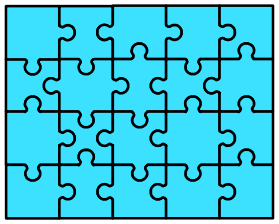
Statistical Techniques II

EXST7015

Treatment Arrangement Examples



Example 7 - Tmt Arrangement

- Example from Snedecor & Cochran, 1980 (pg 305).
- Dependent variable - Rat weight gain
- treatments - factorial arrangement protein source (beef, pork, cereal) and protein level in the diet (with & without).
- Treatments most likely should be fixed, so TYPE III SS will give the correct test results.

Example 7 *(continued)*

- **This is the EMS for this experiment. The TYPE III SS tests are correct.**

Source	d.f.	SS	EMS
Tmt 1	t1-1	SSTmt1	$\sigma^2 + nt_2\Sigma\tau^2_{1i}/(\tau 1-1)$
Tmt 2	t2-1	SSTmt2	$\sigma^2 + nt_1\Sigma\tau^2_{2j}/(\tau 2-1)$
T1 * T2	(t1-1) (t2-1)	SST1T2	$\sigma^2 + n\Sigma(\tau_1\tau_2)^2_{ij}/(\tau 1-1)(\tau 2-1)$
Error	tb(n-1)	SSE	σ^2
Total	tbn-1	SSTotal	

Example 7 *(continued)*

- **Test results**

Source	d.f.	P>F	EMS
Tmt 1	1	0.0003	$\sigma^2 + nt_2\Sigma\tau^2_{1i}/(\tau 1-1)$
Tmt 2	2	0.5411	$\sigma^2 + nt_1\Sigma\tau^2_{2j}/(\tau 2-1)$
T1 * T2	2	0.0732	$\sigma^2 + n\Sigma(\tau_1\tau_2)^2_{ij}/(\tau 1-1)(\tau 2-1)$
Error	54		σ^2
Total	59		

