Categories, Classification, Measurement and Scales

Abraham Lincoln

- “The shepherd drives the wolf from the sheep's throat, for which the sheep thanks the shepherd as his liberator, while the wolf denounces him for the same act…. Plainly the sheep and the wolf are not agreed upon a definition of liberty.”

Assuming the ideal

- Most introductory texts focus on the logical procedures of statistics and assume that the categories (the data) upon which the procedures are apllied are “ideal.”
- Data about people <> ideal
- Also, makes researcher focus too much on technical technique

Imprecision in discussion

- A conversation works because it is not precise and because there is a tacit acceptance of what is meant by any vague terminology
- Remember from lecture 1
  - A typical ‘building’
  - A typical ‘Senator’

Example

- “My husband Ralph is good enough, I suppose, but when I add everything up, I can’t help thinking he’s a failure.”
- The category “failure” tells us something, but what?
- It pretty much only tells us that she has a negative opinion of his efforts.

Need more information

- If we listened longer, maybe we'd get a better sense of what "failure" means to this woman
- We can begin to see how "Social Categories" are typically defined by elaborate stories that keep filling in the particulars
- Recall the definition of a student from lecture 1

No Time

- In statistics, we don't have time for elaborate stories about each particular case
- This is usually the case in policy making as well
- When you are dealing with millions of people, the simplest categorization is needed
- Suppose each of us could tell our life story in 500 pages
- If we published this for the US, we'd have more than 125 BILLION pages!
- If each 500 page volume were 1 inch thick, we'd have a report 4000 miles thick!

Statistics - The Reasoned Simplification of Events

- Statistical thinking and procedures are essential
- The trick is to minimize distortion
- More specific definition of statistics: an effort to achieve comprehensive, simplified descriptions of the world that minimize distortion

Literature vs. Statistics

- Opposite ends of the same continuum
- As we move in one direction, we lose the advantages of moving in the other – we must compromise
- We can substitute “qualitative methods” for the “literature”
- This process of combining (compromising) is the process of “categorization”

Two fundamental points

- No way to avoid arbitrarily simplified categorization when doing statistical analysis
- Arbitrarily simplified categories create serious problems in the quest for precision

Example

- The Statistical Abstract of the United States uses the categories “minority” and “white” to divide populations into ethnic or racial categories
- These are abstracted terms
  - Korean in LA running a shop and an eskimo building an igloo have little in common
  - Tiger Woods and a Navaho Indian living in a trailer in the desert have little in common
  - They all fit into “minority” – what is the use of this category?

How do we deal with categorization?

- Social scientists have come up with different “categories” of “categories” to help discern what type of data we are dealing with, and, therefore, how precise we can get while working with the data
- Levels of Measurement

