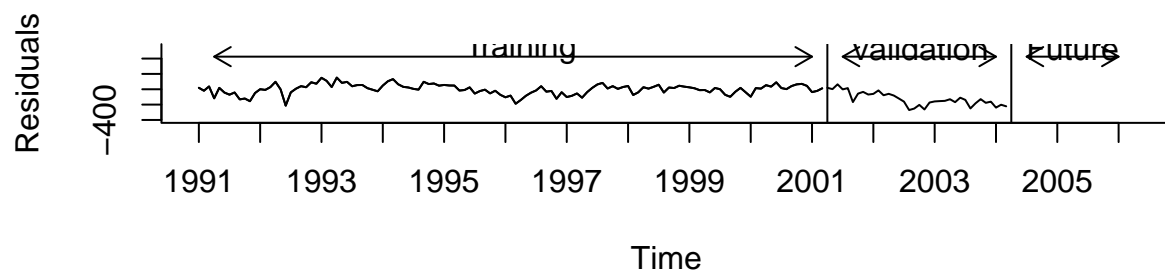
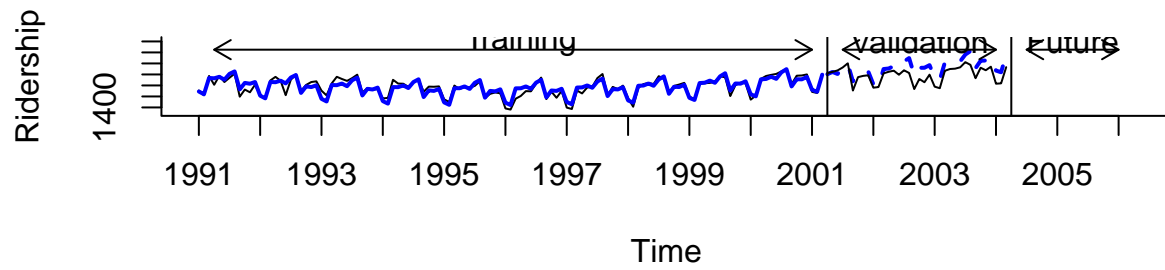


```
##
## Call:
## tslm(formula = train.ts ~ trend + I(sin(2 * pi * trend/12)) +
##       I(cos(2 * pi * trend/12)))
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -318.34  -96.30    8.04   89.73  307.89
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   1748.0335    25.0477   69.788 < 2e-16 ***
## trend           0.4229     0.3507    1.206  0.23015
## I(sin(2 * pi * trend/12)) -48.2666    17.5260  -2.754  0.00681 **
## I(cos(2 * pi * trend/12)) -106.5245    17.6773  -6.026 1.93e-08 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 137.9 on 119 degrees of freedom
## Multiple R-squared:  0.2762, Adjusted R-squared:  0.2579
## F-statistic: 15.14 on 3 and 119 DF, p-value: 2.088e-08
```



