

Overview:

This Excel spreadsheet has been developed as a companion tool for the JCRS guest editorial:

Abulafia A, Koch DD, Holladay JT, Wang L, Hill WE. Pursuing perfection in intraocular lens calculations IV. Rethinking astigmatism analysis for intraocular lens-based surgery: Suggested terminology, analysis, and standards for outcome reports. *Journal of Cataract and Refractive Surgery* 2017; 44(10): 1169-1174.

It will automatically generate the following 3 figures:

1. A cumulative histogram of the magnitudes of the preoperative corneal astigmatism and postoperative refractive astigmatism at the corneal plane.
2. Double-angle plots of preoperative and postoperative refractive astigmatism, centroid values and standard deviations, and 95% confidence ellipses of the dataset and of the centroid values.
3. Double-angle plots of postoperative refractive astigmatism prediction errors, centroid values and standard deviations, and 95% confidence ellipses of the dataset and of the centroid values. Also shown in this figure are the percentages of eyes with prediction errors less than or equal to 0.25 D, 0.50 D, 0.75D, and 1.00 D.

Note:

Please read these instructions in their entirety before entering any data into the Excel spreadsheet and performing astigmatism analysis for IOL-based surgery. There are certain formatting conditions that, if not followed, may create unanticipated errors. None of the fields should be left blank within the spreadsheet. If any fields are left blank, a proper analysis of the data will not be made.

System requirements:

This Excel spreadsheet has been tested with Office 365 (for PC) using Windows 10 Pro (version 1803) with a 64 bit operating system and a 3,000 x 2,000 resolution display. It was also tested with Office 365 (for Mac) using the Macintosh High Sierra operating system (version 10.13.6) and a 2,560 x 1,600 resolution display. For Mac users, the Excel copy icons are not functional.

Worksheets - Overview:

There are five worksheets within this Excel workbook. These worksheets, and the purpose of each, are the following:

1. **Data_Input** - This worksheet provides for the input of user data.
2. **A** – This worksheet will automatically generate a cumulative histogram of the magnitude of the preoperative corneal and postoperative refractive astigmatism at the corneal plane.
3. **B** - This worksheet will automatically generate double-angle plots of the preoperative corneal and the postoperative refractive astigmatism. Centroid values, a SD and 95% confidence ellipses of the centroid (red) and dataset (blue) are also calculated, A mean absolute error, standard deviation and the number of eyes that were included are also displayed.
4. **C** - This worksheet will automatically generate double-angle plots of postoperative refractive astigmatism prediction errors. Centroid values, standard deviations and 95% confidence ellipses of the centroid (red) and dataset (blue) are shown, Also, a mean absolute error and the number of eyes that were included are also displayed. In addition, the percentages of eyes with prediction errors less than or equal to 0.25 D, 0.50 D, 0.75D, and 1.00 D are displayed.
5. **Terminology table** – This worksheet contains a table with the terminology that was suggested within the JCRS guest editorial mentioned above and a comparison to relevant terminology by Alpins.

The Data_Input Worksheet

There are fourteen columns (Columns A – Q) where data is entered. They are arranged in the following manner:

