**Result**

**Summary of mydata\_Hair**

**ID ProdQual Ecom TechSup CompRes Advertising**

Min.: 1.00 Min.:5.000 Min.:2.200 Min.:1.300 Min.:2.600 Min.:1.900

1st Qu.:25.75 1st Qu.: 6.575 1st Qu.:3.275 1st Qu.:4.250 1st Qu.:4.600 1st Qu.:3.175

Median : 50.50 Median : 8.000 Median :3.600 Median :5.400 Median :5.450 Median :4.000

Mean : 50.50 Mean : 7.810 Mean :3.672 Mean :5.365 Mean :5.442 Mean :4.010

3rd Qu.: 75.25 3rd Qu.: 9.100 3rd Qu.:3.925 3rd Qu.:6.625 3rd Qu.:6.325 3rd Qu.:4.800

Max. :100.00 Max. :10.000 Max. :5.700 Max. :8.500 Max. :7.800 Max. :6.500

**ProdLine SalesFImage ComPricing WartyClaim OrdBilling DelSpeed**

Min. :2.300 Min. :2.900 Min. :3.700 Min. :4.100 Min. :2.000 Min. :1.600

1st Qu.:4.700 1st Qu.:4.500 1st Qu.:5.875 1st Qu.:5.400 1st Qu.:3.700 1st Qu.:3.400

Median :5.750 Median :4.900 Median :7.100 Median :6.100 Median :4.400 Median :3.900

Mean :5.805 Mean :5.123 Mean :6.974 Mean :6.043 Mean :4.278 Mean :3.886

3rd Qu.:6.800 3rd Qu.:5.800 3rd Qu.:8.400 3rd Qu.:6.600 3rd Qu.:4.800 3rd Qu.:4.425

Max. :8.400 Max. :8.200 Max. :9.900 Max. :8.100 Max. :6.700 Max. :5.500

**Satisfaction**

Min. :4.700

1st Qu.:6.000

Median :7.050

Mean :6.918

3rd Qu.:7.625

Max. :9.900

**Simple Linear Regression of target variable (Satisfaction) with each variable**

Call:

lm(formula = Satisfaction ~ ProdQual)

Residuals:

Min 1Q Median 3Q Max

-1.88746 -0.72711 -0.01577 0.85641 2.25220

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 3.67593 0.59765 6.151 1.68e-08 \*\*\*

ProdQual 0.41512 0.07534 5.510 2.90e-07 \*\*\*

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.047 on 98 degrees of freedom

Multiple R-squared: 0.2365, Adjusted R-squared: 0.2287

F-statistic: 30.36 on 1 and 98 DF, p-value: 2.901e-07

Call:

lm(formula = Satisfaction ~ Ecom)

Residuals:

Min 1Q Median 3Q Max

-2.37200 -0.78971 0.04959 0.68085 2.34580

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 5.1516 0.6161 8.361 4.28e-13 \*\*\*

Ecom 0.4811 0.1649 2.918 0.00437 \*\*

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.149 on 98 degrees of freedom

Multiple R-squared: 0.07994, Adjusted R-squared: 0.07056

F-statistic: 8.515 on 1 and 98 DF, p-value: 0.004368

Call:

lm(formula = Satisfaction ~ TechSup)

Residuals:

Min 1Q Median 3Q Max

-2.26136 -0.93297 0.04302 0.82501 2.85617

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 6.44757 0.43592 14.791 <2e-16 \*\*\*

TechSup 0.08768 0.07817 1.122 0.265

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.19 on 98 degrees of freedom

Multiple R-squared: 0.01268, Adjusted R-squared: 0.002603

F-statistic: 1.258 on 1 and 98 DF, p-value: 0.2647

Call:

lm(formula = Satisfaction ~ CompRes)

Residuals:

Min 1Q Median 3Q Max

-2.40450 -0.66164 0.04499 0.63037 2.70949

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 3.68005 0.44285 8.310 5.51e-13 \*\*\*

CompRes 0.59499 0.07946 7.488 3.09e-11 \*\*\*

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.9554 on 98 degrees of freedom

Multiple R-squared: 0.3639, Adjusted R-squared: 0.3574

F-statistic: 56.07 on 1 and 98 DF, p-value: 3.085e-11

Call:

lm(formula = Satisfaction ~ Advertising)

Residuals:

Min 1Q Median 3Q Max

-2.34033 -0.92755 0.05577 0.79773 2.53412

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 5.6259 0.4237 13.279 < 2e-16 \*\*\*

