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WHITE PAPER

Discrete Choice Modeling for Prescription Therapies

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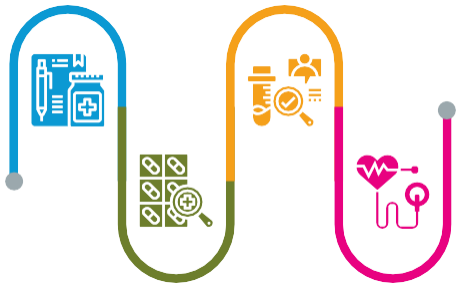


Mathematical models of "discrete choice" for commercial purposes.

Commercializing a product takes a lot of effort and investment. In recent years, mathematical models have played an important role in product development and in the essential processes of moving products from development to the market. Using an example therapy, we will show how mathematical models of discrete choice fit into development and commercialization planning.

The Discrete Choice Principle

A discrete choice is an informed decision involving the selection of one product from a finite number of competing products. Selection criteria take the **characteristics** of each product as well as those of its competitors into account. A mathematical model of discrete choice **assigns each product a probability of being chosen** (a preference share) in relation to each of the competing products.

To build our models, we collect data from on-line surveys in which respondents are asked to make choices among partially described alternative diagnostics, therapeutics, or medical devices to use for dealing with a patient's health issues.

Where Discrete Choice Fits

During its pre-market life, a product will have a set of characteristics (attributes and levels).

Consider the example in Table 1:

Example Prescription Therapy

Attribute	Level
Efficacy: Response Rate	50% to 70%
Safety: Incidence of Grade 4 Side Effects	1% to 5%
Number of Patients in Phase 3 Trials	500 to 2,000
Dosage Form	Syringe and Vial, Autoinjector
Dose Frequency	Once a Day, Once a Week
Monitoring Required	None, Monthly Blood Draw
Included in Treatment Guidelines	No, Recommended
Sales Rep Support Provided to MD	No, Yes
Availability	Specialty Pharmacy Only, Specialty Pharmacy + Retail
Patient Financial Support Program Provided	No, Yes
Patient Monthly Co-Pay	$10 to $100

Table 1

In Table 1, the characteristics shown in green are based on development work and expected clinical trial data for the therapy.

Discrete Choice modeling can help answer critical development phase questions, such as:

- What should be the size of the Clinical Trial?
- Is there a market if the therapy Response Rate is below 60%?
- Will it be worthwhile to spend the development time and money to get Dose Frequency down to Once a Week?

In addition to the development phase, there are decisions a company must make to commercialize a product. Characteristics related to commercialization are shown in orange in Table 1.

Discrete Choice modeling can help answer critical commercialization questions, such as:

- How important is it to the prescribers to have a sales rep visit their office?
- How will contracting with insurance companies impact product uptake?
- Where should the product be available?

The answers can help determine the probability of choosing one therapy over competing therapies based on all of its characteristics and those of its competitors, and fortify the business decision.

The Model

The discrete choice mathematical model is of the following form. Given a decision-maker (e.g., a physician), d, and a product, p.

U_{dp} = the "utility" decision-maker d has for product p = $V_{dp} + e_{dp}$

Where V_{dp} = some function of (tastes of decision-maker d, and attributes of product p) = $V(T_d , A_p)$

And e_{dp} = the governing error probability distribution due to factors not included in V(). The form of e_{dp} is most frequently assumed to be Logit. This assumption has implications for how the model behaves.

In many applications V_{dp} is simply the sum of the values placed on each attribute level by the decision-maker. The preference share can be calculated from the differences in the U_{dp}, depending on the form of the error probability distribution.

Practicalities

Designing a discrete choice model requires an interdisciplinary team familiar with all aspects of the product and the market in which it will compete. A well-defined model must represent the arrays of characteristics of ***all*** the current and future competing therapies. The model will use the physician's responses to a number of relevant questions. Since a survey respondent will give us no more than 45-minutes of their time, the model must tune the number of attributes, levels, and their complexity to deal with that.

