

Understanding accessibility to education from the offer side:

(Spatial-rings analysis in Santiago, Chile)

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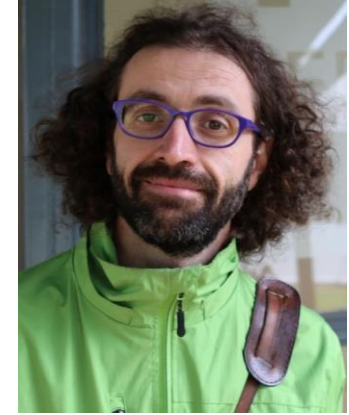
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Presentation structure

- Motivation
- Data
- Methodology
- Results
- Conclusions



Background image from <https://www.supermadre.net/furgon-escolar/>

Motivation

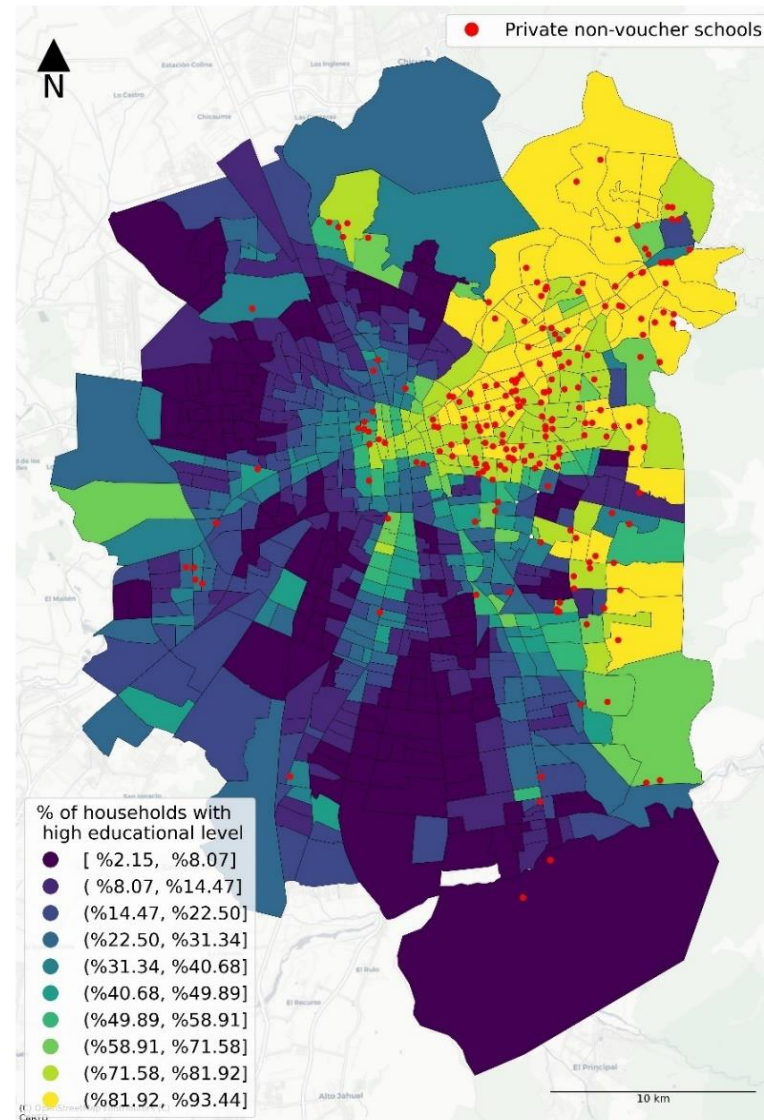
Education-voucher systems

- Provide better quality education and more efficient school systems (Friedman, 1962; Hoxby, 2007; Levin, 2002).
- Play a role on segregation mechanisms through education markets (Elacqua et al., 2006; Elacqua, 2012; Levin, 1998).
- **Free school choice** → parents' preferences and trade-offs become relevant (not restricted to geographical location's school assignment).

Chilean (and Santiago's) case

- Nationwide voucher system implementation in the 1980s (Villalobos and Quaresma, 2015).
- Recurrently criticized for its mechanisms that allow for discrimination and social segregation (Carrasco et al., 2021; Elacqua, 2012; Gayo et al., 2019; Valenzuela et al., 2014)
- Similar to Friedman's original work, no restrictions to the model in comparison to other countries' implementations (Hofflinger et al., 2020).