Column Letter	Column Title	Description
A	No.	This cell generates a row number automatically.
B	Preoperative corneal astigmatism: Kflat	This cell records the pre-operative Flat K value in diopters. The allowable data range is from 30.0 D to 60.0 D.
C	Preoperative corneal astigmatism: @flat	This cell records the pre-operative Flat Meridian value. The allowable data range is from 000° to 180°.
D	Preoperative corneal astigmatism: Ksteep	This cell records the pre-operative Steep K value in diopters. The allowable data range is from 30.0 D to 60.0 D.
E	Preoperative corneal astigmatism: @steep	This cell generates the pre-operative Steep Meridian value. The allowable data range is from 000° to 180°.
G	Postoperative Refraction: Sphere	This cell records the post-operative refraction Sphere value. The allowable data range is from -30.0 D to +30.0 D.
H	Postoperative Refraction: Cylinder	This cell records the post-operative refraction Cylinder value. Both positive and negative cylinder values can be used. The allowable data range is from -30.0 D to +30.0 D.
I	Postoperative Refraction: Axis	This cell records the post-operative refraction cylinder axis value. The allowable data range is from 000° to 180°.
K	Predicted Postoperative Refraction: Sphere	This cell records the predicted post-operative refractive sphere value by a toric IOL calculator. The allowable data range is from -30.0 D to +30.0 D. In the case that this value is not provided by the toric IOL calculator, this cell should be left blank and the predicted post-operative spherical equivalent (SE, column N) should be entered instead.
L	Predicted Postoperative Refraction: Cylinder	This cell records the predicted post-operative refractive cylinder value by a toric IOL calculator. . Both positive and negative cylinder values can be used. The allowable data range is from -30.0 D to +30.0 D.
M	Predicted Postoperative Refraction: Axis	This cell records the predicted post-operative refractive Axis value by a toric IOL calculator. The allowable data range is from 000° to 180°.
N	Predicted Postoperative Refraction: SE	This cell records the predicted post-operative refractive spherical equivalent (SE) value, for the selected toric IOL that was chosen. This value should be entered if no value was entered in column K. The allowable data range is from -30.0 D to +30.0 D.
O	Predicted Postoperative Refraction: Calc_Sphere	This cell generates the calculate predicted post-operative refraction Sphere, based on the values from columns M and N.
Q	Integrity check	This cell generates an integrity check for each individual row. In the case of missing data and / or if the Steep K < Flat K, an “Error” output is displayed, otherwise an “OK” output is displayed.

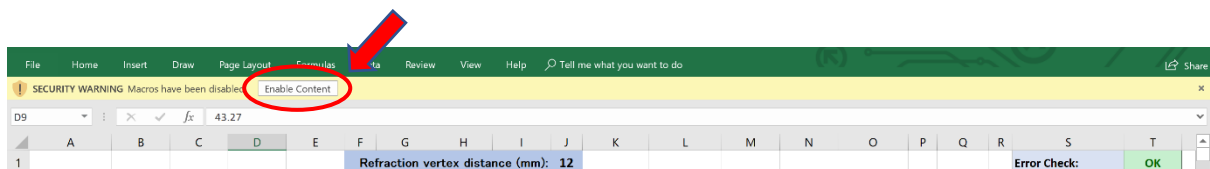
Spreadsheet Instructions

Additional input/output cells:

Cell J1	Refraction vertex distance	J1 cell records the vertex distance of the refraction in mm. The default value is set to 12.
Cell T1	Error Check	T1 cell generates an integrity check for the whole spreadsheet. In case that there is an "Error" output on one or more of any individual row's integrity check, an "Error" output will be displayed, otherwise an "OK" output is displayed.
Cell T2	Empty Rows	T2 cell generates an integrity check for the existence of any blank rows within the entered data that will lead to an incorrect display of the double angle plots diagrams. In case of a blank row an "Error" output is displayed, otherwise an "OK" output is displayed.
Cell T3	# of eyes "OK"	T3 cell generates the number of rows with an integrity check indicated as "OK".
Cell T4	# of eyes "Error"	T4 cell generates the number of rows with an integrity check indicated as "Error".
Cell T5	# of eyes Total	T5 cell generates the total number of cases that were entered by the user (T3+T4).

To utilize this spreadsheet please follow these steps:

- I. The Data_Input Worksheet is the only point of data entry for the user, the 'protected sheet' option is turned on, hence, only unprotected cells are available to the user.
- II. In case a security warning regarding macros appears, the user should click 'Enable Content'.



- III. Enter the desired refraction vertex distance in millimeters (cell J1).

Preoperative corneal astigmatism					Postoperative Refraction			Predicted Postoperative Refraction				
No.	Kflat	@flat	Ksteep	@steep	Sphere	Cylinder	Axis	Sphere	Cylinder	Axis	SE	Calc_Sphere
1	44.64	110	45.73	20	-0.25	-0.25	90	-0.21	-0.16	91		
2	42.83	90	43.66	180	0	-0.25	79	0.20	-0.71	1		

