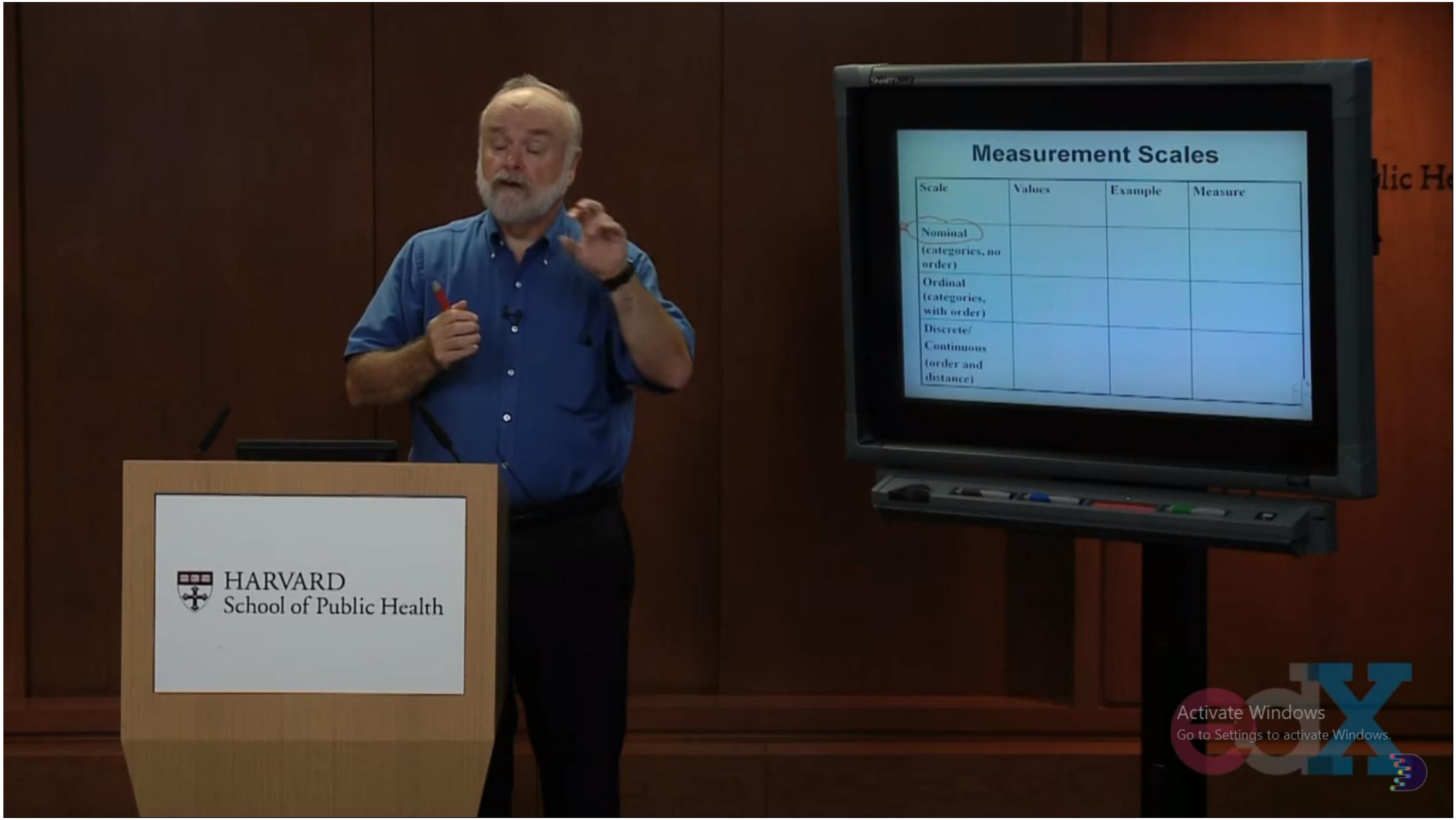
Implication: Measurement

- ***"study of the distribution … of disease frequency in human populations"***
  - Measure Outcomes (Disease)
  - Example: Mean blood pressure, prevalence of hypertension, incidence of CHD, risk, odds, rates
- ***"study of the … determinants of disease frequency in human populations"***
  - Measure Associations between Risk Factors and Outcomes
  - Example: Risk Ratios, Odds Ratios, Rate Ratios, Regression Coefficients

Agenda

- Review role of outcome measurement in Epidemiology
- Binary Outcomes: Proportion and Odds
- Prevalence
- Determinants of Prevalence
- Problem Set


Measurement Scales
Scale
Values
Example
Measure
Nominal (categories, no order)
Ordinal (categories, with order)
Discrete/ Continuous (order and distance)
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Measurement Scales

