Lecture 08
Measuring Airline On-time Performance

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Goals for today

1. Review of time
2. Simulation of the multivariate F-test
3. Introduction to ASA airline dataset

Review from Last Time

The hypothesis set $H_0 : \beta_j = b_j$, yields the following **t-test**:

$$
\begin{aligned}
t &= \frac{\widehat{\beta}_j - b_j}{\sqrt{s^2 \left((X^t X)^{-1}_{jj} \right)}} \\
&= \frac{\widehat{\beta}_j - b_j}{\text{S.E.}(\widehat{\beta}_j)} \\
&\sim t_{n-k}
\end{aligned}
$$

The hypothesis set $H_0 : D\beta = d$, for a full rank k-by-p matrix yields the following **F-test**

$$F = \frac{(\mathrm{SSR}_U - \mathrm{SSR}_R)/k}{\mathrm{SSR}_U/(n-p)}$$
$$\sim F_{k,n-p}$$

Where SSR_U is $r^t r$ and SSR_R is the sum of squared residuals $\tilde{r}^t \tilde{r}$ from the restricted model.

We did a lot of matrix manipulations in the proofs of these two results. The most important 'big picture' results to remember are the lemma:

- If B is a symmetric idempotent matrix and $u \sim \mathcal{N}(0, \mathbb{I}_n)$, then $u^t B u \sim \chi^2_{\mathrm{tr(B)}}$.

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- If B is a symmetric idempotent matrix and $u \sim \mathcal{N}(0, \mathbb{I}_n)$, then $u^t B u \sim \chi^2_{\mathrm{tr(B)}}$.
- If B is a symmetric idempotent matrix, then all of B's eigenvalues are 0 or 1. In terms of the $Q^t \Lambda Q$ eigen-value decomposition, this helps explain why we think of P and M as projection matricies.

F-Test confidence region

ASA Flight Data