# Program Summary - CIND119_ASSIGNMENT1.sas

## Execution Environment

| | |
|---|---|
| Author: | u64024530 |
| File: | /home/u64024530/sasuser.v94/CIND119_ASSIGNMENT1.sas |
| SAS Platform: | Linux LIN X64 5.14.0-284.30.1.el9_2.x86_64 |
| SAS Host: | ODAWS02-USW2-2.ODA.SAS.COM |
| SAS Version: | 9.04.01M7P08062020 |
| SAS Locale: | en_US |
| Submission Time: | 10/14/2024, 1:13:48 AM |
| Browser Host: | S0106400FC1CEB976.CG.SHAWCABLE.NET |
| User Agent: | Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/129.0.0.0 Safari/537.36 |
| Application Server: | ODAMID00-USW2-2.ODA.SAS.COM |

## Code: CIND119_ASSIGNMENT1.sas

```
/*CIND119 – ASSIGNMENT 1*/

/*EMINE UYSAL*/
/*STUDENT NUMBER:501304049*/

/*CIND 119: Introduction to Big Data Analytics Assignment 1 (15% of the final grade)
Perform K-Means clustering on a dataset and analyze the results with using SAS
Dataset: The dataset for this assignment is "heart.csv" attached to the assignment. Details about the dataset can be found at
The dataset contains information about various cardiovascular disease indicators for patients, with 13 numerical/categorical a
Download the heart.csv from your D2L Assignment 1 link. Complete the following tasks (15 points):

1.Read the file in SAS and display the contents using the PROC IMPORT and PROC PRINT procedures, print only the first 10 obse
2.Perform basic Data analysis using PROC Means (2 points).
3.Apply standardization to the numerical attributes using stdize procedure and print the data (obs=10) (2 points).
4.Apply k-means clustering using fastclus procedure of SAS use your standardized dataset. Scatter plot your cluster labels (u
*/

/*ANSWER 1*/
/* Import the CSV file */
PROC IMPORT DATAFILE="//home//u64024530//sasuser.v94//heart.csv"
    OUT=heart_data
    DBMS=CSV
    REPLACE;
    GETNAMES=YES;
RUN;

/* Print the first 10 observations */
PROC PRINT DATA=heart_data (OBS=10);
RUN;

/*ANSWER 2*/
/*output basic descriptive statistics for all numeric variables in the heart_data dataset*/
PROC MEANS DATA=heart_data;
    VAR _NUMERIC_;
RUN;

/*ANSWER 3*/
/* Standardize the numerical attributes */
PROC STDIZE DATA=heart_data OUT=standardized_data METHOD=STD;
    VAR _NUMERIC_;
RUN;

/* Print the first 10 observations of the standardized data */
PROC PRINT DATA=standardized_data (OBS=10);
RUN;

/*ANSWER 4*/
/* Step 1: Standardize the Numerical Attributes */
PROC STDIZE DATA=heart_data OUT=standardized_data METHOD=STD;
    VAR _NUMERIC_;
RUN;

/* Step 2: Apply K-Means Clustering with Different K Values */

/* K-Means Clustering for K=2 */
PROC FASTCLUS DATA=standardized_data OUT=clus2 OUTSTAT=stat2 MAXCLUSTERS=2;
```

```
    VAR _NUMERIC_;
RUN;

/* K-Means Clustering for K=3 */
PROC FASTCLUS DATA=standardized_data OUT=clus3 OUTSTAT=stat3 MAXCLUSTERS=3;
    VAR _NUMERIC_;
RUN;

/* K-Means Clustering for K=4 */
PROC FASTCLUS DATA=standardized_data OUT=clus4 OUTSTAT=stat4 MAXCLUSTERS=4;
    VAR _NUMERIC_;
RUN;

/* K-Means Clustering for K=5 */
PROC FASTCLUS DATA=standardized_data OUT=clus5 OUTSTAT=stat5 MAXCLUSTERS=5;
    VAR _NUMERIC_;
RUN;

/* Step 3: Visualize the Clusters for the Best K Value (Assuming K=5) */
PROC SGPLOT DATA=clus5;
    SCATTER X=age Y=chol / GROUP=cluster;
    TITLE 'Scatter Plot of Clusters K=5';
RUN;

ods pdf file="C:\Users\emine\OneDrive\Masaüstü\CIND119-ASSIGNMENT1\output.pdf";
proc print data=heart_data;
run;
```

### Log: CIND119_ASSIGNMENT1.sas

Errors (1)

