THE

JOURNAL OF SYMBOLIC LOGIC

EDITED BY

ALONZO CHURCH
BURTON S. DREBEN
WILLIAM CRAIG

HERBERT ENDERTON

Dagfinn Føllesdal

C. E. M. YATES
ANIL NERODE
CARL G. JOCKUSCH

Managing Editor: ALFONS BORGERS

Consulting Editors:

C. A. BAYLIS
JIŘÍ BEČVÁŘ
JONATHAN F. BENNETT
PAUL BERNAYS
ANDRZEJ BLIKLE
C. C. CHANG
MARTIN DAVIS
EDWARD E. DAWSON
VERENA H. DYSON

CALVIN C. ELGOT FREDERIC B. FITCH G. HASENJAEGER HANS HERMES H. JEROME KEISLER AZRIEL LÉVY DONALD MONK GERT H. MÜLLER RÓZSA PÉTER

MICHAEL O. RABIN
GENE F. ROSE
BARKLEY ROSSER
ARTO SALOMAA
KURT SCHÜTTE
DANA SCOTT
JOSEPH R. SHOENFIELD
J. F. THOMSON
JEAN VAN HEIJENOORT

VOLUME 41 1976

Published quarterly by the Association for Symbolic Logic, Inc. with support from ICSU and from institutional and corporate members

The four numbers of Volume 41 were issued at the following dates:

Number 1, pages 1-288, April 29, 1976

Number 2, pages 289-560, July 30, 1976

Number 3, pages 561-704, November 1, 1976

Number 4, pages 705-826, January, 1977

All numbers of this volume are copyrighted by the Association for Symbolic Logic, Inc. Reproduction of copyrighted numbers of the Journal by photostat, photoprint, microfilm, or like process is forbidden, except by written permission, to be obtained through the Business Office of the Association for Symbolic Logic, P.O. Box 6248, Providence, Rhode Island 02904, U.S.A.

TABLE OF CONTENTS

An α -finite injury method of the unbounded type. By C. T. CHONG.
The unprovability in intuitionistic formal systems of the continuity of
effective operations on the reals. By Michael Beeson
Omitting types in set theory and arithmetic. By Julia F. Knight
Infinitary compactness without strong inaccessibility. By WILLIAM Boos.
Two variable implicational calculi of prescribed many-one degrees of
unsolvability. By Charles E. Hughes
A reduction class containing formulas with one monadic predicate and
one binary function symbol. By Charles E. Hughes
Probabilities on finite models. By Ronald Fagin
Approximation theorems and model theoretic forcing. By Victor
Harnik
One more aspect of forcing and omitting types. By Zofia Adamowicz .
Completeness properties of Heyting's predicate calculus with respect to
RE models. By Dov M. GABBAY
Negative-existentially complete structures and definability in free exten-
sions. By Volker Weispfennig
Uniform inductive definability and infinitary languages. By ANDERS M.
Nyberg
Semantics of the infinitistic rules of proof. By Krzysztof Rafal Apt
Elementary extensions of countable models of set theory. By JOHN E.
Hutchinson
Ed-regressive sets of order n. By Seth Catlin
Selection in abstract recursion theory. By L. A. HARRINGTON and D. B.
MacQueen
An intuitionistic completeness theorem for intuitionistic predicate logic.
By Wim Veldman
On Σ_1 well-orderings of the universe. By Leo Harrington and Thomas
Jech
Applications of Vaught sentences and the covering theorem. By Victor
HARNIK and MICHAEL MAKKAI
Monotone inductive definitions over the continuum. By Douglas
Cenzer •
Diversity of speed-ups and embeddability in computational complexity.
By Donald A. Alton
The <-order on submodels. By LEO MARCUS
An abstraction algorithm for combinatory logic. By S. KAMAL ABDALI.
A combinatorial property of $p_{\kappa}\lambda$. By Telis K. Menas
Boolean combinations of r.e. open sets. By Louise Hay
The truth about some Post numbers. By Krister Segerberg
A Boolean ultrapower which is not an ultrapower. By Bernd Koppel-
BERG and SABINE KOPPELBERG
Minimal upper bounds for ascending sequences of α -recursively enu-
merable degrees. By C. T. Chong