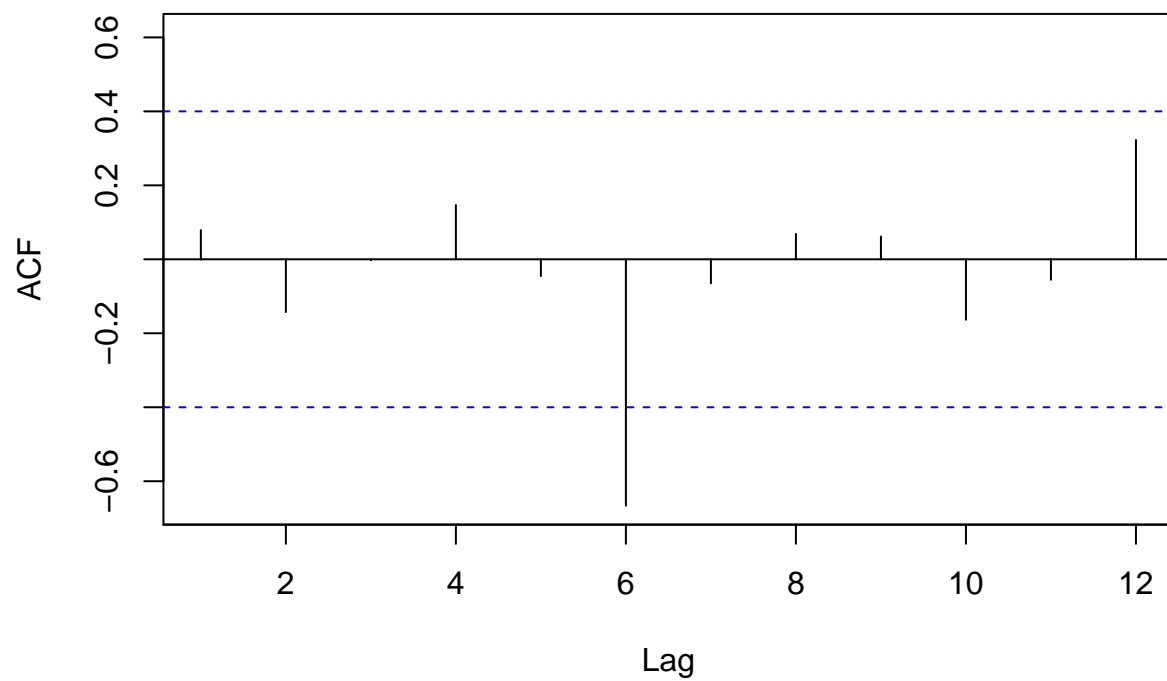
```
##
## Call:
## tslm(formula = train.ts ~ trend + I(trend^2) + season)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -213.775  -39.363    9.711   42.422  152.187
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  1.697e+03  2.768e+01  61.318  < 2e-16 ***
## trend        -7.156e+00  7.293e-01  -9.812  < 2e-16 ***
## I(trend^2)    6.074e-02  5.698e-03  10.660  < 2e-16 ***
## season2      -4.325e+01  3.024e+01  -1.430   0.15556
## season3       2.600e+02  3.024e+01   8.598 6.60e-14 ***
## season4       2.606e+02  3.102e+01   8.401 1.83e-13 ***
## season5       2.938e+02  3.102e+01   9.471 6.89e-16 ***
## season6       2.490e+02  3.102e+01   8.026 1.26e-12 ***
## season7       