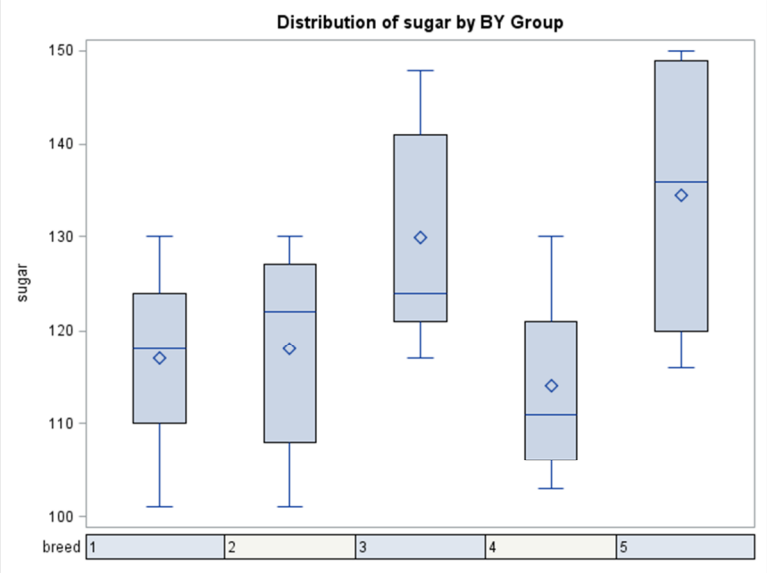
WST311 2018: Memorandum for Assignment I

Answers

1. Summary statistics

	n	Mean	Std dev
Breed A	10	117.0	9.2
Breed B	10	118.0	11.2
Breed C	10	129.9	11.2
Breed D	10	114.0	10.1
Breed E	10	134.5	13.2
Overall	50	122.7	13.3

2.



3a. $H_0 : \mu_A = \mu_B = \mu_C = \mu_D = \mu_E$

H_A : at least one of the means differ significantly from the others.

Use $\alpha = 0.05$.

Since p-value for the overall model is 0.0003 < 0.05 H_0 is rejected and the model is significant.

The mean sugar level for at least one of the breeds differs significantly from the others.

3b. From Tukey pairwise comparisons the means with

Summary statistics

means with different superscripts differ significantly on a 5% level

	n	Mean	Std dev
Breed A	10	117.0^{bc}	9.2
Breed B	10	118.0^{bc}	11.2
Breed C	10	129.9^{ab}	11.2
Breed D	10	114.0^{c}	10.1
Breed E	10	134.5^{a}	13.2

The average blood sugar level of Breeds C and E does not differ significantly from each other and both differ significantly from Breed D. The average blood sugar level of Breeds A, B and D does not differ significantly from one another. Breeds A and B differ significantly from Breed E.

3c. $H_0 : \mu_A = \mu_B$
$H_A : \mu_A \neq \mu_B$
Use $\alpha = 0.05$.
Since p-value = 0.8404 > 0.05 H_0 is not rejected. The mean sugar level of Breed A and Breed B do not differ significantly on the 5% level.

3d. $H_0 : (\mu_A + \mu_B + \mu_C)/3 = (\mu_D + \mu_E)/2$
$H_A : (\mu_A + \mu_B + \mu_C)/3 \neq (\mu_D + \mu_E)/2$
Use $\alpha = 0.05$.
Since p-value = 0.4160 > 0.05 H_0 is not rejected. The mean sugar level of Breeds A, B and C do not differ significantly from the mean sugar level of Breeds D and E on the 5% level.

4a. The model, expressed in terms of dummy variables, D_1, D_2, D_3 and D_4, is

$$y = \mu^* + \tau_1^* D_1 + \tau_2^* D_2 + \tau_3^* D_3 + \tau_4^* D_4 + \varepsilon$$

where

Breed	D_1	D_2	D_3	D_4
A	1	0	0	0
B	0	1	0	0
C	0	0	1	0
D	0	0	0	1
E	-1	-1	-1	-1

The parameter estimates for the model is:

$\hat{\mu} = 122.68$
$\hat{\tau}_1 = -5.68$
$\hat{\tau}_2 = -4.68$
$\hat{\tau}_3 = 7.22$
$\hat{\tau}_4 = -8.68$

The overall average blood sugar level is 122.68 mg/100g. The estimated mean blood sugar levels for each breed, calculated from these estimates are:

$\hat{\mu}_A = \hat{\mu} + \hat{\tau}_1 = 122.68 - 5.68 = 117.0$
$\hat{\mu}_B = \hat{\mu} + \hat{\tau}_2 = 122.68 - 4.68 = 118.0$
$\hat{\mu}_C = \hat{\mu} + \hat{\tau}_3 = 122.68 + 7.22 = 129.9$
$\hat{\mu}_D = \hat{\mu} + \hat{\tau}_4 = 122.68 - 8.68 = 114.0$
$\hat{\mu}_E = \hat{\mu} - \hat{\tau}_1 - \hat{\tau}_2 - \hat{\tau}_3 - \hat{\tau}_4 = 122.68 + 5.68 + 4.68 - 7.22 + 8.68 = 134.5$

4b. $H_0 : \mu_D = \mu_E$
$H_A : \mu_D \neq \mu_E$
Use $\alpha = 0.05$.
Since p-value = 0.0001 < 0.05 H_0 is rejected. The mean sugar level of Breed D and Breed E differ significantly on the 5% level.

4c. $H_0 : (\mu_A + \mu_B)/2 = \mu_C$
$H_A : (\mu_A + \mu_B)/2 \neq \mu_C$
Use $\alpha = 0.05$.
Since p-value = 0.0058 < 0.05 H_0 is rejected. On a 5% level of significance, the mean sugar level of Breeds A and B differ significantly from the mean sugar level of Breed C.

5a. SSE = 5485.40
SSR = 3213.48
SST = 8698.88

5b. $\hat{\mu} = 122.68$
$\hat{\tau}_1 = -5.68$
$\hat{\tau}_2 = -4.68$
$\hat{\tau}_3 = 7.22$
$\hat{\tau}_4 = -8.68$

5c. $H_0 : (\mu_A + \mu_B + \mu_C)/3 = (\mu_D + \mu_E)/2$
$H_A : (\mu_A + \mu_B + \mu_C)/3 \neq (\mu_D + \mu_E)/2$
Use $\alpha = 0.05$.
Since p-value = 0.4160 > 0.05 H_0 is not rejected. The mean sugar level of Breeds A, B and C do not differ significantly from the mean sugar level of Breeds D and E on the 5% level.