



# **Sawtooth Software**

***TECHNICAL PAPER SERIES***

## **The CBC Advanced Design Module (ADM) Technical Paper**

# The CBC Advanced Design Module Technical Paper

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June, 2008

## Capabilities

The CBC Advanced Design Module is an add-on software component that enhances the capabilities of the base CBC/Web (SSI Web platform). When you upgrade to the Advanced Design Module, new items appear on the CBC menus, and additional routines are utilized for the design and analysis of more advanced CBC projects.

Specifically, the CBC Advanced Design Module offers the following:

- Alternative-Specific Plans
- Partial-Profile Interviewing Format
- Capacity Extended to 30 Attributes
- Capacity Extended to 254 Levels per Attribute, and 100 Concepts per Task
- Shelf-Facing Display

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## Introduction

Throughout this paper, we'll assume the reader is already familiar with the essentials of choice-based conjoint and the CBC System. For more information, please read the "CBC Technical Paper," available for download from our Technical Papers library at [www.sawtoothsoftware.com](http://www.sawtoothsoftware.com).

In traditional CBC conjoint, each product concept is composed of one level from every attribute in the study ("full-profile" presentation). A "None" alternative (sometimes called the "constant alternative") is often added. Sometimes choice-based conjoint projects do not fit this model and require a different approach:

- too many attributes to study in full-profile
- too many prohibitions are required to show realistic products
- entire attributes only apply to certain brands or levels of another attribute
- the client wants to show multiple "constant alternatives"

The CBC Advanced Design Module provides more flexibility with "Alternative-Specific" and "Partial-Profile" designs. Additionally, CBC's Advanced Design Module can be used for sophisticated packaged goods studies that present dozens of products at a time, arranged in a realistic shelf-facing display.

Alternative-specific designs let you include attributes that only apply to some alternatives (i.e.

brands, drug treatments or modes of transportation). Partial-profile designs let you study more attributes than is generally considered prudent with full-profile designs. They avoid potential information overload by asking respondents to consider only a subset of the attributes at a time. Both of these design strategies can lead to attribute lists exceeding the limitations of the 10-attribute base CBC system. For that reason, the Advanced Design Module permits up to 30 total attributes.

We reiterate our warning regarding using too many attributes in full-profile conjoint analysis. The success of full-profile conjoint studies depends on the complexity of the task and the knowledge and interest level of the respondents. If the tasks become too complicated, respondents may provide data of questionable value. If using dozens of levels of an attribute (such as in shelf-display studies), sample size requirements increase as the number of parameters to estimate expands.

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## Alternative-Specific Designs

### *Introduction*

Some CBC projects require more flexible designs than the standard approach used with our CBC system. For example, some attributes seem only to apply to a particular brand, performance level, or technology. For example, in a laser printer study, one of the attributes may be a binary attribute with two levels:

- Prints in black and white only
- Prints in both color and black and white

There may be two speed attributes (one appropriate for both color and black and white printers, and the other appropriate *only* for color):

#### **Black and white print speed**

- 20 pages per minute B&W print speed
- 30 pages per minute B&W print speed
- 40 pages per minute B&W print speed

#### **Color print speed**

- 10 pages per minute color print speed
- 15 pages per minute color print speed
- 20 pages per minute color print speed

If you try to implement such a design using prohibitions (between black and white printers only and all levels of color print speed) within the standard base CBC system, you may receive diagnostics indicating that there are too many prohibitions and the design is quite inefficient or even deficient. Before showing how to implement such designs within Advanced Design Module, some background may be useful.

**Background**

Before CBC became popular within marketing circles, researchers in economics and transportation planning were using choice-based modeling. Rather than calling it CBC, other terminology such as discrete choice, or choice modeling was applied. Instead of thinking about a list of attributes each with various levels (as is the common approach when applying conjoint analysis), early choice modelers focused on the notion of multiple alternatives (“product” concepts).

