

Effect of Source and Level of Protein on Weight Gain of Rats

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1 * two factor analysis of variance with interaction;
2 option ls=120 ps=75 nocenter nodate;
3
4 title 'Effect of Source of Protein and Level of Protein on Weight
5 Gains in Rats';
6 * Weight gain is the response variable. The factors are
7 source of protein (cereal, beef and pork) and level of protein
8 (high, low).;
9 * There are ten observations of each treatment combination.;
10
11 data PARTS; array S S1-S10;
12   input TREAT $ SOURCE $ LEVEL $ S1-S10;           * input each sample by treatment;
13   do over S; GAIN=S; output; end;                   * output observations;
14   drop S1-S10;
15   label GAIN='Weight Gain'
16         TREAT='Source and Level of Protein Combination'
17         SOURCE='Source of Protein'
18         LEVEL='Level of Protein';
19
20 cards;
21 BH  Beef   High   73 102 118 104  81 107 100  87 117 111
22 BL  Beef   Low    90  76  90  64  86  51  72  90  95  78
23 PH  Pork   High   94  79  96  98 102 102 108  91 120 105
24 PL  Pork   Low    49  82  73  86  81  97 106  70  61  82
25 CH  Cereal High   98  74  56 111  95  88  82  77  86  92
26 CL  Cereal Low   107  95  97  80  98  74  74  67  89  58
27
28 proc print; var SOURCE LEVEL GAIN;
29 PROC SORT; BY TREAT;
30 PROC UNIVARIATE DEF=5 PLOT;BY TREAT;           * BOXPLOTS FOR ALL SAMPLES;
31 VAR GAIN;
32
33 proc glm; class SOURCE LEVEL;                   * SOURCE and LEVEL are factors;
34   MODEL GAIN=SOURCE|LEVEL/SS1 SS2 SS3 SS4;
35   OUTPUT OUT=NEW P=MEANS R=RESID;           * OUTPUT SAMPLE MEANS AND RESIDUALS;
36   MEANS SOURCE|LEVEL;
37   label MEANS='Sample Means'
38         RESID='Residuals from Model With Interaction';
39 proc glm; class TREAT; model GAIN=TREAT/ss1;
40   MEANS TREAT/TUKEY;                         *TUKEY'S TEST ON ALL MEANS;
41   estimate   'Level of Protein'  TREAT 1 -1 1 -1 1 -1;
42   contrast   'Level of Protein'  TREAT 1 -1 1 -1 1 -1;
43
44   estimate   'Animal vs. Vegetable' TREAT 1 1 -2 -2 1 1;
45   contrast   'Animal vs. Vegetable' TREAT 1 1 -2 -2 1 1;
46
47   estimate   'Interaction of Level with Combined Sources'
48             TREAT .5 -.5 -1 1 .5 -.5;
49   contrast   'Interaction of Level with Combined Sources'
50             TREAT .5 -.5 -1 1 .5 -.5 ;

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51
52 estimate      'Beef vs. Pork'  TREAT 1 1 0 0 -1 -1;
53 contrast      'Beef vs. Pork'  TREAT 1 1 0 0 -1 -1;
54
55 estimate      'Interaction of Level vs. Meat' TREAT 1 -1 0 0 -1 1;
56 contrast      'Interaction of Level vs. Meat' TREAT 1 -1 0 0 -1 1;
57
58 proc plot; plot MEANS*SOURCE=LEVEL;          * interaction plot;
59 proc plot; plot RESID*MEANS;                 * check residuals;