The context in which a physician is making decisions may well influence the relative values they place on various characteristics. This means that we must carefully define the relevant contexts and build a model for each one. The context is usually related to the description of the patient disease state. For example, when choosing a drug for an oncology indication, the context could be a patient with a good performance status vs. a patient with a poor performance status. In this case, the Safety Data may be more important to the treatment decision for the patient with the poor performance status.

Fitting the Model

To fit the model, we recruit a sample of physicians to a specialized survey designed to elicit V_{dl}, the values for physician d, of all attribute levels, l. In our experience, the best survey methodology forces a physician to make a choice in which they will have to trade off the values of multiple attributes. These forced choices, because of the trade-offs, typically yield V's that are less tightly bunched and more realistic than simple rating schemes tend to. Figure 1 is an example of a forced choice question.

Please examine the hypothetical therapies described on the left and right.
Then select your preference level below.

You can assume that any characteristics NOT shown are identical for both therapies.

Therapy I			Therapy II	
Efficacy: Response Rate 50%			Efficacy: Response Rate 70%	
Safety (Grade 4 Side Effects): 5%			Safety (Grade 4 Side Effects): 2%	
Number of Patients in Phase 3 Trials: 1,000			Number of Patients in Phase 3 Trials: 500	
Dosage Form: Syringe and Vial		*versus*	Dosage Form: Auto-Injector	
Dose Frequency: Once a Week			Dose Frequency: Once a day	
Monitoring Required: Monthly Blood Draw			Monitoring Required: None	
Sales Rep Support Provided to MD: Yes			Sales Rep Support Provided to MD: No	
Patient Monthly Co-Pay: $100			Patient Monthly Co-Pay: $25	
Strongly Prefer ☐	Somewhat Prefer ☐	No Preference ☐	Somewhat Prefer ☐	Strongly Prefer ☐

Figure 1

In the past, surveys based on a fixed experimental design were used to determine which forced choices would be shown to the physician. Modern methods do not use a fixed design, but rather adapt themselves to the respondent. Accordingly, Rosa's model creates each new forced choice from an on-the-fly analysis of the stream of answers to the previously posed forced choice questions. The responding physician is asked to state the degree to which they prefer one or the other of the two offered choices. The forced choice flow is outlined in Figure 2.

