

## **SURVEY METHODOLOGY**



---

# **SURVEY METHODOLOGY**

## **This is the Subtitle**

---

**Robert M. Groves**

Universitat de les Illes Balears

**Floyd J. Fowler, Jr.**

University of New Mexico



**A JOHN WILEY & SONS, INC., PUBLICATION**

Copyright ©2007 by John Wiley & Sons, Inc. All rights reserved.

Published by John Wiley & Sons, Inc., Hoboken, New Jersey.  
Published simultaneously in Canada.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, scanning, or otherwise, except as permitted under Section 107 or 108 of the 1976 United States Copyright Act, without either the prior written permission of the Publisher, or authorization through payment of the appropriate per-copy fee to the Copyright Clearance Center, Inc., 222 Rosewood Drive, Danvers, MA 01923, (978) 750-8400, fax (978) 646-8600, or on the web at [www.copyright.com](http://www.copyright.com). Requests to the Publisher for permission should be addressed to the Permissions Department, John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, (201) 748-6011, fax (201) 748-6008.

**Limit of Liability/Disclaimer of Warranty:** While the publisher and author have used their best efforts in preparing this book, they make no representations or warranties with respect to the accuracy or completeness of the contents of this book and specifically disclaim any implied warranties of merchantability or fitness for a particular purpose. No warranty may be created or extended by sales representatives or written sales materials. The advice and strategies contained herein may not be suitable for your situation. You should consult with a professional where appropriate. Neither the publisher nor author shall be liable for any loss of profit or any other commercial damages, including but not limited to special, incidental, consequential, or other damages.

For general information on our other products and services please contact our Customer Care Department with the U.S. at 877-762-2974, outside the U.S. at 317-572-3993 or fax 317-572-4002.

Wiley also publishes its books in a variety of electronic formats. Some content that appears in print, however, may not be available in electronic format.

***Library of Congress Cataloging-in-Publication Data:***

Survey Methodology / Robert M. Groves . . . [et al.].  
p. cm.—(Wiley series in survey methodology)  
“Wiley-Interscience.”  
Includes bibliographical references and index.  
ISBN 0-471-48348-6 (pbk.)  
1. Surveys—Methodology. 2. Social sciences—Research—Statistical methods. I. Groves, Robert M. II. Series.

HA31.2.S873 2007  
001.4'33—dc22 2004044064  
Printed in the United States of America.

10 9 8 7 6 5 4 3 2 1

*To my parents*

## CONTRIBUTORS

---

MASAYKI ABE, Fujitsu Laboratories Ltd., Fujitsu Limited, Atsugi, Japan

L. A. AKERS, Center for Solid State Electronics Research, Arizona State University,  
Tempe, Arizona

G. H. BERNSTEIN, Department of Electrical and Computer Engineering, University of  
Notre Dame, Notre Dame, South Bend, Indiana; formerly of Center for Solid State  
Electronics Research, Arizona State University, Tempe, Arizona



# CONTENTS IN BRIEF

---

**PART I SUBMICRON SEMICONDUCTOR MANUFACTURE**

<b>1 The Submicrometer Silicon MOSFET</b>	<b>3</b>
<b>2 First Edited Book Sample Chapter Title</b> G. Alvarez and R. K. Watts	<b>5</b>
<b>3 Second Edited Book Sample Chapter Title</b> George Smeal, Ph.D., Sally Smith, M.D. and Stanley Kubrick	<b>7</b>





# CONTENTS

---

List of Figures	xi
List of Tables	xiii
Foreword	xv
Preface	xvii
Acknowledgments	xix
Acronyms	xxi
Glossary	xxiii
List of Symbols	xxv
Introduction	xxvii
<i>Catherine Clark, PhD.</i>	
References	xxvii

