### **1990 Census Names Recovery Project**

### Diane Cronkite and Trent Alexander Center for Administrative Records Research and Applications U.S. Census Bureau

FedCASIC Workshop May 4, 2016



### **Project Team**

### **U.S. Census Bureau**

Trent Alexander, Diane Cronkite, Denise Flanagan-Doyle, Catherine Massey, Amy O'Hara

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### National Academies of Sciences, Engineering, and Medicine

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## Background

- CARRA creates and uses person-level data linkages
  - Supports agency's use of administrative records
  - Increases utility of Census and Survey data
- Dedicated staff links administrative records, censuses, surveys
- Linkage keys available from 2000-present
- Key goal of this project
  - Demonstrate methods to extend infrastructure back in time
  - Start with 1990, then move to prior Censuses



## **1990 Name Recovery Pilot**

### 1990 Census

- Names were handwritten on Census form but not captured electronically
- Census forms exist on 130,000 microfilm reels
  - Census Bureau's National Processing Center
  - National Archives and Records Administration
- Most other variables are already available in microdata file



### Last name, first name, middle initial

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		<ul> <li>Roomer, boarder, O Unmarried or foster child partner</li> </ul>	<ul> <li>Roomer, boarder, O Unmarried or foster child partner</li> </ul>	<ul> <li>Roomer, boarder, O Unmarried</li> <li>or foster child</li> <li>partner</li> </ul>	○ Roomer, boarder, ○ Unmarried	<ul> <li>Roomer, boarder, O Unmarried</li> <li>or foster child</li> <li>pattner</li> </ul>
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	<ul> <li>Aleut Asian or Pacific Islander (API)</li> </ul>	<ul> <li>Aleut Asian or Pacific Islander (API)</li> </ul>	<ul> <li>Aleut Asian or Pacific Islander (API)</li> </ul>	<ul> <li>Aleut Asian or Pactfic Islander (API)</li> </ul>	<ul> <li>Aleut Asian or Pacific Islander (API)</li> </ul>	<ul> <li>Aleut Asian or Pacific Islander (API)</li> </ul>
	O Chinese O Japanese	Chinese     Japanese	Chinese     Japanese	O Chinese O Japanese	Chinese O Japanese	Chinese Japanese
er Asian or Pacific Islander (API),	Hawaiian     Samoan	<ul> <li>Filipino</li> <li>Asian indian</li> <li>Hawaiian</li> <li>Samoan</li> </ul>	Filipino     Asian Indian     Hawailan     Samoan	Filipino     Asian Indian     Hawaiian     Samoan	Filipino     Asian Indian     Hawaiian     Samoan	Filipino     Aslan Indian     Hawaiian     Samoan
ne group, for example: Hmong, Laotan Thai Tongan Pakistani	O Korean O Guamanian	· Korean · Guamanian	O Korean O Guamanian	<ul> <li>Korean</li> <li>Guamanian</li> </ul>	<ul> <li>Korean</li> <li>Guamanian</li> </ul>	○ Korean ○ Guamanian
odian, and so on.	Vietnamese Other API 7	Vietnamese Other API 7	○ Vietnamese ○ Other API 7	○ Vietnamese ○ Other API 7	• Vietnamese • Other API 7	• Vietnamese • Other API 7
er race, print race.	Other race (Print race)	Other race (Print race)	Other race (Print race)	Other race (Print race)	Other race (Print race)	Other race (Print race)
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ircle for each person.	Widowed     Never married     Divorced	<ul> <li>Widowed</li> <li>Never married</li> <li>Divorced</li> </ul>	<ul> <li>Widowed</li> <li>Never married</li> <li>Divorced</li> </ul>	<ul> <li>Widowed</li> <li>Never married</li> <li>Divorced</li> </ul>	Widowed     Never married     Divorced	<ul> <li>Widowed</li> <li>Never married</li> <li>Divorced</li> </ul>
rson of Spanish/Hispanic origin?	<ul> <li>No (not Spanish/Hispanic)</li> </ul>	No (not Spanish/Hispanic)	No (not Spanish / Hispanic)	<ul> <li>No (not Spanish /Hispanic)</li> </ul>	No (not Spanish / Hispanic)	No (not Spanish /Himanis)
ircle for each person.	<ul> <li>Yes, Mexican, Mexican-Am., Chicano</li> </ul>	<ul> <li>Yes, Mexican, Mexican-Am., Chicano</li> </ul>	<ul> <li>Yes, Mexican, Mexican-Am., Chicano</li> </ul>	<ul> <li>Yes, Mexican, Mexican-Am., Chicano</li> </ul>	<ul> <li>Yes, Mexican, Mexican-Am., Chicano</li> </ul>	<ul> <li>Yes, Mexican, Mexican-Am., Chicano</li> </ul>
