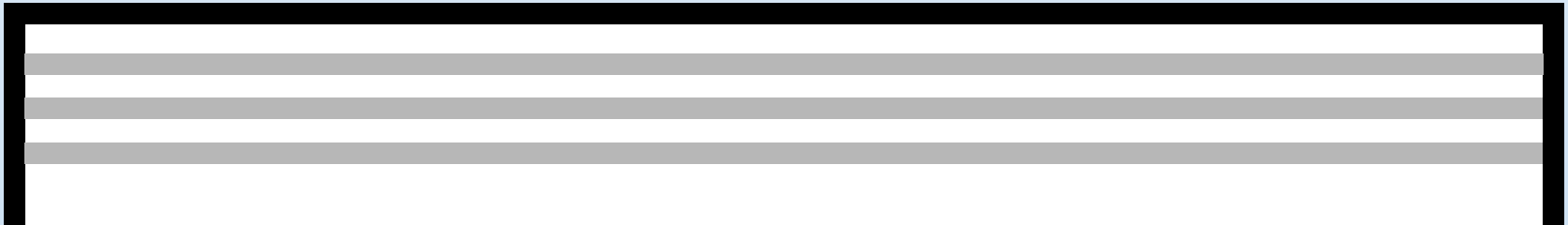
Conjoint Analysis

Industrial Engineering Design

01

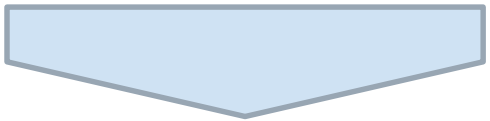
OVERVIEW



An overview- conjoint analysis

- In conjoint analysis, researchers **describe products or services by sets of attribute values or levels and then typically measure respondents' purchase interest.**
- **The primary purpose** of conjoint analysis is to model human behaviour, usually purchase behaviour. By measuring purchase interest in a “complete” product or service

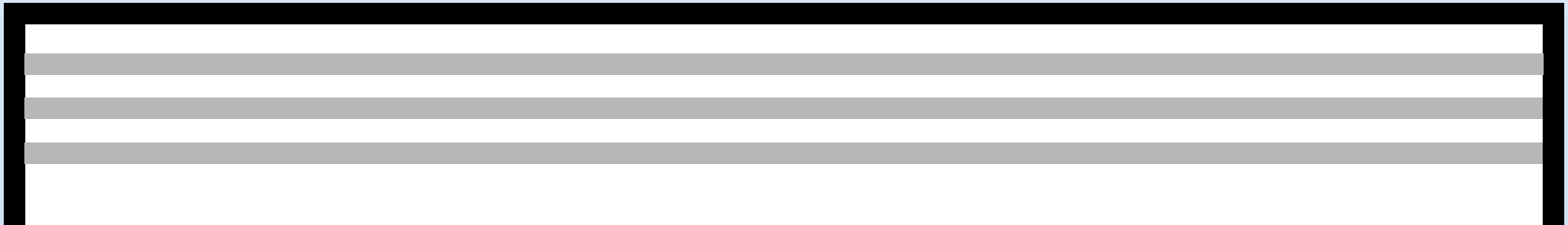
Methods using **ranking, rating,** or **choice designs** (either individually or in combination) to quantify preferences for various attributes of an intervention (often referred to as conjoint analysis, discrete-choice experiments, or stated-choice methods).



Conjoint-analysis methods are particularly useful for **quantifying preferences for nonmarket goods and services or where market choices are severely constrained** by regulatory and institutional factors, such as in health care.

02

REAL CASE TUTORIAL IBM SPSS STATISTICS



Case – Example

In a popular example of conjoint analysis (Green and Wind, 1973), a company interested in **marketing a new carpet cleaner** wants to examine the influence of **five factors on consumer preference - package design, brand name, price, a Good Housekeeping seal, and a money-back guarantee.**

Case – Example

There are three factor levels for **package design**, each one differing in the location of the applicator brush; **three brand names** (K2R, Glory, and Bissell); **three price levels**; and two levels (either no or yes) for each of the last **two factors**. The following table displays the variables used in the carpet-cleaner study, with their variable labels and values.

Variable name	Variable label	Value label	Variable name
package	package design	A*, B*, C*	package
brand	brand name	K2R, Glory, Bissell	Brand
price	price	$1.19, $1.39, $1.59	Price
seal	Good Housekeeping seal	no, yes	seal
money	money-back guarantee	no, yes	money

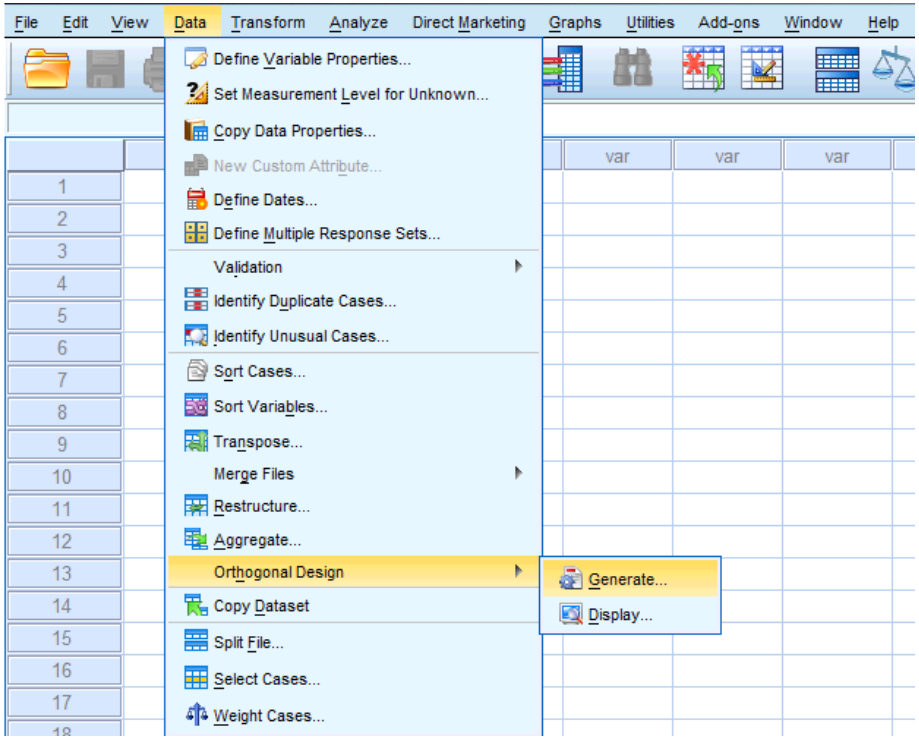
Conjoint Analysis - Orthogonal Design

- The first step in a conjoint analysis is to **create the combinations of factor levels that are presented as product profiles to the subjects.**

