

1.040/1.401/ESD.018
Project Management

Lecture 13

What is a Variable?

(and why we need to know!)

Samuel Labi and Fred Moavenzadeh

Massachusetts Institute of
Technology

CONTENTS OF LECTURE 13

- What is a Variable?
- Types of Variables
- Examples of Variables in ...
 - Everyday Life
 - Project Management
- Why we need to know what type of variable we're dealing with.

Meaning of the Word "Variable"

Is a quantity that ...

- varies (is not fixed)
- takes any value in a given range

Etymology (14th Century):

From Middle-age English: vary,

From Middle French, **variare**

From Latin: variabilis,

Dictionary definitions

- Able or apt to vary
- Subject to variation or changes
- Fickle, inconstant

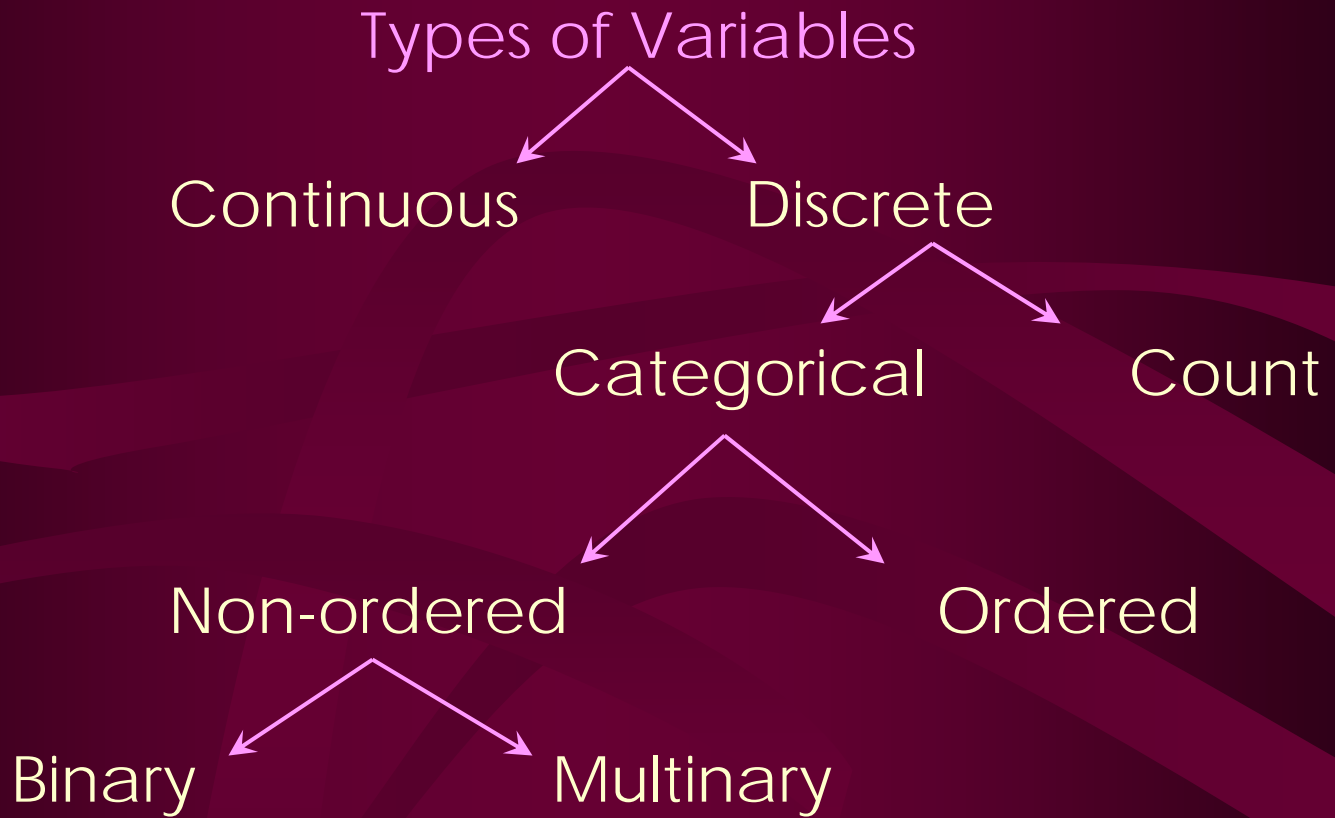
(Merriam Webster's Dictionary)

