BASICS OF SEMI-AUTOMATED RECORD LINKAGE

REVIEW THESE SLIDES AT YOUR OWN PACE

Record Linkage: Same or Different People?

Given multiple databases, determine if records refer to the same real world people or not

Your job in this study is to:
1) Look at pairs of rows of data about people
2) Decide whether or not the pair refers to the same person.

Pair	ID	First name	Last name	DoB(M/D/Y)	Sex	Race
1	8000002767	JUDE	WILLIAM	09/09/1906	M	W
	8000003567	JUDE	WILLIAM JR	09/09/1960	M	B
2	0000006947	BRYANT	MADELINE	05/02/1962	F	W
	0000006947	MADELINE	BRYANT	05/02/1962	F	W
3	9000018540	SALLY	BYRD	07/04/1960	F	W
	6000008928	JOHN	BYRD	04/07/1960	M	

Maybe Father/Son

Probably data error

Maybe Twins

Common Issues with Data about People Make Record Linkage Difficult to do Fully Automatically

Data are expressed differently

- Nick Names (Elizabeth & Beth)

Data change over time

- Women get married and change their last name

Data are not unique attributes

- John Smith (there are different people that have the same name)
- Twins & Family members have similar identifying information such as DOB & last name
- Same names in Families with different suffix (Jr and Sr)

