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Modeling and Estimating Preferences Over Treatment Programs for Depression

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Modeling Tmegectiveness, money costs, time costs, se of psychotherapy, se of anti-depre
After the individuals chooses their preferred alternative, they are ask
treatment option is preferred to remaining depressed. Each respondent
pairs. The data is used to estimate 3 random-utility models. Prelim
The value of consuming market goods is less when one is depressed. T
willingness-to-pay, , to eliminate one's depression and willingnes
to avoid sexual and weight-gain side e ects can be high but varie
uals as a function of observable characteristics. (3) At su ciently high c
side e ects, some individuals will prefer to remain depressed.

Depression makes people worse o , as do the side e ects associated with using anti-depressants. Depression treatment can also involve substantial money and time costs. A discrete-choice random-utility framework is used to model and estimate preferences over treatment programs for depression as a function of the characteristics of the treatment program and characteristics of the individual. Characteristics of treatment include e ectiveness, money cost, time cost, use of psychotherapy, use of anti-depressants, and sexual and weight-gain side e ects. How an individual trades o these treatment characteristics, including cost, is modeled as a function of severity of depression, income, age, gender, and previous experience with side e ects. Issues investigated include: (1) the extent to which the value of market goods is a ected by one's level of depression; (2) income e ects; (3) willingness-to pay ( ) to eliminate or reduce depression versus willingness-to-accept ( ) it; and (4) to avoid side e ects. Preliminary ndings include: (1) The value of consuming market goods is less when one is depressed. This drives a wedge between to eliminate one's depression and . (2) to avoid sexual and weight-gain side e ects can be high but varies extensively across individuals as a function of observable characteristics. (3) At su ciently high costs in terms of money and side e ects, some individuals will prefer to remain depressed.

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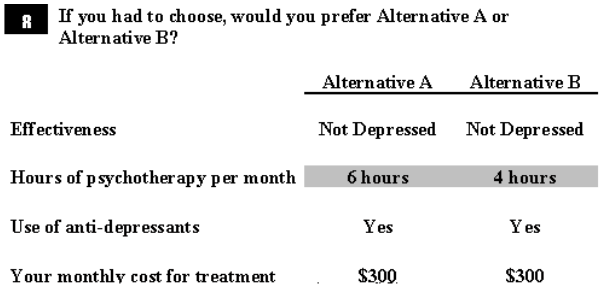
The data used to estimate the models come from a choice question survey administered to depressed patients at a mental health facility in Colorado.[1] A choice question asks an individual to choose her preferred alternative from some discrete number of alternatives, each described in terms of the levels of a common and nite site of characteristics. Figure 1 is an example choice question.



8 If you had to choose, would you prefer Alternative A or Alternative B?

	Alternative A	Alternative B
Effectiveness	Not Depressed	Not Depressed
Hours of psychotherapy per month	6 hours	4 hours
Use of anti-depressants	Yes	Yes
Your monthly cost for treatment	$300	$300

Figure 1: Example Choice Question

In this study, the individual is presented with ve pairs of treatment programs and chooses her preferred alternative in each pair. Each treatment is described in terms of its money cost, hours of psychotherapy, use of anti-depressants, and side e ects experienced if the treatment includes anti-

responses to value, in dollars, treatment programs for depression.

Responses to choice questions are stated-preference data (SP data) in contrast to revealed preference data (RP data). RP data consists of observed behavior and choices that can be used to infer values. SP data are statements about the respondents' preferences. Existing RP data has limited capabilities to estimate preferences over health treatment programs. Reasons include: the widespread presence of insurance within the US and universal health care systems outside the US, which obscures the supply demand relationship; much of the decision-making is done by the clinician; and the non-participation of certain populations in the health care market (Johnson et al, 2000). For these reasons, market prices are unobserved or do not re ect the full values of the services. In addition, since the researcher cannot control the independent variables in a revealed preference study, the researcher may be unable to determine the relative importance of variables because of correlations.[3] SP studies, such as choice

this new drug. This procedure is repeated for each side e ect. The occurrence of multiple side e ects at the same time is not considered. A lower and upper bound for for multiple risk reduction is estimated. The upper bound is calculated as the average over all respondents of the sum of the for each individual side e ect. The lower bound on is calculated by identifying for each individual the side e ect over which she had the greatest WTP and then averaging over all individuals. On average, individuals were willing to pay the most ($Can21.9 per month) to reduce the risk of blurred vision by 5% and the lowest ($Can11.4 per month) to reduce the risk of dry mouth by 25%.

patients took the Shedler QuickPsychoDiagnostics (QPD) survey on a handheld device (Schedler et al, 2000). The QPD is an initial evaluation tool that provides, among other things, a depression score for each patient, a listing of depression symptoms, and any co-morbidities, such as anxiety or substance

ability level is grade six, as assessed by the Flesch-K

From this, 16 choice sets were selected for the nal design. The nal design was divided into four blocks of four choice sets, resulting in four di

are on average rated as Pretty Important. Number of therapy hours is rated as Somewhat Important. While the average rankings are not signi cantly di erent from each other, they vary signi cantly across individuals.