- Since even a small number of factors and a few levels for each factor will lead to **an unmanageable number of potential product profiles**, you need to generate a representative subset known as an **orthogonal array.**

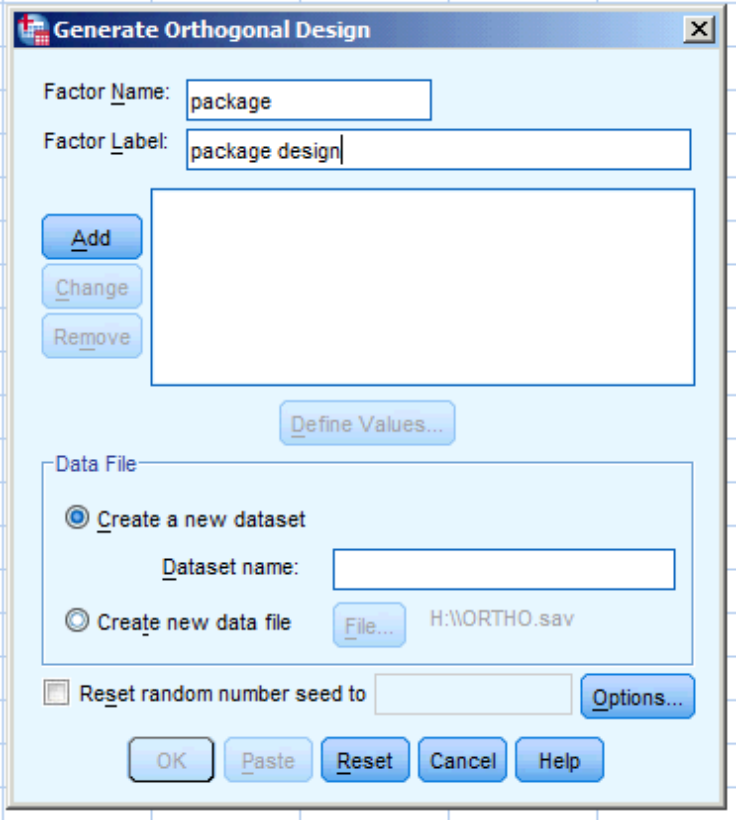
- The “Generate Orthogonal Design” procedure creates an orthogonal array - also referred to as an orthogonal design - and stores the information in a data file. Unlike most procedures, an active dataset is not required before running the Generate Orthogonal Design procedure.

Conjoint Analysis – Orthogonal Design



To create an orthogonal design
From the menus choose:
Data
> Orthogonal Design
> Generate

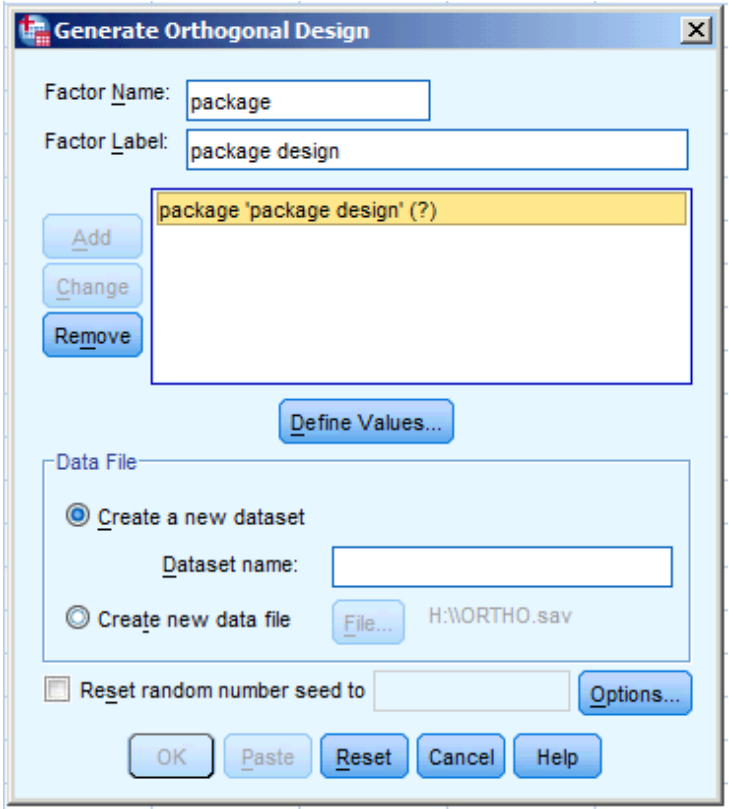
Conjoint Analysis – Orthogonal Design



► Enter package in the **Factor Name** text box and enter package design in the **Factor Label** text box.