Notes (37)

```
1          OPTIONS NONOTES NOSTIMER NOSOURCE NOSYNTAXCHECK;
NOTE: ODS statements in the SAS Studio environment may disable some output features.
69
70         /*CIND119 – ASSIGNMENT 1*/
71
72         /*EMINE UYSAL*/
73         /*STUDENT NUMBER:501304049*/
74
75         /*CIND 119: Introduction to Big Data Analytics Assignment 1 (15% of the final grade)
76         Perform K-Means clustering on a dataset and analyze the results with using SAS
77         Dataset: The dataset for this assignment is "heart.csv" attached to the assignment. Details about the dataset can be
77       ! found at dataset link.
78         The dataset contains information about various cardiovascular disease indicators for patients, with 13
78       ! numerical/categorical attributes and 1 binary target attribute indicating the presence or absence of heart disease.
79         Download the heart.csv from your D2L Assignment 1 link. Complete the following tasks (15 points):
80
81         1.Read the file in SAS and display the contents using the PROC IMPORT and PROC PRINT procedures, print only the first 10
81       ! observations. (3 points)
82         2.Perform basic Data analysis using PROC Means (2 points).
83         3.Apply standardization to the numerical attributes using stdize procedure and print the data (obs=10) (2 points).
84         4.Apply k-means clustering using fastclus procedure of SAS use your standardized dataset. Scatter plot your cluster
84       ! labels (use y=chol and x=age) to visualize and compare with the original data labels. Assuming that you do not know the
84       ! exact number of clusters in the dataset, try k=2, 3, 4, 5 and evaluate the solutions. Choose the best K value based on
84       ! the RMS Std. Deviation. (8 points)
85         */
86
87         /*ANSWER 1*/
88         /* Import the CSV file */
89         PROC IMPORT DATAFILE="//home//u64024530//sasuser.v94//heart.csv"
90             OUT=heart_data
91             DBMS=CSV
92             REPLACE;
93             GETNAMES=YES;
94         RUN;

NOTE: Unable to open parameter catalog: SASUSER.PARMS.PARMS.SLIST in update mode. Temporary parameter values will be saved to
WORK.PARMS.PARMS.SLIST.
95          /*************************************************************************
96          *   PRODUCT:   SAS
97          *   VERSION:   9.4
98          *   CREATOR:   External File Interface
99          *   DATE:      14OCT24
100         *   DESC:      Generated SAS Datastep Code
101         *   TEMPLATE SOURCE:  (None Specified.)
102         *************************************************************************/
103            data WORK.HEART_DATA    ;
104            %let _EFIERR_ = 0; /* set the ERROR detection macro variable */
105            infile '//home//u64024530//sasuser.v94//heart.csv' delimiter = ',' MISSOVER DSD lrecl=32767 firstobs=2 ;
```

```
106               informat age best32. ;
107               informat sex best32. ;
108               informat cp best32. ;
109               informat trestbps best32. ;
110               informat chol best32. ;
111               informat fbs best32. ;
112               informat restecg best32. ;
113               informat thalach best32. ;
114               informat exang best32. ;
115               informat oldpeak best32. ;
116               informat slope best32. ;
117               informat ca best32. ;
118               informat thal best32. ;
119               informat target best32. ;
120               format age best12. ;
121               format sex best12. ;
122               format cp best12. ;
123               format trestbps best12. ;
124               format chol best12. ;
125               format fbs best12. ;
126               format restecg best12. ;
127               format thalach best12. ;
128               format exang best12. ;
129               format oldpeak best12. ;
130               format slope best12. ;
131               format ca best12. ;
132               format thal best12. ;
133               format target best12. ;
134            input
135                        age
136                        sex
137                        cp
138                        trestbps
139                        chol
140                        fbs
141                        restecg
142                        thalach
143                        exang
144                        oldpeak
145                        slope
146                        ca
147                        thal
148                        target
149            ;
150            if _ERROR_ then call symputx('_EFIERR_',1);  /* set ERROR detection macro variable */
151            run;

NOTE: The infile '//home//u64024530//sasuser.v94//heart.csv' is:
      Filename=//home//u64024530//sasuser.v94//heart.csv,
      Owner Name=u64024530,Group Name=oda,
      Access Permission=-rw-r--r--,
      Last Modified=13Oct2024:20:22:04,
      File Size (bytes)=11328

NOTE: 303 records were read from the infile '//home//u64024530//sasuser.v94//heart.csv'.
      The minimum record length was 33.
      The maximum record length was 36.
NOTE: The data set WORK.HEART_DATA has 303 observations and 14 variables.
NOTE: DATA statement used (Total process time):
      real time           0.00 seconds
      user cpu time       0.00 seconds
      system cpu time     0.01 seconds
      memory              9444.81k
      OS Memory           33824.00k
      Timestamp           10/14/2024 07:13:47 AM
      Step Count                        131  Switch Count  2
      Page Faults                       0
      Page Reclaims                     102
      Page Swaps                        0
      Voluntary Context Switches        15
      Involuntary Context Switches      0
      Block Input Operations            0
      Block Output Operations           264


303 rows created in WORK.HEART_DATA from //home//u64024530//sasuser.v94//heart.csv.



NOTE: WORK.HEART_DATA data set was successfully created.
NOTE: The data set WORK.HEART_DATA has 303 observations and 14 variables.
NOTE: PROCEDURE IMPORT used (Total process time):
      real time           0.05 seconds
      user cpu time       0.03 seconds
      system cpu time     0.01 seconds
      memory              9444.81k
```

```
      OS Memory           34080.00k
      Timestamp           10/14/2024 07:13:47 AM
      Step Count                        131  Switch Count  10
      Page Faults                       0
      Page Reclaims                     891
      Page Swaps                        0
      Voluntary Context Switches        93
      Involuntary Context Switches      0
      Block Input Operations            0
      Block Output Operations           320


152
153        /* Print the first 10 observations */
154        PROC PRINT DATA=heart_data (OBS=10);
155        RUN;

NOTE: There were 10 observations read from the data set WORK.HEART_DATA.
NOTE: PROCEDURE PRINT used (Total process time):
      real time           0.02 seconds
      user cpu time       0.02 seconds
      system cpu time     0.00 seconds
      memory              1323.09k
      OS Memory           29608.00k
      Timestamp           10/14/2024 07:13:47 AM
      Step Count                        132  Switch Count  0
      Page Faults                       0
      Page Reclaims                     62
      Page Swaps                        0
      Voluntary Context Switches        0
      Involuntary Context Switches      0
      Block Input Operations            0
      Block Output Operations           8


156
157        /*ANSWER 2*/
158        /*output basic descriptive statistics for all numeric variables in the heart_data dataset*/
159        PROC MEANS DATA=heart_data;
160            VAR _NUMERIC_;
161        RUN;

NOTE: There were 303 observations read from the data set WORK.HEART_DATA.
NOTE: PROCEDURE MEANS used (Total process time):
      real time           0.03 seconds
      user cpu time       0.03 seconds
      system cpu time     0.00 seconds
      memory              6578.37k
      OS Memory           34748.00k
      Timestamp           10/14/2024 07:13:47 AM
      Step Count                        133  Switch Count  1
      Page Faults                       0
      Page Reclaims                     1346
      Page Swaps                        0
      Voluntary Context Switches        22
      Involuntary Context Switches      2
      Block Input Operations            0
      Block Output Operations           16


162
163        /*ANSWER 3*/
164        /* Standardize the numerical attributes */
165        PROC STDIZE DATA=heart_data OUT=standardized_data METHOD=STD;
166            VAR _NUMERIC_;
167        RUN;

NOTE: There were 303 observations read from the data set WORK.HEART_DATA.
NOTE: The data set WORK.STANDARDIZED_DATA has 303 observations and 14 variables.
NOTE: PROCEDURE STDIZE used (Total process time):
      real time           0.00 seconds
      user cpu time       0.00 seconds
      system cpu time     0.00 seconds
      memory              845.71k
      OS Memory           29868.00k
      Timestamp           10/14/2024 07:13:47 AM
      Step Count                        134  Switch Count  2
      Page Faults                       0
      Page Reclaims                     104
      Page Swaps                        0
      Voluntary Context Switches        16
      Involuntary Context Switches      0
      Block Input Operations            0
      Block Output Operations           264
```

```
168
169         /* Print the first 10 observations of the standardized data */
170         PROC PRINT DATA=standardized_data (OBS=10);
171         RUN;

NOTE: There were 10 observations read from the data set WORK.STANDARDIZED_DATA.
NOTE: PROCEDURE PRINT used (Total process time):
      real time           0.02 seconds
      user cpu time       0.02 seconds
      system cpu time     0.00 seconds
      memory              747.34k
      OS Memory           29608.00k
      Timestamp           10/14/2024 07:13:47 AM
      Step Count                        135  Switch Count  0
      Page Faults                       0
      Page Reclaims                     62
      Page Swaps                        0
      Voluntary Context Switches        0
      Involuntary Context Switches      0
      Block Input Operations            0
      Block Output Operations           16


172
173         /*ANSWER 4*/
174         /* Step 1: Standardize the Numerical Attributes */
175         PROC STDIZE DATA=heart_data OUT=standardized_data METHOD=STD;
176             VAR _NUMERIC_;
177         RUN;

NOTE: There were 303 observations read from the data set WORK.HEART_DATA.
NOTE: The data set WORK.STANDARDIZED_DATA has 303 observations and 14 variables.
NOTE: PROCEDURE STDIZE used (Total process time):
      real time           0.00 seconds
      user cpu time       0.00 seconds
      system cpu time     0.00 seconds
      memory              873.59k
      OS Memory           29868.00k
      Timestamp           10/14/2024 07:13:47 AM
      Step Count                        136  Switch Count  2
      Page Faults                       0
      Page Reclaims                     104
      Page Swaps                        0
      Voluntary Context Switches        14
      Involuntary Context Switches      0
      Block Input Operations            0
      Block Output Operations           264


178
179         /* Step 2: Apply K-Means Clustering with Different K Values */
180
181         /* K-Means Clustering for K=2 */
182         PROC FASTCLUS DATA=standardized_data OUT=clus2 OUTSTAT=stat2 MAXCLUSTERS=2;
183             VAR _NUMERIC_;
184         RUN;

NOTE: The data set WORK.CLUS2 has 303 observations and 16 variables.
NOTE: The data set WORK.STAT2 has 20 observations and 17 variables.
NOTE: PROCEDURE FASTCLUS used (Total process time):
      real time           0.06 seconds
      user cpu time       0.06 seconds
      system cpu time     0.00 seconds
      memory              1604.71k
      OS Memory           30128.00k
      Timestamp           10/14/2024 07:13:47 AM
      Step Count                        137  Switch Count  4
      Page Faults                       0
      Page Reclaims                     170
      Page Swaps                        0
      Voluntary Context Switches        29
      Involuntary Context Switches      3
      Block Input Operations            0
      Block Output Operations           560


185
186         /* K-Means Clustering for K=3 */
187         PROC FASTCLUS DATA=standardized_data OUT=clus3 OUTSTAT=stat3 MAXCLUSTERS=3;
188             VAR _NUMERIC_;
189         RUN;

NOTE: The data set WORK.CLUS3 has 303 observations and 16 variables.
NOTE: The data set WORK.STAT3 has 25 observations and 17 variables.
NOTE: PROCEDURE FASTCLUS used (Total process time):
      real time           0.06 seconds
```

```
      user cpu time       0.06 seconds
      system cpu time     0.00 seconds
      memory              1388.06k
      OS Memory           30128.00k
      Timestamp           10/14/2024 07:13:47 AM
      Step Count                        138  Switch Count  4
      Page Faults                       0
      Page Reclaims                     169
      Page Swaps                        0
      Voluntary Context Switches        31
      Involuntary Context Switches      2
      Block Input Operations            0
      Block Output Operations           560


190
191        /* K-Means Clustering for K=4 */
192        PROC FASTCLUS DATA=standardized_data OUT=clus4 OUTSTAT=stat4 MAXCLUSTERS=4;
193            VAR _NUMERIC_;
194        RUN;

NOTE: The data set WORK.CLUS4 has 303 observations and 16 variables.
NOTE: The data set WORK.STAT4 has 30 observations and 17 variables.
NOTE: PROCEDURE FASTCLUS used (Total process time):
      real time           0.06 seconds
      user cpu time       0.07 seconds
      system cpu time     0.00 seconds
      memory              1423.09k
      OS Memory           30128.00k
      Timestamp           10/14/2024 07:13:47 AM
      Step Count                        139  Switch Count  4
      Page Faults                       0
      Page Reclaims                     169
      Page Swaps                        0
      Voluntary Context Switches        28
      Involuntary Context Switches      2
      Block Input Operations            0
      Block Output Operations           560


195
196        /* K-Means Clustering for K=5 */
197        PROC FASTCLUS DATA=standardized_data OUT=clus5 OUTSTAT=stat5 MAXCLUSTERS=5;
198            VAR _NUMERIC_;
199        RUN;

NOTE: The data set WORK.CLUS5 has 303 observations and 16 variables.
NOTE: The data set WORK.STAT5 has 35 observations and 17 variables.
NOTE: PROCEDURE FASTCLUS used (Total process time):
      real time           0.07 seconds
      user cpu time       0.07 seconds
      system cpu time     0.00 seconds
      memory              1387.56k
      OS Memory           30128.00k
      Timestamp           10/14/2024 07:13:47 AM
      Step Count                        140  Switch Count  4
      Page Faults                       0
      Page Reclaims                     169
      Page Swaps                        0
      Voluntary Context Switches        26
      Involuntary Context Switches      2
      Block Input Operations            0
      Block Output Operations           576


200
201        /* Step 3: Visualize the Clusters for the Best K Value (Assuming K=5) */
202        PROC SGPLOT DATA=clus5;
203            SCATTER X=age Y=chol / GROUP=cluster;
204            TITLE 'Scatter Plot of Clusters K=5';
205        RUN;

NOTE: PROCEDURE SGPLOT used (Total process time):
      real time           0.11 seconds
      user cpu time       0.04 seconds
      system cpu time     0.01 seconds
      memory              8254.40k
      OS Memory           33840.00k
      Timestamp           10/14/2024 07:13:47 AM
      Step Count                        141  Switch Count  2
      Page Faults                       0
      Page Reclaims                     1200
      Page Swaps                        0
      Voluntary Context Switches        161
      Involuntary Context Switches      2
      Block Input Operations            0
```

```
      Block Output Operations           544

NOTE: There were 303 observations read from the data set WORK.CLUS5.

206
207       ods pdf file="C:\Users\emine\OneDrive\Masaüstü\CIND119-ASSIGNMENT1\output.pdf";
NOTE: Writing ODS PDF output to DISK destination
      "/pbr/biconfig/940/Lev1/SASApp/C:\Users\emine\OneDrive\Masaüstü\CIND119-ASSIGNMENT1\output.pdf", printer "PDF".
208       proc print data=heart_data;
209       run;

NOTE: There were 303 observations read from the data set WORK.HEART_DATA.
NOTE: PROCEDURE PRINT used (Total process time):
      real time           0.54 seconds
      user cpu time       0.53 seconds
      system cpu time     0.00 seconds
      memory              3209.28k
      OS Memory           37292.00k
      Timestamp           10/14/2024 07:13:48 AM
      Step Count                        142  Switch Count  0
      Page Faults                       0
      Page Reclaims                     552
      Page Swaps                        0
      Voluntary Context Switches        0
      Involuntary Context Switches      2
      Block Input Operations            0
      Block Output Operations           376


210       ods pdf close;
ERROR: Insufficient authorization to access
       /pbr/biconfig/940/Lev1/SASApp/C:\Users\emine\OneDrive\Masaüstü\CIND119-ASSIGNMENT1\output.pdf.
211
212
213       OPTIONS NONOTES NOSTIMER NOSOURCE NOSYNTAXCHECK;
223
```

## Results: CIND119_ASSIGNMENT1.sas

| Obs | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 63 | 1 | 3 | 145 | 233 | 1 | 0 | 150 | 0 | 2.3 | 0 | 0 | 1 | 1 |
| 2 | 37 | 1 | 2 | 130 | 250 | 0 | 1 | 187 | 0 | 3.5 | 0 | 0 | 2 | 1 |
| 3 | 41 | 0 | 1 | 130 | 204 | 0 | 0 | 172 | 0 | 1.4 | 2 | 0 | 2 | 1 |
| 4 | 56 | 1 | 1 | 120 | 236 | 0 | 1 | 178 | 0 | 0.8 | 2 | 0 | 2 | 1 |
| 5 | 57 | 0 | 0 | 120 | 354 | 0 | 1 | 163 | 1 | 0.6 | 2 | 0 | 2 | 1 |
| 6 | 57 | 1 | 0 | 140 | 192 | 0 | 1 | 148 | 0 | 0.4 | 1 | 0 | 1 | 1 |
| 7 | 56 | 0 | 1 | 140 | 294 | 0 | 0 | 153 | 0 | 1.3 | 1 | 0 | 2 | 1 |
| 8 | 44 | 1 | 1 | 120 | 263 | 0 | 1 | 173 | 0 | 0 | 2 | 0 | 3 | 1 |
| 9 | 52 | 1 | 2 | 172 | 199 | 1 | 1 | 162 | 0 | 0.5 | 2 | 0 | 3 | 1 |
| 10 | 57 | 1 | 2 | 150 | 168 | 0 | 1 | 174 | 0 | 1.6 | 2 | 0 | 2 | 1 |

**The MEANS Procedure**

| Variable | N | Mean | Std Dev | Minimum | Maximum |
|---|---|---|---|---|---|
| age | 303 | 54.3663366 | 9.0821010 | 29.0000000 | 77.0000000 |
| sex | 303 | 0.6831683 | 0.4660108 | 0 | 1.0000000 |
| cp | 303 | 0.9669967 | 1.0320525 | 0 | 3.0000000 |
| trestbps | 303 | 131.6237624 | 17.5381428 | 94.0000000 | 200.0000000 |
| chol | 303 | 246.2640264 | 51.8307510 | 126.0000000 | 564.0000000 |
| fbs | 303 | 0.1485149 | 0.3561979 | 0 | 1.0000000 |
| restecg | 303 | 0.5280528 | 0.5258596 | 0 | 2.0000000 |
| thalach | 303 | 149.6468647 | 22.9051611 | 71.0000000 | 202.0000000 |
| exang | 303 | 0.3267327 | 0.4697945 | 0 | 1.0000000 |
| oldpeak | 303 | 1.0396040 | 1.1610750 | 0 | 6.2000000 |
| slope | 303 | 1.3993399 | 0.6162261 | 0 | 2.0000000 |
| ca | 303 | 0.7293729 | 1.0226064 | 0 | 4.0000000 |
| thal | 303 | 2.3135314 | 0.6122765 | 0 | 3.0000000 |
| target | 303 | 0.5445545 | 0.4988348 | 0 | 1.0000000 |