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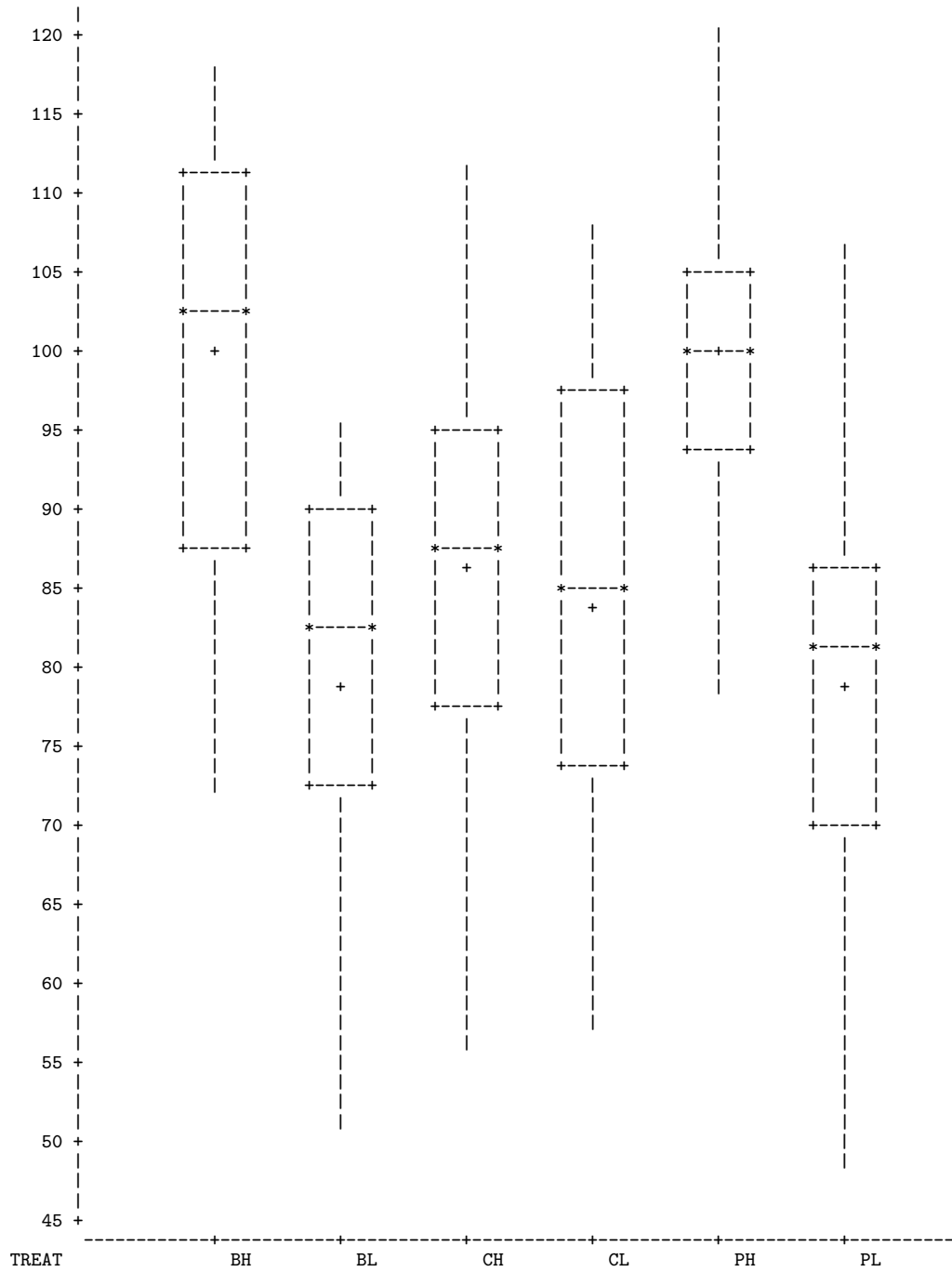
Effect of Source of Protein and Level of Protein on Weight Gains in Rats

OBS	SOURCE	LEVEL	GAIN	OBS	SOURCE	LEVEL	GAIN
1	Beef	High	73	31	Pork	Low	49
2	Beef	High	102	32	Pork	Low	82
3	Beef	High	118	33	Pork	Low	73
4	Beef	High	104	34	Pork	Low	86
5	Beef	High	81	35	Pork	Low	81
6	Beef	High	107	36	Pork	Low	97
7	Beef	High	100	37	Pork	Low	106
8	Beef	High	87	38	Pork	Low	70
9	Beef	High	117	39	Pork	Low	61
10	Beef	High	111	40	Pork	Low	82
11	Beef	Low	90	41	Cereal	High	98
12	Beef	Low	76	42	Cereal	High	74
13	Beef	Low	90	43	Cereal	High	56
14	Beef	Low	64	44	Cereal	High	111
15	Beef	Low	86	45	Cereal	High	95
16	Beef	Low	51	46	Cereal	High	88
17	Beef	Low	72	47	Cereal	High	82
18	Beef	Low	90	48	Cereal	High	77
19	Beef	Low	95	49	Cereal	High	86
20	Beef	Low	78	50	Cereal	High	92
21	Pork	High	94	51	Cereal	Low	107
22	Pork	High	79	52	Cereal	Low	95
23	Pork	High	96	53	Cereal	Low	97
24	Pork	High	98	54	Cereal	Low	80
25	Pork	High	102	55	Cereal	Low	98
26	Pork	High	102	56	Cereal	Low	74
27	Pork	High	108	57	Cereal	Low	74
28	Pork	High	91	58	Cereal	Low	67
29	Pork	High	120	59	Cereal	Low	89
30	Pork	High	105	60	Cereal	Low	58