Advertising 0.3222 0.1018 3.167 0.00206 \*\*

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.141 on 98 degrees of freedom

Multiple R-squared: 0.09282, Adjusted R-squared: 0.08357

F-statistic: 10.03 on 1 and 98 DF, p-value: 0.002056

Call:

lm(formula = Satisfaction ~ ProdLine)

Residuals:

Min 1Q Median 3Q Max

-2.3634 -0.7795 0.1097 0.7604 1.7373

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 4.02203 0.45471 8.845 3.87e-14 \*\*\*

ProdLine 0.49887 0.07641 6.529 2.95e-09 \*\*\*

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1 on 98 degrees of freedom

Multiple R-squared: 0.3031, Adjusted R-squared: 0.296

F-statistic: 42.62 on 1 and 98 DF, p-value: 2.953e-09

Call:

lm(formula = Satisfaction ~ SalesFImage)

Residuals:

Min 1Q Median 3Q Max

-2.2164 -0.5884 0.1838 0.6922 2.0728

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 4.06983 0.50874 8.000 2.54e-12 \*\*\*

SalesFImage 0.55596 0.09722 5.719 1.16e-07 \*\*\*

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.037 on 98 degrees of freedom

Multiple R-squared: 0.2502, Adjusted R-squared: 0.2426

F-statistic: 32.7 on 1 and 98 DF, p-value: 1.164e-07

Call:

lm(formula = Satisfaction ~ ComPricing)

Residuals:

Min 1Q Median 3Q Max

-1.9728 -0.9915 -0.1156 0.9111 2.5845

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 8.03856 0.54427 14.769 <2e-16 \*\*\*

ComPricing -0.16068 0.07621 -2.108 0.0376 \*

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.172 on 98 degrees of freedom

Multiple R-squared: 0.04339, Adjusted R-squared: 0.03363

F-statistic: 4.445 on 1 and 98 DF, p-value: 0.03756

Call:

lm(formula = Satisfaction ~ WartyClaim)

Residuals:

Min 1Q Median 3Q Max

-2.36504 -0.90202 0.03019 0.90763 2.88985

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 5.3581 0.8813 6.079 2.32e-08 \*\*\*

WartyClaim 0.2581 0.1445 1.786 0.0772 .

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.179 on 98 degrees of freedom

Multiple R-squared: 0.03152, Adjusted R-squared: 0.02164

F-statistic: 3.19 on 1 and 98 DF, p-value: 0.0772

Call:

lm(formula = Satisfaction ~ OrdBilling)

Residuals:

Min 1Q Median 3Q Max

-2.4005 -0.7071 -0.0344 0.7340 2.9673

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 4.0541 0.4840 8.377 3.96e-13 \*\*\*

OrdBilling 0.6695 0.1106 6.054 2.60e-08 \*\*\*

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.022 on 98 degrees of freedom

Multiple R-squared: 0.2722, Adjusted R-squared: 0.2648

F-statistic: 36.65 on 1 and 98 DF, p-value: 2.602e-08

Call:

lm(formula = Satisfaction ~ DelSpeed)

Residuals:

Min 1Q Median 3Q Max

-2.22475 -0.54846 0.08796 0.54462 2.59432

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 3.2791 0.5294 6.194 1.38e-08 \*\*\*

DelSpeed 0.9364 0.1339 6.994 3.30e-10 \*\*\*

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.9783 on 98 degrees of freedom

Multiple R-squared: 0.333, Adjusted R-squared: 0.3262

F-statistic: 48.92 on 1 and 98 DF, p-value: 3.3e-10

**PCA or Factor Analysis without considering target variable**

Correlation Data

**ProdQual Ecom TechSup CompRes Advertising ProdLine SalesFImage**

ProdQual 1.00000000 -0.1371632174 0.0956004542 0.1063700 -0.05347313 0.47749341 -0.15181287

Ecom -0.13716322 1.0000000000 0.0008667887 0.1401793 0.42989071 -0.05268784 0.79154371

TechSup 0.09560045 0.0008667887 1.0000000000 0.0966566 -0.06287007 0.19262546 0.01699054

CompRes 0.10637000 0.1401792611 0.0966565978 1.0000000 0.19691685 0.56141695 0.22975176

Advertising -0.05347313 0.4298907110 -0.0628700668 0.1969168 1.00000000 -0.01155082 0.54220366