	<ul> <li>Yes, Puerto Rican</li> <li>Yes, Cuban</li> </ul>	Yes, Puerto Rican     Yes, Cuban	<ul> <li>Yes, Puerto Rican</li> <li>Yes, Cuban</li> </ul>	Yes, Puerto Rican	Yes, Puerto Rican     Yes, Cuban	Yes, Puerto Rican     Yes, Cuban
	<ul> <li>Yes, other Spanish/Hispanic</li> </ul>	<ul> <li>Yes, other Spanish/Hispanic</li> </ul>	<ul> <li>Yes, other Spanish/Hispanic</li> </ul>	<ul> <li>Yes, other Spanish/Hispanic</li> </ul>	Yes, other Spanish/Hispanic	<ul> <li>Yes, other Spanish/Hispanic</li> </ul>
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ther Spanish/Hispanic,	Salvadoran, Spaniard, and so on.) 7	Salvadoran, Spaniard, and so on.) 7	Salvadoran, Spaniard, and so on.) 7	Salvadoran, Spaniard, and so on.)	Salvadoran, Spaniard, and so on.) 7	Salvadoran, Spaniard, and so on.)
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Di	Lunger b p	Last name A La - 2 K	Last name	Langrage 2	PERSON 5	PERSON 6
for each person listed in	First print Widdy into	Pret name Middle total	First name	Frei name Don / Mildona	Willson Node with	Pertagent Middle Instal
Question 1a on page 1.	Mare of	Veronica 92	Perry C	Ross of	Jordan a	Mallace P
his person related ON 1?	/ /	If a RELATIVE of Person 1:	If a RELATIVE of Berson 1:	If a RELATIVE of Person 1:	If a RÉLATIVE of Person 1:	If a RELATIVE of Person 1:
tircle for each person.	START in this column with the household	Natural-born     Father/mother	Natural-born     Father/mother	<ul> <li>Natural-born</li> <li>Father/mother</li> </ul>	<ul> <li>Natural-born</li> <li>Father/mother</li> </ul>	Natural-born     Father/mother
relative of person in column 1,	the home is owned, being bought, or rented.	or adopted O Grandchild son/daughter O Other relative	or adopted O Grandchild	or adopted O Grandchild	or adopted O Grandchild	or adopted O Grandchild
nd print exact relationship, such	If there is no such person, start in this column with	O Stepson/	O Stepson/	<ul> <li>Stepson/</li> </ul>	<ul> <li>Stepson/</li> </ul>	O Stepson/
usin, and so on.	any adult household member.	If NOT RELATED to Person 1:	stepdaughter	stepdaughter	stepdaughter	stepdaughter
		<ul> <li>Roomer, boarder, O Unmarried</li> </ul>	<ul> <li>Roomer, boarder, O Unmarried</li> </ul>	<ul> <li>Roomer, boarder, O Unmarried</li> </ul>	<ul> <li>Roomer, boarder, O Unmarried</li> </ul>	Roomer, boarder, O Unmarried
	_	or foster child partner	or foster child partner	or foster child partner	or foster child partner	or foster child partner
	-	roommate nonrelative	roommate nonrelative	roommate nonrelative	roommale nonrelative	roommate nonrelative
ircle for each person.	O Male O Female	O Male O Female	O Male O Female	O Male O Female	O Male O Female	O Male O Female
ircle for the race that the person	White     Black or Negro	White     Black or Negro	White     Black or Negro	White     Black or Negro	White     Black or Netro	O White
himself/herself to be.	<ul> <li>Indian (Amer.) (Print the name of the</li> </ul>	<ul> <li>Indian (Amer.) (Print the name of the</li> </ul>	<ul> <li>Indian (Amer.) (Print the name of the</li> </ul>	<ul> <li>Indian (Amer.) (Print the name of the</li> </ul>	<ul> <li>Indian (Amer.) (Print the name of the</li> </ul>	<ul> <li>Indian (Amer.) (Print the name of the</li> </ul>
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rson of Spanish/Hispanic origin?	<ul> <li>No (not Spanish/Hispanic)</li> </ul>	<ul> <li>No (not Spanish/Hispanic)</li> </ul>	<ul> <li>No (not Spanish/Hispanic)</li> </ul>	<ul> <li>No (not Spanish/Hispanic)</li> </ul>	<ul> <li>No (not Spanish/Hispanic)</li> </ul>	<ul> <li>No (not Spanish/Hispanic)</li> </ul>
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	O Yes, Cuban	<ul> <li>Yes, Cuban</li> </ul>	<ul> <li>Yes, Cuban</li> </ul>	<ul> <li>Yes, Cuban</li> </ul>	<ul> <li>Yes, Cuban</li> </ul>	<ul> <li>Yes, Cuban</li> </ul>
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	Colombian, Dominican, Nicaraguan, Salvadoran, Spaniard, and so on.)	Colombian, Dominican, Nicaraguan, Salvadoran, Spaniard, and so on.) ->	Colombian, Dominican, Nicaraguan, Salvadoran, Spaniard, and so on.)	Colombian, Dominican, Nicaraguan, Salvadoran, Spaniard, and so on 1	Colombian, Dominican, Nicaraguan, Salvadoran, Spaniard, and so on 1-	Colombian, Dominican, Nicaraguan, Salvadoran, Spaniard, and so on 1
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11-digit household ID



