

Preprocessing of Dataset for Quality Analysis of Contact Lens Material in Ophthalmology Using PCA

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ABSTRACT

The Factor Analysis on the contact lens material and interpretation are the central steps in this paper. Using PCA (Principle Component Analysis) the essential contact lens material for quality analysis of contact lens are extracted. Analysis proves that PCA factor method aids in identifying the latent factors among the contact lens parameters in the analysis of identifying the quality contact lens material.

Keywords:- Contact Lens, PCA, Factor Analysis

I. INTRODUCTION

The Contact lens is commonly used correction medium for refractive errors. Contact lenses are of three types in general, such as RGP, Soft and Hybrid. These materials have different parameters identify their quality. The parameters are classified as physical property, material property and surface property. In this paper the parameters considered is contact lens material property. For identifying the essential parameters for identifying the quality contact lens material PCA (Principle Component analysis) is used.

PCA (Principle Component analysis) factor analysis is commonly known as a common factor model or theoretical model. Factor Analysis is a statistical procedure to study the interrelationship among the variables to obtain a new set of factors, than the original variables. It is a mathematical procedure to simplify the interrelated measure to discover the pattern in the set of variables [1]

A) REVIEW OF LITERATURE

Factor Analysis is required to check the absence of univariate and multivariate outliers [2]. PCA was used in Astrophysics to propose an algorithm for strong, galaxy scale component analysis. PCA acts as a traditional subtraction model for fitting data in astrophysics [3]. It is determined that the water content and diameter is reduced significantly when the temperature is raised to 20-35 degree. The lens quality remained unchanged with the lens made of HEMA/MAA [4]. RGP permeability of gas is done automatically because of its silicon and fluorine occurrence in the material [5].

B) DATA SET

The contact lens materials such as RGP, Soft and Hybrid are consider for factor analysis. The data set for factorization are taken from the contact lens manufactures such as Johnson & Johnson, Baush & Lomb, Cooper Vision.

Material properties of contact lens are taken for the research. Material properties are classified as lens property and optical properties. The lens properties are diameter, base curve radius, thickness and power. Optical properties are classified as water content, Dk value, refractive index, specific gravity and light transmittance.

II. PREPROCESSING

Preprocessing steps involve identifying the observed variable represents the original variables which are used to identify how much the observed variable correlates and interpreted with original variables.

Construction of Quality contact lens material the following dataset were opted from the manufactures catalogue. The lens materials of the three contact lens types are taken for factorization. The table 1.1 depicts the sample materials considered for factor analysis.

Lens Type	Material
RGP	Boston II Itafocan A Fluorex 700 Fluoroperm30paflufocon B Menicon Z Onsi 56 Onsifocon A

Soft	Hioxifilcon B LotrafilconA Galyfilcon A Senofilcon A Enfilcon A Nelfilcon A
Hybrid	PaflucoconD hemi-iberfilcon A Petrafocon A Hemi –iberfilcon A

Table 1.1 Sample Contact lens material

III. FACTOR ANALYSIS FOR QA CL MATERIAL

PCA factor analysis performed for the materials of RGP, Soft and Hybrid by collecting their parameter values.

1. Water Content
2. Dk
3. Diameter
4. Base Curve Radius
5. Thickness
6. Power
7. Refractive Index
8. Specific Gravity
9. Light Transmittance

PCA factorization was performed, for the contact lens materials with the samples of 46,313. Sample data set is as shown in table 1.2

Name	Paflucocon D hemi iberfilcon A
Water content	27
Dk	100
BCR	7.1
Thickness	0.12
Power	-3
Refractive Index	1.53
Specific Gravity	1.1
Light Transmittance	91

Like the table 1.2, the values for all parameters are executed using PCA in SPSS tool.

	Mean	Std. Deviation	Analysis N
Water Content	23.67	8.294	46313
Dk	52.63	42.973	46313
Diameter	8.636	2.1481	46313
Base curve Radius	7.329	1.0330	46313
Thickness	.9103	2.17947	46313
Refractive Index	1.4568	.01843	46313
Specific Gravity	1.134	.0388	46313
Light Transmittance	93.15	4.792	46313

Table 1.3 Descriptive Statistics of dataset

Table 1.3 shows the descriptive statistics of dataset which calculates the mean and standard deviation. Correlation was performed using PCA. Table 1.4 Shows the rotation of component matrix using PCA.

The Factors extracted after rotated matrix, noted that the variables numbered 1 and 2 have the loading -.866 and .840 on factor 1 which has the highest loading nearest to 1.000 shows refractive index and water content. This suggests that the factor 1 is the combination of two original variables. Factor 2 specifies that the specific gravity and diameter which are as -.735 and .725 of column 2 with high loadings which specifies the specific gravity and diameter respectively. Factor 3 was obtained from table 1.4 has the values as .766, .676 and .609 from column 3 of the rotated matrix which are Dk values, light transmittance and base curve radius respectively. Factor 4 was obtained with the values 0.922 from column 4 which determines the thickness of the contact lens.

	Components			
	1	2	3	4
Water Content	.827	.352	-.015	-.012
Diameter	.694	.004	.469	.030
Light Transmittance	-.655	.433	.303	.167
Refractive Index	-.563	-.547	.386	.155
Dk	-.138	.643	-.249	.563
Specific	-.320	.486	-.441	-.357

Gravity				
Base curve Radius	.027	.450	.627	.239
Thickness	.209	-.410	-.428	.683

Table 1.4 RotatedComponent Matric –PCA

According to the analysis it is found that 75% of the factors required for identifying the Quality of contact lens material using PCA.

After RotatedComponent Matrix it is essential to find the communalities obtained using PCA is as shown in table 1.5

	Initial	Extraction
Water Content	1.000	.808
Dk	1.000	.811
Diameter	1.000	.703
Base curve Radius	1.000	.654
Thickness	1.000	.861
Refractive Index	1.000	.789
Specific Gravity	1.000	.661
Light Transmittance	1.000	.737

Table 1.5 Communalities obtained after PCA

Using PCA factor analysis the communalities table shows about 75% of the parameters are essential for identifying the quality lens material of the contact lens.

IV. RESULTS

Finally after extracton process of components, it is found that 5 parameters are much essential than the remaining 4 parameters. The key parameters obtained are water content, Dk, diameter, Refractive index and the thickness. The remaining parameters like base curve radius, specific gravity, light transmittance and power are considered as dependent parameters.

V. CONCLUSION

The objective of this research is to identify a unified solution for identifying the quality contact lens material. The parameters which are found are considered as the key parameters for identifying the quality of the contact lens materials.

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