ProdLine 0.47749341 -0.0526878383 0.1926254565 0.5614170 -0.01155082 1.00000000 -0.06131553

SalesFImage -0.15181287 0.7915437115 0.0169905395 0.2297518 0.54220366 -0.06131553 1.00000000

ComPricing -0.40128188 0.2294624014 -0.2707866821 -0.1279543 0.13421689 -0.49494840 0.26459655

WartyClaim 0.08831231 0.0518981915 0.7971679258 0.1404083 0.01079207 0.27307753 0.10745534

OrdBilling 0.10430307 0.1561473316 0.0801018246 0.7568686 0.18423559 0.42440825 0.19512741

DelSpeed 0.02771800 0.1916360683 0.0254406935 0.8650917 0.27586308 0.60185021 0.27155126

Satisfaction 0.48632500 0.2827450147 0.1125971788 0.6032626 0.30466947 0.55054594 0.50020531

**ComPricing WartyClaim OrdBilling DelSpeed Satisfaction**

ProdQual -0.40128188 0.08831231 0.10430307 0.02771800 0.4863250

Ecom 0.22946240 0.05189819 0.15614733 0.19163607 0.2827450

TechSup -0.27078668 0.79716793 0.08010182 0.02544069 0.1125972

CompRes -0.12795425 0.14040830 0.75686859 0.86509170 0.6032626

Advertising 0.13421689 0.01079207 0.18423559 0.27586308 0.3046695

ProdLine -0.49494840 0.27307753 0.42440825 0.60185021 0.5505459

SalesFImage 0.26459655 0.10745534 0.19512741 0.27155126 0.5002053

ComPricing 1.00000000 -0.24498605 -0.11456703 -0.07287173 -0.2082957

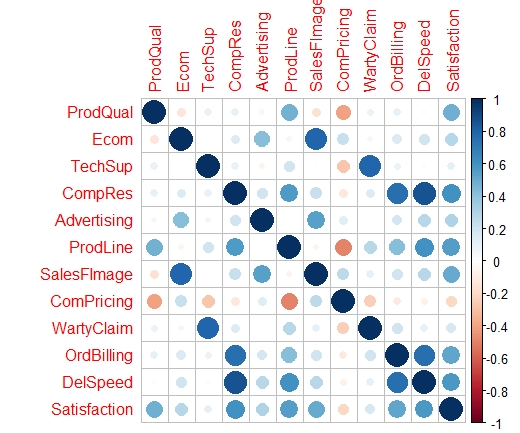
WartyClaim -0.24498605 1.00000000 0.19706512 0.10939460 0.1775448

OrdBilling -0.11456703 0.19706512 1.00000000 0.75100307 0.5217319

DelSpeed -0.07287173 0.10939460 0.75100307 1.00000000 0.5770423

Satisfaction -0.20829569 0.17754482 0.52173191 0.57704227 1.0000000

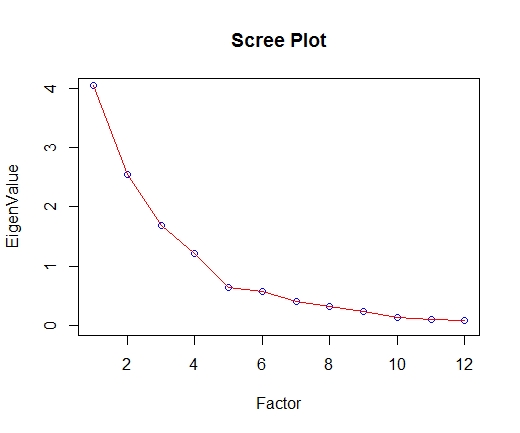
**Correlation Plot**



**Eigen Values**

**4.04285997 2.55292440 1.69222417 1.21754639** 0.63596293 0.56853132 0.40282774 0.32448016 0.23613948 0.14422355 0.09913845 0.08314143

**Scree Plot**

****

**Unrotated Principal Component Factors**

Call: principal(r = mydata, nfactors = 4, rotate = "none")

