```
/*program for figure 1 power for normality assessment*/

libname t1 "";/*set the folder where to save output*/

/*set here the folder where to save logs and outputs*/
proc printto log  ='';run;
proc printto print='';run;

%let rep=1;/*number of replicates for simulations n>5000 recommended*/

%macro gen;
%do obs=2 %to 50 ;      /*number of observations*/
data a&obs;
do rep=1 to &rep;       /*number of replicates*/
        do obs=1 to &obs;
y=RAND('UNIFORM') ;output; /*shape of the distribution change according to
http://support.sas.com/documentation/cdl/en/lrdict/64316/HTML/default/viewer.htm#a001466748.htm*/
        end;
end;
run;
data GOF&obs;Test="XXXXXXXXXXXXXXXXXXXXXXX";run;
%end;
%mend;
%gen;


/*perform the test of normality*/

%macro norm;
%do rep=1 %to &rep;   /*number of replicates  */
        %do obs=2 %to 25 ;/*number of observations*/
```

```
proc univariate data=a&obs normal;where rep=&rep;

ods output TestsForNormality=GOF&obs._&rep;

run;

data GOF&obs._&rep;set GOF&obs._&rep;rep=&rep;run;

data GOF&obs;set GOF&obs GOF&obs._&rep;if pValue=. then delete;if VarName="obs" then
delete;run;

data GOF&obs;set GOF&obs;

result=0;

if pSign=">"            then result=1;

if pSign=" " & pValue>0.05 then result=1;

if Test="XXXXXXXXXXXXXXXXXXXXXXXX" then delete;

run;

proc means data=GOF&obs noprint;class TestLab rep;var result;output out=X&obs sum=sum
mean=mean;run;

data t1.nor&obs;set X&obs;if TestLab="" or rep^=. then delete;drop rep; rename mean=
error_rate;run;

        %end;

%end;

%mend;

%norm;

proc datasets lib=work nolist kill;run;quit; /*clean the work library*/


/*examples for power calculation*/


*t-test equal variances;

proc power;

   twosamplemeans test=diff

    meandiff = 0.3 0.5 0.8 /*cohen's d standardized effect sizes */

    stddev = 1

    npergroup = 10 to 50 by 5

    power = .;

          plot x=n; /*perform the plot*/
```

```
run;


*t-test unequal variances;
proc power;
    twosamplemeans test=test=diff_satt
     meandiff = 0.3 0.5 0.8 /*cohen's d standardized effect sizes */
     stddev = 1
     npergroup = 10 to 50 by 5
     power = .;
            plot x=n; /*perform the plot*/
run;


/*non parametric comparisons*/


proc power;
    twosamplewilcoxon
     vardist("uniform1") = uniform (0, 1)
     vardist("uniform2") = uniform (0.2, 1.2)
     variables = "uniform1" | "uniform2"
     ntotal = 10 to 50 by 5
     power =.;
            plot x=n;
run;


/*example how to compute power for different distributions*/
/*check sas proc power at
https://support.sas.com/documentation/cdl/en/statug/63962/HTML/default/viewer.htm#statug_power_sect015.htm*/


vardist("ordinal")        = ordinal ((0 1 2) : (.2 .3 .5))
vardist("beta")           = beta (1, 2)
vardist("binomial")       = binomial (.3, 3)
```

```
vardist("exponential")   = exponential (2)
vardist("gamma")                 = gamma (1.5, 2)
vardist("laplace")               = laplace (1, 2)
vardist("logistic")        = logistic (1, 2)
vardist("lognormal")     = lognormal (1, 2)
vardist("normal")                = normal (3, 2)
vardist("poisson")               = poisson

/*one way analysis of variance*/;

*test on linear contrast between groups;
proc power;
  onewayanova test=contrast
    contrast = (1 0 -1)              /*coefficient for linear contrasts*/
    groupmeans = -0.5 | 0 | +0.5  /*note mean1-mean3/stdev as Cohen's d*/
    stddev = 1
    npergroup = 10 to 50 by 5
    power = .;
          plot x=n;
run;

*test on omnibus test (F snedecor);
proc power;
  onewayanova test=overall
    contrast = (1 0 -1)
    groupmeans = -0.5 | 0 | +0.5  /*note mean1-mean3/stdev as Cohen's d*/
    stddev = 1
    npergroup = 10 to 50 by 5
    power = .;
run;
```

```
/*comparison between two proportion by Fisher's exact test*/
proc power;
  twosamplefreq test=fisher /*use "chisq" for ordinary chi-squared test*/
    grouppproportions = (.35 .15)
    npergroup = 10 to 50 by 10
    power = .;
          plot x=n;
run;

/*repeated measures ANOVA*/

data use;/*step 1 create a dataset with means by groups*/
    input Treatment $ out1 out2 out3 out4;/*outcomes variables 4 time points*/
    datalines;
    groupA   1   1         1         1
    groupB   1   1.5 2     2.5
;run;


proc glmpower data=use;/*step 2 declare other parameters*/
  class Treatment;
  model out1 out2 out3 out4 = Treatment;
  repeated Time contrast;
  power
    mtest = hlt
    alpha = 0.05
    power = .
    ntotal = 10 to 50 by 10
    stddev = 1
    MATRIX ("corr") = (1                                    /*define the correlation matrix
among measures*/
```

```
                0.2  1
                0.2  0.2  1
                0.2  0.2  0.2   1)
    corrmat = "corr";
            plot x=n;
run;
```