What do the units and calendar controls change?

> Measurement: levels, logs, indexes and purchasing power.

> Calendar specification: trends, seasonality and dated indicators.

An index number compares a level with a base period

A value of 125 on a base-100 index means 25 percent above its base.

> $I_t = 100\,P_t/P_0$; P_0 is the base-period price level.

> $120 \to 125:\quad 100(125/120 - 1) \approx 4.17\%$.

> Index points and percentage changes answer different questions.

Convert nominal money to a common purchasing-power scale

Deflation separates a monetary level from the price scale used to express it.

> Real amount: $Y_t^R = Y_t^N/(I_t/100)$; superscripts R, N denote real and nominal amounts.

> Example: $110/1.25 = 88$, compared with base-period real income 100.

> Choose an index suited to the economic quantity and state the base year.

Practice

Nominal income is 110 and the base-100 price index is 125. What is real income?

Explanation: 110 divided by 1.25 is 88, in base-period monetary units.

A nominal-real restriction is a testable statement about coefficients

Rewrite the real-variable theory in the observed nominal variables.

> $\log(C/P) = a + \beta \log(W/P) + u.$

> $\log C = a + \beta \log W + (1 - \beta) \log P + u.$

> In an unrestricted nominal equation, test $H_0 : b_W + b_P = 1$.

A trend is a gradual time pattern

In a log outcome, a linear trend describes proportional growth.

> $\log A_t = a + gt + u_t$

> Small-change interpretation: about $100g\%$ per month

Seasonality repeats at the same part of the year

Use a reference month to avoid redundant indicators.

> January is the reference category

> Eleven recurring month indicators, not 108 unique date indicators

Write the policy model with its calendar controls

Make the intervention and units explicit.

> $\log A_t = a + gt + \sum_{m=2}^{12} \gamma_m M_{mt} + bB_t + cS_t + dU_t + fW_t + u_t$

> M_{mt}: month indicator; January is the reference.

> U_t: unemployment; u_t: regression error.

Inspect the calendar-only regression

Understand the baseline before adding policy variables.

```
. regress logacc trend i.month

------------------------------------------------------------------------------
      logacc | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
       trend |   .0027471   .0001611    17.06   0.000     .0024274    .0030669
             |
       _cons |   10.46857   .0190028   550.90   0.000     10.43084    10.50629
------------------------------------------------------------------------------
```

Calendar-indicator coefficient rows are omitted here. The output download contains the full numerical results.

A seasonal joint test asks about the whole pattern

One insignificant month does not settle the annual question.

```
. testparm i.month

 ( 1)  2.month = 0
 ( 2)  3.month = 0
 ( 3)  4.month = 0
 ( 4)  5.month = 0
 ( 5)  6.month = 0
 ( 6)  7.month = 0
 ( 7)  8.month = 0
 ( 8)  9.month = 0
 ( 9)  10.month = 0
 (10)  11.month = 0
 (11)  12.month = 0

       F( 11,    91) =   10.29
            Prob > F =    0.0000
```

Calendar-indicator coefficient rows are omitted here. The output download contains the full numerical results.

Read the adjusted accident regression

Connect the coefficient with the actual outcome and controls.

