MATH 308 Assignment 18: Exercises 8.5

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p=$P(X >= 20)$ = `1-ppois(19,lambda=15)` $\approx$ 12.5%. This implies that more than 10% of the months will have a birth rate as extreme as the one observed, which means that we cannot reject the null ($\lambda = 15$) even at the 5% significance level.

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a)

Running the test gives a p-value of 10^{-4}. This lets us reject the null hypothesis (that the difference in means is zero) at the 1% significance level.

b)

The random assignment of seedlings to plots tends to remove confounding effects. Thus, the result hints at a causal relationship between presence of competition and diameter change.

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Running the chi-squared test gives a p-value of 0.012, allowing us to reject the null at the 5% significance level.

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A Type I error would be incorrectly concluding that the drug is effective when in fact it is not. This would lead to to patients wasting money on a useless drug.

A Type II error would be failing to conclude that the drug is effective, when in fact it is. This would lead to a waste of the research money put into the drug, since the pharmaceutical company would then not be able to sell it.

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Under the null, $\overline{X} \sim \mathcal{N}(25, 16/30)$. Thus $Z = \frac{\overline{X}-25}{4/\sqrt{30}}$, where Z is a standard normal random variable. Thus, the null is rejected if $Z \geq z_{1-\alpha} \implies \frac{\overline{X}-25}{4/\sqrt{30}} \geq z_{0.95} \implies \overline{X} \geq 25 + \frac{4z_{0.95}}{\sqrt{30}} \equiv C$.

But $\overline{X} \sim \mathcal{N}\left(27, 16/\sqrt{30}\right) \implies Z = \frac{\overline{X}-27}{4/\sqrt{30}}$. So,

$$
\begin{aligned}
1 - \beta &= P(\overline{X} \geq C | \mu = 27) \\
&= P\left(\frac{4Z}{\sqrt{30}} + 27 \geq C\right) \\
&= P\left(Z \geq \frac{\sqrt{30}(C-27)}{4}\right) \equiv P(Z \geq C_1) \\
&= 1 - P(Z < C_1) \approx 86.3\%
\end{aligned}
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