Time Series in General Insurance
Workshop to be given by Patrick Carroll

1   Background and Rationale

Whereas much actuarial work in the UK in General Insurance has concentrated on Claims Reserving and Claims Analysis that uses Linear Model and Regression methodology, Time Series have received little attention at General Insurance conventions and there are no papers to describe how this important methodology can be used. But where there is seasonality and serial correlation with an apparent trend over time this is the more appropriate methodology to use.

Modern developments in Time Series developed by university based statisticians have brought into prominence Structured Models. The approach is somewhat different from the ARIMA Box-Jenkins modelling that is well known to actuaries from investment applications (e.g. the Wilkie model). But the authors believe it is worthwhile to make known Structured Models as there seems to be some potential for applications in General Insurance. Those who wish to participate in the Workshop may like to experiment with the data set provided (one of two to be used in the workshop) and compare their results with the preliminary analysis using a Structured Model approach.

2   Structured Models

The basic Structured Model assumes the following decomposition for a Time Series:

Series = Trend + Seasonal Component + Error

There is no requirement to achieve stationarity by differencing as in the Box-Jenkins approach, so there is the attraction that the model fits more naturally into a pattern of development over time that is often observed in insurance business. The explicit allowance for seasonality is also appropriate for some General Insurance data as in the series used as illustrations.

Those who would like to see a modern description of how the techniques of Time Series analysis can be applied using Kalman Filters in advance of the convention could refer to books such as "Time Series Models" (2nd ed.) by Andrew C. Harvey, published by Harvester/Wheatsheaf 1993 £14.99.

Time Series - Fire Protection Association data

Date	Index	Year	Month	Malicious	All
Jan-82	1	1	1	n/k	8,975
Feb-82	2	1	2	n/k	7,281
Mar-82	3	1	3	n/k	8,583
Apr-82	4	1	4	n/k	8,723
May-82	5	1	5	n/k	8,935
Jun-82	6	1	6	n/k	7,524
Jul-82	7	1	7	n/k	7,577
Aug-82	8	1	8	n/k	7,287
Sep-82	9	1	9	n/k	7,091
Oct-82	10	1	10	n/k	7,806
Nov-82	11	1	11	n/k	8,096
Dec-82	12	1	12	n/k	8,359
Jan-83	13	2	1	n/k	8,100
Feb-83	14	2	2	n/k	8,174
Mar-83	15	2	3	n/k	8,292
Apr-83	16	2	4	n/k	8,063
May-83	17	2	5	n/k	7,570
Jun-83	18	2	6	n/k	7,634
Jul-83	19	2	7	n/k	8,232
Aug-83	20	2	8	n/k	8,209
Sep-83	21	2	9	n/k	7,568
Oct-83	22	2	10	n/k	8,666
Nov-83	23	2	11	n/k	8,711
Dec-83	24	2	12	n/k	8,271
Jan-84	25	3	1	n/k	8,253
Feb-84	26	3	2	n/k	8,028
Mar-84	27	3	3	n/k	8,627
Apr-84	28	3	4	n/k	9,401
May-84	29	3	5	n/k	9,083
Jun-84	30	3	6	n/k	7,979
Jul-84	31	3	7	n/k	9,200
Aug-84	32	3	8	n/k	8,401
Sep-84	33	3	9	n/k	7,548
Oct-84	34	3	10	n/k	8,366
Nov-84	35	3	11	n/k	8,238
Dec-84	36	3	12	n/k	8,421
Jan-85	37	4	1	n/k	9,648
Feb-85	38	4	2	n/k	9,086
Mar-85	39	4	3	n/k	8,904
Apr-85	40	4	4	n/k	8,446
May-85	41	4	5	n/k	8,940
Jun-85	42	4	6	n/k	8,025
Jul-85	43	4	7	n/k	8,058
Aug-85	44	4	8	n/k	7,775
Sep-85	45	4	9	n/k	8,137
Oct-85	46	4	10	n/k	8,973
Nov-85	47	4	11	n/k	10,035

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Time Series - Fire Protection Association data