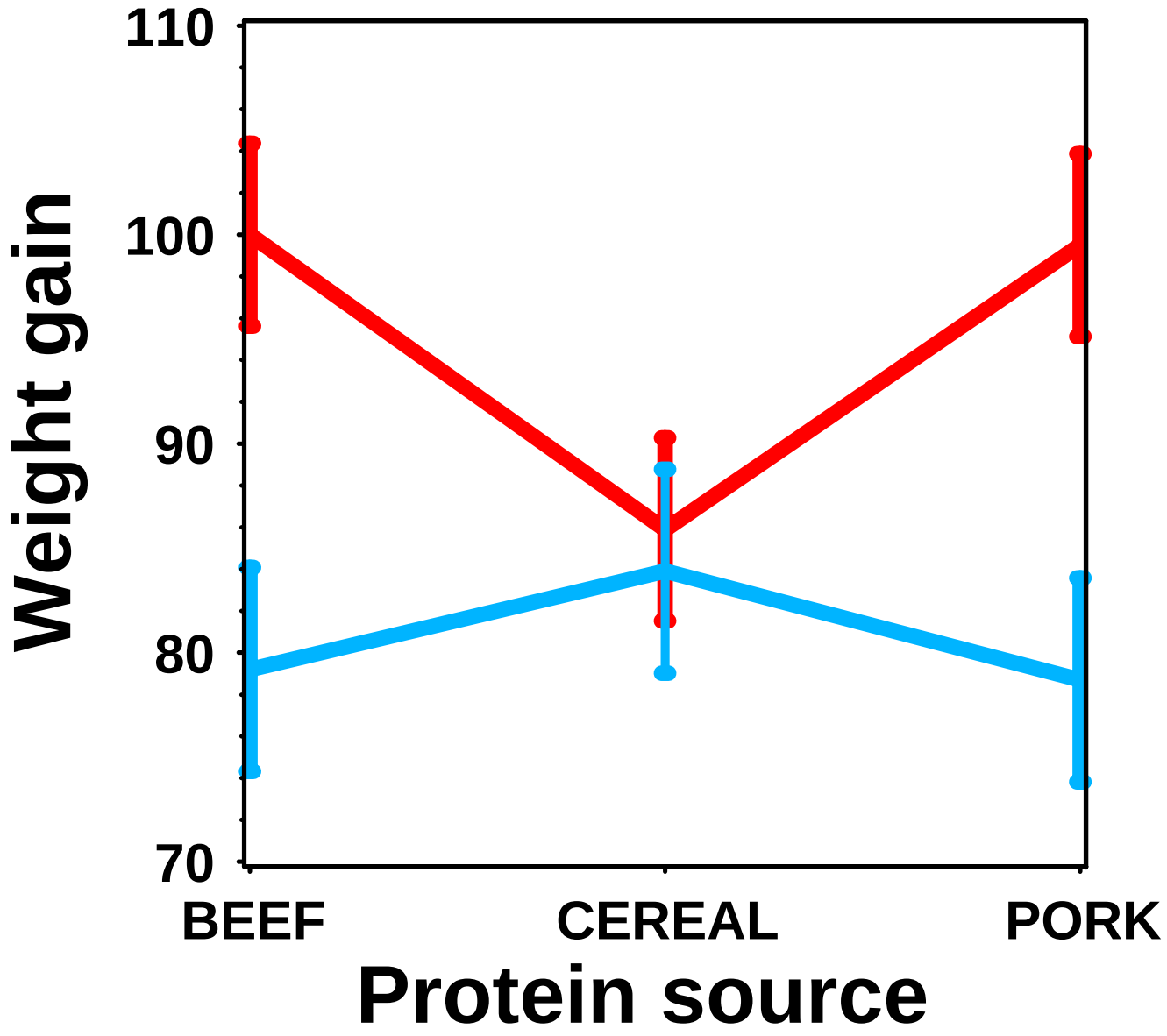
Example 7 *(continued)*

- **The interactions were not quite significant, but were perhaps a little too large to ignore entirely (P>F = 0.07).**
- **From the plots (next 2 pages) it appears that growth is enhanced by high levels of beef & pork protein sources while the high protein level with cereal does not enhance growth much, and is about the same as the low levels of all 3 sources.**

WEIGHT GAIN IN RATS ON VARIOUS DIETS

FACTORIAL DESIGN (2 POR 3) WITH REPLICATES

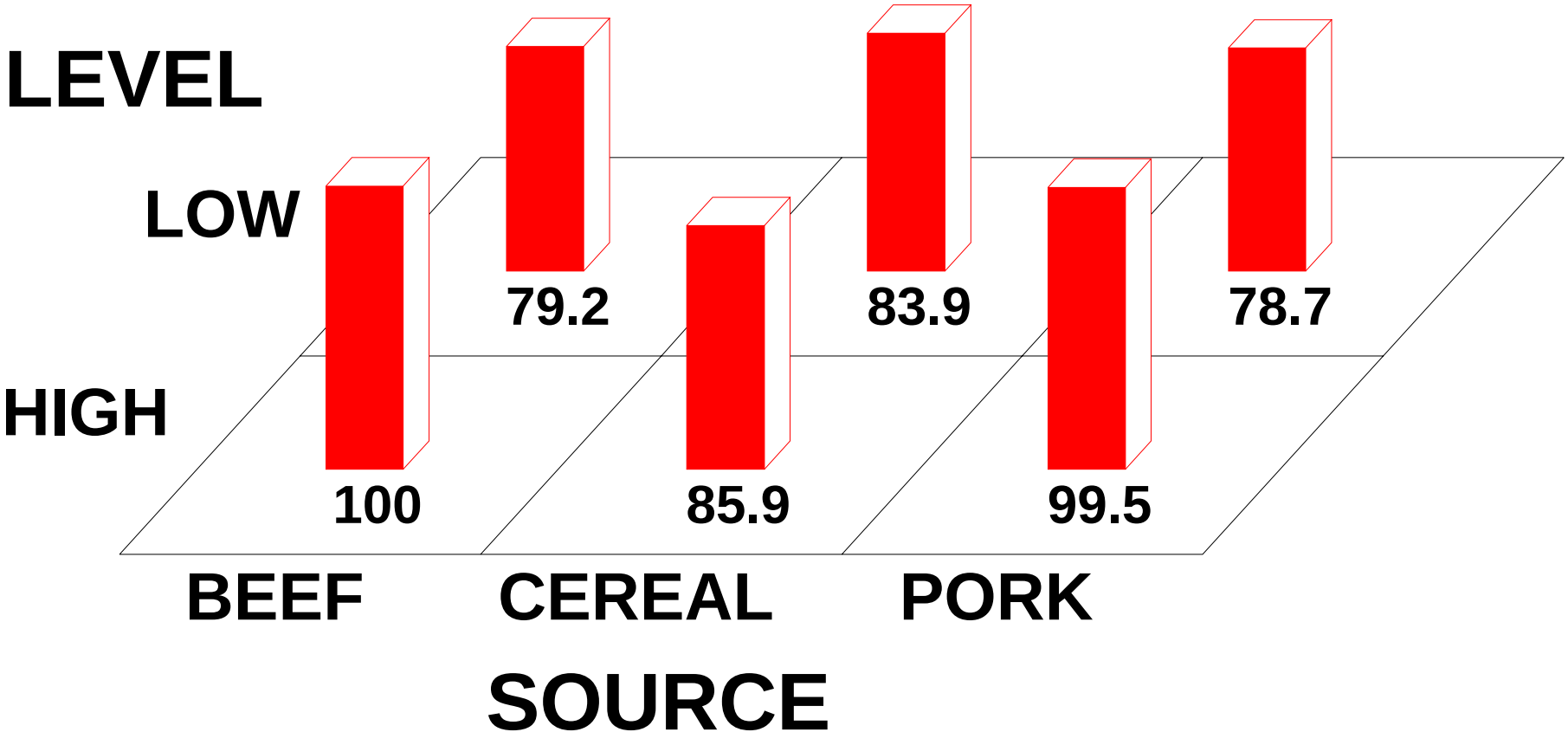
Plot with 2x standard errors to examine interaction