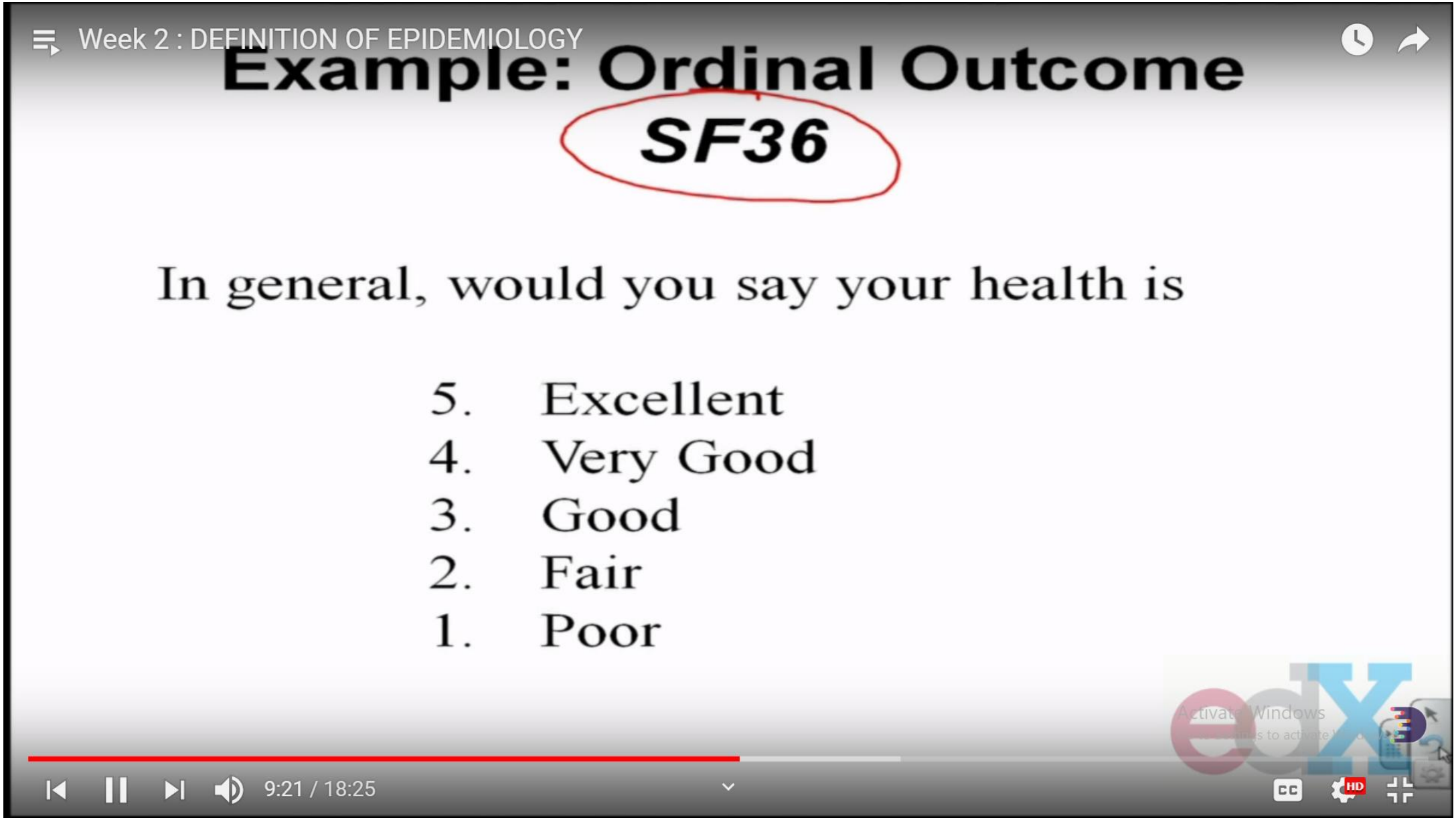
Scale	Values	Example	Measure
Nominal (categories, no order)			
Ordinal (categories, with order)			
Discrete/ Continuous (order and distance)			

Example: Nominal Outcome
International Classification of Disease (ICD9 Code)

Cause of Death	ICD-9
Breast Cancer	174
Acute Myocardial Infarction	410
Complication of Pregnancy	646

Measurement Scales

Scale	Values	Example	Measure
Nominal (categories, no order)	Labels	Diagnosis, Marital Status	Proportion Odds
Ordinal (categories, with order)	**Reflect Order**	**Severity of Disease, QOL**	**Above Median**
Discrete/ Continuous (order and distance)			


Week 2 : DEFINITION OF EPIDEMIOLOGY
Example: Ordinal Outcome
SF36
In general, would you say your health is
5. Excellent
4. Very Good
3. Good
2. Fair
1. Poor
9:21 / 18:25

Measurement Scales

Scale	Values	Example	Measure
Nominal (categories, no order)	Labels	Diagnosis, Marital Status	Proportion Odds
Ordinal (categories, with order)	Reflect Order	Severity of Disease, QOL	Above Median
Discrete/ Continuous (order and distance)	**Reflect Order and Distance**	**# MD Visits, Age, SBP**	**Above Average (Mean)**

Questions

- Can this be treated as a continuous measurement?
- Do integer values reflect order and distance.
  - Are health states equally distanced apart?
  - Is “Good Health” halfway between “Fair Health” and “Very Good Health”?
  - If yes, the average scores across subjects make sense.

Exercise

Place an X at locations of “Fair”, “Good” and “Very Good” health states, and measure distances between locations on line

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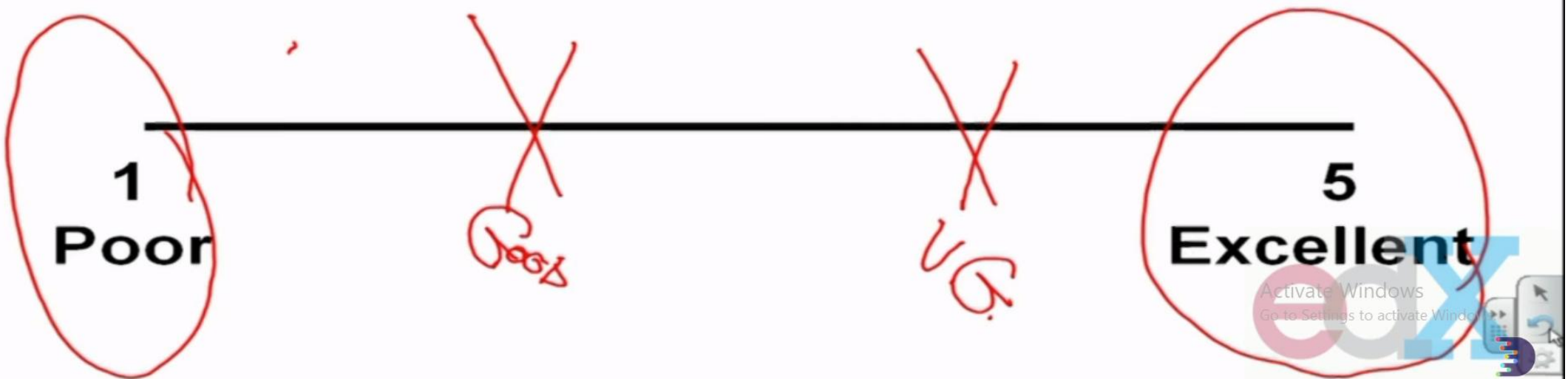