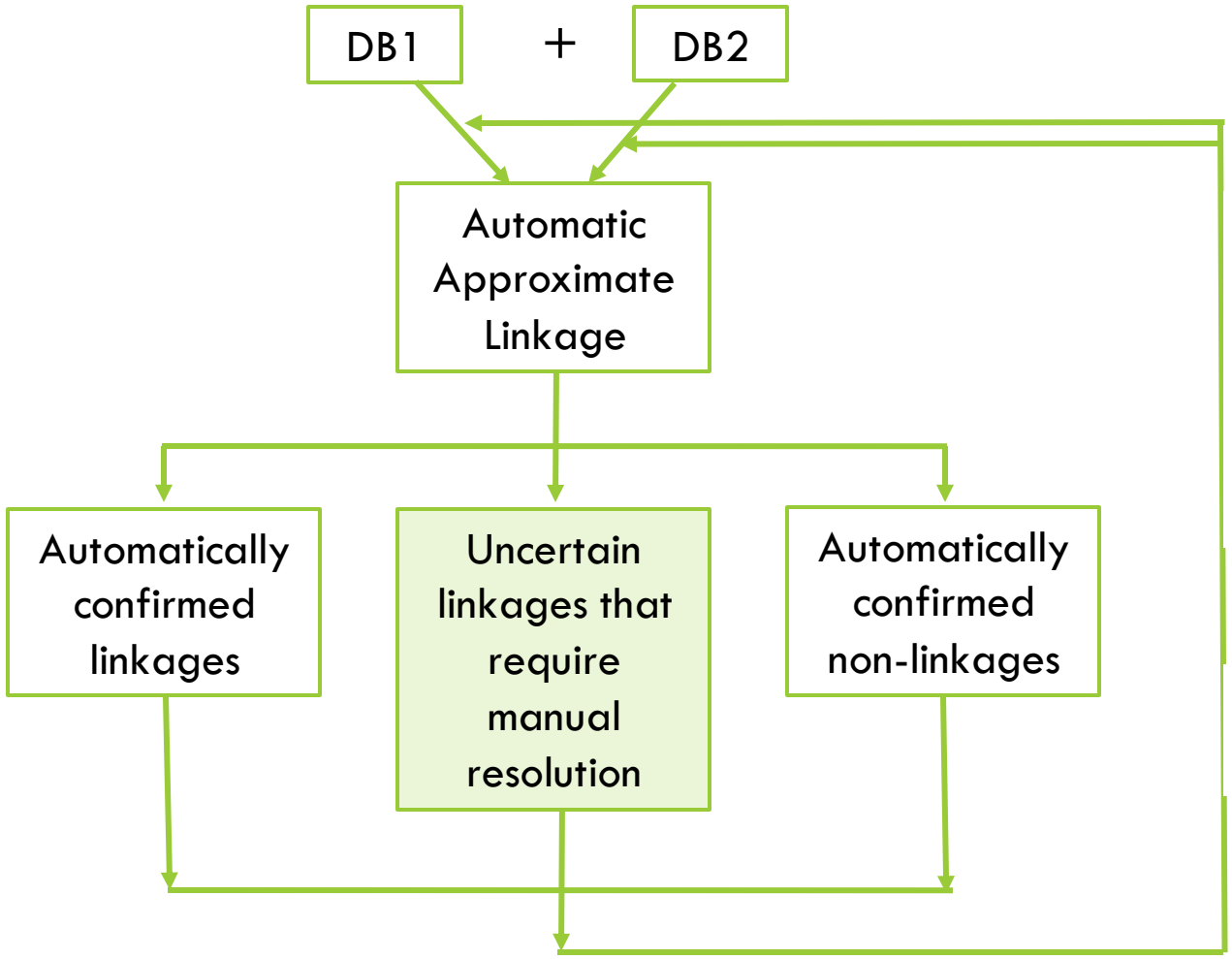
Data are sometimes missing

- SSN are often missing

Data have errors

- Inserting/deleting extra characters
- Typing in the wrong character
- Transposing two characters
- First name and last name are mixed up
- Day and month is mixed up

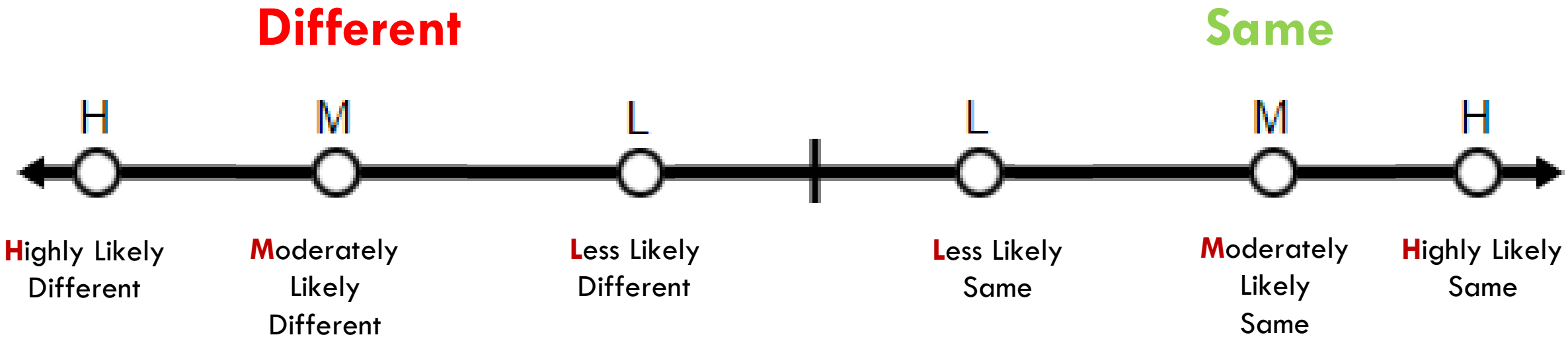
Approximate Record Linkage Human-Computer System (semi-automated system)



- Human Interaction With Data for
  - Standardize
  - Clean Data
  - Tuning parameters for automatic algorithms
  - Build Training Data

- 75%-80% automatics
- 15%-25% manual resolution

The Answer Buttons: Task is to answer given a pair



If you think the rows are the **same person**, click one of the choices on the **right side**. Pick one of L, M, H depending on your confidence level.

If you think the rows are for **different people**, click one of the choices on the **left side**. Pick one of L, M, H depending on your confidence level.

Status Quo: Show everything

Pair	ID	First name	Last name	DoB(M/D/Y)	Sex	Race
1	8000002767	JUDE	WILLIAM	09/09/1906	M	W
	8000003567	JUDE	WILLIAM JR	09/09/1960	M	B
2	0000006947	BRYANT	MADELINE	05/02/1962	F	W
	0000006947	MADELINE	BRYANT	05/02/1962	F	W
3	9000018540	SALLY	BYRD	07/04/1960	F	W
	6000008928	JOHN	BYRD	04/07/1960	M	

Are there ways to enhance privacy during the human interaction with data for semi-automated record linkage ?

1. USE VISUAL MARK UP

- TO SHARE META DATA ABOUT THE DIFFERENCES BETWEEN RECORDS
- TO FACILITATE LINKAGE DECISIONS

Missing Values ?

Data are sometimes missing.