WEIGHT GAIN IN RATS ON VARIOUS DIETS

FACTORIAL DESIGN (2 POR 3) WITH REPLICATES

BLOCK CHART TO EXAMINE INTERACTIONS



Example 8 - 2x2x2 factorial

- Example from Snedecor & Cochran, 1980 (pg 359).
- Dependent variable - Hog weight gain
- treatments - factorial arrangement of hog sex, high & low levels of protein and with or without a lysine dietary supplement.
- Treatments most likely should be fixed, so TYPE III SS will give the correct test results.
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Example 8 *(continued)*

- EMS

Source	d.f.	EMS
Tmt 1	t1-1	$\sigma^2 + nt_2t_3\Sigma\tau^2_{1i}/_{(t1-1)}$
Tmt 2	t2-1	$\sigma^2 + nt_1t_3\Sigma\tau^2_{2j}/_{(t2-1)}$
Tmt 3	t3-1	$\sigma^2 + nt_1t_2\Sigma\tau^2_{3j}/_{(t3-1)}$
T1*T2	(t1-1) (t2-1)	$\sigma^2 + nt_3\Sigma(\tau_1\tau_2)^2_{ij}/_{(t1-1)(t2-1)}$
T1*T3	(t1-1) (t3-1)	$\sigma^2 + nt_2\Sigma(\tau_1\tau_3)^2_{ij}/_{(t1-1)(t2-1)}$
T2*T3	(t2-1) (t3-1)	$\sigma^2 + nt_1\Sigma(\tau_2\tau_3)^2_{ij}/_{(t1-1)(t2-1)}$
T1*T2*T3	(t1-1) (t2-1) (t3-1)	$\sigma^2 + n\Sigma(\tau_1\tau_2\tau_3)^2_{ij}/_{(t1-1)(t2-1)(t3-1)}$
Error	$t_1t_2t_3(n-1)$	σ^2

Example 8 *(continued)*

- Test results

Source	d.f.	P>F	EMS
Lysine	1	0.7069	$\sigma^2 + nt_2t_3\Sigma\tau^2_{1i}/_{(t1-1)}$
Protein	1	<.0001	$\sigma^2 + nt_1t_3\Sigma\tau^2_{2j}/_{(t2-1)}$
L*P	1	0.0012	$\sigma^2 + nt_1t_2\Sigma\tau^2_{3j}/_{(t3-1)}$
Sex	1	0.1143	$\sigma^2 + nt_3\Sigma(\tau_1\tau_2)^2_{ij}/_{(t1-1)(t2-1)}$
L*S	1	0.1983	$\sigma^2 + nt_2\Sigma(\tau_1\tau_3)^2_{ij}/_{(t1-1)(t2-1)}$
P*S	1	0.9533	$\sigma^2 + nt_1\Sigma(\tau_2\tau_3)^2_{ij}/_{(t1-1)(t2-1)}$
L*P*S	1	0.4783	$\sigma^2 + n\Sigma(\tau_1\tau_2\tau_3)^2_{ij}/_{(t1-1)(t2-1)(t3-1)}$
Error	56		σ^2