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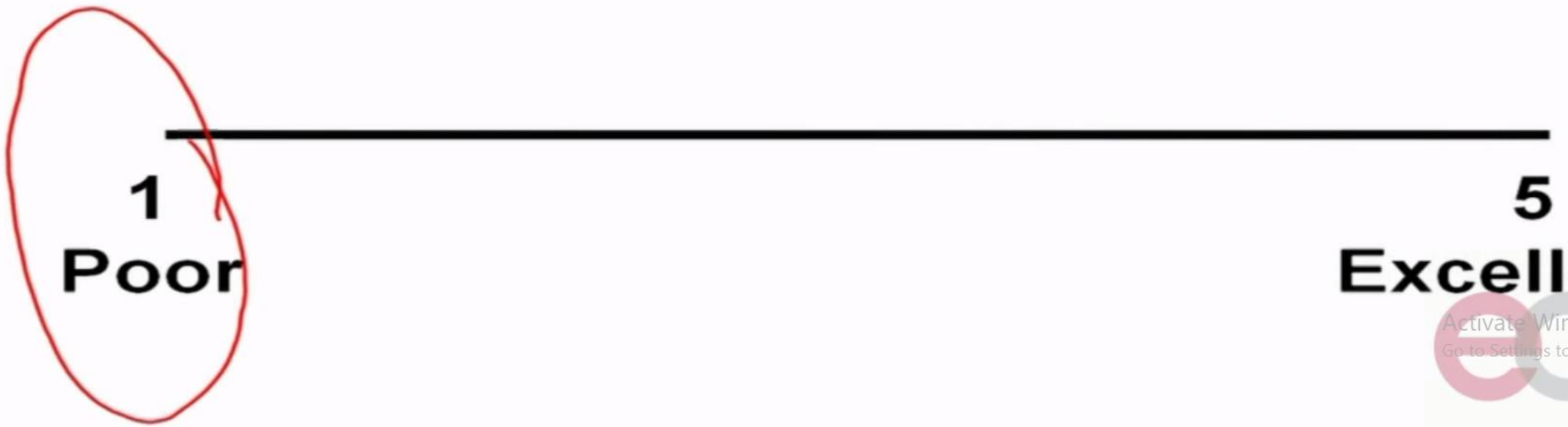

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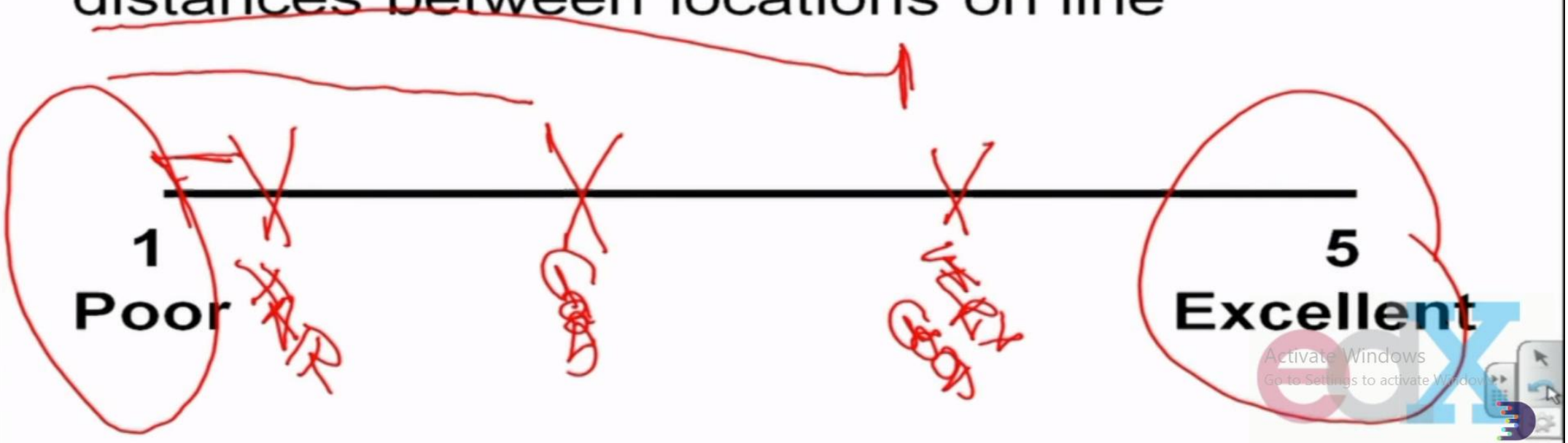

Transforming Ordinal Outcome into a Continuous Outcome

Median location of health states by HSPH students on 5-point scale

5.	Excellent	→	5
4.	Very Good	→	4.4
3.	Good	→	3.3
2.	Fair	→	2
1.	Poor	→	1

Averages (Means)

- Measures of central tendency
- Mean = ($\sum$ values)/ (# values)
- **May not reflect typical value**
- *"Say you were standing with one foot in the oven and one foot in an ice bucket. According to the percentage people, you should be perfectly comfortable." (Bobby Bragen)*

http://sportsillustrated.cnn.com/vault/article/magazine/MAG1074702/index.htm

Prevalence of CHD in Framingham Heart Study Data

Sex	Age Group	Number at Exam	Number with CHD	Prevalence
Female	30-40	415	0	0/415= .00
	41-50	908	6	6/908= .01
	51-60	795	38	38/795=.05
	> 60	372	26	26/372=.07
Male	30-40	339	6	6/339=.02
	41-50	731	24	24/731=.03
	51-60	584	37	37/584=.06
	> 60	290	57	57/290=.20