| Obs | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | targe |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.9506240215 | 0.6798805249 | 1.9698642473 | 0.7626940758 | -0.255910365 | 2.3904835162 | -1.004170712 | 0.0154172814 | -0.695480041 | 1.0855422911 | -2.270822075 | -0.713248971 | -2.145323783 | 0.913018817 |
| 2 | -1.912149695 | 0.6798805249 | 1.0009212815 | -0.092584625 | 0.0720802521 | -0.416944799 | 0.8974775738 | 1.6307737425 | -0.695480041 | 2.1190672376 | -2.270822075 | -0.713248971 | -0.512074772 | 0.913018817 |
| 3 | -1.471722969 | -1.465992382 | 0.0319783157 | -0.092584625 | -0.815423771 | -0.416944799 | -1.004170712 | 0.9758995015 | -0.695480041 | 0.3103985813 | 0.9747396642 | -0.713248971 | -0.512074772 | 0.913018817 |
| 4 | 0.1798772518 | 0.6798805249 | 0.0319783157 | -0.662770426 | -0.198029668 | -0.416944799 | 0.8974775738 | 1.2378491979 | -0.695480041 | -0.206363892 | 0.9747396642 | -0.713248971 | -0.512074772 | 0.913018817 |
| 5 | 0.2899839332 | -1.465992382 | -0.93696465 | -0.662770426 | 2.078611086 | -0.416944799 | 0.8974775738 | 0.5829749569 | 1.4331103867 | -0.37861805 | 0.9747396642 | -0.713248971 | -0.512074772 | 0.913018817 |
| 6 | 0.2899839332 | 0.6798805249 | -0.93696465 | 0.4776011755 | -1.046946559 | -0.416944799 | 0.8974775738 | -0.071899284 | -0.695480041 | -0.550872207 | -0.648041205 | -0.713248971 | -2.145323783 | 0.913018817 |
| 7 | 0.1798772518 | -1.465992382 | 0.0319783157 | 0.4776011755 | 0.9209971433 | -0.416944799 | -1.004170712 | 0.1463921296 | -0.695480041 | 0.2242715024 | -0.648041205 | -0.713248971 | -0.512074772 | 0.913018817 |
| 8 | -1.141402925 | 0.6798805249 | 0.0319783157 | -0.662770426 | 0.3228966063 | -0.416944799 | 0.8974775738 | 1.0195577842 | -0.695480041 | -0.895380523 | 0.9747396642 | -0.713248971 | 1.1211742386 | 0.913018817 |
| 9 | -0.260549474 | 0.6798805249 | 1.0009212815 | 2.3021957372 | -0.911891599 | 2.3904835162 | 0.8974775738 | 0.5393166742 | -0.695480041 | -0.464745129 | 0.9747396642 | -0.713248971 | 1.1211742386 | 0.913018817 |
| 10 | 0.2899839332 | 0.6798805249 | 1.0009212815 | 1.047786976 | -1.509992136 | -0.416944799 | 0.8974775738 | 1.063216067 | -0.695480041 | 0.482652739 | 0.9747396642 | -0.713248971 | -0.512074772 | 0.913018817 |

**The FASTCLUS Procedure**
**Replace=FULL Radius=0 Maxclusters=2 Maxiter=1**

**Initial Seeds**

| Cluster | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.510197296 | 0.679880525 | -0.936964650 | 1.846047097 | -1.355643610 | 2.390483516 | -1.004170712 | -2.604079683 | -0.695480041 | -0.034109734 | -0.648041205 | 1.242537800 | -2.145323783 | -1.091652933 |
| 2 | 1.391050747 | -1.465992382 | 1.000921281 | -0.947863326 | 6.130259885 | -0.416944799 | -1.004170712 | 0.452000109 | -0.695480041 | 0.482652739 | -0.648041205 | -0.713248971 | 1.121174239 | 0.913018817 |

| Criterion Based on Final Seeds = | 0.9722 |
|---|---|

**Cluster Summary**

| Cluster | Frequency | RMS Std Deviation | Maximum Distance from Seed to Observation | Radius Exceeded | Nearest Cluster | Distance Between Cluster Centroids |
|---|---|---|---|---|---|---|
| 1 | 231 | 1.0058 | 6.5728 | | 2 | 2.3600 |
| 2 | 72 | 0.8180 | 5.4510 | | 1 | 2.3600 |

**Statistics for Variables**

| Variable | Total STD | Within STD | R-Square | RSQ/(1-RSQ) |
|---|---|---|---|---|
| age | 1.00000 | 1.00165 | 0.000016 | 0.000016 |
| sex | 1.00000 | 0.88424 | 0.220715 | 0.283227 |
| cp | 1.00000 | 0.99402 | 0.015189 | 0.015423 |
| trestbps | 1.00000 | 1.00027 | 0.002773 | 0.002781 |
| chol | 1.00000 | 0.86561 | 0.253207 | 0.339058 |
| fbs | 1.00000 | 0.99841 | 0.006485 | 0.006527 |
| restecg | 1.00000 | 1.00121 | 0.000890 | 0.000891 |
| thalach | 1.00000 | 0.96558 | 0.070750 | 0.076137 |
| exang | 1.00000 | 0.97235 | 0.057662 | 0.061191 |
| oldpeak | 1.00000 | 0.96902 | 0.064112 | 0.068503 |
| slope | 1.00000 | 0.94526 | 0.109443 | 0.122893 |
| ca | 1.00000 | 0.98114 | 0.040556 | 0.042270 |
| thal | 1.00000 | 0.99080 | 0.021557 | 0.022032 |
| target | 1.00000 | 0.92402 | 0.149006 | 0.175096 |
| OVER-ALL | 1.00000 | 0.96476 | 0.072311 | 0.077948 |

| Pseudo F Statistic = | 23.46 |
|---|---|

| Approximate Expected Over-All R-Squared = | 0.05990 |
|---|---|

| Cubic Clustering Criterion = | 4.701 |
|---|---|

**WARNING: The two values above are invalid for correlated variables.**

**Cluster Means**

| Cluster | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | ta |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | -.0022039270 | 0.2618533353 | -.0686910833 | 0.0293512128 | -.2804658123 | 0.0448832353 | 0.0166275020 | -.1482540297 | 0.1338409051 | 0.1411271795 | -.1843895283 | 0.1122454454 | 0.0818339588 | -.215151 |
| 2 | 0.0070709324 | -.8401127840 | 0.2203838924 | -.0941684745 | 0.8998278143 | -.1440003798 | -.0533465691 | 0.4756483452 | -.4294062372 | -.4527830343 | 0.5915830700 | -.3601208039 | -.2625506180 | 0.690277 |

**Cluster Standard Deviations**

| Cluster | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.993942206 | 0.851719945 | 1.021257519 | 1.035790991 | 0.793738221 | 1.043059831 | 1.014328738 | 1.043254788 | 1.040286608 | 1.052996641 | 1.010274139 | 1.056356333 | 1.084736467 | 0.996565218 |
| 2 | 1.026229411 | 0.982207643 | 0.900161727 | 0.875359370 | 1.065640863 | 0.837565831 | 0.957496675 | 0.653332601 | 0.708905281 | 0.623640596 | 0.694017245 | 0.682763199 | 0.591722715 | 0.634428710 |

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**The FASTCLUS Procedure**
**Replace=FULL Radius=0 Maxclusters=3 Maxiter=1**

**Initial Seeds**

| Cluster | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | -0.260549474 | 0.679880525 | -0.936964650 | -0.206621785 | -0.815423771 | 2.390483516 | 0.897477574 | 0.277366978 | 1.433110387 | -0.034109734 | -0.648041205 | -0.713248971 | -3.778572795 | -1.091652933 |
| 2 | 0.840517340 | -1.465992382 | -0.936964650 | 1.617972777 | -1.587166399 | -0.416944799 | -1.004170712 | -0.202874132 | -0.695480041 | 4.444498367 | -2.270822075 | 2.220431185 | 1.121174239 | -1.091652933 |
| 3 | 1.391050747 | -1.465992382 | 1.000921281 | -0.947863326 | 6.130259885 | -0.416944799 | -1.004170712 | 0.452000109 | -0.695480041 | 0.482652739 | -0.648041205 | -0.713248971 | 1.121174239 | 0.913018817 |

| Criterion Based on Final Seeds = | 0.9108 |
|---|---|

**Cluster Summary**

| Cluster | Frequency | RMS Std Deviation | Maximum Distance from Seed to Observation | Radius Exceeded | Nearest Cluster | Distance Between Cluster Centroids |
|---|---|---|---|---|---|---|
| 1 | 166 | 0.9009 | 5.0671 | | 3 | 2.2795 |
| 2 | 87 | 0.9334 | 5.6728 | | 1 | 3.2307 |
| 3 | 50 | 0.8229 | 5.2206 | | 1 | 2.2795 |

**Statistics for Variables**

| Variable | Total STD | Within STD | R-Square | RSQ/(1-RSQ) |
|---|---|---|---|---|
| age | 1.00000 | 0.88745 | 0.217644 | 0.278190 |
| sex | 1.00000 | 0.90369 | 0.188760 | 0.232681 |
| cp | 1.00000 | 0.94485 | 0.113173 | 0.127615 |
| trestbps | 1.00000 | 0.96041 | 0.083730 | 0.091381 |
| chol | 1.00000 | 0.83477 | 0.307777 | 0.444622 |
| fbs | 1.00000 | 1.00261 | 0.001429 | 0.001431 |
| restecg | 1.00000 | 0.98132 | 0.043393 | 0.045361 |

| Statistics for Variables | | | | |
|---|---|---|---|---|
| Variable | Total STD | Within STD | R-Square | RSQ/(1-RSQ) |
| thalach | 1.00000 | 0.84496 | 0.290776 | 0.409991 |
| exang | 1.00000 | 0.92843 | 0.143735 | 0.167863 |
| oldpeak | 1.00000 | 0.78843 | 0.382499 | 0.619431 |
| slope | 1.00000 | 0.87237 | 0.244015 | 0.322778 |
| ca | 1.00000 | 0.88635 | 0.219580 | 0.281361 |
| thal | 1.00000 | 0.92356 | 0.152685 | 0.180198 |
| target | 1.00000 | 0.78315 | 0.390734 | 0.641320 |
| OVER-ALL | 1.00000 | 0.89821 | 0.198566 | 0.247764 |

| Pseudo F Statistic = | 37.16 |
|---|---|

| Approximate Expected Over-All R-Squared = | 0.10646 |
|---|---|

| Cubic Clustering Criterion = | 27.528 |
|---|---|

**WARNING: The two values above are invalid for correlated variables.**

| Cluster Means | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cluster | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
| 1 | -0.423056323 | 0.111094935 | 0.154555438 | -0.259518540 | -0.394684567 | 0.005860670 | 0.187223395 | 0.358634504 | -0.169743851 | -0.364090591 | 0.202452383 | -0.306775214 | -0.256264686 | 0.345431032 |
| 2 | 0.521587642 | 0.334567643 | -0.513748182 | 0.362908629 | 0.090930288 | 0.034825274 | -0.195423740 | -0.847210167 | 0.576780904 | 0.970706186 | -0.741304474 | 0.736730876 | 0.614303856 | -0.976441913 |
| 3 | 0.496984494 | -0.950982884 | 0.380797783 | 0.230140538 | 1.152134061 | -0.080053401 | -0.281544363 | 0.283479137 | -0.440049189 | -0.480248003 | 0.617727873 | -0.263418014 | -0.218089950 | 0.552177902 |

| Cluster Standard Deviations | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cluster | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
| 1 | 0.959175790 | 0.949979501 | 0.995999143 | 0.873967056 | 0.673710847 | 1.007145509 | 0.946126109 | 0.866257606 | 0.920752748 | 0.675417806 | 0.973698145 | 0.813971635 | 0.967728687 | 0.905877899 |
| 2 | 0.760070854 | 0.793086564 | 0.844978182 | 1.060232370 | 0.963901640 | 1.037588792 | 1.070726834 | 0.904655339 | 1.049829922 | 1.066924247 | 0.756969232 | 1.094457235 | 0.974564668 | 0.469273842 |
| 3 | 0.842562447 | 0.925770581 | 0.933901990 | 1.049893546 | 1.052274725 | 0.921568448 | 0.932405446 | 0.638666225 | 0.698732632 | 0.521338585 | 0.679055832 | 0.690345182 | 0.633844235 | 0.777988919 |