## PART I SUBMICRON SEMICONDUCTOR MANUFACTURE

<b>1</b>	<b>The Submicrometer Silicon MOSFET</b>	<b>3</b>
1.1	Here is a normal section	3
1.1.1	This is the subsection	3
1.2	Tips On Special Section Heads	4
1.3	This Version of Section Head will be sent Contents	4
		<b>ix</b>

1.4	This show how to explicitly break lines in Table of Contents	4
1.5	How to get lower case in section head: $pH$	4
1.6	How to use a macro that has both upper and lower case parts: $V_{Txyz}$	4
1.7	Equation	4
<b>2</b>	<b>First Edited Book Sample Chapter Title</b>	<b>5</b>
	G. Alvarez and R. K. Watts	
2.1	Here is a normal section	5
<b>3</b>	<b>Second Edited Book Sample Chapter Title</b>	<b>7</b>
	George Smeal, Ph.D., Sally Smith, M.D. and Stanley Kubrick	
3.1	Sample Section	7
3.2	Example, Figure and Tables	8
3.2.1	Side by Side Tables and Figures	8
3.3	Algorithm	9
	Problems	10
	Exercises	10
3.4	Summary	11
	References	11
	Appendix: This is the Chapter Appendix Title	11
	Chapter Appendix	11
<b>A</b>	<b>This is the Appendix Title</b>	<b>13</b>
<b>B</b>	<b>Appendix</b>	<b>15</b>
<b>C</b>	<b>Alternate Reference Styles</b>	<b>17</b>
	References	19
	References	21
	Index	23

## LIST OF FIGURES

---

3.1	Short figure caption.	8
3.2	Oscilloscope for memory address access operations, showing 500 ps address access time and superimposed signals of address access in 1 kbit memory plane.	8
3.3	This caption will go on the left side of the page. It is the initial caption of two side-by-side captions.	8
3.4	This caption will go on the right side of the page. It is the second of two side-by-side captions.	8
3-A.1	This is an appendix figure caption.	11
A.1	This is an appendix figure caption.	13



# LIST OF TABLES

---

3.1	Small Table	8
3.2	Effects of the two types of $\alpha\beta\sum_B^A$ scaling proposed by Dennard and co-workers <sup>a,b</sup>	8
3.3	Table Caption	9
3.4	Table Caption	9
3-A.1	This is an appendix table caption	12
A.1	Appendix table caption	13



# FOREWORD

---

This is the foreword to the book.





# PREFACE

---

This is an example preface. This is an example preface. This is an example preface. This is an example preface.

R. K. WATTS

*Durham, North Carolina*  
*September, 2007*



## ACKNOWLEDGMENTS

---

From Dr. Jay Young, consultant from Silver Spring, Maryland, I received the initial push to even consider writing this book. Jay was a constant “peer reader” and very welcome advisor during this year-long process.

To all these wonderful people I owe a deep sense of gratitude especially now that this project has been completed.

G. T. S.



## ACRONYMS

---

ACGIH	American Conference of Governmental Industrial Hygienists
AEC	Atomic Energy Commission
OSHA	Occupational Health and Safety Commission
SAMA	Scientific Apparatus Makers Association



## GLOSSARY

---

NormGibbs	Draw a sample from a posterior distribution of data with an unknown mean and variance using Gibbs sampling.
pNull	Test a one sided hypothesis from a numerically specified posterior CDF or from a sample from the posterior
sintegral	A numerical integration using Simpson's rule





## SYMBOLS

---

- $A$  Amplitude
- $\&$  Propositional logic symbol
- $a$  Filter Coefficient
  
- $\mathcal{B}$  Number of Beats



# INTRODUCTION

---

CATHERINE CLARK, PHD.  
Harvard School of Public Health  
Boston, MA, USA

The era of modern began in 1958 with the invention of the integrated circuit by J. S. Kilby of Texas Instruments [1]. His first chip is shown in Fig. I. For comparison, Fig. I.2 shows a modern microprocessor chip, [4].