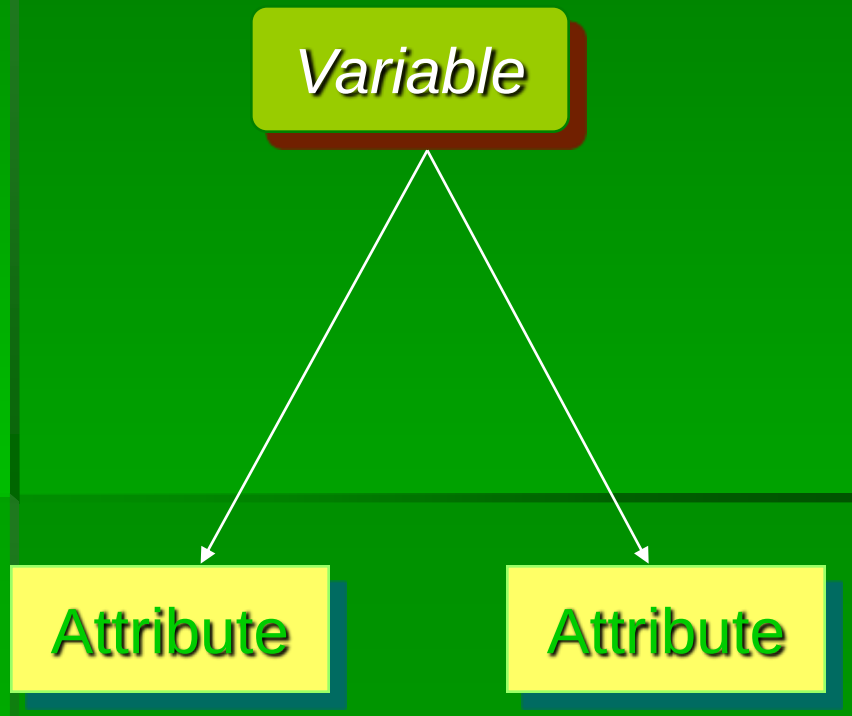
The Levels of Measurement

- Nominal
- Ordinal
- Interval
- Ratio

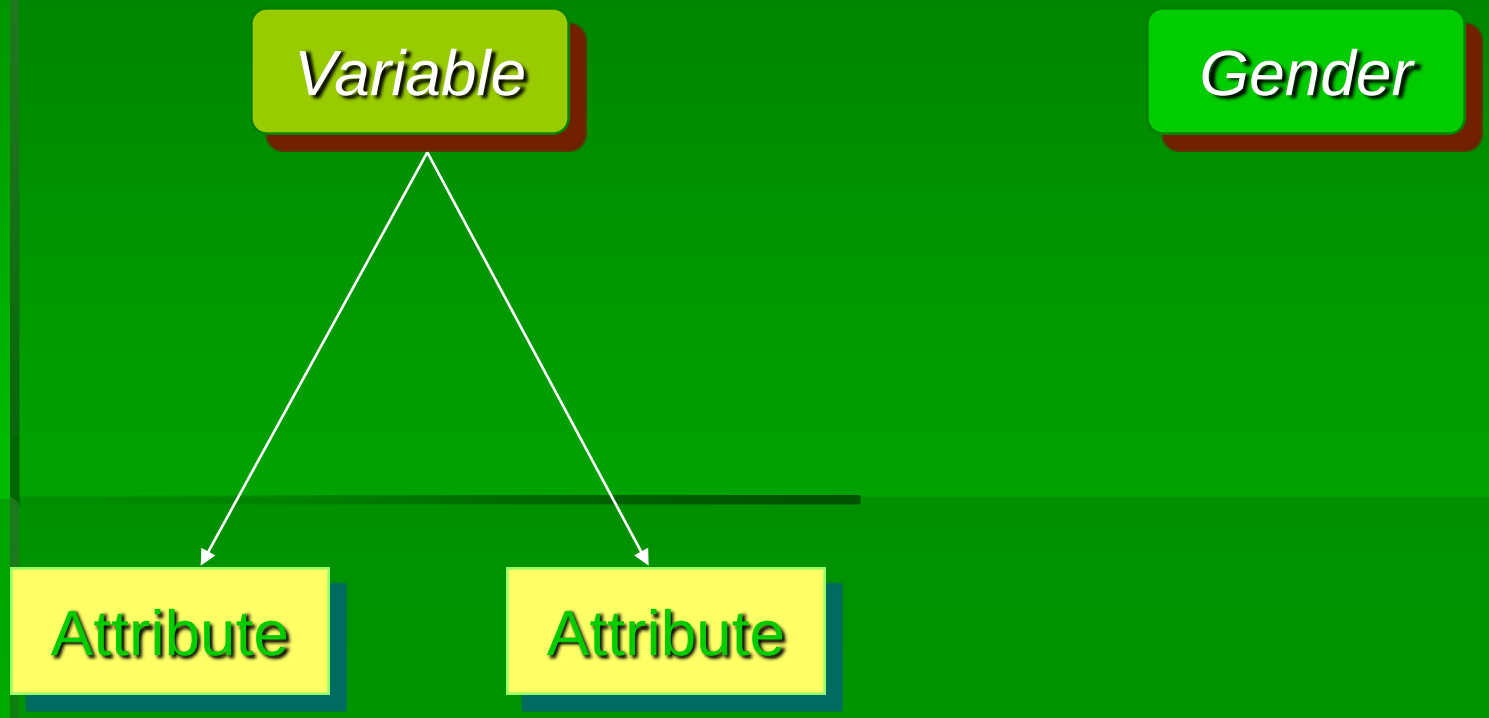
Some Definitions

Variable

Some Definitions



Some Definitions



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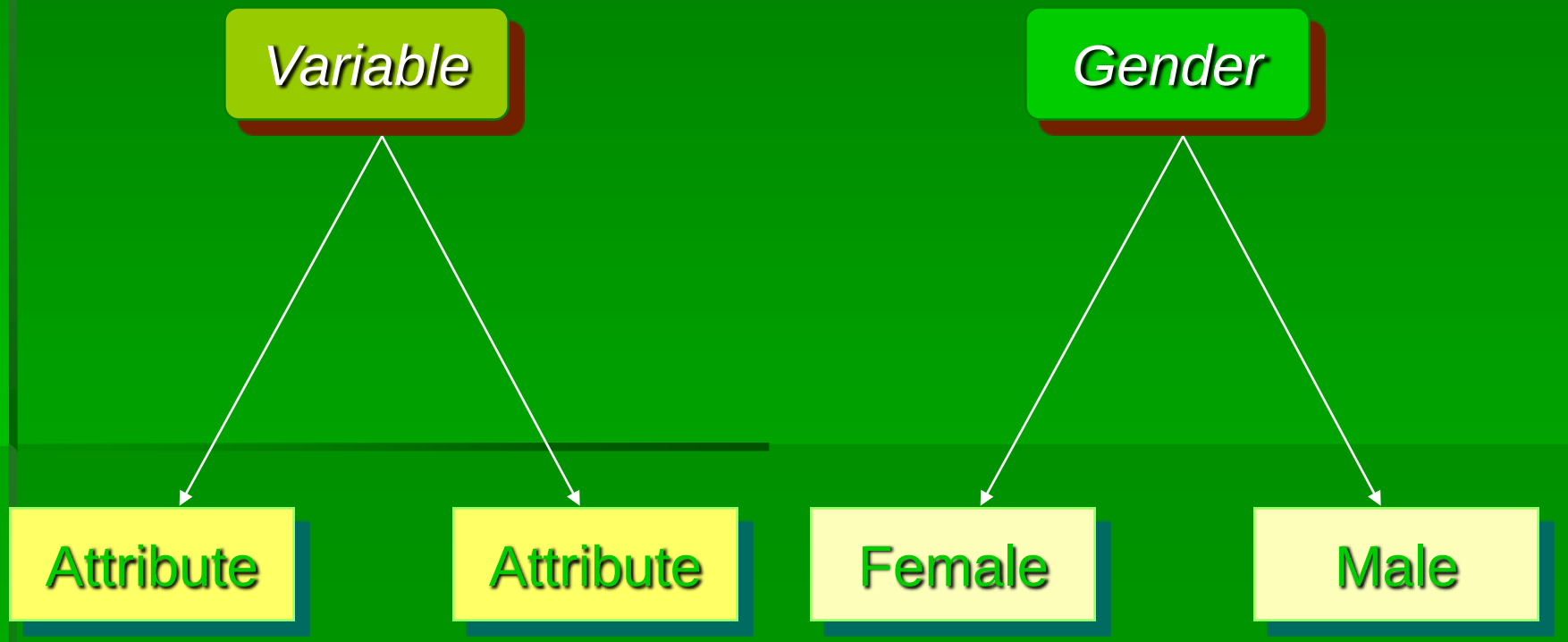

Qualities of Variables

- Exhaustive -- Should include all possible answerable responses.
- Mutually exclusive -- No respondent should be able to have two attributes simultaneously (for example, employed vs. unemployed -- it is possible to be both if looking for a second job while employed).

What Is Level of Measurement?

The relationship of the values that are assigned to the attributes for a variable

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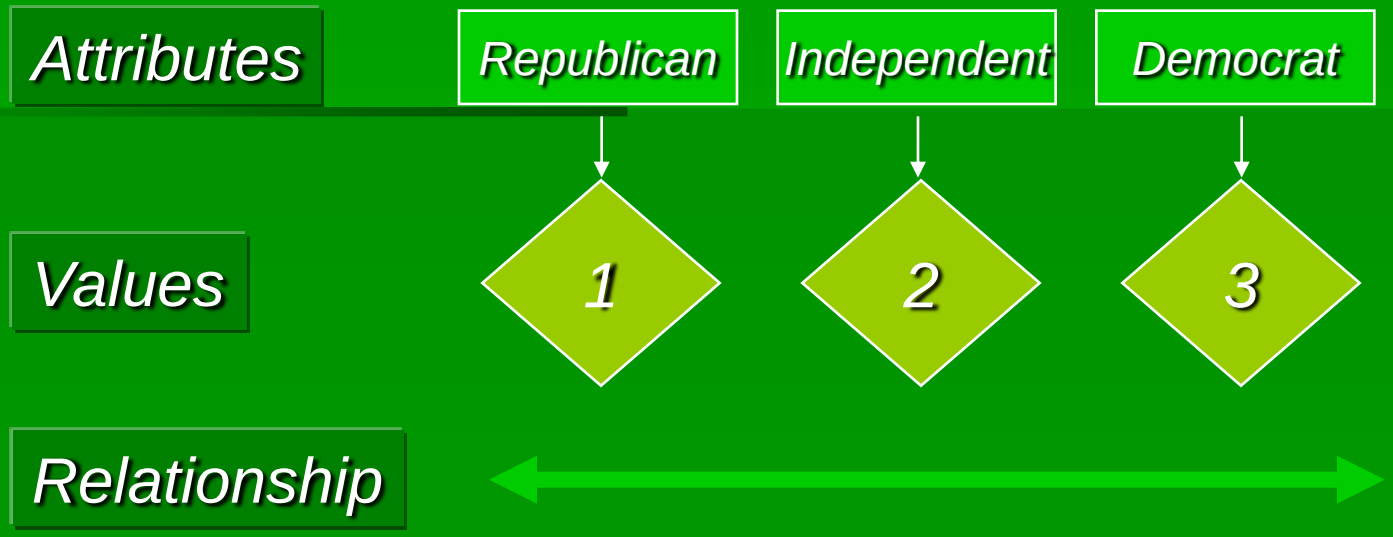

What Is Level of Measurement?