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**The FASTCLUS Procedure**
**Replace=FULL Radius=0 Maxclusters=4 Maxiter=1**

| Initial Seeds | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cluster | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
| 1 | 0.400090615 | 0.679880525 | -0.936964650 | -1.004881906 | 1.384042720 | -0.416944799 | 2.799125860 | -0.421165546 | -0.695480041 | 2.894210947 | -2.270822075 | 2.220431185 | -2.145323783 | -1.091652933 |
| 2 | 1.060730703 | -1.465992382 | -0.936964650 | 2.758344378 | 1.519097680 | -0.416944799 | 0.897477574 | 0.190050412 | 1.433110387 | -0.895380523 | 0.974739664 | -0.713248971 | -0.512074772 | 0.913018817 |
| 3 | -1.251509606 | 0.679880525 | -0.936964650 | 0.021452535 | 0.014199555 | 2.390483516 | -1.004170712 | -0.290190698 | 1.433110387 | -0.809253444 | -0.648041205 | 3.198324570 | 1.121174239 | -1.091652933 |
| 4 | 1.391050747 | -1.465992382 | 1.000921281 | -0.947863326 | 6.130259885 | -0.416944799 | -1.004170712 | 0.452000109 | -0.695480041 | 0.482652739 | -0.648041205 | -0.713248971 | 1.121174239 | 0.913018817 |

| Criterion Based on Final Seeds = | 0.8966 |
|---|---|

| Cluster Summary | | | | | | |
|---|---|---|---|---|---|---|
| Cluster | Frequency | RMS Std Deviation | Maximum Distance from Seed to Observation | Radius Exceeded | Nearest Cluster | Distance Between Cluster Centroids |
| 1 | 42 | 1.0287 | 6.0532 | | 3 | 2.2750 |
| 2 | 162 | 0.8422 | 4.7876 | | 3 | 3.0613 |
| 3 | 94 | 0.8898 | 4.9759 | | 1 | 2.2750 |
| 4 | 5 | 0.9090 | 3.4353 | | 3 | 4.6023 |

| Statistics for Variables | | | | |
|---|---|---|---|---|
| Variable | Total STD | Within STD | R-Square | RSQ/(1-RSQ) |
| age | 1.00000 | 0.96879 | 0.070775 | 0.076166 |
| sex | 1.00000 | 0.92983 | 0.144000 | 0.168224 |
| cp | 1.00000 | 0.90978 | 0.180528 | 0.220298 |
| trestbps | 1.00000 | 0.99295 | 0.023841 | 0.024423 |
| chol | 1.00000 | 0.87898 | 0.235072 | 0.307312 |
| fbs | 1.00000 | 0.99672 | 0.016423 | 0.016698 |
| restecg | 1.00000 | 0.96570 | 0.076689 | 0.083059 |
| thalach | 1.00000 | 0.86863 | 0.252972 | 0.338638 |
| exang | 1.00000 | 0.89035 | 0.215160 | 0.274145 |
| oldpeak | 1.00000 | 0.72866 | 0.474325 | 0.902317 |
| slope | 1.00000 | 0.83577 | 0.308431 | 0.445988 |
| ca | 1.00000 | 0.89515 | 0.206661 | 0.260495 |
| thal | 1.00000 | 0.85677 | 0.273237 | 0.375965 |
| target | 1.00000 | 0.59457 | 0.649997 | 1.857121 |
| OVER-ALL | 1.00000 | 0.88564 | 0.223437 | 0.287725 |

| Pseudo F Statistic = | 28.68 |
|---|---|

| Approximate Expected Over-All R-Squared = | 0.14537 |
|---|---|

| Cubic Clustering Criterion = | 20.491 |
|---|---|

**WARNING: The two values above are invalid for correlated variables.**

**Cluster Means**

| Cluster | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.363388387 | 0.117866192 | -0.337142814 | 0.370351942 | 0.013740184 | -0.015883611 | 0.308872152 | -0.727813008 | 0.622218795 | 1.495671238 | -1.150330522 | 0.311210766 | -0.512074772 | -0.757540975 |
| 2 | -0.229284614 | -0.260594638 | 0.390846081 | -0.077098097 | -0.122046366 | -0.105008320 | 0.146209115 | 0.452539100 | -0.419551652 | -0.517378343 | 0.443829874 | -0.417466404 | -0.320520876 | 0.739775579 |
| 3 | 0.184562642 | 0.474424608 | -0.514340591 | -0.045271335 | 0.007221031 | 0.180380374 | -0.336570782 | -0.468539427 | 0.459393489 | 0.183956700 | -0.233714175 | 0.555931806 | 0.756299460 | -0.942368867 |
| 4 | 0.906581349 | -1.465992382 | -0.161810277 | 0.238123139 | 3.703129319 | 0.144540864 | -1.004170712 | 0.259903665 | -0.269761955 | 0.741033976 | -0.323485031 | 0.460223092 | 0.467874634 | 0.111150117 |

**Cluster Standard Deviations**

| Cluster | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.885763237 | 0.954914774 | 1.068998953 | 1.224156781 | 0.926997431 | 0.994303522 | 1.149314658 | 0.982423191 | 1.046218021 | 1.056004293 | 0.759301016 | 1.078873620 | 1.349706972 | 0.756153104 |
| 2 | 1.033728026 | 1.068029926 | 0.915653500 | 0.986527464 | 0.869174444 | 0.885025388 | 0.956313033 | 0.791777207 | 0.717200962 | 0.520869730 | 0.845067234 | 0.707099424 | 0.714026845 | 0.565025048 |
| 3 | 0.901466659 | 0.634788884 | 0.810781822 | 0.894912576 | 0.846758715 | 1.155138696 | 0.912529016 | 0.955961925 | 1.066119825 | 0.834431223 | 0.855926088 | 1.061874795 | 0.799919379 | 0.529110665 |
| 4 | 0.457969678 | 0.000000000 | 1.061423839 | 0.739485042 | 1.366128874 | 1.255520111 | 0.000000000 | 0.165095284 | 0.951934578 | 1.072273485 | 0.725729667 | 1.275016982 | 0.894567325 | 1.098003938 |

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**The FASTCLUS Procedure**
**Replace=FULL Radius=0 Maxclusters=5 Maxiter=1**

**Initial Seeds**

| Cluster | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.840517340 | -1.465992382 | -0.936964650 | 1.617972777 | -1.587166399 | -0.416944799 | -1.004170712 | -0.202874132 | -0.695480041 | 4.444498367 | -2.270822075 | 2.220431185 | 1.121174239 | -1.091652933 |
| 2 | 0.510197296 | 0.679880525 | -0.936964650 | 1.846047097 | -1.355643610 | 2.390483516 | -1.004170712 | -2.604079683 | -0.695480041 | -0.034109734 | -0.648041205 | 1.242537800 | -2.145323783 | -1.091652933 |
| 3 | 0.400090615 | 0.679880525 | -0.936964650 | -1.004881906 | 1.384042720 | -0.416944799 | 2.799125860 | -0.421165546 | -0.695480041 | 2.894210947 | -2.270822075 | 2.220431185 | -2.145323783 | -1.091652933 |
| 4 | -1.802043013 | 0.679880525 | 1.969864247 | -0.662770426 | -0.294497496 | -0.416944799 | 0.897477574 | 1.412482329 | 1.433110387 | 2.377448474 | -0.648041205 | -0.713248971 | 1.121174239 | -1.091652933 |
| 5 | 1.391050747 | -1.465992382 | 1.000921281 | -0.947863326 | 6.130259885 | -0.416944799 | -1.004170712 | 0.452000109 | -0.695480041 | 0.482652739 | -0.648041205 | -0.713248971 | 1.121174239 | 0.913018817 |

| Criterion Based on Final Seeds = | 0.8792 |
|---|---|

**Cluster Summary**

| Cluster | Frequency | RMS Std Deviation | Maximum Distance from Seed to Observation | Radius Exceeded | Nearest Cluster | Distance Between Cluster Centroids |
|---|---|---|---|---|---|---|
| 1 | 38 | 0.8425 | 4.6979 | | 3 | 2.3097 |
| 2 | 56 | 1.0135 | 4.8127 | | 3 | 2.6803 |
| 3 | 38 | 0.8764 | 4.6395 | | 1 | 2.3097 |
| 4 | 140 | 0.8227 | 4.7877 | | 5 | 2.7101 |
| 5 | 31 | 0.7718 | 4.7351 | | 4 | 2.7101 |

**Statistics for Variables**

| Variable | Total STD | Within STD | R-Square | RSQ/(1-RSQ) |
|---|---|---|---|---|
| age | 1.00000 | 0.79935 | 0.369498 | 0.586037 |
| sex | 1.00000 | 0.89841 | 0.203547 | 0.255567 |
| cp | 1.00000 | 0.92814 | 0.149969 | 0.176428 |
| trestbps | 1.00000 | 0.94993 | 0.109585 | 0.123072 |
| chol | 1.00000 | 0.86740 | 0.257590 | 0.346965 |
| fbs | 1.00000 | 0.85811 | 0.273403 | 0.376279 |
| restecg | 1.00000 | 0.88277 | 0.231034 | 0.300447 |
| thalach | 1.00000 | 0.75178 | 0.442311 | 0.793115 |
| exang | 1.00000 | 0.88799 | 0.221923 | 0.285219 |
| oldpeak | 1.00000 | 0.75641 | 0.435426 | 0.771248 |
| slope | 1.00000 | 0.87630 | 0.242262 | 0.319717 |
| ca | 1.00000 | 0.91077 | 0.181493 | 0.221737 |
| thal | 1.00000 | 0.91683 | 0.170550 | 0.205619 |
| target | 1.00000 | 0.80045 | 0.367772 | 0.581708 |
| OVER-ALL | 1.00000 | 0.86530 | 0.261169 | 0.353489 |

| Pseudo F Statistic = | 26.33 |
|---|---|

| Approximate Expected Over-All R-Squared = | 0.17880 |
|---|---|

| Cubic Clustering Criterion = | 20.396 |
|---|---|

**WARNING: The two values above are invalid for correlated variables.**

**Cluster Means**

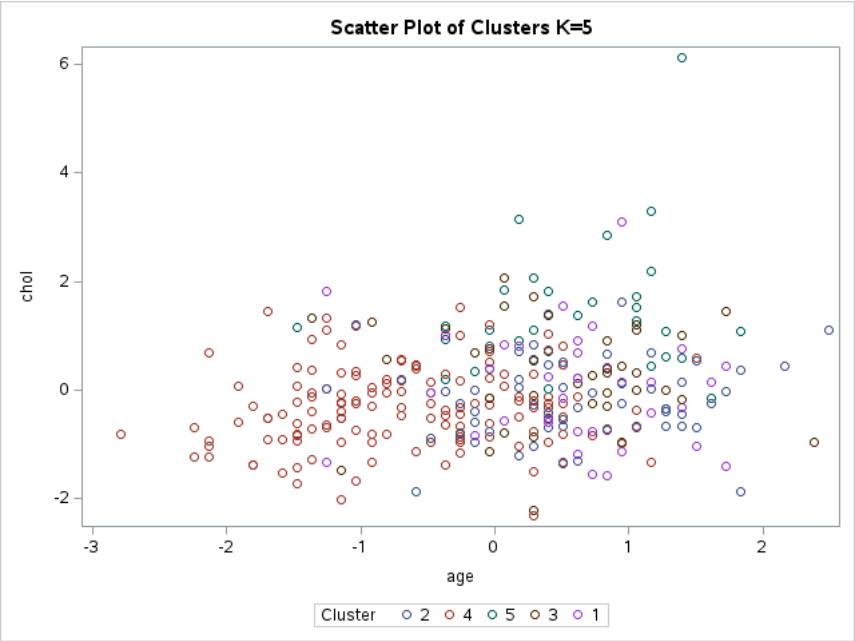
| Cluster | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.579738358 | 0.228117808 | -0.656481160 | 0.635152515 | 0.021307711 | -0.121426029 | -0.703910456 | -0.578565144 | 0.592877323 | 1.518444188 | -0.861565004 | 0.650654961 | 0.949253290 | -1.038898414 |
| 2 | 0.594743498 | 0.181731457 | -0.037231896 | 0.298399924 | -0.163921400 | 1.087034655 | -0.528758641 | -0.524853967 | 0.216773000 | -0.178680188 | -0.039498379 | 0.317031560 | -0.482909612 | -0.268305607 |
| 3 | 0.478324309 | 0.058706789 | -0.605484162 | -0.199119340 | 0.279739946 | -0.343065107 | 0.847434198 | -1.147271722 | 0.816939474 | 0.591444839 | -0.733450725 | 0.521984779 | 0.089648547 | -0.775125815 |
| 4 | -0.653787622 | 0.143412298 | 0.274214057 | -0.273414979 | -0.321232866 | -0.276573384 | 0.218317472 | 0.614159445 | -0.360987259 | -0.413684075 | 0.325627316 | -0.370986286 | -0.010434005 | 0.440489047 |
| 5 | 0.581233865 | -1.327548968 | 0.375796787 | 0.161240022 | 1.377818990 | -0.145258188 | -0.206705302 | 0.290041963 | -0.489487419 | -0.395287807 | 0.555957504 | -0.334709596 | -0.354018417 | 0.719018325 |