### **Person 7 information**

PERSUNY /       Martine State       Stepson/       mediation       Stepson/       mediation       Martine State       Onther Celetion       Martine State       Other recentiation       Martine State       Other recentiation       Martine State       State       Martine State       Other recentiation       Martine State       Other recentiation       State       State	Anow FLEASE Arts were QUESTIONS F     Anow FLEASE Arts were QUESTIONS F     A constraint of your list of persons for     Question Ia on page 1 because you were not sure if     the person should be listed — for example, someone     temporarily away on a business trip or vacation, a     newborn baby still in the hospital, or a person who     stays here once in a while and has no other home?     Yee, please print the name(s)     not resonable the listed of persons for     Question Ia on page 1 even though you were not sure     that the person should be listed of persons for     Question Ia on page 1 even though you were not sure     that the person should be listed of persons for     guestion Ia on page 1 even though you were not sure     that the person should be listed of persons for     guestion Ia on page 1 even though you were not sure     that the person should be listed of persons for     guestion Ia on page 1 even though you were not sure     that the person should be listed of persons for     guestion Ia on page 1 even though you were not sure     that the person should be listed of persons for     guestion Ia on page 1 even though you were not sure     that the person should be listed of persons for     guestion Ia on page 1 even though you were not sure     that the person should be listed of persons for     guestion Ia on page 1 even though you were not sure     that the person should be listed of persons for     guestion Ia on page 1 even though you were not sure     that the person should be listed of persons for     guestion Ia on page 1 even though you were not sure     that the person should be listed of persons for     guestion Ia on page 1 even though you were not sure     houlding with 50 a partments     A building with 50 to 9 partments     A building with 20 to 9	In the set ONE FANLY HOUSE HOLD         If the is a ONE FANLY HOUSE -         Her a business (such as a store or barber shop) or a medical office on this property?         Yes       No         Is there a business (such as a store or barber shop) or a medical office on this property?         Yes       No         Answer only if you or someone in the household OWNS OR IS BUYNG the house or apartment         H6.       What is the value of this property: that is, how much do you think this house and lot or condominian unit would sell for if it were for sale?         Less than \$10,000       \$70,000 to \$74,999         \$10,000 to \$14,999       \$70,000 to \$74,999         \$10,000 to \$12,999       \$100,000 to \$124,999         \$25,000 to \$29,999       \$100,000 to \$124,999         \$40,000 to \$14,999       \$100,000 to \$149,999         \$40,000 to \$44,999       \$100,000 to \$124,999         \$40,000 to \$44,999       \$200,000 to \$239,999         \$40,000 to \$44,999       \$200,000 to \$249,999         \$400,000 to \$44,999       \$200,000 to \$249,999 </th
Indam (Amer.) (Pinn the name of the enroled or principal trike.) 7         H           Eakimo         Alseut         Asian or Pacfic Islander (API)           Chines         Japanese           Filpino         Asian Indian           Korean         Guamonian           Vietnamese         Other API           Other race (Print race) ✓         H           Age         Jensora           Other race (Print race) ✓         H           Age         Jensora           Other race (Print race) ✓         H           H         Jensora           Other race (Print race) ✓         H           H         Jensora           Other race (Print race) ✓         H	H2. Which best describes this building? Include all apartments, flats, etc., even if vacant.     A mobile home or trailer     A one-family house datached from any other house     A one-family house attached to one or more houses     A building with 2 apartments     A building with 3 or 4 apartments     A building with 10 to 19 apartments     A building with 10 to 9 apartments     A building with 20 or 4 apartments     A building with 20 to 49 apartments	540,000 to 543,999         \$125,0000 to 5179,999           \$45,000 to 544,999         \$220,0000 to 5249,999           \$55,000 to 554,999         \$220,000 to 5249,999           \$55,000 to 554,999         \$300,000 to 5399,999           \$55,000 to 549,999         \$300,000 to 5399,999           \$55,000 to 564,999         \$300,000 to 5399,999           \$550,000 to 564,999         \$500,000 to 549,999           \$650,000 to 569,999         \$500,000 to 760,999           \$650,000 to 569,999         \$500,000 to 760,999 </td
