Nonparametric Tests

Inferential statistics: Uses what we know about a sample to *infer* about the larger population, using the concept of probability

- Probability & the Normal distribution
- Null Hypothesis Testing
- Common types include t tests (one sample, t test of r vs. 0, independent samples, dependent samples), ANOVA (one way ANOVA, factorial ANOVA, repeated measures ANOVA), regression, and chi square

Assumptions of t & F

1. **Normality** – the populations are normally distributed
2. **Homogeneity of variance** – the groups have similar amounts of variance within the groups
3. **Independence** – a person is only in one group and not related to the person in the other group

But what if you don't meet these assumptions?

Up to this point, we have used *parametric statistics*. An alternative: *non-parametric statistics.* Use these when:

- You don't know the population variance (σ)
- You don't meet the assumptions for F and t tests (not normally distributed)
- Data are frequency counts or ranks

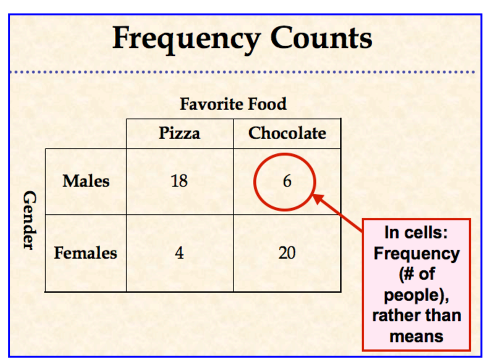
Parametric and non-parametric tests are similar in that they use the same logic – we are testing a null hypothesis and reject if things are significant, retain if nonsignificant. They also both require random assignment to groups. How are they different? First of all, as mentioned, parametric tests have certain assumptions. Non-parametric tests do not have these assumptions. Sounds good, right? However, these tests aren't as powerful – it's harder to find an effect that is there using these tests. Also, it's easier to interpret the results of the parametric tests. Nonparametric tests usually aren't normally distributed – so what do means and standard deviations really mean? If we reject the null, it's not always clear what that means. In the end, it's not very clear which you should use when.

Types of nonparametric statistics

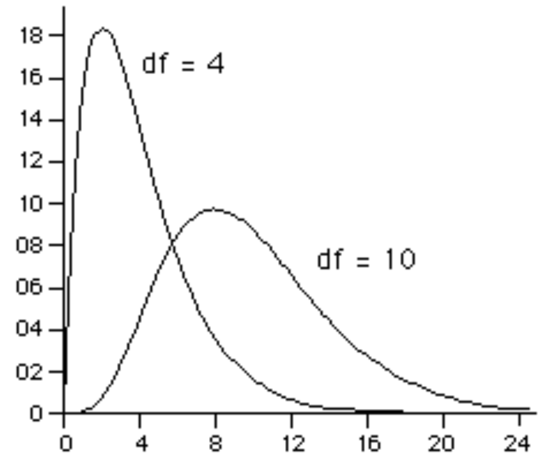
- Chi square (test of independence, test of goodness of fit)
- Mann-Whitney U, Wilcoxon matched-pairs sign ranks T, Wilcoxon-Wilcox comparisons
- Spearman r_s
- AND many others (logistic regression, survival analysis, growth curve analyses…)

Chi Square

- 2 types: test of independence and test of goodness of fit
  - In both cases, independence of observations is required.
- With the chi square, we are comparing data that we actually gather to what we would expect based on a theory.
- Used with *frequency counts* in categories. Comparing *observed* frequencies to *expected* frequencies. Uses a *chi square distribution* of values.
  - Frequency counts - Comparing number of people in each category, rather than comparing means, variances, and other values
  - Chi square distribution - Positively skewed curve, changes depending on df
  - Observed frequencies (O) - Actual count of events in a category
  - Expected frequencies (E) - Theoretical frequency



    - based on the null hypothesis. These are the values we'd expect to see if the null hypothesis is true
    - We compare the observed and expected frequencies using a chi square test
- **Chi sq distribution**
    - Theoretical distribution, changes as df changes, positively skewed (no negative values)



<u>Test of Independence</u>

- Tests whether two variables are independent of each other
    - Null hypothesis: there is no relationship between Variable A and Variable B
    - Alternative hypothesis: there is a relationship between Variable A and Variable B
- Example:
    - Two categorical variables (Variable A & Variable B): Gender & Favorite Food
    - Main question: Are these variables related?
        - H_0: There is no relationship between them
            - By knowing a person's favorite food, you can predict whether they are male or female.
        - H_a: There is a relationship between them
            - By knowing a person's favorite food, you can predict whether they are male or female.

<u>Goodness of Fit</u>

- Compares observed values to a theory
    - Null hypothesis: there is no difference between the observed values and our theory (our theory works!)
    - Alternative hypothesis: there is a difference between the observed values and our theory (time to rethink things!)
    - This is opposite – usually we want to reject the null, but here we want to retain it.
- Example: I think that people become more inactive as they get older.
    - I would collect data and compare this to some expected values, using the chi square test.
    - Here, I want to retain the null hypothesis – this means my theory is possible.

<u>Using chi square</u>

- Use when you have categories with counts, rather than scores
- Observations must be independent
    - Independence of observations, not variables
    - Subjects only appear in one cell of the table
- Conclusions only apply when a sample is representative of the population
    - Use random sampling

All of the procedures and tests that we have covered offer different tools for us to examine a set of data and come to quantitatively-informed conclusions. Each of these tools are useful at different times, depending on your theory, your research questions, your sample, and your data.