This is the introduction. This is the introduction. This is the introduction. This is the introduction. This is the introduction. This is the introduction.

$$ABC\mathcal{D}\mathcal{E}\mathcal{F}\alpha\beta\Gamma\Delta\sum_{def}^{abc} \tag{I.1}$$

## REFERENCES

1. J. S. Kilby, "Invention of the Integrated Circuit," *IEEE Trans. Electron Devices*, **ED-23**, 648 (1976).
2. R. W. Hamming, *Numerical Methods for Scientists and Engineers*, Chapter N-1, McGraw-Hill, New York, 1962.
3. J. Lee, K. Mayaram, and C. Hu, "A Theoretical Study of Gate/Drain Offset in LDD MOSFETs" *IEEE Electron Device Lett.*, **EDL-7**(3), 152 (1986).



## PART I

---

# SUBMICRON SEMICONDUCTOR MANUFACTURE

---



# CHAPTER 1

---

## THE SUBMICROMETER SILICON MOSFET

---

The sheer volume of answers can often stifle insight...The purpose of computing is insight, not numbers.

—Hamming [2]

### 1.1 Here is a normal section

Here is some text.

#### 1.1.1 This is the subsection

Here is some normal text. Here is some normal text. Here is some normal text. Here is some normal text. Here is some normal text. Here is some normal text. Here is some normal text. Here is some normal text. Here is some normal text. Here is some normal text.

**1.1.1.1 This is the subsubsection** Here is some text after the subsubsection. Here is some text after the subsubsection. Here is some text after the subsubsection. Here is some text after the subsubsection.

*This is the paragraph* Here is some normal text. Here is some normal text. Here is some normal text. Here is some normal text.



## 1.2 Tips On Special Section Heads

Here are some things you can do for a special section head.

### 1.3 Break Long Section heads with double backslash

Here is some normal text. Here is some normal text. Here is some normal text.

### 1.4 Here is a Section Title

See this section head for information on how to explicitly break lines in table of contents.

### 1.5 How to get lower case in section head: $pH$

Here is some normal text. Here is some normal text. Here is some normal text.

### 1.6 How to use a macro that has both upper and lower case parts: $V_{Txyz}$

See the top of this file where the definition and box were set.

### 1.7 Equation

For optimal vertical spacing, no blank lines before or after equations

$$\alpha\beta\Gamma\Delta \tag{1.1}$$

as you see here.

## CHAPTER 2

---

# FIRST EDITED BOOK SAMPLE CHAPTER TITLE

---

G. ALVAREZ AND R. K. WATTS

Carnegie Mellon University, Pittsburgh, Pennsylvania

### 2.1 Here is a normal section

Here is some text.



## CHAPTER 3

---

# SECOND EDITED BOOK SAMPLE CHAPTER TITLE

---

GEORGE SMEAL, PH.D.<sup>1</sup>, SALLY SMITH, M.D.<sup>2</sup> AND STANLEY KUBRICK<sup>1</sup>

<sup>1</sup>AT&T Bell Laboratories Murray Hill, New Jersey

<sup>2</sup>Harvard Medical School, Boston, Massachusetts

### 3.1 Sample Section

Here is some sample text.

3.2 Example, Figure and Tables

EXAMPLE 3.1 Optional Example Name

Use Black’s law [Equation (6.3)] to estimate the reduction in useful product life if a metal line is initially run at 55°C at a maximum line current density.

illustration here

Figure 3.1 Short figure caption.

Figure 3.2 Oscillograph for memory address access operations, showing 500 ps address access time and superimposed signals of address access in 1 kbit memory plane.

Table 3.1 Small Table

one	two	three	four
C	D	E	F

Table 3.2 Effects of the two types of  $\alpha\beta\sum_B^A$  scaling proposed by Dennard and co-workers<sup>a,b</sup>

Parameter	$\kappa$ Scaling	$\kappa, \lambda$ Scaling
Dimension	$\kappa^{-1}$	$\lambda^{-1}$
Voltage	$\kappa^{-1}$	$\kappa^{-1}$
Currant	$\kappa^{-1}$	$\lambda/\kappa^2$
Dopant Concentration	$\kappa$	$\lambda^2/\kappa$

<sup>a</sup>Refs. 19 and 20.

