Estimating the Effect of Financial Aid Offers on College Enrollment: A Regression Discontinuity Approach

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Regression Discontinuity Design

The Treatment Model

$W_i = 1$: Treatment (union, financial aid)
$W_i = 0$: Control (nonunion, non-financial aid)
$Y_i(0)$: Outcome if not treated
$Y_i(1)$: Outcome if treated

$$Y_i = (1 - W_i) \times Y_i(0) + W_i \times Y_i(1) = \begin{cases} Yi(0) & \text{if } W_i = 0 \\ Y_i(1) & \text{if } W_i = 1 \end{cases}$$

Fuzzy RD Design

The treatment assignment may not follow an exact rule, such as $W(X_i)$. That is, the assignment rule could be as follows.

$$W_i = W(X_i) + \epsilon_i$$

Even then, as long as the assighment probabilty function $Pr(W_i = 1|X_i) = E(X_i|S_i)$ has discontinuity at c, we can still use RD design to estimate the treatment effect.
The below assumptions allow for treatment effect α_i to be different among individuals.

Assumptions

Assumption 1

$$E\left[Y(0)|X=x\right],\ E\left[Y(1)|X=x\right]$$

are continuous in x.

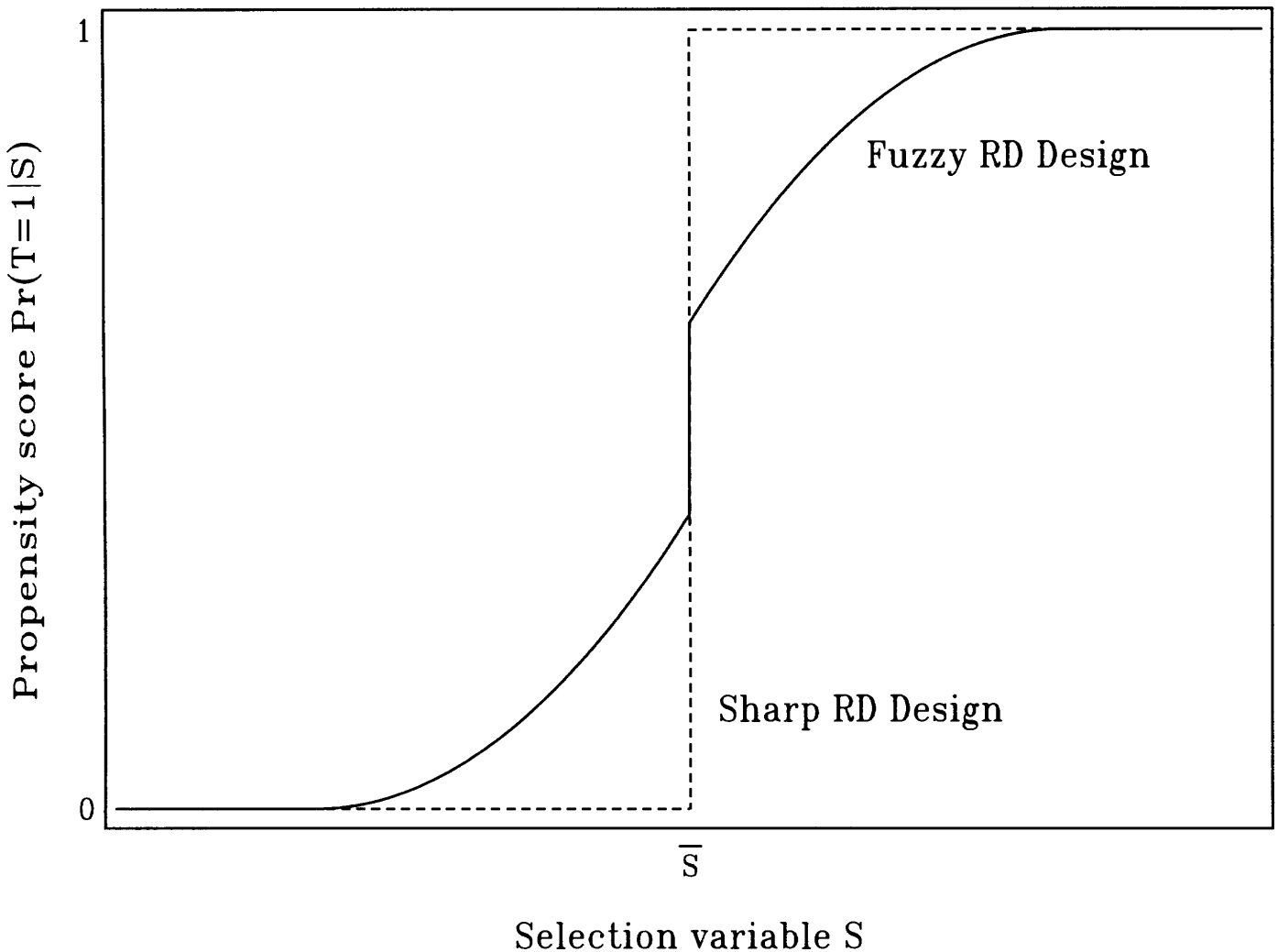
Assumption 2

$$lim_{x\nearrow c} Pr\left[W_i=1|X_i=x\right] \neq lim_{x\searrow c} E\left[W_i=1|X_i=x\right]$$

Fuzzy RD Design Estimator

The Average Treatment Effect can be estimated as:

$$\tau = \frac{lim_{X\searrow c} E[Y_i|X_i=x] - lim_{X\nearrow c} E[Y_i|X_i=x]}{lim_{X\searrow c} Pr[W_i=1|X_i=x] - lim_{X\nearrow c} Pr[W_i=1|X_i=x]}$$


1
0
Propensity score Pr(T=1|S)
Fuzzy RD Design
Sharp RD Design
$\overline{S}$
Selection variable S

Estimation

- First estimate the treatment probability, which has a discontinuity at c:

$$E[W_i|X_i] = Pr(W_i = 1|X_i) = f(X_i) + \gamma 1(X_i \geq c)$$

- Then, using the above probability, estimate the below equation using OLS.

$$Y_i = \beta + \alpha Pr(W_i = 1|X_i) + k(X_i) + \omega_i$$

or

$$Y_i = \beta + \alpha E(W_i|X_i) + k(X_i) + \omega_i$$

Both $f(S_i)$ and $k(S_i)$ are set to be continous functions of S_i

The Dataset

- Academic year: 1991-92.
- age, gender, race, place of residence, citizenship
- high school records: GPA, SAT, school and class rank, recommendation letter, statement of purpose
- Federal and state aid eligible students: parental income, parents' expected financial contribution.
- Detailed aid package: amounts of different aid, loan or grant , federal/state or college aid.

- Filers: applied for federal/state aid as well. Includes data on parental income, expected financial contribution.
- Nonfilers: did not qualify for federal/state aid. Info on parental income, expected financial contribution not available.
- The relationship between financial aid rank and enrollment is not monotone.
- For nonfilers, students who enrolled received lower financial aid than those who did not enroll. Negative correlation between financial aid and enrollment.

Estimated Financial Aid Function

- Sharp increase in financial aid offers at three discontinuity points. Especially pronounced for the nonfilers.
- Discontinuity points correspond to the threshold points of financial aid rank.
- For filers, outside the discontinuity points, ability and financial aid are slightly negatively correlated. This is because income is positively correlated with, and minority status negatively correlated with ability index.