Figure 1: Private non-voucher school distribution and household's educational level distribution in Santiago, Chile.



Source: González-Espejo et al. (2022)

From the demand side

- Parents' role in the decision process vastly studied in the Chilean context.
- Academic and location attributes affect a household's preferences towards regarding school choice (Chumacero et al., 2011; Gómez et al., 2012)
- However, for several groups, socioeconomic aspects of the student body prevail over academic characteristics (Bellei et al., 2020; Elacqua et al., 2006), fostering social and spatial segregation dynamics.

From the demand side

There are families that “send” their kids to farther, more expensive, and lower quality schools only for the neighborhood that the school is located.



Screenshot from Chilean 90's comedy sketch

From the demand side

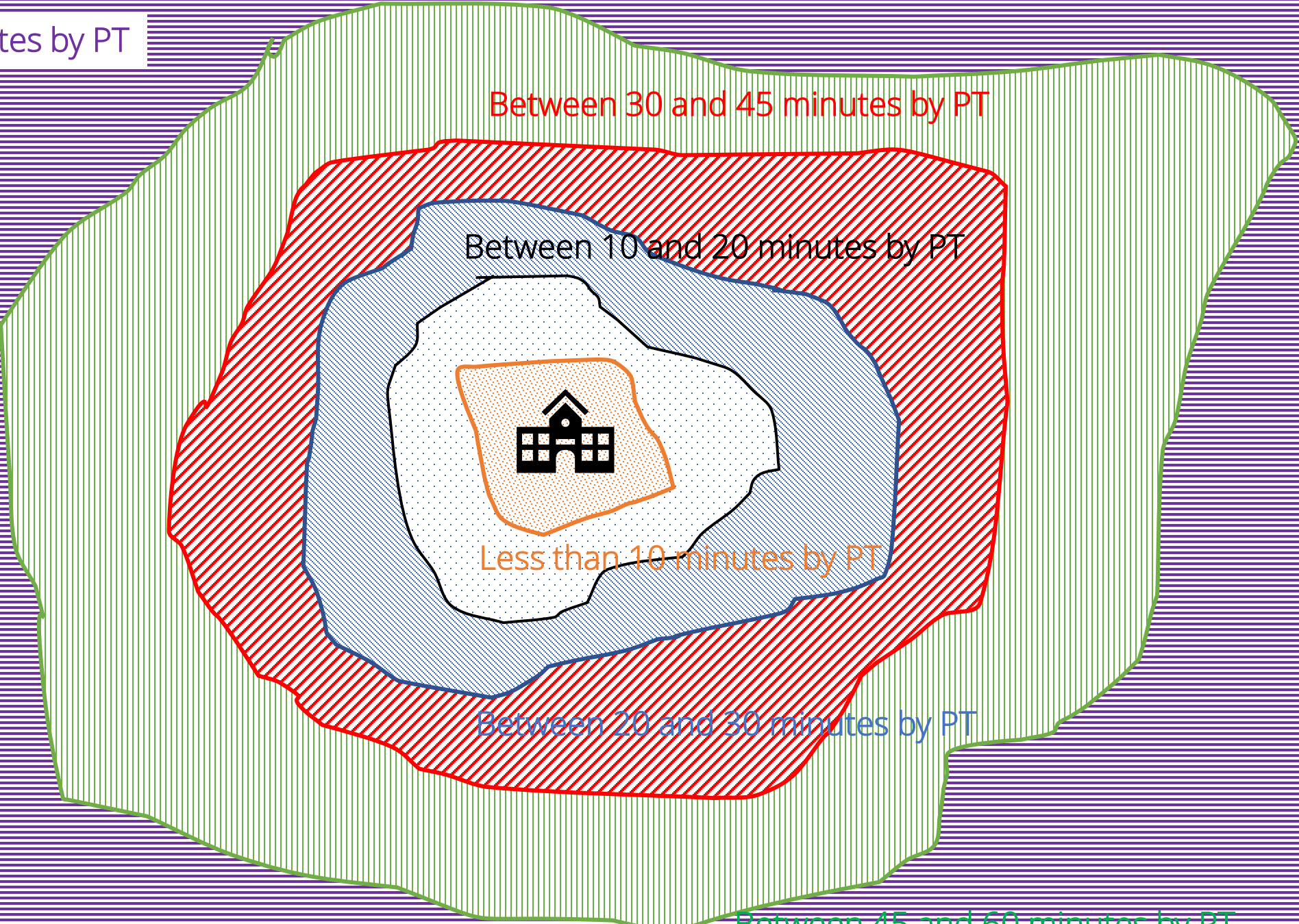
- **Spatially segregated** city as income distribution strictly correlates with urban location (de Mattos, 1999).
- School-related travel corresponds to **25% of the trips** made at morning peak hour → half of them being made in **motorized modes** (SECTRA, 2014 : Origin-Destination Survey).



