Advanced Biostatistics **Homework 1** ***Due on or before Thursday Sept. 4 by 5pm***

An Important Note on Homework Assignments – Graduate Students are to submit their own answers (report), whereas Undergraduate Students are to work in a team of three (3) students (the same team throughout the semester). Thus, Undergraduate Students will submit one solution report per team and the subsequent grade will apply to all students in the corresponding group.

Directions: Answer the (parts of the) following four exercises, showing all relevant work. Conclusions and justifications are to be given in clear detailed English. Please type up your solutions or write ***very*** neatly.

1. [All Students] Norman & Streiner report (p.146) the medical data set reproduced below. Analyze these data by performing each of the following analyses. In each case, list all necessary assumptions, and clearly summarize your conclusions.

Subject	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Y	46	36	40	44	36	30	42	35	42	50	45	53	48	38	43	58
Treatment	A	A	B	A	A	B	A	B	B	A	A	B	B	B	B	A
X	12	14	27	35	26	21	48	51	62	64	60	77	91	84	55	74

   (a) Perform two independent sample t-tests (one assuming equal variances and one assuming unequal variances) comparing the Y averages for the two treatment groups.

   (b) Regress Y on X, obtain parameter estimates, and test whether X is a good predictor of Y.

   (c) Perform the ANOCOV (Analysis of covariance) analysis to determine if the Y averages differ for the two treatment groups after removing the effect of X.

2. [All Students] Extracorporeal membrane oxygenation (ECMO) is a potentially life-saving procedure that is used to treat newborn babies who suffer from severe respiratory failure. An experiment was conducted in which 20 babies were treated with ECMO and 30 babies were treated with conventional medical therapy (CMT). At the end of the study, 11 of the CMT babies died (19 survived), and only 2 of the ECMO babies died (18 survived).

   (a) Test whether these data suggest that the therapies significantly differ. Also, test the one-tailed alternative that the ECMO procedure is better than (in terms of better survival rates) the conventional therapy.

   (b) Find and interpret the Odds Ratio (OR) of survival comparing the ECMO therapy with the CMT, and provide a 95% confidence interval for the true OR.

   (c) Let's alter the above data by supposing that of the 20 ECMO babies, only one died (19 survived). Explain why the usual (chi-square) test statistic is inappropriate here, and analyze these new data using the correct analysis. For this part, perform only the one-tailed test specified as the second test in part (a).

3. [G students only] Two groups of children, one with attention deficit disorder (ADD) and a control group of children without ADD, were randomly given either a placebo or the drug Ritalin. A measure of activity was made on all the children with the results shown in the table below (higher numbers indicate more activity). Analyze these data (listing all necessary assumptions), including all relevant observations and implications.

Treatment	**Group**	**Drug**	**Activity**
1	ADD	PLACEBO	90
1	ADD	PLACEBO	88
1	ADD	PLACEBO	95
2	CONTROL	PLACEBO	60
2	CONTROL	PLACEBO	62

2	CONTROL	PLACEBO	66
3	ADD	RITALIN	72
3	ADD	RITALIN	70
3	ADD	RITALIN	64
4	CONTROL	RITALIN	86
4	CONTROL	RITALIN	86
4	CONTROL	RITALIN	82

