Best Practice
Fundamentals

BPM

Best Practice Fundamentals

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BEST PRACTICE MODELLING (BPM)

Best Practice Modelling (BPM) is a business modeling organization that specialises in the provision of best practice spreadsheet modeling resources including software, consulting and training services. BPM is the founding member of the Spreadsheet Standards Review Board (SSRB) and remains committed to overseeing the ongoing maintenance, development and adoption of the Best Practice Spreadsheet Modeling Standards. BPM can be contacted as follows:

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Introducing Best Practice Spreadsheets

This document provides you with an overview of spreadsheet best practice, and an introduction to a best practice Excel workbook.

In essence, a best practice model is a spreadsheet that has been built in compliance with a set of rules known as the Best Practice Spreadsheet Modeling Standards.

The Standards introduce order and consistency into spreadsheets, thereby making them easier to understand, use, share and maintain.

Best Practice Spreadsheet Modeling Standards

The Best Practice Spreadsheet Modeling Standards are a comprehensive set of guidelines relating to spreadsheet development and use.

The Standards can be viewed online (www.bestpracticemodelling.com/resources/standards) or downloaded as a simple listing or with detailed commentary and examples:

Standards & Conventions

Standardization is common to all areas of life. As with putting the brake pedal on the left and the accelerator on the right, standardization is crucial to enabling everyone to use a system efficiently while at the same time substantially reducing the risk of error.

Each item within the Standards is classified as either a *standard* or a *convention*:

- **Standard** – A methodology or approach that is *required* to implement best practice spreadsheet modeling.
- **Convention** – A methodology or approach that is *recommended* to implement best practice spreadsheet modeling.

For example, a standard might *require* that the type of content within cells be distinguishable at all times, whilst an associated convention *recommend* that blue font color be used for constants, black font color for formulas, and so on.

Model Users vs. Model Developers

A fundamental concept underlying the Standards is the distinction between *model users* and *model developers*:

- **Model Developers** are involved in the physical construction of a spreadsheet model and the derivation of the underlying calculations.
- **Model Users** rely upon outputs from a spreadsheet model but are not involved in its construction.

On a basic level, model users only edit the assumptions within a model, whereas model developers build the infrastructure that collects these assumptions, calculates outputs and presents these outputs.

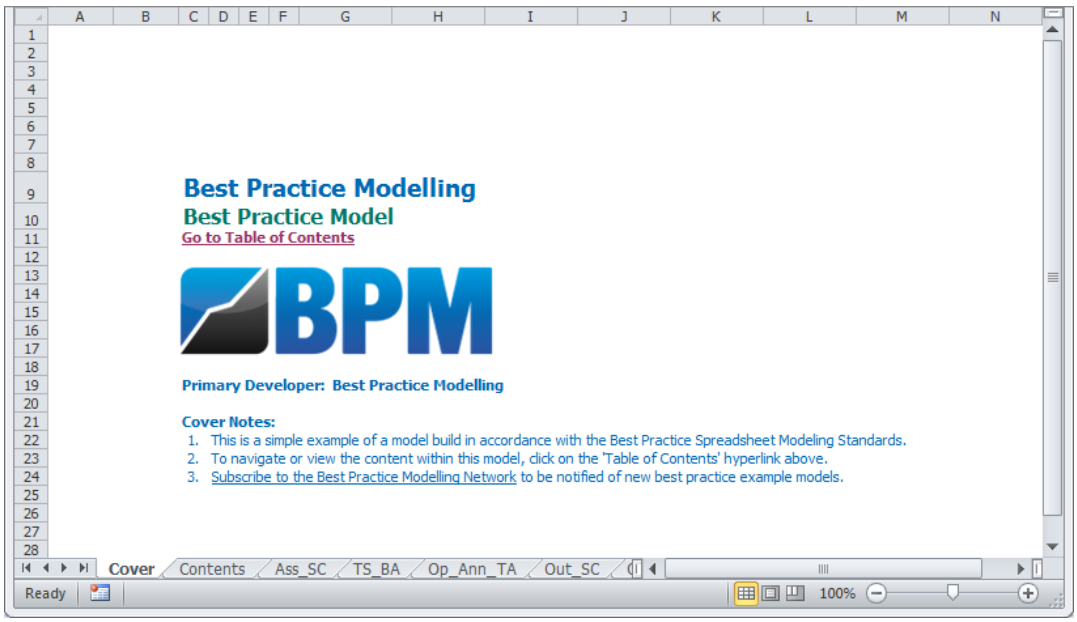
Exploring a Best Practice Model

The best way to experience the benefits of a best practice model is to walk through an example.

Cover Sheets

Best practice models use *cover sheets* to create structure and communicate information to model users. When a best practice model is first opened, the workbook cover sheet will be visible, and contain important information about the model such as its name, developer and notes:

Workbook Cover Sheet



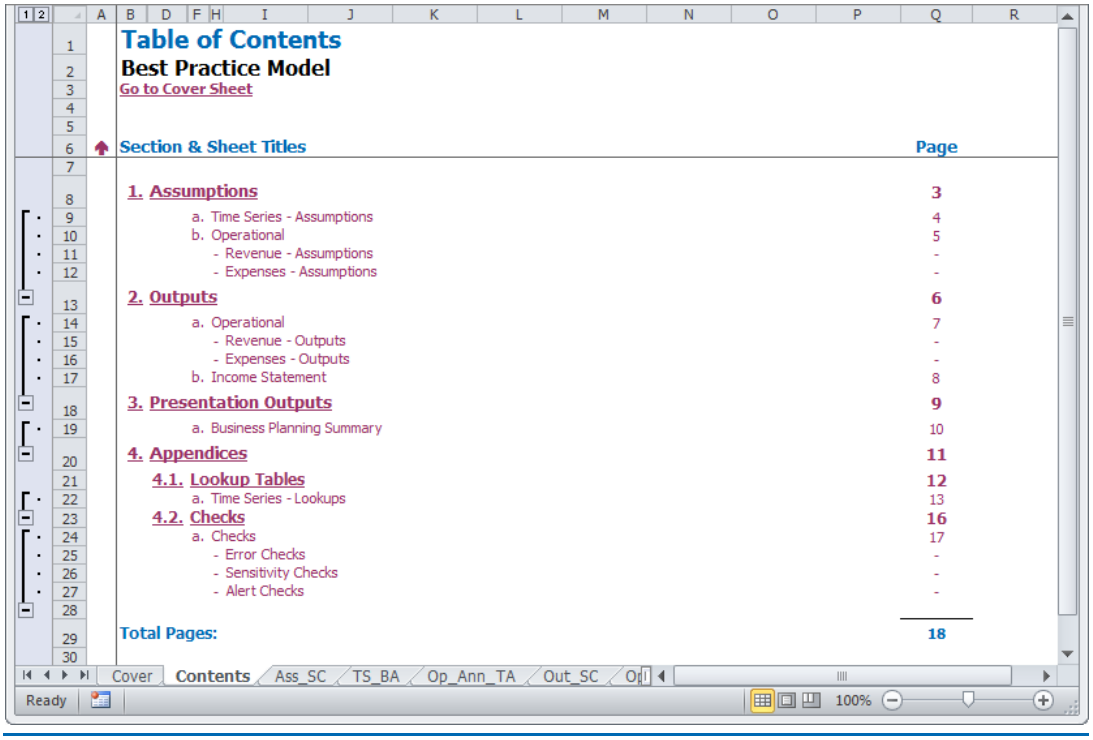
Cover sheets, like all sheets in best practice model, contain a hyperlink to the table of contents, shown in cell C11 in the above image. These hyperlinks, which are by default plum and underlined, make the table of contents accessible from anywhere in the workbook with a single mouse click.

Table of Contents

Rather than relying on sheet tabs, which become somewhat irrelevant to model users in best practice models, a hyperlink-based table of contents is used for efficient workbook navigation.

The table of contents also provides a summary of the structure and content within the underlying spreadsheet, often containing assumptions, outputs, presentation outputs and appendices sections as shown below:

Table of Contents



This table of contents contains a hyperlink to every worksheet in the model, making navigation throughout the model simple. It also contains page numbers to assist in the printing and viewing of the underlying model.

Hyperlink Navigation

A best practice model can be navigated without reference to sheet tab names. Instead, by using the hyperlinks within the table of contents and each worksheet, model users can navigate between any two worksheets using only two clicks – effectively hopping back to the table of contents each time:

Two-Click Navigation via the Table of Contents

Every sheet in a best practice model contains common content, such as a sheet title, a reference to the model name, hyperlinks to neighbouring sheets and error checks, and a hyperlink back to the table of contents.