For example, the alternatives might be ways to get to work, such as:

- Ride the bus
- Bike
- Drive my car
- Walk
- I’d choose another way to get to work

And, a choice question might be formulated for the respondent, such as:

**If you lived one mile away from your workplace in downtown New York and these were your choices for getting there, which would you choose?**

Ride the bus	Bike	Drive my car	Walk	I’d choose another way to get to work
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In terms of estimating parameters (part worth utilities), one of the parameters was held constant (the “reference” level), and the others were estimated with respect to that reference level usually under a multinomial logit model. The estimated parameters associated with each main alternative were called *Alternative-Specific Constants*.

If using “Effects-Coding,” k-1 parameters are estimated (remember, one condition is the reference level, and does not need to be explicitly estimated). If the alternative is present, it is coded as a “1.” Absent alternatives are coded with “0,” and the reference alternative is coded as all columns set to “-1” (which leads to the property that the parameter for the reference alternative is equal to negative the sum of the other parameters).

The design (independent variable) matrix for the simple choice task above is as follows (assuming the fifth alternative is the reference parameter):

	Bus	Bike	Car	Walk
Alternative #1 (bus)	1	0	0	0
Alternative #2 (bike)	0	1	0	0
Alternative #3 (car)	0	0	1	0
Alternative #4 (walk)	0	0	0	1
Alternative #5 (none)	-1	-1	-1	-1

Researchers could extend this model to add additional attributes that modified some or all of the alternatives. For example, the researcher might want to learn how frequency of bus pickup:

- Picks up every 20 minutes
- Picks up every 15 minutes
- Picks up every 10 minutes
- Picks up every 5 minutes

affects the preference for riding buses.

Or, the researcher might consider how the parking fee for cars affects the preference for driving a car to work:

- Parking fee \$5.00/day
- Parking fee \$8.00/day
- Parking fee \$10.00/day

With the addition of these “conditional” attributes, the choice question might look like:

**If you lived one mile away from your workplace in downtown New York and these were your choices for getting there, which would you choose?**

Ride the bus Picks up every 15 minutes	Bike	Drive my car Parking fee \$10.00/day	Walk	I'd choose another way to get to work
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And the design matrix would expand, to include 3 new parameters for bus frequency (remember, we code a new attribute as k-1 parameters), and 2 new parameters for parking fee.

Alternative #1 (bus @ 15 min)	1	0	0	0	0	1	0	0	0
Alternative #2 (bike)	0	1	0	0	0	0	0	0	0
Alternative #3 (car @ \$10 fee)	0	0	1	0	0	0	0	-1	-1
Alternative #4 (walk)	0	0	0	1	0	0	0	0	0
Alternative #5 (none)	-1	-1	-1	-1	0	0	0	0	0

(We've added vertical bars for clarity, to mark where the codes for one "attribute" end, and the other begins. Note that the design codes remain at "0" if the attribute doesn't apply to the alternative.)

With this extended choice model, we still estimate alternative-specific constants (preference for riding the bus, biking, etc.). But, we additionally estimate parameters for how the frequency of bus pickup adds to or subtracts from the overall preference for riding buses, and how the cost of parking a car adds to or subtracts from the overall preference for driving a car to work. Since Bike, Walk, and "None" are never modified by additional attributes, these are referred to as *constant alternatives*. The parameter associated with "None" reflects a threshold utility that the other alternatives must each surpass before having a higher probability of selection than the "None."

The design of these experiments can get somewhat complicated. However, the basic idea is that each "main" alternative is typically available in each choice set. In generating an experimental plan, one only needs to consider the alternative-specific (conditional) attributes that appear *beneath* the main alternative's description.

