Quantitative Methods 2

Tutorial 4

Nhan La

Last week

1. Descriptive statistics
2. Normality test

- Visual assessment

- Descriptive measures: relative comparisons
    - Mean vs. median
    - Skewness
        - $\widehat{SK}$ vs. 0
        - $\left|\widehat{SK}\right|$ vs. $2s_{\widehat{SK}}$
    - Kurtosis
        - $\widehat{K}$ vs. 3
        - $\left|\widehat{K} - 3\right|$ vs. $2s_{\widehat{K}}$

- Hypothesis test: Jacque-Bera

Last week

3. Test of population's central location

- Parametric: *t* test
- Non-parametric
  - Sign test
  - Wilcoxon signed ranks test
  - Sample size: n = number of non-zero deviations
- Find confidence interval of the population mean

Last week

- Some tests need d.f: $t,\ \chi^2, F$
  - Probability distribution, and thus the estimation, of the test statistics depend on the sample size or the number of groups, or both
  - E.g., $t = \dfrac{\bar{X} - \mu_0}{s/\sqrt{n}}$
- Some don't: Z, Fisher's exact test

Hypothesis testing

- Choose the appropriate test based on:
    - Levels of measurement
    - Types of variable
    - Distribution of the underlying population
    - Sample size
    - Relevant population parameter (e.g., σ^2) known/unknown
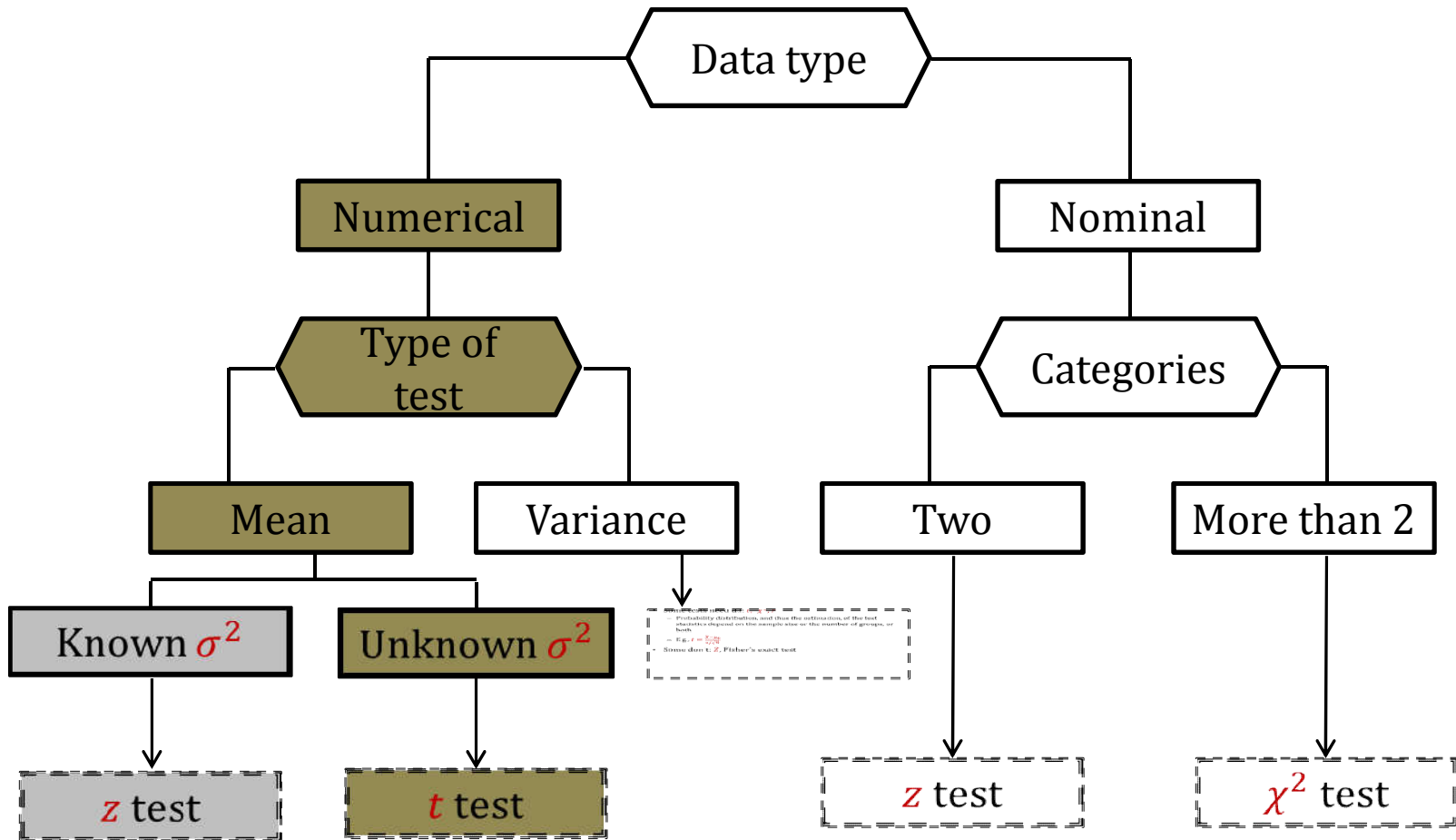
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1. Paired-sample test
   - Parametric: Z test or t test
   - Nonparametric: sign test or Wilcoxon signed rank test
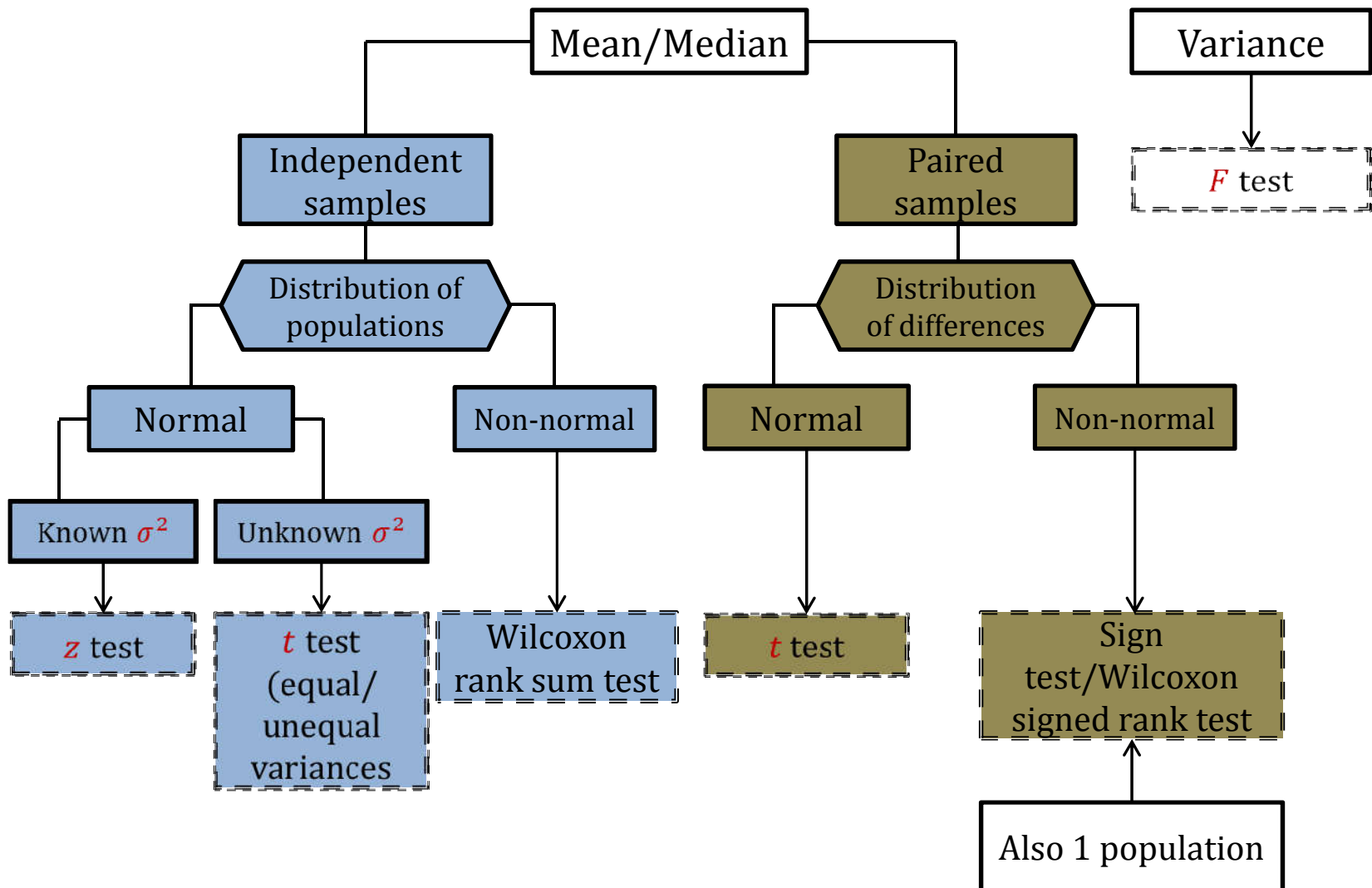2. Independent samples test
   - Parametric: Z test or t test
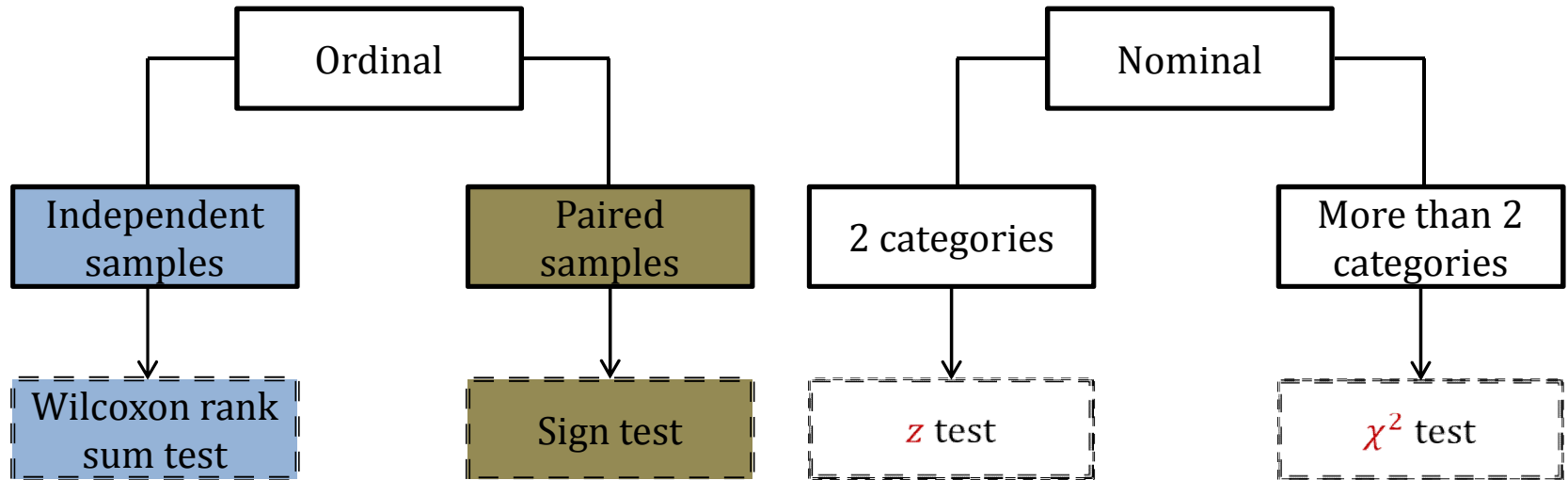   - Nonparametric: Wilcoxon rank sum test