3.606e+02  3.102e+01  11.626  < 2e-16 ***
## season8       4.117e+02  3.102e+01  13.270  < 2e-16 ***
## season9       9.032e+01  3.102e+01   2.911  0.00437 **
## season10      2.146e+02  3.102e+01   6.917 3.29e-10 ***
## season11      2.057e+02  3.103e+01   6.629 1.34e-09 ***
## season12      2.429e+02  3.103e+01   7.829 3.44e-12 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

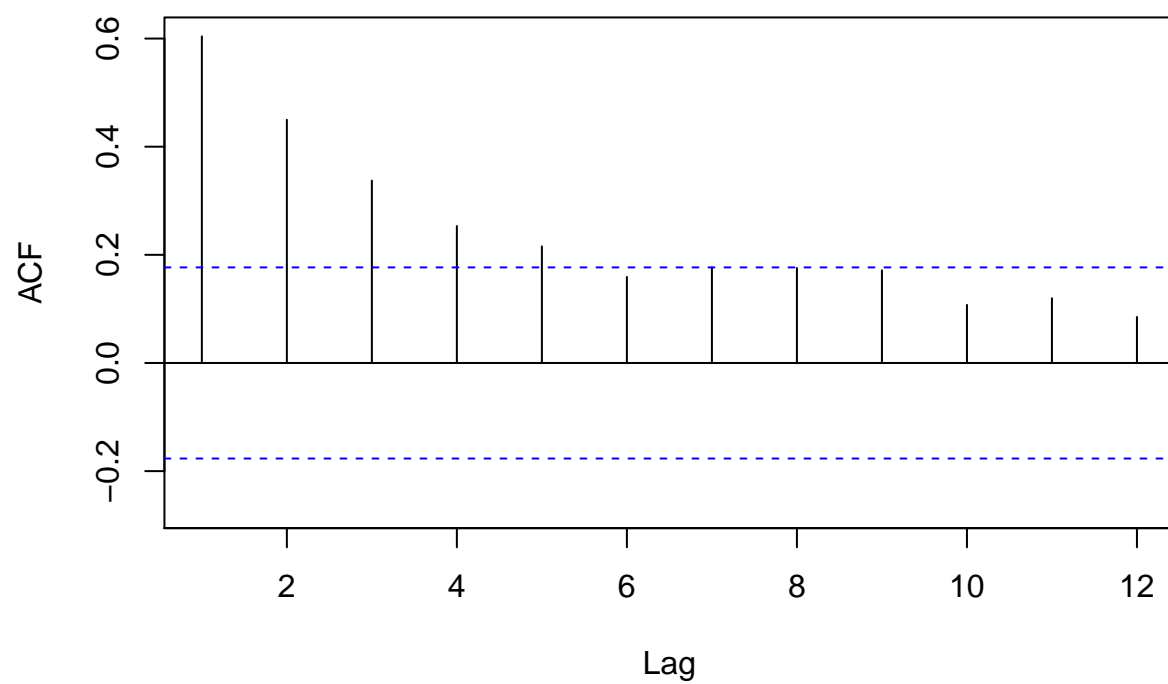
```
##
## Residual standard error: 70.92 on 109 degrees of freedom
## Multiple R-squared:  0.8246, Adjusted R-squared:  0.8037
## F-statistic: 39.42 on 13 and 109 DF,  p-value: < 2.2e-16
```



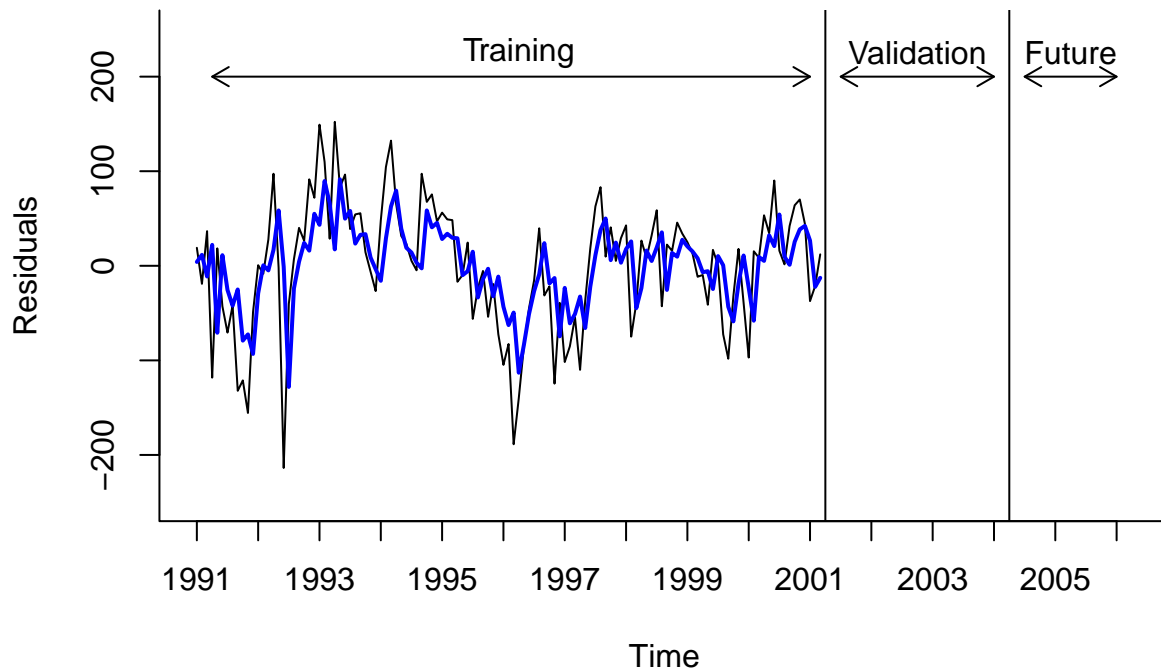
```
## null device
##          1
```

Auto Correlations Plot and Treatment