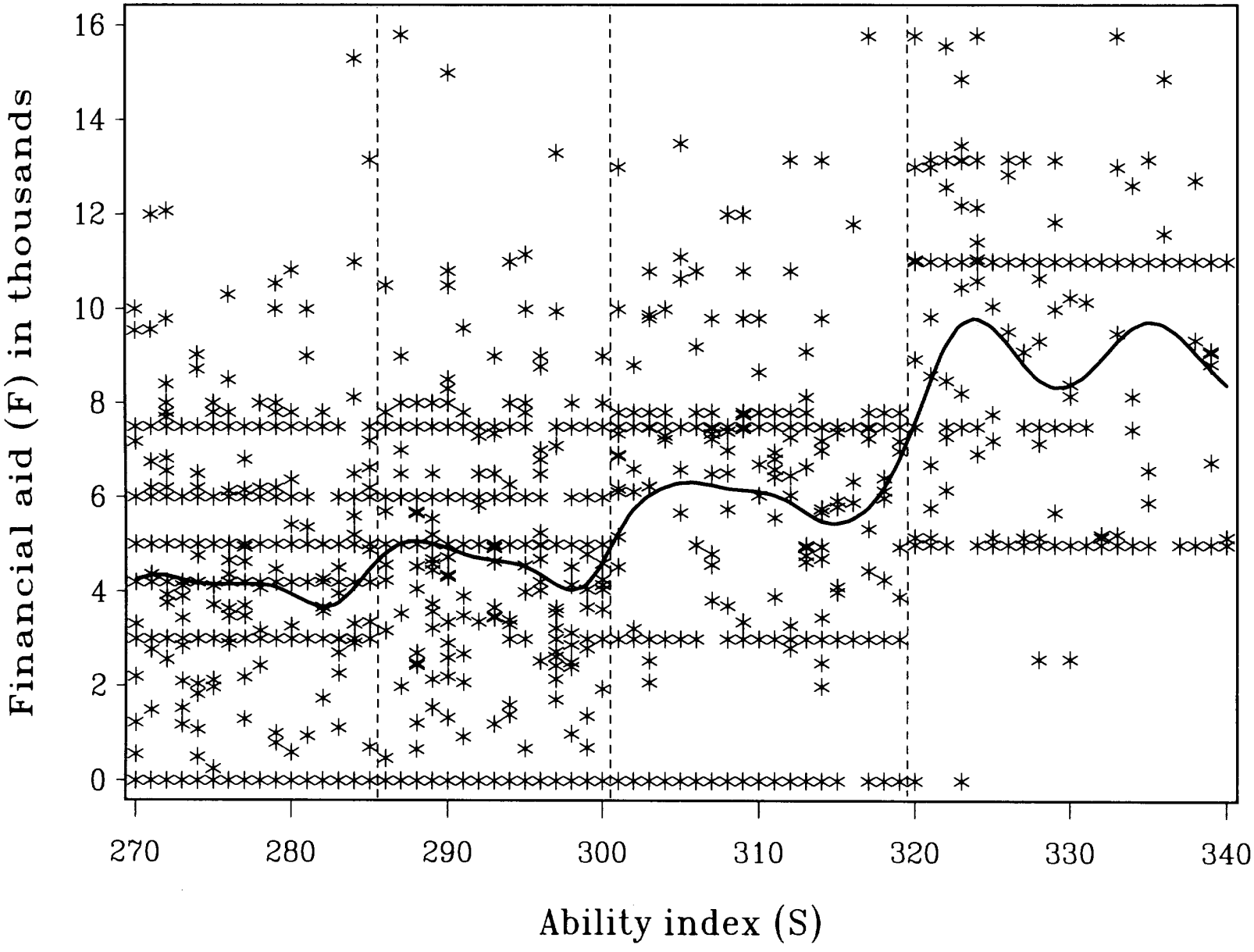


FIGURE 3

FINANCIAL AID OFFERS—FILERS. RAW DATA AND SPLINE SMOOTH (SOLID CURVE)