Prevalence of CHD in Framingham Heart Study Data

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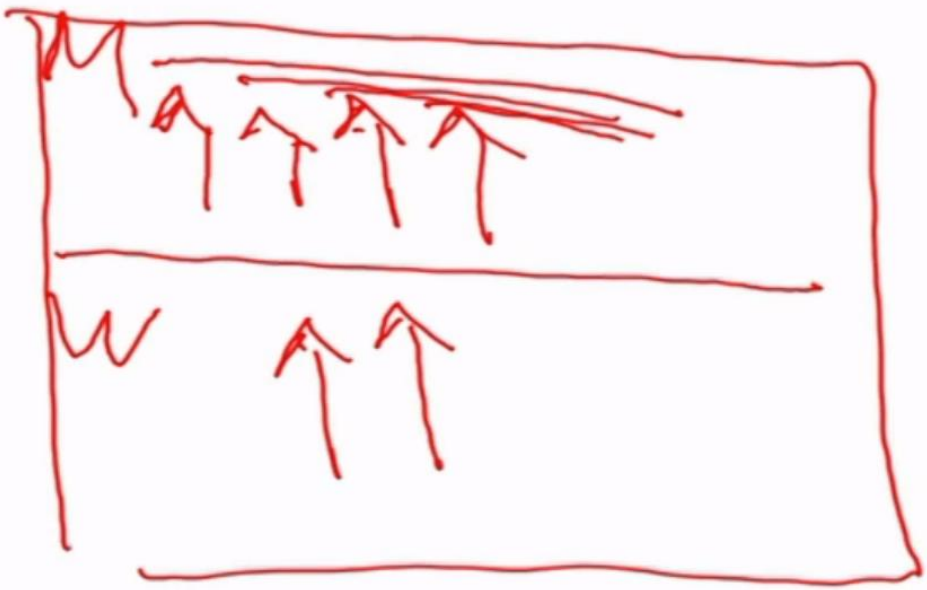
	> 60	372	26	26/372=.07
Male	30-40	339	6	6/339=.02
	41-50	731	24	24/731=.03
	51-60	584	37	37/584=.06
	> 60	290	57	57/290=.20

Question?

What are some possible reasons for the general tendency for men to have higher prevalence of CHD at baseline than women?

Possible Answers

- Men are at high risk for developing CHD (**Higher Incidence**)



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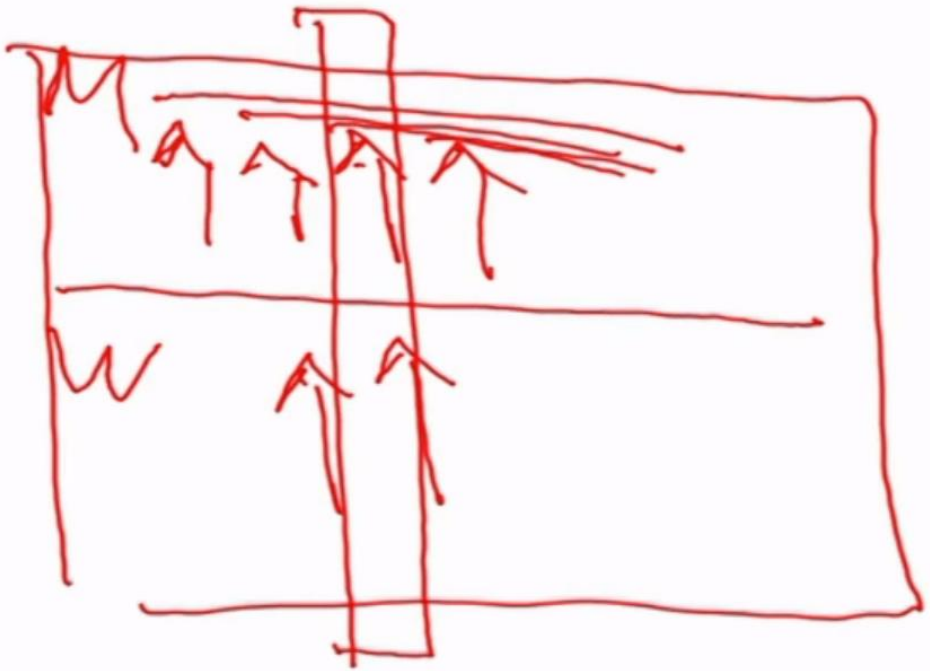
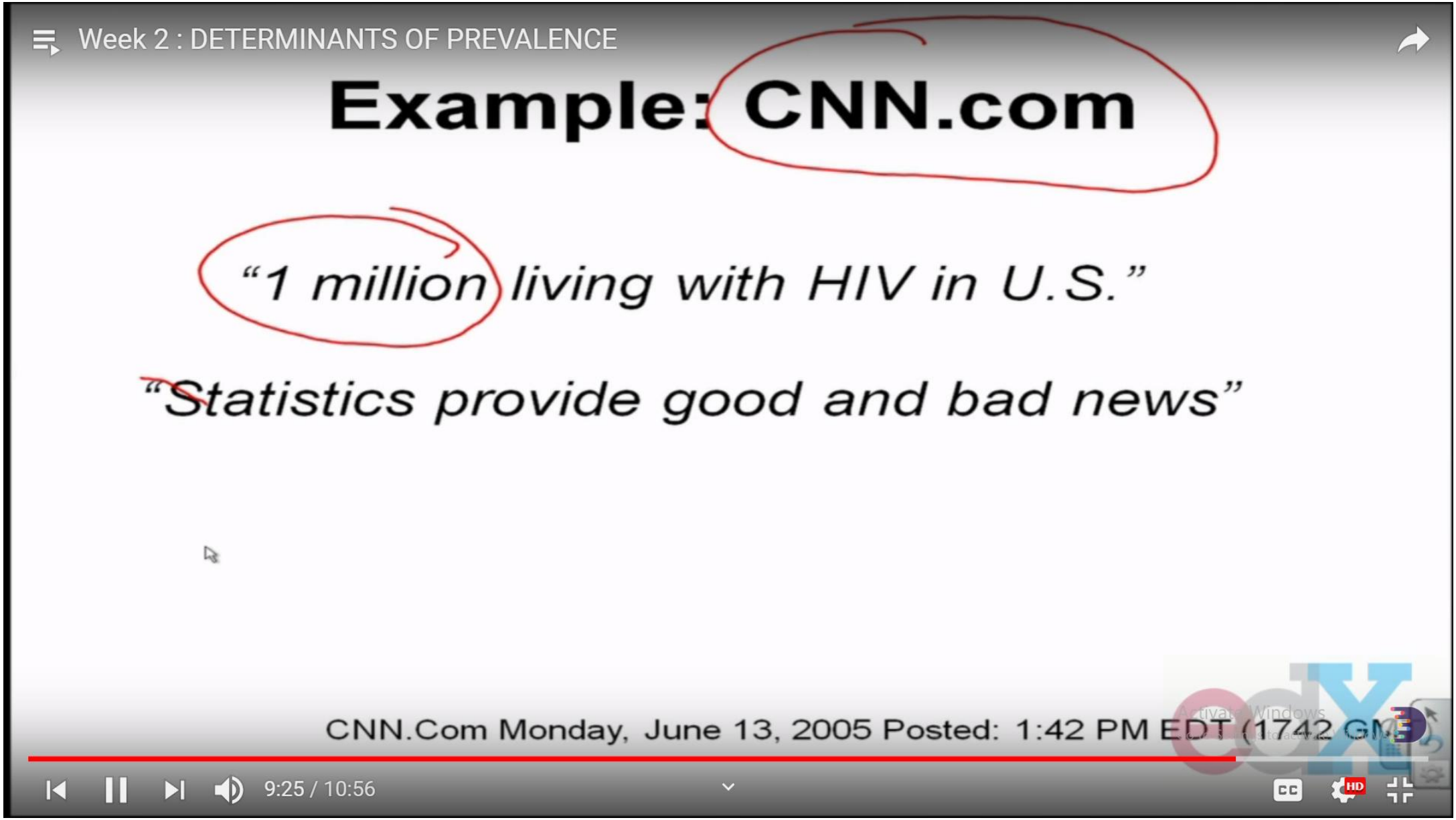