Standardized loadings (pattern matrix) based upon correlation matrix

PC1 PC2 PC3 PC4 h2 u2 com

ProdQual 0.3188 -0.5003 -0.0957 0.6776 0.8202 0.17978 2.370

Ecom 0.3341 0.7040 0.3077 0.2166 0.7488 0.25119 2.083

TechSup 0.2516 -0.3807 0.8017 -0.1980 0.8902 0.10976 1.802

CompRes 0.8498 0.0021 -0.2558 -0.3086 0.8828 0.11717 1.457

Advertising 0.3635 0.5708 0.1169 0.2273 0.5232 0.47675 2.165

ProdLine 0.7094 -0.4758 -0.1447 0.1104 0.7628 0.23717 1.907

SalesFImage 0.4382 0.7428 0.3134 0.2201 0.8905 0.10952 2.244

ComPricing -0.2711 0.6675 -0.0672 -0.2657 0.5942 0.40583 1.690

WartyClaim 0.3519 -0.3214 0.7876 -0.2092 0.8912 0.10876 1.924

OrdBilling 0.7801 0.0145 -0.2017 -0.3384 0.7640 0.23603 1.515

DelSpeed 0.8492 0.0870 -0.2836 -0.3199 0.9114 0.08856 1.547

Satisfaction 0.8305 0.0382 -0.0374 0.3654 0.8261 0.17393 1.383

PC1 PC2 PC3 PC4

SS loadings 4.0429 2.5529 1.6922 1.2175

Proportion Var 0.3369 0.2127 0.1410 0.1015

Cumulative Var 0.3369 0.5496 0.6907 0.7921

Proportion Explained 0.4253 0.2686 0.1780 0.1281

Cumulative Proportion 0.4253 0.6939 0.8719 1.0000

Mean item complexity = 1.8

Test of the hypothesis that 4 components are sufficient.

The root mean square of the residuals (RMSR) is 0.0551

with the empirical chi square 40.1477 with prob < 0.02062

Fit based upon off diagonal values = 0.9754

**Rotated Principal Component Factors**

Call: principal(r = mydata, nfactors = 4, rotate = "varimax")

Standardized loadings (pattern matrix) based upon correlation matrix

RC1 RC2 RC4 RC3 h2 u2 com

ProdQual -0.0065 -0.0259 0.9048 -0.0287 0.8202 0.17978 1.004

Ecom 0.0506 0.8547 -0.1155 0.0488 0.7488 0.25119 1.050

TechSup 0.0182 -0.0186 0.0955 0.9383 0.8902 0.10976 1.022

CompRes 0.9246 0.1205 0.1058 0.0472 0.8828 0.11717 1.066

Advertising 0.1399 0.7062 -0.0107 -0.0699 0.5232 0.47675 1.099

ProdLine 0.5882 -0.0991 0.6176 0.1602 0.7628 0.23717 2.188

SalesFImage 0.1311 0.9275 -0.0952 0.0630 0.8905 0.10952 1.071

ComPricing -0.0883 0.2841 -0.6576 -0.2707 0.5942 0.40583 1.775

WartyClaim 0.1089 0.0563 0.0937 0.9314 0.8912 0.10876 1.055

OrdBilling 0.8620 0.1091 0.0467 0.0831 0.7640 0.23603 1.057

DelSpeed 0.9375 0.1723 0.0532 -0.0026 0.9114 0.08856 1.074

Satisfaction 0.5223 0.4788 0.5678 0.0397 0.8261 0.17393 2.955

RC1 RC2 RC4 RC3

SS loadings 3.1549 2.4695 2.0115 1.8696

Proportion Var 0.2629 0.2058 0.1676 0.1558

Cumulative Var 0.2629 0.4687 0.6363 0.7921

Proportion Explained 0.3319 0.2598 0.2116 0.1967

Cumulative Proportion 0.3319 0.5917 0.8033 1.0000

Mean item complexity = 1.4

Test of the hypothesis that 4 components are sufficient.

The root mean square of the residuals (RMSR) is 0.0551

with the empirical chi square 40.1477 with prob < 0.02062

Fit based upon off diagonal values = 0.9754

**Muliple Linear Regression**

**Initial regression model**

**Summary**

lm(formula = Satisfaction ~ ., data = mydata)

Residuals:

Min 1Q Median 3Q Max

-1.43005 -0.31165 0.07621 0.37190 0.90120

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) -0.66961 0.81233 -0.824 0.41199

ProdQual 0.37137 0.05177 7.173 2.18e-10 \*\*\*

Ecom -0.44056 0.13396 -3.289 0.00145 \*\*

TechSup 0.03299 0.06372 0.518 0.60591

CompRes 0.16703 0.10173 1.642 0.10416

Advertising -0.02602 0.06161 -0.422 0.67382

ProdLine 0.14034 0.08025 1.749 0.08384 .