European meeting of the Association for Symbolic Logic, Kiel, 1974. By
G. H. Müller, A. Oberschelp and K. Potthoff
Abstracts of papers
Meeting of the Association for Symbolic Logic, Washington, D.C.,
1975. By James Owings, Hilary Putnam and Gerald Sacks
Abstracts of papers
Countable initial segments of the degrees of unsolvability. By A. H.
LACHLAN and R. LEBEUF
Modal reduction principles. By J. F. A. K. VAN BENTHEM
On finite lattices of degrees of constructibility of reals. By Zofia
ADAMOWICZ
A completeness theorem for Zermelo-Fraenkel set theory. By WILLIAM
C. Powell
Derived rules of inference related to the continuity of effective opera-
tions. By Michael J. Beeson
An interpretation of "finite" modal first-order languages in classical
second-order languages. By Scott K. Lehmann
Krom formulas with one dyadic predicate letter. By HARRY R. LEWIS
Uniformly defined descending sequences of degrees. By HARVEY
Friedman
Noncharacterizability of the syntax set. By John Paulos
λ -scales, κ -Souslin sets and a new definition of analytic sets. By
Douglas R. Busch
Large and small existentially closed structures. By H. Simmons
Projective planes of infinite but isolic order. By J. C. E. DEKKER
Congruence relations, filters, ideals, and definability in lattices of
α -recursively enumerable sets. By Manuel Lerman
Types of simple α -recursively enumerable sets. By Manuel Lerman
Equivalence of some definitions of recursion in a higher type object. By
F. LOWENTHAL
Modal formulas are either elementary or not $\Sigma\Delta$ -elementary. By
J. F. A. K. Van Benthem
Normal functions and constructive ordinal notations. By LARRY W.
Miller
The decision problem for standard classes. By Yuri Gurevich
Relative consistency of an extension of Ackermann's set theory. By JOHN LAKE
The inconsistency of \mathscr{F}_{21}^* . By M. W. Bunder
Effective coloration. By Dwight R. Bean
Adding a closed unbounded set. By J. E. BAUMGARTNER, L. A.
HARRINGTON and E. M. KLEINBERG
α -decompositions of α -spaces. By Northrup Fowler III
Order types of ordinals in models of set theory. By John E. Hutchinson
Gödel's second incompleteness theorem for Q. By A. Bezboruah and
J. C. Shepherdson
The infinite injury priority method, By Robert I. Soare

An introduction to recursively saturated and resplendent models. By
JON BARWISE and JOHN SCHLIPF
Reviews
Meeting of the Association for Symbolic Logic, Chicago 1975. By John
BALDWIN, D. A. MARTIN, ROBERT I. SOARE and W. W. TAIT
Abstracts of papers
On the complexity of the theories of weak direct powers. By CHARLES
RACKOFF
The theory of the Gödel functionals. By Nicolas D. Goodman
Hanf numbers for omitting types over particular theories. By Julia F.
KNIGHT
Undecidable properties of finite sets of equations. By George F.
McNulty
On definable subsets of p-adic fields. By Angus MacIntyre
Co-hypersimple structures. By J. B. REMMEL
Noncomplex sequences: characterizations and examples. By ROBERT P.
Daley
Categoricity regained. By Erik Ellentuck
Another intuitionistic completeness proof. By H. DE SWART
Higher Souslin trees and the generalized continuum hypothesis. By
John Gregory
A note on countable complete theories having three isomorphism types
of countable models. By Robert E. Woodrow
Types of simple α -recursively enumerable sets. By Anne Leggett and
RICHARD A. SHORE
Degrees of classes of RE sets. By J. R. SHOENFIELD
Reviews
Special notice
Notices of meetings
Notice of the Polish Academy of Sciences
Embedding first order predicate logic in fragments of intuitionistic logic.
By M. H. Löb
Models for recursion theory. By Johan Moldestad and Dag Normann.
A complete infinitary logic. By Kenneth Slonneger
Comparison of Russell's resolution of the semantical antinomies with
that of Tarski. By Alonzo Church
The work of Kurt Gödel. By Stephen C. Kleene
On deciding the truth of certain statements involving the notion of
consistency. By George Boolos
Reviews
List of officers and members of the Association for Symbolic Logic .
Notices of meetings

ERRATA

VOLUME 34

Page 108, line 10 from below. For «foundation», read «foundations».

VOLUME 38

Page 720, column 2, line 18. For «moda», read «modal».

VOLUME 40

Page 602, line 19 from below. For «L1» at the beginning of the line, read «L1». Page 692, column 1, line 10. For «XXXIV 320», read «XXXIV 310». Page 713, column 2, line 2 from below. For «XXXIX 257», read «XXXIX 357».