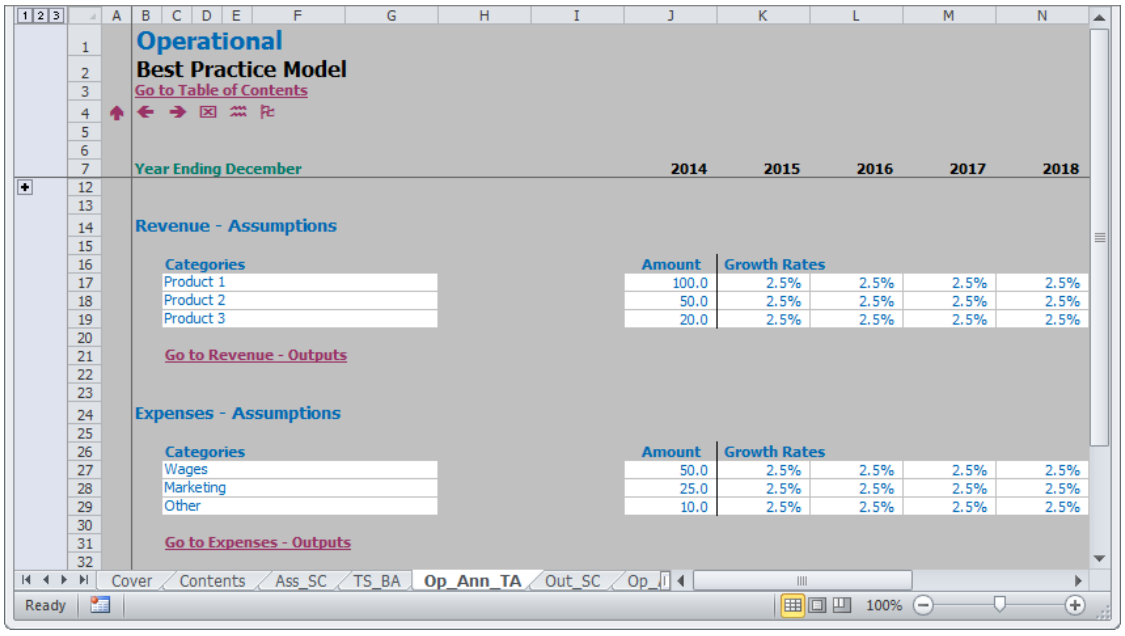
Some of this content is common to all sheets while other content, such as fill coloring and time series period titles, is specific to certain types of sheets.

Sheet Purpose

Every sheet in a best practice model is classified as either an *assumptions sheet* or an *outputs sheet*. The purpose of assumptions sheets is to collect assumptions from model users, while outputs sheets calculate and present model outputs.

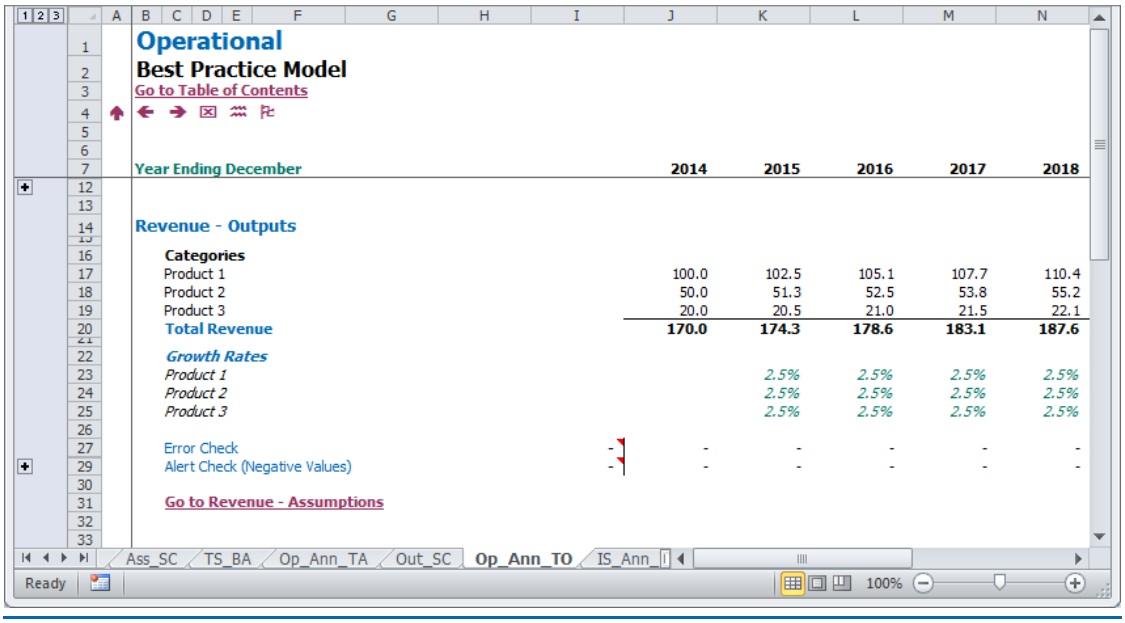
The Standards require that assumptions sheet be visually distinguishable from outputs sheets, and recommend that this is done by using *gray fill color* for assumptions sheets, as shown for an Operational assumptions sheet below:

Assumptions Sheet



Outputs sheets have *no fill color*, as shown below for an Operational outputs sheet below:

Outputs Sheet

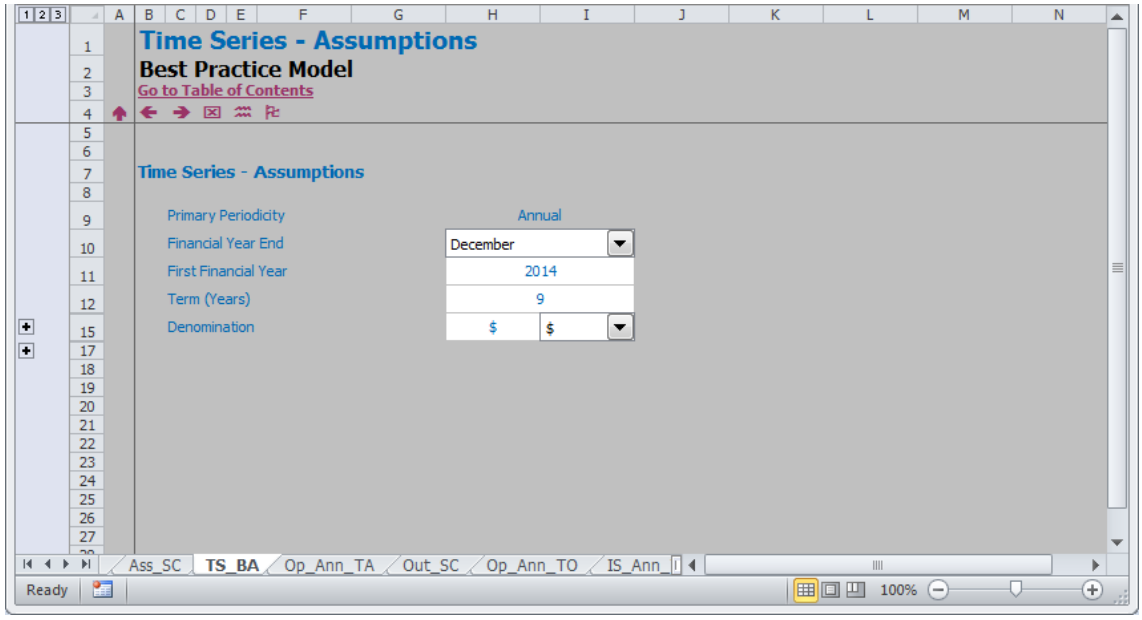


Sheet Content

In addition to each sheet being classified as either an assumptions sheet or outputs sheet, most non-cover sheets within a best practice model can be classified as either a *blank sheet* or *time series sheet*.

