بسم الله الرحمن الرحيم

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التوثيق الالكتروني والميكروفيلم

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Cairo University
Institute of Statistical Studies
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Statistical Inference For The Generalized Additive Models

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CERTIFICATION

I certify that this work has not been accepted in substance for any academic degree and is not being concurrently submitted in candidature for any other degree.

Any portions of this thesis for which I am indebted to other sources are mentioned and explicit references are given.

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<u>Approval Sheet</u>

Statistical Inference For The Generalized Additive Models

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To: My parents

My wife

My daughters

Rawda, Rahma & Doha

Contents

Glossary of Abbreviations

GAMs	Generalized Additive Models
GLMs	Generalized Linear Models
Loess	locally weighted scatterplot smoothing
OLS	Ordinary Least Squares
ave	average
NCS	Natural Cubic Spline
BCa	Bias-Corrected and accelerated
se	Standard error
CI	confidence intervals
c.d.f	Cumulative distribution function
MSE	Mean square error
WLS	Weighted least squares
Var	Variance
IID	Independent identically distributed
df	Degrees of freedom
CV	Cross Validation
GCV	Generalized cross validation
tr	Trace
LS	Least squares
D	Deviance
SLR	Simple linear regression
MLR	Multiple linear regression
PMSE	Prediction mean square error
RSS	Residual sum of square
Dev	Deviance
Std.error	Standard error
s	Spline
lo	loess

Summary

Generalized additive models (GAMs) (Hastie and Tibshirani 1986) are non-parametric extensions of Generalized linear models (GLMs) . The only assumption underlying GAMs is the functions are additive and that the components are smooth. A GAM, like a GLM, uses a link function to establish a relationship between the mean of the response variable and a 'smooth' function of the explanatory variable(s). The strength of GAMs is their ability to deal with highly non-linear and non-monotonic relationships between the response and the set of explanatory variables.

Estimation in GAM is based on a combination of the local scoring algorithm (Hastie and Tibshirani (1986)) and the backfitting algorithm (Friedman , Stuetzle (1981) and Buja, Hastie and Tibshirani (1989)) . The backfitting algorithm is a general algorithm that can fit additive model using the smoothers.

Our uses of GAMs rely extensively on two popular smoothers: the spline (Schoenberg (1964) and Reinsch (1967)) and locally weighted scatterplot smoother (Cleveland (1979 and Cleveland and Devlin (1988)). A large body of statistical research establishes that these smoothers have many desirable properties.

In this thesis, the problems of estimating the percentiles and constructing prediction intervals will be considered for some generalized additive models (GAMs) such as the normal, gamma, binomial, and Poisson models.

Comprehensive comparisons between GAM and GLM will be carried out using real data and simulation studies .

Chapter one