<sup>b</sup> $\kappa, \lambda > 1$ .

3.2.1 Side by Side Tables and Figures

Space for figure...

Figure 3.3 This caption will go on the left side of the page. It is the initial caption of two side-by-side captions.

Space for second figure...

Figure 3.4 This caption will go on the right side of the page. It is the second of two side-by-side captions.

The command `\sidebyside{\}{ }` works similarly for tables:  
When using `\sidebyside`, one must use the cross referencing command `\label{ }` after and *outside* of `\caption{ }`:  
`\begin{table}`

**Table 3.3** Table Caption

one	two	three	four
a	little	sample	table

**Table 3.4** Table Caption

A	B	C	D
a	second little	sample	table

```
\sidebyside{\caption{Table Caption}\label{tab1}
first table}
{\caption{Table Caption}\label{tab2} second table}
\end{table}
```

or,

```
\begin{figure}
\sidebyside{\vskip<dimen>\caption{fig caption}\label{fig1}}
{\vskip<dimen>\caption{fig caption}\label{fig2}}
\end{figure}
```

### 3.3 Algorithm

This is a sample algorithm.

#### Algorithm 3.1

```
state.transition algorithm {
  for each neuron  $j \in \{0, 1, \dots, M-1\}$ 
  {
    calculate the weighted sum  $S_j$  using Eq. (6);
    if ( $S_j > t_j$ )
      {turn ON neuron;  $Y_1 = +1$ }
    else if ( $S_j < t_j$ )
      {turn OFF neuron;  $Y_1 = -1$ }
    else
      {no change in neuron state;  $y_j$  remains unchanged;}
  }
}
```

Here is some normal text. Here is some normal text. Here is some normal text. Here is some normal text. Here is some normal text. Here is some normal text. Here is some normal text. Here is some normal text. Here is some normal text. Here is some normal text. Here is some normal text. Here is some normal text. Here is some normal text.

This is a sample of extract or quotation. This is a sample of extract or quotation. This is a sample of extract or quotation.

1. This is the first item in the numbered list.
  2. This is the second item in the numbered list. This is the second item in the numbered list. This is the second item in the numbered list.
- This is the first item in the itemized list.

- This is the first item in the itemized list. This is the first item in the itemized list. This is the first item in the itemized list.

This is the first item in the itemized list.

This is the first item in the itemized list. This is the first item in the itemized list. This is the first item in the itemized list.

## PROBLEMS

**3.1** For Hooker's data, Problem 1.2, use the Box and Cox and Atkinson procedures to determine a appropriate transformation of PRES in the regression of PRES on TEMP. find  $\hat{\lambda}$ ,  $\tilde{\lambda}$ , the score test, and the added variable plot for the score. Summarize the results.

**3.2** The following data were collected in a study of the effect of dissolved sulfur on the surface tension of liquid copper (Baes and Killogg, 1953).

$x = \text{Weight \% sulfur}$		$Y = \text{Decrease in Surface Tension}$ (dynes/cm), two Replicates	
0.	034	301	316
0.	093	430	422
0.	30	593	586

- Find the transformations of  $X$  and  $Y$  sot that in the transformed scale the regression is linear.
- Assuming that  $X$  is transformed to  $\ln(X)$ , which choice of  $Y$  gives better results,  $Y$  or  $\ln(Y)$ ? (Sclove, 1972).
- In the case of  $\alpha_1$ ?
- In the case of  $\alpha_2$ ?