Consider a discrete choice study with the "main" alternatives as described below, but each with alternative-specific attributes with numbers of levels as following:

Drive my car	(one attribute with 3 levels)
Bike	(two attributes, one with 4 and one with 3 levels)
Ride the bus	(two attributes, both with 3 levels)
Walk	(two attributes, one with 4 and one with 2 levels)
I'd choose another way to get to work	

To design the experiment, one can take a page from "traditional ratings-based conjoint" and consider this as a card-sort conjoint design in which there are a total of 7 attributes, expressed as  $3 \times 4 \times 3 \times 3 \times 3 \times 4 \times 2$ . There are 2,592 possible combinations—or in this case, choice tasks. But, by referring to an orthogonal plan catalog, or by using a computer search based on a design criterion such as D-efficiency (such as offered by our CVA software system for traditional full-profile conjoint), an efficient design plan can be found that requires a manageable (and much lower) number of combinations to be offered to respondents.

Choice modelers have often estimated pooled (across respondents) models known as "mother logit" models, which include not only the main effect of each alternative and level, but all cross-effects as well. An example of a cross-effect is how a bus that picks up every 20 minutes affects the utility for walking or how the availability of buses affects the choice of cars. Cross-effects were often needed to account for IIA (independence from irrelevant alternatives) problems in pooled (aggregate) choice models. Many researchers today recognize that many (if not most) of the IIA difficulties can be effectively managed using parsimonious "main effects" models and HB estimation, where a full set of parameters are estimated for each individual. When heterogeneous respondents (with individual-level part worths) are included in market simulators, aggregated shares of preference for competitive alternatives are not necessarily bound by IIA

(Orme 1998).

We have now spent some time covering background design and coding principles associated with alternative-specific plans. We've done this for educational and instructive purposes. Fortunately, the CBC Advanced Design Module handles the complicated parts of the execution, so the details are mostly transparent to users.

***Implementing Alternative-Specific Designs within the Software***

We'll now discuss how to implement an alternative-specific design within the software. Consider the following attributes for cars and buses:

<b>Car</b>	<b>Bus</b>
Parking fee \$5.00/day Parking fee \$8.00/day Parking fee \$10.00/day	Picks up every 20 min. Picks up every 15 min. Picks up every 10 min. Picks up every 5 min.  25 cents per one-way trip 50 cents per one-way trip 75 cents per one-way trip \$1.00 per one-way trip

Assume we wanted to measure three other (constant) alternatives: biking, walking, or "I'd choose another way to get to work."

The CBC question might look like the following:

**If you lived one mile away from your workplace in downtown New York and these were your choices for getting there, which would you choose?**

Ride the bus	Bike	Drive my car	Walk	I'd choose another way to get to work
Picks up every 10 min.		Parking fee \$8.00/day		
\$1.00 per one-way trip				

To implement this design using CBC's Advanced Design Module, you define the attributes as following:

Attribute 1:

Walk  
Bike  
Ride the bus  
Drive my car

Attribute 2:

Picks up every 20 min.  
Picks up every 15 min.  
Picks up every 10 min.  
Picks up every 5 min.

Attribute 3:

25 cents per one-way trip  
50 cents per one-way trip  
75 cents per one-way trip  
\$1.00 per one-way trip

Attribute 4:

Parking fee \$5.00/day  
Parking fee \$8.00/day  
Parking fee \$10.00/day

Before proceeding, it is useful to introduce some terminology to describe the different roles attributes can play in alternative-specific designs.

*Primary* attribute: an attribute whose levels appear in every product concept and upon which conditional attributes (described below) depend. In the example above, attribute 1 is the primary attribute.

*Conditional* attribute: attributes only displayed with a particular level or levels of the primary attribute. Attributes 2 through 4 are conditional attributes.

*Common* attribute: attributes displayed with all levels of the primary attribute. (The example above doesn't include a common attribute.) In traditional CBC designs, all attributes are common.

### ***Specifying an Alternative-Specific Design***

Choose **Compose / Conjoint Settings / CBC Settings...** to bring up the **Specify CBC Interview Parameters** dialog. From that dialog, click the *Advanced Design Module* Tab and then check the *Alternative-Specific CBC Design* box.