► Click Add

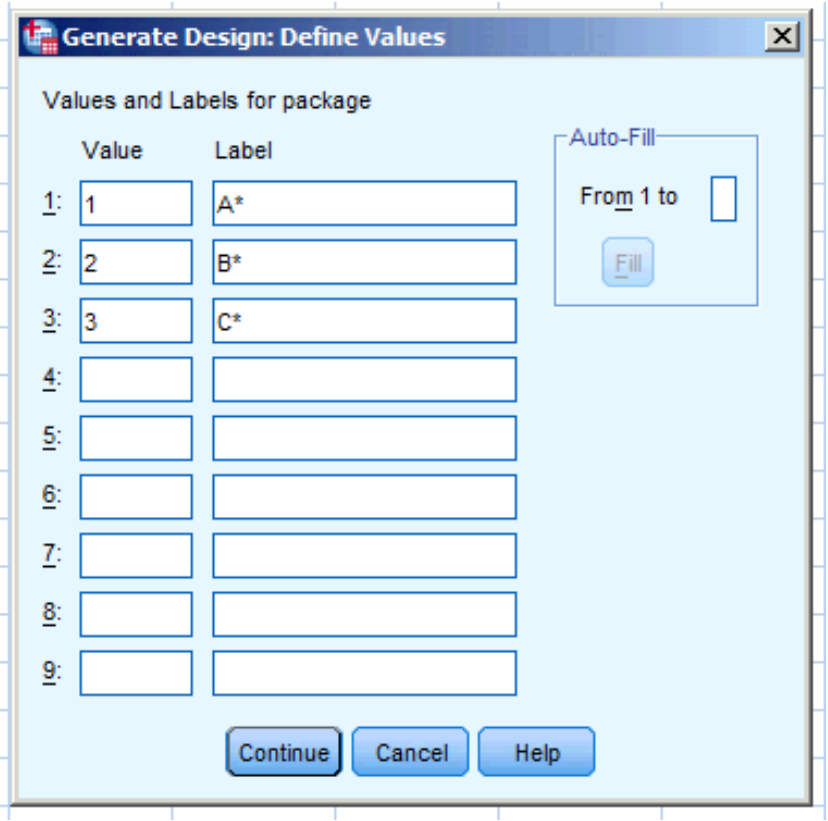
Conjoint Analysis – Orthogonal Design



Last procedure creates an item labelled package 'package design' (?). **Select this item.**

► Click Define Values.

Conjoint Analysis – Orthogonal Design

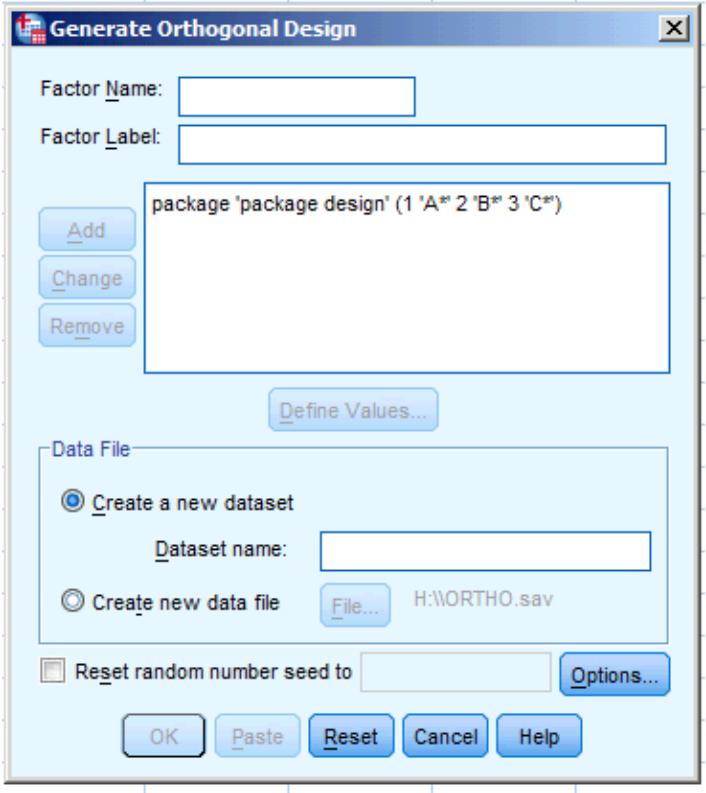


► Enter the values 1, 2, and 3 to represent the package designs A*, B*, and C*.

Enter the labels A*, B*, and C* as well.

► Click **Continue.**

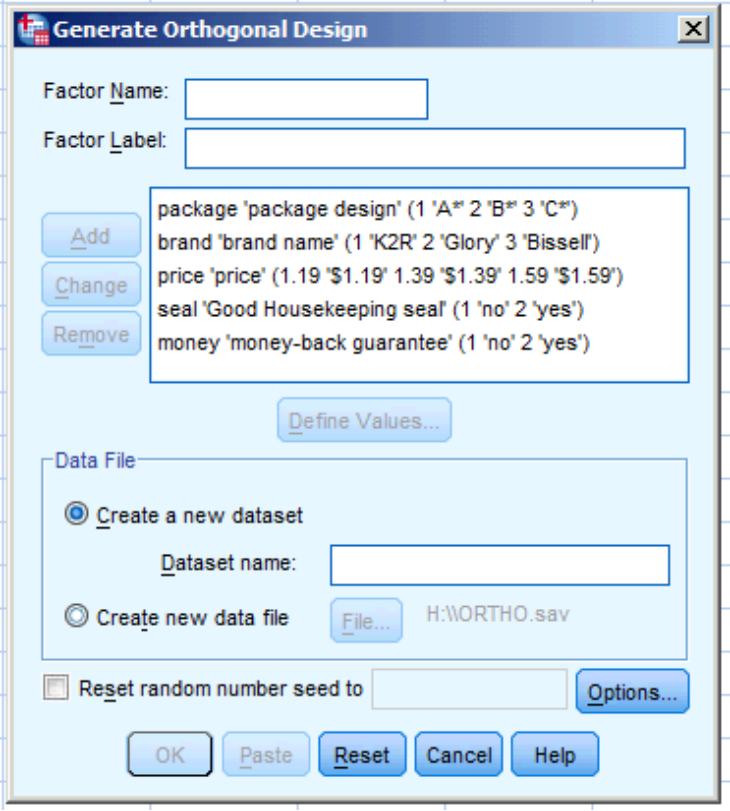
Conjoint Analysis – Orthogonal Design



You'll now want **to repeat this process** for the remaining factors, brand, price, seal, and money.

