

## **1 Univariate Tests**

### **1.1 One-Sample T-test of a Mean**

#### **Example: Public School Spending**

- Dataset: average pay for public school teachers and average public school spending per pupil for each state and the District of Columbia in 1985.
- Download dataset `eduspending.sav`.
- Conduct the following exercises:
  - Show some descriptive statistics for teacher pay and expenditure per pupil.
  - Is there statistical evidence that teachers make less than \$25,000 per year?
  - Is there statistical evidence that expenditure per pupil is more than \$3,500?

#### **Opening the data:**

1. Save `eduspending.sav` somewhere.
2. Open SPSS.
3. Click radio button `Open an existing data source`.
4. Double-click `More files...`
5. Go find and double click `eduspending.sav`.

#### **Descriptive Statistics**

1. Click `Analyze` menu, select `Descriptive Statistics`, then select `Descriptives`.
2. Click on `Pay` and click right arrow button.
3. Click on `Spending` and click right arrow button.
4. Click `Options`.
  - (a) Check any options you find interesting.
  - (b) Click `OK`

5. Click OK

## Test Hypotheses

1. Click **Analyze** menu, select **Compare Means**, then select **One-Sample T test**.
2. Select **Pay**, then click right arrow.
3. Enter in Test Value text box 25000.
4. Output tables show descriptive statistics for pay, and hypothesis test results.

## 1.2 One-Sample Tests for Proportions

### Example: Economic Outlook

- Data from Montana residents in 1992 concerning their outlook for the economy.
- All data is ordinal or nominal:
  - AGE = 1 under 35, 2 35-54, 3 55 and over
  - SEX = 0 male, 1 female
  - INC = yearly income: 1 under \$20K, 2 20-35\$K, 3 over \$35K
  - POL = 1 Democrat, 2 Independent, 3 Republican
  - AREA = 1 Western, 2 Northeastern, 3 Southeastern Montana
  - FIN = Financial status 1 worse, 2 same, 3 better than a year ago
  - STAT = 0, State economic outlook better, 1 not better than a year ago
- Do the majority of Montana residents feel their financial status is the same or better than one year ago?
- Do the majority of Montana residents have a more positive economic outlook than one year ago?
- Open the dataset *econoutlook.sav*.
- Parametric approach:
  1. If the variable is a zero or one, the *sample mean* is the same as the *proportion of the sample* that has a value equal to 1.
  2. Convert Financial Status (FIN) to a 0 if worse, and 1 if same or better:
    - (a) Click **Transform** menu, select **Recode into Different Variables**.
    - (b) Select FIN on left and click right arrow button.
    - (c) Click **Old and New Values** button.
    - (d) First transform FIN=1 into value 0:

- i. On the left under **Old Value**, click radio box for **Value**. In textbox enter 1.
    - ii. On the right under **New Value**, click radio box for **Value**. In textbox enter 0.
    - iii. Click **Add** button.
  - (e) Next transform  $FIN=2$  or  $FIN=3$  into value 1:
    - i. On the left under **Old Value**, click radio box for **Range**. In textboxes enter 2 and 3.
    - ii. On the right under **New Value**, click radio box for **Value**. In textbox enter 1.
    - iii. Click **Add** button.
  - (f) Click **Continue**
  - (g) In original Recode window, under **Output Variable**, type a name.
  - (h) Click **Change**
  - (i) Click **OK!**
3. Do a simple T-Test!
- Binomial approach:
    1. Independent observations that are a 0 or 1 have a binomial distribution (regardless of sample size).
    2. Click **Analyze** menu, select **Nonparametric Tests**, select **Legacy Dialogs**, then select **Binomial**.
    3. On the left, select variable to test and click right arrow button.
    4. In Test Proportion, enter 0.5.
    5. Click **OK!**

### 1.3 One-Sample Nonparametric Tests for Medians

#### Example: Attitudes Grade School Kids

- Dataset: 438 students in grades 4 through 6 were sampled from three school districts in Michigan. Students ranked from 1 (most important) to 5 (least important) how important grades, sports, being good looking, and having lots of money were to each of them.
  - Open dataset `gradschools.sav`. Choose second worksheet, titled **Data**.
  - Answer some of these questions:
    - Is the median importance for grades is greater than 3?
    - Is the median importance for money less than 3?
1. Click **Analyze** menu, select **Nonparametric Tests**, select **Legacy Dialogs**, then select **Binomial...**
  2. Click on **Grades** (or a different variable of interest), then click on right arrow.
  3. Click radio button for **Cut point** and enter 3 into text box.

4. Do you want the exact (binomial distribution) p-value or asymptotic distribution (normal distribution)?
  - (a) Exact: click on **Exact...**
  - (b) Click **Exact** radio button.
  - (c) Click **Continue**.
5. Click **OK**
  - Output table shows exact p-value and normal distribution p-value for a two-tailed test.
  - What is your conclusion?

## 2 Bivariate Statistics

### 2.1 Two-Sample T-Test for Differences in Means

#### Example

- Dataset: average pay for public school teachers and average public school spending per pupil for each state and the District of Columbia in 1985.
  - Test the following hypotheses:
    - Does spending per pupil differ in the North (region 1) and the South (region 2)?
    - Does teacher salary differ in the North and the West (region 3)?
  - Do you see any weaknesses in our statistical analysis?
1. Open **eduspending.sav** in SPSS.
  2. Click **Analyze** menu, select **Compare Means**, then select **Independent-Samples T test**.
  3. Select **Pay** or **Spending**, depending on which you are currently interested in.
  4. Click the right arrow that is just to the left of **Test Variables**.
  5. Select **Area** and click on right arrow to the left of **Grouping Variable**.
  6. You need to tell SPSS what your grouping variable means and what groups you are interested in:
    - (a) Click on **Define Groups**
    - (b) Click radio button **Use specified values**.
    - (c) Enter in the appropriate numbers for Group 1 and Group 2 (i.e. if you want the North to be group 1, type a 1 in Group 1 text box, and if you want the West to be group 2, type a 3 in the Group 2 text box.

(d) Click **Continue**.

7. Click **OK**!

- The first output table shows some descriptive statistics for each group.
- The next output table shows:
  - Statistical evidence about whether the variances are different.
  - Statistical evidence about whether the means are different.
  - Descriptive statistics about the difference in the means.
  - Confidence intervals for the difference in the means.

## **2.2 Mann-Whitney Test: Two-Sample Nonparametric Test for Difference in Medians**

1. Use the same Education Spending dataset as above.
2. Click **Analyze** menu, select **Nonparametric Tests**, then select **2 Independent Samples...**
3. Move **Pay** (or whatever you are interested in) into **Test Variable List**
4. Move **Area** into **Grouping Variable**
5. Define groups as before.
6. You can get exact p-values if absolutely necessary (takes more time).
7. Click **OK**.
  - The value of the Mann-Whitney test statistic can be huge and this does not have much interpretation (it's equal the smaller of the two sums of ranks).
  - The Significance is the p-value.
  - What is your conclusion?