Other race (Print race)_/         H           Age         b. Year of birth         H           0 0 0 0 0 1 9 9 1 0 1 0         2 0 2 0         2 0 2 0           2 0 2 0 3 3 0 3 0         3 0 3 0         3 0 3 0		
5 0 5 0       -       5 0 5 0         6 0 6 0       6 0 6 0         7 0 7 0       7 0 7 0         8 0 8 0       8 0 8 0         9 0 9 0       9 0 9 0	13.     Frow many rooms do you have in this house or apartment?       Do NOT court bathrooms, porches, balconies, foyers, halls, or half-cooms.     1 rooms       1 room     4 rooms     7 rooms       2 rooms     5 rooms     8 rooms       3 rooms     6 rooms     9 or more       14.     Is this house or apartment –     •       •     Owned by you or someone in this household with a mortgage or loan?       •     Owned by you or someone in this household       •     The for cash ren?	580 to 359         \$400 to 3424           \$100 to 3124         \$425 to 5449           \$125 to 5149         \$450 to 5474           \$150 to 5174         \$475 to 5499           \$175 to 5199         \$500 to 5524           \$225 to 5249         \$555 to 5549           \$225 to 5274         \$660 to 5699           \$235 to 5274         \$660 to 5699           \$300 to 5324         \$770 to 5799           \$350 to 5374         \$1,000 or more           b. Does the monthly rent include any meals?         Yes
Now married Separated     Widowed Never married     Divorced     No (not Spanish/Hispanic)     Yes, Mexican, Mexican-Am., Chicano     Yes, Devetor Birsa	A. Total persons         B. Type of unit Occupied         D. Months vacas           0         First form         Regular           0         First form         Regular           0         Cont^n         Usual hore           0         Lesseban 1         2 upto 6	NSUS USE ant G. DO ID 6 up to 12 12 up to 24 24 or more ker
Ves, Cuban Mik/Hspanic     Yes, Cuban Mik/Hspanic     Ore, other Spanish/Hspanic     Ortic negroup.for example. Argentinea,     Colombian, Dominican, Nicrarguan,     Saleudoran, Spaniard, and so on J	I     C1.     Vacancy status     ○     LR     ○     TC       Image: Construction of the state only     For rent     ○     For state only     ○     P/F     RE       Image: Construction only     For state only     rec/occ     ○     P/F     RE       Image: Construction only     For state only     rec/occ     ○     P/F     C       Image: Construction only     Construction only     Construction only     Construction only     Construction only     Construction only       Image: Construction only     Construction only     Construction only     Construction only     Construction only     Construction only       Image: Construction only     Construction only     Construction only     Construction only     Construction only	O       QA       JC1       I

Census Bureau



Handwritten household ID with FOSDIC bubbles

Census Bureau

# **Scope of Work**

### Scan Microfilm

- Make hand-keyed "truth data"
- Do Optical Character Recognition (OCR)
- Evaluate Results



### Goals

- Determine best settings
- Determine best scanner
- Estimate cost of scanning all 130,000 reels





### CROWLEY

### MEET THE MACH MICROFILM SCANNERS

### And Meet (or Exceed) True Optical DPI Requirements with Ease and Precision

For archivists, records managers and service bureaus there is no greater measure of success than accuracy to the original media. In today's business climate, that accuracy has to be paired with maximum efficiency in order to be costeffective. The Mekel Technology **MACH-series** microfilm scanners combine the best of worlds, using NARA and Library of Congress preservation specifications as the gold standards and pairing them with innovative technology for an unmatched return on investment.