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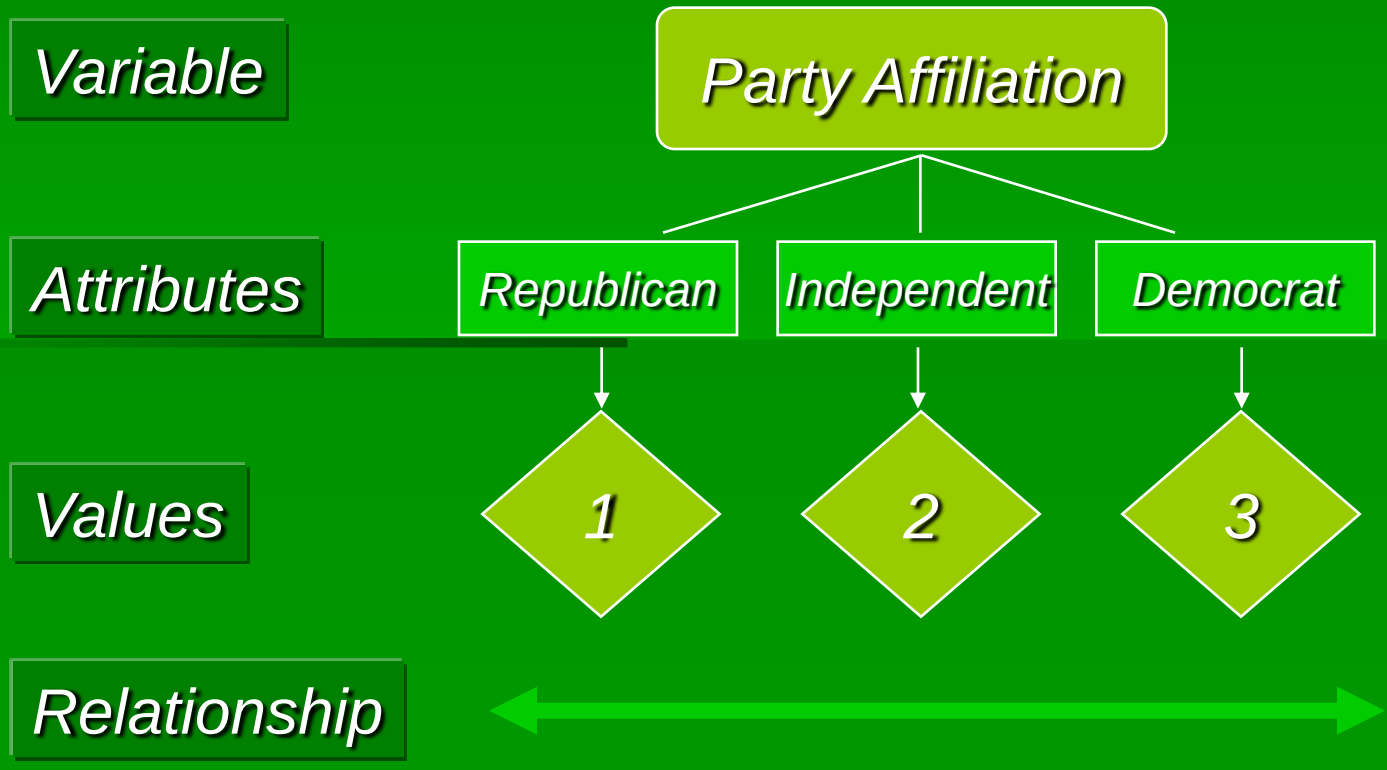

Why Is Level of Measurement Important?

- Helps you decide what statistical analysis is appropriate on the values that were assigned
- Helps you decide how to interpret the data from that variable

Nominal Measurement

- The values "name" the attribute uniquely.

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- The value does not imply any ordering of the cases, for example, jersey numbers in football.
- Even though player 32 has higher number than player 19, you can't say from the data that he's greater than or more than the other.

Ordinal Measurement

When attributes can be rank-ordered…

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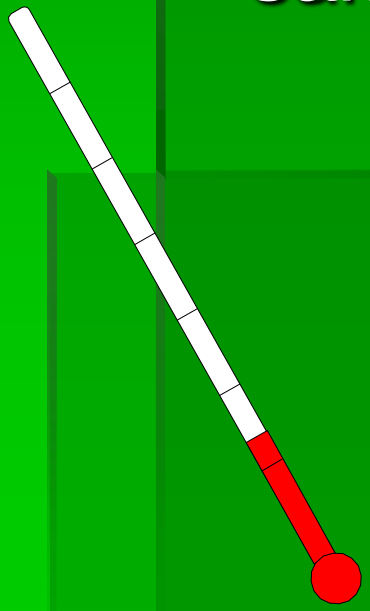
Is the distance from 0 to 1 the same as 3 to 4?

Interval Measurement

- When distance between attributes has meaning…

Interval Measurement

When distance between attributes has meaning, for example, temperature (in Fahrenheit) -- distance from 30-40 is same as distance from 70-80



Interval Measurement

When distance between attributes has meaning, for example, temperature (in Fahrenheit) -- distance from 30-40 is same as distance from 70-80

- Note that ratios don't make any sense -- 80 degrees is not twice as hot as 40 degrees (although the attribute values are).

Ratio Measurement

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- Can construct a meaningful ratio (fraction)

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Ratio Measurement

- Has an absolute zero that is meaningful
- Can construct a meaningful ratio (fraction), for example, number of clients in past six months
- It is meaningful to say that "...we had twice as many clients in this period as we did in the previous six months.

The Hierarchy of Levels

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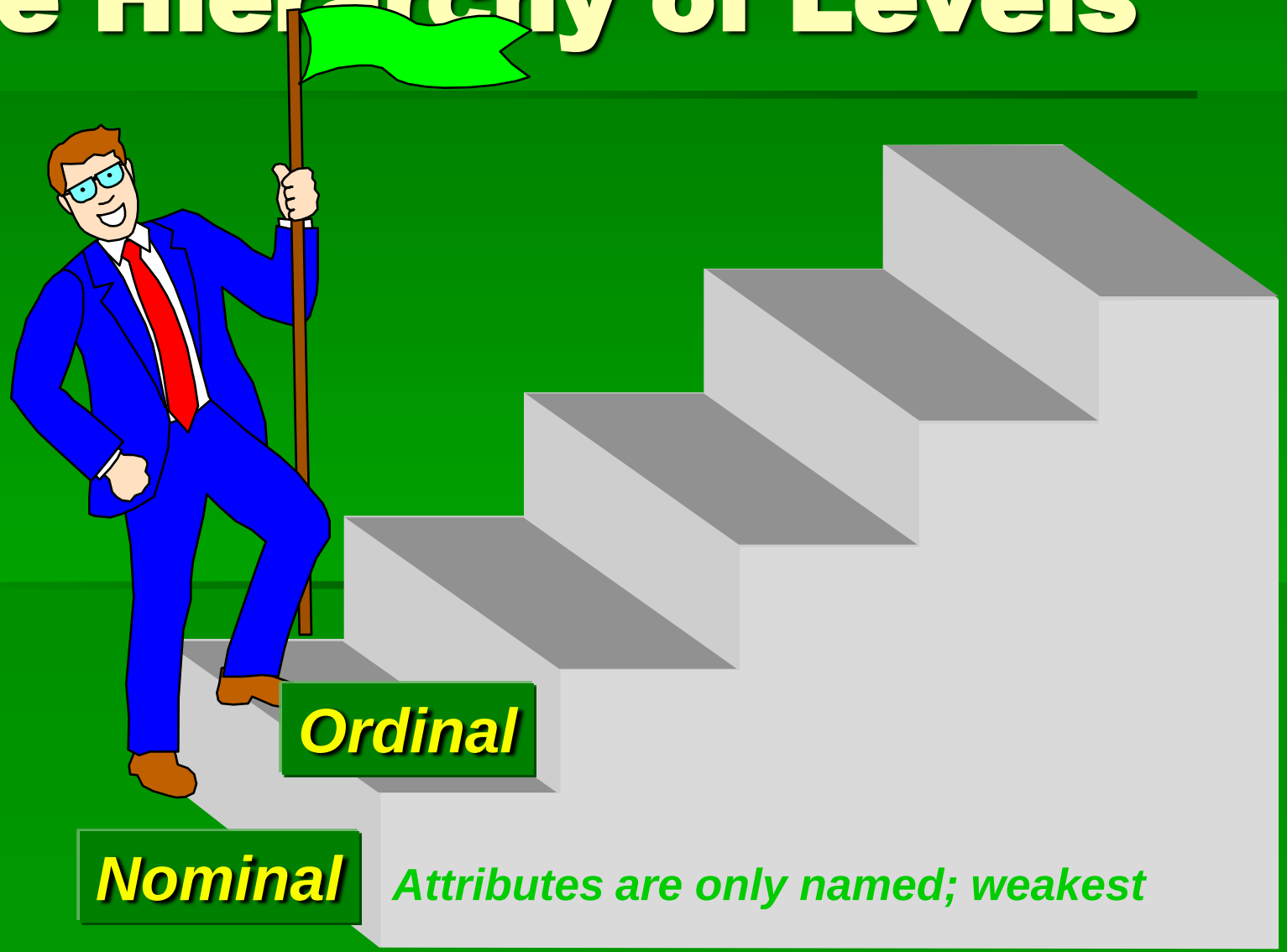
Nominal *Attributes are only named; weakest*