```
## , , 1
##
##      [,1]
## [1,] 1.00000000
## [2,] 0.60405883
## [3,] 0.44983171
## [4,] 0.33730830
## [5,] 0.25329034
## [6,] 0.21565844
## [7,] 0.15901326
## [8,] 0.17676683
## [9,] 0.17553762
## [10,] 0.17140882
## [11,] 0.10739472
## [12,] 0.11976519
## [13,] 0.08512942
```



```
## null device
##          1

## Series: train.lm.trend.season$residuals
## ARIMA(1,0,0) with non-zero mean
##
## Coefficients:
##          ar1      mean
##         0.5998  0.3728
## s.e.  0.0712  11.8408
##
## sigma^2 estimated as 2876:  log likelihood=-663.54
## AIC=1333.08  AICc=1333.29  BIC=1341.52
##
## Training set error measures:
##              ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -0.1223159 53.19141 39.8277 103.3885 175.2219 0.5721356
##              ACF1
## Training set -0.07509305

## [1] 159

## a 12-7-1 network with 99 weights
## options were - linear output units
##   b->h1  i1->h1  i2->h1  i3->h1  i4->h1  i5->h1  i6->h1  i7->h1  i8->h1
##    7.62   3.26  -0.51  -7.79  -0.40   4.18  -3.67   4.26  -6.99
##  i9->h1 i10->h1 i11->h1 i12->h1
##    4.26  -0.37   1.22   4.58
```

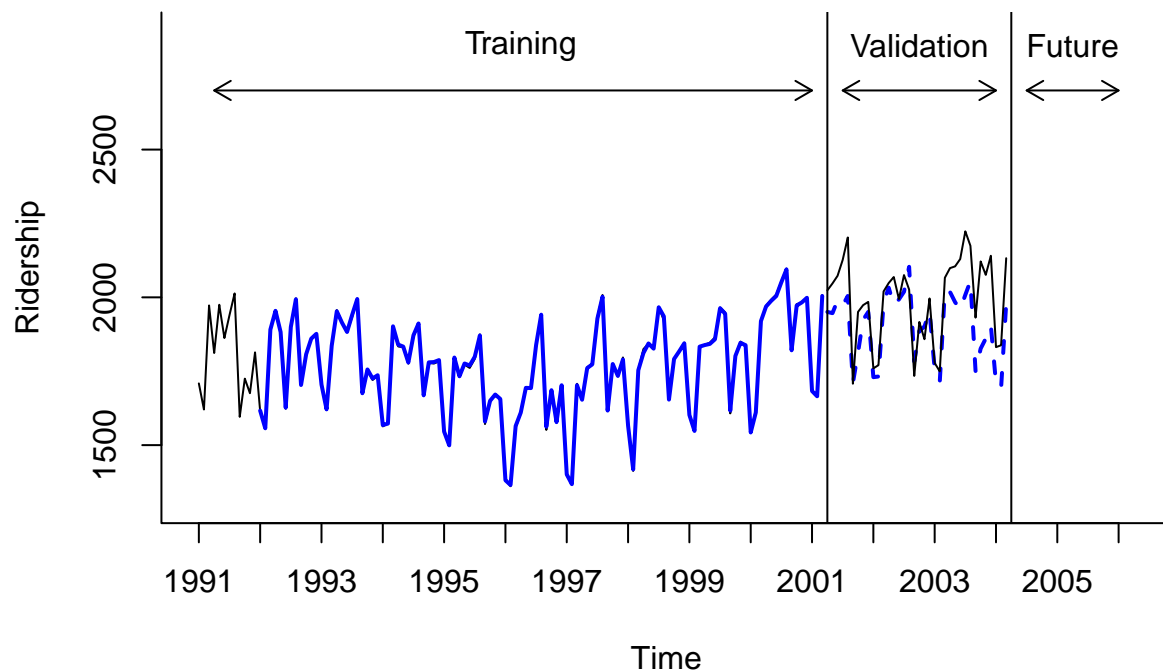


