The Basic Practice of Statistics

Seventh Edition

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averages. You will rarely need to know the details because software automates the calculation, but here they are.

Confidence and Prediction Intervals for Regression Response

A level C **confidence interval for the mean response μ_y** when x takes the value x^* is

$$\hat{y} \pm t^*SE_{\hat{\mu}}$$

The standard error $SE_{\hat{\mu}}$ is

$$SE_{\hat{\mu}} = s\sqrt{\frac{1}{n} + \frac{(x^* - \bar{x})^2}{\Sigma(x - \bar{x})^2}}$$

A level C **prediction interval for a single observation y** when x takes the value x^* is

$$\hat{y} \pm t^*SE_{\hat{y}}$$

The standard error for prediction $SE_{\hat{y}}$ is

$$SE_{\hat{y}} = s\sqrt{1 + \frac{1}{n} + \frac{(x^* - \bar{x})^2}{\Sigma(x - \bar{x})^2}}$$

In both intervals, t^* is the critical value for the $t(n - 2)$ density curve with area C between $-t^*$ and t^*.

There are two standard errors: $SE_{\hat{\mu}}$ for estimating the mean response μ_y, and $SE_{\hat{y}}$ for predicting an individual response y. The only difference between the two standard errors is the extra 1 under the square root sign in the standard error for prediction. The extra 1 makes the prediction interval wider. Both standard errors are multiples of the regression standard error s. The degrees of freedom are again $n - 2$, the degrees of freedom of s.

LaunchPad Online Resources

- The **StatBoards video**, *Confidence and Prediction Intervals*, uses an example to make clear the difference in these two intervals.
- The **Snapshots video**, *Regression Inference*, discusses inference for regression.

Apply Your Knowledge

26.12 Wine and Cancer in Women: Prediction. Exercise 26.1 gives data on wine consumption and the risk of breast cancer. For a new group of women who drink an average of 10 grams of wine per day, predict their relative risk of breast cancer.

(a) Figure 26.8 is part of the output from Minitab for prediction when $x^* = 10.0$. Which interval in the output is the proper 95% interval for predicting the relative risk?

(b) Minitab gives only one of the two standard errors used in prediction. It is $SE_{\hat{\mu}}$, the standard error for estimating the mean response. Use this fact along with the output to give a 90% confidence interval for the mean relative risk of breast cancer in all women who drink an average of 10 grams of wine per day.