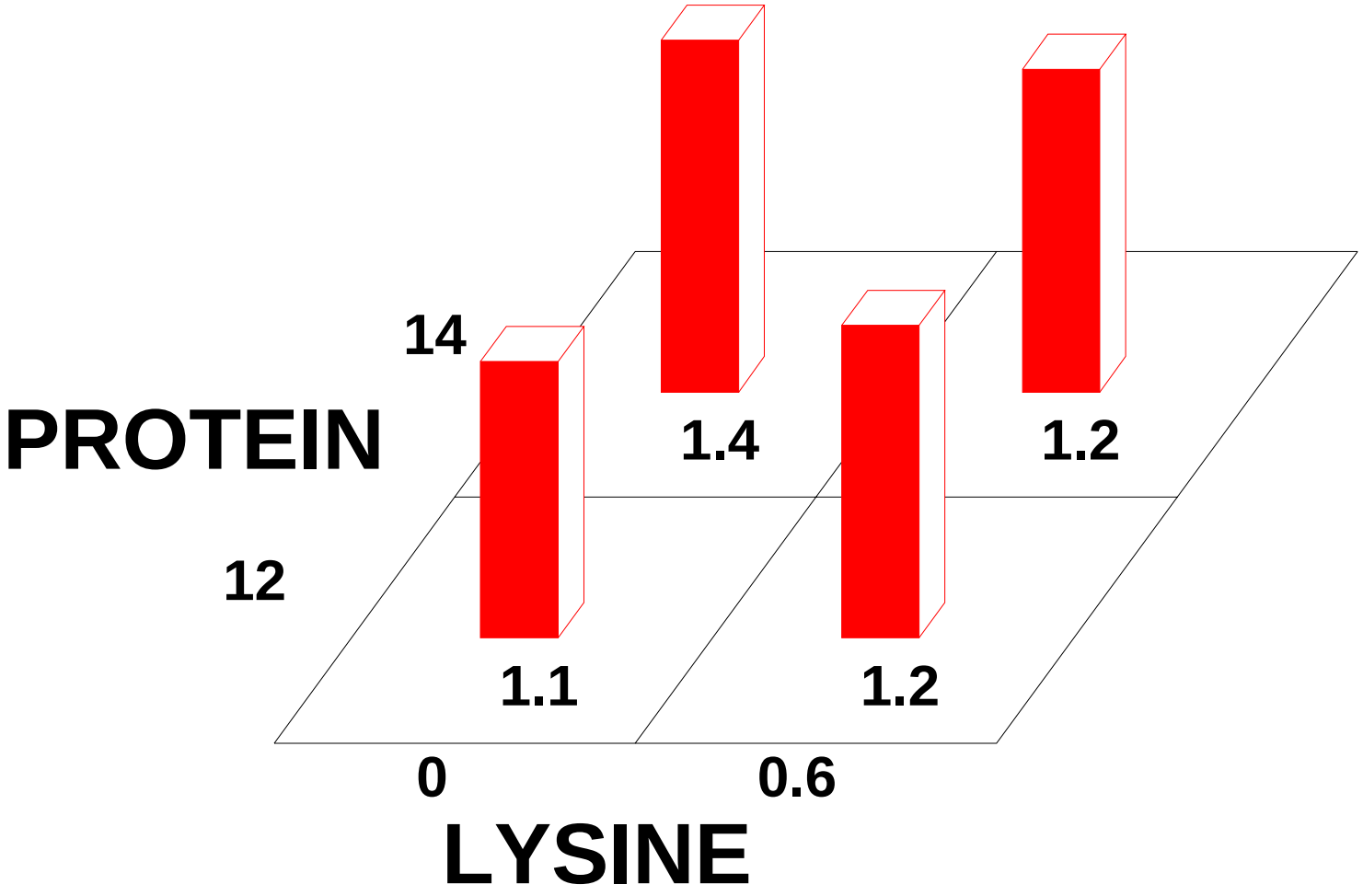
Example 8 *(continued)*

- **Note that sex and its interactions are not significant. There is no need to interpret or further consider sex differences for this experiment.**
- **Lysine is not significant, but protein and the interaction with Lysine IS significant, so lysine does have some effect.**
- **Examine the plots to determine the nature of the interaction.**