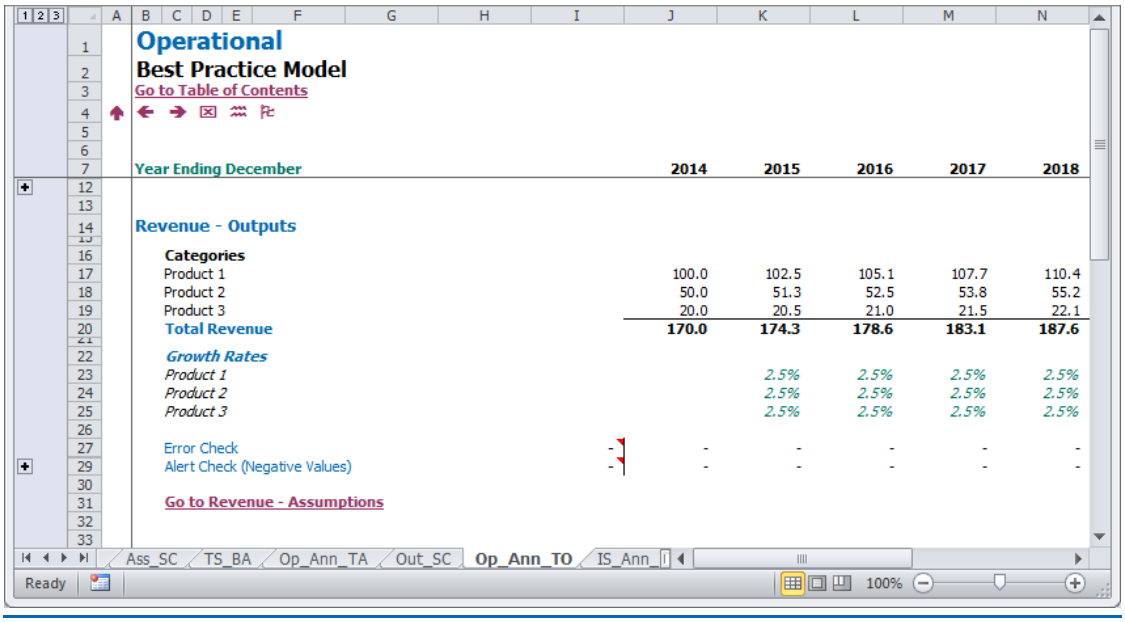
A common example of a blank assumptions sheet is an assumptions sheet used to collect time series assumptions from the model user, as shown below:

Blank Assumptions Sheet



A common example of a time series outputs sheet is an outputs sheet used to calculate revenue projections over a number of time series periods, as shown below:

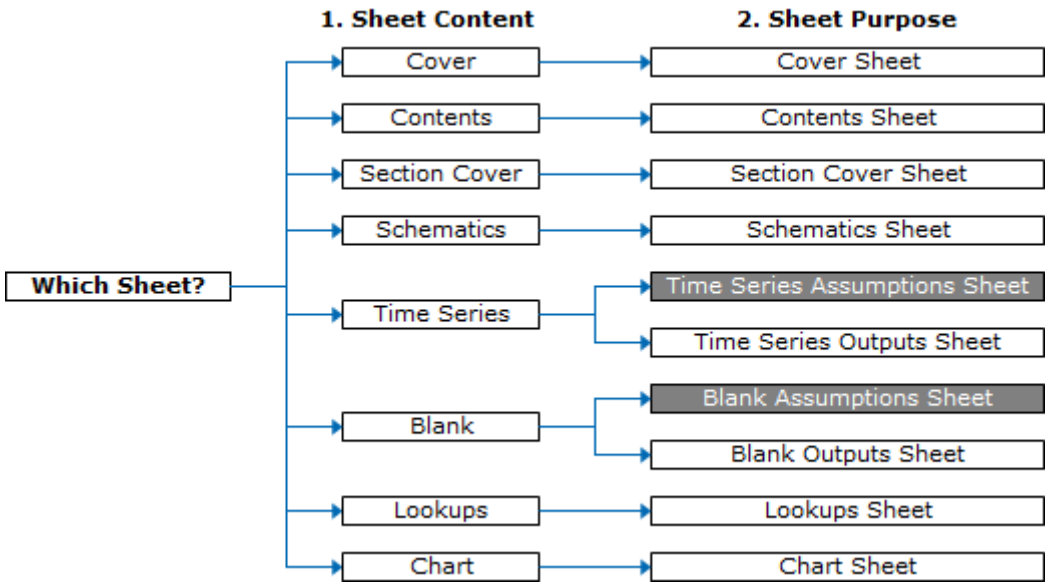
Time Series Outputs Sheet



In addition to blank sheets and time series sheets, the Standards provide for a range of other sheet types including schematics sheets (for diagrams and flow charts) and lookups sheets (for tables of data for use in controls and worksheet formulas).

A summary of the sheet classification process is provided in the diagram below:

Sheet Classification – Summary

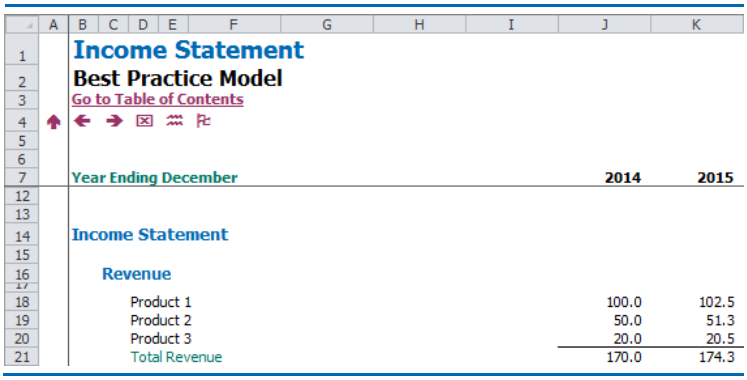


Cell Content

Like the classification of sheets, best practice models employ a principle called *purpose-based formatting* in which the *content* and *purpose* of each cell is communicated via the use of consistent cell formatting.

The use of purpose-based formatting has already been encountered above in the case of hyperlinks – i.e. the Standards require that all hyperlinks have the same font color and recommend plum, as shown below in rows 3 – 4 of an income statement worksheet:

Consistent Hyperlink Formatting



The same principle is used throughout best practice models to distinguish cells based on their content, with each cell being classified as containing one of three types of content:

Content Type	Description	Example	Color
Constant	• Hard-coded, non-formula.	100	Blue
Formula	• Pure formula.	=J20*J45	Black
Mixed	• Formula containing constants.	=J20+100	Green

Many spreadsheet users will be familiar with distinguishing *constants* and *formulas*. The Standards further require *mixed* content to be distinguished because of risks created by hard-coding data into formulas (e.g. hiding assumptions within formulas).

When this font coloring is applied consistently, each worksheet becomes a visual dictionary of the content within each of its cells, as demonstrated in the time series outputs sheet shown below:

Cell Content Identification

Operational

Best Practice Model

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Year Ending December	2014	2015	2016	2017	2018
Revenue - Outputs					
Categories					
Product 1	100.0	102.5	105.1	107.7	110.4
Product 2	50.0	51.3	52.5	53.8	55.2
Product 3	20.0	20.5	21.0	21.5	22.1
Total Revenue	**170.0**	**174.3**	**178.6**	**183.1**	**187.6**
Growth Rates					
Product 1		*2.5%*	*2.5%*	*2.5%*	*2.5%*
Product 2		*2.5%*	*2.5%*	*2.5%*	*2.5%*
Product 3		*2.5%*	*2.5%*	*2.5%*	*2.5%*
Error Check	-	-	-	-	-
Alert Check (Negative Values)	-	-	-	-	-

Go to Revenue - Assumptions

If the Standards have been applied consistently, it is possible to quickly and easily identify all the constants, formulas and mixed cells within this worksheet.

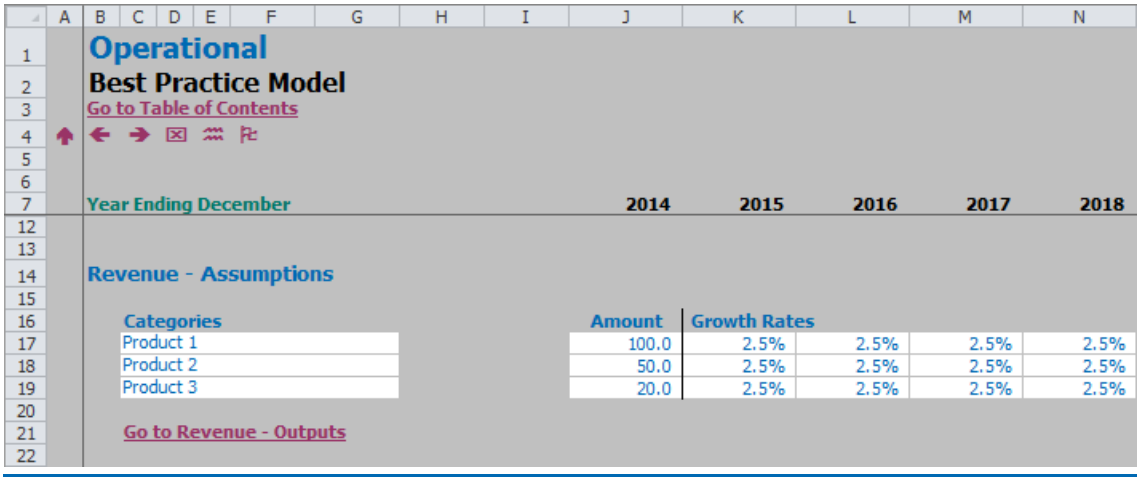
In this example, cell B7 has been formatting using mixed green font color because it contains a formula made up of the entered word *Year Ending* and a reference to the time series assumptions which evaluates to the selected financial month end *December*.