**Cluster Standard Deviations**

| Cluster | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.690431730 | 0.886578014 | 0.744016932 | 0.965404072 | 1.007542411 | 0.873143187 | 0.702729443 | 0.734939584 | 1.054408727 | 1.025831554 | 0.857952994 | 1.055171829 | 0.507959629 | 0.325200700 |
| 2 | 0.798693687 | 0.914185950 | 1.042882257 | 1.074143354 | 0.754627038 | 1.412799781 | 0.830889941 | 0.906410127 | 1.062912113 | 0.726018282 | 1.005719552 | 1.109806465 | 1.302549581 | 0.995150579 |
| 3 | 0.776847741 | 0.986255779 | 0.756477412 | 0.870216674 | 0.961810589 | 0.455425011 | 0.936514973 | 0.878484090 | 0.978312650 | 0.867691076 | 0.526499638 | 1.082847950 | 1.165510673 | 0.740800428 |
| 4 | 0.845605498 | 0.932526646 | 0.959310216 | 0.903925098 | 0.736004859 | 0.614061824 | 0.914460677 | 0.695902692 | 0.777451008 | 0.691251106 | 0.929468981 | 0.768518379 | 0.805299557 | 0.853926932 |

**Cluster Standard Deviations**

| Cluster | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 0.729561469 | 0.535891069 | 0.954245254 | 0.989436801 | 1.235615814 | 0.843736515 | 0.953886386 | 0.496015678 | 0.639720508 | 0.525972251 | 0.721817350 | 0.652454461 | 0.490852009 | 0.602478342 |




**Scatter Plot of Clusters K=5**

| Obs | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 63 | 1 | 3 | 145 | 233 | 1 | 0 | 150 | 0 | 2.3 | 0 | 0 | 1 | 1 |
| 2 | 37 | 1 | 2 | 130 | 250 | 0 | 1 | 187 | 0 | 3.5 | 0 | 0 | 2 | 1 |
| 3 | 41 | 0 | 1 | 130 | 204 | 0 | 0 | 172 | 0 | 1.4 | 2 | 0 | 2 | 1 |
| 4 | 56 | 1 | 1 | 120 | 236 | 0 | 1 | 178 | 0 | 0.8 | 2 | 0 | 2 | 1 |
| 5 | 57 | 0 | 0 | 120 | 354 | 0 | 1 | 163 | 1 | 0.6 | 2 | 0 | 2 | 1 |
| 6 | 57 | 1 | 0 | 140 | 192 | 0 | 1 | 148 | 0 | 0.4 | 1 | 0 | 1 | 1 |
| 7 | 56 | 0 | 1 | 140 | 294 | 0 | 0 | 153 | 0 | 1.3 | 1 | 0 | 2 | 1 |
| 8 | 44 | 1 | 1 | 120 | 263 | 0 | 1 | 173 | 0 | 0 | 2 | 0 | 3 | 1 |
| 9 | 52 | 1 | 2 | 172 | 199 | 1 | 1 | 162 | 0 | 0.5 | 2 | 0 | 3 | 1 |
| 10 | 57 | 1 | 2 | 150 | 168 | 0 | 1 | 174 | 0 | 1.6 | 2 | 0 | 2 | 1 |
| 11 | 54 | 1 | 0 | 140 | 239 | 0 | 1 | 160 | 0 | 1.2 | 2 | 0 | 2 | 1 |
| 12 | 48 | 0 | 2 | 130 | 275 | 0 | 1 | 139 | 0 | 0.2 | 2 | 0 | 2 | 1 |
| 13 | 49 | 1 | 1 | 130 | 266 | 0 | 1 | 171 | 0 | 0.6 | 2 | 0 | 2 | 1 |
| 14 | 64 | 1 | 3 | 110 | 211 | 0 | 0 | 144 | 1 | 1.8 | 1 | 0 | 2 | 1 |
| 15 | 58 | 0 | 3 | 150 | 283 | 1 | 0 | 162 | 0 | 1 | 2 | 0 | 2 | 1 |
| 16 | 50 | 0 | 2 | 120 | 219 | 0 | 1 | 158 | 0 | 1.6 | 1 | 0 | 2 | 1 |
| 17 | 58 | 0 | 2 | 120 | 340 | 0 | 1 | 172 | 0 | 0 | 2 | 0 | 2 | 1 |
| 18 | 66 | 0 | 3 | 150 | 226 | 0 | 1 | 114 | 0 | 2.6 | 0 | 0 | 2 | 1 |
| 19 | 43 | 1 | 0 | 150 | 247 | 0 | 1 | 171 | 0 | 1.5 | 2 | 0 | 2 | 1 |
| 20 | 69 | 0 | 3 | 140 | 239 | 0 | 1 | 151 | 0 | 1.8 | 2 | 2 | 2 | 1 |
| 21 | 59 | 1 | 0 | 135 | 234 | 0 | 1 | 161 | 0 | 0.5 | 1 | 0 | 3 | 1 |
| 22 | 44 | 1 | 2 | 130 | 233 | 0 | 1 | 179 | 1 | 0.4 | 2 | 0 | 2 | 1 |
| 23 | 42 | 1 | 0 | 140 | 226 | 0 | 1 | 178 | 0 | 0 | 2 | 0 | 2 | 1 |
| 24 | 61 | 1 | 2 | 150 | 243 | 1 | 1 | 137 | 1 | 1 | 1 | 0 | 2 | 1 |
| 25 | 40 | 1 | 3 | 140 | 199 | 0 | 1 | 178 | 1 | 1.4 | 2 | 0 | 3 | 1 |
| 26 | 71 | 0 | 1 | 160 | 302 | 0 | 1 | 162 | 0 | 0.4 | 2 | 2 | 2 | 1 |
| 27 | 59 | 1 | 2 | 150 | 212 | 1 | 1 | 157 | 0 | 1.6 | 2 | 0 | 2 | 1 |
| 28 | 51 | 1 | 2 | 110 | 175 | 0 | 1 | 123 | 0 | 0.6 | 2 | 0 | 2 | 1 |
| 29 | 65 | 0 | 2 | 140 | 417 | 1 | 0 | 157 | 0 | 0.8 | 2 | 1 | 2 | 1 |
| 30 | 53 | 1 | 2 | 130 | 197 | 1 | 0 | 152 | 0 | 1.2 | 0 | 0 | 2 | 1 |
| 31 | 41 | 0 | 1 | 105 | 198 | 0 | 1 | 168 | 0 | 0 | 2 | 1 | 2 | 1 |
| 32 | 65 | 1 | 0 | 120 | 177 | 0 | 1 | 140 | 0 | 0.4 | 2 | 0 | 3 | 1 |
| 33 | 44 | 1 | 1 | 130 | 219 | 0 | 0 | 188 | 0 | 0 | 2 | 0 | 2 | 1 |
| 34 | 54 | 1 | 2 | 125 | 273 | 0 | 0 | 152 | 0 | 0.5 | 0 | 1 | 2 | 1 |
| 35 | 51 | 1 | 3 | 125 | 213 | 0 | 0 | 125 | 1 | 1.4 | 2 | 1 | 2 | 1 |
| 36 | 46 | 0 | 2 | 142 | 177 | 0 | 0 | 160 | 1 | 1.4 | 0 | 0 | 2 | 1 |
| 37 | 54 | 0 | 2 | 135 | 304 | 1 | 1 | 170 | 0 | 0 | 2 | 0 | 2 | 1 |
| 38 | 54 | 1 | 2 | 150 | 232 | 0 | 0 | 165 | 0 | 1.6 | 2 | 0 | 3 | 1 |
| 39 | 65 | 0 | 2 | 155 | 269 | 0 | 1 | 148 | 0 | 0.8 | 2 | 0 | 2 | 1 |
| 40 | 65 | 0 | 2 | 160 | 360 | 0 | 0 | 151 | 0 | 0.8 | 2 | 0 | 2 | 1 |
| 41 | 51 | 0 | 2 | 140 | 308 | 0 | 0 | 142 | 0 | 1.5 | 2 | 1 | 2 | 1 |
| 42 | 48 | 1 | 1 | 130 | 245 | 0 | 0 | 180 | 0 | 0.2 | 1 | 0 | 2 | 1 |
| 43 | 45 | 1 | 0 | 104 | 208 | 0 | 0 | 148 | 1 | 3 | 1 | 0 | 2 | 1 |
| 44 | 53 | 0 | 0 | 130 | 264 | 0 | 0 | 143 | 0 | 0.4 | 1 | 0 | 2 | 1 |

