

Time-Series

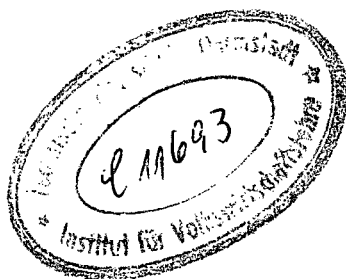
M. G. Kendall, M.A., Sc.D., F.B.A.

Past President of the Royal
Statistical Society

GRIFFIN



LONDON



Contents

1	GENERAL IDEAS	
	Aggregation	5
	Continuity and discontinuity	7
	Calendar problems	7
	The length of a time-series	8
	Some examples of time-series	9
	The object of time-series analysis	12
	Decomposition	16
2	TESTS OF RANDOMNESS	
	Turning points	22
	Phase-length	24
	The difference-sign test	26
	Rank tests	26
3	TREND	
	Moving averages	29
	Spencer's 15-point formula	36
	Spencer's 21-point formula	36
	End-effects	37
	Centred averages	38
	The effect of moving averages on other constituents	38
	Autocorrelation	39
	The Slutsky–Yule effect	40
4	THE CHOICE OF A MOVING AVERAGE	
	The variate-difference method	47
	Practical cases	49
5	SEASONALITY	
	Types of model	56
	The Bureau of the Census program	63
	The regression method	66
6	STATIONARY SERIES	
	The correlogram	70
	Autoregression	70
	The Markoff scheme	71

	The Yule scheme	73
	Partial autocorrelation	78
	The spectrum	80
	Autocorrelation generating functions	82
	Spectrum of the Markoff series	83
	Spectrum of the Yule scheme	84
	The transfer function	85
7	PROBLEMS IN SAMPLING SERIAL CORRELATION AND CORRELOGRAM	
	Bias in the estimation of autocorrelations	91
8	SPECTRUM ANALYSIS	
	Frequency and wavelength	96
	Intensity	97
	Examples of power spectra	99
	Side-bands	100
	Echo effects	100
	Sampling variance of the spectral ordinate	102
	Computation of ordinates	109
	Seasonality and harmonic components	112
9	FORECASTING BY AUTOPROJECTIVE METHODS	
	Autoprojection	116
	Exponential smoothing	118
	Holt–Winters model	122
	Harrison’s seasonal model	122
	Box–Jenkins model	123
	Choice of predictive method	126
	Kalman filters	126
10	MULTIVARIATE SERIES	
	Cross-correlation	129
	Cross-spectra	130
	Coherence	130
	Types of models	133
	The unidentifiability problem	138
11	FORECASTING FROM LAGGED RELATIONSHIPS	
	Discarding variables	142
	Stepwise forward and stepwise backward procedures	142
	The optimal regression method	143
	Some practical examples	143
12	NOTES ON SOME PROBLEMS OF ESTIMATION AND SIGNIFICANCE	
	Fitting autoregressions	157
	Moving-average schemes	160

Regression with autocorrelated residuals	162
Analysis of residuals	163
The Durbin–Watson test	164
References	167
Appendix A: Weights for fitting polynomial trends	171
Appendix B1: Significance points of the Durbin–Watson statistics d_L and d_U : 1 per cent.	193
Appendix B2: Significance points of the Durbin–Watson statistics d_L and d_U : 5 per cent.	194
Index	195