Answers for Questions

Q1

independent variable: the condition of test, congruent and incongruent.
dependent variable: the time it takes to name the ink colors

Q2

Dependent t-test for paired samples: two conditions
μ_1 is used for denoting population mean on the congruent condition test
μ_2 is used for denoting population mean on the incongruent condition test
$H_0{:}\ \mu_1=\mu_2$ there is no significant difference between population parameters on the two kinds of tests
$H_A{:}\ \mu_1\neq\mu_2$ the congruent population performed faster or slower than the incongruent population

Justify the choice of the test:
1 choose t-test instead of the z-test, since we don't know the population standard deviation. In addition, the sample size is 24 which is smaller than 30.
2 Each sample does the task twice on different conditions—congruent and incongruent conditions
   The test is a within-subject design.
   It helps us to reduce the individual difference.
   However, the independent samples test needs two group of samples, each group does the task only once. It is possible that some people are good at doing such kind of task. Independent test may be less precise.
3 I prefer two-tailed test.
   If we use one-tailed test, we may miss an effect in the untested direction.
   What's more, the most commonly used test statistic distributions are symmetric, most on-tailed p-values can be derived from the two-tailed p-values

Assumptions for the t-test:
1 the samples are randomly selected from its population.
2 the dependent variables must be continuous.
3 the dependent variables must follow the normal probability distribution.
4 the dependent variable of each sample cannot be affected by other's.