| Obs | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 45 | 39 | 1 | 2 | 140 | 321 | 0 | 0 | 182 | 0 | 0 | 2 | 0 | 2 | 1 |
| 46 | 52 | 1 | 1 | 120 | 325 | 0 | 1 | 172 | 0 | 0.2 | 2 | 0 | 2 | 1 |
| 47 | 44 | 1 | 2 | 140 | 235 | 0 | 0 | 180 | 0 | 0 | 2 | 0 | 2 | 1 |
| 48 | 47 | 1 | 2 | 138 | 257 | 0 | 0 | 156 | 0 | 0 | 2 | 0 | 2 | 1 |
| 49 | 53 | 0 | 2 | 128 | 216 | 0 | 0 | 115 | 0 | 0 | 2 | 0 | 0 | 1 |
| 50 | 53 | 0 | 0 | 138 | 234 | 0 | 0 | 160 | 0 | 0 | 2 | 0 | 2 | 1 |
| 51 | 51 | 0 | 2 | 130 | 256 | 0 | 0 | 149 | 0 | 0.5 | 2 | 0 | 2 | 1 |
| 52 | 66 | 1 | 0 | 120 | 302 | 0 | 0 | 151 | 0 | 0.4 | 1 | 0 | 2 | 1 |
| 53 | 62 | 1 | 2 | 130 | 231 | 0 | 1 | 146 | 0 | 1.8 | 1 | 3 | 3 | 1 |
| 54 | 44 | 0 | 2 | 108 | 141 | 0 | 1 | 175 | 0 | 0.6 | 1 | 0 | 2 | 1 |
| 55 | 63 | 0 | 2 | 135 | 252 | 0 | 0 | 172 | 0 | 0 | 2 | 0 | 2 | 1 |
| 56 | 52 | 1 | 1 | 134 | 201 | 0 | 1 | 158 | 0 | 0.8 | 2 | 1 | 2 | 1 |
| 57 | 48 | 1 | 0 | 122 | 222 | 0 | 0 | 186 | 0 | 0 | 2 | 0 | 2 | 1 |
| 58 | 45 | 1 | 0 | 115 | 260 | 0 | 0 | 185 | 0 | 0 | 2 | 0 | 2 | 1 |
| 59 | 34 | 1 | 3 | 118 | 182 | 0 | 0 | 174 | 0 | 0 | 2 | 0 | 2 | 1 |
| 60 | 57 | 0 | 0 | 128 | 303 | 0 | 0 | 159 | 0 | 0 | 2 | 1 | 2 | 1 |
| 61 | 71 | 0 | 2 | 110 | 265 | 1 | 0 | 130 | 0 | 0 | 2 | 1 | 2 | 1 |
| 62 | 54 | 1 | 1 | 108 | 309 | 0 | 1 | 156 | 0 | 0 | 2 | 0 | 3 | 1 |
| 63 | 52 | 1 | 3 | 118 | 186 | 0 | 0 | 190 | 0 | 0 | 1 | 0 | 1 | 1 |
| 64 | 41 | 1 | 1 | 135 | 203 | 0 | 1 | 132 | 0 | 0 | 1 | 0 | 1 | 1 |
| 65 | 58 | 1 | 2 | 140 | 211 | 1 | 0 | 165 | 0 | 0 | 2 | 0 | 2 | 1 |
| 66 | 35 | 0 | 0 | 138 | 183 | 0 | 1 | 182 | 0 | 1.4 | 2 | 0 | 2 | 1 |
| 67 | 51 | 1 | 2 | 100 | 222 | 0 | 1 | 143 | 1 | 1.2 | 1 | 0 | 2 | 1 |
| 68 | 45 | 0 | 1 | 130 | 234 | 0 | 0 | 175 | 0 | 0.6 | 1 | 0 | 2 | 1 |
| 69 | 44 | 1 | 1 | 120 | 220 | 0 | 1 | 170 | 0 | 0 | 2 | 0 | 2 | 1 |
| 70 | 62 | 0 | 0 | 124 | 209 | 0 | 1 | 163 | 0 | 0 | 2 | 0 | 2 | 1 |
| 71 | 54 | 1 | 2 | 120 | 258 | 0 | 0 | 147 | 0 | 0.4 | 1 | 0 | 3 | 1 |
| 72 | 51 | 1 | 2 | 94 | 227 | 0 | 1 | 154 | 1 | 0 | 2 | 1 | 3 | 1 |
| 73 | 29 | 1 | 1 | 130 | 204 | 0 | 0 | 202 | 0 | 0 | 2 | 0 | 2 | 1 |
| 74 | 51 | 1 | 0 | 140 | 261 | 0 | 0 | 186 | 1 | 0 | 2 | 0 | 2 | 1 |
| 75 | 43 | 0 | 2 | 122 | 213 | 0 | 1 | 165 | 0 | 0.2 | 1 | 0 | 2 | 1 |
| 76 | 55 | 0 | 1 | 135 | 250 | 0 | 0 | 161 | 0 | 1.4 | 1 | 0 | 2 | 1 |
| 77 | 51 | 1 | 2 | 125 | 245 | 1 | 0 | 166 | 0 | 2.4 | 1 | 0 | 2 | 1 |
| 78 | 59 | 1 | 1 | 140 | 221 | 0 | 1 | 164 | 1 | 0 | 2 | 0 | 2 | 1 |
| 79 | 52 | 1 | 1 | 128 | 205 | 1 | 1 | 184 | 0 | 0 | 2 | 0 | 2 | 1 |
| 80 | 58 | 1 | 2 | 105 | 240 | 0 | 0 | 154 | 1 | 0.6 | 1 | 0 | 3 | 1 |
| 81 | 41 | 1 | 2 | 112 | 250 | 0 | 1 | 179 | 0 | 0 | 2 | 0 | 2 | 1 |
| 82 | 45 | 1 | 1 | 128 | 308 | 0 | 0 | 170 | 0 | 0 | 2 | 0 | 2 | 1 |
| 83 | 60 | 0 | 2 | 102 | 318 | 0 | 1 | 160 | 0 | 0 | 2 | 1 | 2 | 1 |
| 84 | 52 | 1 | 3 | 152 | 298 | 1 | 1 | 178 | 0 | 1.2 | 1 | 0 | 3 | 1 |
| 85 | 42 | 0 | 0 | 102 | 265 | 0 | 0 | 122 | 0 | 0.6 | 1 | 0 | 2 | 1 |
| 86 | 67 | 0 | 2 | 115 | 564 | 0 | 0 | 160 | 0 | 1.6 | 1 | 0 | 3 | 1 |
| 87 | 68 | 1 | 2 | 118 | 277 | 0 | 1 | 151 | 0 | 1 | 2 | 1 | 3 | 1 |
| 88 | 46 | 1 | 1 | 101 | 197 | 1 | 1 | 156 | 0 | 0 | 2 | 0 | 3 | 1 |
| 89 | 54 | 0 | 2 | 110 | 214 | 0 | 1 | 158 | 0 | 1.6 | 1 | 0 | 2 | 1 |
| 90 | 58 | 0 | 0 | 100 | 248 | 0 | 0 | 122 | 0 | 1 | 1 | 0 | 2 | 1 |
| 91 | 48 | 1 | 2 | 124 | 255 | 1 | 1 | 175 | 0 | 0 | 2 | 2 | 2 | 1 |
| 92 | 57 | 1 | 0 | 132 | 207 | 0 | 1 | 168 | 1 | 0 | 2 | 0 | 3 | 1 |
| 93 | 52 | 1 | 2 | 138 | 223 | 0 | 1 | 169 | 0 | 0 | 2 | 4 | 2 | 1 |
| 94 | 54 | 0 | 1 | 132 | 288 | 1 | 0 | 159 | 1 | 0 | 2 | 1 | 2 | 1 |
| 95 | 45 | 0 | 1 | 112 | 160 | 0 | 1 | 138 | 0 | 0 | 1 | 0 | 2 | 1 |
| 96 | 53 | 1 | 0 | 142 | 226 | 0 | 0 | 111 | 1 | 0 | 2 | 0 | 3 | 1 |
| 97 | 62 | 0 | 0 | 140 | 394 | 0 | 0 | 157 | 0 | 1.2 | 1 | 0 | 2 | 1 |
| 98 | 52 | 1 | 0 | 108 | 233 | 1 | 1 | 147 | 0 | 0.1 | 2 | 3 | 3 | 1 |
| 99 | 43 | 1 | 2 | 130 | 315 | 0 | 1 | 162 | 0 | 1.9 | 2 | 1 | 2 | 1 |
| 100 | 53 | 1 | 2 | 130 | 246 | 1 | 0 | 173 | 0 | 0 | 2 | 3 | 2 | 1 |
| 101 | 42 | 1 | 3 | 148 | 244 | 0 | 0 | 178 | 0 | 0.8 | 2 | 2 | 2 | 1 |
| 102 | 59 | 1 | 3 | 178 | 270 | 0 | 0 | 145 | 0 | 4.2 | 0 | 0 | 3 | 1 |
| 103 | 63 | 0 | 1 | 140 | 195 | 0 | 1 | 179 | 0 | 0 | 2 | 2 | 2 | 1 |
| 104 | 42 | 1 | 2 | 120 | 240 | 1 | 1 | 194 | 0 | 0.8 | 0 | 0 | 3 | 1 |
| 105 | 50 | 1 | 2 | 129 | 196 | 0 | 1 | 163 | 0 | 0 | 2 | 0 | 2 | 1 |
| 106 | 68 | 0 | 2 | 120 | 211 | 0 | 0 | 115 | 0 | 1.5 | 1 | 0 | 2 | 1 |
| 107 | 69 | 1 | 3 | 160 | 234 | 1 | 0 | 131 | 0 | 0.1 | 1 | 1 | 2 | 1 |
| 108 | 45 | 0 | 0 | 138 | 236 | 0 | 0 | 152 | 1 | 0.2 | 1 | 0 | 2 | 1 |
| 109 | 50 | 0 | 1 | 120 | 244 | 0 | 1 | 162 | 0 | 1.1 | 2 | 0 | 2 | 1 |
| 110 | 50 | 0 | 0 | 110 | 254 | 0 | 0 | 159 | 0 | 0 | 2 | 0 | 2 | 1 |
| 111 | 64 | 0 | 0 | 180 | 325 | 0 | 1 | 154 | 1 | 0 | 2 | 0 | 2 | 1 |
| 112 | 57 | 1 | 2 | 150 | 126 | 1 | 1 | 173 | 0 | 0.2 | 2 | 1 | 3 | 1 |
| 113 | 64 | 0 | 2 | 140 | 313 | 0 | 1 | 133 | 0 | 0.2 | 2 | 0 | 3 | 1 |
| 114 | 43 | 1 | 0 | 110 | 211 | 0 | 1 | 161 | 0 | 0 | 2 | 0 | 3 | 1 |
| 115 | 55 | 1 | 1 | 130 | 262 | 0 | 1 | 155 | 0 | 0 | 2 | 0 | 2 | 1 |
| 116 | 37 | 0 | 2 | 120 | 215 | 0 | 1 | 170 | 0 | 0 | 2 | 0 | 2 | 1 |
| 117 | 41 | 1 | 2 | 130 | 214 | 0 | 0 | 168 | 0 | 2 | 1 | 0 | 2 | 1 |
| 118 | 56 | 1 | 3 | 120 | 193 | 0 | 0 | 162 | 0 | 1.9 | 1 | 0 | 3 | 1 |
| 119 | 46 | 0 | 1 | 105 | 204 | 0 | 1 | 172 | 0 | 0 | 2 | 0 | 2 | 1 |
| 120 | 46 | 0 | 0 | 138 | 243 | 0 | 0 | 152 | 1 | 0 | 1 | 0 | 2 | 1 |
| 121 | 64 | 0 | 0 | 130 | 303 | 0 | 1 | 122 | 0 | 2 | 1 | 2 | 2 | 1 |
| 122 | 59 | 1 | 0 | 138 | 271 | 0 | 0 | 182 | 0 | 0 | 2 | 0 | 2 | 1 |
| 123 | 41 | 0 | 2 | 112 | 268 | 0 | 0 | 172 | 1 | 0 | 2 | 0 | 2 | 1 |
| 124 | 54 | 0 | 2 | 108 | 267 | 0 | 0 | 167 | 0 | 0 | 2 | 0 | 2 | 1 |