Cell Purpose

While it is important for model developers to be able to quickly and easily distinguish cell content based on font color, model *users* are more concerned with quickly and easily locating assumptions cells.

In best practice models, *fill color* is used to communicate the purpose of cells, with *white fill color* being used to differentiate assumptions cells within gray assumptions sheets. This makes assumptions cells very easy to detect, as shown below in the ranges C17:G19 and J17:N19:

Cell Purpose Identification - Assumptions



Operational
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Year Ending December	2014	2015	2016	2017	2018
Revenue - Assumptions					
Categories	**Amount**	**Growth Rates**			
Product 1	100.0	2.5%	2.5%	2.5%	2.5%
Product 2	50.0	2.5%	2.5%	2.5%	2.5%
Product 3	20.0	2.5%	2.5%	2.5%	2.5%

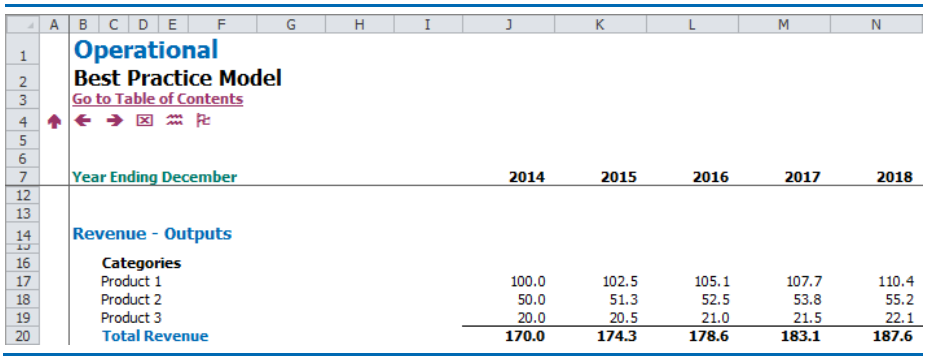
Go to Revenue - Outputs

This clear identification of assumptions is fundamentally important because it prevents model users from confusing non-assumptions constants (such as the 'Categories' heading in cell C16) with assumptions cells. This in turn mitigates the risk of model users changing structural content in a model when the sheets are not protected.

The Standards also address the use of styles within worksheets to assist in the application of purpose-based formatting. Styles are very powerful when used in this way, and assumptions styles are particularly important because they are *unlocked*, meaning that the values (i.e. assumptions) within their cells can still be changed when worksheets are protected.

Where practical, the Standards require that assumptions not be located within output sheets. For this reason, it is recommended that non-assumptions cells contain *no fill color*, meaning they should always be the same color as their parent worksheet:

Cell Purpose Identification - Outputs



Operational
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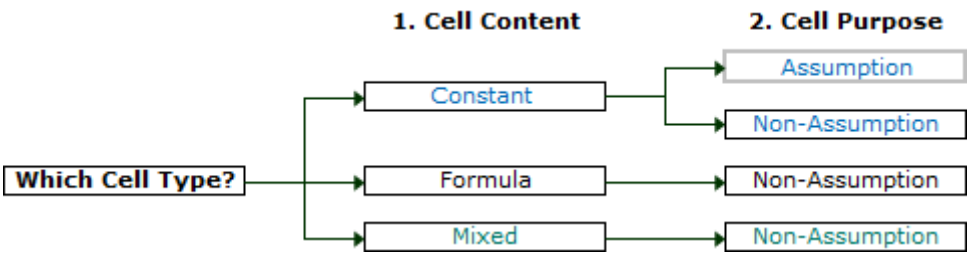
Go to Table of Contents

Year Ending December	2014	2015	2016	2017	2018
Revenue - Outputs					
Categories					
Product 1	100.0	102.5	105.1	107.7	110.4
Product 2	50.0	51.3	52.5	53.8	55.2
Product 3	20.0	20.5	21.0	21.5	22.1
Total Revenue	**170.0**	**174.3**	**178.6**	**183.1**	**187.6**

Understanding the difference between *cell content* and *cell purpose* is fundamental to the effective creation and use of best practice models.

A summary of the cell classification process is provided in the diagram below:

Cell Classification – Summary

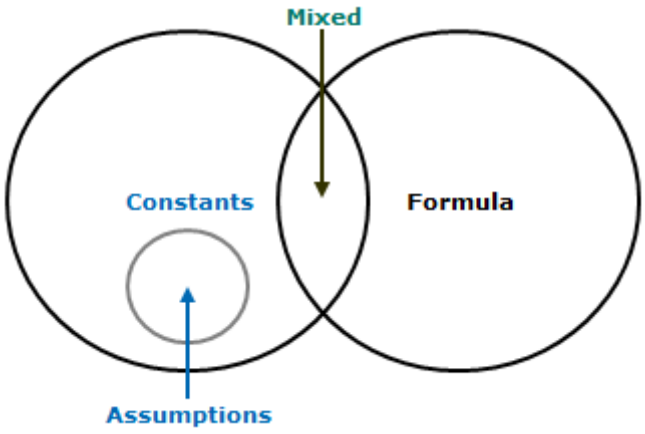


A great way to avoid confusion when classifying cells is avoiding the use of the word 'input'. The word 'input' is both a noun and a verb, and is often used ambiguously when referring to both constants (which is cell content) and assumptions (which is cell purpose). An example of correct and unambiguous terminology is:

Assumptions should always be constants but not all constants are assumptions.

The following Venn diagram shows every possible cell type that can exist in a workbook, allowing for both cell content and cell purpose:

Cell Content & Purpose – Venn Diagram



Checks

Best practice models contain a centralized checks system which allows for three types of checks:

- **Error Checks** – Detect and indicate the existence of errors.
- **Sensitivity Checks** – Detect and indicate the existence of active sensitivity assumptions.
- **Alert Checks** – Detect and indicate the occurrence of designated events that the model developer intends to notify the model user of, excluding error checks and sensitivity checks.

Checks of the appropriate type are used throughout the model to detect and isolate issues at the source, thereby ensuring model users are able to quickly and easily locate and resolve them.

Checks are used to capture and indicate all sorts of issues, such as error values, illogical outputs, failed reconciliations and unexpected negative values. An example of the use of error and alert checks to detect erroneous and negative revenue and expenses is shown below:

Checks Utilization

Operational

Best Practice Model

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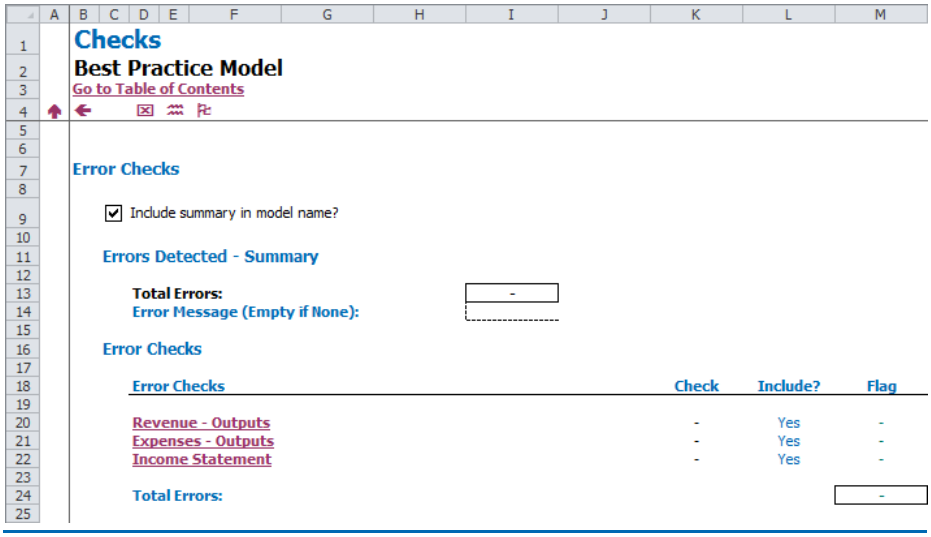
Year Ending December		2014	2015	2016	2017	2018
Revenue - Outputs						
Categories						
Product 1		100.0	102.5	105.1	107.7	110.4
Product 2		50.0	51.3	52.5	53.8	55.2
Product 3		20.0	20.5	21.0	21.5	22.1
Total Revenue		**170.0**	**174.3**	**178.6**	**183.1**	**187.6**
Growth Rates						
Product 1			*2.5%*	*2.5%*	*2.5%*	*2.5%*
Product 2			*2.5%*	*2.5%*	*2.5%*	*2.5%*
Product 3			*2.5%*	*2.5%*	*2.5%*	*2.5%*
Error Check	-	-	-	-	-	-
Alert Check (Negative Values)	-	-	-	-	-	-
Go to Revenue - Assumptions						
Expenses - Outputs						
Categories						
Wages		50.0	51.3	52.5	53.8	55.2
Marketing		25.0	25.6	26.3	26.9	27.6
Other		10.0	10.3	10.5	10.8	11.0
Total Expenses		**85.0**	**87.1**	**89.3**	**91.5**	**93.8**
Growth Rates						
Wages			*2.5%*	*2.5%*	*2.5%*	*2.5%*
Marketing			*2.5%*	*2.5%*	*2.5%*	*2.5%*
Other			*2.5%*	*2.5%*	*2.5%*	*2.5%*
Error Check	-	-	-	-	-	-
Alert Check (Negative Values)	-	-	-	-	-	-
Go to Expenses - Assumptions						