Q3

Congruent condition(1 subscript):
n1 = 24
df1 = 23
SS1 = 291.39
M1 = 14.05
SD1 = 3.56
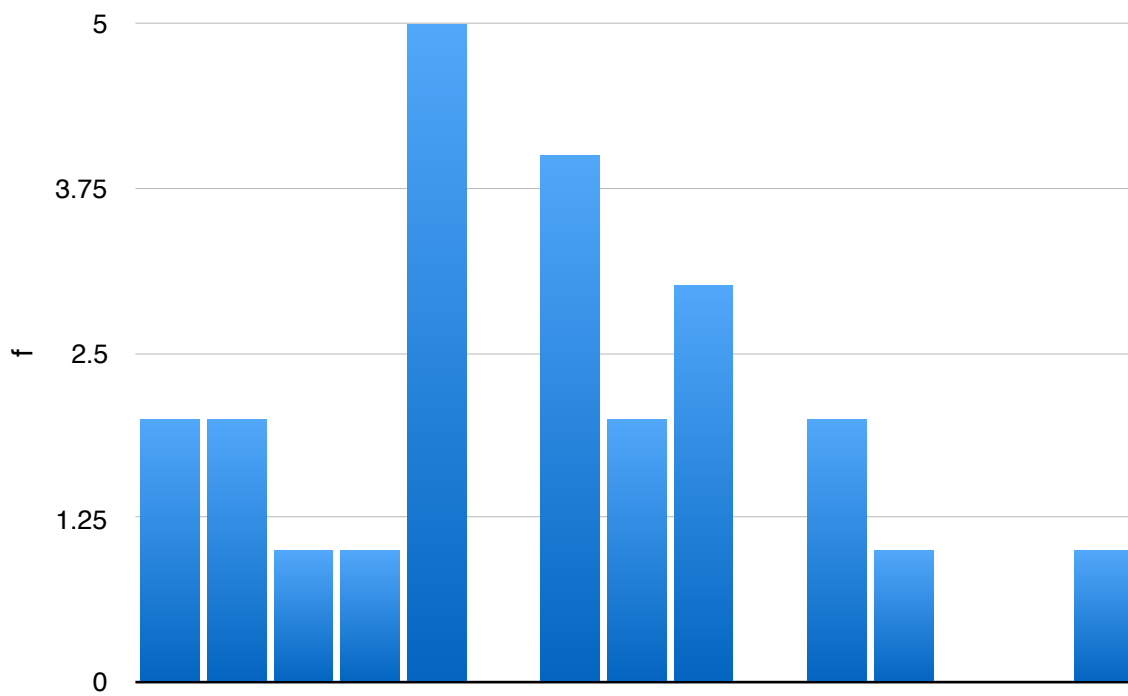
Incongruent condition(2 subscript):
n2 = 24
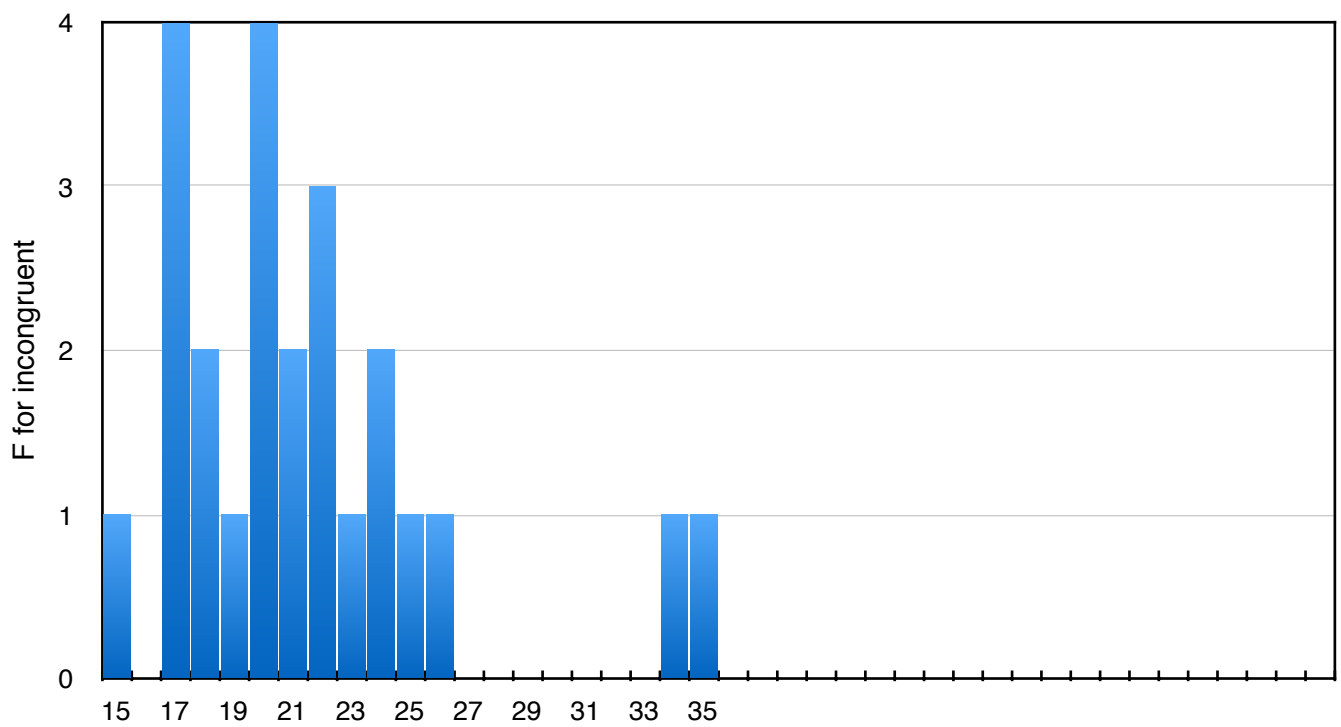df2 = 23
SS2 = 529.27
M2 = 22.02
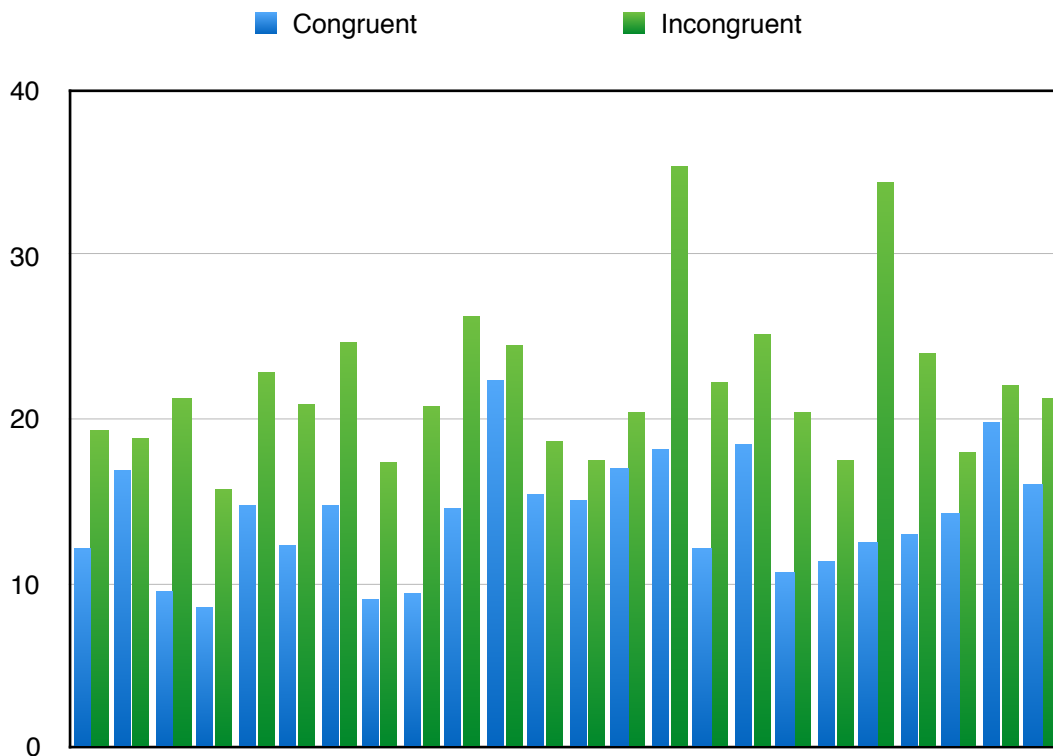SD2 = 4.80

Histogram for Congruent Data

1 bin size is 1
2 normal distribution

Histogram for Incongruent Data

1 bin size is 1
2 normal distribution

1. Each participant spent more time for incongruent condition

Q5
S = 4.864826910359053
Md = -7.96479166666666
n = 24
SED = S/math.sqrt(n) = 0.99302863477834
t-statistics = Md/SED = -8.020706944109955

t(23) = 2.069, p<.05, two-tailed

confidence interval:
(Md− t(23)*S/math.sqrt(n), Md + t(23)*S/math.sqrt(n))
=(−10.019367912023046,−5.910215421310274)

result: reject the H_0 and accept H_A
        People perform faster on congruent task than the incongruent task.

Reference:
1 http://stats.idre.ucla.edu/other/mult-pkg/faq/general/faq-what-are-the-differences-between-one-tailed-and-two-tailed-tests/
2 http://www.csic.cornell.edu/Elrod/t-test/t-test-assumptions.html