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      "from sklearn.impute import SimpleImputer\n",
      "from sklearn.model_selection import train_test_split\n",
      "from sklearn.model_selection import GridSearchCV\n",
      "from sklearn.metrics import roc_curve, auc, roc_auc_score, classification_report,
confusion_matrix, make_scorer\n",
      "from sklearn.tree import DecisionTreeClassifier\n",
      "from sklearn import neighbors\n",
      "from sklearn import preprocessing\n",
      "from sklearn.ensemble import RandomForestClassifier, GradientBoostingClassifier,
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      "from sklearn.neighbors import KNeighborsClassifier\n",
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      "  \"(https://pypi.org/project/six/).\", FutureWarning)\n",
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    "                    names = list(original.columns))\n",
    "\n",
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    "    axes[j,i+(j*(-4))].set_title(cols[i], fontsize=8)\n",
    "    a=df_filter[cols[i]].value_counts()/len(df_filter)\n",
    "    plots = a.head(6).plot(kind='bar', ax = axes[j,i+(j*(-4))])\n",
    "    plt.ylim((0,a.max()+0.10))\n",
    "    for bar in plots.patches:\n",
    "      plots.annotate(format(bar.get_height(), '.2f'),\n",
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    "      <td>Camisas</td>\n",
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  "'M[38-39]':3, \n",
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  "'XXXL[46-48]':7,\n",
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  "'M':4, \n",
  "'L':5, \n",
  "'XL':6,\n",
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  "'28/XS':2,\n",
  "'30/S':3, \n",
  "'32/M':4,\n",
  "'34/L':5,\n",
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```

```
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      "\n",
      "df_filter['Size'] = df_filter['Size'].astype('category')\n",
      "df_filter['Ordinal_size'] = df_filter['Size'].map(dict_size)\n",
      "\n",
      "#Creacion variables adicionales: IMC y ordinal_size\n",
      "df_validacion_filter['imc']=
df_validacion_filter['Weight']/((df_validacion_filter['Height']/100)*(df_validacion_filter['Height']/100))\n
",
      "\n",
      "df_validacion_filter['Size'] = df_validacion_filter['Size'].astype('category')\n",
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```

```
      "df_filter['segmento_imc']=np.where(df_filter['imc']< 18.5,1,np.where(df_filter['imc']<
25,2,np.where(df_filter['imc']< 30,3,4)))\n",
      "\n",
      "df_validacion_filter['segmento_imc']=np.where(df_validacion_filter['imc']<
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"     <th>Height</th>\n",
"     <th>Item</th>\n",
"     <th>Size</th>\n",
"     <th>Date</th>\n",
"     <th>Survey</th>\n",
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"     <td>Polos</td>\n",
```

```
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  "print(df_filter.groupby(by=['Body Section','Gender','Size']).count())"
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```

```
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      "for i in list(df_filter['Ordinal_size'].unique()):\n",
      "  for j in list(df['Survey'].unique()):\n",
      "    df_temp[j].loc[[i]] =
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       "    x =
df_filter[(df_filter['Gender']==i)&(df_filter['Survey']==0)&(df_filter['Body_Type']==j)]['imc']\n",
       "    y =
df_filter[(df_filter['Gender']==i)&(df_filter['Survey']==1)&(df_filter['Body_Type']==j)]['imc']\n",
       "    res = stats.ttest_ind(x,y)\n",
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      "  # finding the 3rd quartile\n",
      "  q3 = np.quantile(arr1, 0.75)\n",
      "  med = np.median(arr1)\n",
      "  \n",
      "  # finding the iqr region\n",
      "  iqr = q3-q1\n",
      "  \n",
      "  # finding upper and lower whiskers\n",
      "  upper_bound = q3+(1.5*iqr)\n",
      "  lower_bound = q1-(1.5*iqr)\n",
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      "  outliers = filter(lambda x: x < lower_bound or x > upper_bound, arr1)\n",
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      "\n",
      "for h in df_filter['Gender'].unique():\n",
      "  for i in df_filter['Survey'].unique():\n",
      "    for j in df_filter['Body_Type'].unique(): \n",
      "      temp = df_filter[(df_filter['Survey']==i)&(df_filter['Body_Type']==j)&(df_filter['Gender']==h)]['imc']\n",
      "      n_outliers = len(find_outliers(temp))\n",
      "      df_outliers.loc[j,i] = n_outliers\n",
      "      df_outliers_perc.loc[j,i]= (n_outliers/len(temp))*100\n",
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"y = []\n",
"for i in list(df_filter['Gender'].unique()):\n",
"    x = df_filter[(df_filter['Gender']==i)&(df_filter['Survey']==0)]['Weight']\n",
"    y = df_filter[(df_filter['Gender']==i)&(df_filter['Survey']==1)]['Weight']\n",
"    print(x.mean(),y.mean())\n",
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"    print(\"p-value para \",i, res[1])"
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"\n",
"contigency= pd.crosstab(df_filter[df_filter['Gender']== gender]['Survey'], df_filter[df_filter['Gender']== gender][variable]) \n",
```

```
      "contigency_pct = pd.crosstab(df_filter[df_filter['Gender']== gender]['Survey'],
df_filter[df_filter['Gender']== gender][variable] , normalize='index')\n",