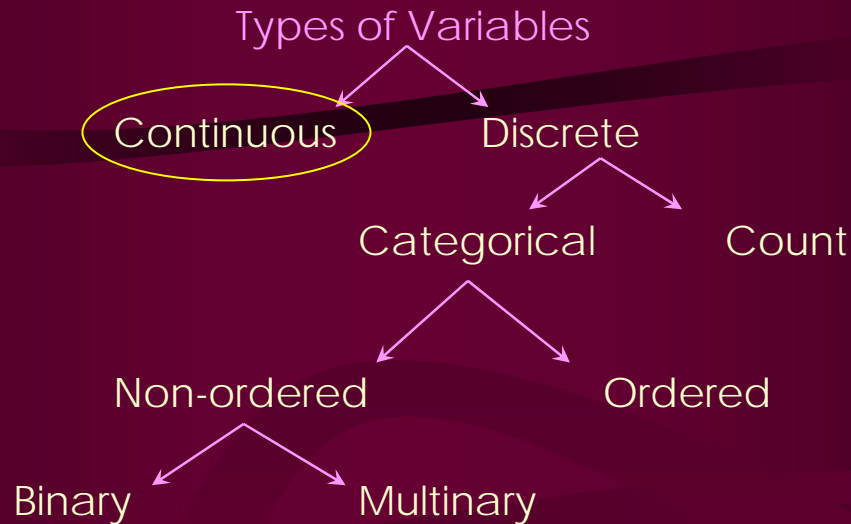
TYPES OF VARIABLES ENCOUNTERED IN EVERYDAY LIFE

- Time spent in walking to class today
- Level of satisfaction with today's lunch
- Number of friends you have met today
- Your body temperature today
- Weight of your backpack today
- Whether to sleep early tonight
- Number of times you yawned in today's classes
- Etc.

TYPES OF VARIABLES ENCOUNTERED IN PROJECT MANAGEMENT

- Quality of crew workmanship
- Whether to carry out a certain activity X
- How much of activity X should be carried out?
- Level of satisfaction of the Owner
- Number of worker fatalities on site
- Amount of money to be spent on a project
- Duration of Task Y in hours,
- Etc.





Continuous Variables

- Have values that are real numbers, includes fractions, whole numbers, negative numbers, etc., such as -3.76 , 556.21 , 0.07 , $1,000$, -0.00013 , $24,45$
- Typically, are values that are measured, e.g., weight, height, length, time.