Our proposal

- Take a look “from the offer side.”
- Observation unit: school.
- Methodology: spatial (or time) rings (“isochrons”)

More than 60 minutes by PT



Research questions

- Are there **differences or patterns** on the **spatial distribution** of the students' locations attending each school?
- What **factors impact** the **spatial distribution** of the students' locations for each school?



Data

The sample

- 2016 enrollment data from the ministry of education.
- 456,817 students from 1,882 schools.

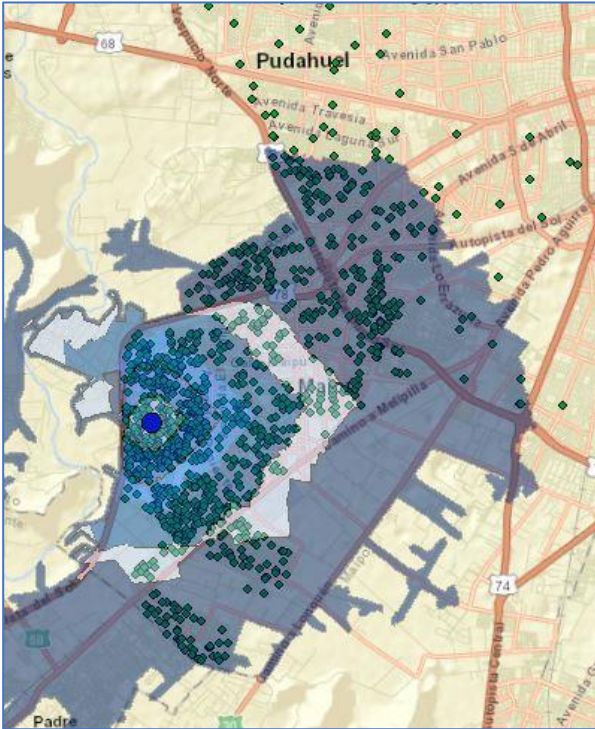
Type of institution	Sample	Real
Public	31.19%	21.17%
Private voucher	55.90%	61.93%
Private non-voucher	12.91%	16.90%

Table 1: Sample vs population
distribution of schools by type

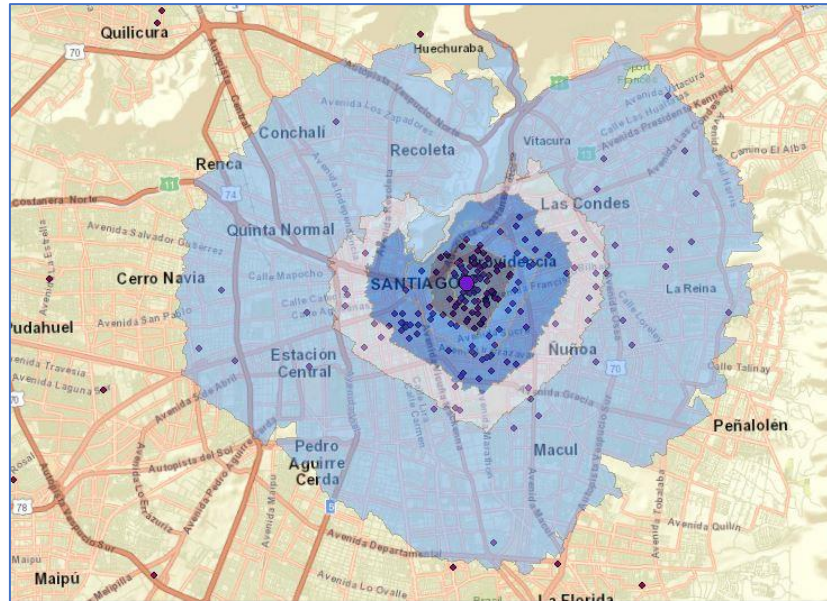
Enrollment	Sample	Real
Public	28.98%	25.44%
Private voucher	65.79%	61.27%
Private non-voucher	5.23%	13.29%