Variable name	Variable label	Value label	Variable name
package	package design	A*, B*, C*	package
brand	brand name	K2R, Glory, Bissell	Brand
price	price	$1.19, $1.39, $1.59	Price
seal	Good Housekeeping seal	no, yes	seal
money	money-back guarantee	no, yes	money

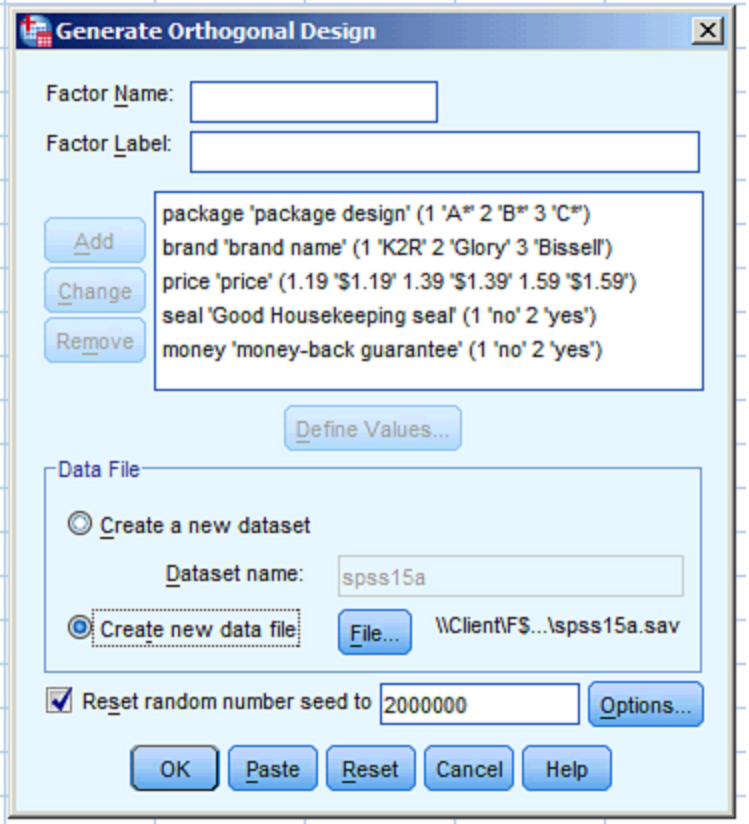
Conjoint Analysis – Orthogonal Design



Once you have completed the factor specifications:

► In the Data File group, leave the default of **Create a new dataset**

Conjoint Analysis – Orthogonal Design



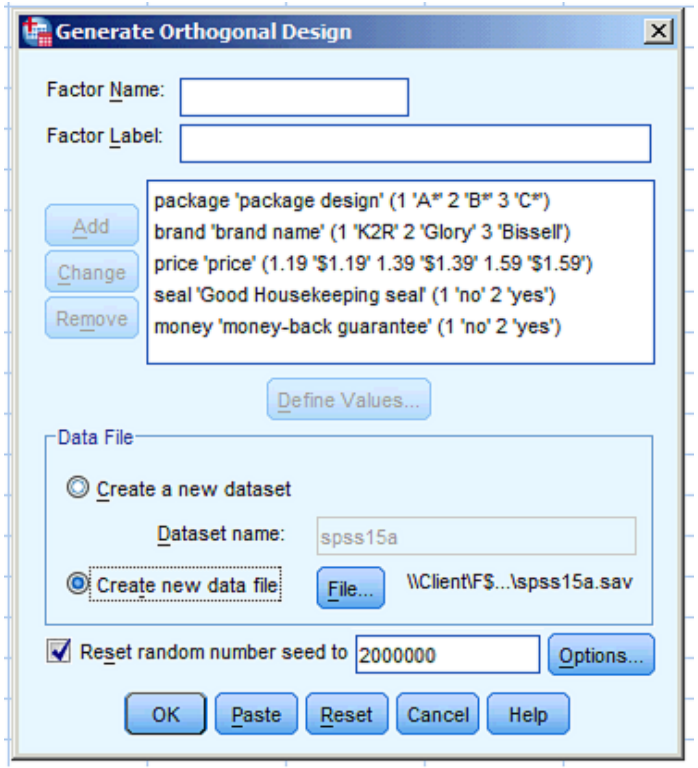
Generating an orthogonal design requires a set of random numbers. If you want to duplicate a design - in this case, the design used for the present case study - you need to set the seed value before you generate the design. The design used for this case study was generated with a seed value of 2000000. This value is essential to ensure repeat analysis will reproduce identical results. DIFFERENT SEED DIFFERENT ORTHOGONAL ARRAY

► In the Data File group, change the default of Create a new data file

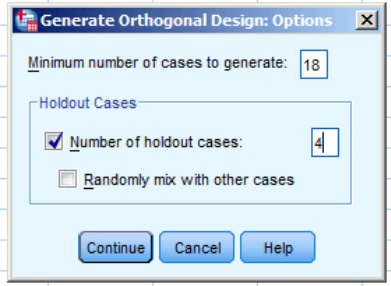
Enter a data file name (with appropriate directory structure for your machine).

The generated design will be saved to a new data file.

Conjoint Analysis – Orthogonal Design



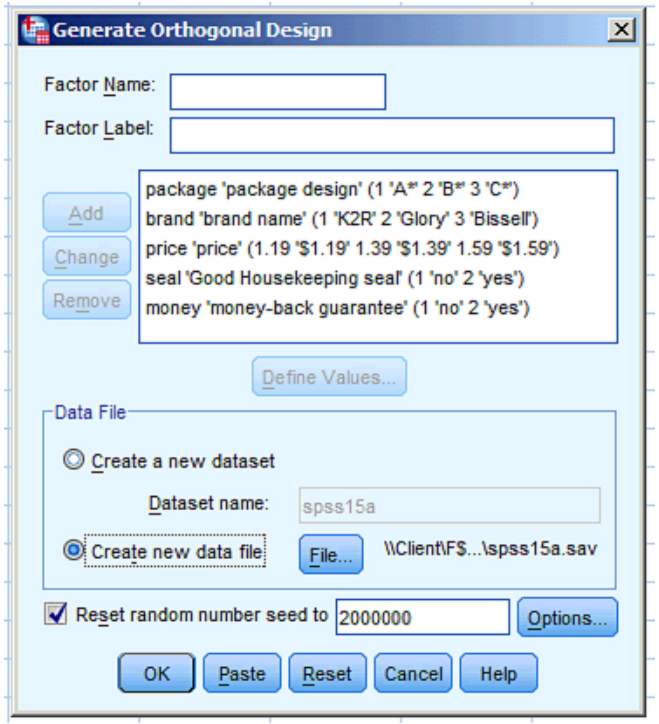
► Click Options



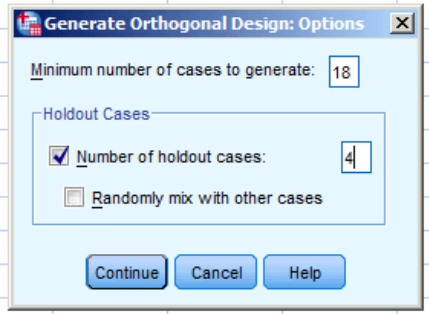
► In the Minimum number of cases to generate text box, type 18.