Examples: Time spent in walking to class today

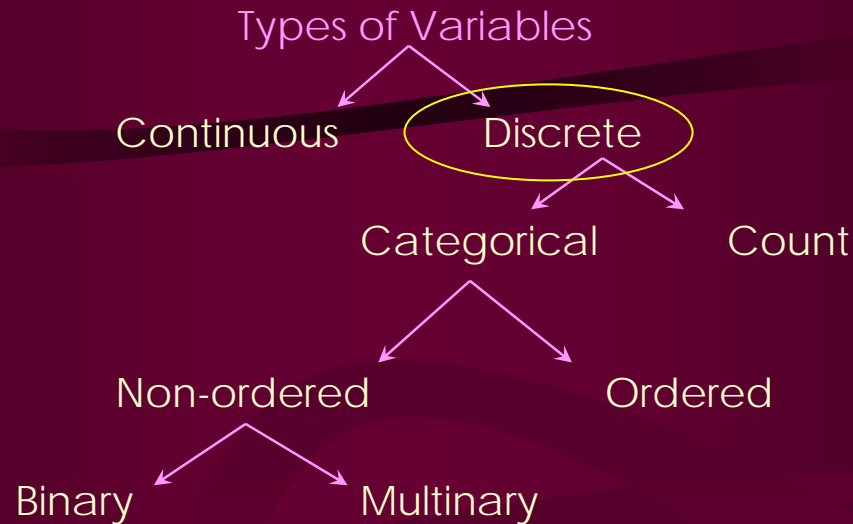
Your body temperature today

Weight of your backpack today

How much of activity X should be carried out?

Amount of money to be spent on a project

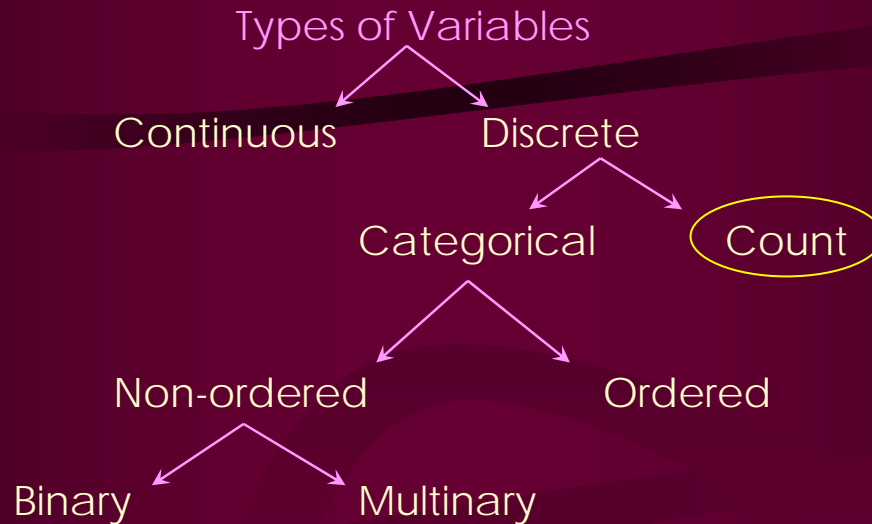
Duration of Task Y in hours,



Discrete Variables

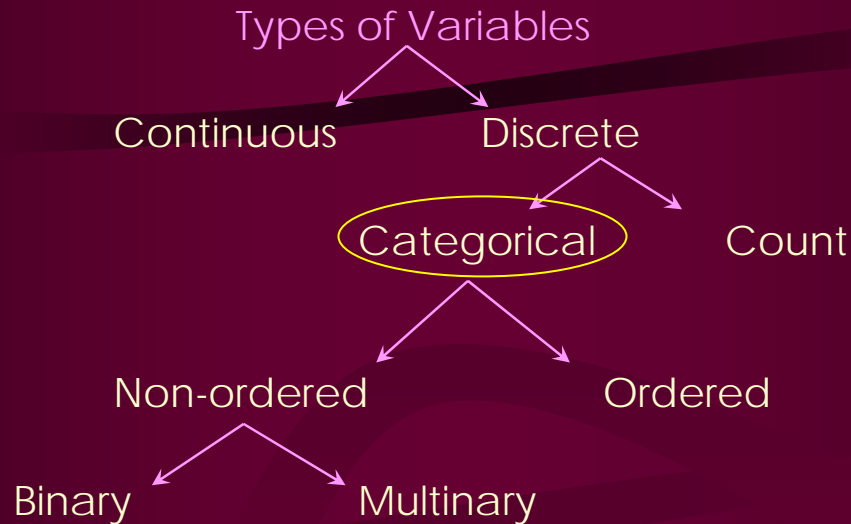
- Have values that are not continuous -- due to counting or due to their placement in ordered or non-ordered categories,

See examples under each class of discrete variables.