All manuscripts for publication should be typewritten with wide margin and wide spacing between the lines, and the author should keep a complete copy; footnotes should be numbered consecutively and should also be typed with wide margin and wide spacing (preferably on a separate sheet). If an article is of more than thirty-two (printed) pages in length, the editors reserve the right to divide it between two or more, not necessarily consecutive, numbers. Authors receive fifty reprints of each article, with covers, and additional reprints may be purchased if desired.

The Association assesses page charges at the rate of \$30.00 per page for all papers (excluding reviews) that appear in the JOURNAL. All bills for page charges will be submitted to the author's host institution or employing company, if any. Authors are not liable for the payment of page charges, nor for their acceptance and payment by employing organizations.

Attention is called to the fact that the JOURNAL invites submission of (1) original technical papers in the field of symbolic logic, (2) expository papers in this field, (3) philosophical papers which bear upon this field or make use of its methods, and (4) studies in the history of logic in which modern technical developments are taken into account.

	NAGEMENT AND CIRCU	LATION
TITLE OF PUBLICATION Journal of Symbolic Logic	沙美风 原	October 1, 1976
FREQUENCY OF ISSUE	A. NO. OF ISSUES PUBLIS	HED B. ANNUAL SUBSCRIPTION
Quarterly		\$40.00(1976)
201 Charles Street, Providence, Rhode Island	2904	
LOCATION OF THE HEADQUARTERS OR GENERAL BUSINESS O		(printers)
201 Charles Street, Providence, Rhode Island (NG EDITOR
UBLISHER (Name and Address)	a a Marine	11-11-15
Association for Symbolic Logic, P.O. Box 6248.		and 02940
Alfons Borgers, Weldadigheidstraat 61, B-3000	Leuven, Belgium	
Alfons Borgers, Weldadigheidstraat 61, B-3000	Leuven, Belgium	1 - 1 UT
OWNER (If owned by a corporation, its name and address must be a holders owning or holding I percent or more of total amount of stock, owners must be given. If owned by a partnership or other unincorpo be given.)	If not owned by a corporation, the	ames and addresses of the individu
NAME		PRESS
Association for Symbolic Logic	P.O. Box 6248, Provide	ence, RI 02940
TO BELLEVIEW OF WAR AND	10/1/1	A TIME AND
KNOWN BONDHOLDERS, MORTGAGEES, AND OTHER SECUR	ITY HOLDERS OWNING OR HOLD	ING 1 PERCENT OR MORE OF
TOTAL AMOUNT OF BONDS, MORTGAGES OF	OTHER SECURITIES (If there are	none, so state)
NAME	ADDRESS	
Tone	17 19 9	THE WAY TO THE THE
11/10/10/10/10/10/10/10/10/10/10/10/10/1	2000	The State of the S
HAVE NOT CHANGED DURING HAVE CHANGED DU	RING (If changed, publisher with this statement.)	must submit explanation of change
KAR THE THE THE TAIL AND A STATE OF THE TAIL AND A STA		
The state of the s	AVERAGE NO. COPIES EACH ISSUE DURING PRECEDING 12 MONTHS 3,500	
0. EXTENT AND NATURE OF CIRCULATION 4. TOTAL NO. COPIES PRINTED (Net Press Run)	AVERAGE NO. COPIES EACH ISSUE DURING PRECEDING 12 MONTHS	ACTUAL NO. COPIES OF SING ISSUE PUBLISHED NEAREST FILING DATE