The Hierarchy of Levels



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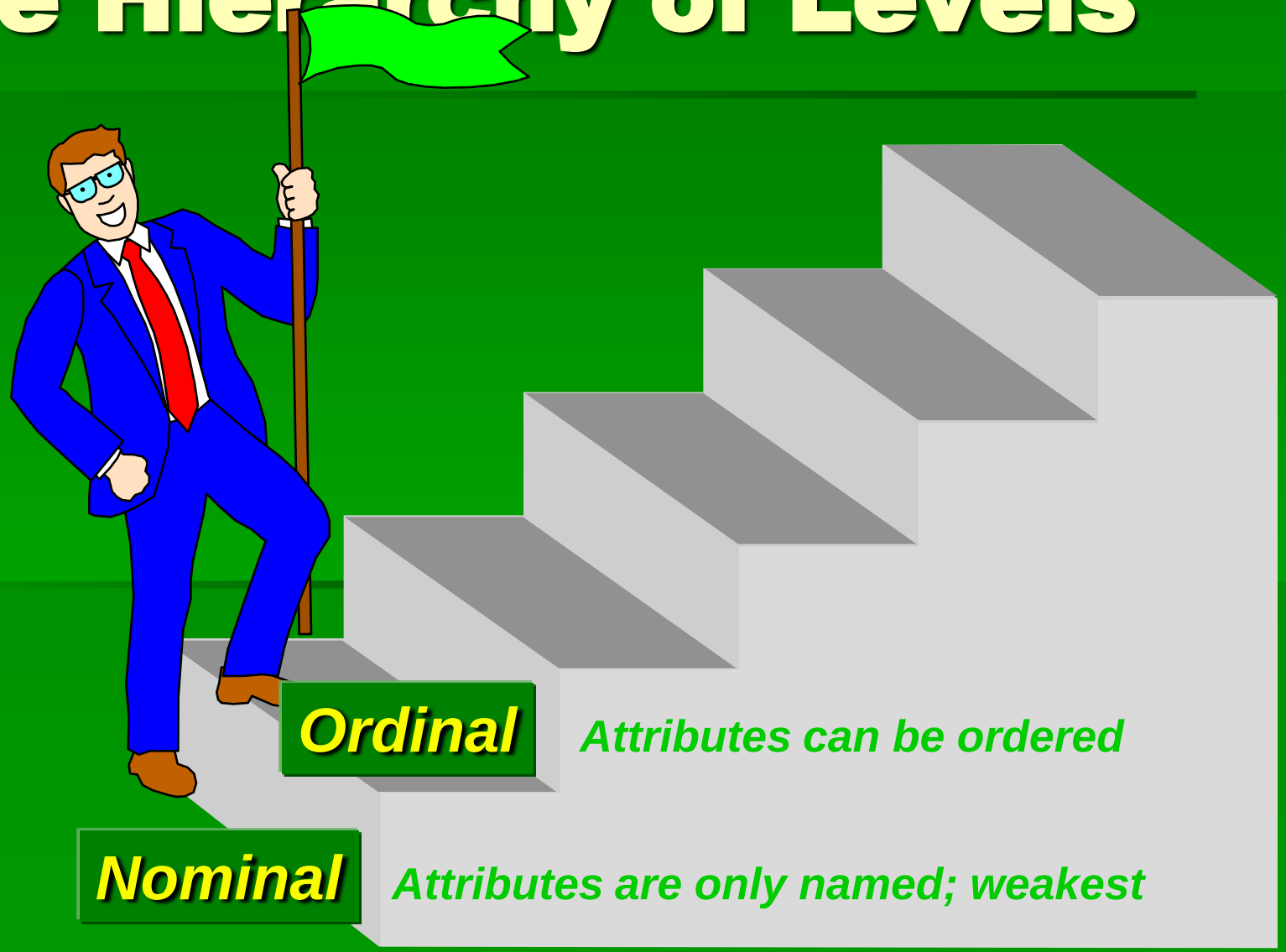
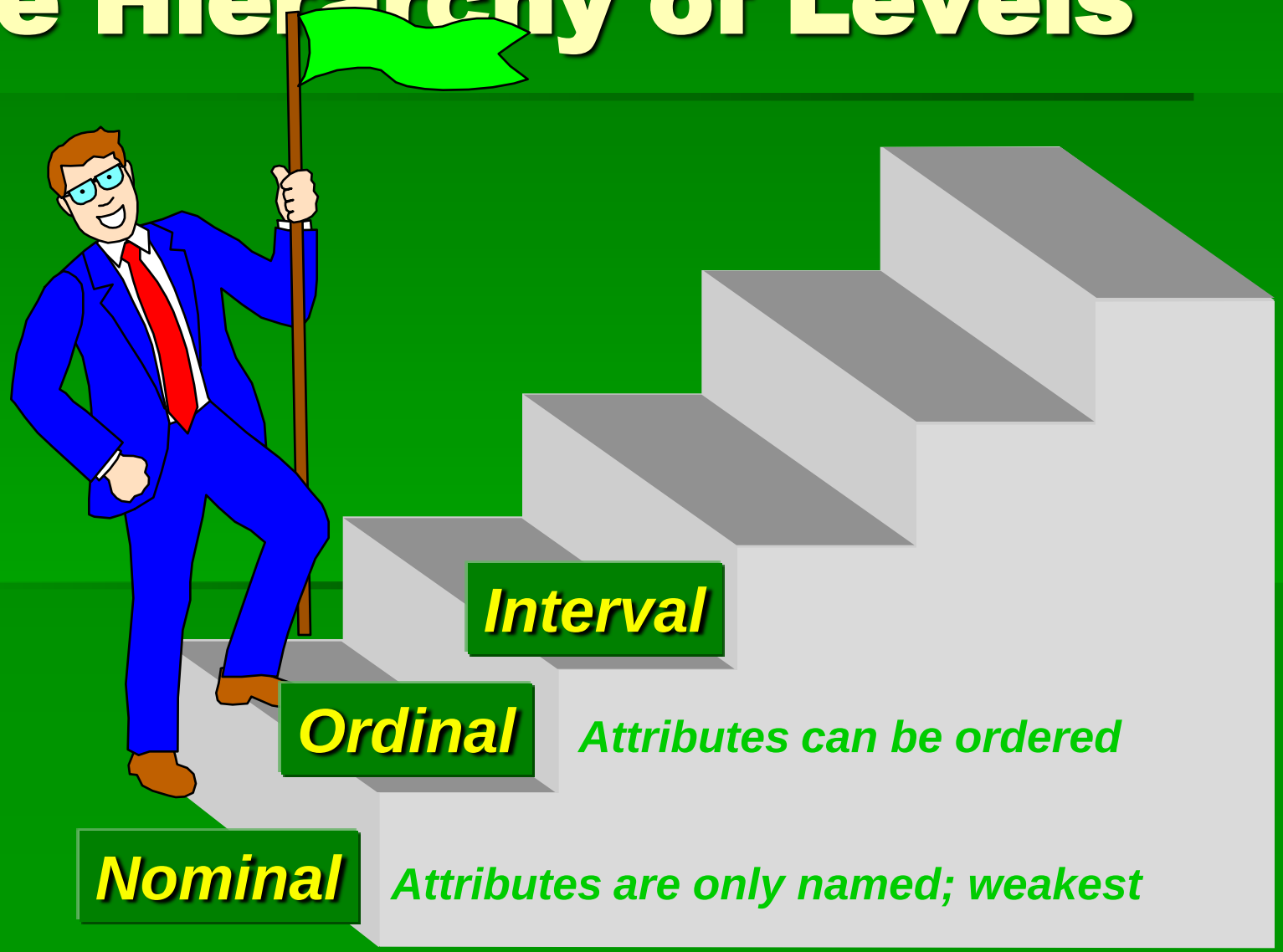