SalesFImage 0.80611 0.09775 8.247 1.45e-12 \*\*\*

ComPricing -0.03853 0.04677 -0.824 0.41235

WartyClaim -0.10298 0.12330 -0.835 0.40587

OrdBilling 0.14635 0.10367 1.412 0.16160

DelSpeed 0.16570 0.19644 0.844 0.40124

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.5623 on 88 degrees of freedom

Multiple R-squared: 0.8021, Adjusted R-squared: 0.7774

F-statistic: 32.43 on 11 and 88 DF, p-value: < 2.2e-16

**Variation Inflation Factor of initial regression model**

ProdQual Ecom TechSup CompRes Advertising ProdLine SalesFImage ComPricing

1.635797 2.756694 2.976796 4.730448 1.508933 3.488185 3.439420 1.635000

WartyClaim OrdBilling DelSpeed

3.198337 2.902999 6.516014

**Factor analysis using principal axis factoring 4 factors**

**Correlation value after removing target variable (Satisfaction) from the sample data**

ProdQual Ecom TechSup CompRes Advertising ProdLine SalesFImage

ProdQual 1.00000000 -0.1371632174 0.0956004542 0.1063700 -0.05347313 0.47749341 -0.15181287

Ecom -0.13716322 1.0000000000 0.0008667887 0.1401793 0.42989071 -0.05268784 0.79154371

TechSup 0.09560045 0.0008667887 1.0000000000 0.0966566 -0.06287007 0.19262546 0.01699054

CompRes 0.10637000 0.1401792611 0.0966565978 1.0000000 0.19691685 0.56141695 0.22975176

Advertising -0.05347313 0.4298907110 -0.0628700668 0.1969168 1.00000000 -0.01155082 0.54220366

ProdLine 0.47749341 -0.0526878383 0.1926254565 0.5614170 -0.01155082 1.00000000 -0.06131553

SalesFImage -0.15181287 0.7915437115 0.0169905395 0.2297518 0.54220366 -0.06131553 1.00000000

ComPricing -0.40128188 0.2294624014 -0.2707866821 -0.1279543 0.13421689 -0.49494840 0.26459655

WartyClaim 0.08831231 0.0518981915 0.7971679258 0.1404083 0.01079207 0.27307753 0.10745534

OrdBilling 0.10430307 0.1561473316 0.0801018246 0.7568686 0.18423559 0.42440825 0.19512741

DelSpeed 0.02771800 0.1916360683 0.0254406935 0.8650917 0.27586308 0.60185021 0.27155126

ComPricing WartyClaim OrdBilling DelSpeed

ProdQual -0.40128188 0.08831231 0.10430307 0.02771800

Ecom 0.22946240 0.05189819 0.15614733 0.19163607

TechSup -0.27078668 0.79716793 0.08010182 0.02544069

CompRes -0.12795425 0.14040830 0.75686859 0.86509170

Advertising 0.13421689 0.01079207 0.18423559 0.27586308

ProdLine -0.49494840 0.27307753 0.42440825 0.60185021

SalesFImage 0.26459655 0.10745534 0.19512741 0.27155126

ComPricing 1.00000000 -0.24498605 -0.11456703 -0.07287173

WartyClaim -0.24498605 1.00000000 0.19706512 0.10939460

OrdBilling -0.11456703 0.19706512 1.00000000 0.75100307

DelSpeed -0.07287173 0.10939460 0.75100307 1.00000000

**Eigen values of sample data without considering target variable**

**4.04285997 2.55292440 1.69222417 1.21754639** 0.63596293 0.56853132 0.40282774 0.32448016 0.23613948 0.14422355 0.09913845 0.08314143

**Factor analysis using principal axis factoring 4 factors**

Factor Analysis using method = pa

Call: fa(r = mydata1, nfactors = 4, rotate = "none", fm = "pa")