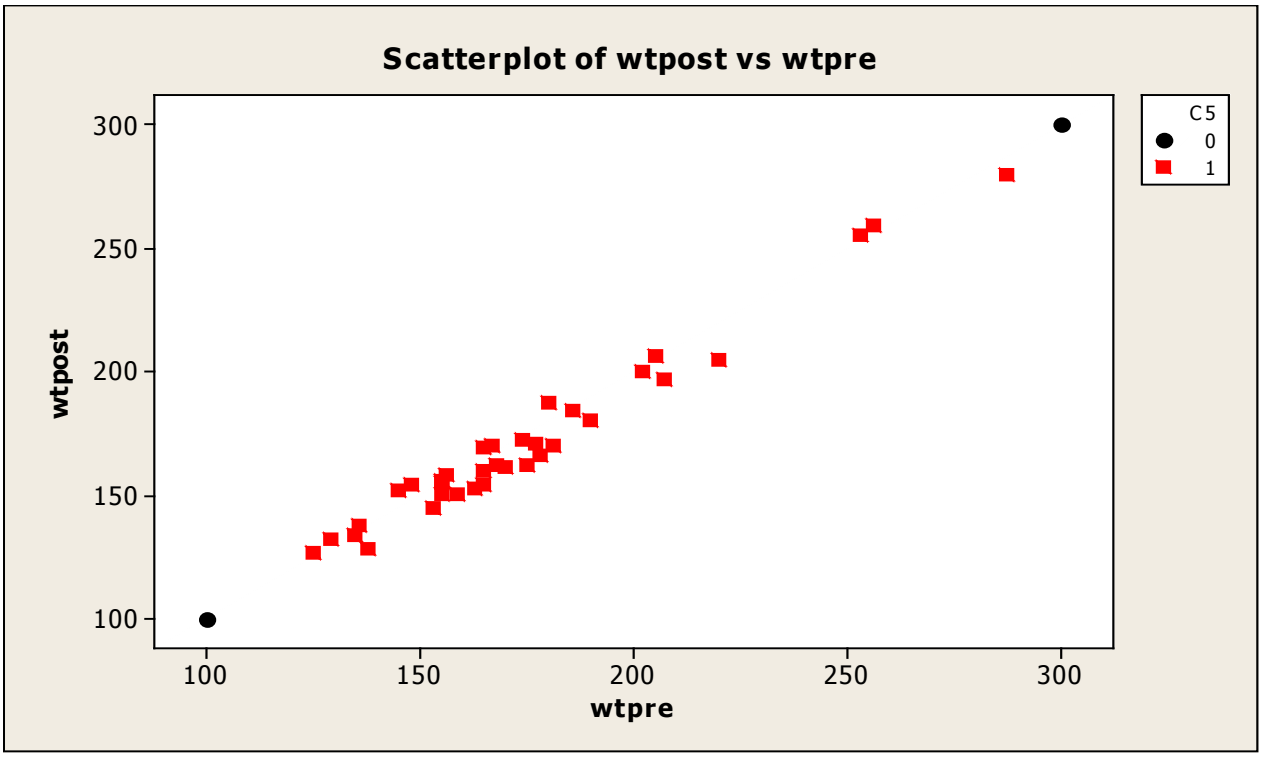
4. [All Students; Walker, 2002:61] A drug company is developing a new appetite suppressing compound for use in weight reduction. A preliminary study of 35 obese patients provided the following data on patients' body weights (in pounds) before ("PreW", in pounds) and after ("PostW", in pounds) 10 weeks of treatment with the new compound. These data are graphed on the next page (red squares) with two additional points (black circles): one at the point (100,100) and one at the point (300,300); these latter two points are not a part of the data, but may be useful for part (c) of this exercise.

Sub	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
PreW	165	202	256	155	135	175	180	174	136	168	207	155	220	163	159	253	138	287
PostW	160	200	259	156	134	162	187	172	138	162	197	155	205	153	150	255	128	280
Sub	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	
PreW	177	181	148	167	190	165	155	153	205	186	178	129	125	165	156	170	145	
PostW	171	170	154	170	180	154	150	145	206	184	166	132	127	169	158	161	152	

(a) Does the new treatment look at all promising? Be specific and list all necessary assumptions and/or reasons why some usual one(s) are not needed here.

(b) Does a subjects' "Pre" weight appear to be a good linear predictor of his/her "Post" weight? Again, be specific and list all necessary assumptions and/or reasons why some usual one(s) are not needed here.

(c) Reconcile the analyses in parts (a) and (b). That is, discuss any connection(s) (if any) between the two analyses.



Homework 1 Attachment – Minitab Output

Exercise 1(a)

Two-Sample T-Test and CI: y, trt

```
Two-sample T for y
trt         N      Mean     StDev   SE Mean
a           8     44.63      7.23       2.6
b           8     41.13      7.22       2.6

Difference = mu (a) - mu (b)      Estimate for difference:  3.50
95% CI for difference: (-4.25, 11.25)
T-Test of difference = 0 (vs not =): T-Value = 0.97  P-Value = 0.349  DF = 14
Both use Pooled StDev = 7.22
```

Two-Sample T-Test and CI: y, trt

```
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trt         N      Mean     StDev   SE Mean
a           8     44.63      7.23       2.6
b           8     41.13      7.22       2.6

Difference = mu (a) - mu (b)     Estimate for difference:  3.50
95% CI for difference: (-4.30, 11.30)
T-Test of difference = 0 (vs not =): T-Value = 0.97  P-Value = 0.350  DF = 13
```

Exercise 1(b)

Regression Analysis: y versus x

```
The regression equation is
y = 35.0 + 0.158 x

Predictor        Coef     SE Coef           T        P
Constant       34.978       3.553        9.84    0.000
x             0.15774     0.06381        2.47    0.027
S = 6.227       R-Sq = 30.4%     R-Sq(adj) = 25.4%

Analysis of Variance
Source            DF          SS          MS         F        P
Regression         1      236.94      236.94      6.11    0.027
Residual Error    14      542.81       38.77
Total             15      779.75
```

Exercise 1(c)