```

## b->h2 i1->h2 i2->h2 i3->h2 i4->h2 i5->h2 i6->h2 i7->h2 i8->h2
## 0.84 -0.47 4.11 -6.37 -7.74 8.22 -6.46 2.65 -6.84
## i9->h2 i10->h2 i11->h2 i12->h2
## 8.29 1.42 5.43 -0.05
## b->h3 i1->h3 i2->h3 i3->h3 i4->h3 i5->h3 i6->h3 i7->h3 i8->h3
## 7.45 -7.59 -4.51 5.28 -2.60 -2.31 -7.64 1.37 -1.36
## i9->h3 i10->h3 i11->h3 i12->h3
## 3.91 4.33 -1.65 0.83
## b->h4 i1->h4 i2->h4 i3->h4 i4->h4 i5->h4 i6->h4 i7->h4 i8->h4
## -4.48 1.53 -1.92 -1.55 -6.22 8.73 -2.41 -1.68 -0.84
## i9->h4 i10->h4 i11->h4 i12->h4
## 9.37 -10.92 5.00 4.68
## b->h5 i1->h5 i2->h5 i3->h5 i4->h5 i5->h5 i6->h5 i7->h5 i8->h5
## 0.27 -2.11 -3.05 -3.50 -5.15 0.64 8.94 -6.71 -0.37
## i9->h5 i10->h5 i11->h5 i12->h5
## 12.48 -2.84 -0.30 -0.55
## b->h6 i1->h6 i2->h6 i3->h6 i4->h6 i5->h6 i6->h6 i7->h6 i8->h6
## -6.31 -4.68 1.54 -7.47 3.65 3.42 4.15 0.39 0.70
## i9->h6 i10->h6 i11->h6 i12->h6
## 0.28 -5.94 -4.73 -0.23
## b->h7 i1->h7 i2->h7 i3->h7 i4->h7 i5->h7 i6->h7 i7->h7 i8->h7
## 0.70 7.03 -8.27 2.06 -13.59 -0.39 8.68 2.16 3.89
## i9->h7 i10->h7 i11->h7 i12->h7
## 9.90 -1.84 -4.01 -4.10
## b->o h1->o h2->o h3->o h4->o h5->o h6->o h7->o
## 0.60 1.05 -1.05 -1.11 1.33 -1.64 -1.58 1.28

## ME RMSE MAE MPE MAPE
## Training set 0.1345029 4.60624 3.355614 0.001476058 0.1921153
## Test set 87.7655536 121.60742 97.251127 4.250144613 4.7525810
## MASE ACF1 Theil's U
## Training set 0.04067807 -0.03689506 NA
## Test set 1.17891637 0.62628789 0.6955393

```



```
## Series: train.ts
## Model: NNAR(2,1,2)[12]
## Call: nnetar(y = train.ts)
##
## Average of 20 networks, each of which is
## a 3-2-1 network with 11 weights
## options were - linear output units
##
## sigma^2 estimated as 6766
##
```

	ME	RMSE	MAE	MPE	MAPE	MASE
## Training set	-0.3492673	82.25378	67.07129	-0.2610314	3.875977	0.8130646
## Test set	-37.1540134	130.87578	100.48248	-2.2095656	5.236845	1.2180881

```
##
```

	ACF1	Theil's U
## Training set	0.3979050	NA
## Test set	0.3529398	0.762112