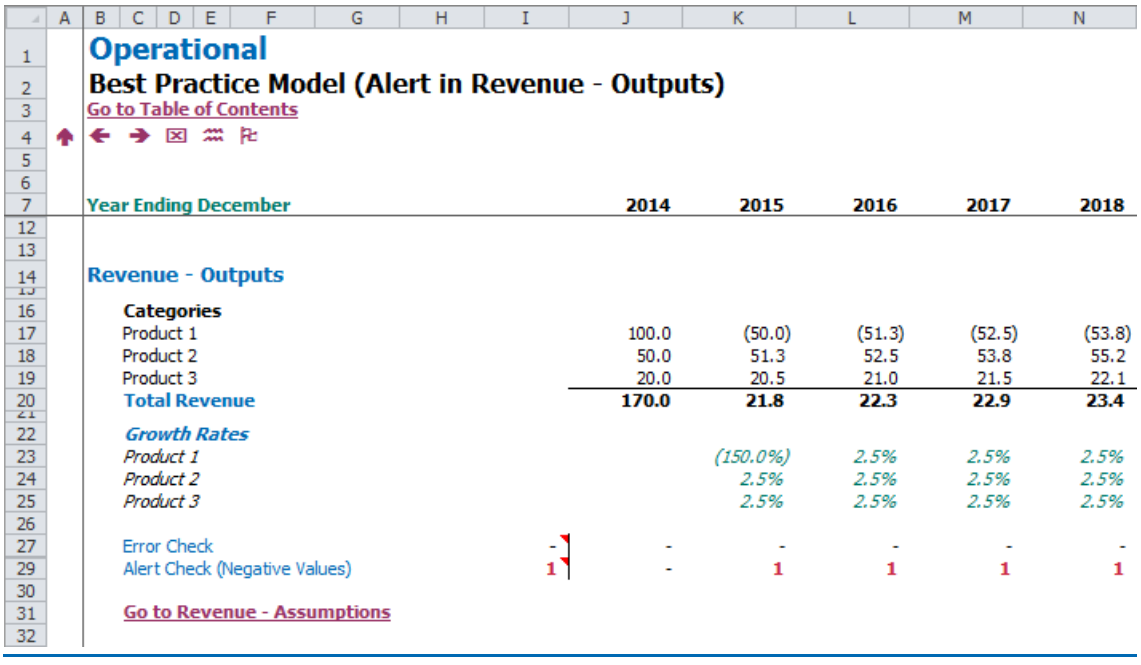
All the checks within the workbook are then summarized in separate error, sensitivity and alert check summaries, such as the error checks summary shown below:

Error Checks Summary



The model name cell on the workbook cover sheet is then linked to the result of each of these checks summaries. As a result, any triggered checks are communicated via the model name cell on every worksheet, as shown below in cell B2:

Triggered Alert Check



Model users are then able to use the check hyperlinks on each worksheet (in the range D4:F4 in the above image) to quickly navigate to the checks summaries and then to the source of the triggered check. In this way, there should never be an undetected check in a best practice model.

1. General Concepts

BPMS 1-1 Workbook Purpose
The purpose of a workbook should be the primary consideration of a model developer during every stage of a workbook's development. The purpose of a workbook can be universally segregated into three levels as follows: a) the purpose of the workbook; b) the purpose of each sheet; and c) the purpose of each component within each sheet.

BPMS 1-2 Sheet Classification
The sheet content and sheet purpose of every sheet in a workbook should be visually identifiable at all times.

BPMS 1-3 Sheet Content
Every sheet in a workbook should be visually identifiable as being one of the following sheet types: a) cover sheet; b) contents sheet; c) section cover sheet; d) schematics sheet; e) time series sheet; f) blank sheet; g) lookups sheet; or h) chart sheet.

BPMS 1-4 Sheet Purpose
Every sheet in a workbook should have the purpose of either collecting assumptions or not collecting assumptions. Hence, every sheet in a workbook should be visually identifiable as having one of the following sheet purposes: a) Assumptions sheet; or b) Outputs sheet.

BPMS 1-5 Cell Classification
The cell content and cell purpose of every cell in every worksheet should be visually identifiable at all times.

BPMS 1-6 Cell Content
Every cell in every worksheet should be visually identifiable as containing one of the following content types: a) Constant; b) Formula; or c) Mixed (combination of constant and formula).

BPMS 1-7 Cell Purpose
Every cell in every worksheet should have the purpose of either collecting assumptions or not collecting assumptions. Hence, every cell in every worksheet should be visually identifiable as having one of the following cell purposes: a) Assumption cell; or b) Output cell.

BPMS 1-8 Assumption Classification
An assumption is defined as anything within a workbook that is intended to be manipulated by model users to affect outputs. Every assumption in a workbook must be classified as one of the following types: a) Base assumption; or b) Sensitivity assumption.

BPMS 1-9 Assumption Cell Content
Every assumption cell in every worksheet should contain constant cell content.

2. Workbook Structure

BPMS 2-1 Workbook Cover Sheet
Every workbook that contains more than one sheet should contain a separate cover sheet as the first sheet in the workbook.

BPMS 2-2 Workbook Sections
Every workbook that contains multiple categories or similar types of information should be separated into sections. A separate section should be created in a workbook for each sheet or group of sheets containing similar types of information.

BPMS 2-3 Section Cover Sheets
A section cover sheet should be used at the start of each section in a workbook to indicate the commencement of each new section.

BPMS 2-4 Table of Contents
Every workbook with more than one sheet should contain a table of contents outlining the structure and composition of the underlying workbook.

BPMS 2-5 Table of Contents Information
A Table of Contents should: a) show the sections of the workbook (if any sections have been created); b) reference the sheet title of each sheet in the model; c) clearly number each section and sheet; and d) be located near the front of the workbook (generally the second sheet in the workbook).

BPMS 2-6 Workbook Navigation
Every workbook with more than one sheet should contain: a) a table of contents sheet outlining the sections and sheets in the workbook; b) hyperlinks from the table of contents to every sheet in the workbook; and c) a hyperlink to the table of contents always in view on every sheet in the workbook.

3. Sheet Structure

BPMS 3-1 Sheet Titles
Every sheet in a workbook should contain a clearly highlighted sheet title that is: a) consistently formatted on every sheet; b) consistently located on every sheet type; and c) always in view on the screen when that sheet is active.

BPMS 3-2 Sheet Type Consistency
Sheets of the same sheet type within a workbook should be consistently structured and formatted. This standard applies to: a) sheet title, styles and positioning; b) heading styles and spacing; c) column and row dimensions; d) data entry points; e) hyperlink positioning; f) visibility of gridlines; g) grouping levels; h) zoom and viewing properties; i) window panes and splits; and j) formats and colors.

BPMS 3-3 Grouping Rows or Columns
When hiding rows or columns in a worksheet, the rows or columns should always be grouped, not hidden.

4. Formats & Styles

BPMS 4-1 Formats and Styles Key
Every workbook should contain a key or legend that explains the purpose of each format and style that has been applied to the cells in the workbook.

BPMS 4-2 Worksheet Data Alignment
All data of the same type on a worksheet should be consistently aligned down rows or across columns.

BPMS 4-3 Denomination Identification
Every number in a workbook should clearly indicate what type of denomination it is by either: a) stating the denomination of a number in an appropriate corresponding heading, title column, row or label; or b) formatting the number such that it is displayed as its denominator (e.g. $20, 20 tonnes, 20% or 20.0x).

BPMS 4-4 Workbook Denomination
There should be a primary denomination that is used consistently throughout the workbook. Where denominations differ from the primary denomination, they should be clearly labelled to inform other model developers and model users.

BPMS 4-5 Hyperlink Consistency
All hyperlinks within a workbook should use a consistent, dedicated style or format so that they are visually identifiable as being hyperlinks.

BPMS 4-6 Work in Progress
Any cell within a workbook that is subject to further work or not finalized should be visually identifiable as being work in progress.