Standardized loadings (pattern matrix) based upon correlation matrix

PA1 PA2 PA3 PA4 h2 u2 com

ProdQual 0.20 -0.41 -0.06 0.46 0.42 0.576 2.4

Ecom 0.29 0.66 0.27 0.22 0.64 0.362 2.0

TechSup 0.28 -0.38 0.74 -0.17 0.79 0.205 1.9

CompRes 0.86 0.01 -0.26 -0.18 0.84 0.157 1.3

Advertising 0.29 0.46 0.08 0.13 0.31 0.686 1.9

ProdLine 0.69 -0.45 -0.14 0.31 0.80 0.200 2.3

SalesFImage 0.39 0.80 0.35 0.25 0.98 0.021 2.1

ComPricing -0.23 0.55 -0.04 -0.29 0.44 0.557 1.9

WartyClaim 0.38 -0.32 0.74 -0.15 0.81 0.186 2.0

OrdBilling 0.75 0.02 -0.18 -0.18 0.62 0.378 1.2

DelSpeed 0.90 0.10 -0.30 -0.20 0.94 0.058 1.4

PA1 PA2 PA3 PA4

SS loadings 3.21 2.22 1.50 0.68

Proportion Var 0.29 0.20 0.14 0.06

Cumulative Var 0.29 0.49 0.63 0.69

Proportion Explained 0.42 0.29 0.20 0.09

Cumulative Proportion 0.42 0.71 0.91 1.00

Mean item complexity = 1.9

Test of the hypothesis that 4 factors are sufficient.

The degrees of freedom for the null model are 55 and the objective function was 6.55 with Chi Square of 619.27

The degrees of freedom for the model are 17 and the objective function was 0.33

The root mean square of the residuals (RMSR) is 0.02

The df corrected root mean square of the residuals is 0.03

The harmonic number of observations is 100 with the empirical chi square 3.19 with prob < 1

The total number of observations was 100 with Likelihood Chi Square = 30.27 with prob < 0.024

Tucker Lewis Index of factoring reliability = 0.921

RMSEA index = 0.096 and the 90 % confidence intervals are 0.032 0.139

BIC = -48.01

Fit based upon off diagonal values = 1

Measures of factor score adequacy

PA1 PA2 PA3 PA4

Correlation of (regression) scores with factors 0.98 0.97 0.95 0.88

Multiple R square of scores with factors 0.96 0.95 0.91 0.78

Minimum correlation of possible factor scores 0.92 0.90 0.82 0.56

Call: fa(r = mydata1, nfactors = 4, rotate = "varimax", fm = "pa")

Standardized loadings (pattern matrix) based upon correlation matrix

PA1 PA2 PA3 PA4 h2 u2 com

ProdQual 0.02 -0.07 0.02 0.65 0.42 0.576 1.0

Ecom 0.07 0.79 0.03 -0.11 0.64 0.362 1.1

TechSup 0.02 -0.03 0.88 0.12 0.79 0.205 1.0

CompRes 0.90 0.13 0.05 0.13 0.84 0.157 1.1

Advertising 0.17 0.53 -0.04 -0.06 0.31 0.686 1.2

ProdLine 0.53 -0.04 0.13 0.71 0.80 0.200 1.9

SalesFImage 0.12 0.97 0.06 -0.13 0.98 0.021 1.1

ComPricing -0.08 0.21 -0.21 -0.59 0.44 0.557 1.6

WartyClaim 0.10 0.06 0.89 0.13 0.81 0.186 1.1

OrdBilling 0.77 0.13 0.09 0.09 0.62 0.378 1.1

DelSpeed 0.95 0.19 0.00 0.09 0.94 0.058 1.1

PA1 PA2 PA3 PA4

SS loadings 2.63 1.97 1.64 1.37

Proportion Var 0.24 0.18 0.15 0.12

Cumulative Var 0.24 0.42 0.57 0.69

Proportion Explained 0.35 0.26 0.22 0.18

Cumulative Proportion 0.35 0.60 0.82 1.00

Mean item complexity = 1.2

Test of the hypothesis that 4 factors are sufficient.

The degrees of freedom for the null model are 55 and the objective function was 6.55 with Chi Square of 619.27

The degrees of freedom for the model are 17 and the objective function was 0.33

The root mean square of the residuals (RMSR) is 0.02

The df corrected root mean square of the residuals is 0.03

The harmonic number of observations is 100 with the empirical chi square 3.19 with prob < 1

The total number of observations was 100 with Likelihood Chi Square = 30.27 with prob < 0.024