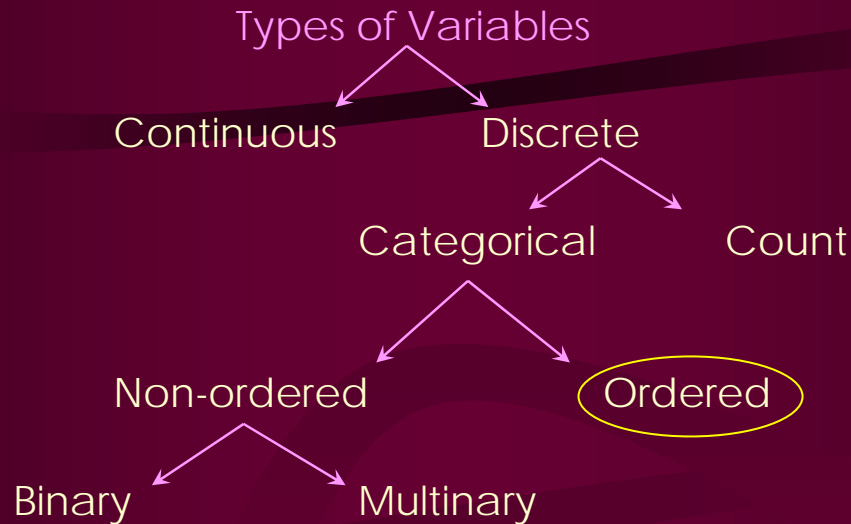
Count Variables (Natural Numbers, N)

- Are discrete variables that take values due to counting only. Also called “quantitative discrete variables”
- Can therefore only be natural numbers (i.e., positive integers), such as 0, 1, 2, 3...etc
- Examples:
 - *Number of friends you have met today,*
 - *Number of times you yawned in today’s classes*
 - *Number of worker fatalities on site*



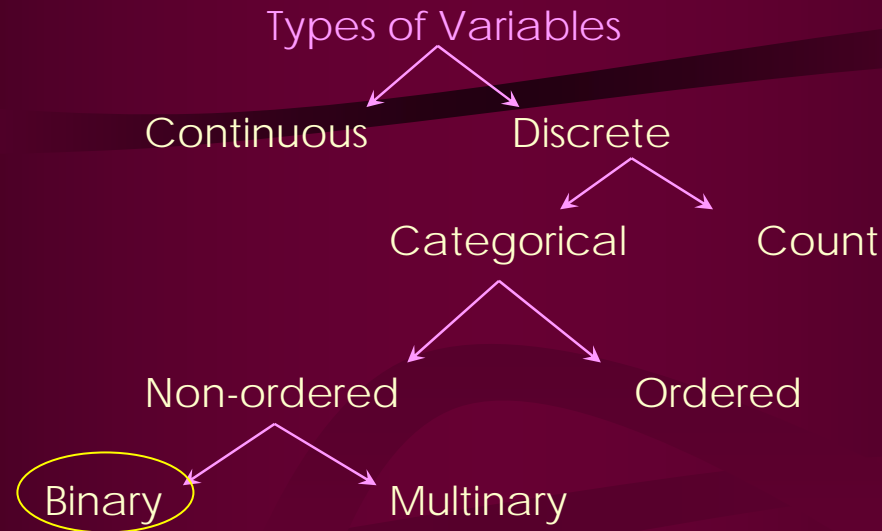
Categorical Variables

- Are discrete variables that take values that are not quantitative.
- Also called indicator variables, dummy variables, qualitative variables.
- Categorical variables are either ordered (ordinal) or non-ordered (non-ordinal)
- Examples for each type are shown in subsequent pages



