Case Study E
Housing Rent Prices in Munich

Background

- Munich, Germany controls rent levels to not exceed “the commonly accepted rent for a housing comparable as of size, equipment and location” excessively
- Necessity to model the rent prices for this task
- Data from 2003 contains rents, location and attributes based on an official survey

Goals of Study

- Discover patters in descriptive attributes associated with housing
- Investigate influences of various covariates and their combinations on the rent

Description of Data

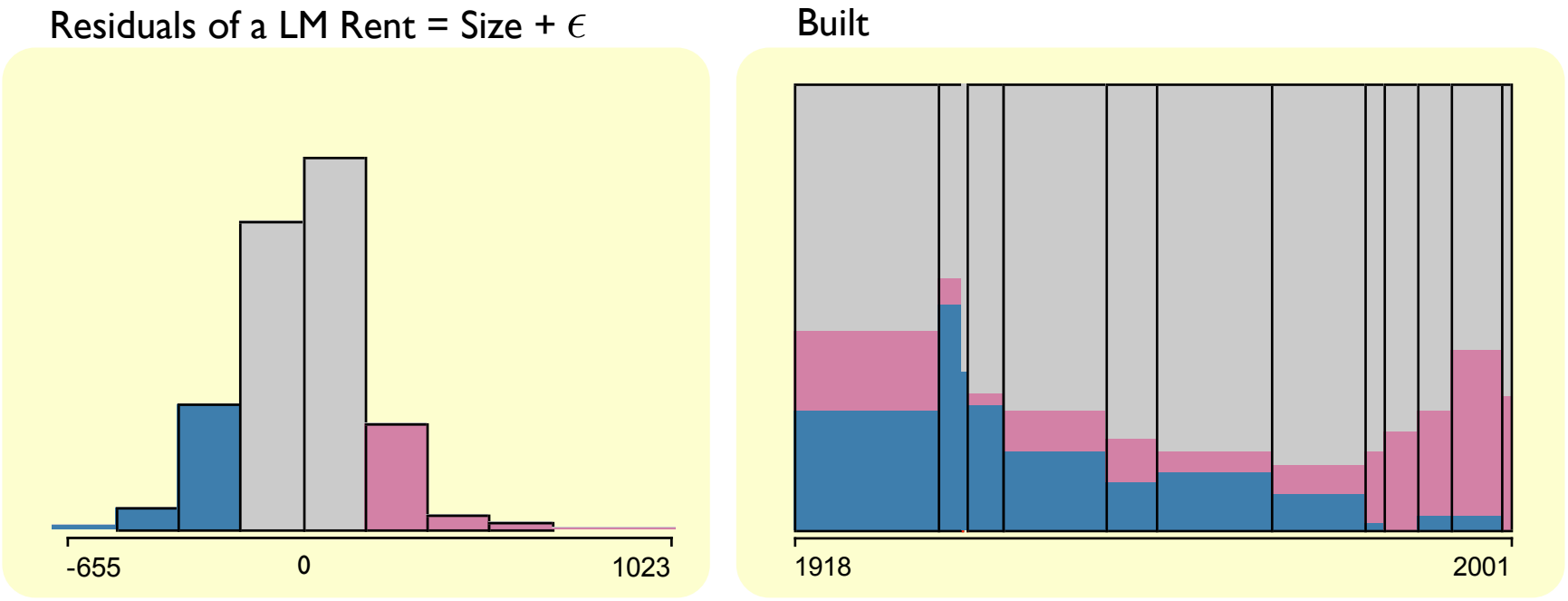
- Rent (in Euros per month)
- Size (in m^2)
- Num. Rooms (excludes kitchen and bath)
- Built
  - year in which the construction of the building was completed
- District, District No.
  - name and number of the district of Munich in which the dwelling is located
- Neighborhood
  - average, good or best as defined by the city of Munich based on the location
- Warm Water (in house yes/no)
- Central Heating (yes/no)
- Tiled Bath (yes/no)
- Plus Bath (additional, unusual amenities in the bath - yes/no)
- Plus Kitchen (additional amenities in the kitchen - yes/no)

Analysis

- First look
  - histogram of Built
  - barchart of binary attributes and Neighborhood
- Influences on Rent
  - barchart of Number of Rooms, color brush
  - scatterplot Rent vs Size, add linear model
  - spinogram of derived Rent/m^2
  - histogram of Rent (select high), spinogram of Built
  - boxplots Rent by binary attributes and Neighborhood
  - mosaic plot of all binary variables
- Spatial analysis
  - aggregated data averaged per district
  - scatterplot Mean Rent vs Neighborhoods, Ratio Central Heating vs Built
  - maps, weighted by Mean Rent, Neighborhoods, Mean Built, Central Heating

Further Analysis

- Simple linear model Rent = Size + ε
- Look at residuals



Further Analysis (cont.)

- Add Size × Built interaction to a full model

Rcode

```
> m<-lm(Rent ~. + Size * Built - District - Rent.per.sqm, rent)
> summary(m)
...
Coefficients:
                   Estimate Std.Error  t value  Pr(>|t|)
(Intercept)        1.45e+03  8.21e+02   1.774     0.0762
Size              -4.25e+01  1.00e+01  -4.247   2.26e-05
Built             -8.45e-01  4.20e-01  -2.012     0.0443
Num..Rooms        -3.32e+01  6.42e+00  -5.172   2.54e-07
Neighborhoodgood   5.38e+01  6.99e+00   7.706   2.01e-14
Neighborhoodbest   1.44e+02  2.29e+01   6.269   4.43e-10
Warm.WaterYes      1.63e+02  2.12e+01   7.684   2.37e-14
Central.HeatingYes 7.39e+01  1.45e+01   5.097   3.76e-07
Tiled.BathYes      4.29e+01  8.65e+00   4.957   7.73e-07
Extra.BathYes      4.87e+01  1.20e+01   4.067   4.94e-05
Premium.KitchenYes 1.11e+02  1.30e+01   8.514     <2e-16
Size:Built         2.58e-02  5.15e-03   5.018   5.68e-07
...
Residual standard error: 150.1 on 2041 degrees of freedom
Multiple R-Squared:0.6281, Adjusted R-squared: 0.6261
F-statistic: 313.4 on 11 and 2041 DF, p-value:<2.2e-16
```