5. Assumptions Entry Interfaces

BPMS 5-1 Assumptions Location
All assumptions contained in a workbook should be located on dedicated and visually identifiable assumptions sheets. Assumptions should never be located on outputs sheets.

BPMS 5-2 No Assumption Repetition
Any single assumption should never be entered more than once into a workbook.

BPMS 5-3 Control Cell Link Placement
Every cell link that is attached to a control in a workbook should be located in the top left cell of the range over which its control is placed.

BPMS 5-4 Control Lookup Data
When using a control in a workbook that requires an input range (lookup data), the lookup data should always be located on a separate lookups sheet.

BPMS 5-5 In-Cell Drop Down Lists
A cell in which data validation is used to create in cell drop down lists should always be formatted as an assumption cell.

6. Sensitivity Analysis

BPMS 6-1 Separate Sensitivity Assumptions Section
Every workbook that contains sensitivity analysis functionality should contain a dedicated sensitivity assumptions section (which is separate to the base assumptions section).

BPMS 6-2 Sheet Type for Sensitivity Assumptions Entry Interfaces
All sensitivity assumptions in a workbook should be located on assumptions sheets.

BPMS 6-3 Separate Sensitivity Assumptions Entry Interfaces
Sensitivity assumptions should always be located on a dedicated sensitivity assumptions sheet which is separate to its corresponding base assumptions sheet.

7. Outputs & Presentations

BPMS 7-1 Segregation of Outputs
Outputs sheets and presentations, which may take the form of tables, graphs, diagrams or pictures, amongst other forms, should always be located in either: a) a separate, clearly labelled section of a workbook; or b) a separate dedicated outputs workbook.

BPMS 7-2 Presentation Sheets
A workbook may contain sheets which do not comply with the standards and conventions, but these sheets must be presentation sheets. A presentation sheet is a sheet that is included in a workbook in order to present outputs which are necessarily exempt from the standards and conventions in order to meet aesthetic or corporate requirements.

BPMS 7-3 Presentation Sheet Usage
Presentation sheets should only be included in a workbook where it is not possible to use non-presentation sheets to achieve the same objective.

The Standards are universally applicable and are considered the best way to develop best practice spreadsheet models.
For detailed commentary and examples, go to www.bestpracticemodeling.com.
The full version of these Standards can be downloaded from www.ssrb.org.

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8. Calculation Formulas

BPMS 8-1 Consistent Formulas
When more than one adjacent cell contains a similar type of output the structure and components of the formulas within the cells should always be consistent, so that the cell can be copied across / down the relevant range without needing to make changes.

BPMS 8-2 No Assumptions in Mixed Content
Assumptions should not be embedded in cells containing mixed content – i.e. cells containing content with a combination of constant and formula.

BPMS 8-3 Circular References
A workbook or group of linked workbooks should never contain a circular reference.

9. Naming Principles

BPMS 9-1 Workbook Naming
Each workbook should be named such that the name: a) allows for different versions of the workbook; b) remains consistent between versions of the workbook; and c) differentiates the workbook from other workbooks.

BPMS 9-2 Sheet Naming
Every sheet name in a workbook should indicate the sheet type.

BPMS 9-3 Range Naming
Every range name in a workbook should describe the content or use of the range being named.

BPMS 9-4 Standardized Naming Prefixes
Every range name in a workbook should have a standardized prefix to identify what type of range the name refers to or the purpose of that range.

10. Time Series Analysis

BPMS 10-1 Time Series Assumptions
Every workbook that undertakes time series analysis should clearly state, for each distinct time series: a) the time series start date; and b) the time series periodicity.

BPMS 10-2 Time Series Period Labels
A time series should always contain a consistent set of periodicity labels and counters that are located in the same position on every relevant worksheet in the workbook. The periodicity labels and counters that should appear in every time series sheet are: a) period start date; b) period end date; and c) period number (counter).

BPMS 10-3 Time Series Period End Dates
The period end date label for each period in a time series sheet should always be in view on the screen.

BPMS 10-4 Time Series Periodicity Identification
The periodicity of each time series sheet should be clearly identified and always in view on each time series sheet.

BPMS 10-5 Time Series Number of Periods
A workbook that undertakes time series analysis should always include a cell or cell range that indicates the number of periods in each distinct time series.

BPMS 10-6 Time Series Sheet Consistency
Time series sheets for each distinct time series within a workbook should always: a) contain the same number of periods; and b) have the first period starting in the same column (or more rarely, row).

11. Checks

BPMS 11-1 Checks Classification
All checks in a workbook should be classified as being one of the following check types: a) error check; b) sensitivity check; or c) alert check.

BPMS 11-2 Error Checks
Every workbook should contain appropriate error checks to assist in identifying errors in the workbook.

BPMS 11-3 Sensitivity Checks
Every workbook that contains one or more sensitivity assumptions should contain sensitivity checks to identify when there is an operative sensitivity assumption.

BPMS 11-4 Alert Checks
Every workbook that requires checks that are not classified as error checks or sensitivity checks should contain alert checks to identify when such a check has been triggered.

BPMS 11-5 Error Checks Summary
The outcome of every error check in a workbook should be displayed in a dedicated and separate error checks summary.

BPMS 11-6 Sensitivity Checks Summary
The outcome of every sensitivity check in a workbook should be displayed in a dedicated and separate sensitivity checks summary.

BPMS 11-7 Alert Checks Summary
The outcome of every alert check in a workbook should be displayed in a dedicated and separate alert checks summary.

BPMS 11-8 Check Indicator Flag
A message or indicator that clearly notifies the model developer or user that a check has been triggered in a workbook should always be in view on every worksheet in a workbook.

BPMS 11-9 Check Cell Formatting
Each check cell in a workbook should be formatted in such a way that it will visually indicate when an error, sensitivity or alert check has been triggered.

BPMS 11-10 Dedicated Checks Summaries
A workbook should not contain more than one of each of the following types of check summaries: a) error checks summary; b) sensitivity checks summary; and/or c) alert checks summary.

12. Printing & Viewing

BPMS 12-1 Table of Contents Page Numbers
Every workbook with more than one sheet should contain a table of contents that displays the corresponding printed page numbers for each sheet. As such a workbook should always print with a Table of Contents that is consistent with any page numbers printed on the individual sheet pages.

BPMS 12-2 Sheet Page Numbers
Every sheet within a workbook should contain page numbers that correspond with the printed page numbers stated in the workbook table of contents, when printing the entire workbook.

BPMS 12-3 Page Margin Consistency
The page margins on every sheet in a workbook should be consistent.

BPMS 12-4 Print View Consistency
The print scaling setting and hence the size of the content on each printed page in a workbook should, where feasible, be consistent for each sheet.

BPMS 12-5 Page View Consistency
The view type should be the same for each sheet in a workbook.

BPMS 12-6 Worksheet View Consistency
Prior to providing a workbook to a model user, the view of every worksheet in the workbook should be set such that the top-left corner of the worksheet is in view (i.e. cell A1 is selected).

13. Multiple Workbooks

BPMS 13-1 External Workbook Imports
All links from an external workbook into a workbook should be made via dedicated and separate import sheets.

BPMS 13-2 External Workbook Exports
All links to an external workbook from a workbook should be made via dedicated and separate export sheets.

BPMS 13-3 Workbook Outputs Links
All formulas on a export worksheet should always be linked directly to the workbook calculations. Content on an export worksheet should never be moved from one workbook to another workbook in a manner (e.g. copied and pasted as values) which creates static data that will not change when changes are made to the workbook from which the data originated.

14. Security & Protection

(No Standards)

15. Visual Basic Programming

(No Standards)

16. Miscellaneous

BPMS 16-1 Automatic Calculation Setting
A workbook should, where feasible, be set to calculate automatically.

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1. General Concepts

BPMC 1-1 Sheet Types
It is recommended that the eight basic sheet types stated in BPMS 1-3 Sheet Content, be further sub-divided into 10 different sheet types as follows: a) cover sheet; b) contents sheet; c) section cover sheet; d) schematics sheet; e) time series assumptions sheet; f) time series outputs sheet; g) blank assumptions sheet; h) blank outputs sheet; i) lookups sheet; and j) chart sheet. These categories are exhaustive, and should be the only sheet types required to develop any form of workbook.

BPMC 1-2 Sheet Purpose Identification
It is recommended that the purpose of every sheet in a workbook be identified using its fill color property as follows: a) light grey fill color for assumptions sheets; and b) white / no fill color for outputs sheets.

BPMC 1-3 Cell Content Identification
It is recommended that the content of every cell in a worksheet be identified using its font color property as follows: a) blue font color for constants; b) black font color for formula; and c) green font color for mixed (combination of constant and formula).

BPMC 1-4 Cell Purpose Identification
It is recommended that the purpose of every cell in a worksheet be identified using its fill color property as follows: a) white / no fill color for assumption cells on (grey fill color) assumptions sheets; and b) fill color the same as the fill color of the applicable worksheet for output cells.