### ALL MEKEL PRODUCTION MICROFILM SYSTEMS FEATURE:

- Robust work ethic; works 24/7 with minimal maintenance requirements
- ▶ 16mm and 35mm microfilm conversion capability
- Scanning up to 1,000' rollfilm and 3M/ANSI/Ektamate cartridges as standard
- Conversion to most electronic imaging formats, including PDF varieties and archival formats
- Fast throughput
- Highly-refined precision lenses
- Mekel's one-of-a-kind Quantum Scan and Quantum Process suite
- 100% accurate image capture; no re-loading necessary scan once and done
- A sophisticated toolkit of automated and manual image processing features to guarantee the best image quality possible; eliminates the need for re-scans
- An external PC, allowing for maximum uptime and technology updates
- Calibrated/focused LED light source
- Sturdy case with built-in reel storage
- Stable and gentle transport system
- "Load and go" intuitive operation



### **MACH12 Key Features**

- High optical resolution: 100-750 dpi true optical resolution
- 12-bit camera exceeds true optical dpi requirements for capture of books, newspapers, manuscripts, financial records and more
   Unrivaled image guality and capture accuracy – excellent tonality
- Unrivated image quality and capture accuracy excellent tonalit and depth of field
- Crystal clear scanning of small fonts and highly-reduced images
- Higher OCR accuracy as a result of better image quality

### **MACH10 Key Features**

- Highest efficiency for the combination of speed and image quality
- Scans up to 700 images per minute/3 minutes per 100' roll (up to 1400 images per minute via speed mode)

### **MACH5 Key Features**

- Offers speed and image quality when scanning a wide variety of microfilm in various states of composition
- Scans under 6 minutes per 100'roll



### Edipse with next Sta

### The World's Premier scanning platform for film

The Eclipse 16/35mm roll film scanning solution provides a complete package of hardware, software, training and support to provide the fastest throughput and highest quality digital images in the market today.

The Eclipse 16/35mm roll film scanning solution includes the scanner, PC, high resolution lens, NextStar software, on-site training and long term support. Also offered with this solution is an optional expanded digital storage server (RSD), cassette adapter and/or 1000' reel adapter.

### The system can handle all of the challenging properties of roll film scanning including:

- Variable size documents
- Variable position images
- Multiple film files
- Variable indexing to digital files
- Captures up to 3 levels of blips
- Enhancement of signatures and handwritten data on filmed images
- Multiple output formats including PDF/A

### Unique scanner features:

- Scan 16 and 35mm roll film at speeds up to 1000 ppm and beyond
- Patented LuminTec illumination system runs cool with lower power consumption, longer lamp life and sharper images
- Ribbon scanning software for guaranteed image capture and detection
- Patented film transport to ensure linearity (eliminates image distortion due to environmental vibration)
- Special capabilities for handling 1000' reels and blipped film
- Choice of scanner chassis to accommodate internal or external expanded digital storage
- Scan system workflow is configured to minimize any impact on your internal network

next Scan The Next Generation in Film and Fiche Scanning Technology



U.S. Department of Commerce Economics and Statistics Administration U.S. CENSUS BUREAU census.gov

13

- Worked at Census's National Processing Center
  - Census has copy of the archival original reels
  - 2 microfilm scanners
  - Scanned 600 reels
    - Mix of short-form and long-form census
    - >1,000,000 total images
  - October December 2015



- National Archives master version
  - Census Bureau version is a copy of these
  - National Archives scanned 2 reels
    - Provided images to Census
    - Images looked better but achieved similar OCR results
    - Is performing OCR themselves on these reels



# **Scope of Work**

- Scan Microfilm
- Make hand-keyed "truth data"
- Do Optical Character Recognition (OCR)
- Evaluate Results