Spreadsheet Instructions

IV. Insert / Edit a Record:

- Enter patient data starting from column B ('Kflat' column) of row number 5.
Please notice, row number 5 contains data as an example, and the user should override this data. This row should not be deleted by the "clear content" option!
- For values that are outside of the allowed range, a warning box will appear.
- Spaces, or blank cells (except for column K or M) are not allowed. Confirm that all data has been properly entered. If a cell is left blank, or if Ksteep is a value less than Kflat, an error message will be displayed in column Q, and in cell T1.
Rows with missing data are not automatically removed from the analysis and this should be manually corrected by the user.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T		
1						Refraction vertex distance (mm): 12															Error Check:	Error
2																					Empty Rows:	OK
3		Preoperative corneal astigmatism					Postoperative Refraction			Predicted Postoperative Refraction						Integrity check	# of eyes "OK":	76				
4		No.	Kflat	@flat	Ksteep	@steep	Sphere	Cylinder	Axis	Sphere	Cylinder	Axis	SE	Calc_Sphere				# of eyes "Error":	2			
5	1	44.64	110	45.73	20	-0.25	-0.25	90	-0.21	-0.16	91						OK	# of eyes Total:	78			
6	2	42.83	90	43.66	180	0		79	0.20	-0.71	1						Error					
7	3	44.29	97	43	7	0.5	-1	93	0.11	-0.30	92						OK					
8	4	43.16	89	44.64	179	0	-1	127	-0.35	-0.23	92						OK					
9	5	42.19	89	43.27	179	-0.5	-0.5	90	-0.25	-0.02	3						OK					

- Blank rows within the data entry area are not allowed. If blank rows are present within the data entry area, an error message will be displayed in cell T2. Blank data rows within the dataset will lead to an incorrect display of the double angle plot and this should be manually corrected by the user.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T		
1						Refraction vertex distance (mm): 12															Error Check:	OK
2																					Empty Rows:	Error
3		Preoperative corneal astigmatism					Postoperative Refraction			Predicted Postoperative Refraction						Integrity check	# of eyes "OK":	77				
4		No.	Kflat	@flat	Ksteep	@steep	Sphere	Cylinder	Axis	Sphere	Cylinder	Axis	SE	Calc_Sphere				# of eyes "Error":	0			
5	1	44.64	110	45.73	20	-0.25	-0.25	90	-0.21	-0.16	91						OK					
6	2	42.83	90	43.66	180	0	-0.25	79	0.20	-0.71	1						OK					
7	3																					
8	4	43.16	89	44.64	179	0	-1	127	-0.35	-0.23	92						OK					
9	5	42.19	89	43.27	179	-0.5	-0.5	90	-0.25	-0.02	3						OK					

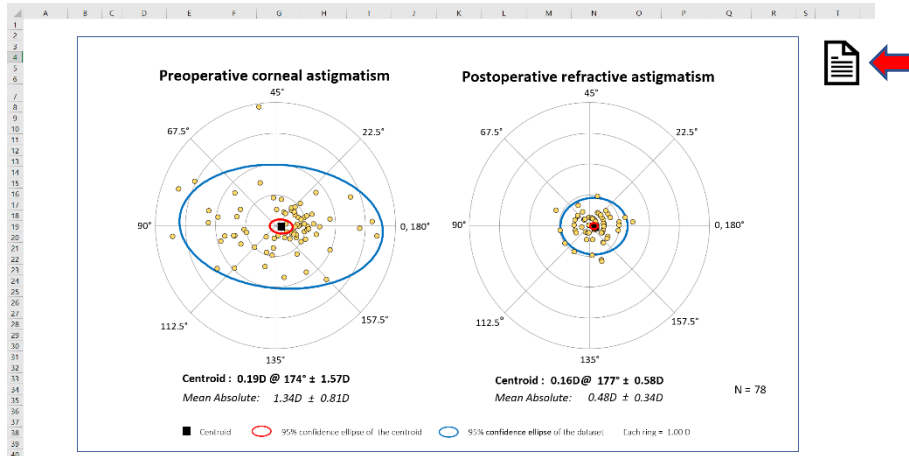
V. Delete Row(s) / Cell(s):

The Data_Input worksheet does not allow the user to delete rows or cells using the normal Excel Select and Delete functions. To delete entered data, the user must use the clear content option.

VI. Worksheets A to C contains graphs / tables as mentioned above.

These worksheets are not protected, and the user can change their style. Nevertheless, please be aware that this action is not recommended as it might unintentionally disrupt the proper presentation of the data.

To copy the graphs / tables from Worksheets A-C, the user can either use the copy icon next to it (this option will not work properly in Office for Mac), or simply select & copy it in a standard way.



For problems, or specific questions, users are welcome to contact:

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End of Excel spreadsheet instructions.