| Obs | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 125 | 39 | 0 | 2 | 94 | 199 | 0 | 1 | 179 | 0 | 0 | 2 | 0 | 2 | 1 |
| 126 | 34 | 0 | 1 | 118 | 210 | 0 | 1 | 192 | 0 | 0.7 | 2 | 0 | 2 | 1 |
| 127 | 47 | 1 | 0 | 112 | 204 | 0 | 1 | 143 | 0 | 0.1 | 2 | 0 | 2 | 1 |
| 128 | 67 | 0 | 2 | 152 | 277 | 0 | 1 | 172 | 0 | 0 | 2 | 1 | 2 | 1 |
| 129 | 52 | 0 | 2 | 136 | 196 | 0 | 0 | 169 | 0 | 0.1 | 1 | 0 | 2 | 1 |
| 130 | 74 | 0 | 1 | 120 | 269 | 0 | 0 | 121 | 1 | 0.2 | 2 | 1 | 2 | 1 |
| 131 | 54 | 0 | 2 | 160 | 201 | 0 | 1 | 163 | 0 | 0 | 2 | 1 | 2 | 1 |
| 132 | 49 | 0 | 1 | 134 | 271 | 0 | 1 | 162 | 0 | 0 | 1 | 0 | 2 | 1 |
| 133 | 42 | 1 | 1 | 120 | 295 | 0 | 1 | 162 | 0 | 0 | 2 | 0 | 2 | 1 |
| 134 | 41 | 1 | 1 | 110 | 235 | 0 | 1 | 153 | 0 | 0 | 2 | 0 | 2 | 1 |
| 135 | 41 | 0 | 1 | 126 | 306 | 0 | 1 | 163 | 0 | 0 | 2 | 0 | 2 | 1 |
| 136 | 49 | 0 | 0 | 130 | 269 | 0 | 1 | 163 | 0 | 0 | 2 | 0 | 2 | 1 |
| 137 | 60 | 0 | 2 | 120 | 178 | 1 | 1 | 96 | 0 | 0 | 2 | 0 | 2 | 1 |
| 138 | 62 | 1 | 1 | 128 | 208 | 1 | 0 | 140 | 0 | 0 | 2 | 0 | 2 | 1 |
| 139 | 57 | 1 | 0 | 110 | 201 | 0 | 1 | 126 | 1 | 1.5 | 1 | 0 | 1 | 1 |
| 140 | 64 | 1 | 0 | 128 | 263 | 0 | 1 | 105 | 1 | 0.2 | 1 | 1 | 3 | 1 |
| 141 | 51 | 0 | 2 | 120 | 295 | 0 | 0 | 157 | 0 | 0.6 | 2 | 0 | 2 | 1 |
| 142 | 43 | 1 | 0 | 115 | 303 | 0 | 1 | 181 | 0 | 1.2 | 1 | 0 | 2 | 1 |
| 143 | 42 | 0 | 2 | 120 | 209 | 0 | 1 | 173 | 0 | 0 | 1 | 0 | 2 | 1 |
| 144 | 67 | 0 | 0 | 106 | 223 | 0 | 1 | 142 | 0 | 0.3 | 2 | 2 | 2 | 1 |
| 145 | 76 | 0 | 2 | 140 | 197 | 0 | 2 | 116 | 0 | 1.1 | 1 | 0 | 2 | 1 |
| 146 | 70 | 1 | 1 | 156 | 245 | 0 | 0 | 143 | 0 | 0 | 2 | 0 | 2 | 1 |
| 147 | 44 | 0 | 2 | 118 | 242 | 0 | 1 | 149 | 0 | 0.3 | 1 | 1 | 2 | 1 |
| 148 | 60 | 0 | 3 | 150 | 240 | 0 | 1 | 171 | 0 | 0.9 | 2 | 0 | 2 | 1 |
| 149 | 44 | 1 | 2 | 120 | 226 | 0 | 1 | 169 | 0 | 0 | 2 | 0 | 2 | 1 |
| 150 | 42 | 1 | 2 | 130 | 180 | 0 | 1 | 150 | 0 | 0 | 2 | 0 | 2 | 1 |
| 151 | 66 | 1 | 0 | 160 | 228 | 0 | 0 | 138 | 0 | 2.3 | 2 | 0 | 1 | 1 |
| 152 | 71 | 0 | 0 | 112 | 149 | 0 | 1 | 125 | 0 | 1.6 | 1 | 0 | 2 | 1 |
| 153 | 64 | 1 | 3 | 170 | 227 | 0 | 0 | 155 | 0 | 0.6 | 1 | 0 | 3 | 1 |
| 154 | 66 | 0 | 2 | 146 | 278 | 0 | 0 | 152 | 0 | 0 | 1 | 1 | 2 | 1 |
| 155 | 39 | 0 | 2 | 138 | 220 | 0 | 1 | 152 | 0 | 0 | 1 | 0 | 2 | 1 |
| 156 | 58 | 0 | 0 | 130 | 197 | 0 | 1 | 131 | 0 | 0.6 | 1 | 0 | 2 | 1 |
| 157 | 47 | 1 | 2 | 130 | 253 | 0 | 1 | 179 | 0 | 0 | 2 | 0 | 2 | 1 |
| 158 | 35 | 1 | 1 | 122 | 192 | 0 | 1 | 174 | 0 | 0 | 2 | 0 | 2 | 1 |
| 159 | 58 | 1 | 1 | 125 | 220 | 0 | 1 | 144 | 0 | 0.4 | 1 | 4 | 3 | 1 |
| 160 | 56 | 1 | 1 | 130 | 221 | 0 | 0 | 163 | 0 | 0 | 2 | 0 | 3 | 1 |
| 161 | 56 | 1 | 1 | 120 | 240 | 0 | 1 | 169 | 0 | 0 | 0 | 0 | 2 | 1 |
| 162 | 55 | 0 | 1 | 132 | 342 | 0 | 1 | 166 | 0 | 1.2 | 2 | 0 | 2 | 1 |
| 163 | 41 | 1 | 1 | 120 | 157 | 0 | 1 | 182 | 0 | 0 | 2 | 0 | 2 | 1 |
| 164 | 38 | 1 | 2 | 138 | 175 | 0 | 1 | 173 | 0 | 0 | 2 | 4 | 2 | 1 |
| 165 | 38 | 1 | 2 | 138 | 175 | 0 | 1 | 173 | 0 | 0 | 2 | 4 | 2 | 1 |
| 166 | 67 | 1 | 0 | 160 | 286 | 0 | 0 | 108 | 1 | 1.5 | 1 | 3 | 2 | 0 |
| 167 | 67 | 1 | 0 | 120 | 229 | 0 | 0 | 129 | 1 | 2.6 | 1 | 2 | 3 | 0 |
| 168 | 62 | 0 | 0 | 140 | 268 | 0 | 0 | 160 | 0 | 3.6 | 0 | 2 | 2 | 0 |
| 169 | 63 | 1 | 0 | 130 | 254 | 0 | 0 | 147 | 0 | 1.4 | 1 | 1 | 3 | 0 |
| 170 | 53 | 1 | 0 | 140 | 203 | 1 | 0 | 155 | 1 | 3.1 | 0 | 0 | 3 | 0 |
| 171 | 56 | 1 | 2 | 130 | 256 | 1 | 0 | 142 | 1 | 0.6 | 1 | 1 | 1 | 0 |
| 172 | 48 | 1 | 1 | 110 | 229 | 0 | 1 | 168 | 0 | 1 | 0 | 0 | 3 | 0 |
| 173 | 58 | 1 | 1 | 120 | 284 | 0 | 0 | 160 | 0 | 1.8 | 1 | 0 | 2 | 0 |
| 174 | 58 | 1 | 2 | 132 | 224 | 0 | 0 | 173 | 0 | 3.2 | 2 | 2 | 3 | 0 |
| 175 | 60 | 1 | 0 | 130 | 206 | 0 | 0 | 132 | 1 | 2.4 | 1 | 2 | 3 | 0 |
| 176 | 40 | 1 | 0 | 110 | 167 | 0 | 0 | 114 | 1 | 2 | 1 | 0 | 3 | 0 |
| 177 | 60 | 1 | 0 | 117 | 230 | 1 | 1 | 160 | 1 | 1.4 | 2 | 2 | 3 | 0 |
| 178 | 64 | 1 | 2 | 140 | 335 | 0 | 1 | 158 | 0 | 0 | 2 | 0 | 2 | 0 |
| 179 | 43 | 1 | 0 | 120 | 177 | 0 | 0 | 120 | 1 | 2.5 | 1 | 0 | 3 | 0 |
| 180 | 57 | 1 | 0 | 150 | 276 | 0 | 0 | 112 | 1 | 0.6 | 1 | 1 | 1 | 0 |
| 181 | 55 | 1 | 0 | 132 | 353 | 0 | 1 | 132 | 1 | 1.2 | 1 | 1 | 3 | 0 |
| 182 | 65 | 0 | 0 | 150 | 225 | 0 | 0 | 114 | 0 | 1 | 1 | 3 | 3 | 0 |
| 183 | 61 | 0 | 0 | 130 | 330 | 0 | 0 | 169 | 0 | 0 | 2 | 0 | 2 | 0 |
| 184 | 58 | 1 | 2 | 112 | 230 | 0 | 0 | 165 | 0 | 2.5 | 1 | 1 | 3 | 0 |
| 185 | 50 | 1 | 0 | 150 | 243 | 0 | 0 | 128 | 0 | 2.6 | 1 | 0 | 3 | 0 |
| 186 | 44 | 1 | 0 | 112 | 290 | 0 | 0 | 153 | 0 | 0 | 2 | 1 | 2 | 0 |
| 187 | 60 | 1 | 0 | 130 | 253 | 0 | 1 | 144 | 1 | 1.4 | 2 | 1 | 3 | 0 |
| 188 | 54 | 1 | 0 | 124 | 266 | 0 | 0 | 109 | 1 | 2.2 | 1 | 1 | 3 | 0 |
| 189 | 50 | 1 | 2 | 140 | 233 | 0 | 1 | 163 | 0 | 0.6 | 1 | 1 | 3 | 0 |
| 190 | 41 | 1 | 0 | 110 | 172 | 0 | 0 | 158 | 0 | 0 | 2 | 0 | 3 | 0 |
| 191 | 51 | 0 | 0 | 130 | 305 | 0 | 1 | 142 | 1 | 1.2 | 1 | 0 | 3 | 0 |
| 192 | 58 | 1 | 0 | 128 | 216 | 0 | 0 | 131 | 1 | 2.2 | 1 | 3 | 3 | 0 |
| 193 | 54 | 1 | 0 | 120 | 188 | 0 | 1 | 113 | 0 | 1.4 | 1 | 1 | 3 | 0 |
| 194 | 60 | 1 | 0 | 145 | 282 | 0 | 0 | 142 | 1 | 2.8 | 1 | 2 | 3 | 0 |
| 195 | 60 | 1 | 2 | 140 | 185 | 0 | 0 | 155 | 0 | 3 | 1 | 0 | 2 | 0 |
| 196 | 59 | 1 | 0 | 170 | 326 | 0 | 0 | 140 | 1 | 3.4 | 0 | 0 | 3 | 0 |
| 197 | 46 | 1 | 2 | 150 | 231 | 0 | 1 | 147 | 0 | 3.6 | 1 | 0 | 2 | 0 |
| 198 | 67 | 1 | 0 | 125 | 254 | 1 | 1 | 163 | 0 | 0.2 | 1 | 2 | 3 | 0 |
| 199 | 62 | 1 | 0 | 120 | 267 | 0 | 1 | 99 | 1 | 1.8 | 1 | 2 | 3 | 0 |
| 200 | 65 | 1 | 0 | 110 | 248 | 0 | 0 | 158 | 0 | 0.6 | 2 | 2 | 1 | 0 |
| 201 | 44 | 1 | 0 | 110 | 197 | 0 | 0 | 177 | 0 | 0 | 2 | 1 | 2 | 0 |
| 202 | 60 | 1 | 0 | 125 | 258 | 0 | 0 | 141 | 1 | 2.8 | 1 | 1 | 3 | 0 |
| 203 | 58 | 1 | 0 | 150 | 270 | 0 | 0 | 111 | 1 | 0.8 | 2 | 0 | 3 | 0 |
| 204 | 68 | 1 | 2 | 180 | 274 | 1 | 0 | 150 | 1 | 1.6 | 1 | 0 | 3 | 0 |