Ordinal — *Attributes can be ordered*

Nominal — *Attributes are only named; weakest*

The Hierarchy of Levels



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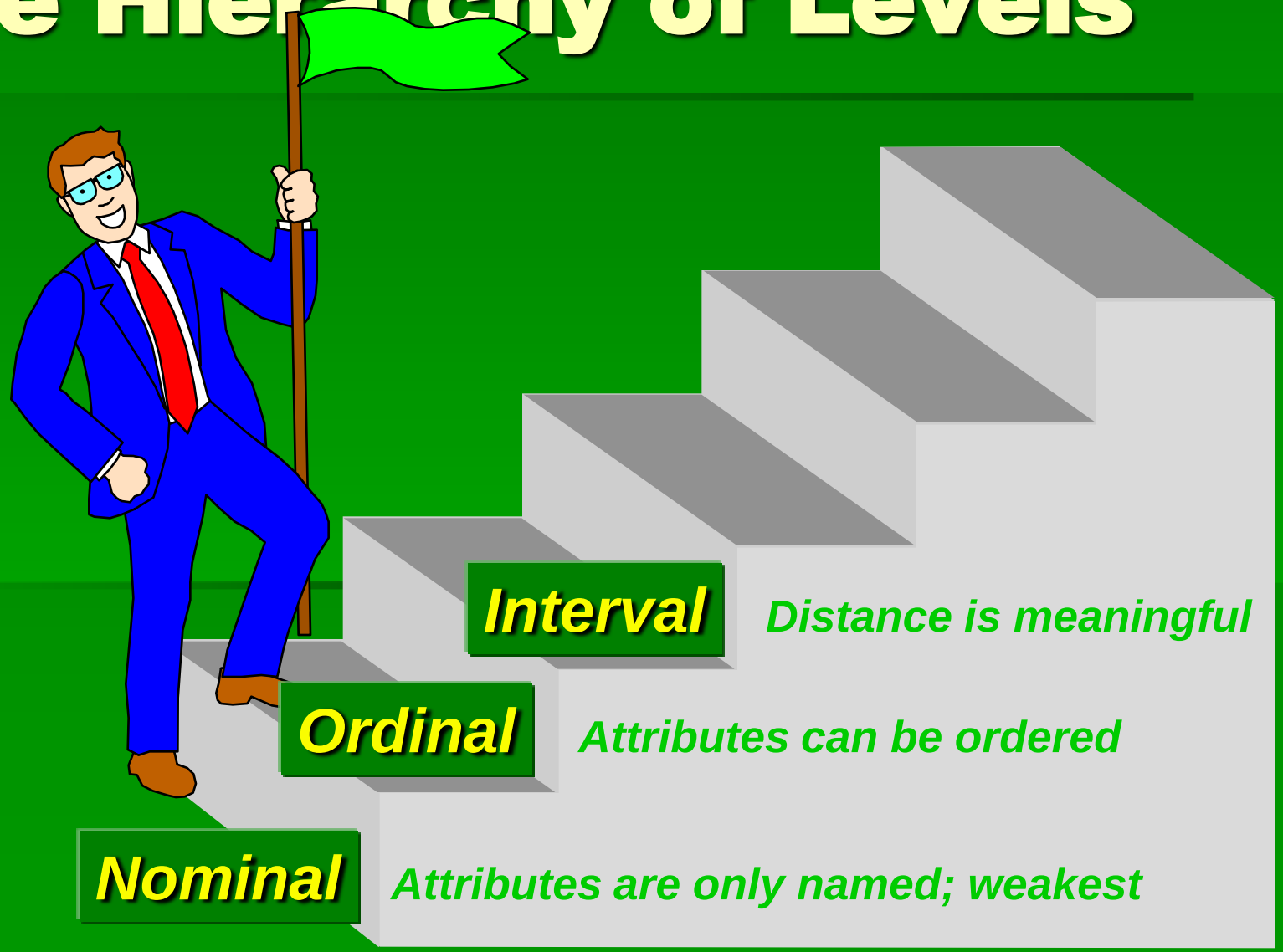

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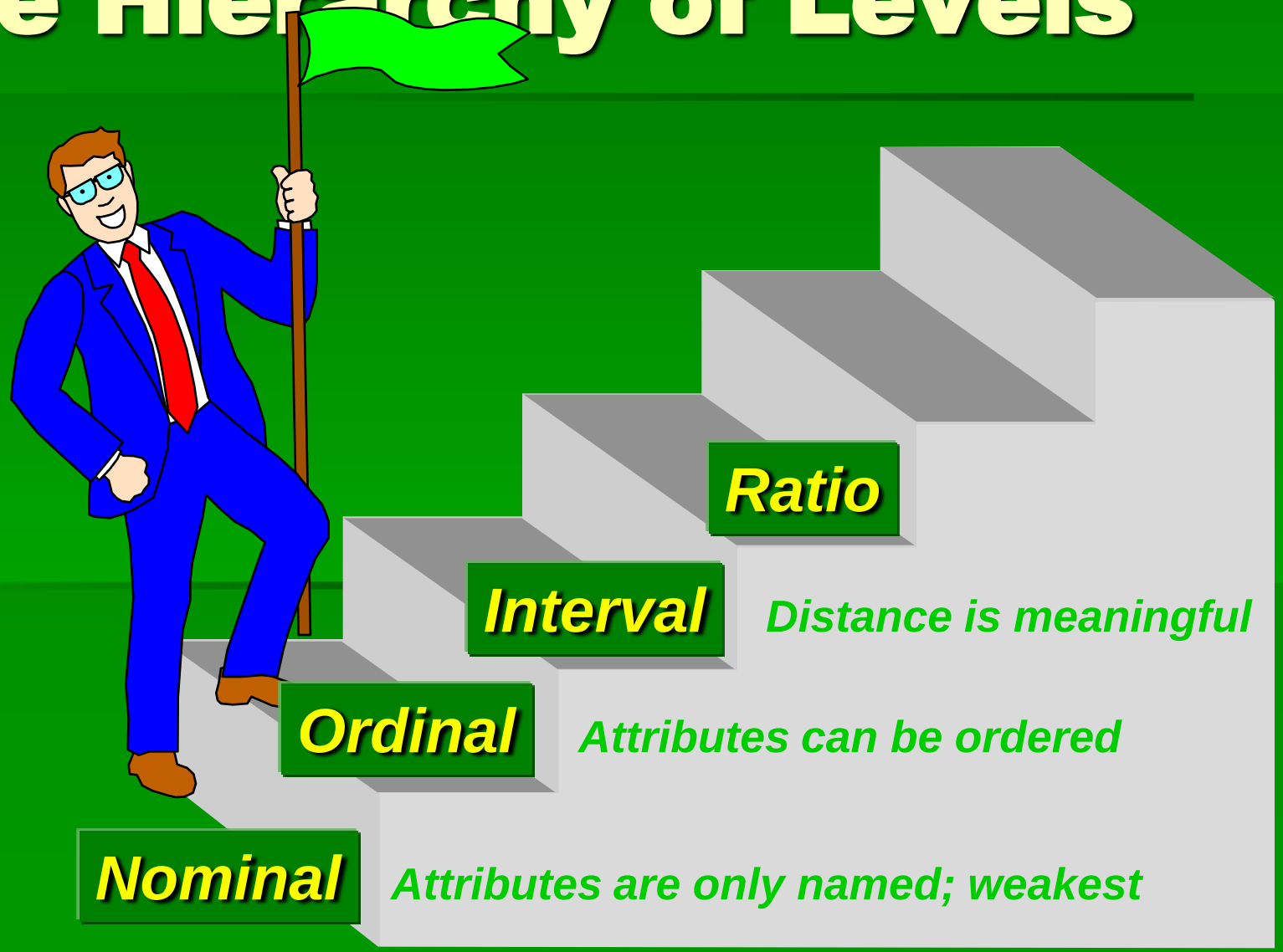

