Homework 4 Solutions

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Aniline

Organic chemists often purify organic compounds by a method known as fractional crystallization. An experimenter wanted to prepare and purify 5 grams of aniline. It is postulated that 5 grams of aniline would yield 4 grams of acetanilide. Ten 5-gram quantities of aniline were individually prepared and purified.

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% (a) Test the hypothesis that the mean dry yield differs from 4 grams if
% the mean yield observed in a sample was X = 4.21. The population is
% assumed normal with known variance sigma^2 = 0.08. The significance level
% is set to alpha = 0.05.

% H0: mu = 4g
% HA: mu >= 4g

n = 10;
xbar = 4.21;
v = 0.08;
mu0 = 4;
alpha = 0.05;

RR = norminv(1-alpha); %1.6449; rejection region is Z>=1.6449
z = (xbar - mu0)/(sqrt(v/n)); %2.3479

% we can reject the null hypothesis because z = 2.3479, which is greater
% than 1.6449

% (b) Report the p-value.
p1 = 1-normcdf(z); %0.0094
% reject the null hypothesis with p = 0.0094, which is less than 0.05

% (c) For what values of X will the null hypothesis be rejected at the
% level alpha = 0.05?

%  1.96 <= (xbar - mu0)/(sqrt(v/n))
Xmin = 1.6449 * (sqrt(v/n)) + mu0; %4.1471 <= X

% (d) What is the power of the test for the alternative H1 : μ = 3.6 at ? =
% 0.05?

mu1=3.6;
power = normcdf(norminv(alpha) + (mu0 - mu1)/sqrt(v/n)); %0.9977
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% (e) If you are to design a similar experiment but would like to achieve a
% power of 90% versus the alternative H1 : μ = 3.6 at alpha = 0.05, what sample
% size would you recommended?

beta = 0.1;

n = (v/(mu0-mu1)^2)*(norminv(1-alpha)+norminv(1-beta))^2; %n = 4.2819
% we need a sample size of 5. You must round up because we want the power
% to be at least 90%, and you can't have a part of a sample.
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Is the Cloning of Humans Moral?

Gallup Poll estimates that 88% Americans believe that cloning humans is morally unacceptable. Results are based on telephone interviews with a randomly selected national sample of n = 1, 000 adults, aged 18 and older.

```
n = 1000;
phat = 0.88;
alpha = 0.05;

% (a) Test the hypothesis that the true proportion is 0.9, versus the
% twosided alternative, based on the Gallup data. Use alpha = 0.05.

p0 = 0.9;
z = (phat - p0)/sqrt(p0*(1-p0)/n); %-2.1082
p = 2*normcdf(-abs(z)); %0.0350, reject the null hypothesis that the true
% proportion is 0.9 since 0.035 < alpha

% Using the exact method
k2 = binoinv(1-alpha/2, n, p0);
k2star = k2 + 1; %919
k1 = binoinv(alpha/2, n, p0);
k1star = k1 - 1; %880
% RR: 880 <= X <= 919

alphastar = 2*min(binocdf(k1star,n,p0), 1-binocdf(k2star, n, p0));
% alphastar = 0.0352 < 0.05
% again, we reject the null hypothesis. Notice that this pvalue is very
% similar to the pvalue from the approximation method used above

% (b) Does 0.9 fall in the 95% confidence interval for the proportion?
rr = norminv(1-alpha/2);
UB = phat + rr*(sqrt(phat*(1-phat)/n)); %0.9001
LB = phat - rr*(sqrt(phat*(1-phat)/n)); %0.8599

% Yes. 85.99<90<90.01

% (c) What is the power of this test against the alternative H1 : p = 0.85?
p1 = 0.85;
power = normcdf((sqrt(n)*abs(p1-p0) - ...
norminv(1-alpha/2)*sqrt(p0*(1-p0)))/sqrt(p1*(1-p1)) ); %0.9973

% exact power
```

```
kargs = 0:n;
u = 2*min(binocdf(kargs, n, p0),1-binocdf(kargs-1, n, p0)) <= alpha; %indicator
exactpower = sum( binopdf(kargs, n, p1).*u ); %0.9972
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