

方差分析

检验两组样本均数是否相同，用 t 检验。检验多组样本均数是否相同，用方差分析。如文化程度分“低、中、高”三组，要比较三组一秒肺活量是否相同。

使用本模块，如有两个分组因素（区组设计），自动进行两变量交互作用的方差分析，详见下例。

例 1，打开练习项目 DEMO，比较不同文化程度之间的第一秒肺活量及最大肺活量的差异。输入界面：（或下载练习数据：www.empowerstats.com/empowerStats/exdata/demo1.xls）

输入要检验的变量（如一秒肺活量、最大肺活量）、分组变量（如文化程度），如要再分层，输入第二层分组变量（如性别）。

方差分析 ?

标题:

选择分析对象:

选择变量

变量

FEV1

FVC

选择分组变量

选择分层变量

输出结果：

N、均数、标准差：FEV1

| | SEX | N | Mean | Sd | Min | Median | Max |
|---------------------|--------|-----|--------|--------|------|--------|------|
| elementary of lower | Male | 71 | 3.0575 | 1.2995 | 0.56 | 3.14 | 5.92 |
| middle | Male | 134 | 3.7995 | 1.1569 | 0.47 | 4.095 | 5.84 |
| high or above | Male | 165 | 4.2105 | 1.1481 | 0.48 | 4.33 | 7.57 |
| elementary of lower | Female | 236 | 2.9133 | 0.7737 | 0.42 | 2.94 | 4.9 |
| middle | Female | 89 | 3.3339 | 0.7364 | 0.65 | 3.44 | 4.86 |
| high or above | Female | 39 | 3.2403 | 0.6425 | 0.79 | 3.3 | 4.35 |

方差分析（无交互作用模型）：FEV1

| 模型 | 自由度 | 离均差平方和 | 均方 | F 值 | P 值 |
|-----------|-----|----------|---------|---------|-----------|
| Education | 2 | 151.2145 | 75.6072 | 75.5926 | <0.000001 |
| SEX | 1 | 28.7679 | 28.7679 | 28.7624 | <0.000001 |
| Residuals | 730 | 730.1414 | 1.0002 | | NA |

方差分析后多组间两两比较：FEV1

| Education | SEX | - | Education | SEX | 均数差 | 95%区间下限 | 95%区间上限 | P 值 |
|---------------|--------|---|---------------------|------|---------|---------|---------|-----------|
| middle | . | - | elementary of lower | . | 0.6671 | 0.4604 | 0.8737 | <0.000001 |
| high or above | . | - | elementary of lower | . | 1.0784 | 0.8662 | 1.2905 | <0.000001 |
| high or above | . | - | middle | . | 0.4113 | 0.1838 | 0.6389 | 0.000073 |
| . | Female | - | . | Male | -0.3454 | -0.4903 | -0.2004 | 0.000003 |

方差分析（有交互作用模型）：FEV1

| 模型 | 自由度 | 离均差平方和 | 均方 | F 值 | P 值 |
|-----------------|-----|----------|---------|---------|-----------|
| Education | 2 | 151.2145 | 75.6072 | 76.8219 | <0.000001 |
| SEX | 1 | 28.7679 | 28.7679 | 29.2301 | <0.000001 |
| Education * SEX | 2 | 13.6517 | 6.8258 | 6.9355 | 0.001038 |
| Residuals | 728 | 716.4898 | 0.9842 | | NA |

方差分析后多组间两两比较：FEV1

| Education | SEX | - | Education | SEX | 均数差 | 95%区间下限 | 95%区间上限 | P 值 |
|---------------------|--------|---|---------------------|--------|---------|---------|---------|-----------|
| middle | . | - | elementary of lower | . | 0.6671 | 0.4621 | 0.8721 | <0.000001 |
| high or above | . | - | elementary of lower | . | 1.0784 | 0.8679 | 1.2888 | <0.000001 |
| high or above | . | - | middle | . | 0.4113 | 0.1856 | 0.6370 | 0.000063 |
| . | Female | - | . | Male | -0.3454 | -0.4892 | -0.2016 | 0.000003 |
| middle | Male | - | elementary of lower | Male | 0.7420 | 0.3259 | 1.1581 | 0.000007 |
| high or above | Male | - | elementary of lower | Male | 1.1530 | 0.7507 | 1.5554 | <0.000001 |
| elementary of lower | Female | - | elementary of lower | Male | -0.1442 | -0.5279 | 0.2395 | 0.891722 |
| middle | Female | - | elementary of lower | Male | 0.2765 | -0.1746 | 0.7275 | 0.498181 |
| high or above | Female | - | elementary of lower | Male | 0.1828 | -0.3822 | 0.7478 | 0.940219 |
| high or above | Male | - | middle | Male | 0.4110 | 0.0814 | 0.7406 | 0.005229 |
| elementary of lower | Female | - | middle | Male | -0.8862 | -1.1928 | -0.5796 | <0.000001 |
| middle | Female | - | middle | Male | -0.4655 | -0.8532 | -0.0779 | 0.008291 |
| high or above | Female | - | middle | Male | -0.5592 | -1.0750 | -0.0435 | 0.024650 |
| elementary of lower | Female | - | high or above | Male | -1.2972 | -1.5849 | -1.0096 | <0.000001 |
| middle | Female | - | high or above | Male | -0.8766 | -1.2494 | -0.5037 | <0.000001 |
| high or above | Female | - | high or above | Male | -0.9702 | -1.4749 | -0.4655 | <0.000001 |
| middle | Female | - | elementary of lower | Female | 0.4207 | 0.0681 | 0.7733 | 0.008969 |
| high or above | Female | - | elementary of lower | Female | 0.3270 | -0.1630 | 0.8170 | 0.398673 |
| high or above | Female | - | middle | Female | -0.0937 | -0.6380 | 0.4507 | 0.996462 |