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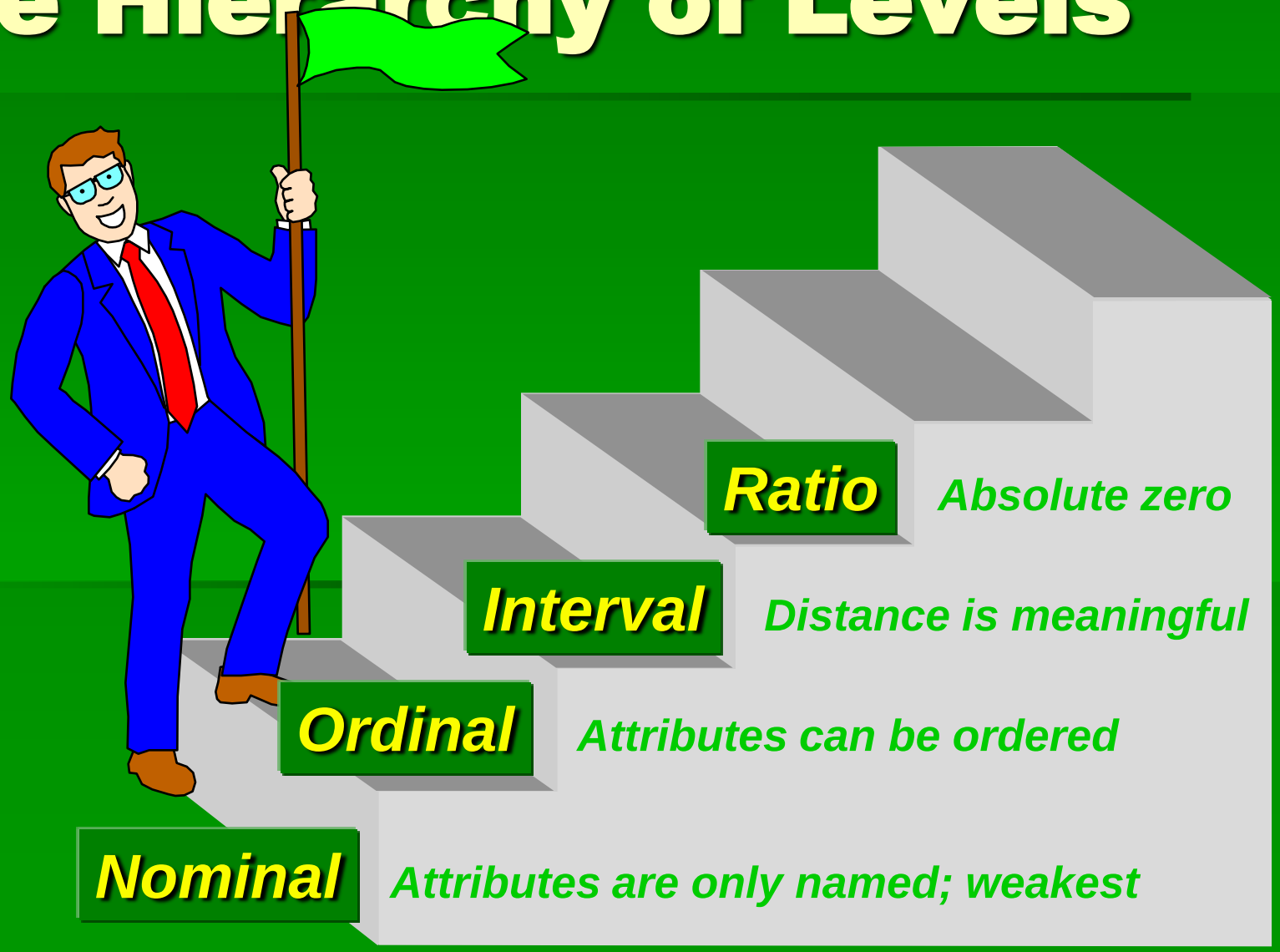


Why do we categorize our variables like this?

- Different levels call for different methods
- You can convert down but not up!
  - Can’t get “better” information by assigning numbers to nominal categories for the purposes of doing math with them

Quiz – 30 seconds

- What level of measurement are the following variables most likely to be?
  - Whether a city is located in Illinois or Ohio or Indiana
  - Traffic fatalities
  - Attitude toward health maintenance organizations (HMOs)
  - School Enrollment

Task

- Think about and write down three qualities of a top Masters of Public Administration Program
  - What makes for a “great” MPA program
  - Take 10 minutes
- Now, how would you measure each one of these qualities?
- What level of measurement are we dealing with with each indicator?

Good Indicators

- Most Importantly
  - Valid
  - Reliable
- But also
  - Comprehensible
  - Cost Effective

Indicator needs to be "Valid"

- "Construct" Validity
  - Should measure what it is supposed to measure
- Can be very difficult
- What if you want to measure public opinion on an issue?
  - Who's the public?
  - Does it change depending on the issue?
    - White vs. minority?

Construct Validity Example

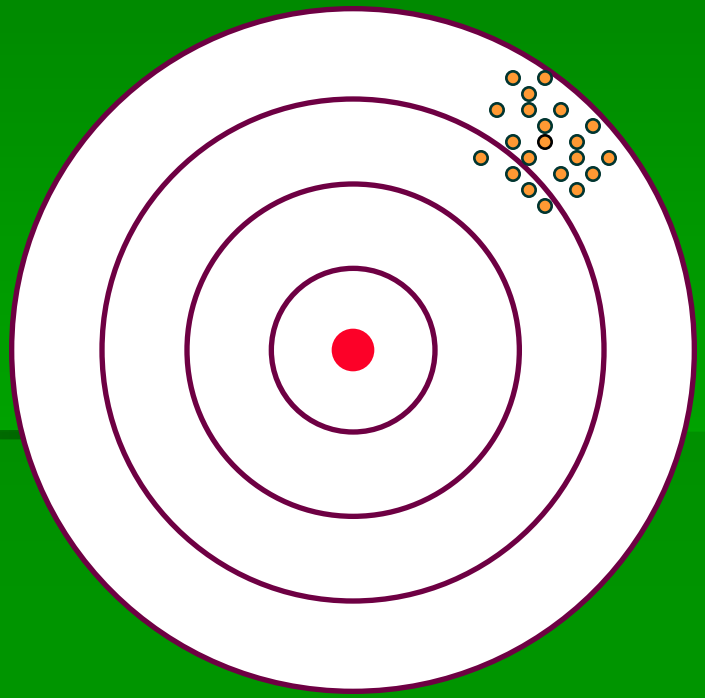
- The Prudeville police are directed to “crack down” on prostitution in the city
- The police chief increases daily arrests by the vice squad from 3.4 to 4.0
- Police chief goes to council to show success
- What is the construct validity problem?

An indicator needs to be reliable

- Can you repeat it and get the same results?
  - Will it get what you are trying to get?
  - Will it NOT get what you are NOT trying to get?