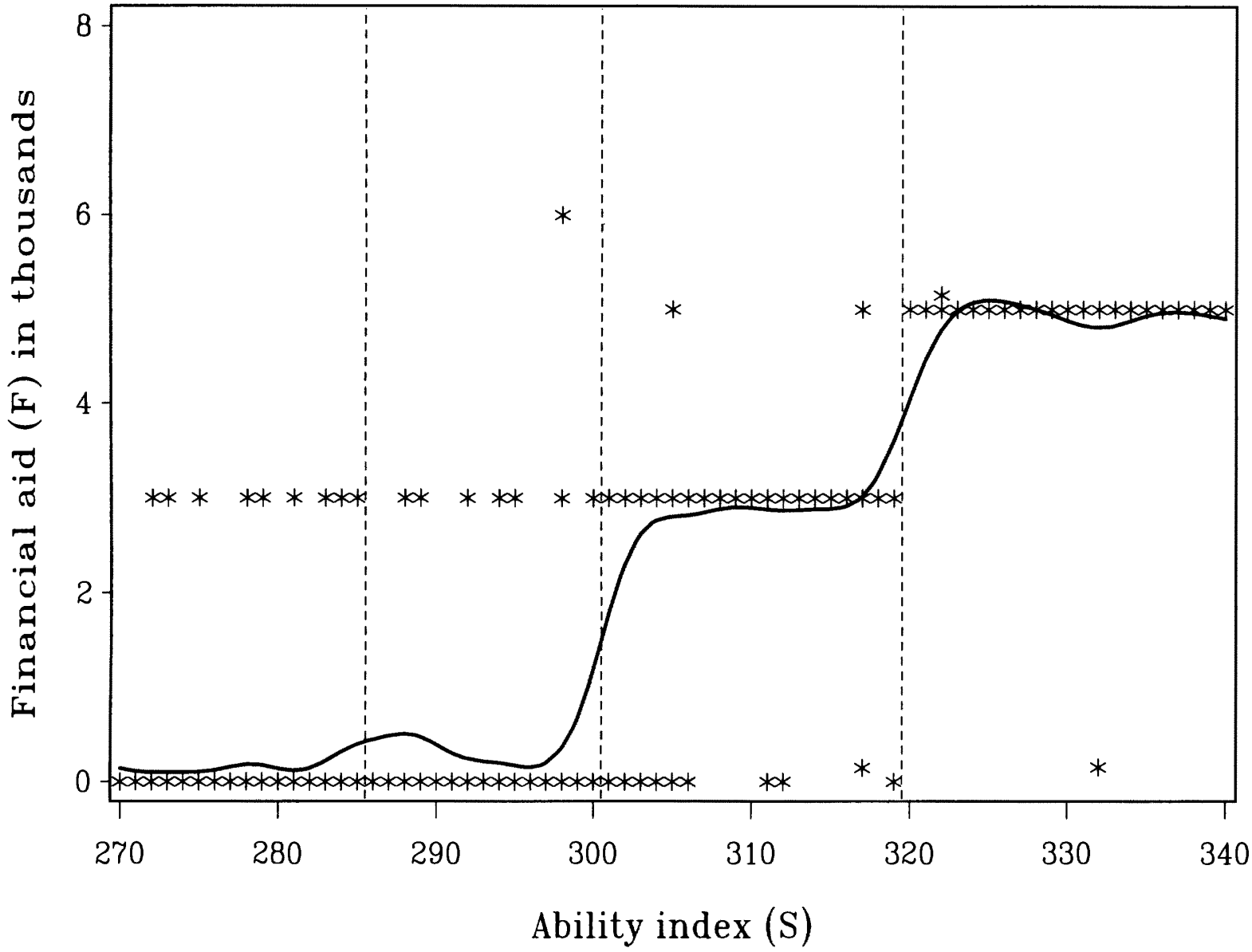


FIGURE 4

FINANCIAL AID OFFERS—NONFILERS. RAW DATA AND SPLINE SMOOTH (SOLID CURVE)

Estimated Enrollment Function

- For filers, within rank, enrollment declines with ability index.
- For filers, jump in enrollment at threshold points of financial aid.
- For nonfilers, similar relationship but less clear.

Estimation Results

- Estimating equation.

$$EN_i = \beta + \alpha E[F|S_i] + k(S_i) + \epsilon_i$$

$E[F|S_i]$: piecewise cubic equation shown in Figures 5 and 6.

Parameters	Filers		Nonfilers	
Parameters	Estimate	Std. Err.	Estimate	Std. Err.
Constant	66.19	44.96	0.722	0.192
S	-93.36	65.14	-0.212	0.071
S^2	49.41	35.15		
S^3	-11.55	8.372		
S^4	1.002	0.743		
F	0.051	0.015	0.019	0.011
Observation	2225		1150	

- Positive and significant effect of financial aid for filers. Positive but barely insignificant effect for nonfilers.
- Consistent with the idea that filers are more subject to finance constraint when making enrollment decisions.