To create the "None" alternative, check the *Include None Option* box under the *General* tab and specify the text: "I'd choose another way to get to work." Additional constant alternatives are defined as levels within the primary attribute.

To complete the design, set the following attribute level prohibitions (make sure to check "alternative-specific design" prior to setting these prohibitions):

Attribute 1, Level 1	with	Attributes 2 through 4 (all levels)
Attribute 1, Level 2	with	Attributes 2 through 4 (all levels)
Attribute 1, Level 3	with	Attribute 4 (all levels)
Attribute 1, Level 4	with	Attributes 2 and 3 (all levels)

### ***Additional Guidelines for Alternative-Specific Designs***

Recall that within our paradigm for alternative-specific designs, main effects for conditional attributes are measured specific to particular levels of the primary attribute.

The "None" alternative is always displayed in the last concept position (or it may be placed in the footer). Other constant alternatives you define (with exhaustive prohibitions) within the primary attribute are positioned randomly within the task by default, but you can control their order of presentation on the *Design* tab of the **Specify CBC Interview Parameters** dialog in CBC. Depending on how many concepts are displayed per task and the design method, it is possible that a constant alternative may not appear in some tasks. If you want the constant alternatives to appear in every task, you should display at least as many concepts as levels in the primary attribute and then choose either the Complete Enumeration or Shortcut design strategies.

It is possible to have multiple primary attributes and multiple conditional "branches" in an alternative-specific design. Conditional attributes can be shared (common) between two or more levels of the primary attribute.

Fixed alternative-specific tasks (or entire designs) may be specified.

### ***Design Efficiency and Alternative-Specific Designs***

Alternative-specific designs usually require a complex set of prohibitions. Therefore, we strongly encourage you to test the design to ensure acceptably stable estimation of the part worths. Testing design efficiency for alternative-specific designs is an advanced topic. The suggestions offered here are basic and practical.

When using CBC's "Quick" Test Design program, you should note that the design efficiency for attribute levels is computed with respect to an "ideal" hypothetical orthogonal design under full-profile traditional CBC design assumptions, where all attributes are "common." Therefore, for all but the common attributes, the ideal will be unobtainable, and design efficiencies will be understated. Especially for advanced designs, we recommend the Advanced Test provided in the CBC software.

The Advanced Test automatically generates dummy data (random responses, assuming no prior knowledge of preferences) and estimates effects using logit. You request a sample size similar to the number of respondents you plan to eventually obtain. When running logit, the first thing you should check is that it doesn't return the message: "WARNING - THE DESIGN IS DEFICIENT." Next, you should examine the size of the standard errors for all parameters of interest. Finally, a relative D-Efficiency statistic is reported as "strength of design." This lets you compare the efficiency of a design relative to the efficiency of a comparison design.

Below are results from a logit estimation report, for the example we've been discussing, using 300 "dummy" respondents answering randomly, where each respondent received a unique version of the design with 12 choice tasks.

CBC System Multinomial Logit Estimation  
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Total number of choices in each response category:

1	705	19.58%
2	706	19.61%
3	721	20.03%
4	730	20.28%
NONE	738	20.50%

Files built for 300 respondents.  
There are data for 3600 choice tasks.