| Obs | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 205 | 62 | 0 | 0 | 160 | 164 | 0 | 0 | 145 | 0 | 6.2 | 0 | 3 | 3 | 0 |
| 206 | 52 | 1 | 0 | 128 | 255 | 0 | 1 | 161 | 1 | 0 | 2 | 1 | 3 | 0 |
| 207 | 59 | 1 | 0 | 110 | 239 | 0 | 0 | 142 | 1 | 1.2 | 1 | 1 | 3 | 0 |
| 208 | 60 | 0 | 0 | 150 | 258 | 0 | 0 | 157 | 0 | 2.6 | 1 | 2 | 3 | 0 |
| 209 | 49 | 1 | 2 | 120 | 188 | 0 | 1 | 139 | 0 | 2 | 1 | 3 | 3 | 0 |
| 210 | 59 | 1 | 0 | 140 | 177 | 0 | 1 | 162 | 1 | 0 | 2 | 1 | 3 | 0 |
| 211 | 57 | 1 | 2 | 128 | 229 | 0 | 0 | 150 | 0 | 0.4 | 1 | 1 | 3 | 0 |
| 212 | 61 | 1 | 0 | 120 | 260 | 0 | 1 | 140 | 1 | 3.6 | 1 | 1 | 3 | 0 |
| 213 | 39 | 1 | 0 | 118 | 219 | 0 | 1 | 140 | 0 | 1.2 | 1 | 0 | 3 | 0 |
| 214 | 61 | 0 | 0 | 145 | 307 | 0 | 0 | 146 | 1 | 1 | 1 | 0 | 3 | 0 |
| 215 | 56 | 1 | 0 | 125 | 249 | 1 | 0 | 144 | 1 | 1.2 | 1 | 1 | 2 | 0 |
| 216 | 43 | 0 | 0 | 132 | 341 | 1 | 0 | 136 | 1 | 3 | 1 | 0 | 3 | 0 |
| 217 | 62 | 0 | 2 | 130 | 263 | 0 | 1 | 97 | 0 | 1.2 | 1 | 1 | 3 | 0 |
| 218 | 63 | 1 | 0 | 130 | 330 | 1 | 0 | 132 | 1 | 1.8 | 2 | 3 | 3 | 0 |
| 219 | 65 | 1 | 0 | 135 | 254 | 0 | 0 | 127 | 0 | 2.8 | 1 | 1 | 3 | 0 |
| 220 | 48 | 1 | 0 | 130 | 256 | 1 | 0 | 150 | 1 | 0 | 2 | 2 | 3 | 0 |
| 221 | 63 | 0 | 0 | 150 | 407 | 0 | 0 | 154 | 0 | 4 | 1 | 3 | 3 | 0 |
| 222 | 55 | 1 | 0 | 140 | 217 | 0 | 1 | 111 | 1 | 5.6 | 0 | 0 | 3 | 0 |
| 223 | 65 | 1 | 3 | 138 | 282 | 1 | 0 | 174 | 0 | 1.4 | 1 | 1 | 2 | 0 |
| 224 | 56 | 0 | 0 | 200 | 288 | 1 | 0 | 133 | 1 | 4 | 0 | 2 | 3 | 0 |
| 225 | 54 | 1 | 0 | 110 | 239 | 0 | 1 | 126 | 1 | 2.8 | 1 | 1 | 3 | 0 |
| 226 | 70 | 1 | 0 | 145 | 174 | 0 | 1 | 125 | 1 | 2.6 | 0 | 0 | 3 | 0 |
| 227 | 62 | 1 | 1 | 120 | 281 | 0 | 0 | 103 | 0 | 1.4 | 1 | 1 | 3 | 0 |
| 228 | 35 | 1 | 0 | 120 | 198 | 0 | 1 | 130 | 1 | 1.6 | 1 | 0 | 3 | 0 |
| 229 | 59 | 1 | 3 | 170 | 288 | 0 | 0 | 159 | 0 | 0.2 | 1 | 0 | 3 | 0 |
| 230 | 64 | 1 | 2 | 125 | 309 | 0 | 1 | 131 | 1 | 1.8 | 1 | 0 | 3 | 0 |
| 231 | 47 | 1 | 2 | 108 | 243 | 0 | 1 | 152 | 0 | 0 | 2 | 0 | 2 | 0 |
| 232 | 57 | 1 | 0 | 165 | 289 | 1 | 0 | 124 | 0 | 1 | 1 | 3 | 3 | 0 |
| 233 | 55 | 1 | 0 | 160 | 289 | 0 | 0 | 145 | 1 | 0.8 | 1 | 1 | 3 | 0 |
| 234 | 64 | 1 | 0 | 120 | 246 | 0 | 0 | 96 | 1 | 2.2 | 0 | 1 | 2 | 0 |
| 235 | 70 | 1 | 0 | 130 | 322 | 0 | 0 | 109 | 0 | 2.4 | 1 | 3 | 2 | 0 |
| 236 | 51 | 1 | 0 | 140 | 299 | 0 | 1 | 173 | 1 | 1.6 | 2 | 0 | 3 | 0 |
| 237 | 58 | 1 | 0 | 125 | 300 | 0 | 0 | 171 | 0 | 0 | 2 | 2 | 3 | 0 |
| 238 | 60 | 1 | 0 | 140 | 293 | 0 | 0 | 170 | 0 | 1.2 | 1 | 2 | 3 | 0 |
| 239 | 77 | 1 | 0 | 125 | 304 | 0 | 0 | 162 | 1 | 0 | 2 | 3 | 2 | 0 |
| 240 | 35 | 1 | 0 | 126 | 282 | 0 | 0 | 156 | 1 | 0 | 2 | 0 | 3 | 0 |
| 241 | 70 | 1 | 2 | 160 | 269 | 0 | 1 | 112 | 1 | 2.9 | 1 | 1 | 3 | 0 |
| 242 | 59 | 0 | 0 | 174 | 249 | 0 | 1 | 143 | 1 | 0 | 1 | 0 | 2 | 0 |
| 243 | 64 | 1 | 0 | 145 | 212 | 0 | 0 | 132 | 0 | 2 | 1 | 2 | 1 | 0 |
| 244 | 57 | 1 | 0 | 152 | 274 | 0 | 1 | 88 | 1 | 1.2 | 1 | 1 | 3 | 0 |
| 245 | 56 | 1 | 0 | 132 | 184 | 0 | 0 | 105 | 1 | 2.1 | 1 | 1 | 1 | 0 |
| 246 | 48 | 1 | 0 | 124 | 274 | 0 | 0 | 166 | 0 | 0.5 | 1 | 0 | 3 | 0 |
| 247 | 56 | 0 | 0 | 134 | 409 | 0 | 0 | 150 | 1 | 1.9 | 1 | 2 | 3 | 0 |
| 248 | 66 | 1 | 1 | 160 | 246 | 0 | 1 | 120 | 1 | 0 | 1 | 3 | 1 | 0 |
| 249 | 54 | 1 | 1 | 192 | 283 | 0 | 0 | 195 | 0 | 0 | 2 | 1 | 3 | 0 |
| 250 | 69 | 1 | 2 | 140 | 254 | 0 | 0 | 146 | 0 | 2 | 1 | 3 | 3 | 0 |
| 251 | 51 | 1 | 0 | 140 | 298 | 0 | 1 | 122 | 1 | 4.2 | 1 | 3 | 3 | 0 |
| 252 | 43 | 1 | 0 | 132 | 247 | 1 | 0 | 143 | 1 | 0.1 | 1 | 4 | 3 | 0 |
| 253 | 62 | 0 | 0 | 138 | 294 | 1 | 1 | 106 | 0 | 1.9 | 1 | 3 | 2 | 0 |
| 254 | 67 | 1 | 0 | 100 | 299 | 0 | 0 | 125 | 1 | 0.9 | 1 | 2 | 2 | 0 |
| 255 | 59 | 1 | 3 | 160 | 273 | 0 | 0 | 125 | 0 | 0 | 2 | 0 | 2 | 0 |
| 256 | 45 | 1 | 0 | 142 | 309 | 0 | 0 | 147 | 1 | 0 | 1 | 3 | 3 | 0 |
| 257 | 58 | 1 | 0 | 128 | 259 | 0 | 0 | 130 | 1 | 3 | 1 | 2 | 3 | 0 |
| 258 | 50 | 1 | 0 | 144 | 200 | 0 | 0 | 126 | 1 | 0.9 | 1 | 0 | 3 | 0 |
| 259 | 62 | 0 | 0 | 150 | 244 | 0 | 1 | 154 | 1 | 1.4 | 1 | 0 | 2 | 0 |
| 260 | 38 | 1 | 3 | 120 | 231 | 0 | 1 | 182 | 1 | 3.8 | 1 | 0 | 3 | 0 |
| 261 | 66 | 0 | 0 | 178 | 228 | 1 | 1 | 165 | 1 | 1 | 1 | 2 | 3 | 0 |
| 262 | 52 | 1 | 0 | 112 | 230 | 0 | 1 | 160 | 0 | 0 | 2 | 1 | 2 | 0 |
| 263 | 53 | 1 | 0 | 123 | 282 | 0 | 1 | 95 | 1 | 2 | 1 | 2 | 3 | 0 |
| 264 | 63 | 0 | 0 | 108 | 269 | 0 | 1 | 169 | 1 | 1.8 | 1 | 2 | 2 | 0 |
| 265 | 54 | 1 | 0 | 110 | 206 | 0 | 0 | 108 | 1 | 0 | 1 | 1 | 2 | 0 |
| 266 | 66 | 1 | 0 | 112 | 212 | 0 | 0 | 132 | 1 | 0.1 | 2 | 1 | 2 | 0 |
| 267 | 55 | 0 | 0 | 180 | 327 | 0 | 2 | 117 | 1 | 3.4 | 1 | 0 | 2 | 0 |
| 268 | 49 | 1 | 2 | 118 | 149 | 0 | 0 | 126 | 0 | 0.8 | 2 | 3 | 2 | 0 |
| 269 | 54 | 1 | 0 | 122 | 286 | 0 | 0 | 116 | 1 | 3.2 | 1 | 2 | 2 | 0 |
| 270 | 56 | 1 | 0 | 130 | 283 | 1 | 0 | 103 | 1 | 1.6 | 0 | 0 | 3 | 0 |
| 271 | 46 | 1 | 0 | 120 | 249 | 0 | 0 | 144 | 0 | 0.8 | 2 | 0 | 3 | 0 |
| 272 | 61 | 1 | 3 | 134 | 234 | 0 | 1 | 145 | 0 | 2.6 | 1 | 2 | 2 | 0 |
| 273 | 67 | 1 | 0 | 120 | 237 | 0 | 1 | 71 | 0 | 1 | 1 | 0 | 2 | 0 |
| 274 | 58 | 1 | 0 | 100 | 234 | 0 | 1 | 156 | 0 | 0.1 | 2 | 1 | 3 | 0 |
| 275 | 47 | 1 | 0 | 110 | 275 | 0 | 0 | 118 | 1 | 1 | 1 | 1 | 2 | 0 |
| 276 | 52 | 1 | 0 | 125 | 212 | 0 | 1 | 168 | 0 | 1 | 2 | 2 | 3 | 0 |
| 277 | 58 | 1 | 0 | 146 | 218 | 0 | 1 | 105 | 0 | 2 | 1 | 1 | 3 | 0 |
| 278 | 57 | 1 | 1 | 124 | 261 | 0 | 1 | 141 | 0 | 0.3 | 2 | 0 | 3 | 0 |
| 279 | 58 | 0 | 1 | 136 | 319 | 1 | 0 | 152 | 0 | 0 | 2 | 2 | 2 | 0 |
| 280 | 61 | 1 | 0 | 138 | 166 | 0 | 0 | 125 | 1 | 3.6 | 1 | 1 | 2 | 0 |
| 281 | 42 | 1 | 0 | 136 | 315 | 0 | 1 | 125 | 1 | 1.8 | 1 | 0 | 1 | 0 |
| 282 | 52 | 1 | 0 | 128 | 204 | 1 | 1 | 156 | 1 | 1 | 1 | 0 | 0 | 0 |
| 283 | 59 | 1 | 2 | 126 | 218 | 1 | 1 | 134 | 0 | 2.2 | 1 | 1 | 1 | 0 |
| 284 | 40 | 1 | 0 | 152 | 223 | 0 | 1 | 181 | 0 | 0 | 2 | 0 | 3 | 0 |

| Obs | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 285 | 61 | 1 | 0 | 140 | 207 | 0 | 0 | 138 | 1 | 1.9 | 2 | 1 | 3 | 0 |
| 286 | 46 | 1 | 0 | 140 | 311 | 0 | 1 | 120 | 1 | 1.8 | 1 | 2 | 3 | 0 |
| 287 | 59 | 1 | 3 | 134 | 204 | 0 | 1 | 162 | 0 | 0.8 | 2 | 2 | 2 | 0 |
| 288 | 57 | 1 | 1 | 154 | 232 | 0 | 0 | 164 | 0 | 0 | 2 | 1 | 2 | 0 |
| 289 | 57 | 1 | 0 | 110 | 335 | 0 | 1 | 143 | 1 | 3 | 1 | 1 | 3 | 0 |
| 290 | 55 | 0 | 0 | 128 | 205 | 0 | 2 | 130 | 1 | 2 | 1 | 1 | 3 | 0 |
| 291 | 61 | 1 | 0 | 148 | 203 | 0 | 1 | 161 | 0 | 0 | 2 | 1 | 3 | 0 |
| 292 | 58 | 1 | 0 | 114 | 318 | 0 | 2 | 140 | 0 | 4.4 | 0 | 3 | 1 | 0 |
| 293 | 58 | 0 | 0 | 170 | 225 | 1 | 0 | 146 | 1 | 2.8 | 1 | 2 | 1 | 0 |
| 294 | 67 | 1 | 2 | 152 | 212 | 0 | 0 | 150 | 0 | 0.8 | 1 | 0 | 3 | 0 |
| 295 | 44 | 1 | 0 | 120 | 169 | 0 | 1 | 144 | 1 | 2.8 | 0 | 0 | 1 | 0 |
| 296 | 63 | 1 | 0 | 140 | 187 | 0 | 0 | 144 | 1 | 4 | 2 | 2 | 3 | 0 |
| 297 | 63 | 0 | 0 | 124 | 197 | 0 | 1 | 136 | 1 | 0 | 1 | 0 | 2 | 0 |
| 298 | 59 | 1 | 0 | 164 | 176 | 1 | 0 | 90 | 0 | 1 | 1 | 2 | 1 | 0 |
| 299 | 57 | 0 | 0 | 140 | 241 | 0 | 1 | 123 | 1 | 0.2 | 1 | 0 | 3 | 0 |
| 300 | 45 | 1 | 3 | 110 | 264 | 0 | 1 | 132 | 0 | 1.2 | 1 | 0 | 3 | 0 |
| 301 | 68 | 1 | 0 | 144 | 193 | 1 | 1 | 141 | 0 | 3.4 | 1 | 2 | 3 | 0 |
| 302 | 57 | 1 | 0 | 130 | 131 | 0 | 1 | 115 | 1 | 1.2 | 1 | 1 | 3 | 0 |
| 303 | 57 | 0 | 1 | 130 | 236 | 0 | 0 | 174 | 0 | 0 | 1 | 1 | 2 | 0 |