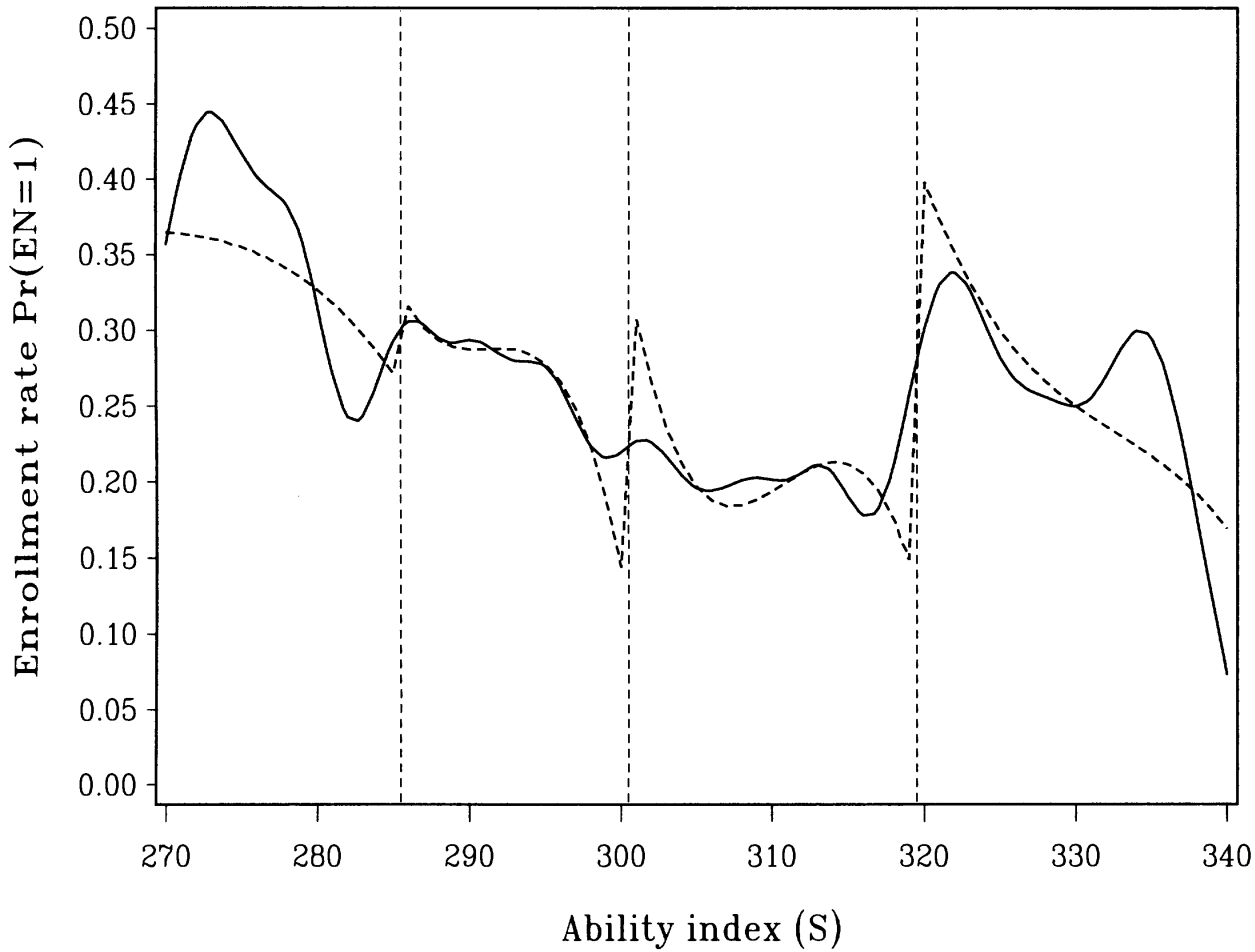


FIGURE 7

ENROLLMENT PROBABILITY—FILERS. PIECEWISE CUBIC REGRESSION (DASHED CURVE) AND NONPARAMETRIC SPLINE SMOOTH (SOLID CURVE)