Table 2: Sample vs population
distribution of enrollment by type

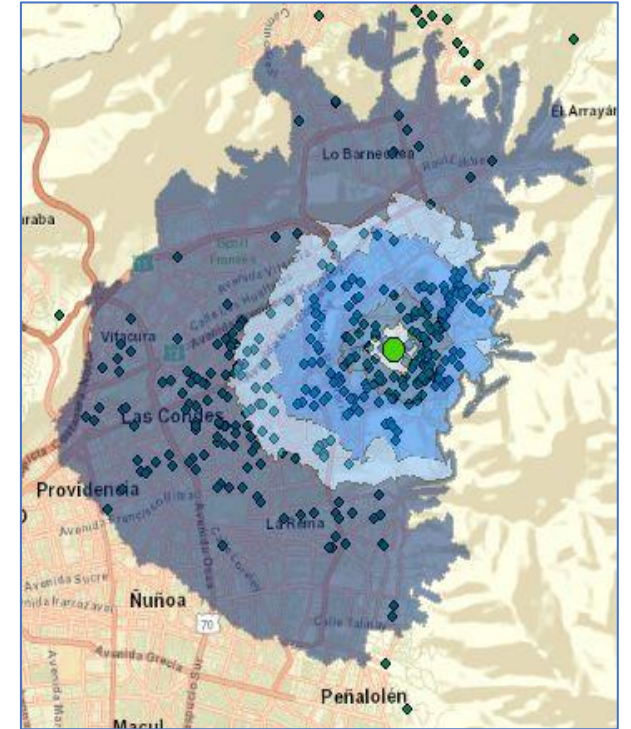
Examples



Liceo Nacional de Maipú
(public school)

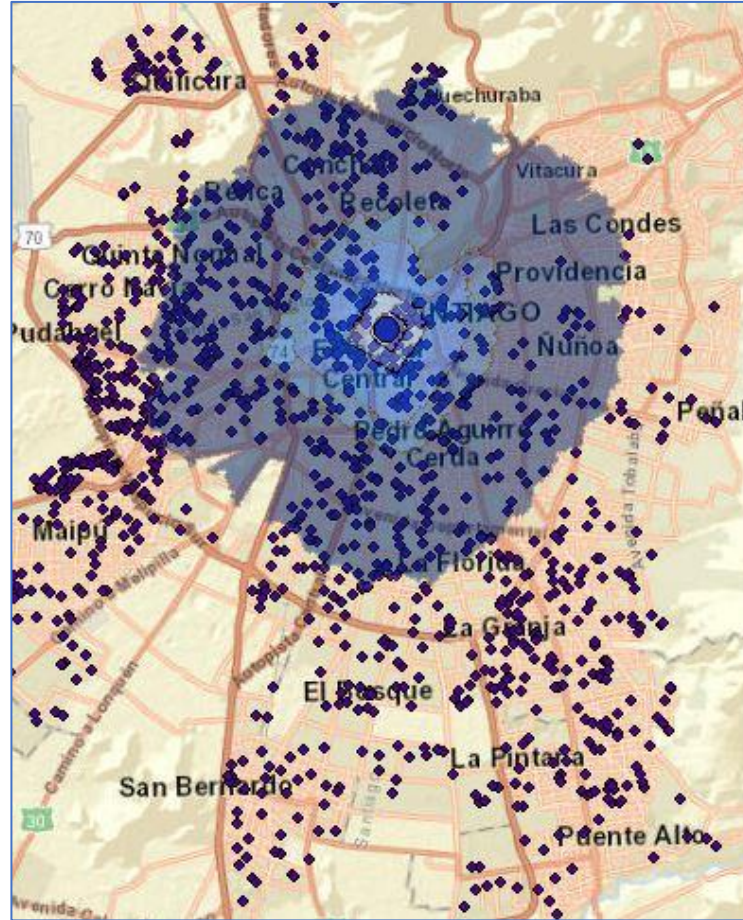


Colegio Josefino Ssma Trinidad
(private voucher)