Forty ve percent of respondents would need to take time o work in order to attend therapy sessions while 31% would need to arrange for child care. The most commonly picked descriptions of therapy are: helpful, chance to deal with things, self-exploration, and problem-solving. The most commonly picked descriptions of anti-depressants are: helpful, embarrassing, and common method.

2.1 Summary Statistics

Table 2 shows the share of times that the chosen alternative had certain attributes. For example, 61% of the time, individuals choose a treatment plan that eliminates their depression over a treatment plan that merely reduces it. Table 3 shows how respondents answer the follow-up question on the basis of treatment. In 89% of the follow-up choices, treatment, which either eliminated or reduced depression, is chosen.

	Frequency	Percentage
Eliminated Depression	114	61%
Had Lower Weight Gain Side Effect	262	70%
No Orgasm Side Effect Does Not Occur	149	65%
No Sex Side Effect Does Not Occur	123	51%
Involved Therapy [a]	121	62%
Use of Anti-Depressants [a]	47	40%

[a] both therapy and anti-depressants [illegible] treatment program could includ

Table 2: What Share of Times did the Chosen Alternative Have Certain Attributes?

	237	89%	Chose Not Depressed over Current Depression
	29	6%	Chose Current depression over Not Depressed
pressio	134	25%	Chose Some Depressive Symptoms over Current De
mptoms	31	4%	Chose Current Depression over Some Depressive Sy

Table 3: Treatment Choices in Follow-up Question

As noted earlier, after the set of choice questions, respondents use a ve point scale to identify the importance of each attribute in answering the choice questions. In order to identify potential sources of heterogeneity, OLS regressions were run on how respondents ranked the importance of each attribute as a function of personal characteristics. However, when an individual answers that an attribute was important to him, it is not clear whether it was important in a positive or negative way. Therefore, the expected sign of the preference parameter may be positive or negative.

These regressions show that respondents who are older, more highly educated, work more hours per week, or who have no previous treatment experience feel that treatment e ectiveness is relatively more important. There is an inverse relationship between income, education, weekly work hours and how individuals rank the importance of the cost. These explanatory variables are most likely highly correlated.

In general, how individuals feel about the side e ects is a function of gender and age. For example, compared to men, women tended to rate the weight gain side e

+(, + ,

probability

imply an estimated maximum willingness-to-pay, , of $1471 per month to eliminate depression by therapy alone and $810 to reduce depression through the same method, a ratio of almost two to one.[18] In interpreting these results, it should be recalled that these estimates do not allow for any individual heterogeneity in preferences. These estimates are an average over all income levels. Furthermore, these amounts would be paid a limited amount of time, while the costs of not treating depression can increase proportionately over time.

Ignoring monetary costs, one's utility if treated solely with anti-depressants is

$$= 2\ 29 + (58 \quad 27 \quad 1\ 08) + B \tag{6}$$

On average, estimated to eliminate depression through anti-depressants only is approximately $300 less than the to achieve the same outcome through therapy alone. If treatment combines both therapy and anti-depressants,

$$= 02[\quad]$$
$$+2\ 67$$
$$(58 \quad 27 \quad 1\ 08) + B$$

The parameter estimate on is not signi cantly di erent from the parameter estimate on but it is signi cantly larger than the parameter estimate on . Estimated to eliminate depression with both therapy and anti-depressants is $1350.

Similar to Revicki and Wood (1998) and O'Brien et al (1995), the results suggest that individuals view some side e ects as being worse than others. By assumption, the impact of side e ects from anti-depressants is the same independent of whether one receives therapy. Estimated is $548 per month to avoid weight gain[19], $295 to avoid the no-orgasm side e ect, and $138 to avoid the no sex-drive side e

3.2 Model 2: Allowing the Value of Goods to Depend on Emotional state

Model 2 generalizes Model 1 by allowing the value of market goods to di er depending on one's emotional state. The conjecture is that individuals get greater pleasure from the consumption of goods when they are not depressed. Assume

$$= \quad (+ \quad + + \quad + + \quad)(\quad) + + [\quad] \qquad (7)$$

$$+ , \quad + ,$$

$$+ , \quad + ,$$

$$+ , \quad + , \quad + ,$$

$$+ B$$

where

= Emotional state is depressed (1=Yes, 0=No)

= Emotional state is some depressive symptoms (1=Yes, 0=No)

Equation 7 is identical to Equation 2 except + is generalized to (+ + + + +); that is, this speci cation allows the marginal utility of money to di er as a function of the three emotional states. Assuming Equation 7, income does not drop out of the choice probabilities. Income e ects are implied in the sense that the alternative chosen in the choice pairs a ects one's emotional state, which in turn a ects the value one places on market goods. Table 5 shows the parameter estimates for this model.