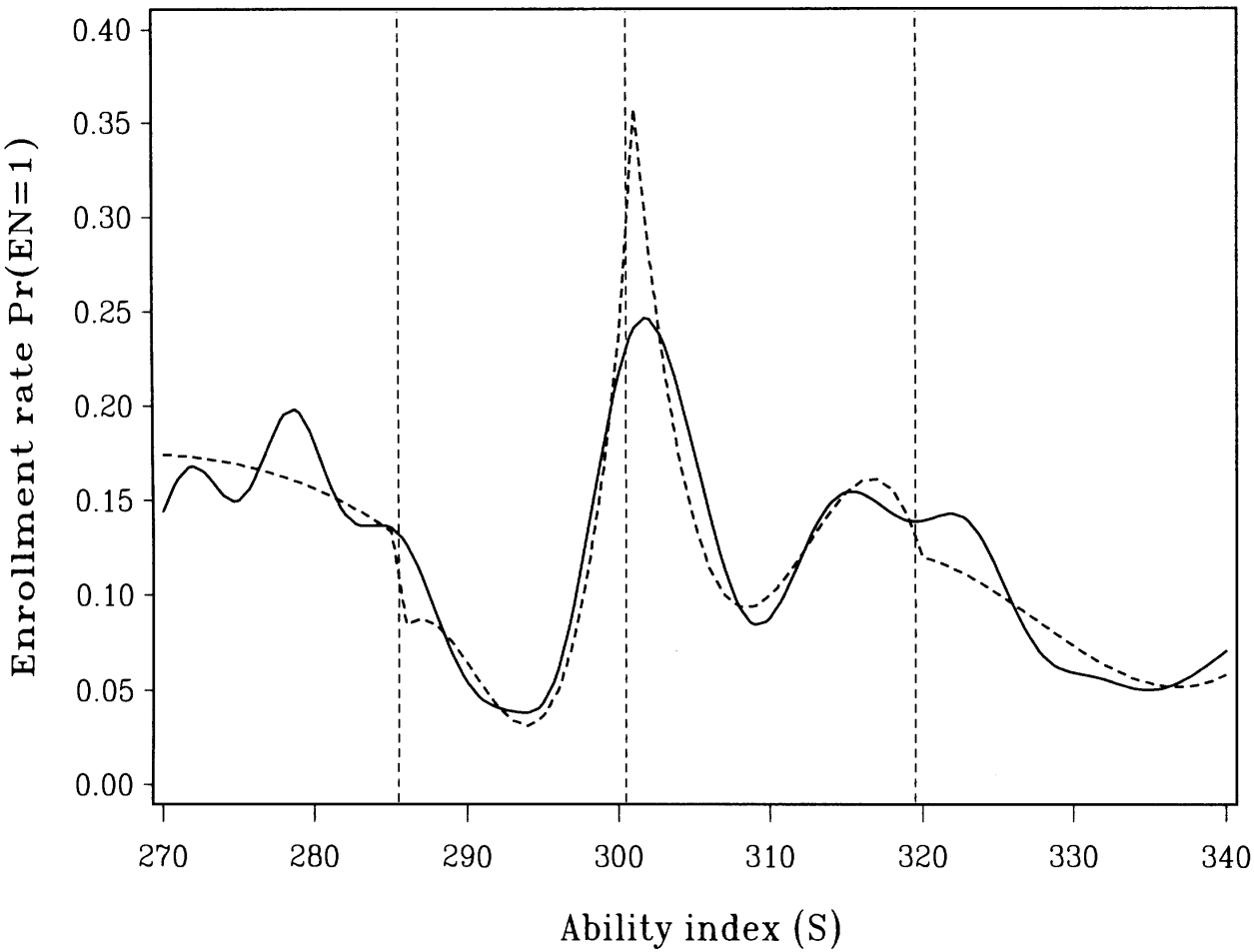


FIGURE 8

ENROLLMENT PROBABILITY—NONFILERS. PIECEWISE CUBIC REGRESSION (DASHED CURVE) AND NONPARAMETRIC SPLINE SMOOTH (SOLID CURVE)