Regression Analysis: y versus x, dum, dumx

```
The regression equation is
y = 35.1 + 0.228 x - 5.09 dum - 0.039 dumx

Predictor        Coef     SE Coef           T        P
Constant       35.127       4.192        8.38    0.000
x             0.22819     0.08908        2.56    0.025
dum            -5.093       6.673       -0.76    0.460
dumx          -0.0386      0.1212       -0.32    0.756

S = 5.532       R-Sq = 52.9%     R-Sq(adj) = 41.1%

Analysis of Variance
Source            DF          SS          MS         F        P
Regression         3      412.55      137.52      4.49    0.025
Residual Error    12      367.20       30.60
Total             15      779.75
```

Regression Analysis: y versus x, dum

```
The regression equation is
y = 36.0 + 0.207 x - 7.00 dum

Predictor        Coef     SE Coef           T        P
Constant       35.994       3.074       11.71    0.000
x             0.20735     0.05829        3.56    0.004
dum            -6.999       2.844       -2.46    0.029

S = 5.337       R-Sq = 52.5%     R-Sq(adj) = 45.2%

Analysis of Variance
Source            DF          SS          MS         F        P
Regression         2      409.45      204.72      7.19    0.008
Residual Error    13      370.30       28.48
Total             15      779.75
```

Exercise 2(a)

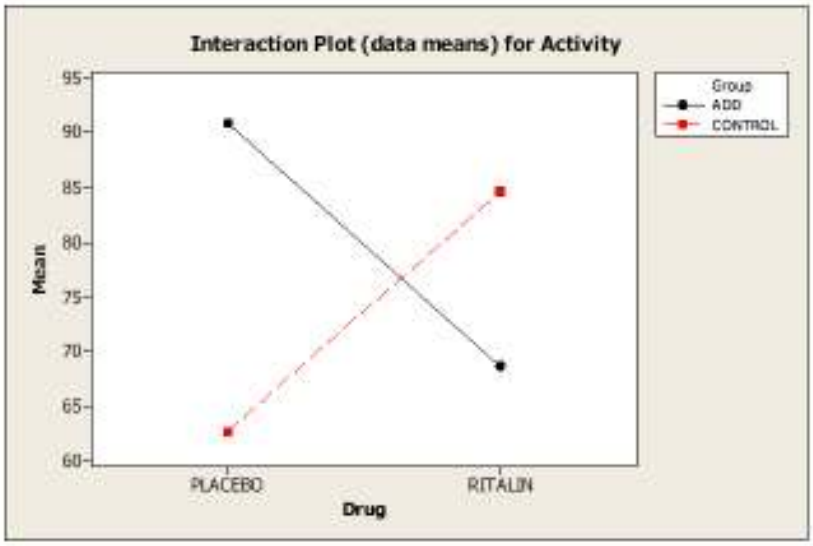
Chi-Square Test: CMT, ECMO

```
Expected counts are printed below observed counts

          ECMO      CMT    Total
    1       18       19       37
          14.80    22.20

    2        2       11       13
           5.20     7.80

Total       20       30       50

Chi-Sq =  0.692 +  0.461 +
          1.969 +  1.313 = 4.435
DF = 1, P-Value = 0.035
```

Exercise 3

Two-way ANOVA: activity versus group, drug

```
Analysis of Variance for activity
Source        DF        SS        MS        F        P
group          1     114.1     114.1    10.14    0.013
drug           1       0.1       0.1     0.01    0.934
Interaction    1    1474.1    1474.1   131.03    0.000
Error          8      90.0      11.3
Total         11    1678.3
```



Exercise 4(a)

Paired T-Test and CI: wtpre, wtpost

```
Paired T for wtpre - wtpost

                 N      Mean     StDev   SE Mean
wtpre           35    174.94     35.94      6.07
wtpost          35    171.49     35.45      5.99
Difference      35      3.46      6.34      1.07

95% lower bound for mean difference: 1.65
T-Test of mean difference = 0 (vs > 0): T-Value = 3.23  P-Value = 0.001
```

Exercise 4(b)

Regression Analysis: wtpost versus wtpre

```
The regression equation is
wtpost = 1.61 + 0.971 wtpre

Predictor        Coef     SE Coef          T        P
Constant        1.615       5.407       0.30    0.767
wtpre         0.97101     0.03030      32.05    0.000

S = 6.348       R-Sq = 96.9%     R-Sq(adj) = 96.8%

Analysis of Variance
Source            DF          SS          MS         F        P
Regression         1       41397       41397   1027.31    0.000
Residual Error    33        1330          40
Total             34       42727

Unusual Observations
Obs      wtpre     wtpost         Fit      SE Fit    Residual    St Resid
  3        256     259.00      250.19        2.68        8.81        1.53 X
 18        287     280.00      280.29        3.56       -0.29       -0.06 X
X denotes an observation whose X value gives it large influence.
```