

ByoungSeon Choi

# ARMA Model Identification



Springer-Verlag

New York Berlin Heidelberg London Paris  
Tokyo Hong Kong Barcelona Budapest

# Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	ARMA Model . . . . .	1
1.2	History . . . . .	2
1.3	Algorithms . . . . .	3
1.3.1	AR Parameters . . . . .	3
1.3.2	MA Parameters . . . . .	9
1.4	Estimation . . . . .	13
1.4.1	Extended Yule-Walker Estimates . . . . .	14
1.4.2	Maximum Likelihood Estimates . . . . .	17
1.5	Nonstationary Processes . . . . .	19
1.5.1	Sample ACRF of a Nonstationary Process . . . . .	21
1.5.2	Iterated Least Squares Estimates . . . . .	23
1.6	Additional References . . . . .	25
<b>2</b>	<b>The Autocorrelation Methods</b>	<b>29</b>
2.1	Box and Jenkins' Method . . . . .	29
2.2	The Inverse Autocorrelation Method . . . . .	31
2.2.1	Inverse Autocorrelation Function . . . . .	31
2.2.2	Estimates of the Spectral Density . . . . .	33
2.2.3	Estimates of the IACF . . . . .	37
2.2.4	Identification Using the IACF . . . . .	39
2.3	Additional References . . . . .	41
<b>3</b>	<b>Penalty Function Methods</b>	<b>43</b>
3.1	The Final Prediction Error Method . . . . .	44
3.2	Akaike's Information Criterion . . . . .	47
3.2.1	Kullback-Leibler Information Number . . . . .	47
3.2.2	Akaike's Information Criterion . . . . .	49
3.3	Generalizations . . . . .	51
3.4	Parzen's Method . . . . .	55
3.5	The Bayesian Information Criterion . . . . .	58
3.5.1	Schwarz' Derivation . . . . .	58
3.5.2	Kashyap's Derivation . . . . .	60
3.5.3	Shortest Data Description . . . . .	60
3.5.4	Some Comments . . . . .	64

3.6	Hannan and Quinn's Criterion . . . . .	65
3.7	Consistency . . . . .	67
3.8	Some Relations . . . . .	68
	3.8.1 A Bayesian Interpretation . . . . .	68
	3.8.2 The BIC and Prediction Errors . . . . .	69
	3.8.3 The AIC and Cross-Validations . . . . .	71
3.9	Additional References . . . . .	72
<b>4</b>	<b>Innovation Regression Methods</b>	<b>75</b>
4.1	AR and MA Approximations . . . . .	75
4.2	Hannan and Rissanen's Method . . . . .	77
	4.2.1 A Three-Stage Procedure . . . . .	77
	4.2.2 Block Toeplitz Matrices . . . . .	79
	4.2.3 A Modification of the Whittle Algorithm . . . . .	84
	4.2.4 Some Modifications . . . . .	86
4.3	Koreisha and Pukkila's Method . . . . .	91
4.4	The KL Spectral Density . . . . .	94
4.5	Additional References . . . . .	98
<b>5</b>	<b>Pattern Identification Methods</b>	<b>101</b>
5.1	The 3-Pattern Method . . . . .	102
	5.1.1 The Three Functions . . . . .	102
	5.1.2 Asymptotic Distributions . . . . .	106
	5.1.3 Two Chi-Squared Statistics . . . . .	111
5.2	The $R$ and $S$ Array Method . . . . .	113
	5.2.1 The $R$ and $S$ Patterns . . . . .	113
	5.2.2 Asymptotic Distributions . . . . .	117
	5.2.3 The $RS$ Array . . . . .	118
5.3	The Corner Method . . . . .	119
	5.3.1 Correlation Determinants . . . . .	119
	5.3.2 Asymptotic Distribution . . . . .	120
5.4	The GPAC Methods . . . . .	121
	5.4.1 Woodward and Gray's GPAC . . . . .	121
	5.4.2 Glasbey's GPAC . . . . .	124
	5.4.3 Takemura's GPAC . . . . .	125
5.5	The ESACF Method . . . . .	126
5.6	The SCAN Method . . . . .	129
	5.6.1 Eigen-analysis . . . . .	129
	5.6.2 The SCAN Method . . . . .	131
5.7	Woodside's Method . . . . .	132
5.8	Three Systems of Equations . . . . .	133
5.9	Additional References . . . . .	136

<b>6 Testing Hypothesis Methods</b>	<b>139</b>
6.1 Three Asymptotic Test Procedures . . . . .	139
6.2 Some Test Statistics . . . . .	141
6.3 The Portmanteau Statistic . . . . .	145
6.4 Sequential Testing Procedures . . . . .	147
6.5 Additional References . . . . .	148
<b>Bibliography</b>	<b>149</b>
<b>Index</b>	<b>197</b>