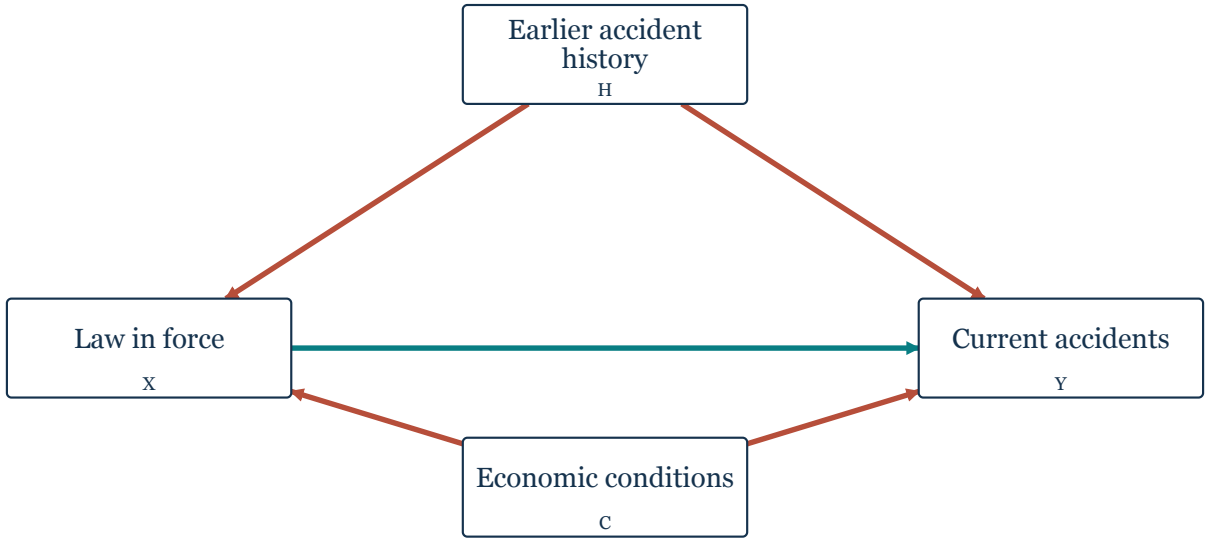
```
. regress logacc trend i.month unem spdlaw beltlaw wkends, vce(robust)

------------------------------------------------------------------------------
             |               Robust
      logacc | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
       trend |   .0011011   .0002676     4.12   0.000     .0005696    .0016326
             |
        unem |  -.0212173   .0038238    -5.55   0.000    -.0288128   -.0136218
      spdlaw |  -.0537593   .0120059    -4.48   0.000    -.0776076    -.029911
     beltlaw |   .0954526   .0123682     7.72   0.000     .0708847    .1200206
      wkends |   .0033333   .0039443     0.85   0.400    -.0045016    .0111682
       _cons |   10.63986   .0681238   156.18   0.000     10.50454    10.77518
------------------------------------------------------------------------------
```

Calendar-indicator coefficient rows are omitted here. The output download contains the full numerical results.

A date indicator can mix several simultaneous changes

A coefficient needs a counterfactual interpretation.



1 open directed route · 2 open alternatives · gold: conditioned on

Assumed causal structure · dashed boxes: unobserved · gold boxes: conditioned on

A linear trend does not remove every nonstationary process

A straight calendar pattern need not describe accumulated random changes.

> A fixed calendar drift and accumulated unexpected changes are different mechanisms.

> Inspect whether deviations fade before relying on a trend regression.

Interpret the traffic-law coefficient with its timing

Reproduce the evidence, then explain its economic meaning.

Practice

Refit the traffic model without its linear trend, retaining the same month controls, other regressors and 108 months. Compare the law slopes and explain the changed time-path assumption. Keep your commands, log, output and interpretation.

Interpret the traffic-law coefficient with its timing: explanation

A reproducible result needs both a calculation and an interpretation.

> Law slope with trend: 0.095453; without trend: 0.130158.

> Same 108 months and remaining regressors.

> The models impose different time-path assumptions.

From calendar controls to persistence

From calendar controls to persistence

Frequency and season

Try the comparison before opening the explanation.

Practice

An accident dataset runs monthly from January 1981 through December 1989. How many observations are there, and why use eleven month indicators with an intercept?

Frequency and season: explanation

Follow the calculation and interpret its units.

> There are $9 \times 12 = 108$ observations. Eleven indicators compare months with an omitted reference month; including all twelve plus an intercept creates exact collinearity. Their purpose is seasonal adjustment, not causal identification by itself.

Before–after is not enough

Try the comparison before opening the explanation.

Practice

Accidents fall after a road-safety law. Why is this not yet evidence of its causal effect?

Before–after is not enough: explanation

Follow the calculation and interpret its units.

> Traffic volume, seasonality, fuel prices, enforcement, reporting or other policies may also change. A defensible causal comparison must rule out relevant counterfactual changes; adding a trend is useful only insofar as its assumptions are credible.

Record the time-series specification in words

Dates and frequency are part of reproducibility.

> A useful description gives the date range, monthly frequency, outcome scale, policy coding, trend and seasonal controls.

> Then explain the proposed economic comparison and its main uncertainty and identification conditions.