**3.3** Examine the Longley data, Problem 3.3, for applicability of assumptions of the linear model.

**3.4** In the case of  $\Gamma_1$ ?

**3.5** In the case of  $\Gamma_2$ ?

## EXERCISES

**3.1** For Hooker's data, Exercise 1.2, use the Box and Cox and Atkinson procedures to determine a appropriate transformation of PRES in the regression of PRES on TEMP. find  $\hat{\lambda}$ ,  $\tilde{\lambda}$ , the score test, and the added variable plot for the score. Summarize the results.

**3.2** The following data were collected in a study of the effect of dissolved sulfur on the surface tension of liquid copper (Baes and Killogg, 1953).

$x = \text{Weight \% sulfur}$		$Y = \text{Decrease in Surface Tension}$ (dynes/cm), two Replicates	
0.	034	301	316
0.	093	430	422
0.	30	593	586

- a) Find the transformations of  $X$  and  $Y$  so that in the transformed scale the regression is linear.
- b) Assuming that  $X$  is transformed to  $\ln(X)$ , which choice of  $Y$  gives better results,  $Y$  or  $\ln(Y)$ ? (Sclove, 1972).
- c) In the case of  $\Delta_1$ ? d) In the case of  $\Delta_2$ ?

**3.3** Examine the Longley data, Problem 3.3, for applicability of assumptions of the linear model.

**3.4** In the case of  $\Gamma_1$ ?

**3.5** In the case of  $\Gamma_2$ ?

### 3.4 Summary

This is a summary of this chapter. Here are some references: [1], [4].

## REFERENCES

1. J. S. Kilby, "Invention of the Integrated Circuit," *IEEE Trans. Electron Devices*, **ED-23**, 648 (1976).
2. R. W. Hamming, *Numerical Methods for Scientists and Engineers*, Chapter N-1, McGraw-Hill, New York, 1962.
3. J. Lee, K. Mayaram, and C. Hu, "A Theoretical Study of Gate/Drain Offset in LDD MOSFETs" *IEEE Electron Device Lett.*, **EDL-7**(3), 152 (1986).
4. A. Berenbaum, B. W. Colbry, D.R. Ditzel, R. D Freeman, and K.J. O'Connor, "A Pipelined 32b Microprocessor with 13 kb of Cache Memory," in *Int. Solid State Circuit Conf.*, Dig. Tech. Pap., p. 34 (1987).

## Appendix: This is the Chapter Appendix Title

This is an appendix with a title.

$$\alpha\beta\Gamma\Delta \tag{A.1}$$

**Figure 3-A.1** This is an appendix figure caption.

## Appendix

This is a Chapter Appendix without a title.

Here is a math test to show the difference between using Computer Modern math fonts and MathTimes math fonts. When MathTimes math fonts are used the letters in an equation will match TimesRoman italic in the text. (*g, i, y, x, P, F, n, f, etc.*) Caligraphic fonts, used for *ABC* below, will stay the same in either case.

$$g_i(y|f) = \sum_x P(x|F_n) f_i(y|x) ABC \tag{B.1}$$



**Table 3-A.1** This is an appendix table caption

Date	Event
1867	Maxwell speculated the existence of electromagnetic waves.
1887	Hertz showed the existence of electromagnetic waves.
1890	Branly developed technique for detecting radio waves.
1896	Marconi demonstrated wireless telegraph.
1897	Marconi patented wireless telegraph.
1898	Marconi awarded patent for tuned communication.
1898	Wireless telegraphic connection between England and France established.

where  $g_i(y|F_n)$  is the function specifying the probability an object will display a value  $y$  on a dimension  $i$  given  $F_n$  the observed feature structure of all the objects.

# APPENDIX A

## THIS IS THE APPENDIX TITLE

---

This is an appendix with a title.

$$\alpha\beta\Gamma\Delta$$

(A.1)

**Figure A.1** This is an appendix figure caption.

**Table A.1** Appendix table caption

Alpha	Beta	Gamma	Delta
$\alpha$	$\beta$	$\Gamma$	$\Delta$



## APPENDIX B

---

This is an appendix without a title.