# Hand-keyed "Truth Data"

### Goals

- Create "truth data" to evaluate OCR results
- Double-keyed data gives a measure of keying error
- To measure proportion of hard-to-read names
  - If a person cannot read the name, this should not be counted as an OCR "error"



## Hand-keyed "Truth Data"

- Used a key-from-image SharePoint application
  - Developed by Census's Center for Applied Technology
- Hand-keyed 44,000 names double-keyed
  - double-keyed names matched 95% of the time
- December 2015 March 2016



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	DEDCON 1		
Contraction of the second	PERSON I	Census Name Red     A     Census Name Red     Substant     S	covery
		1 Person 🛩	2
	First name Middle initial F		+2. ADD PERSON
		Survey ID 1	Instructions
	H	Survey ID 2	The Name Recovery Form allows you to
			manually enter viewed data based on Images displayed through the
	START in this column with the bousehold		Image Viewer. If you have any questions,
member (or one	member (or one of the members) in whose name	Person 1 of 1	contact Diane Cronkite at 301-763-2537.
	the home is owned, being bought, or rented.	Last Name	
	If there is no such person, start in this column with	Suffix (Jr, Sr, the 3rd, etc.)	
	any adult household member	First Name	
		Middle Name	
		Age	
		Alternate Names	
		Low Quality	
		Illegible	
		CANCEL	
		0 of 0 Images Remaini	ina



# **Scope of Work**

- Scan Microfilm
- Make hand-keyed "truth data"
- Do Optical Character Recognition (OCR)
- Evaluate Results



- Currently happening at Census HQ
  - One academic institution and one company
  - Both providing own servers
    - Quarantined machines
    - Hard-drives will be destroyed







- Census created "dictionaries" of every name
  - Included every first and last name ever associated with a Social Security number
  - Initial dictionaries were too large
  - Provided dictionaries including names of 95% and 99% of the population (reduced size by >half)



- OCR began in March 2016
  - Both teams provided preliminary results in April
  - Will be complete in May 2016
  - National Archives is also doing limited OCR



# **Scope of Work**

- Scan Microfilm
- Make hand-keyed "truth data"
- Do Optical Character Recognition (OCR)
- Evaluate Results



### Preliminary Results: Scanning and Truth Data

- Scanning: identified optimal scanner and settings
- "truth data": have measures of keying error rate and hard-to-read names
- OCR: will compare output of 2 teams and National Archives



### Preliminary Results: Optical Character Recognition

- OCR quality when compared to truth data
  - Perfect Matches
    - Household ID 85%
    - First name 71%
    - Last name 67%



### Preliminary Results: Optical Character Recognition

- OCR quality when compared to truth data
  - "Good" Matches (Jaro-Winkler distance >0.83)
    - First name 82%
      - Mary and Gary
      - Cora and Lora
      - Morgan and Megan
    - Last name 78%
      - Conners and Coppers
      - Leke and Lake
      - Boyd and Byrd



### Preliminary Results: Unexpected Discovery

- Located file that will greatly simplify linkage
  - Addresses for every record in 1990
    - Street addresses, rural routes, apartment numbers, etc.
  - Includes householder name for 30% of units
    - 27 million names
    - Were collected in a pre-census address canvassing operation at a cost of \$68 million in 1989 dollars



### Preliminary Results: Unexpected Discovery

- Why is the address file a big deal?
  - Allows for address linkage to a same-year administrative records composite that has names
  - Composite contains demographic characteristics to validate address matches
- May enable good links without names



### **Next steps**

- Assign linkage keys to 40,000 names
  - Will be conducted by CARRA's linkage staff
  - Can compare links made with OCR'ed names to links made with hand-keyed names
- Will answer question:
  - Is current OCR good enough for linkage?



### **Next steps**

- Create linked file for entire 1990 Census
  - Will use address/name file that was discovered
  - Matched to IRS/SSA data from same period
- Seeking funding for similar pilots on Censuses of 1960, 1970, and 1980
  - No address file for those
  - OCR is the only option



### Thank you

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This report is released to inform interested parties of ongoing research and to encourage discussion of work in progress. Any views expressed on statistical, methodological, technical, or operational issues are those of the author and not necessarily those of the U.S. Census Bureau.