	Effect	Std Err	t Ratio	Attribute Level
1	0.05609	0.03183	1.76206	1 1 Walk
2	0.01002	0.03232	0.30990	1 2 Bike
3	-0.04030	0.03293	-1.22379	1 3 Ride the bus
4	-0.02581	0.03274	-0.78836	1 4 Drive my car
5	0.13155	0.07182	1.83153	2 1 Picks up every 20 min.
6	-0.14203	0.07590	-1.87128	2 2 Picks up every 15 min.
7	-0.09456	0.07507	-1.25961	2 3 Picks up every 10 min.
8	0.10505	0.07224	1.45411	2 4 Picks up every 5 min.
9	0.04437	0.07311	0.60689	3 1 25 cents per one-way trip
10	-0.06430	0.07465	-0.86132	3 2 50 cents per one-way trip
11	-0.01501	0.07368	-0.20374	3 3 75 cents per one-way trip
12	0.03494	0.07299	0.47866	3 4 \$1.00 per one-way trip
13	0.03111	0.05944	0.52340	4 1 Parking fee \$5.00/day
14	0.07940	0.05904	1.34488	4 2 Parking fee \$8.00/day
15	-0.11051	0.06080	-1.81774	4 3 Parking fee \$10.00/day
16	0.03332	0.04131	0.80668	NONE

You should pay particular attention to the standard errors of the part worths (the column labeled “Std Err”). Lack of convergence or very large standard errors are an indication that your design is deficient.

One rule of thumb is to look for standard errors from logit for main effects of no greater than about 0.05, and standard errors for interaction effects to be no greater than about 0.10 (alternative-specific attribute effects have standard errors roughly the same magnitude as first-order interaction effects). In our example, the largest standard error for non-conditional attributes is 0.03293 (Ride the bus), which is indeed less than 0.05. And, the largest standard error for conditional attributes is 0.07590 (Picks up every 15 min.), which is less than 0.10. This design, given the simulated number of respondents, meets the criteria suggested by this simple rule of thumb.

If your design is like those described in our transportation example where prohibitions are between *all* levels of the conditional attribute(s) with a particular level (or levels) of the primary attribute, you will likely be on safe ground. If you define additional prohibitions, you may encounter problems during design and analysis.

During estimation, you can specify two-way interactions for alternative-specific designs, though in our example it doesn't make sense to specify two-way interactions between primary and conditional attributes, since the effects measured are already "specific" to the reference levels of the primary attribute. However, for this example design, it is possible to study the interaction between the frequency of bus pick-up and the cost per bus trip, since there were no prohibitions between those two attributes. If a common attribute were defined (applying to all levels of the primary attribute), it is possible to specify other interactions, such as between the primary and common attribute.

Analysis proceeds as with any other CBC study. The only difference is that when specifying product concepts in the market simulator, you type "N/A" for conditional attributes that aren't applicable.

Logit, Latent Class or HB estimation are possible with alternative-specific designs.

***How Alternative-Specific Attribute Designs are Coded***

With alternative-specific designs, the coding is a bit different from traditional CBC designs. Consider again the example of ways to get to work in New York. We previously showed the following CBC task:

**If you lived 1 mile away from your workplace in downtown New York and these were your alternatives for getting there, which would you choose?**

Ride the bus	Bike	Drive my car	Walk	I'd choose another way to get to work
Picks up every 10 min.		Parking fee \$8.00/day		
\$1.00 per one-way trip				

If you export the data to the CBC version 1 .CHO file, the attribute levels displayed for each alternative are coded as follows (rows are concepts, columns are attributes):

```
3 3 4 0
2 0 0 0
4 0 0 2
1 0 0 0
```

(The layout for the .CHO file is described in the CBC software help documentation.) Note that levels not applying to the current concept are recorded as 0s.

When our analytical programs estimate part-worth utilities, a matrix as shown directly above is not used. Rather, the matrix is expanded into an “effects-coded” design matrix. An example is shown below (we’ve added vertical dividing lines for clarity):

Att1	Att2	Att3	Att4	None	Choice
0 0 1	0 0 1	-1 -1 -1	0 0	0	3
0 1 0	0 0 0	0 0 0	0 0	0	3
-1 -1 -1	0 0 0	0 0 0	0 1	0	3
1 0 0	0 0 0	0 0 0	0 0	0	3
0 0 0	0 0 0	0 0 0	0 0	1	3

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## Partial Profile Designs

In spite of their advantages, CBC questions can overwhelm some respondents, particularly if there are many attributes. The base CBC system can measure up to ten attributes (shown in full profile), but in general we suggest limiting CBC designs to about six or fewer attributes.