Tucker Lewis Index of factoring reliability = 0.921

RMSEA index = 0.096 and the 90 % confidence intervals are 0.032 0.139

BIC = -48.01

Fit based upon off diagonal values = 1

Measures of factor score adequacy

PA1 PA2 PA3 PA4

Correlation of (regression) scores with factors 0.98 0.99 0.94 0.88

Multiple R square of scores with factors 0.96 0.97 0.88 0.78

Minimum correlation of possible factor scores 0.93 0.94 0.77 0.55

**Binding target variable (Satisfaction) and factors**

**Head Values**

Satisfaction Rating Price OtherCompanyPrice CustomerSupport

1 8.2 -0.1338871 0.9175166 -1.719604873 0.09135411

2 5.7 1.6297604 -2.0090053 -0.596361722 0.65808192

3 8.9 0.3637658 0.8361736 0.002979966 1.37548765

4 4.8 -1.2225230 -0.5491336 1.245473305 -0.64421384

5 7.1 -0.4854209 -0.4276223 -0.026980304 0.47360747

6 4.7 -0.5950924 -1.3035333 -1.183019401 -0.95913571

**Building regression model on train data (70%)**

lm(formula = Satisfaction ~ ., data = train)

Residuals:

Min 1Q Median 3Q Max

-1.6857 -0.4018 0.1051 0.4027 1.2036

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 6.92625 0.08263 83.827 < 2e-16 \*\*\*

Rating 0.62022 0.08408 7.377 3.73e-10 \*\*\*

Price 0.57735 0.08047 7.175 8.50e-10 \*\*\*

OtherCompanyPrice 0.09567 0.08667 1.104 0.274

CustomerSupport 0.66562 0.09374 7.101 1.15e-09 \*\*\*

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.6814 on 65 degrees of freedom

Multiple R-squared: 0.7079, Adjusted R-squared: 0.69

F-statistic: 39.39 on 4 and 65 DF, p-value: < 2.2e-16

**Testing the trained regression model**

Satisfaction Rating Price OtherCompanyPrice CustomerSupport Satisfaction.predict

1 8.2 -0.13388710 0.9175166 -1.719604873 0.09135411 7.269232

2 5.7 1.62976040 -2.0090053 -0.596361722 0.65808192 7.158146

3 8.9 0.36376581 0.8361736 0.002979966 1.37548765 8.550469

4 4.8 -1.22252302 -0.5491336 1.245473305 -0.64421384 5.541333

5 7.1 -0.48542093 -0.4276223 -0.026980304 0.47360747 6.690958

7 5.7 -2.52885363 0.3883688 -0.603275803 -1.29659025 4.661277

14 7.6 0.18944710 -0.1200159 0.341391428 1.43748733 7.963941

21 5.4 -0.49662748 -0.4051355 1.413398115 -1.42620085 5.570249

23 7.0 -0.08593028 -0.2064799 0.954813784 1.29099542 7.704405

27 6.3 0.69040218 -1.2767621 0.980470048 0.97700863 7.361437

**Source Code**

**### Install Packages and Loading Library**

library(readr)

**### Setting working directory**

setwd("D:/great learning/advanced statistics/Project-2")

mydata\_Hair = read.csv("Factor-Hair-Revised.csv", header=TRUE)

attach(mydata\_Hair)

mydata\_Hair

**### Exploratory Data Analysis**

summary(mydata\_Hair)

str(mydata\_Hair)

boxplot(ProdQual, horizontal = TRUE, col = "Red", main="boxplot for Product Quality")

boxplot(Ecom, horizontal = TRUE, col = "Blue", main="boxplot for E-commerce")

boxplot(TechSup, horizontal = TRUE, col = "Green", main="boxplot for Technical Support")

boxplot(CompRes, horizontal = TRUE, col = "Yellow", main="boxplot for Complaint Resolution")

boxplot(Advertising, horizontal = TRUE, col = "Orange", main="boxplot for Advertising")

boxplot(ProdLine, horizontal = TRUE, col = "Pink", main="boxplot for Product Line")

boxplot(SalesFImage, horizontal = TRUE, col = "Grey", main="boxplot for sales")

boxplot(ComPricing, horizontal = TRUE, col = "Purple", main="boxplot for Competitive Pricing")

boxplot(WartyClaim, horizontal = TRUE, col = "Magenta", main="boxplot for Warranty")

boxplot(OrdBilling, horizontal = TRUE, col = "violet", main="boxplot for Order Billing")

boxplot(DelSpeed, horizontal = TRUE, col = "Brown", main="boxplot for Delivery Speed")

boxplot(Satisfaction, horizontal = TRUE, col = "Ivory", main="boxplot for Customer satisfaction")

plot(ProdQual,Satisfaction, col= "Red", abline(lm(Satisfaction~ProdQual)), main = "Scatter plot between Product Quality versus Satisfaction")

plot(Advertising,Satisfaction, col= "Blue", abline(lm(Satisfaction~ProdQual)), main = "Scatter plot between Advertising versus Satisfaction")

interaction.plot(ProdQual, Advertising, Satisfaction, col = c("Red","Blue"), main = "Interaction between Product Quality and Advertising")