0. EXTENT AND NATURE OF CIRCULATION	AVERAGE NO. COPIES EACH ISSUE DURING PRECEDING 12 MONTHS 3,500	ACTUAL NO. COPIES OF SING ISSUE PUBLISHED NEAREST FILING DATE 3,500
O. EXTENT AND NATURE OF CIRCULATION A. TOTAL NO. COPIES PRINTED (Net Press Run) B. PAID CIRCULATION 1. SALES THROUGH DEALERS AND CARRIERS, STREET VENDORS AND COUNTER SALES 2. MAIL SUSSCRIPTIONS	AVERAGE NO. COPIES EACH ISSUE DURING PRECEDING 1 2 3,500 170 2,796	ACTUAL NO. COPIES OF SING ISSUE PUBLISHED NEAREST TILLING DATE 3,500 170 2,722
D. EXTENT AND NATURE OF CIRCULATION 1. TOTAL NO. COPIES PRINTED (Net Press Run) 1. SALES THROUGH CALLERS AND CARRIERS, STREET 2. MAIL SUBSCRIPTIONS 2. TOTAL PAID CIRCULATION (Sum of 1081 and 1082)	AVERAGE NO. COPIES EACH ISSUE DURING PRECEDING 12 MONTHS 3,500	ACTUAL NO. COPIES OF SING ISSUE PUBLISHED NEAREST FILING DATE 3,500
D. EXTENT AND NATURE OF CIRCULATION 1. TOTAL NO. COPIES PRINTED (Net Press Run) 1. SALES THROUGH CALLERS AND CARRIERS, STREET 2. MAIL SUBSCRIPTIONS 2. TOTAL PAID CIRCULATION (Sum of 1081 and 1082)	AVERAGE NO. COPIES EACH ISSUE DURING PRECEDING 1 2 3,500 170 2,796	ACTUAL NO. COPIES OF SING ISSUE PUBLISHED NEAREST TILLING DATE 3,500 170 2,722
O. EXTENT AND NATURE OF CIRCULATION A. TOTAL NO. COPIES PRINTED (Net Pres Rus) D. PAID CIRCULATION 1. SALES THROUGH DEALERS AND CARRIERS, STREET VENDORS AND COUNTER SALES Z. MAIL SUSSCRIPTIONS 2. TOTAL PAID CIRCULATION (Sum of 1081 and 1082) D. FREE DISTRIBUTION BY MAIL, CARRIER OR OTHER MEANS SAMPLES, COMPLIMENTARY, AND OTHER FREE COPIES	3,500 170 2,796	ACTUAL NO COPIES OF SING ISSUE PUBLISHED NEAREST FILLING DATE 3,500 170 2,722 2,892
O. EXTENT AND NATURE OF CIRCULATION S. TOTAL NO. COPIES PRINTED (Net Press Rus) D. PAID CIRCULATION 1. SALES THROUGH DEALERS AND CARRIERS, STREET VENDORS AND COUNTER SALES Z. MAIL SUSSCRIPTIONS D. TOTAL PAID CIRCULATION (Sum of 1081 and 1082) D. PREC DISTRIBUTION BY MAIL, CARRIER OR OTHER MEARS SAMPLES, COMPLIMENTARY, AND OTHER FREE COPIES E. TOTAL DISTRIBUTION (Sum of C and D)	AVERAGE NO COPIES EACH 185UE DUTING PRECEDING 3,500 170 2,796 2,966	ACTUAL NO. COPIES OF SINC ISSUE PUBLISHED NEAREST FILLING DATE 3,500 170 2,722 2,892
O. EXTENT AND NATURE OF CIRCULATION 1. TOTAL NO. COPIES PRINTED (Not Pres Rus) 1. PAID CIRCULATION 1. SALES THROUGH DEALERS AND CARRIERS, STREET VENDORS AND COUNTER FALES 2. MAIL SUSSCRIPTIONS 1. TOTAL PAID CIRCULATION (Sum of 1081 and 1082) 2. PEER DISTRIBUTION BY MAIL, CARRIER OR OTHER MEANS SAMPLES, COMPLIMENTARY, AND OTHER FREE COPIES 1. TOTAL DISTRIBUTION (Sum of C and D)	AVERAGE NO COPIES EACH INSUE DIFFERENCE DING PRECEDING 3,500 170 2,796 2,966 22 2,988	ACTUAL NO. COPIES OF SING ISSUE PUBLISHED NEAREST FILING DATE 3,500 170 2,722 2,892 22 2,914
D. EXTENT AND NATURE OF CIRCULATION 1. TOTAL NO. COPIES PRINTED (Net Press Run) 1. RAID CIRCULATION 1. RALES THROUGH DEALERS AND CARRIERS, STREET VENDORS AND COUNTER RALES 2. MAIL SUBSCRIPTIONS 1. TOTAL PAID CIRCULATION (Sum of 1081 and 1082) 2. PREE DISTRIBUTION BY MAIL, CARRIER OR OTHER MEANS SAMPLES, COMPLIMENTARY, AND OTHER PREE COPIES 1. TOTAL DISTRIBUTION (Sum of C and D) 1. COPIES NOT DISTRIBUTED 1. OPPICE USE, LEFT OVER, UNACCOUNTED, SPOILED AFTER PRINTING 2. RETURNS PROM NEWS AGENTS 3. TOTAL (Sum of E, F1 and 2-should equal net press run shown Internal Control of the Control of t	3,500 170 2,796 2,966 22 2,988 512 0 3,500	ACTUAL NO. COPIES OF SINC ISSUE PUBLISHED NEAREST FILLING DATE 3,500 170 2,722 2,892 22 2,914 586 0