Pair	ID	First name	Last name	DoB(M/D/Y)	Sex	Race
7	0000018335	PATSY	CALLAHAN	11/13/1948	F	B
	?	PATSY	CALLAHAN	?	F	B

Added or Deletions Characters

Insertion (or deletion) of characters are common typing errors

Pair	ID	First name	Last name	DoB(M/D/Y)	Sex	Race
	8000001276	JAYDEN	TIPTON	09/09/1960	M	W
1						
	8000002768	JADEN	TIPTON	09/09/1960	M	W

Different Characters ✗

Mistyping can lead to certain characters replacing others

Pair	ID	First name	Last name	DoB(M/D/Y)	Sex	Race
	9000018540	SAL	BYRD	04/07/1960	F	W
3	✗		✗	✗		
	9000018870	SAL	BIRD	04/09/1960	F	W

Switched Characters

Two characters can be interchanged by mistake

Pair	ID	First name	Last name	DoB(M/D/Y)	Sex	Race
	1719582520	ROGRES	HYLEMON	07/15/1924	M	W
11	⇄	⇄		⇄		
	1719852520	ROGERS	HYLEMON	07/15/1942	M	W

Column Swaps

Sometimes whole values are swapped as well:

Date Swaps

Pair	ID	First name	Last name	DoB(M/D/Y)	Sex	Race
9	0000020502	SAMANTHA	MORGAN	02/11/1958	F	W
	0000020502	SAMANTHA	MORGAN	11/02/1958	F	W

Name Swaps

Pair	ID	First name	Last name	DoB(M/D/Y)	Sex	Race
5	0000006947	BRYANT	MADELINE	09/22/1926	F	W
	0000006947	MADELINE	BRYANT	09/22/1926	F	W

Different DIFF

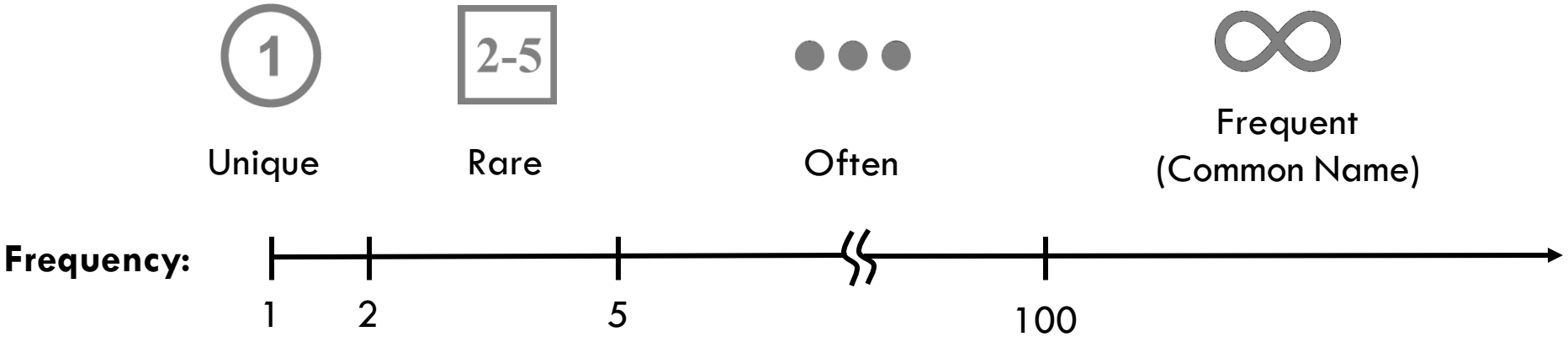
This icon is shown if the values in a column are very different.

Pair	ID	First name	Last name	DoB(M/D/Y)	Sex	Race
	6556368585	WILL	GREENE	07/03/1950	M	B
13	DIFF	DIFF				DIFF
	1092091430	DAVE	GREENE	07/03/1950	M	W

Name Frequency

It would not be surprising for two people to have the same **common name**, but it might be unlikely for two people to have the same **rare names**.

Frequency icons indicate how many times a given name occurred in the data source



2. USE VISUAL MASKING FOR PRIVACY

- USE VISUAL MASKING TO HIDE INFORMATION

Checkmarks: Identical Values

Identical values are shown as checkmarks.

Pair	ID	FFreq	First name	Last name	LFreq	DoB(M/D/Y)	Sex	Race
1	1234567891	•••	BRIAN	TIPTON	∞	09/09/1960	F	W
	1234561291	2-5	BRIANNA	TIPTON	∞	09/09/1960	F	W

Pair	ID	FFreq	First name	Last name	LFreq	DoB(M/D/Y)	Sex	Race
1	******@@**	•••	*****	✓	∞	✓	✓	✓
	******&&**	2-5	*****&&	✓	∞	✓	✓	✓

Stars Used in Similar IDs

When two items are similar, **stars** (they look like this ***) are used for characters that are the **same**.

@@@ and &&& show the characters that are **different**.