Some researchers have proposed "partial-profile" choice experiments as a way to estimate preferences for a large set of attributes (Chrzan and Elrod 1995, Chrzan 1999). With partial-profile designs, each choice task includes a subset of the attributes (typically around four). Research suggests that asking respondents to evaluate from three to five attributes at a time is about right for partial-profile studies (Patterson and Chrzan 2003). Across all tasks and respondents, a much larger list of attributes is evaluated. The Advanced Design Module permits up to 30 attributes.

Partial-profile choice designs are somewhat new to the industry, but have become more mainstream over the last few years. Research suggests that they can be valuable for some situations. Though some research has suggested that full-profile and partial-profile CBC experiments lead to essentially the same parameters (utility values, after rescaling), other research has shown that the techniques do not yield equivalent results (Chrzan 1999; Frazier and Jones 2003; Johnson *et al.* 2003). Specifically, partial-profile may produce lower price importance than full-profile, leading to conclusions that respondents are less price sensitive and willing to pay more for features (Frazier and Jones 2003; Johnson *et al.* 2003). Similar problems have been found with ACA (also a partial-profile technique) with respect to a bias in price (Pinnell 1994; Williams and Kilroy 2000). An option in partial-profile studies is to always include price in the task, but no research (at least that we are aware of) has been completed to determine if this remedies the potential understatement of price in partial-profile CBC. When the data are particularly sparse, partial-profile experiments may also lead to troubles estimating stable individual-level parameters (Pinnell and Fridley 2001; Orme 2003).

We haven't yet formed a definite opinion about partial-profile CBC's performance versus other methods like ACA for dealing with large numbers of attributes. We hope that including partial-profile in the Advanced Design Module encourages further research and experimentation.

With partial-profile designs, we assume respondents can evaluate the product concepts holding all attributes not represented as constant. If respondents cannot maintain this *ceteris paribus* mind set, the resulting data may be incorrect. Therefore, when asking the choice question, we suggest including language such as, "Please assume that all features not shown are alike in all other ways," or "Please assume that these toasters differ only on the features shown." This may help respondents answer appropriately, but it is no guarantee.

The use of the "None" concept in partial-profile CBC studies is problematic. The None weight varies significantly depending on how many attributes are displayed in the partial-profile task (Patterson and Chrzan 2003).

Analysis methods for partial-profile include logit, Latent Class, and HB. The success of the methods (particularly for Latent Class and HB) hinge upon how much information is available from each respondent on each attribute. We caution that individual-level estimation may not be stable for partial-profile designs if the information available from each respondent relative to the number of parameters to be estimated is low. Given enough information per respondent relative to the number of parameters to be estimated, Hierarchical Bayes estimation may provide useful individual-level utilities for use in market simulations where the results are summarized across respondents. Still, choice data are not as rich in terms of statistical information content as ratings-based data. The individual-level estimates for large partial-profile designs may contain a significant amount of noise and counter-intuitive relationships (reversals). If the goal of the research is to estimate stable utilities for individual-level profiling and predictions, the partial-profile approach alone may be insufficient. For sparse partial-profile designs, it may be helpful in CBC/HB software to use a lower *prior variance* assumption and a higher *degrees of freedom for prior covariance matrix* to avoid potential overfitting.

### ***Specifying Partial-Profile Designs***

Choose ***Compose / Conjoint Settings / CBC Settings...*** to bring up the ***Specify CBC Interview Parameters*** dialog. From that dialog, click the ***Advanced Design Module Tab*** and then check the ***Partial-Profile CBC Design*** box.

There are a number of control parameters governing partial-profile designs. For purposes of illustration, let's assume there are 12 total attributes in the study. The researcher wants to display 5 attributes per task with attributes 1 and 12 to appear in every choice task.