D. EXTENT AND NATURE OF CIRCULATION 1. ALLES THROUGH DEALERS AND CARRIERS, STREET 2. MAIL SUBSCRIPTIONS 1. TOTAL PAID CIRCULATION (Sum of 1081 and 1082) 2. TOTAL PAID CIRCULATION (Sum of 1081 and 1082) 2. PREC DISTRIBUTION BY MAIL, CARRIER OR OTHER MEARS SAMPLES, COMPLIENTATIVA, AND OTHER PREC COPIES 3. TOTAL DISTRIBUTION (Sum of C and D) 4. COPIES NOT DISTRIBUTED 5. TOTAL COPIES NOT DISTRIBUTED 6. ATTER PRINTING NEWS AGENTS 5. TOTAL (Sum of E, F1 and 2—should equal net press run shourn 10 A)	AVERAGE NO COPIES EACH INSUE OF INSUE O	ACTUAL NO. COPIES OF SINC 18SUE PUBLISHED NEAREST FILLING DATE 3,500 170 2,722 2,892 22 2,914 586
C. TOTAL ISTRIBUTION BY MAIL, CARRIER OR OTHER MEANS SAMELES, COMPLIANTON BY MAIL, CARRIER OR OTHER MEANS SAME CONTROL OF COMPLEX CONTROL OF CONTRO	3,500 ATURA AND VITLE OF EDITOR. AGER, OD DWINER AVERAGE NO COPIES EACH 185UE DITAMONTHS 3,500 170 2,796 22 2,988 512 0 ATURA AND VITLE OF EDITOR. AGER, OD DWINER	ACTUAL NO COPIES OF SING ISSUE PUBLISHED NARAEST FILING DATE 3,500 170 2,722 2,892 22 2,914 586 0 0 3,500 USALISHER, BUSINESS , EXECUTIVE DIrector
C. TOTAL ISTRIBUTION BY MAIL, CARRIER OR OTHER MEANS SAMELES, COMPLIANTON BY MAIL, CARRIER OR OTHER MEANS SAME CONTROL OF COMPLEX CONTROL OF CONTRO	AVERAGE NO COPIES EACH 1850'E DUTING MEETEDING 12 MONTHS 3,500 170 2,796 2,966 22 2,988 512 0 3,500 ATURE AND TITLE OF EDITOR	ACTUAL NO. COPIES OF SING ISSUE PUBLISHED NEAREST FILING DATE 3,500 170 2,722 2,892 2,914 586 0 3,500 UBLISHER, SUBINESS EXECUTIVE DIRECTOR Exercise Manual) 22 23 24 25 25 29 29 29 29 20 20 20 20 20 20
EXTENT AND NATURE OF CIRCULATION 1. ALES THROUGH DEALERS AND CARRIERS, BTREET VENDORS AND CONTER SALES 2. MAIL SUBSCRIPTIONS 2. MAIL SUBSCRIPTIONS 2. TOTAL PAID CIRCULATION (Sum of 1081 and 1082) 3. PREC DISTRIBUTION BY MAIL, CARRIER OR OTHER MEANS SAMPLES, COMPLIMENTARY, AND OTHER PREC COPIES 4. TOTAL DISTRIBUTION (Sum of C and D) 7. COPIES NO "DISTRIBUTED" 1. OPTICE VOES FRY OVER, UNACCOUNTED, SPOILED AFTER PRINTING 2. RETURNS PRIOM NEWS AGENTS 5. TOTAL (Sum of E, F1 and 2-should equal net press run shown in A) 11. I certify that the statements made by meabove are correct and complete. 12. FOR COMPLETION BY PUBLISHERS MAILING AT THE SECULA 38 U.S. C. 3828 provides in pertinent pert: "No person with would bell mall such matter at the rest provided under this subsection unless male bill mall such matter at the rest provided under this subsection under the matter at the rest provided under this subsection under the complete.	AVERAGE NO COPIES EACH 185UE OF PROPERTY OF THE SECRET OF	ACTUAL NO. COPIES OF SINCE SSUE PUBLISHED NEAREST FILING DATE 3,500 170 2,722 2,892 2,914 586 0 3,500 UBLISHER, BUSINESS EXECUTIVE DIrector cervice Manual) ser former section 4359 of this title lice a written request for permission