Here is a math test to show the difference between using Computer Modern math fonts and MathTimes math fonts. When MathTimes math fonts are used the letters in an equation will match TimesRoman italic in the text. (*g, i, y, x, P, F, n, f, etc.*) Caligraphic fonts, used for  $\mathcal{ABC}$  below, will stay the same in either case.

$$g_i(y|f) = \sum_x P(x|F_n) f_i(y|x) \mathcal{ABC} \quad (\text{B.1})$$

where  $g_i(y|F_n)$  is the function specifying the probability an object will display a value  $y$  on a dimension  $i$  given  $F_n$  the observed feature structure of all the objects.



## APPENDIX C

### ALTERNATE REFERENCE STYLES

---



## REFERENCES

---

1. J. S. Kilby, "Invention of the Integrated Circuit," *IEEE Trans. Electron Devices*, **ED-23**, 648 (1976).
2. R. W. Hamming, *Numerical Methods for Scientists and Engineers*, Chapter N-1, McGraw-Hill, New York, 1962.
3. J. Lee, K. Mayaram, and C. Hu, "A Theoretical Study of Gate/Drain Offset in LDD MOSFETs" *IEEE Electron Device Lett.*, **EDL-7**(3), 152 (1986).
4. A. Berenbaum, B. W. Colbry, D.R. Ditzel, R. D Freeman, and K.J. O'Connor, "A Pipelined 32b Microprocessor with 13 kb of Cache Memory," in Int. Solid State Circuit Conf., Dig. Tech. Pap., p. 34 (1987).





## REFERENCES

---

- [Kil76] J. S. Kilby, "Invention of the Integrated Circuit," *IEEE Trans. Electron Devices*, **ED-23**, 648 (1976).
- [Ham62] R. W. Hamming, *Numerical Methods for Scientists and Engineers*, Chapter N-1, McGraw-Hill, New York, 1962.
- [Hu86] J. Lee, K. Mayaram, and C. Hu, "A Theoretical Study of Gate/Drain Offset in LDD MOS-FETs" *IEEE Electron Device Lett.*, **EDL-7**(3). 152 (1986).
- [Ber87] A. Berenbaum, B. W. Colbry, D.R. Ditzel, R. D Freeman, and K.J. O'Connor, "A Pipelined 32b Microprocessor with 13 kb of Cache Memory," in *Int. Solid State Circuit Conf.*, Dig. Tech. Pap., p. 34 (1987).



# Index

---

## A

Abrupt changes, 2  
Activation function, 275, 276, 281, 283  
    hyperbolic tangent, 279  
    logistic, 278  
    piecewise-linear, 276, 277  
    sigmoidal, 276–278  
    signum, 278–280  
    squashing, 277  
    threshold, 276, 280  
Adaptive estimation, 284  
Adaptive features, 301  
Adaptive nonlinear model, 275  
Admissibility condition, 101, 103  
Aggregate heterogeneity  
    trader classes, 10  
Akaike Information Criteria, 195, 294  
Alias, 107, 166  
Aliasing, 107  
Almon lag, 24  
Amplitude, 26, 27, 29  
Amplitude spectrum, 270  
Analysis equation, 30, 103  
Approximation, 276  
    function, 273  
Artificial neural network, 272  
Artificial neuron, 276  
Asymmetry  
    cross-correlation, 10  
Augmented Dickey-Fuller test, 150, 152

Autocorrelation, 55  
    correlogram, 62  
    definition of, 61  
    in practice, 62, 63  
    pitfalls, 61, 62  
    sample, 61  
    spurious, 61  
Autocorrelation function (ACF), 194, 236  
Autocovariance function  
    autocorrelation, 3, 61  
    definition of, 56  
Autocovariance sequence (ACVS), 61–63, 148,  
    183, 236, 267  
Autospectra, 252, 254, 269

## B

Backpropagation, 283  
    dynamic, 302  
Bagging, 299  
(and so on)