Parameter		Estimate	Est./s.e.	Prob.
MU of Income= - (money cost parameter)	α_m	2.21	2.5500	0.0054
Reduction in MU of Income if Depressed	α_{md}	-0.36	-4.5300	0.0000
Reduction in MU of Income if Depressive Symptoms	α_{mds}	-0.08	-1.9200	0.0274
MU of Time= - (time cost parameter)	[illegible]	-0.04	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	1.6[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 5: Model 2 Maximum Likelihood Parameter Estimates

The mean log likelihood is -0.89. Model 2 correctly predicts 70% of the AB choices, 89% of the follow-up choices, and 63% of both choices. A likelihood ratio test was performed to test the hypothesis that + = + = 0. This hypothesis was rejected at the 1% level. Model 2 statistically dominates Model 1.

The conjecture is con rmed. The estimated marginal utility of money is 2 21 if the individual is not depressed, 2 13 (2 21 08) if the individual has some depressive symptoms and 1 84 if the individual is depressed. Consumption loses 17% of its value when an individual is depressed.

Given that Model 2 incorporates income e ects, calculation of is more complicated and no longer equals [20] Consider an individual's to eliminate her depression through the use of therapy alone. Ignoring the insigni cant time costs associated with therapy and assuming zero cost for treatment, [21]

$$= \frac{+}{+} + \frac{'}{+} \tag{8}$$

Equation 8 shows that eliminating depression has two e ects on an individual's utility level. The rst term is an income e ect. Eliminating depression increases

Income	WTP	WTA
$30,000	$1,128	$1,351
$55,000	$1,471	$1,763
$90,000	$1,953	$2,351

Table 6: Estimated WTP vs WTA by Income Level (when depression can be eliminated by therapy alone)

Table 9 shows the average and for individuals in the sample when depression could be eliminated using therapy .

	Average	Std Dev	Min	Max
WTP	$1,458	$422	$783	$2,780
WTA	$1,747	$506	$939	$3,330

Table 7: Sample WTP vs WTA (when depression can be eliminated with therapy alone)

Assuming no side e ects, the estimated average to eliminate depression with only anti-depressants is $1206 per month; estimated is $1444. Generalizing the model to allow the value of goods to depend on one's emotional state increases the and associated with successful treatment of depression. Model 1 was underestimating for these scenarios.

In Model 2, estimated to avoid side e ects and side e ects depends on the reference point (depressed, some depressive symptoms and not depressed). For example one could ask how much an individual on anti-depressants who is currently experiencing side e ects but no depression would pay per month to eliminate those side e ects. This amount is calculated using the individual's marginal utility of money when she is not depressed. For this scenario, estimated to avoid weight gain is $484 per month. It is $258 to avoid the no-orgasm side e ect and $156 to avoid the no sex-drive side e ect. = as we are assuming the same emotional state in both scenarios.

Alternatively, one could use the model to estimate what a depressed individual would pay per month to not gain weight. To value that scenario, one would use the marginal utility of money that applies when the individual is depressed. For the weight gain, this estimated is $580; the individual is willing to pay more when depressed because money is worth less when one is depressed.

Using anti-depressants alone or in combination with therapy to eliminate depression when it results in all three side e ects has a negative but not signi cant impact on utility. The combined impact of the side e ects cancels out the gain from eliminating the depression.

Summarizing, Model 1 and 2 give di erent results and Model 2 is statistically preferred. Both Model 1 and Model 2 are highly restrictive in that, conditional on emotional state, both assume everyone has the same preferences over depression treatment programs. Model 2 suggests that with side e ects, treatment with anti-depressants will be an improvement for some and a (non-signi cant) deterioration for others. Previous studies have found a similar result: severe depression is considered worse than an improved emotional state combined with medication side e ects (Revicki and Wood, 1998). Model 3 generalizes Model 2 by allowing preferences for treatment to vary as a function of observable characteristics of the individual. In this case, when certain personal characteristics are accounted for, some individuals do not rank the elimination of their depression as an improvement and in certain extreme cases view the treatment and improved emotional state as worse than their current depression.