One population

Two populations - Numerical

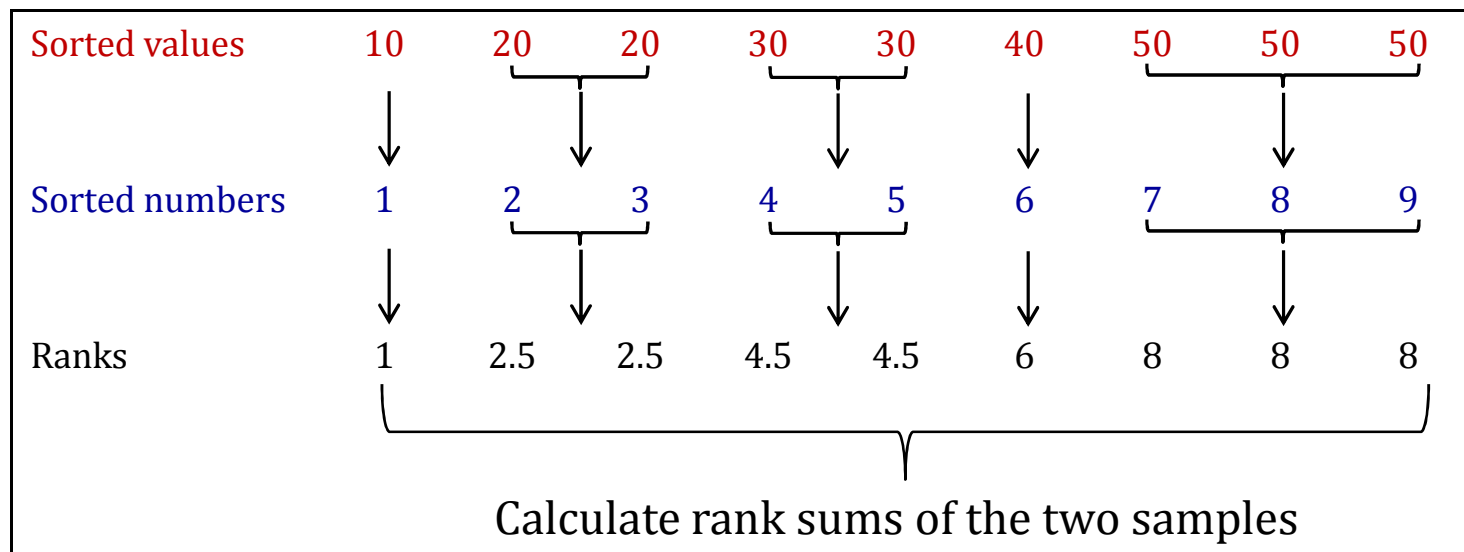# Two populations - Ordinal and Nominal

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Wilcoxon signed rank test: Rank of each observation given by its deviation from the population median.

Values	7	3	4	6	10	5	6	4	3	8
Deviation	1	-3	-2	0	4	-1	0	-2	-3	2
Abs. dev.	1	3	2	0	4	1	0	2	3	2
Ranks	1.5	6.5	4		8	1.5		4	6.5	4

Calculate the sums of negative and positive
deviation groups

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Wilcoxon rank sum test: Rank of each observation given by its position in the pooled sample

Sorted values	10	20	20	30	30	40	50	50	50
Sorted numbers	1	2	3	4	5	6	7	8	9
Ranks	1	2.5	2.5	4.5	4.5	6	8	8	8

Calculate rank sums of the two samples

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Parameter	Population	Test	EViews default reported p-values
Normality		Jacque-Bera test	One-sided
Central location	One population	Mean: Z- or t-test	Two-sided
		Median: Sign test or Wilcoxon signed rank test (using normal approx. Z-test)	Two-sided
	Two populations – Paired samples	Mean: Z- or t-test	Two-sided
		Median: Sign test or Wilcoxon signed rank test (using normal approx. Z-test)	Two-sided
	Two populations – Independent samples	Mean: Z- or t-test	Two-sided
		Median: Wilcoxon rank-sum test (using normal approx. Z-test)	Two-sided
	Three or more populations – Independent samples	Mean: F-test	One-sided
		Median: Kruskal-Wallis test	One-sided

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Why always 0?

Depend on the question being asked.

Two sided test:

$$H_0: \mu_0 = \mu_1 \ or \ H_0: \mu_0 - \mu_1 = 0;$$
$$H_A: \mu_0 \neq \mu_1 \ or \ H_A: \mu_0 - \mu_1 \neq 0$$

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Parameter	Population	Test	EViews default reported p-values
Variance	One population	test	One-sided, smaller value (see Week 4 lecture slides) Note: it's more straightforward to rely on the comparison between and
	Two populations	F-test	Two-sided (see Week 4 lecture slides, especially for one-sided test hypotheses and statistic formation)
Proportion	One population	Z-test	Two-sided
	Two populations	t-test (to produce approximated results)	Two-sided

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Parameter	Population	Test	EViews default reported p-values
Correlation and regression	Pearson correlation coefficient	t-test	Two-sided
	Coefficient (slopes or intercept)	t-test	Two-sided
	Model significance/utility	F-test	One-sided
	Linear restriction of coefficient	One conjecture ($<$, $>$ or $=$): t-test or F-test Note: the conjecture can involve more than one parameter	t-test: Two-sided F-test: One-sided
		More than one conjecture: F-test	One-sided
	Heteroskedasticity White test	F-test	One-sided