假设性检验：

h0: 与我们想得到的结论相反 （优先减少1类错误）通过显著性控制1类错误概率

h1: 我们想要得到的结论

\*\*\*性质：正态分布下，无论标准差怎么变，平均值+—标准差 的概率都是68%

引申 平均值+— 2.56 （方差的倍数）\*标准差的概率为99%

由样本推结论，我们目前的数据均为样本数据，用于检测结论是否正确

显著性水平：人为判定的拒绝域的值

某t，z，f检验就是某种计算检验统计量的方法

根据样本计算，检验统计量（方差的倍数）

大于某一值，例如1.96（95%）或2.58则本样本在h0的基础上是一个小概率事件，概率为p，否定原假设。

statsmodels.tsa.stattools.grangercausalitytests

我们要研究2个时间序列的关系，所以h0 是第二个序列不影响第一个序列。

if p < 0.05 第二个序列对第一个序列有影响。

**问题**

1.

为什么Total Solids 与 Total Solids的结果为

“params\_ftest” = 0.000, “ssr\_ftest=1” are based on F distribution

“ssr\_chi2test=1”, “lrtest=1” are based on chi-square distribution

2.

SO4 have an effect on P-TOT

Granger Causality

number of lags (no zero) 1

ssr based F test: F=25.5289 , p=0.0000 , df\_denom=6570, df\_num=1

ssr based chi2 test: chi2=25.5406 , p=0.0000 , df=1

likelihood ratio test: chi2=25.4911 , p=0.0000 , df=1

parameter F test: F=25.5289 , p=0.0000 , df\_denom=6570, df\_num=1

Granger Causality

number of lags (no zero) 2

ssr based F test: F=6.1892 , p=0.0021 , df\_denom=6567, df\_num=2

ssr based chi2 test: chi2=12.3879 , p=0.0020 , df=2

likelihood ratio test: chi2=12.3762 , p=0.0021 , df=2

parameter F test: F=6.1892 , p=0.0021 , df\_denom=6567, df\_num=2

Granger Causality

number of lags (no zero) 3

ssr based F test: F=4.1654 , p=0.0059 , df\_denom=6564, df\_num=3

ssr based chi2 test: chi2=12.5097 , p=0.0058 , df=3

likelihood ratio test: chi2=12.4978 , p=0.0059 , df=3

parameter F test: F=4.1654 , p=0.0059 , df\_denom=6564, df\_num=3

Granger Causality

number of lags (no zero) 4

ssr based F test: F=3.9675 , p=0.0032 , df\_denom=6561, df\_num=4

ssr based chi2 test: chi2=15.8917 , p=0.0032 , df=4

likelihood ratio test: chi2=15.8726 , p=0.0032 , df=4

parameter F test: F=3.9675 , p=0.0032 , df\_denom=6561, df\_num=4

Granger Causality

number of lags (no zero) 5

ssr based F test: F=2.7349 , p=0.0179 , df\_denom=6558, df\_num=5

ssr based chi2 test: chi2=13.6975 , p=0.0176 , df=5

likelihood ratio test: chi2=13.6832 , p=0.0178 , df=5

parameter F test: F=2.7349 , p=0.0179 , df\_denom=6558, df\_num=5

Granger Causality

number of lags (no zero) 6

ssr based F test: F=2.6107 , p=0.0158 , df\_denom=6555, df\_num=6

ssr based chi2 test: chi2=15.6952 , p=0.0155 , df=6

likelihood ratio test: chi2=15.6764 , p=0.0156 , df=6

parameter F test: F=2.6107 , p=0.0158 , df\_denom=6555, df\_num=6

Granger Causality

number of lags (no zero) 7

ssr based F test: F=2.8059 , p=0.0065 , df\_denom=6552, df\_num=7

ssr based chi2 test: chi2=19.6861 , p=0.0063 , df=7

likelihood ratio test: chi2=19.6566 , p=0.0064 , df=7

parameter F test: F=2.8059 , p=0.0065 , df\_denom=6552, df\_num=7

Granger Causality

number of lags (no zero) 8

ssr based F test: F=2.8705 , p=0.0034 , df\_denom=6549, df\_num=8

ssr based chi2 test: chi2=23.0240 , p=0.0033 , df=8

likelihood ratio test: chi2=22.9837 , p=0.0034 , df=8

parameter F test: F=2.8705 , p=0.0034 , df\_denom=6549, df\_num=8

Granger Causality

number of lags (no zero) 9

ssr based F test: F=2.9881 , p=0.0015 , df\_denom=6546, df\_num=9

ssr based chi2 test: chi2=26.9710 , p=0.0014 , df=9

likelihood ratio test: chi2=26.9157 , p=0.0014 , df=9

parameter F test: F=2.9881 , p=0.0015 , df\_denom=6546, df\_num=9

Granger Causality

number of lags (no zero) 10

ssr based F test: F=3.6215 , p=0.0001 , df\_denom=6543, df\_num=10

ssr based chi2 test: chi2=36.3315 , p=0.0001 , df=10

likelihood ratio test: chi2=36.2314 , p=0.0001 , df=10

parameter F test: F=3.6215 , p=0.0001 , df\_den

为什么第延迟越多，还越影响。