Colegio Redland
(private non-voucher school)

Examples



Instituto Nacional
(traditional public school with high
performance)

Variables

- Education level (elementary, secondary, both)
- Dependency type (public, private voucher, private non-voucher)
- Distance to city center.
- Municipality.
- School performance in SIMCE (Education Quality Measurement System)
- Built environment.
- Other school characteristics (number of teachers per student, religious status, extra-curricular infrastructure, etc.)

Methodology

Multiple Discrete-Continuous Model

$$\begin{aligned} \max U(\mathbf{x}) &= \sum_{k=1}^K \frac{\tau_k}{\alpha_k} \psi_k \left(\left(\frac{x_k}{\tau_k} + 1 \right)^{\alpha_k} - 1 \right) \\ \text{s.t. } \sum_{k=1}^K x_k &= 1 \end{aligned}$$

K : number of rings (6 in our case)

x_k : % of student enrollment with residence in ring k

τ_k , ψ_k and α_k : parameters to estimate (with response heterogeneity and error)

Reference: Bhat (2008)

Spatial Multiple Discrete-Continuous Probit (S-MDCP) Model

$$\begin{aligned} \max U(\mathbf{x}) &= \sum_{k=1}^{K-1} \tau_{qk} \psi_{qk} \ln \left(\frac{x_{qk}}{\tau_{qk}} + 1 \right) + \psi_{qK} \ln(x_{qK}) \\ \text{s.t. } \sum_{k=1}^K x_{qk} &= 1 \end{aligned}$$


K : number of rings (6 in our case)

x_k : % of student enrollment with residence in ring k

τ_k and ψ_k : parameters to estimate

q : index for school (or educational institution)

Spatial Correlation



$$\bar{\psi}_{qk} = \bar{\psi}_{qk}^* - \bar{\psi}_{qK}^* = \beta'_q \mathbf{z}_{qk} + \delta_k \sum_{q'} w_{qq'} \bar{\psi}_{q'k}, \text{ for } k = 1, 2, \dots, K-1$$

$$\bar{\psi}_{qK} = 0 \text{ for } k = K.$$

$$w_{qq} = 0, \quad \sum_{q'} w_{qq'} = 1 \quad \text{and} \quad 0 < \delta_k < 1$$

Reference: Bhat *et al.* (2015)

Results

Preliminary estimation

- Schools with **elementary education** tend to have students more concentrated and near (less than 10 minutes)
- **Private non-voucher schools** have less students living nearby (less than 20 minutes)
- **Providencia** is a particular case: attract students from far away (many farther than 60 minutes)

Preliminary estimation

- **Coed schools** attract more students from nearby than single-gender schools.
- Schools with **higher scores in SIMCE** (Education Quality Measurement System) attract more students from farther rings.
- Schools with **better access to public transport** (metro and buses) attract more students from farther rings.

Preliminary estimation

- Spatial correlation is statistically significant and equal to 0.217
- Proximity measure: 1 divided by distance (in km)

Conclusions

Conclusions

- We can characterize the coverage area of each school.
- It is possible to determine precisely the impact of each school and built environment characteristic.
- There is evidence of a segregated city, even after controlling for many other factors.

Further Research

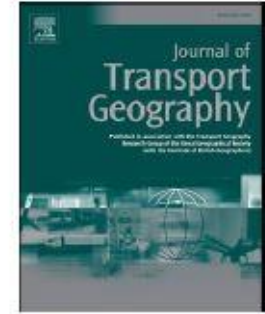
- Testing different definitions of rings.
- Expanding the model to other cities in the country.
- Panel version of the model.
- Other measures of “proximity” (competition)



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On the relation between school and residential location choice: Evidence of heterogeneous strategies from Santiago de Chile

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Questions?

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