Week 2 : DETERMINANTS OF PREVALENCE
Example: CNN.com
"1 million living with HIV in U.S."
"Statistics provide good and bad news"
CNN.Com Monday, June 13, 2005 Posted: 1:42 PM EDT (1742 GMT)
9:25 / 10:56

ATLANTA, Georgia (AP) – "For the first time since the height of the AIDS epidemic in the 1980s, more than a million Americans are believed to be living with the virus that causes AIDS, the government said Monday."

"The latest estimate is both ***good and bad news*** *-- reflecting the success of drugs that keep more people alive and the failure of the government to "break the back" of the AIDS epidemic by its stated goal of 2005."*

CNN.Com Monday, June 13, 2005 Posted: 1:42 PM EDT (1742 GMT)

Prevalence of CHD at 1956 Exam by Hypertension Medication Use

Hypertension Medication	Pre-Existing CHD Yes	No	Total
Yes	20	124	144
No	166	4063	4229
Total	186	4187	4373

Prevalence of CHD at 1956 Exam by Hypertension Medication Use

Hypertension Medication	Pre-Existing CHD		Total
	Yes	No	
Yes	20	124	144
No	166	4063	4229
Total	186	4187	4373

Question 1

a) What is the Prevalence of CHD among participants who are on treatment for hypertension? 20/144 = 0.14

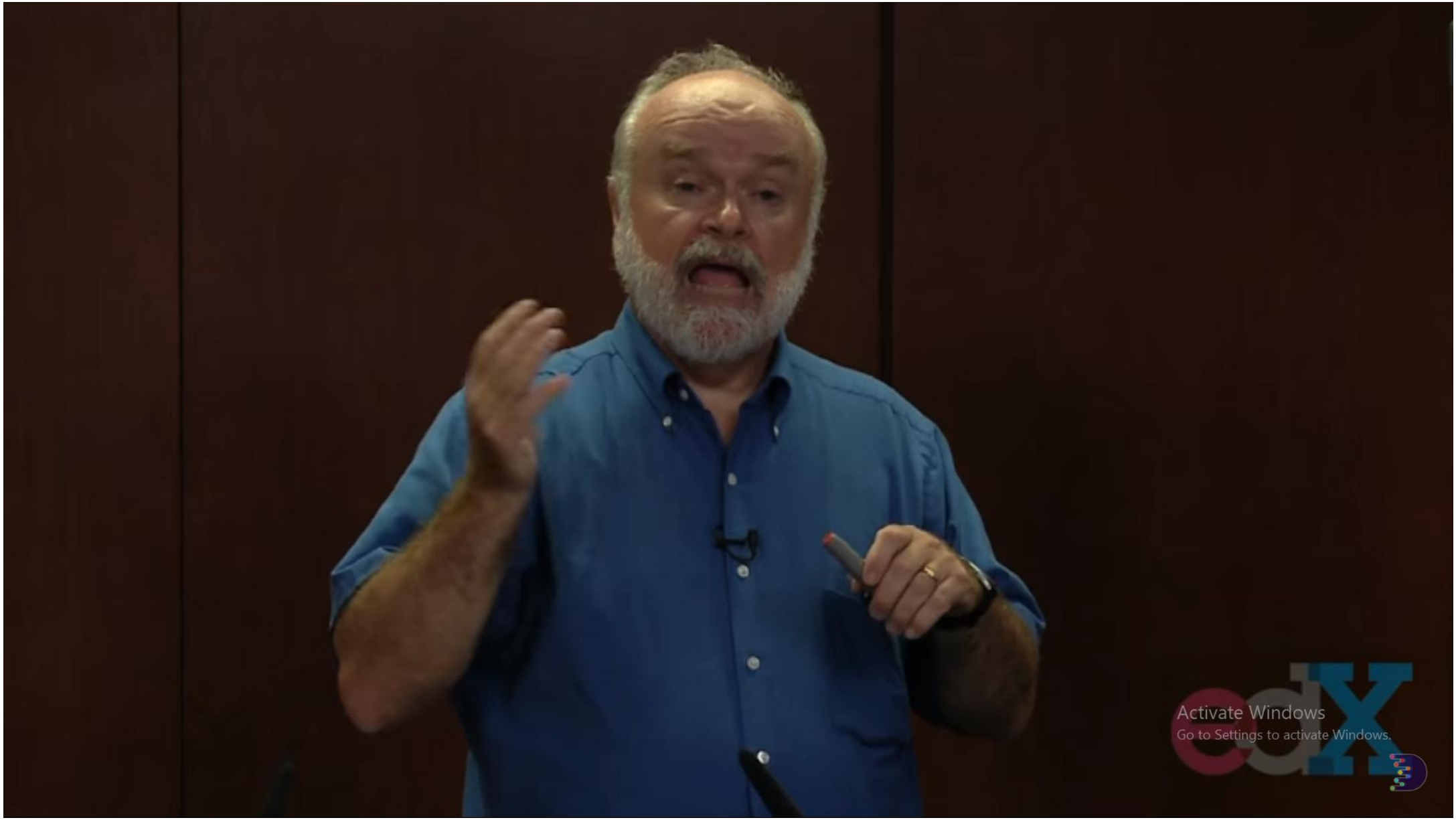
b) What is the Prevalence of CHD among participants who are not on treatment for hypertension?

