

MODELING AND INTERPRETING  
INTERACTIVE HYPOTHESES  
IN REGRESSION ANALYSIS

MODELING AND INTERPRETING  
INTERACTIVE HYPOTHESES  
IN REGRESSION ANALYSIS



*Cindy D. Kam &*  
*Robert J. Franzese Jr.*

The University of Michigan Press  
*Ann Arbor*

Copyright © by the University of Michigan 2007

All rights reserved

Published in the United States of America by

The University of Michigan Press

Manufactured in the United States of America

♻️ Printed on acid-free paper

2010 2009 2008 2007 4 3 2 1

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, or otherwise, without the written permission of the publisher.

*A CIP catalog record for this book is available from the British Library.*

Library of Congress Cataloging-in-Publication Data

Kam, Cindy D., 1975–

Modeling and interpreting interactive hypotheses in regression analysis / Cindy D. Kam & Robert J. Franzese.

p. cm.

Includes bibliographical references and index.

ISBN-13: 978-0-472-09969-6 (cloth : alk. paper)

ISBN-10: 0-472-09969-8 (cloth : alk. paper)

ISBN-13: 978-0-472-06969-9 (pbk. : alk. paper)

ISBN-10: 0-472-06969-1 (pbk. : alk. paper)

1. Regression analysis. 2. Social sciences—Statistical methods.

I. Franzese, Robert J., 1969– II. Title.

QA278.2.K344 2007

519.5'36—dc22

200605009

*To Anthony & Shelley Kam*

—C. D. K.

*To Jennifer, Angelina, & Liliana*

—R. J. F.

## PREFACE

This pedagogical book addresses the modeling, interpreting, testing, and presentation of interactive propositions in regression analysis. We intend it to provide guidance on these issues to advanced undergraduates, graduate students, and researchers in political science and other social-science disciplines. We begin by explaining how verbal statements of interactive arguments and hypotheses translate into mathematical empirical models including, and statistical inferences regarding, interactive terms. The book then provides advice on estimating, interpreting, and presenting the results from such models. It provides next an explanation of some existing general practice rules and, last, a discussion of more advanced topics including nonlinear models and stochastically interactive models. The concluding chapter outlines our general advice for researchers as they formulate, estimate, test, interpret, and present interactive hypotheses in their empirical work.

This project evolved from a previous paper, Cindy D. Kam, Robert J. Franzese, Jr., and Amaney Jamal, "Modeling Interactive Hypotheses and Interpreting Statistical Evidence Regarding Them," presented at the 1999 Annual Meetings of the American Political Science Association. We thank Amaney Jamal for her key role in those origins, and we also gratefully acknowledge Joel Simmons for research assistance in updating some data from the previous project. Finally, we thank Jacob Felson and Michael Robbins for assistance in preparing the final manuscript.

All calculations, tables, and figures can be reproduced using supplementary materials located at [www.press.umich.edu/KamFranzese/Interactions.html](http://www.press.umich.edu/KamFranzese/Interactions.html).

## CONTENTS

1. Introduction 1
  2. Interactions in Social Science 7
  3. Theory to Practice 13
    - Specifying Empirical Models to Reflect Interactive Hypotheses*
    - Interpreting Coefficients from Interactive Models*
    - Linking Statistical Tests with Interactive Hypotheses*
    - Presentation of Interactive Effects*
  4. The Meaning, Use, and Abuse of Some Common General-Practice Rules 93
    - Colinearity and Mean-Centering the Components of Interaction Terms*
    - Including x and z when xz Appears*
  5. Extensions 103
    - Separate-Sample versus Pooled-Sample Estimation of Interactive Effects*
    - Nonlinear Models*
    - Random-Effects Models and Hierarchical Models*
  6. Summary 131
- Appendix A. Differentiation Rules 133
- Appendix B. Stata Syntax 136
  - Marginal Effects, Standard Errors, and Confidence Intervals*
  - Predicted Values, Standard Errors, and Confidence Intervals*
  - Marginal Effects, Using “lincom”*
- References 147
- Index 151