- By default, the minimum number of cases necessary for an orthogonal array is generated. The procedure determines the number of cases that need to be administered to allow estimation of the utilities.
- You can also specify a minimum number of cases to generate, as you've done here. You might want to do this because the default number of minimum cases is too small to be useful or because you have experimental design considerations that require a certain minimum number of cases.

Conjoint Analysis – Orthogonal Design



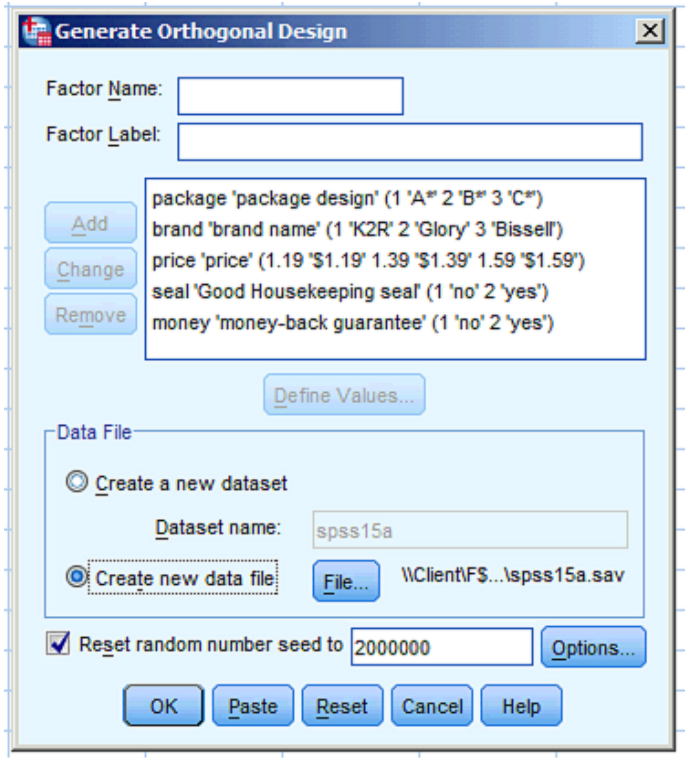
► Click Options



► Select Number of holdout cases and type 4.

Holdout cases are judged by the subjects but are not used by the conjoint analysis to estimate utilities. They are used as a check on the validity of the estimated utilities. The holdout cases are generated from another random plan, not the experimental orthogonal plan.

Conjoint Analysis – Orthogonal Design



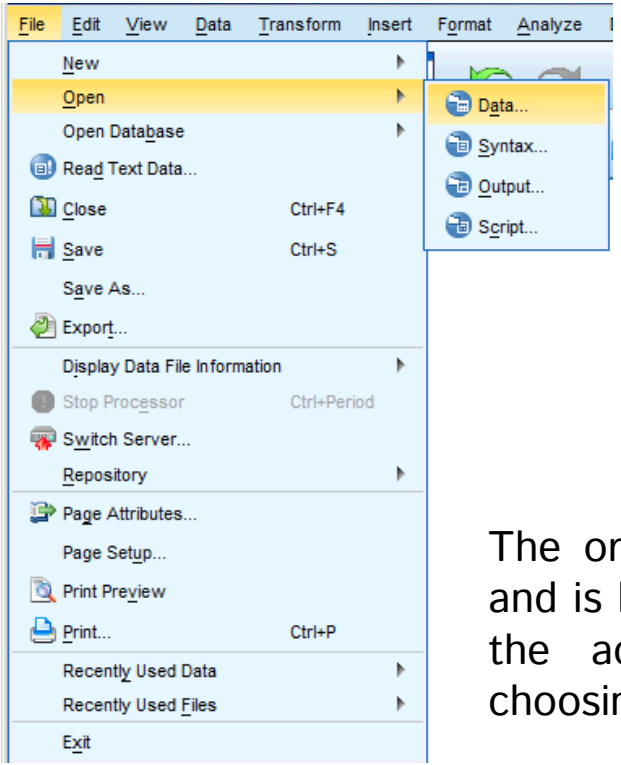
► Click OK in the Generate Orthogonal Design dialog box.

Conjoint Analysis – Orthogonal Design

Copy this syntax (or type :)

```
*Generate Orthogonal Design.
SET SEED 2000000.
ORTHOPLAN
  /FACTORS=package 'package design' (1 'A*' 2 'B*' 3 'C*')
                   brand 'brand name' (1 'K2R' 2 'Glory'  3 'Bissell')
                   price 'price' (1.19 '$1.19' 1.39 '$1.39' 1.59 '$1.59')
                   seal 'Good Housekeeping seal' (1 'no' 2 'yes')
                   money 'money-back guarantee' (1 'no' 2 'yes')
  /OUTFILE='15a.sav'
  /MINIMUM 18
  /HOLDOUT 4
  /MIXHOLD NO.
```

Conjoint Analysis – Orthogonal Design



	package	brand	price	seal	money	STATUS_	CARD_
1	1.00	2.00	1.39	2.00	1.00	0	1
2	2.00	1.00	1.19	1.00	1.00	0	2
3	2.00	2.00	1.39	1.00	2.00	0	3
4	3.00	2.00	1.59	1.00	1.00	0	4
5	3.00	3.00	1.39	1.00	1.00	0	5
6	1.00	3.00	1.39	1.00	1.00	0	6
7	2.00	3.00	1.59	2.00	1.00	0	7
8	1.00	1.00	1.59	1.00	2.00	0	8
9	3.00	1.00	1.39	1.00	1.00	0	9
10	3.00	2.00	1.19	1.00	2.00	0	10
11	3.00	1.00	1.59	2.00	1.00	0	11
12	2.00	2.00	1.59	1.00	1.00	0	12
13	3.00	3.00	1.19	2.00	2.00	0	13
14	1.00	2.00	1.19	2.00	1.00	0	14
15	2.00	1.00	1.39	2.00	2.00	0	15
16	1.00	1.00	1.19	1.00	1.00	0	16
17	1.00	3.00	1.59	1.00	2.00	0	17
18	2.00	3.00	1.19	1.00	1.00	0	18
19	1.00	3.00	1.59	2.00	1.00	1	19
20	3.00	1.00	1.19	2.00	1.00	1	20
21	1.00	2.00	1.59	1.00	1.00	1	21
22	1.00	3.00	1.19	1.00	1.00	1	22

