# Classwork 13: Trend Stationary Processes

EC 421

2024-05-21

**1) Show that $y_t$ is nonstationary when $y_t = \beta_0 + \beta_1 t + u_t$, where $u_t \sim$ iid N(0, $\sigma^2$).**

**2) Suppose $x_t$ and $y_t$ are unrelated except that they both have time trends, so**

$y_t = \alpha_0 + \alpha_1 t + w_t$

$x_t = \gamma_0 + \gamma_1 t + v_t$

Where $w_t$ and $v_t$ are iid N(0, 1). If we estimate the model $y_t = \beta_0 + \beta_1 x_t + u_t$, why do we often conclude that $\beta_1 \neq 0$? What will the sign of $\hat{\beta}_1$ be?

**3) In the previous problem, should we expect that as the number of observations $t$ increases, we find that x seems to have an effect on y less often?**

Make a hypothesis and then answer the question by doing a monte carlo simulation in R using `map` or `map_dfr`. By looking at your results, do the estimates from this model seem to be biased or inconsistent?

*Hint: I would solve this problem like this: generate a dataset with variables t, x, and y. t should be the sequence 1:n, where n is the sample size (which you will end up varying). x should be some linear function of t and random noise. y should be another linear function of t and random noise. You will take that dataset and use lm() to estimate the model y ~ x, then select the estimate for beta 1. Write a function that takes a sample size n and does everything I just talked about, returning n and the estimate for beta 1. That's the .f you'll use in your map_dfr simulation. The .x should be sample sizes you want to test: something like a vector of a bunch of 5s, 10s, 20s, 40s, etc. I would present my final results using geom_density with fill represented by n.*