Question 3

Other reasons being equal, which of the following is the most likely explanation for the higher prevalence of CHD among participants on treatment for hypertension?

1. Hypertension Treatment increases the survival time with CHD

2. Hypertension Treatment decreases the survival time with CHD


Activate Windows
Go to Settings to activate Windows.

Question 5

Other reasons being equal, which of the following is the most likely explanation for the higher prevalence of CHD among participants on treatment for hypertension?

1. Participants on Hypertension Treatment are more likely to be tested for CHD

2. Participants on Hypertension Treatment are less to be tested for CHD

Question 4

Other reasons being equal, which of the following is the most likely explanation for the higher prevalence of CHD among participants on treatment for hypertension?

1. Participants on Hypertension Treatment have more other risk factors for developing CHD

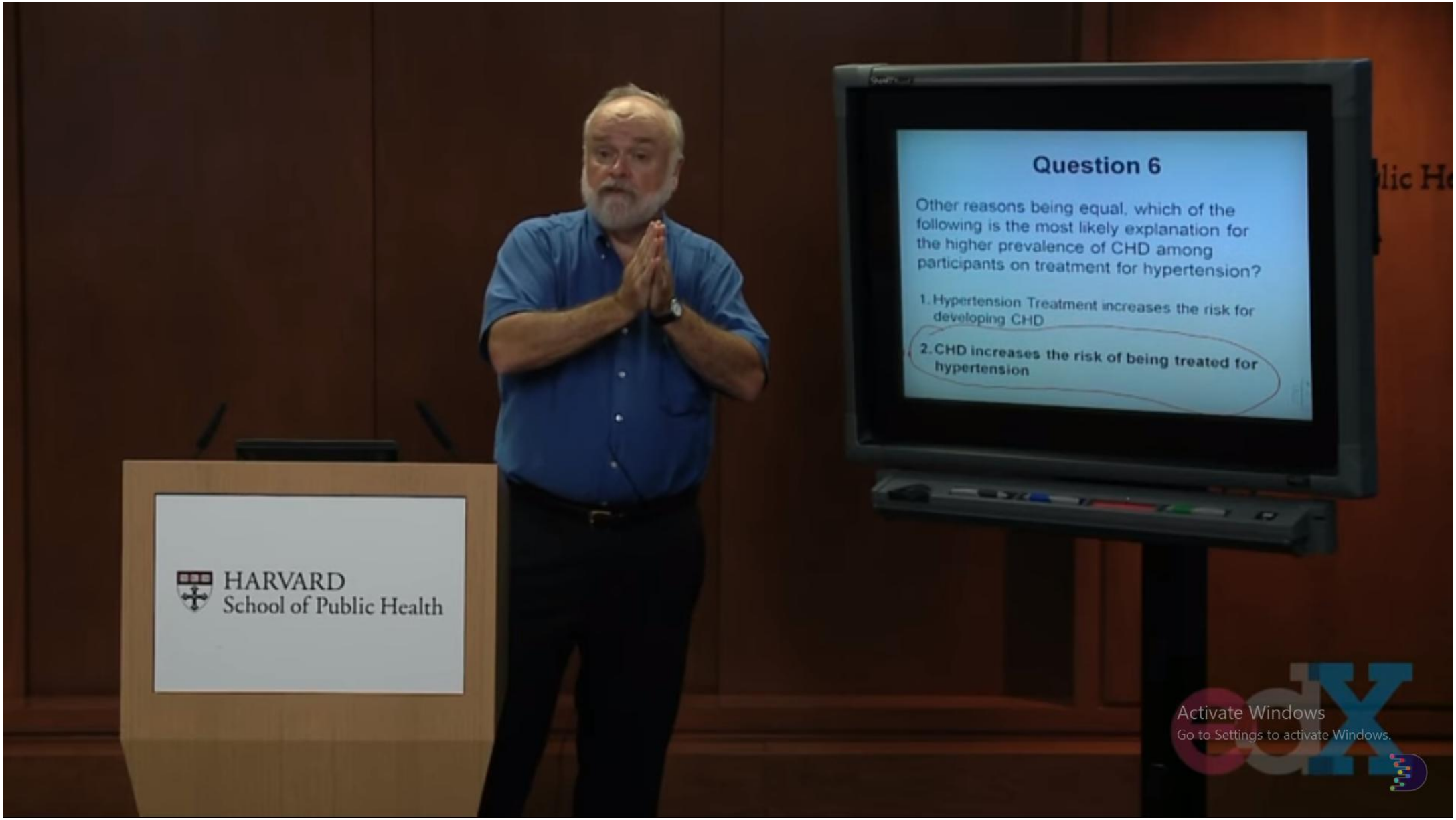
2. Participants on Hypertension Treatment have less other risk factors for developing CHD

Question 6

Other reasons being equal, which of the following is the most likely explanation for the higher prevalence of CHD among participants on treatment for hypertension?

