

TS Module 19 Seasonal models basics

(The attached PDF file has better formatting.)

Seasonal models practice problems

Know how to include a seasonal component in a time series. Most student projects have seasonal components, and even if seasonality is not obvious in the data, you should test for seasonality in your analysis. Many time series that do not have obvious seasonality, like GDP, unemployment, and insurance claim severity, often have seasonality.

The final exam problems have both quantitative and qualitative questions on seasonality. The seasonality for repeat business, such as renewals of insurance coverage, differs from the seasonality that depends on weather or holidays, such as sales of summer sports equipment in June and July or sales on children's toys in November and December. The time series student project discussion forum has full explanation of seasonality methods.

*Question 19.1: Policy Writings

Workers' compensation policy writings for new plus renewal business is likely to be seasonal, since the policy is 12 months long and most insureds renew their policies. To model this phenomenon, which of the following time series models would one most likely use for a *quarterly* model?

- A. A homogeneous model of order 4
- B. An AR(12) model
- C. An AR(4) model
- D. An ARMA(2, 2) model
- E. An ARIMA(2, 1, 2) model

Answer 19.1: C

Jacob: Why is the process autoregressive instead of moving average? Cryer and Chan show first a seasonal moving average process.

Rachel: The problem says that "most insureds renew their policies." The renewals are based on the number of insureds who bought policies 12 months ago, not the residual from 12 months ago. Cryer and Chan say that autoregressive processes are more common, and this is especially true for repeat buying.

*Question 19.2: Policy Counts

An actuary models policy counts for Homeowners policies with a monthly ARMA model.

- The policies have a 12 month term.
- $\theta_1 = -0.20$, $\phi_1 = +0.25$, $\phi_2 = +0.15$, and $\Phi_1 = +0.45$ with a seasonal lag of 12 months.
 - Φ_1 is like ϕ_{12} .
- Average policy counts are the same each month.

What is the expected percentage of policyholders who renew their policies?

- A. 20%
- B. 25%
- C. 45%
- D. 55%
- E. 75%

Answer 19.2: C

If 100 policyholders buy policies in January 20X1, we expect 45 policyholders to buy policies in January 20X2.

Cryer and Chan note that a 12 month autoregressive parameter of +45% causes correlation at 10, 11, 13, and 14 months in this process as well, because of the other parameters. They multiply the regular ARMA process by the 12 month seasonal process.