CLASS EXERCISE, March 30, 2023

1. Consider a call center that receives random call arrivals. The number of total calls that arrive between 9 and 9.30 is estimated from the data according to the process:

$$D_t = 100 + 0.6D_{t-1} + \epsilon_t$$

   (a) Assume that $d_{t-1} = 80$ and ϵ_t is normal with mean zero and variance $\hat{\sigma}^2 = 900$. How many calls are expected at time interval t?

   Solution:

$$\hat{d}_t = 100 + 0.6(80) = 148$$

   (b) Each call takes an average of 3 minutes to answer. How many agents should be scheduled to handle average demand in time interval t?

   Solution: Each agent answers 10 calls in half and hour. To respond to 148 calls, 15 agents are needed.

   (c) The call center aims to answer at least 95% of all incoming calls, what is the minimum number of agents needed to answer 95% of calls in time interval t. ($z_{0.95} = 1.64$.)

   Solution: We are looking for s such that $P(D \geq s) = 0.95$. We figured our that D is normally distributed with $\mu = 148$ and $\sigma = 30$. Let $Z = (D - \mu)/\sigma$. Then, $P(D \leq s) = P(Z \leq z)$ where $s = \mu + z\sigma$. Given that $P(Z \leq z^*) = 0.95$ for $z^* = 1.64$, we have:

$$s^* = \hat{d}_t + z_{0.95}\hat{\sigma} = 148 + 1.64(30) = 197.2$$

   20 agents will be needed to cover all calls with 95% probability.

2. Australian Beer Production Data: which statements are true?

   (a) the indicator (dummy) for the month of January is statistically significant at 5% *True*

(b) The linear trend term 't' is statistically significant at 5% *True*

(c) If we remove the indicator for January from the model, R-squared will increase *False* Removing any predictor automatically reduces the R-squared.

(d) If we remove the indicator for January from the model, AIC will increase *False*: This is not clear. Removing the indicator reduces the R-squared (and therefore may decrease likelihood) but one fewer parameter is used thefore the AIC penalty term is lower. The overall result can go either way.

(e) If we remove the linear trend term 't' from the model, R-squared will increase *False* It does not matter whether the predictor is statistically significant or not. Removing it will reduce the R-squared value.

(f) If we remove the linear trend term 't' from the model, AIC will increase *False* Not clear. It can go either way.