BPMC 1-5 Mixed Cell Exceptions
It is recommended that the following constants be disregarded for the purposes of classifying a cell as having mixed content: a) '1'; b) '0'; c) 'TRUE'; and d) 'FALSE'.

2. Workbook Structure

BPMC 2-1 Workbook Section Structure
It is recommended that every workbook be structured consistently to at least include the following sections: a) cover and contents; b) model documentation and diagrams (where relevant); c) assumptions; d) outputs; e) presentations (where relevant); and f) appendices (where relevant).

3. Sheet Structure

BPMC 3-1 Sheet Content Consistency
It is recommended that every sheet of the same sheet type in a workbook consistently apply the following properties: a) sheet title style and position; b) heading styles and spacing; c) purpose-based formats and styles; d) hyperlink positions and styles; e) zoom / scaling percentage of the visible and printed sheets; f) visibility of gridlines; g) grouping levels; and h) window panes/splits.

BPMC 3-2 Hyperlinks in Worksheets
It is recommended that every worksheet, where relevant, contain the following hyperlinks: a) sheet left hyperlink (to move to the worksheet to the left); b) sheet right hyperlink (to move to the worksheet to the right); c) sheet top hyperlink (to move to the top of the worksheet); d) error check hyperlink (to move to the workbook error checks summary); e) sensitivity check hyperlink (to move to the workbook sensitivity checks summary); and f) alert check hyperlink (to move to the workbook alert checks summary). It is recommended that all of these hyperlinks be in view on the screen at all times.

BPMC 3-3 No Chart Sheets
To ensure hyperlink access to all the sheets within a workbook, it is recommended that charts be placed within worksheets rather than using chart sheets. This convention does not apply to spreadsheet applications which allow chart sheets to contain hyperlinks and to be specified as the target of hyperlinks.

BPMC 3-4 Workbook Cover Sheet Content
It is recommended that the cover sheet of a workbook contain the following information: a) the model name; b) the model developer's name and contact details (if appropriate); and c) workbook cover sheet notes.

BPMC 3-5 Workbook Cover Sheet Notes
It is recommended that the cover sheet of a workbook include provision for notes that are in view and in a consistent location. Cover sheet notes should include: a) a description of the contents of the underlying workbook; b) instructions for model users or developers; and/or c) warnings for model users or developers.

BPMC 3-6 Section Cover Sheet Content
It is recommended that every section cover sheet in a workbook contain the following information: a) a title for the following section; b) the section number for the following section; c) section cover sheet notes; and d) the model name. This information should be consistently formatted and positioned on all section cover sheets in the workbook.

BPMC 3-7 Section Cover Sheet Notes
It is recommended that section cover sheets within a workbook include provision for notes that are in view and in a consistent location. Section cover sheet notes should include: a) a description of the contents of the underlying section; b) instructions for model users or developers; and/or c) warnings for model users or developers.

BPMC 3-8 Limiting Worksheet Depth
It is recommended that the number of rows utilized on any worksheet be limited, where feasible, to what can be seen on the screen without vertical scrolling. It is recommended that the number of rows utilized on any one worksheet be limited to the minimum possible. To reduce the depth of a worksheet where there is an unavoidably large amount of information it is recommended that: a) rows are grouped and collapsed; or b) different types of information be moved to new worksheets (splitting the worksheet information).

BPMC 3-9 Freezing Panes
It is recommended that frozen panes be used on every worksheet in a workbook (excluding cover sheets) to ensure that the sheet title, any hyperlinks, check indicator flags or periodicity and time titles are always in view.

BPMC 3-10 Grouping Levels
It is recommended that rows and columns within the worksheets in a workbook be grouped consistently across all worksheets to create the following three views: a) summary view (compacted); b) print view (semi-compacted, if required); and c) expanded view (un-compacted).

BPMC 3-11 Heading Indentation
It is recommended that headings within a workbook are consistently indented using different columns that visually communicate the appropriate level of emphasis or importance that should be attached to each heading.

4. Formats & Styles

BPMC 4-1 Use of Purpose-Based Styles
It is recommended that standardized, purpose-based styles be applied in order to adopt the most efficient method of applying different combinations of formats and consistently identify and differentiate cell purpose and cell content.

BPMC 4-2 Cell Data Alignment
It is recommended that all data within cells or ranges of cells be aligned such that different number formats, including any relevant symbols are perfectly aligned to the right of the cell or cell range (different number formats might include positive numbers, negative numbers, currency, percentages and multiples).

BPMC 4-3 Work in Progress Identification
It is recommended that any cells in a workbook which have not been finalized be colored in light yellow fill color to visually identify these cells as being work in progress.

BPMC 4-4 Hyperlink Formats
It is recommended that all hyperlinks in a workbook be consistently formatted as follows: a) bold and underlined font; and b) plum font color.

5. Assumptions Entry Interfaces

BPMC 5-1 Preventing Invalid Assumption Entries
It is recommended that controls, data validation and sheet protection be used to limit the scope for model users to enter invalid assumptions into assumptions sheets.

BPMC 5-2 Assumptions Entry Interfaces
It is recommended that every assumption in a workbook that has a finite number of entry possibilities should use an assumptions entry interface that limits the model user to only those finite entry possibilities.

BPMC 5-3 Controlling Assumptions Entry Interfaces
It is recommended that combinations of the following tools be used to limit assumptions entry interfaces to finite possibilities: a) controls; b) data validation; c) error checking; d) conditional formatting; and e) sheet protection.

BPMC 5-4 No Heading, Title or Label Repetition
It is recommended that, where feasible, no heading, title or label that is inserted into a workbook be entered more than once. All identical headings, titles and labels that are contained in a workbook should be linked to the base heading, title or label that was entered.

BPMC 5-5 Control Cell Link Range Names
It is recommended that control cell link ranges be named to indicate the type of control to which the cell link relates.

BPMC 5-6 Use of Check Box Controls
It is recommended that a check box be used in a workbook when the assumption entry is binary (or boolean).

BPMC 5-7 Use of Button Controls
It is recommended that a button be used in a workbook only when a macro needs to be assigned to a control.

BPMC 5-8 Use of Drop Down Box or List Box Controls
It is recommended that a drop down box or list box be used in a workbook when there are a definite and limited number of possible assumption entries.

BPMC 5-9 Use of Spin Button or Scroll Bar Controls
It is recommended that a spin button or scroll bar be used in a workbook when an assumption entry is in the form of a numbered sequence that has upper and lower bounds.

BPMC 5-10 Data Validation
It is recommended that data validation be used to: a) inform model users about the assumption entries required; b) control the type of data being entered into assumption cells; and/or c) set the minimum and maximum bounds of the assumptions that are entered. Data validation should be used when the type of assumption entry is known, but the use of controls is not suitable.

BPMC 5-11 Conditional Formatting of Assumption Cells
It is recommended that conditional formatting be used to indicate to model users which assumption cells are inactive at any point in time – i.e. not relevant to outputs calculations.

BPMC 5-12 Visual Identification of Inactive Assumptions
It is recommended that an assumption cell that is currently irrelevant for outputs as a consequence of a prevailing assumption in another assumptions entry interface be visually identifiable as being an inactive assumption cell using grey fill color and white font color.

6. Sensitivity Analysis

BPMC 6-1 Sensitivity Assumptions Entry Interface Structure
It is recommended that, to the extent that it is practical, any sensitivity assumptions entry interface in a workbook be structured consistently with its corresponding base assumptions entry interface.

7. Outputs & Presentations

BPMC 7-1 Separate Outputs Workbooks
It is recommended that separate, dedicated outputs workbooks be created for medium to large workbooks or where the model developer does not want to divulge certain workbook content to certain model users.

The Conventions are universally applicable and are recommended to implement best practice spreadsheet modeling.
For detailed commentary and examples, go to www.bestpracticemodeling.com.
The full version of these Conventions can be downloaded from www.ssrb.org.

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BPMC 7-2 Outputs Section Structure
It is recommended that, where feasible, the outputs sections within a workbook be structured consistently with their corresponding assumptions sections.

BPMC 7-3 Outputs Worksheet Summaries
It is recommended that, where feasible, a summary of the primary outputs on each outputs worksheet be provided at the top of the outputs worksheet. It is recommended that an outputs worksheet is structured in the following order, going down or across the worksheet: a) outputs summary (primary outputs only); then b) outputs calculations (including details).

8. Calculation Formulas

BPMC 8-1 Avoid Complex Formulas
It is recommended, where feasible, that complex formulas not be used within a workbook.

BPMC 8-2 Complex Formula Schematics
It is recommended, where feasible, that complex formulas within a workbook be explained through the creation of formula schematics (diagrams representing formula logic) that are placed in a separate model schematics section of the workbook.