**Rotate attributes into concepts starting with:** In this example, attribute 1 appears in every choice task. Therefore, attributes rotate in and out of the choice tasks starting with attribute 2. (If you want all attributes to rotate into the tasks, always specify 1). Note that, all else equal, attributes displayed in every task are measured with greater precision than those rotated into the tasks.

**and ending with attribute:** In this example, attribute 12 appears in every choice task. Therefore, attributes rotate into choice tasks ending with attribute 11. (If you want all attributes to rotate into the tasks, specify the last attribute number.)

**Number of attributes shown in each concept:** In this example, 5 attributes are displayed in each choice task, so we specify a 5. Recent research suggests that between 2 to 4 attributes may be optimal to use in partial-profile studies. The length of the level text has a bearing on the appropriate number, along with the familiarity and interest respondents have for the product category.

If the ***Randomize Attribute Order*** box is checked, the attributes appear in random order (held constant within respondent) within the concept. If unchecked (default), the attributes appear in their natural order.

## *Design Strategies for Partial-Profile Designs*

All of the design strategies available for standard CBC designs are also available for partial-profile. The design selection has two stages. The first stage involves choosing the subset of attributes displayed in the choice task. To formulate the first task, we randomly select a subset of attributes. For all subsequent tasks, we examine a two-way joint frequency table of attribute presentation within choice tasks. We choose attributes so that the off-diagonal cells in this table remain approximately balanced.

The second stage of the design selection involves deciding which levels of the selected attributes are displayed for each concept. The strategies are Complete Enumeration, Shortcut, Balanced Overlap, and Random. The details for these design methods are provided in the CBC Technical Paper.

For partial-profile designs, we generally suggest the Complete Enumeration or Shortcut strategies. This leads to more efficient estimation of main effects than the Balanced Overlap or Random methods. In our opinion, the only reason to use the Random strategy is if the measurement of interactions (through aggregate analysis) is the primary goal, the attribute set is relatively small and the sample size is quite large.

### *Notes for Partial-Profile Designs*

Estimation of main effects and especially interaction terms for attributes rotated into choice tasks is significantly less precise than with manageable full-profile CBC designs.

We strongly suggest you test your design prior to fielding to ensure you can estimate reasonably stable part worths. The *Test Design* module provided with CBC may be used, but with partial-profile designs we strongly recommend the Advanced Test Design capabilities with simulated data generation and the logit report. When using this module, you should recognize that the design efficiency is estimated with respect to a hypothetical full-profile orthogonal design. The efficiency of part worths for attributes rotated into the design is naturally lower than with a full-profile design (where the attribute is always present), since comparatively less information about that attribute is available.

Fixed partial-profile tasks (or entire designs) may be specified.

Partial-profile designs are more robust in the face of level prohibitions than full profile designs. For example, consider a study with 10 attributes, where 4 attributes are shown at a time in product concepts. Further consider that there are prohibitions between the levels of attributes 1 and 2. When attributes 1 and 2 appear together within the same choice task, the prohibitions introduce correlations (and resulting lower precision) within the design matrix. However, for the many tasks in which attributes 1 and 2 appear separate from one another, the prohibitions have no negative effect on the design efficiency. These tasks in which attributes 1 and 2 appear separately provide uncompromised information (assuming no bias due to partial-profile displays) for stabilizing the parameters for attribute 1 and 2.

## Shelf-Facing Display Presentation

The CBC Advanced Design Module supports “shelf-facing” presentation, as shown below. This graphic has been sized to fit within this document—it is bigger and clearer on a PC monitor.

If these were your only options, which would you choose?