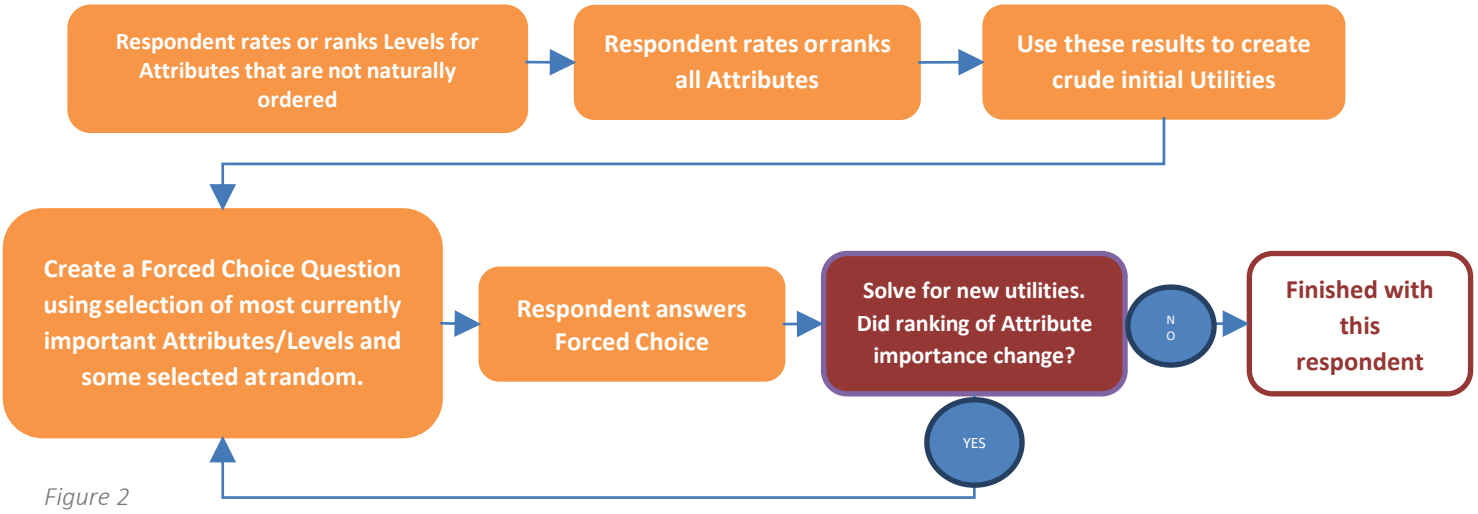


Figure 2

Simulation

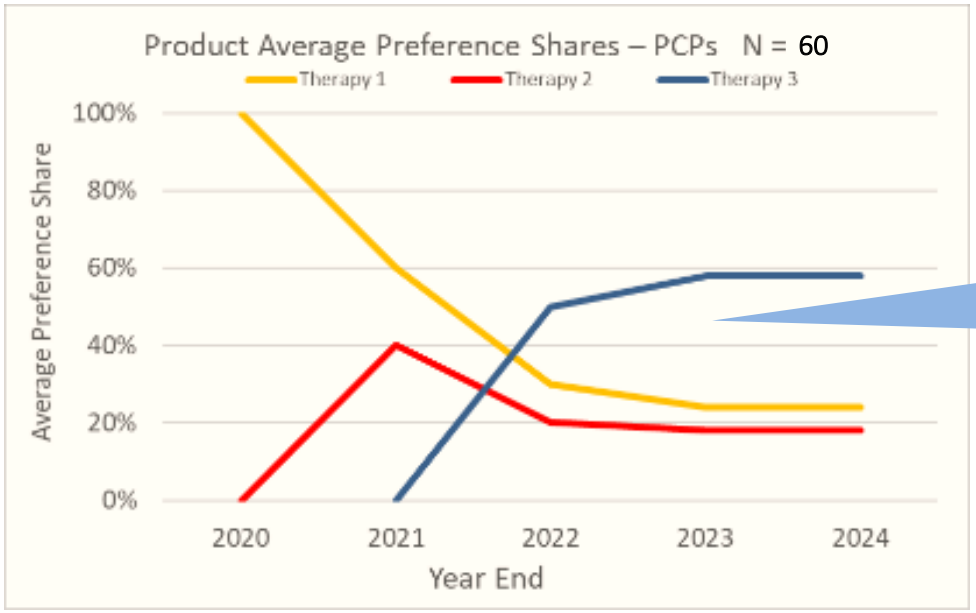
Having computed the utility estimates for all attribute levels for each respondent, Rosa's models can simulate a marketplace of the respondents, offer them competing therapies, and calculate the preference share of specific therapies for each respondent and for the aggregate. Thus, our simulations can show how much a product's share changes for each modification of its characteristics or its competitor's characteristics. Figure 3 shows three such therapies defined to investigate their preference shares.

Product Scenarios				
Product Name	Therapy 1	Therapy 2	Therapy 3	
Include product in a model run?	Yes	Yes	Yes	
Color on graphs				
Starting Values				
Product Launch Year	2018	2021	2022	
Known Share End 2020	60%	0%	0%	
Static Attributes				
Efficacy (Response Rate)	50%	70%	60%	
Safety (Grade 4 Side Effects)	5%	2%	1%	
Number of Patients in Phase 3 Trials	1,000	500	2,000	
Dosage Form	Syringe and Vial	Autoinjector	Autoinjector	
Dose Frequency	Once a Week	Once a Day	Once a Week	
Monitoring Required	Monthly Blood Draws	None	None	
Included in Treatment Guidelines	No	Recommended	Recommended	
Sales Rep Support Provided to MD	Yes	No	Yes	
Availability	Specialty Pharmacy Only	Specialty Pharmacy + Retail	Specialty Pharmacy + Retail	Compute Shares
Patient Financial Support Program Provided	Yes	No	Yes	
Dynamic Attributes				
Patient Monthly Co-Pay	$50	$100	$150 2023 $50	

Figure 3

Figure 4 shows the dynamic preference shares resulting from respondent utilities we measured, and the characteristics of the three competing therapies. Since these shares are based on models of real physicians, and we can explain how much each therapy's characteristics contribute to these shares, these results can be used as scientifically defensible inputs to financial models.