注解：上表中 Education 或 Sex 等于“.”表示相应分层因素的合计。

N、均数、标准差：FVC

| | SEX | N | Mean | Sd | Min | Median | Max |
|---------------------|--------|-----|--------|--------|------|--------|------|
| elementary of lower | Male | 71 | 4.5306 | 1.1521 | 2.1 | 4.65 | 6.96 |
| middle | Male | 134 | 5.1583 | 1.0592 | 1.78 | 5.21 | 7.73 |
| high or above | Male | 165 | 5.3933 | 1.1242 | 2.01 | 5.38 | 8.81 |
| elementary of lower | Female | 236 | 3.7721 | 0.7672 | 1.34 | 3.73 | 6.49 |
| middle | Female | 89 | 4.0836 | 0.7004 | 2.03 | 4.16 | 5.59 |
| high or above | Female | 39 | 4.1436 | 0.657 | 1.92 | 4.14 | 5.35 |

方差分析（无交互作用模型）：FVC

| 模型 | 自由度 | 离均差平方和 | 均方 | F 值 | P 值 |
|-----------|-----|----------|----------|----------|-----------|
| Education | 2 | 192.5050 | 96.2525 | 107.6469 | <0.000001 |
| SEX | 1 | 136.9971 | 136.9971 | 153.2148 | <0.000001 |
| Residuals | 730 | 652.7298 | 0.8942 | | NA |

方差分析后多组间两两比较：FVC

| Education | SEX | - | Education | SEX | 均数差 | 95%区间下限 | 95%区间上限 | P 值 |
|---------------|--------|---|---------------------|------|---------|---------|---------|-----------|
| middle | . | - | elementary of lower | . | 0.7819 | 0.5865 | 0.9773 | <0.000001 |
| high or above | . | - | elementary of lower | . | 1.2069 | 1.0063 | 1.4075 | <0.000001 |
| high or above | . | - | middle | . | 0.4250 | 0.2099 | 0.6402 | 0.000012 |
| . | Female | - | . | Male | -0.7537 | -0.8907 | -0.6167 | <0.000001 |

方差分析（有交互作用模型）：FVC

| 模型 | 自由度 | 离均差平方和 | 均方 | F 值 | P 值 |
|-----------------|-----|----------|----------|----------|-----------|
| Education | 2 | 192.5050 | 96.2525 | 108.2537 | <0.000001 |
| SEX | 1 | 136.9971 | 136.9971 | 154.0784 | <0.000001 |
| Education * SEX | 2 | 5.4371 | 2.7185 | 3.0575 | 0.047610 |
| Residuals | 728 | 647.2928 | 0.8891 | | NA |

方差分析后多组间两两比较：FVC

| Education | SEX | - | Education | SEX | 均数差 | 95%区间下限 | 95%区间上限 | P 值 |
|---------------|--------|---|---------------------|------|---------|---------|---------|-----------|
| middle | . | - | elementary of lower | . | 0.7819 | 0.5870 | 0.9767 | <0.000001 |
| high or above | . | - | elementary of lower | . | 1.2069 | 1.0069 | 1.4070 | <0.000001 |
| high or above | . | - | middle | . | 0.4250 | 0.2105 | 0.6396 | 0.000012 |
| . | Female | - | . | Male | -0.7537 | -0.8904 | -0.6170 | <0.000001 |
| middle | Male | - | elementary of lower | Male | 0.6277 | 0.2322 | 1.0232 | 0.000098 |
| high or above | Male | - | elementary of lower | Male | 0.8628 | 0.4804 | 1.2452 | <0.000001 |

| | | | | | | | | |
|---------------------|--------|---|---------------------|--------|---------|---------|---------|----------|
| elementary of lower | Female | - | elementary of lower | Male | -0.7585 | -1.1232 | -0.3938 | <0.00001 |
| middle | Female | - | elementary of lower | Male | -0.4470 | -0.8757 | -0.0182 | 0.035289 |
| high or above | Female | - | elementary of lower | Male | -0.3870 | -0.9240 | 0.1500 | 0.310210 |
| high or above | Male | - | middle | Male | 0.2350 | -0.0783 | 0.5484 | 0.266125 |
| elementary of lower | Female | - | middle | Male | -1.3862 | -1.6776 | -1.0948 | <0.00001 |
| middle | Female | - | middle | Male | -1.0747 | -1.4431 | -0.7063 | <0.00001 |
| high or above | Female | - | middle | Male | -1.0147 | -1.5049 | -0.5245 | <0.00001 |
| elementary of lower | Female | - | high or above | Male | -1.6213 | -1.8947 | -1.3478 | <0.00001 |
| middle | Female | - | high or above | Male | -1.3097 | -1.6641 | -0.9554 | <0.00001 |
| high or above | Female | - | high or above | Male | -1.2497 | -1.7295 | -0.7700 | <0.00001 |
| middle | Female | - | elementary of lower | Female | 0.3115 | -0.0236 | 0.6467 | 0.085617 |
| high or above | Female | - | elementary of lower | Female | 0.3715 | -0.0942 | 0.8372 | 0.203817 |
| high or above | Female | - | middle | Female | 0.0600 | -0.4574 | 0.5774 | 0.999471 |

注解：上表中 Education 或 Sex 等于“-”表示相应分层因素的合计。