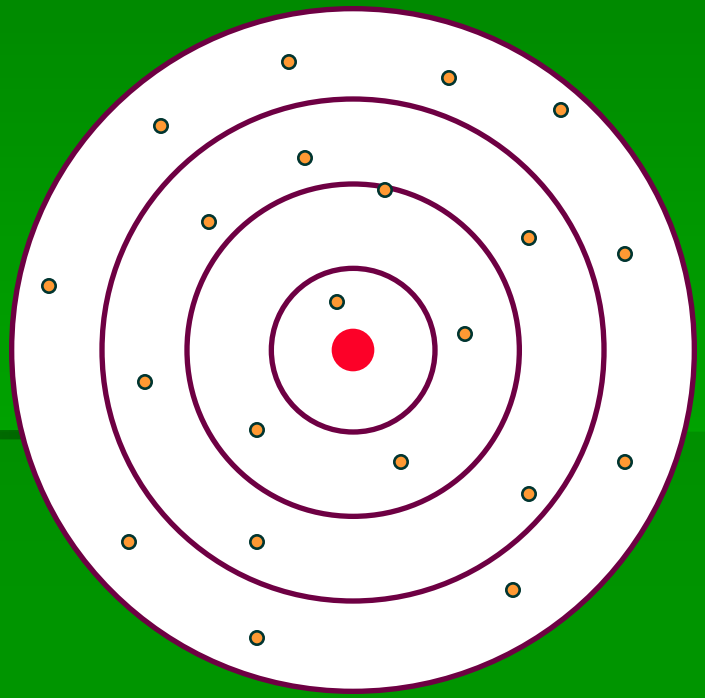
Reliability and Validity

Reliable but not valid



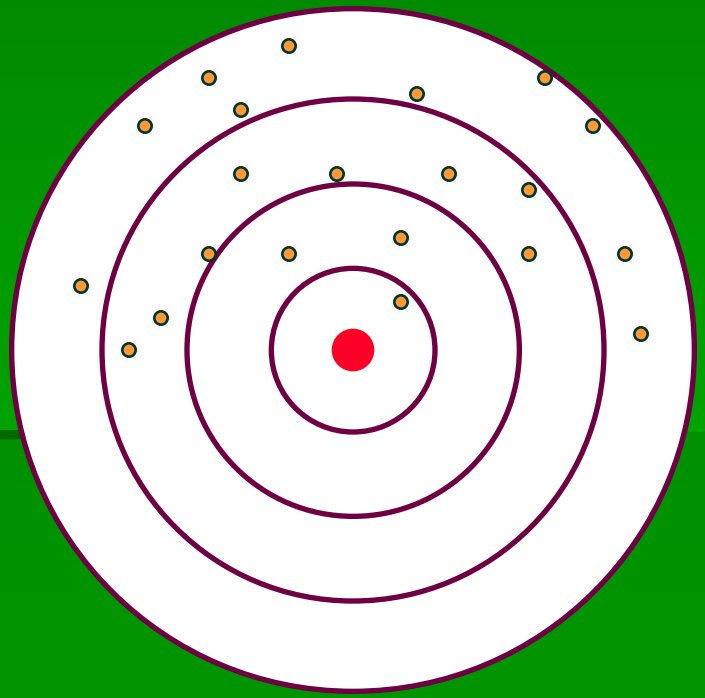
Reliability and Validity

Valid but not reliable



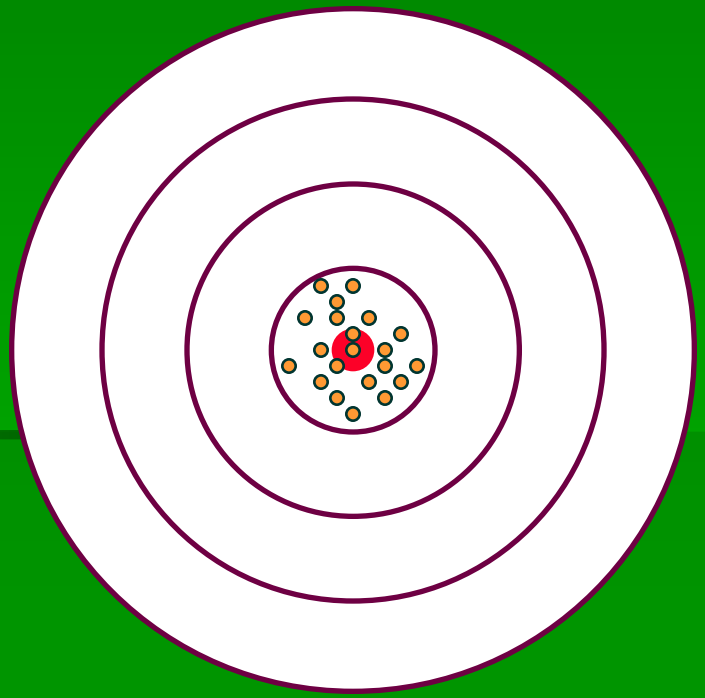
Reliability and Validity

Neither reliable nor valid



Reliability and Validity

Reliable and valid



People need to understand your indicator

- Comprehensibility
  - Will people and/or policy makers understand it?
  - The farther removed the indicator is from the subject it purports to measure, the easier it is to be dismissed
    - Need to clearly link variables for the audience
  - What if you could link free daycare services to prostitution levels in Prudeville?
    - Even if it is an indicator, it might be very difficult to get the point across to policy makers or the public

You need to be able to afford the data collection

- What will it cost to collect this indicator?
- Are there other indicators that might be just as good for less cost?
- Can a trade-off be made that will still be satisfactory?

Exercise

- In four groups:
- Think of two possible indicators to measure for each concept.
  - Citizen support for the current city government
  - The incidence of chronic illness among those over 65 in your state
  - Citizen satisfaction with garbage collection in your community
- Discuss each measure in terms of potential validity, reliability, comprehensibility, and cost

Indexes and Scales

- Often we cannot contain a concept with a single measure
  - How would we determine if someone is a Blacksburg resident?
- Many times, we will combine measures to form what is commonly referred to as either an index or a scale
- Can we think of any common indexes?

Indexes and Scales

- Indexes can be constructed from items in
  - Public Opinion Surveys
  - Data in Public Records
  - Personal Observations
- An indexes size is generally dictated by the respondents" willingness to answer
  - Nobody will want to respond to a 200 item survey
  - Usually 2 to 10 items

Indexes and Scales

- The simplest indexes involve merely adding together several responses
- More complicated indexes provide “weights” for different factors

Example

- Suppose you're researching divorce rates and you're wondering if a husband's willingness to share in the household duties has any bearing on the outcome
- To measure this, you might ask the husband how much times he spends doing household chores
  - Would this be reliable?

Example cont.

- Instead you might construct a scale composed of something like:
  - Which of the following household chores do you regularly do (check all that apply)
    - Washing up after meals
    - Preparing meals
    - Doing the laundry
    - Routine household cleaning
    - Shopping for groceries
    - Caring for the children
  - Could ask spouse to verify for reliability
  - Add together to get a score (index number) between 0-6

Example cont.

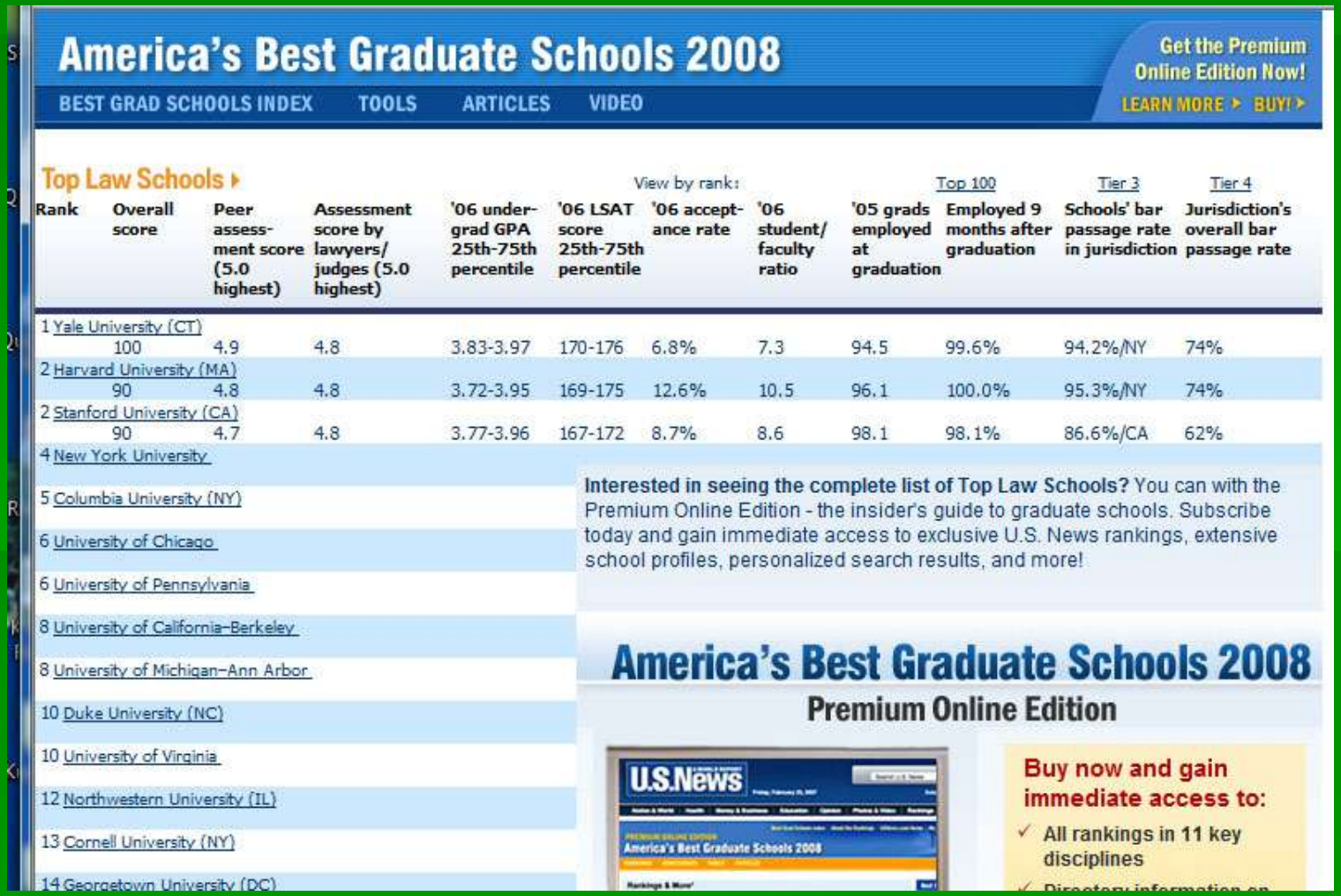
- Problem
  - Are all chores equal in magnitude?
- Solution 1
  - Give each chore some weight based on relative importance
- Maybe .3 for childcare?
- Maybe .2 for laundry?
- .1 for everything else?