**### Simple Linear Regression Model and multicollinearity**

Model1 = lm(Satisfaction~ProdQual)

summary(Model1)

Model2 = lm(Satisfaction~Ecom)

summary(Model2)

Model3 = lm(Satisfaction~TechSup)

summary(Model3)

Model4 = lm(Satisfaction~CompRes)

summary(Model4)

Model5 = lm(Satisfaction~Advertising)

summary(Model5)

Model6 = lm(Satisfaction~ProdLine)

summary(Model6)

Model7 = lm(Satisfaction~SalesFImage)

summary(Model7)

Model8 = lm(Satisfaction~ComPricing)

summary(Model8)

Model9 = lm(Satisfaction~WartyClaim)

summary(Model9)

Model10 = lm(Satisfaction~OrdBilling)

summary(Model10)

Model11 = lm(Satisfaction~DelSpeed)

summary(Model11)

**### PCA or Factor Analysis without considering target variable**

install.packages("nFactors")

install.packages("corrplot")

library(corrplot)

library(nFactors)

mydata = mydata\_Hair[, 2:13] ### Removing ID varaible

mydata

mydata\_corr = cor(mydata)

mydata\_corr

corrplot(mydata\_corr)

ev = eigen(cor(mydata))

ev

EigenValue = ev$values

EigenValue

Factor = c(1,2,3,4,5,6,7,8,9,10,11,12)

Scree = data.frame(Factor, EigenValue)

plot(Scree, main = "Scree Plot", col = "Blue", ylim = c(0,4))

lines(Scree, col = "Red")

library(psych)

unrotate = principal(mydata, nfactors = 4, rotate = "none")

print(unrotate,digits = 4)

unrotateProfile = plot(unrotate, row.names(unrotate$loadings))

Rotate = principal(mydata, nfactors = 4, rotate = "varimax")

print(Rotate, digits = 4)

RotateProfile = plot(Rotate, row.names(Rotate$loadings),cex = 1.0)

Rotate$scores

factor.scope(mydata, f = Rotate$loadings, method = "Harman")

**### Multiple Linear Regression**

install.packages("car")

library(car)

**### Building initial regression model**

MLM0 = lm(Satisfaction~.,mydata)

summary(MLM0)

vif(MLM0)

**### Factor analysis using principal axis factoring 4 factors**

install.packages("nFactors")

library(nFactors)

mydata1 = mydata[-c(12)] ### Removing Satisfaction from mydata

mydata1

names(mydata1)

mydata1corr = cor(mydata1)

mydata1corr

ev1 = eigen(cor(mydata1))

ev1

EigenValue1 = ev$values

EigenValue1

solution = fa(r = mydata1, nfactors = 4, rotate = "none", fm = "pa")

solution

solution1 = fa(r = mydata1, nfactors = 4, rotate = "varimax", fm = "pa")

solution1

solution1$scores

**### Binding target variable satisfaction and factors**

mydata\_bind = cbind(mydata[12], solution1$scores)

mydata\_bind

**### Labelling data**

names(mydata\_bind) = c("Satisfaction", "Rating", "Price", "OtherCompanyPrice", "CustomerSupport")

head(mydata\_bind)

**### Splitting data 70:30**

set.seed(100)

indices = sample(1:nrow(mydata\_bind), 0.70\*nrow(mydata\_bind))

train = mydata\_bind[indices,]

test = mydata\_bind[-indices,]

**### Building regression on train data**

MLM1 = lm(Satisfaction~.,data = train)

summary(MLM1)

vif(MLM1)

**### Mean square error and RMSE**

mse1 = mean(MLM1$residuals^2)

mse1

rmse1 = sqrt(mse1)

rmse1

**### Testing the trained regression model**

MLM2 = predict(MLM1, newdata = test, type = "response")

MLM2

test$Satisfaction.predict = MLM2

head(test,10)

**### Mean square error and RMSE**

mse2 = mean((test$Satisfaction-test$Satisfaction.predict)^2)

mse2

rmse2 = sqrt(mse2)

rmse2