3.3 Model 3: Preference Heterogeneity

Model 3 generalizes Model 2 by making parameters a function of characteristics of the individual. We investigated the impact of the following individual characteristics: household income, gender, education level, the individual's current level of depression as rated by the clinician, race/ethnicity, age, previous experience with the side e

For example, the impact of weight gain side-e ect, (, + , + , + ,) is a function of gender, previous experience with this side e ect, and whether one is underweight according

is, individuals with more income have a higher
because of di

to eliminate depression and side e ects. Simply

13 1 68 + B . She would rather remain depressed than experience the weight-gain side e ect, and is close to indi erent between remaining depressed and not being depressed but experiencing the no orgasm side e ect. She is a ected little by the no sex drive side e ect. Alternatively, if the same female was moderately depressed, = 1 62 1 02 13 1 68 + B , she is indi erent being not depressed with the weight gain or remaining depressed, but she would not accept both the weight gain and no orgasm side e ects. In the case of severe depression, she is indi erent between all three side e ects and eliminating her depression. The result that to avoid side e ects varies with income level and demographic characteristics is di erent from O'Brien et al (1995).

4 Extensions

As noted earlier, this paper remains a work in progress. The primary work to be done deals with exploring additional types of preference heterogeneity. Model 3 will be expanded to deal with other potential sources of preference heterogeneity. Additional examination of how individuals answered attitudinal questions will be used to help identify and model this heterogeneity. In addition, this paper will explore how latent class models and cluster analysis can be used to model heterogeneity.

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$$\cap = (5 \sim 5)$$

$$= [(+ B \geqslant + B) \sim (+ B \geqslant + B)]$$

$$= [(B 4 + B) \sim (B 4 + B)]$$

By assumption, the error terms B B B are independent draws from the extreme value distribution. Given this asumption, we can rewrite the above as

$$\cap = \int_{-\infty}^{\infty} \int_{-\infty}^{ijA - ijB + ijA} (B) B \int_{-\infty}^{ijA - ijNT + ijA} (B) B (B) B$$

$$= \int_{-\infty}^{\infty} [(B)] |_{-\infty}^{ijA - ijB + ijA} [(B)] |_{-\infty}^{ijA - ijNT + ijA} (B) B$$

For the extreme value distribution, (B) = exp(B $^{-}$) and (B) = exp($^{-}$) Substituting,

$$\cap = \int_{-\infty}^{\infty} [\exp({}^{ijB})] |_{-\infty}^{ijA - ijB + ijA} [\exp({}^{ijNT})] |_{-\infty}^{ijA - ijNT + ijA} \exp(B {}^{-ijA}) B$$

$$= \int_{-\infty}^{\infty} \exp({}^{ijB - ijA - ijA}) \exp({}^{ijNT - ijA - ijA}) \exp(B {}^{-ijA}) B$$

$$= \int_{-\infty}^{\infty} \exp {}^{ijB - ijA - ijA} {}^{ijNT - ijA}$$

and

$$= \frac{{}_{ijNT}}{{}_{ijA} + {}_{ijB} + {}_{ijNT}}$$

6 Appendix 2

Effectiveness Attribute		
Level	Frequency	Percent
Some Depressive Symptoms	365	36%
Not Depressed	641	64%

Therapy Hours Attribute		
Level	Frequency	Percentand

Sex Drive Side Effect Attribute		
Level	Frequency	Percent
No Sex Drive Side E ect Does Not Occur	680	68%
No Sex Drive Side E ect Occurs	326	32%

Weight Gain Side Effect Attribute		
Level	Frequency	Percent
No Weight Gain	521	52%
5% Weight Gain	244	24%
10% Weight Gain	130	13%
15% Weight Gain	111	11%

	Not Depressed	Therapy Hours	Cost	Anti-Depressants	No Orgasm	No Sex Drive	Weight Gain
Not Depressed	1.00	0.18	0.23	0.07	0.20	0.27	-0.09
Therapy Hours	0.18	1.00	-0.02	-0.09	-0.24	0.09	-0.44
Cost	0.23	-0.02	1.00	-0.12	-0.09	-0.35	-0.32
Anti-Depressants	0.07	-0.09	-0.12	1.00	0.05	0.30	0.14
No Orgasm	0.20	-0.24	-0.09	0.05	1.00	0.00	-0.11
No Sex Drive	0.27	0.09	-0.35	0.30	0.00	1.00	0.02
Weight Gain	-0.09	-0.44	-0.32	0.14	-0.11	0.02	1.00

Design Correlation between Attribute Di erences