Our clients have used the findings from our models for internal discussions about product planning and strategy as well as for external discussions with investors and partners to convey the commercial potential for their products.



Differing shares are based on **differing product characteristics** and measured **physician attitudes**

Figure 4

Our clients receive the survey results in an easy-to-use Excel™-based simulation model that allows them **to analyze shares due to changes to their own products or the products of their competitors**.

Because of the direct link from measured physicians' opinions and product characteristics, discrete choice market models are more accurate, credible, transparent, and durable than traditional black box approaches.

- **More accurate**, since a physician's probability of choosing a particular product is directly related to the **measured** importance they place on each product characteristic.
- **More credible**, because this physician dataset can be used to explain exactly how the market model **shares relate to differing physician opinions** and differing product characteristics.
- **More transparent**, since the Excel-based market model is an easy-to-use dashboard into the physician dataset and changes made to product characteristics yield changes in share.
- **Durable**, because the market model can be used repeatedly to explore changes in the market as they develop, without having to re-survey physicians.

Implementing the Findings

Our clients can use the Market Model results to support both **internal and external communication** about their products in discussing product design, commercialization, funding, and partnering.

Analyses showing **product characteristics and the resulting potential shares** can be used to inform internal **product design** discussions regarding, for example, the most profitable efficacy targets to aim for. Share results can also answer commercialization questions around **pricing and logistics as well as go/no go decisions** with a company's Board of Directors.

The results can also be used to inform external discussions with **prospective investors and partnering companies** to demonstrate the potential demand for the product.

Summary

Quantitative discrete choice models give companies the ability to predict how their asset's performance on key product attributes will impact demand by physicians. A **quantitative discrete choice model can quantify physician preference for your product versus its current and future competitors**. Results from these studies can be used during internal discussions about product planning decisions as well as external discussions with investors and partners regarding the market potential for your asset.

Rosa Market Modeling

For 20 years, Rosa Market Modeling has been delivering insights that are difficult if not impossible to achieve any other way. Using a combination of carefully executed qualitative and advanced applied mathematics-based tools, our models are transparent, dynamic, and individually tailored to a specific product, therapy, or diagnostic. Furthermore, they cover a wide range of situations, including product development, product design, and promotional methods. To answer each client's needs in the complex world of commercialization, our models consider complex interactions between relevant factors within a wide variety of competitive scenarios. Rosa Market Models are the antidote to traditional, unrealistic, overly optimistic revenue forecasts and provide concrete evidence for your business decisions.

About The Author

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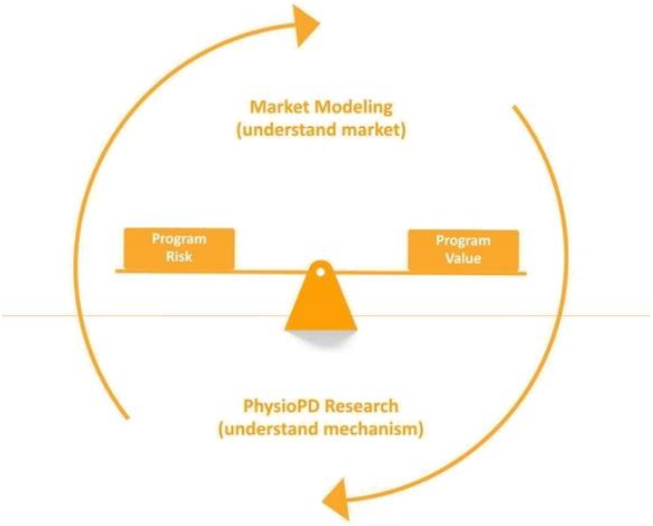
As the Chief Technology Officer of Rosa's Market Modeling practice, Dr. Brastow specializes in the design and implementation of customized market research surveys, physician choice models, and dynamic market models for biopharmaceutical and diagnostic companies



To learn more or to see a demonstration, please contact

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