1. Hypertension Treatment increases the risk for developing CHD

2. CHD increases the risk of being treated for hypertension


Question 6
Other reasons being equal, which of the following is the most likely explanation for the higher prevalence of CHD among participants on treatment for hypertension?
1. Hypertension Treatment increases the risk for developing CHD
2. CHD increases the risk of being treated for hypertension
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Binary Outcome Measurements

- Example: success versus failure, disease versus no disease, dead versus alive, …
  - Some are binary by definition (dead/alive)
  - Some are created as binary (hypertension)
    - Potential loss of information
- Options for measurement:
  - Proportion and Odds

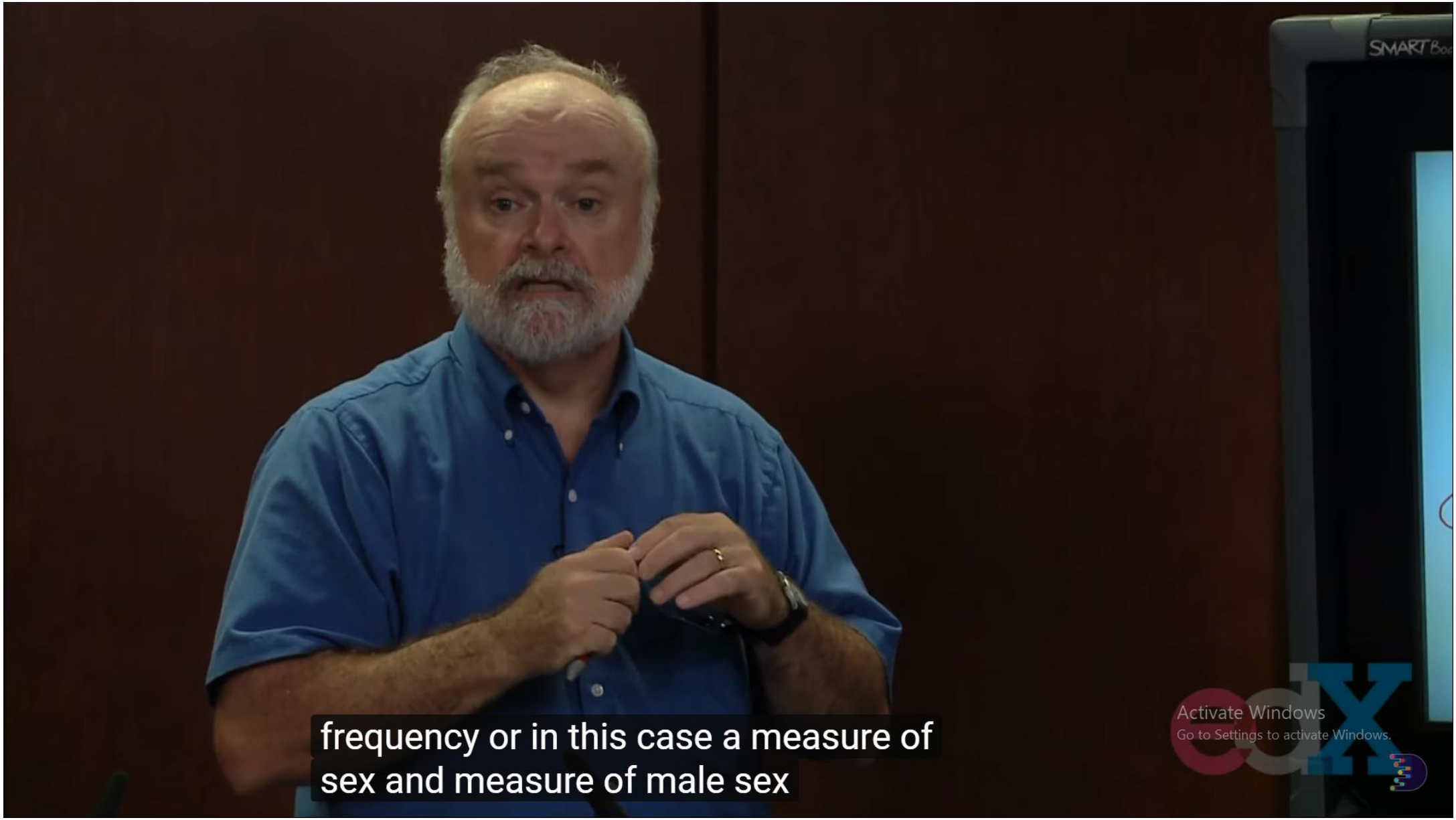
there's a huge potential that you could lose information by grouping people into

Example: Sex Distribution in Framingham Heart Study Data

Males:	1944
Females:	2490
Total	4434

How would you summarize the frequency of Males?

people who exist who attended the 1956 Framingham Heart Study exam of those


frequency or in this case a measure of
sex and measure of male sex
Activate Windows
Go to Settings to activate Windows.

Example: Distribution of Sex in Framingham Heart Study Data

Males:	1944
Females:	2490
Total	4434

Option # 1: Part/Whole

1944/4434 = 43.84% = Proportion of Males

total number of people in the study we have 1944 men in this study out

Example: Distribution of Sex in Framingham Heart Study Data

Males:	1944
Females:	2490
Total	4434

Option # 2: Part/(Non-Part)

1944/2490 = 0.78 = Odds of being Male

the number of men to the number of women
the part

Proportions and Odds

- Proportion
  - Part / Whole
  - Range: 0 – 1
- Odds
  - Part/ (Non-Part)
  - Range: 0 - infinity

other hand and odds is the pot not divided by the whole

Proportion and Odds

- Odds = Proportion/(1-Proportion)