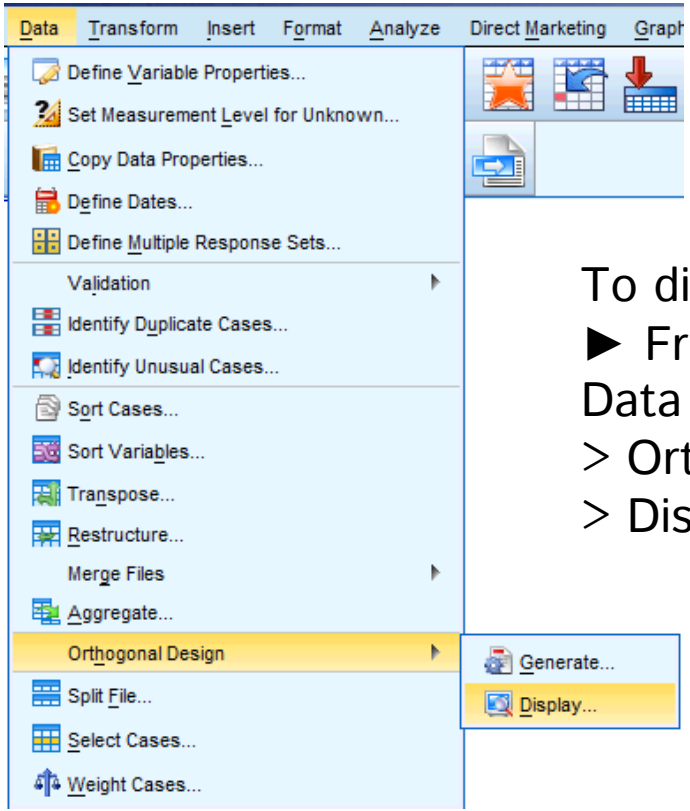
The orthogonal design is displayed in the Data Editor and is best viewed by displaying value labels rather than the actual data values. This is accomplished by choosing Value Labels from the View menu.

Conjoint Analysis – Orthogonal Design

The orthogonal design is a required input to the analysis of the data. Therefore, you will want to **save your design to a data file**. For convenience, the current design has been saved in 15a.sav (orthogonal designs are also referred to as plans).

Once you have created an orthogonal design, you'll want to use it to create the product profiles to be rated by the subjects. You can obtain a listing of the profiles in a single table or display each profile in a separate table.

Conjoint Analysis – Orthogonal Design



To display an orthogonal design:

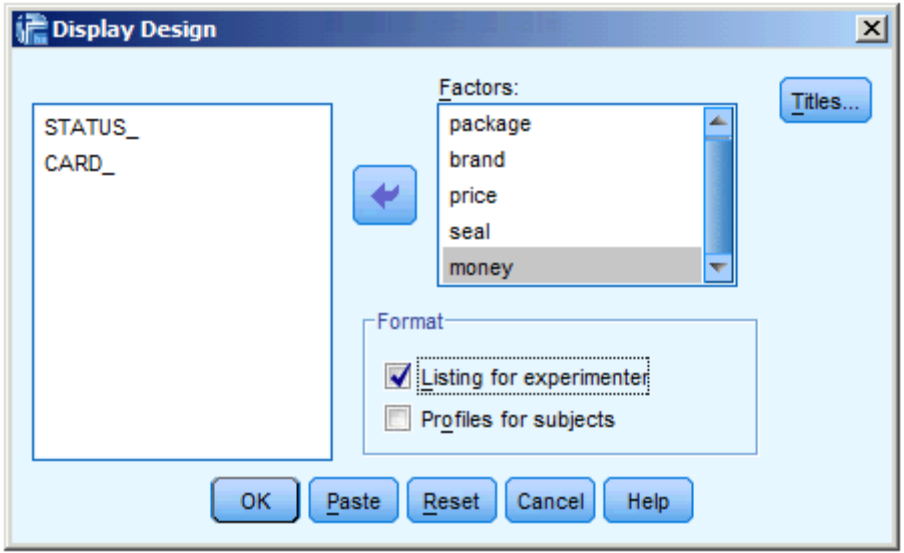
► From the menus choose:

Data

> Orthogonal Design

> Display

Conjoint Analysis – Orthogonal Design



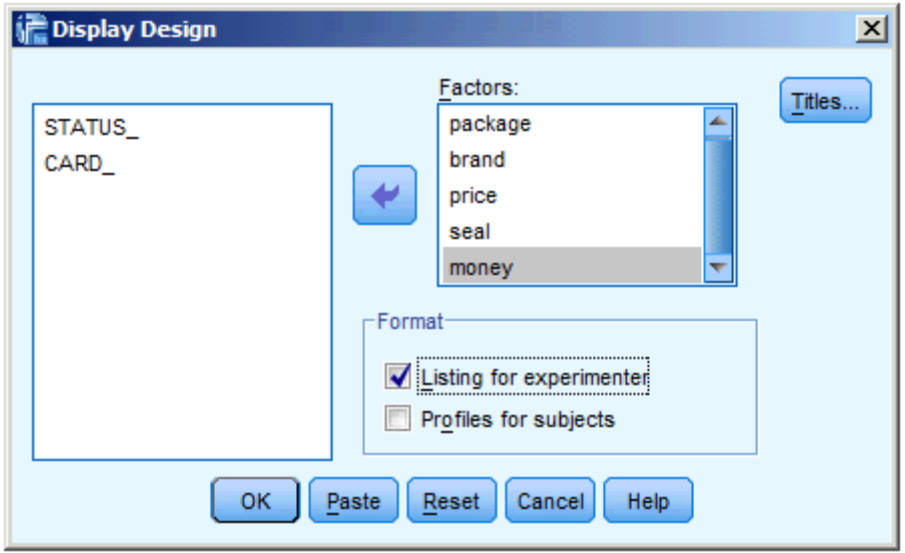
► Select package, brand, price, seal, and money for the factors.