Date	Index	Year	Month	Malicious	All
Dec-85	48	4	12	n/k	8,628
Jan-86	49	5	1	n/k	9,057
Feb-86	50	5	2	n/k	9,700
Mar-86	51	5	3	n/k	9,678
Apr-86	52	5	4	n/k	9,129
May-86	53	5	5	n/k	8,842
Jun-86	54	5	6	n/k	8,100
Jul-86	55	5	7	n/k	8,557
Aug-86	56	5	8	n/k	7,861
Sep-86	57	5	9	n/k	8,355
Oct-86	58	5	10	n/k	8,882
Nov-86	59	5	11	n/k	8,932
Dec-86	60	5	12	n/k	8,557
Jan-87	61	6	1	n/k	10,365
Feb-87	62	6	2	n/k	8,400
Mar-87	63	6	3	n/k	9,452
Apr-87	64	6	4	n/k	8,425
May-87	65	6	5	n/k	8,860
Jun-87	66	6	6	n/k	7,656
Jul-87	67	6	7	n/k	7,884
Aug-87	68	6	8	n/k	8,154
Sep-87	69	6	9	n/k	7,921
Oct-87	70	6	10	n/k	8,622
Nov-87	71	6	11	n/k	9,130
Dec-87	72	6	12	n/k	9,210
Jan-88	73	7	1	1,445	8,614
Feb-88	74	7	2	1,611	9,405
Mar-88	75	7	3	1,655	9,498
Apr-88	76	7	4	1,665	8,894
May-88	77	7	5	1,805	9,074
Jun-88	78	7	6	1,609	8,318
Jul-88	79	7	7	1,501	7,933
Aug-88	80	7	8	1,707	8,490
Sep-88	81	7	9	1,602	8,188
Oct-88	82	7	10	1,891	9,107
Nov-88	83	7	11	1,828	9,874
Dec-88	84	7	12	1,565	8,981
Jan-89	85	8	1	1,783	9,310
Feb-89	86	8	2	1,530	8,324
Mar-89	87	8	3	1,853	9,623
Apr-89	88	8	4	1,851	9,168
May-89	89	8	5	2,105	9,811
Jun-89	90	8	6	2,072	9,567
Jul-89	91	8	7	2,055	9,442
Aug-89	92	8	8	2,008	9,071
Sep-89	93	8	9	1,888	8,711
Oct-89	94	8	10	2,018	9,054

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Time Series - Fire Protection Association data

Date	Index	Year	Month	Malicious	All
Nov-89	95	8	11	1,879	9,152
Dec-89	96	8	12	1,700	8,926
Jan-90	97	9	1	1,678	9,001
Feb-90	98	9	2	1,634	8,073
Mar-90	99	9	3	2,075	9,922
Apr-90	100	9	4	2,356	9,726
May-90	101	9	5	2,289	9,976
Jun-90	102	9	6	1,963	8,338
Jul-90	103	9	7	1,911	9,071
Aug-90	104	9	8	1,973	8,948
Sep-90	105	9	9	2,019	8,764
Oct-90	106	9	10	2,034	8,599
Nov-90	107	9	11	1,909	8,688
Dec-90	108	9	12	1,756	9,008
Jan-91	109	10	1	1,844	9,037
Feb-91	110	10	2	1,605	8,837
Mar-91	111	10	3	2,053	8,883
Apr-91	112	10	4	2,091	9,032
May-91	113	10	5	2,259	9,270
Jun-91	114	10	6	2,074	8,280
Jul-91	115	10	7	1,856	8,258
Aug-91	116	10	8	2,091	8,771
Sep-91	117	10	9	2,351	8,932
Oct-91	118	10	10	2,342	9,391
Nov-91	119	10	11	2,236	9,244
Dec-91	120	10	12	2,060	9,468
Jan-92	121	11	1	1,978	9,248
Feb-92	122	11	2	1,985	8,802
Mar-92	123	11	3	2,187	8,979
Apr-92	124	11	4	2,258	8,673
May-92	125	11	5	2,419	9,228
Jun-92	126	11	6	2,118	8,720
Jul-92	127	11	7	2,110	8,568
Aug-92	128	11	8	2,183	8,843
Sep-92	129	11	9	2,036	8,239
Oct-92	130	11	10	2,496	9,661
Nov-92	131	11	11	2,466	9,412
Dec-92	132	11	12	2,029	9,064

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