Example: Proportion = .20
Odds = .20/.80 = .25

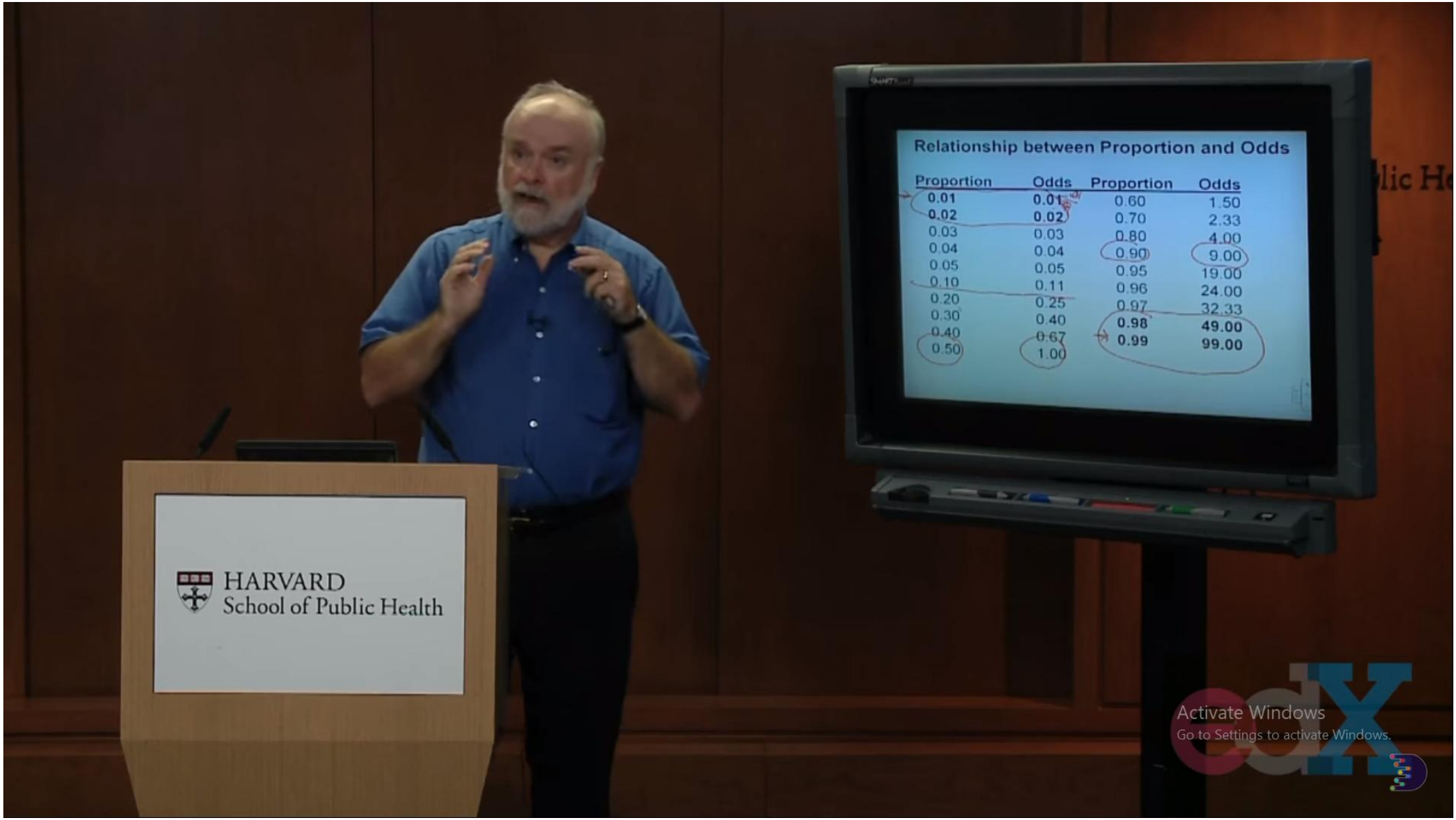
- Proportion = Odds/(1+Odds)

Example: Odds = .25
Proportion = .25/1.25 = .20

would be you take the 20 percent divided by 1 minus 20

Relationship between Proportion and Odds

Proportion	Odds	Proportion	Odds
0.01	**0.01**	0.60	1.50
0.02	**0.02**	0.70	2.33
0.03	0.03	0.80	4.00
0.04	0.04	0.90	9.00
0.05	0.05	0.95	19.00
0.10	0.11	0.96	24.00
0.20	0.25	0.97	32.33
0.30	0.40	**0.98**	**49.00**
0.40	0.67	**0.99**	**99.00**
0.50	1.00		


Relationship between Proportion and Odds
Proportion Odds Proportion Odds
0.01 0.01 0.60 1.50
0.02 0.02 0.70 2.33
0.03 0.03 0.80 4.00
0.04 0.04 0.90 9.00
0.05 0.05 0.95 19.00
0.10 0.11 0.96 24.00
0.20 0.25 0.97 32.33
0.30 0.40 0.98 49.00
0.40 0.67 0.99 99.00
0.50 1.00
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Implications: Small versus Large Proportions

- Example: Small Proportions
  - **Proportions = .02 and .01**
    - Ratio = .02/.01 = 2.0
  - **Odds = .02/.98 = .0204 and .01/.99 = .0101**
    - Ratio = .0204/.0101 = 2.02
- Example: Large Proportions
  - **Proportions = .99 and .98**
    - Ratio = .99/.98 = 1.01
  - **Odds = .99/.01 = 99 and .98/.02 = 49**
    - Ratio = 99/49 = 2.02

TABLE 1. RATE OF REFERRAL FOR CARDIAC CATHETERIZATION, ODDS OF REFERRAL, ODDS RATIO, AND RISK RATIO ACCORDING TO SEX AND RACE.*

PATIENTS	MEAN REFERRAL RATE	ODDS OF REFERRAL	ODDS RATIO (95% CI)	RISK RATIO (95% CI)
	%			
Four strata				
White men†	90.6	9.6 to 1	1.0	
Black men	90.6	9.6 to 1	1.0 (0.5–2.1)	
White women	90.6	9.6 to 1	1.0 (0.5–2.1)	
Black women	78.8	3.7 to 1	0.4 (0.2–0.7)	0.87 (0.80–0.95)
Aggregate data				
White†	90.6	9.6 to 1	1.0	
Black	84.7	5.5 to 1	0.6 (0.4–0.9)	0.93 (0.89–0.99)
Men†	90.6	9.6 to 1	1.0	
Women	84.7	5.5 to 1	0.6 (0.4–0.9)	0.93 (0.89–0.99)
Overall	87.7	7.1 to 1		

*Referral rates for the four strata were inferred from aggregate rates and odds ratios reported by Schulman et al.[1] The odds of referral were calculated according to the following formula: referral rate÷(100%−referral rate). The risk ratio was calculated as the referral rate for the group in question divided by the referral rate for the reference group. CI denotes confidence interval.

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N ENGL J MED 1999; 340:618-626; N Eng J Med1999;341:279-83

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M .906
F .847

.847 / .906 = .93

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point five that's listed in this table now

N ENGL J MED 1999; 340:618-626; N Eng J Med1999;341:279-83

.906
M .906 .094
F .847 .847
.153
.847
.906 = .93

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you get an odds ratio of 0.6 so here the results if

N ENGL J MED 1999; 340:618-626; N Eng J Med1999;341:279-83