PIG WEIGHT GAIN WITH DIET SUPPLEMENTS

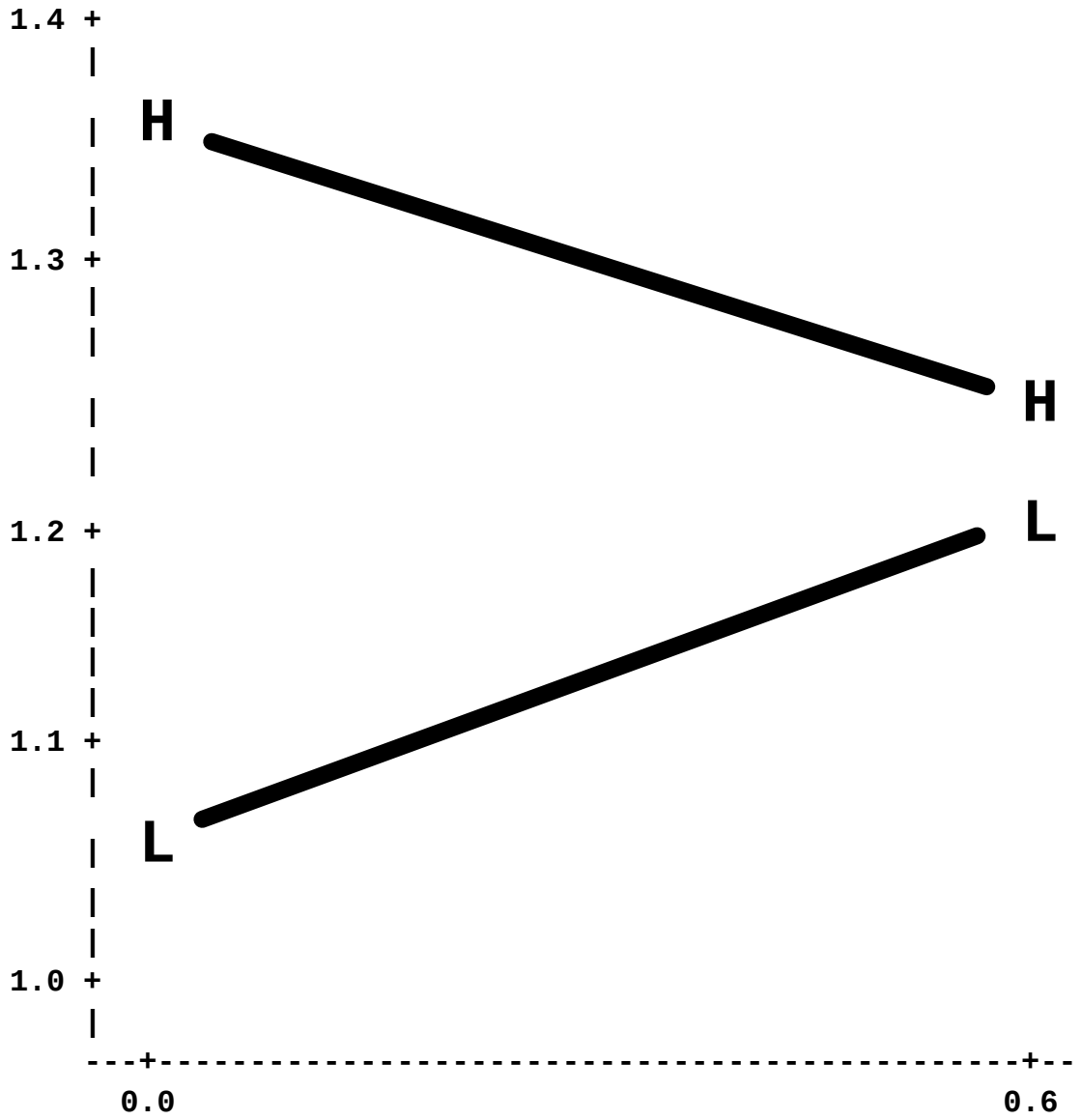
FACTORIAL DESIGN (2x2x2) WITH REPLICATES

BLOCK CHART TO EXAMINE INTERACTIONS



Example 8 *(continued)*

- **Character graphics from SAS.**



Example 8 *(continued)*

- **Take a look at what would happen if the effects were random.**
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Example 8 *(continued)*

- Test results

Source	EMS
Lysine	$\sigma^2+n\sigma^2_{LSP}+np\sigma^2_{LS}+ns\sigma^2_{LP}+nsp\sigma^2_{L}$
Protein	$\sigma^2+n\sigma^2_{LSP}+ns\sigma^2_{LP}+nl\sigma^2_{SP}+nls\sigma^2_{P}$
Sex	$\sigma^2+n\sigma^2_{LSP}+np\sigma^2_{LS}+nl\sigma^2_{SP}+nlp\sigma^2_{S}$
L*S	$\sigma^2+n\sigma^2_{LSP}+np\sigma^2_{LS}$
L*P	$\sigma^2+n\sigma^2_{LSP}+ns\sigma^2_{LP}$
P*S	$\sigma^2+n\sigma^2_{LSP}+nl\sigma^2_{SP}$
L*P*S	$\sigma^2+n\sigma^2_{LSP}$
Error	σ^2

Example 8 *(continued)*

- **The residual error is used to test the third order interaction.**
- **The third order interaction is used to test the second order interactions.**
- **There is no proper error term for testing the main effects, though one can be calculated (see SAS GLM - Random / test statement output).**
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