Pair	ID	FFreq	First name	Last name	LFreq	DoB(M/D/Y)	Sex	Race
1	1234567891	•••	BRIAN	TIPTON	∞	09/09/1960	F	W
	✖		✚					
	1234561291	2-5	BRIANNA	TIPTON	∞	09/09/1960	F	W

Pair	ID	FFreq	First name	Last name	LFreq	DoB(M/D/Y)	Sex	Race
1	******@@**	•••	*****	✓	∞	✓	✓	✓
	✖		✚					
	******&&**	2-5	*****&&	✓	∞	✓	✓	✓

*** for Missing Values

When one of the values in a pair is missing, the other one is represented by ***

Pair	ID	FFreq	First name	Last name	LFreq	DoB(M/D/Y)	Sex	Race
7	0000018335	•••	PATSY	CALLAHAN	•••	11/13/1948	F	B
	?	•••	PATSY	CALLAHAN	•••	?	F	B

Pair	ID	FFreq	First name	Last name	LFreq	DoB(M/D/Y)	Sex	Race
7	**********	•••	✓	✓	•••	**/**/****	✓	✓
	?	•••	✓	✓	•••	?	✓	✓

Different Items

@@@@@@@@@@
DIFF
&&&&&&&&&&

When two items are very different, they are shown as @@@ and &&&

Pair	ID	FFreq	First name	Last name	LFreq	DoB(M/D/Y)	Sex	Race
13	6556368585	1	WILL	GREENE	•••	07/03/1950	M	B
	DIFF		DIFF					DIFF
	1092091430	1	DAVE	GREENE	•••	07/03/1950	M	W

Pair	ID	FFreq	First name	Last name	LFreq	DoB(M/D/Y)	Sex	Race
13	@@@@@@@@@@	1	@@@@	✓	•••	✓	✓	@
	DIFF		DIFF					DIFF
	&&&&&&&&&&	1	&&&&	✓	•••	✓	✓	&

Swaps

When columns have swapped values, the swapped parts are shown by &&& and @@@

Pair	ID	FFreq	First name	Last name	LFreq	DoB(M/D/Y)	Sex	Race
5	0000006947	1	BRYANT	MADELINE	1	02/05/1962	F	W
	0000006947	2-5	MADELINE	BRYANT	•••	05/02/1962	F	W

Pair	ID	FFreq	First name	Last name	LFreq	DoB(M/D/Y)	Sex	Race
5	✓	1	&&&&&&	@@@@@@@@	1	@@/&&/****	✓	✓
	✓	2-5	@@@@@@@@	&&&&&&	•••	&&/@@/****	✓	✓

Pair	ID	FFreq	First name	Last name	LFreq	DoB(M/D/Y)	Sex	Race
1	8000002767	1	JUDE	WILLIAM	1	09/09/1906	M	W
	✖			+		⇄		DIFF
	8000003567	1	JUDE	WILLIAM JR	1	09/09/1960	M	B
2	0000006947	1	BRYANT	MADELINE	1	05/02/1962	F	W
	0000006947	2-5	MADELINE	BRYANT	•••	05/02/1962	F	W
3	9000018540	•••	SALLY	BYRD	•••	07/04/1960	F	W
	DIFF		DIFF			✖	DIFF	
	6000008928	∞	JOHN	BYRD	•••	04/07/1960	M	?

Pair	ID	FFreq	First name	Last name	LFreq	DoB(M/D/Y)	Sex	Race
1	******@@**	1	✓	*******	1	**/**/**@@	✓	@
	✖			+		⇄		DIFF
	******&&**	1	✓	******* &&	1	**/**/**&&	✓	&
2	✓	1	&&&&&&	@@@@@@@@	1	✓	✓	✓
	✓	2-5	@@@@@@@@	&&&&&&	•••	✓	✓	✓
3	@@@@@@@@@@	•••	@@@@@	✓	•••	@@/&&/****	@	*
	DIFF		DIFF			✖	DIFF	
	&&&&&&&&&&	∞	&&&&	✓	•••	&&/@@/****	&	?

3. INTERACTIVE ON-DEMAND INTERFACE

- TO FIND THE OPTIMAL BALANCE BETWEEN PRIVACY AND HIGH QUALITY RECORD LINKAGE RESULTS

Interactive On-Demand Interface

That was hard, wasn't it?

Sometimes, data masking can hide data that might be essential for record linkage. What if **you could open up the masked data as you need to see more**?

Over the next few pages, we will walk you through an interactive on-demand interface for record linkage.