Ordered (Ordinal) Variables

- Have a value that is a result of ranking or result of being placed on a non-quantitative scale
- Rank or scale ranges from a bad attribute (e.g., poor condition) to a good attribute (e.g., excellent condition).
- Examples:
 - 1) *Level of your satisfaction with today's lunch*
 - 2) *Quality of Crew workmanship*
 - 3) *Owner's satisfaction with a project delivery*



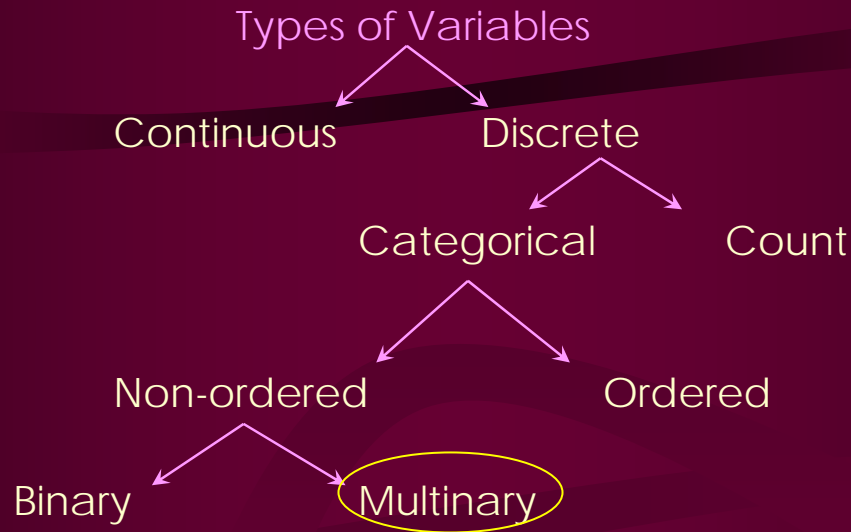
Non-Ordered Binary Variables

Have values that have **only two** outcomes that are not ranked. In other words any one outcome is not rated higher than the other.

Often, the two outcomes are Yes or No.

Examples:

- 1) *Your marital status*
- 2) *Whether to carry out a certain activity X*
- 3) *Type of project*



Non-Ordered Multinary Variables

Have values that have **more than two** outcomes that are not ranked.

In other words any one outcome is not rated higher than the other.

Examples:

- 1) *Your Career Choice: Teaching/Consulting/Research*
- 2) *Favorite dessert: Ice-cream/Fruit Salad/Apple Pie/Cake*
- 3) *Bridge Type: Reinforced-concrete/Steel/Wood/Masonry*

Why do we need to know this?

Probabilistic modeling and analysis of project management

Helps us to select the appropriate probability distribution for describing/predicting a project management variable

Continuous variables – Use Normal distribution, Beta distribution, Exponential distribution, etc.

Discrete variables

Count variables – Use Poisson or Negative Binomial distributions

Binary non-ordinal variable – Use Binomial or hypergeometric distr.

Multinary non-ordinal – Multinomial distribution

Multinary ordinal – Probit

Discrete choice models – logit, probit (Gumbel distributions)

Why do we need to know this?

Probabilistic modeling and analysis of project management

Helps us to select the appropriate probability distribution for describing/predicting a project management variable

Continuous variables – Use Normal distribution, Beta distribution, Exponential distribution, etc.

Discrete variables

Count variables – Use Poisson or Negative Binomial distributions

Binary non-ordinal variable – Use Binomial or hypergeometric distr.

Multinary non-ordinal – Multinomial distribution

Multinary ordinal – Probit

Discrete choice models – logit, probit (Gumbel distributions)

Resource allocation

Helps in selecting appropriate technique for efficient resource allocations:

Continuous variables – Use Linear programming

Discrete variables – Use Integer programming



Therefore:

Incorrect identification of variable type

➔ Incorrect resource allocation technique

➔ Incorrect selection of the optimal mix of resources for most efficient and most effective project management.

Next Lecture:

Basics of Resource Allocation

(using Discrete or Continuous Variables)