BPMC 8-3 Multiple Function Formulas
It is recommended that formulas within a workbook that contain more than one function be separated within the formula such that each new function is displayed on a separate line of the formula bar.

9. Naming Principles

BPMC 9-1 Workbook Name Display
It is recommended that every workbook has a name and that the name corresponds with the file name. It is recommended that every worksheet in the workbook displays the model name (in addition to the sheet title) and that the model name is consistently formatted and located.

BPMC 9-2 File Name Visibility
It is recommended that the file name for every workbook is contained within the header or footer of each sheet in the workbook.

BPMC 9-3 Sheet Type Naming Suffixes
It is recommended that the following suffixes be appended to sheet tab names to indicate the type of sheet that is being named: a) cover sheet – Cover; b) contents sheet – Contents; c) section cover sheet – SC; d) schematics sheet – MS; e) time series assumptions sheet – TA; f) time series outputs sheet – TO; g) blank assumptions sheet – BA; h) blank outputs sheet – BO; i) lookups sheet – LU; and j) chart sheet – CHT. These suffixes are exhaustive and, other than secondary sheet naming suffixes, should be the only sheet naming suffixes required when naming sheets.

BPMC 9-4 Secondary Sheet Naming Suffixes
In addition sheet type naming suffixes, it is recommended that the following suffixes be appended to any sheet tab names to indicate any of the following sub-classifications of the sheet: a) import – MI; b) export – ME; c) presentation – P. These secondary sheet naming suffixes should be appended prior to appending the applicable sheet type naming suffix.

BPMC 9-5 Sheet Naming Key
Where the sheet naming prefixes or suffixes are used in a workbook, it is recommended that a key or legend that explains the sheet naming prefixes or suffixes also be included in the workbook.

BPMC 9-6 Range Naming Prefixes
It is recommended that prefixes be used when naming ranges to indicate the type of range that is being named or the purpose of that range. See page 53 of the Standards – Commentary & Examples booklet. The list of range naming prefixes is exhaustive, and should be the only range naming prefixes required when naming cells, cell ranges or control cell links.

BPMC 9-7 Range Naming Key
Where range naming prefixes are used in a workbook, it is recommended that a key or legend that explains the range naming prefixes also be included in the workbook.

BPMC 9-8 Range Naming Conflicts
Where a worksheet range qualifies for more than one range naming prefix under BPMC 9-6, the prefix derived from the purpose of the range should be used when naming the range, not the prefix derived from its type.

10. Time Series Analysis

BPMC 10-1 Time Series Constants
It is recommended that every workbook that undertakes time series analysis contains time constants (e.g. months in year, days in week, weeks in year, etc.).

BPMC 10-2 No Mixing of Periodicities
It is recommended that where feasible, a time series sheet never contains assumptions or outputs for more than one periodicity.

BPMC 10-3 Multiple Periodicities in One Workbook
It is recommended that no section in a time series workbook contains more than one periodicity.

BPMC 10-4 Time Series Data Direction
It is recommended, that where feasible, periodicity labels be positioned across rows, not down columns.

11. Checks

BPMC 11-1 Linking Checks to Model Name Entry Cell
It is recommended, that where relevant, the outcome of the check type summary cell referred to in BPMC 11-4 be linked to the model name entry cell on the workbook cover sheet.

BPMC 11-2 Check Cell Conditional Formatting
It is recommended that every check cell in a workbook be consistently formatted such that, when triggered, they appear formatted as follows: a) bold font; and b) red font color.

BPMC 11-3 Check Calculation Location
It is recommended that the calculations for checks be located on the sheet to which the check is relevant and not on the associated check sheet.

BPMC 11-4 Check Type Summary Cell
It is recommended that the outcome of all checks of each check type be summarized into a single check cell for each check type contained within a workbook.

12. Printing & Viewing

BPMC 12-1 Workbook Print Scaling
It is recommended that, where feasible, the print scaling for every sheet in a workbook should be set to 100%, where possible, to ensure clarity and consistency when printing and viewing a printed copy of the workbook.

BPMC 12-2 Printed Information
It is recommended that every printed page include the following information: a) the date and time that the page was printed; b) the name of the workbook; c) the name of the sheet; and d) the page number.

13. Multiple Workbooks

BPMC 13-1 Workbook-Specific Import and Export Sheets
It is recommended that, where feasible, a separate import and export sheet be created for each external workbook that a workbook links from and to.

BPMC 13-2 Import and Export Sheet Consistency
It is recommended that the import sheet in one workbook be structured in exactly the same way as the corresponding export sheet in the relevant linked workbook.

BPMC 13-3 No Complex Formulas on Import Sheets
It is recommended that, where feasible, functions not be included within formulas that contain links to external workbooks.

BPMC 13-4 Import and Export Sections
It is recommended that import and export sheets be placed in separate, dedicated sections of a workbook.

BPMC 13-5 Linked Workbooks Diagrams
It is recommended that whenever there are more than two workbooks linked to each other in a workbook group, that a diagram be created within each workbook showing the links between the group of linked workbooks.

14. Security & Protection

BPMC 14-1 Workbook Protection
It is recommended that workbook protection be used whenever a model developer is required to: a) control access to a workbook; b) control access to designated sheets within a workbook; and/or c) prevent structural changes being made to a workbook.

BPMC 14-2 Protection of Non-Assumptions
Security and protection tools should be used to ensure that only the assumptions components of a workbook are capable of manipulation by model users.

BPMC 14-3 Sheet and Cell Protection
It is recommended that every cell in a workbook that is not an assumption cell be protected (locked) prior to distribution of the workbook to model users. For this cell protection to operate effectively, every sheet in the workbook must be protected.

BPMC 14-4 No Unnecessary Passwords
It is recommended that unless the model developer does not want model users to access certain areas of a workbook when protecting a worksheet or workbook, that no password be applied.

BPMC 14-5 Storing Passwords
It is recommended that when applying workbook or worksheet protection using passwords, that a password list be printed and stored in a safe location for future reference.

15. Visual Basic Programming

BPMC 15-1 Recording Macros
It is recommended that only extremely simple macros be created using the macro recorder. Macros created using the macro recorder should not be relied upon by model developers who are not familiar with the resulting source code. Macros should only be written by experienced VBE programmers.

16. Miscellaneous

BPMC 16-1 Model Developer Identification
It is recommended that the name of the model developer is entered into the workbook (normally on the cover sheet, if applicable).

BPMC 16-2 Emphasizing Information
It is recommended that you create and consistently apply various levels of headings in a workbook that visually communicate the appropriate level of emphasis or importance that should be attached to each cell or range of cells.

BPMC 16-3 Help Files and Instructions
It is recommended that every workbook be accompanied by instructions that explain the following for both model users and future model developers: a) what the primary outputs are; b) what the primary assumptions are; c) how to use the workbook or group of workbooks; and d) any other relevant notes or commentary.

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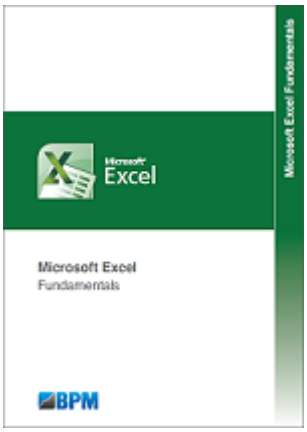

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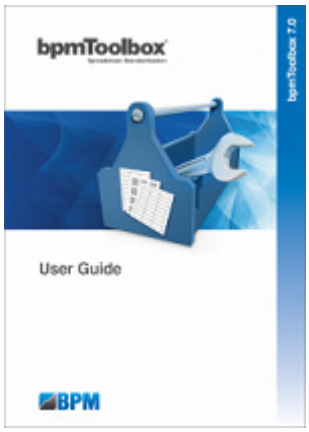

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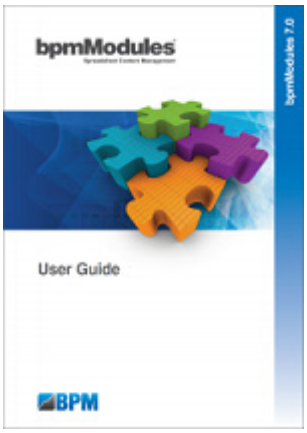
User Guide



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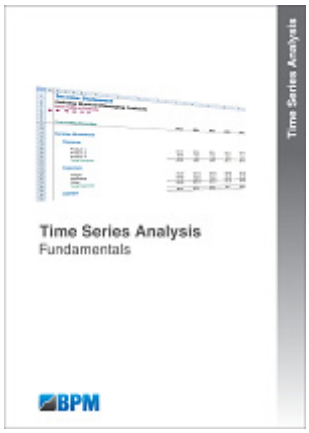
User Guide



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