Univariate Procedure
Schematic Plots

Variable=GAIN

Weight Gain



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General Linear Models Procedure
Class Level Information

Class	Levels	Values
SOURCE	3	Beef Cereal Pork
LEVEL	2	High Low

Number of observations in data set = 60

General Linear Models Procedure

Dependent Variable: GAIN Weight Gain

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	4612.93333333	922.58666667	4.30	0.0023
Error	54	11586.00000000	214.55555556		
Corrected Total	59	16198.93333333			

R-Square	C.V.	Root MSE	GAIN Mean
0.284768	16.67039	14.64771503	87.86666667

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SOURCE	2	266.53333333	133.26666667	0.62	0.5411
LEVEL	1	3168.26666667	3168.26666667	14.77	0.0003
SOURCE*LEVEL	2	1178.13333333	589.06666667	2.75	0.0732

Source	DF	Type II SS	Mean Square	F Value	Pr > F
SOURCE	2	266.53333333	133.26666667	0.62	0.5411
LEVEL	1	3168.26666667	3168.26666667	14.77	0.0003
SOURCE*LEVEL	2	1178.13333333	589.06666667	2.75	0.0732

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SOURCE	2	266.53333333	133.26666667	0.62	0.5411
LEVEL	1	3168.26666667	3168.26666667	14.77	0.0003
SOURCE*LEVEL	2	1178.13333333	589.06666667	2.75	0.0732

Source	DF	Type IV SS	Mean Square	F Value	Pr > F
SOURCE	2	266.53333333	133.26666667	0.62	0.5411
LEVEL	1	3168.26666667	3168.26666667	14.77	0.0003
SOURCE*LEVEL	2	1178.13333333	589.06666667	2.75	0.0732

Level of SOURCE	N	Mean	SD
Beef	20	89.60000000	17.7123210
Cereal	20	84.90000000	14.9943849
Pork	20	89.10000000	17.3202042

Level of LEVEL	N	Mean	SD
High	30	95.13333333	14.9083021
Low	30	80.60000000	15.0690365

Level of SOURCE	Level of LEVEL	N	Mean	SD
Beef	High	10	100.00000000	15.1364167
Beef	Low	10	79.20000000	13.8868443
Cereal	High	10	85.90000000	15.0218360
Cereal	Low	10	83.90000000	15.7088086
Pork	High	10	99.50000000	10.9163486
Pork	Low	10	78.70000000	16.5465673

General Linear Models Procedure
Class Level Information

Class	Levels	Values
TREAT	6	BH BL CH CL PH PL

Number of observations in data set = 60
General Linear Models Procedure

Dependent Variable: GAIN Weight Gain

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	4612.93333333	922.58666667	4.30	0.0023
Error	54	11586.00000000	214.55555556		
Corrected Total	59	16198.93333333			

R-Square	C.V.	Root MSE	GAIN Mean
0.284768	16.67039	14.64771503	87.86666667

Source	DF	Type I SS	Mean Square	F Value	Pr > F
TREAT	5	4612.93333333	922.58666667	4.30	0.0023

Tukey's Studentized Range (HSD) Test for variable: GAIN

NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.

Alpha= 0.05 df= 54 MSE= 214.5556
Critical Value of Studentized Range= 4.178
Minimum Significant Difference= 19.354

