
CONTENTS

Chapter 1	Introduction	1
1.1	Fourier Analysis,	1
1.2	Historical Development of Fourier methods,	2
1.3	Why Use Trigonometric Functions?,	7
Chapter 2	The Search for Periodicity	9
2.1	A Curve-Fitting Approach,	9
2.2	Least Squares Estimation of Amplitude and Phase,	11
2.3	Least Squares Estimation of Frequency,	18
2.4	Multiple Periodicities,	20
2.5	The Effect of Discrete Time: Aliasing,	26
2.6	Some Statistical Results,	28
	Appendix,	32
Chapter 3	Harmonic Analysis	42
3.1	The Fourier Frequencies,	42
3.2	Complex-Valued Data: the Discrete Fourier Transform,	46
3.3	Decomposing the Sum of Squares,	50
3.4	Harmonic Analysis of Some Special Functions,	51
3.5	Smooth Functions,	57
Chapter 4	The Fast Fourier Transform	61
4.1	The Computational Cost of Fourier Transforms,	61
4.2	The Two-Factor Case,	62
4.3	General Theory,	65

- 4.4 Programming Considerations, 69
- 4.5 Application to Harmonic Analysis of Data, 72
- Appendix, 74

Chapter 5 Examples of Harmonic Analysis 77

- 5.1 The Variable-Star Data, 77
- 5.2 Leakage Reduction by Data Windows: Tapers and Faders, 80
- 5.3 Tapering the Variable-Star Data, 87
- 5.4 Wolf's Sunspot Numbers, 94
- 5.5 Nonsinusoidal Oscillations, 96
- 5.6 Amplitude and Phase Fluctuations, 99
- 5.7 Transformations, 101
- 5.8 The Periodogram of a Noise Series, 106
- 5.9 Fisher's Test for Periodicity, 110
- Appendix, 113

Chapter 6 Complex Demodulation 118

- 6.1 Motivation, 118
- 6.2 Smoothing; Linear Filtering, 120
- 6.3 Designing a Filter, 125
- 6.4 Least Squares Filter Design, 129
- 6.5 Demodulating the Sunspot Series, 137
- 6.6 Another Example of Complex Demodulation, 140
- Appendix, 145

Chapter 7 The Spectrum 151

- 7.1 Periodogram Analysis of Wheat Prices, 151
- 7.2 Analysis of Segments of a Series, 160
- 7.3 Smoothing the Periodogram, 162
- 7.4 Computing Autocovariances and Lag-Weights Spectrum Estimates, 165
- 7.5 Alternative Representations of a Spectrum Estimate, 167
- 7.6 Choice of a Spectral Window, 172
- 7.7 Examples of Smoothing the Periodogram, 173
- Appendix, 177

Chapter 8 Some Stationary Time Series Theory 181

- 8.1 Stationary Time Series, 181
- 8.2 Continuous Spectra, 185

8.3	Time Averaging and Ensemble Averaging,	187
8.4	The Periodogram of a Time Series with a Continuous Spectrum,	188
8.5	The Approximate Mean and Variance of Spectrum Estimates,	189
8.6	Properties of Spectral Windows,	199
8.7	Aliasing and the Spectrum,	204
Chapter 9	Analysis of Multiple Series	209
9.1	The Cross Periodogram,	210
9.2	Estimating the Cross Spectrum,	212
9.3	The Theoretical Cross Spectrum,	217
9.4	The Distribution of the Cross Periodogram,	220
9.5	Means and Variances of Smoothed Spectra,	224
9.6	Alignment,	228
	Appendix,	231
Chapter 10	Further Topics	234
10.1	Time Domain Analysis,	234
10.2	Spatial Series,	235
10.3	Multiple Series,	237
10.4	Higher-Order Spectra,	240
10.5	Nonquadratic Spectrum Estimates,	241
10.6	Incomplete Data, Irregularly Spaced Data, and Point Processes,	243
	References	247
	Index	251