Example cont.

- Solution 2
  - Assess the proportion of work done
  - Maybe give weights to each level

	almost always	usually	half the time	occasionally	almost never
Washing up after meals					
Preparing meals					
Doing the laundry					
Routine household leaning					
Shopping for Groceries					
Caring for children					

School Rankings (Indexes)



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Rank	Overall score	Peer assessment score (5.0 highest)	Assessment score by lawyers/ judges (5.0 highest)	'06 undergrad GPA 25th-75th percentile	'06 LSAT score 25th-75th percentile	'06 acceptance rate	'06 student/ faculty ratio	'05 grads employed at graduation	Employed 9 months after graduation	Schools' bar passage rate in jurisdiction	Jurisdiction's overall bar passage rate
1 Yale University (CT)	100	4.9	4.8	3.83-3.97	170-176	6.8%	7.3	94.5	99.6%	94.2%/NY	74%
2 Harvard University (MA)	90	4.8	4.8	3.72-3.95	169-175	12.6%	10.5	96.1	100.0%	95.3%/NY	74%
2 Stanford University (CA)	90	4.7	4.8	3.77-3.96	167-172	8.7%	8.6	98.1	98.1%	86.6%/CA	62%
4 New York University											
5 Columbia University (NY)											
6 University of Chicago											
6 University of Pennsylvania											
8 University of California–Berkeley											
8 University of Michigan–Ann Arbor											
10 Duke University (NC)											
10 University of Virginia											
12 Northwestern University (IL)											
13 Cornell University (NY)											
14 Georgetown University (DC)											

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1 Harvard University (MA)	100	4.8	4.6	3.64	707	14.9%	$125,527	90.4%	94.9%	$39,600	1,821
2 Stanford University (CA)	99	4.8	4.5	3.61	720	9.9%	$126,661	84.2%	93.6%	$43,380	764
3 University of Pennsylvania (Wharton)											
4 Massachusetts Institute of Technology (Sloan)											
5 Northwestern University (Kellogg) (IL)											

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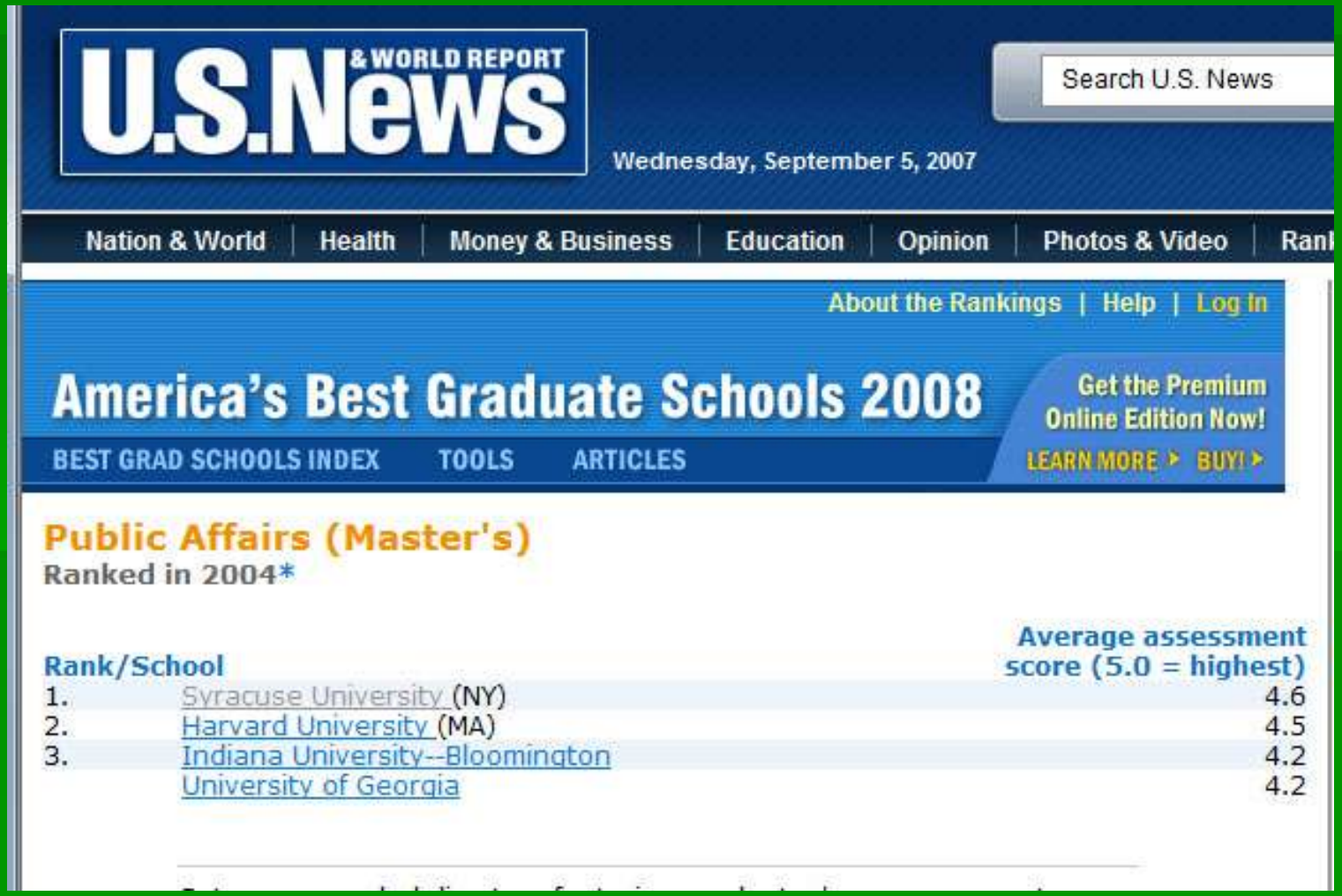
School Rankings (Indexes)



Assignment

- You are given an assignment to come up with a survey of MPA students past and present about the MPA program
- You need to measure both the perceived quality of the program and the general student satisfaction with their experience
- Come up with 4 indicators that will need to be measured to get at each concept (8 total).
- Describe why each is a good indicator for the concept it represents
- Tell which level of measurement each indicator represents
- Suggest an index that will summarize all of your indicators