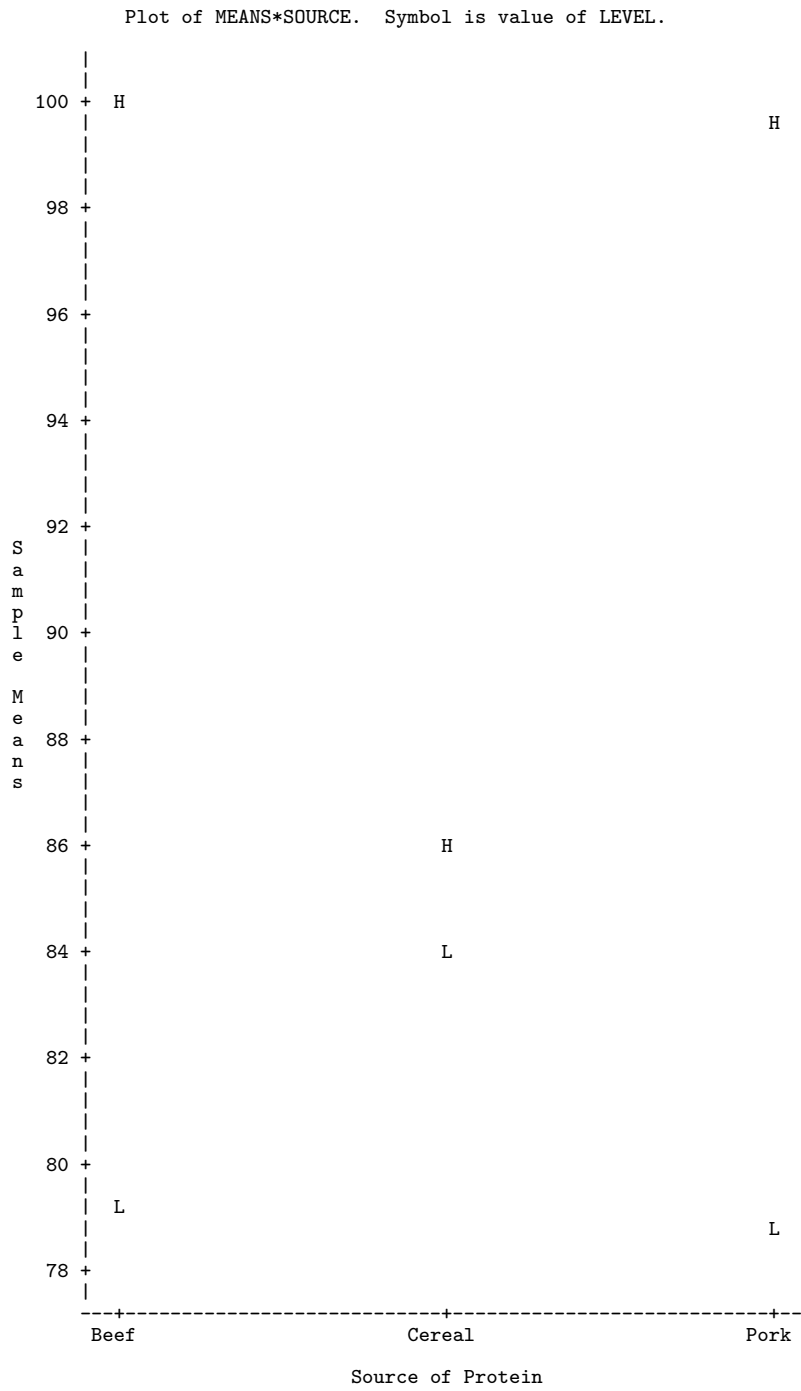
Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	TREAT
A	100.000	10	BH
A			
A	99.500	10	PH
A			
B	85.900	10	CH
B			
B	83.900	10	CL
B			
B	79.200	10	BL
B			
B	78.700	10	PL

Dependent Variable: GAIN Weight Gain

Contrast	DF	Contrast SS	Mean Square	F Value	Pr > F
Level of Protein	1	3168.26666667	3168.26666667	14.77	0.0003
Animal vs. Vegetable	1	264.03333333	264.03333333	1.23	0.2722
Interaction of Level	1	1178.13333333	1178.13333333	5.49	0.0228
Beef vs. Pork	1	2.50000000	2.50000000	0.01	0.9144
Interaction of Level	1	0.00000000	0.00000000	0.00	1.0000

Parameter	Estimate	T for H0: Parameter=0	Pr > T	Std Error of Estimate
Level of Protein	43.6000000	3.84	0.0003	11.3460713
Animal vs. Vegetable	17.8000000	1.11	0.2722	16.0457679
Interaction of Level	18.8000000	2.34	0.0228	8.0228839
Beef vs. Pork	1.0000000	0.11	0.9144	9.2640284
Interaction of Level	-0.0000000	-0.00	1.0000	9.2640284



NOTE: 54 obs hidden.

Plot of RESID*MEANS. Legend: A = 1 obs, B = 2 obs, etc.