Product	Price
Ariel (4 bottles)	\$ 3.99
Persil (2 bottles)	\$ 7.59
Sunil (2 bottles)	\$ 7.59
Sunil (1 bottle)	\$ 5.59
Sunil (1 bottle)	\$ 3.89
Sunil (2 bottles)	\$ 3.39
Sunil (2 bottles)	\$ 3.39
Freshly (1 package)	\$ 3.39
Freshly (1 package)	\$ 5.19
Mr. Proper (3 bottles)	\$ 2.59
Ariel (3 packages)	\$ 5.69
Persil (3 packages)	\$ 5.09
Sunil (2 packages)	\$ 4.49
Dash (2 packages)	\$ 6.49
Speed (2 packages)	\$ 4.09
Mr. Proper (3 packages)	\$ 3.29
Ariel (3 packages)	\$ 11.39
Persil (3 packages)	\$ 6.59
Sunil (2 packages)	\$ 4.09
Dash (2 packages)	\$ 5.99
Speed (2 packages)	\$ 2.49
Wisk (1 package)	\$ 3.69
Mr. Proper (3 packages)	\$ 4.09
Ariel (2 packages)	\$ 15.49
Persil (2 packages)	\$ 11.59
Sunil (1 package)	\$ 11.89
Dash (1 package)	\$ 9.39
Speed (1 package)	\$ 7.39
Wisk (1 package)	\$ 9.39
Mr. Proper (2 packages)	\$ 9.29
None of these	

To achieve this look, the user supplies graphics in which each product is situated on a shelf “segment,” such as:



When the graphics are placed side-by-side (with no space between them), and a black border is shown directly beneath the graphic, the resulting display looks like a continuous shelf.

We needed to implement three new features in the software to support the shelf-facing look.

1. In the shelf display shown on the previous page, there are 29 different products. Previous versions of CBC only supported up to 15 levels per attribute and a maximum of 16 concepts per task, so it was impossible to show so many unique products on the screen at once. The CBC Advanced Design Module can include up to 254 levels for an attribute and up to 100 concepts within a task, which should offer great flexibility for showing quite complex packaged goods displays.
2. Some package sizes are larger than others (or the researcher may want to include more units in a graphic to represent more linear shelf space), so the software supports differing widths of product concepts. Also, the software is flexible so that if multiple rows of products are displayed, the number of products shown per shelf does not need to be constant. The table below more explicitly demonstrates these properties.

Concept 1	Concept 2		Concept 3		Concept 4
Concept 5	Concept 6			Concept 7	Concept 8
Concept 9	Concept 10	Concept 11	Concept 12	Concept 13	Concept 14

Notice that some concepts (such as concept 6) are much wider than others. The total row widths and the number of products per row may differ.

3. CBC allows the researcher to specify that the brands should not change positions on the screen across choice tasks (suppress the randomization of level order for brand). We expect most researchers choosing shelf-type display will prefer fixed positions for brands. But, if desired, brands can have randomized position, either across tasks, or held constant within a respondent interview but randomized across respondents.

CBC leverages web browser technology to display the product concepts. This leads to a great deal of flexibility in the programming and in fielding the questionnaire. HTML and JavaScripting elements can be added by the author, to add elements such as pop-ups showing

more detail about a package (detailed image and text) if the graphic is clicked. With JavaScripting, pop-ups can automatically appear upon “mouse-over” (without the need for the click). The surveys can be either fielded over the Web or in CAPI mode, from a PC or laptop not connected to the Internet, or even via paper-and-pencil. These benefits lead to greater realism in the interview, and greater flexibility for interviewing respondents.

Research to date is inconclusive regarding whether the shelf-display layout is superior to the standard CBC layout. A recent study of three packaged goods categories by researchers at Procter & Gamble suggested that the standard CBC layout worked slightly better for predicting actual market shares, but the shelf-display layout was slightly more accurate in estimating price sensitivity (Rogers and Renkin, 2004). The news may be better than that for shelf-display as the authors made no adjustment for a significant difference in sample sizes between standard CBC and shelf-display cells in this test. The performance of shelf-display (with fewer respondents) may have been understated.

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