Conjoint Analysis – Orthogonal Design

- The variables in the data file are the factors used to specify the design. Each case represents one product profile in the design. Notice that two additional variables, CARD_ and STATUS_, appear in the data file. CARD_ assigns a sequential number to each profile that is used to identify the profile. STATUS_ indicates whether a profile is part of the experimental design (the first 18 cases), a holdout case (the last 4 cases), or a simulation case (to be discussed in a later topic in this case study).

- The information contained in the variables STATUS_ and CARD_ is automatically included in the output, so they don't need to be selected.

Conjoint Analysis – Orthogonal Design



► Select Listing for experimenter in the Format group.

This results in displaying the entire orthogonal design in a single table.

► Click OK.

Card List						
	Card ID	package design	brand name	price	Good House keeping seal	money-back guarantee
1	1	A*	Glory	$1.39	yes	no
2	2	B*	K2R	$1.19	no	no
3	3	B*	Glory	$1.39	no	yes
4	4	C*	Glory	$1.59	no	no
5	5	C*	Bissell	$1.39	no	no
6	6	A*	Bissell	$1.39	no	no
7	7	B*	Bissell	$1.59	yes	no
8	8	A*	K2R	$1.59	no	yes
9	9	C*	K2R	$1.39	no	no
10	10	C*	Glory	$1.19	no	yes
11	11	C*	K2R	$1.59	yes	no
12	12	B*	Glory	$1.59	no	no
13	13	C*	Bissell	$1.19	yes	yes
14	14	A*	Glory	$1.19	yes	no
15	15	B*	K2R	$1.39	yes	yes
16	16	A*	K2R	$1.19	no	no
17	17	A*	Bissell	$1.59	no	yes
18	18	B*	Bissell	$1.19	no	no
19[a]	19	A*	Bissell	$1.59	yes	no
20[a]	20	C*	K2R	$1.19	yes	no
21[a]	21	A*	Glory	$1.59	no	no
22[a]	22	A*	Bissell	$1.19	no	no

a. Holdout

The output resembles the look of the orthogonal design as shown in the Data Editor—one row for each profile, with the factors as columns.

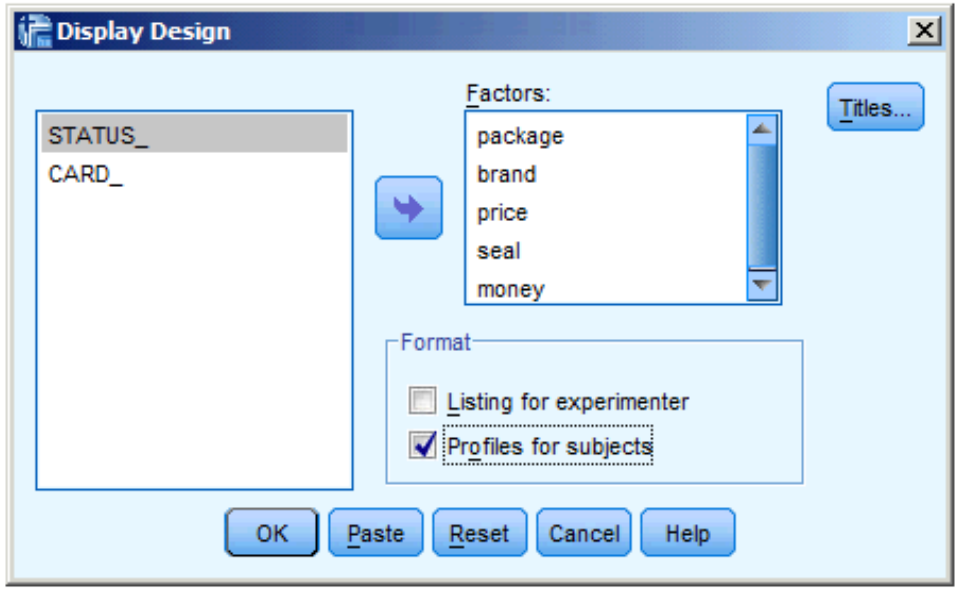
Notice, however, that the column headers are the variable labels rather than the variable names that you see in the Data Editor.

Also notice that the holdout cases are identified with a footnote. This is of interest to the experimenter, but you certainly don't want the subjects to know which, if any, cases are holdouts.

Depending on how you create and deliver your final product profiles, you may want to save this table as an HTML, Word/RTF, Excel, or PowerPoint file.

Conjoint Analysis – Survey Inquiries

Perhaps the needs for your survey are better served by generating a separate table for each product profile. This choice lends itself nicely to exporting to PowerPoint, since each table (product profile) is placed on a separate PowerPoint slide.



To display each profile in a separate table:

► Click the Dialog Recall button and select Display Design.

► Deselect Listing for experimenter and select Profiles for subjects.

► Click OK.

Conjoint Analysis – Survey Inquiries

The information for each product profile is displayed in a separate table.

Profile Number 1

Card ID	package design	brand name	price	Good Housekeeping seal	money-back guarantee
1	A*	Glory	$1.39	yes	no

…

Profile Number 22

Card ID	package design	brand name	price	Good Housekeeping seal	money-back guarantee
22	A*	Bissell	$1.19	no	no

Conjoint Analysis – Run the Method

- You've generated an orthogonal design and learned how to display the associated product profiles. You're now ready to learn how to run a conjoint analysis.
- The preference data collected from the subjects is stored in 15b.sav.
- Note that this data is available only after survey has been conducted

	ID	PREF1	PREF2	PREF3	PREF4	PREF5	PREF6	PREF7	PREF8	PREF9	PREF10	PREF11	PREF12	PREF13	PREF14	PREF15	PREF16	PREF17	PREF18	PREF19	PREF20	PREF21	PREF22
1	1	13	15	1	20	14	7	11	19	3	10	17	8	5	9	6	12	4	21	18	2	22	16
2	2	15	7	18	2	12	3	11	20	16	21	6	22	8	17	19	1	14	4	9	5	10	13
3	3	2	18	14	16	22	13	20	10	15	3	1	6	9	5	7	12	19	8	17	21	11	4
4	4	13	10	20	14	2	18	16	22	15	3	1	9	5	6	8	17	11	7	19	4	12	21
5	5	13	18	2	10	20	15	9	5	3	7	11	4	12	22	14	16	1	6	19	21	17	8
6	6	15	2	3	12	18	7	20	10	11	4	9	5	13	16	14	22	8	6	1	21	19	17
7	7	13	7	15	18	2	3	10	20	14	11	19	17	12	1	9	5	4	6	8	16	21	22
8	8	15	7	13	4	6	16	8	22	5	9	21	18	10	3	2	20	14	11	17	19	1	12
9	9	20	9	10	11	4	5	13	15	2	3	12	18	7	1	21	14	16	22	8	6	17	19
10	10	8	21	19	17	4	11	12	7	1	6	9	5	3	15	14	16	22	20	10	13	2	18

