

SAS CODE AND OUTPUT

```
/* problem 2*/
data oneway;
do level = 1 to 4; input delta @@; output; end;
lines;
0 10 0 10
;
proc glmpower data=oneway;
class level;
model delta = level;
power
stddev = 5 6 7
alpha = 0.05
ntotal = .
power = 0.90;
run;
/* problem 4: john's code edited*/
DM 'LOG; CLEAR; OUT; CLEAR;';
OPTIONS NODATE NONUMBER;

DATA in410; INPUT nozzle velocity shape @@; CARDS;
1 11.73 .78 2 11.73 .85 3 11.73 .93 4 11.73 1.14 5 11.73 .97
1 14.37 .80 2 14.37 .85 3 14.37 .92 4 14.37 .97 5 14.37 .86
1 16.59 .81 2 16.59 .92 3 16.59 .95 4 16.59 .98 5 16.59 .78
1 20.43 .75 2 20.43 .86 3 20.43 .89 4 20.43 .88 5 20.43 .76
1 23.46 .77 2 23.46 .81 3 23.46 .89 4 23.46 .86 5 23.46 .76
1 28.74 .78 2 28.74 .83 3 28.74 .83 4 28.74 .83 5 28.74 .75
;

PROC GLM DATA=in410 PLOTS=(ALL);
  CLASS nozzle velocity;
  MODEL shape = nozzle velocity / SS3 SOLUTION;
  MEANS velocity;
  MEANS nozzle / BON;
  ESTIMATE 'TAU 1' nozzle 4 -1 -1 -1 -1 / DIVISOR=5;
  ESTIMATE 'TAU 2' nozzle -1 4 -1 -1 -1 / DIVISOR=5;
  ESTIMATE 'TAU 3' nozzle -1 -1 4 -1 -1 / DIVISOR=5;
  ESTIMATE 'TAU 4' nozzle -1 -1 -1 4 -1 / DIVISOR=5;
  ESTIMATE 'TAU 5' nozzle -1 -1 -1 -1 4 / DIVISOR=5;

  ESTIMATE 'BETA 1' velocity 5 -1 -1 -1 -1 -1 / DIVISOR=6;
  ESTIMATE 'BETA 2' velocity -1 5 -1 -1 -1 -1 / DIVISOR=6;
  ESTIMATE 'BETA 3' velocity -1 -1 5 -1 -1 -1 / DIVISOR=6;
  ESTIMATE 'BETA 4' velocity -1 -1 -1 5 -1 -1 / DIVISOR=6;
  ESTIMATE 'BETA 5' velocity -1 -1 -1 -1 5 -1 / DIVISOR=6;
  ESTIMATE 'BETA 6' velocity -1 -1 -1 -1 -1 5 / DIVISOR=6;

TITLE 'PROBLEM 4.10';
```

RUN;

PROBLEM 4

Means with the same letter are not significantly different.					
Bon Grouping		Mean	N	nozzle	
	A	0.94333	6	4	
	A				
B	A	0.90167	6	3	
B	A				
B	A	C	0.85333	6	2
B		C			
B		C	0.81333	6	5
		C			
		C	0.78167	6	1

Parameter	Estimate		Standard Error	t Value	Pr > t
Intercept	0.7586666667	B	0.03090307	24.55	<.0001
nozzle 1	-.0316666667	B	0.03090307	-1.02	0.3177
nozzle 2	0.0400000000	B	0.03090307	1.29	0.2103
nozzle 3	0.0883333333	B	0.03090307	2.86	0.0097
nozzle 4	0.1300000000	B	0.03090307	4.21	0.0004
nozzle 5	0.0000000000	B	-	-	-
velocity 11.73	0.1300000000	B	0.03385262	3.84	0.0010
velocity 14.37	0.0760000000	B	0.03385262	2.25	0.0362
velocity 16.59	0.0840000000	B	0.03385262	2.48	0.0221
velocity 20.43	0.0240000000	B	0.03385262	0.71	0.4865
velocity 23.46	0.0140000000	B	0.03385262	0.41	0.6836
velocity 28.74	0.0000000000	B	-	-	-

Dependent Variable: shape

Parameter	Estimate	Standard Error	t Value	Pr > t
TAU 1	-0.06416667	0.01628735	-3.94	0.0008
TAU 2	-0.00444444	0.01628735	-0.27	0.7877
TAU 3	0.03583333	0.01628735	2.20	0.0397
TAU 4	0.07055556	0.01628735	4.33	0.0003
TAU 5	-0.03777778	0.01628735	-2.32	0.0311
BETA 1	0.09040000	0.02622213	3.45	0.0025
BETA 2	0.02560000	0.02622213	0.98	0.3406
BETA 3	0.03520000	0.02622213	1.34	0.1945
BETA 4	-0.03680000	0.02622213	-1.40	0.1758
BETA 5	-0.04880000	0.02622213	-1.86	0.0775
BETA 6	-0.06560000	0.02622213	-2.50	0.0212