Conjoint Analysis – Run the Method

- The data consist of responses from 10 subjects, each identified by a unique value of the variable ID.
- Subjects were asked to rank the 22 product profiles from the most to the least preferred. The variables PREF1 through PREF22 contain the IDs of the associated product profiles, that is, the card IDs from 15a.sav. Subject 1, for example, liked profile 13 most of all, so PREF1 has the value 13.

	ID	PREF1	PREF2	PREF3	PREF4	PREF5	PREF6	PREF7	PREF8	PREF9	PREF10	PREF11	PREF12	PREF13	PREF14	PREF15	PREF16	PREF17	PREF18	PREF19	PREF20	PREF21	PREF22
1	1	13	15	1	20	14	7	11	19	3	10	17	8	5	9	6	12	4	21	18	2	22	16
2	2	15	7	18	2	12	3	11	20	16	21	6	22	8	17	19	1	14	4	9	5	10	13
3	3	2	18	14	16	22	13	20	10	15	3	1	6	9	5	7	12	19	8	17	21	11	4
4	4	13	10	20	14	2	18	16	22	15	3	1	9	5	6	8	17	11	7	19	4	12	21
5	5	13	18	2	10	20	15	9	5	3	7	11	4	12	22	14	16	1	6	19	21	17	8
6	6	15	2	3	12	18	7	20	10	11	4	9	5	13	16	14	22	8	6	1	21	19	17
7	7	13	7	15	18	2	3	10	20	14	11	19	17	12	1	9	5	4	6	8	16	21	22
8	8	15	7	13	4	6	16	8	22	5	9	21	18	10	3	2	20	14	11	17	19	1	12
9	9	20	9	10	11	4	5	13	15	2	3	12	18	7	1	21	14	16	22	8	6	17	19
10	10	8	21	19	17	4	11	12	7	1	6	9	5	3	15	14	16	22	20	10	13	2	18

Conjoint Analysis – Run the Method

Analysis of the data is a task that requires the use of command syntax - A graphical user interface is not yet available for the Conjoint procedure. To obtain a conjoint analysis, **you must enter command syntax for a CONJOINT command into a syntax window and then run it.**

Conjoint Analysis – Run the Method

```
CONJOINT PLAN='C:\Users\User\Desktop\PTI 2021\Case
     Study\15a.sav'
/DATA='C:\Users\User\Desktop\PTI 2021\Case Study\15b.sav'
/SEQUENCE=PREF1 TO PREF22
/SUBJECT=ID
/FACTORS=package brand (DISCRETE)
      price (LINEAR LESS)
      seal (LINEAR MORE)
      money (LINEAR MORE)
/PRINT=SUMMARYONLY.
```

Analysis of the data is a task that requires the use of command syntax - specifically, the CONJOINT command. The necessary command syntax has been provided above.

Conjoint Analysis – the Result Analysis

Overall Statistics

Utilities

		Utility Estimate	Std. Error
package	A*	-2.233	.192
	B*	1.867	.192
	C*	.367	.192
brand	K2R	.367	.192
	Glory	-.350	.192
	Bissell	-.017	.192
price	$1.19	-6.595	.988
	$1.39	-7.703	1.154
	$1.59	-8.811	1.320
seal	no	2.000	.287
	yes	4.000	.575
money	no	1.250	.287
	yes	2.500	.575
(Constant)		12.870	1.282

- This table shows the utility (part-worth) scores and their standard errors for each factor level. **Higher utility values indicate greater preference.**
- Since the utilities are all expressed in a common unit, they can be added together to give the total utility of any combination.

For example, the total utility of a cleaner with package design B*, brand K2R, price $1.19, and no seal of approval or money-back guarantee is:

utility(package B*) + utility(K2R) + utility($1.19) + utility(no seal)
+ utility(no money-back) + constant

$$1.867 + 0.367 + (-6.595) + 2.000 + 1.250 + 12.870 = 11.759$$

Conjoint Analysis – the Result Analysis

Coefficients

	B Coefficient
	Estimate
price	-5.542
seal	2.000
money	1.250

This table shows the linear regression coefficients for those factors specified as LINEAR (for IDEAL and ANTIIDEAL models, there would also be a quadratic term). The utility for a particular factor level is determined by multiplying the level by the coefficient. For example, the predicted utility for a price of $1.19 was listed as −6.595 in the utilities table. This is simply the value of the price level, 1.19, multiplied by the price coefficient, −5.542.

Importance Values

package	35.635
brand	14.911
price	29.410
seal	11.172
money	8.872

Averaged Importance Score

This table provides a measure of the relative importance of each factor known as an importance score or value. The values are computed by taking the utility range for each factor separately and dividing by the sum of the utility ranges for all factors. The values thus represent percentages and have the property that they sum to 100. The calculations, it should be noted, are done separately for each subject, and the results are then averaged over all of the subjects.

Conjoint Analysis – the Result Analysis

Correlations[a]

	Value	Sig.
Pearson's R	.982	.000
Kendall's tau	.892	.000
Kendall's tau for Holdouts	.667	.087

a. Correlations between observed and estimated preferences

This table displays two statistics, Pearson's R and Kendall's tau, which provide measures of the correlation between the observed and estimated preferences.

The table also displays Kendall's tau for just the holdout profiles. Remember that the holdout profiles (four in the present example) were rated by the subjects but not used by the Conjoint procedure for estimating utilities. Instead, the Conjoint procedure computes correlations between the observed and predicted rank orders for these profiles as a check on the validity of the utilities.

THANKS!

Source:

https://www.ibm.com/support/knowledgecenter/SSLVMB_23.0.0/statistics_casestudies_project_ddita-gentopic1.html