      "\n",
      "print(contigency_pct)\n",
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      "# Chi-square test of independence. \n",
      "c, p, dof, expected = chi2_contingency(contigency)\n",
      "# Print the p-value\n",
      "print('\\n P-value chi cuadrado: ',p)\n",
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      "        lab[(y, str(x))]= contigency.loc[int(y)][x]\n",
      "mosaic(df_filter[df_filter['Gender']== gender], ['Survey', variable], properties=props, gap = 0.04,
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      "plt.rcParams.update({'font.size': 28})\n",
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  "np.random.seed(0)\n",
  "X_train, X_val, y_train, y_val = train_test_split(X,y, test_size = 0.15, stratify=y)\n",
  "indices_train = list(X_train.index.values)\n",
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  "print(X_train.shape)\n",
  "print(X_val.shape)\n",
  "print(y_train.shape)\n",
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  "print(list(set(list(X_train.index.values)) & set(list(X_val.index.values))))"
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  "undersample = RandomUnderSampler(1, random_state=0)\n",
  "X_balanced , y_balanced = undersample.fit_resample(X_balanced , y_balanced)\n",
  "\n",
  "X_train = pd.DataFrame(X_balanced, columns = list(X_train.columns))\n",
  "y_train = list(y_balanced)\n",
  "\n",
  "#Verificar que la base de train si quedo balanceada y la de test mantiene la proporcion inicial\n",
  "print(np.unique(y_train, return_counts=True))\n",
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     "#classifier = AdaBoostClassifier(base_estimator=DecisionTreeClassifier(max_leaf_nodes = 20, max_features=3), random_state=0,n_estimators=100)\n",
```

```
"#classifier = GradientBoostingClassifier(random_state = 0, max_leaf_nodes = 7,  max_features=5, n_estimators = 70)\n",
"classifier = DecisionTreeClassifier(max_leaf_nodes = 13, random_state =0,  criterion= 'gini') \n",
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"# Entrenamos el modelo classifier_RF con los datos de entrenamiento\n",
"classifier.fit(X_train, y_train)\n",
"class_threshold = 0.25\n",
"\n",
"# Usamos el modelo desarrollado, para predecir sobre los datos de validación\n",
"y_pred_prob_val = classifier.predict_proba(X_val)[:,1] # probabilities \n",
"y_pred_val = np.where(y_pred_prob_val > class_threshold, 1, 0) # clasificación\n",
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"# Revisemos las métricas del modelo\n",
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"print('Métricas del modelo de Random Forest en VALIDACION: \\n')\n",
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"print(\"          Sensitivity (Recall): \" + str(custom_sensitivity_score(y_val, y_pred_val)))\n",
"print(\"          Specificity (Fall-out): \" + str(custom_specificity_score(y_val, y_pred_val)))\n",
"print(\"Positive predictive value (Precision): \" + str(custom_ppv_score(y_val, y_pred_val)))\n",
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"print(\"                        AUC: \" + str(roc_auc_score(y_val, y_pred_prob_val)))\n",
"\n",
"plot_roc(y_val, y_pred_prob_val)\n",
"\n",
"# Usamos el modelo desarrollado, para predecir sobre los datos de entrenamiento \n",
"y_pred_prob_train = classifier.predict_proba(X_train)[:,1] # probabilities \n",
"y_pred_train = np.where(y_pred_prob_train > class_threshold, 1, 0) # clasificación\n",
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"print(\"       Negative predictive value: \" + str(custom_npv_score(y_train, y_pred_train)))\n",
```

```
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"   y_pred_prob = classifier_DT.predict_proba(X_val)[:,1]   \n",
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"\n",
"   array.append([n,roc_auc_score(y_val, y_pred_prob)])\n",
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      "y_pred_prob = classifier.predict_proba(X_test)[:,1] # probabilities \n",
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     "hist_satisfied = df_filter[df_filter['Survey']==1].filter(items = indices_train, axis=0)\n",
     "\n",
     "#Prediccion No satisfechos: Personas del grupo de test (\"nuevos\") con predicción = 0 \n",
     "X_val['Pred_survey'] = y_pred_val\n",
     "pred_unsatisfied = df_filter.filter(items = list(X_val[X_val['Pred_survey']==0].index.values), 
axis=0)\n",
     "pred_unsatisfied['Pred_survey'] = X_val['Pred_survey']\n",
```

```
      "\n",
      "print('Satisfied: ',len(hist_satisfied))\n",
      "print('Unsatisfied: ',len(pred_unsatisfied), '\\n')\n",
      "\n",
      "contigency= pd.crosstab(pred_unsatisfied['Pred_survey'], pred_unsatisfied['Survey']) \n",
      "contigency_pct = pd.crosstab(pred_unsatisfied['Pred_survey'], pred_unsatisfied['Survey']
,normalize= True)\n",
      "print(contigency)\n",
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        "Try using .loc[row_indexer,col_indexer] = value instead\n",
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        "See the caveats in the documentation: https://pandas.pydata.org/pandas-
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      "  if scaler_method == 'MinMax': scaler = preprocessing.MinMaxScaler()\n",
      "  else: scaler = preprocessing.StandardScaler()\n",
      "\n",
      "  for category in pred_unsatisfied['Category'].unique():\n",
      "    for item in pred_unsatisfied['Item'].unique():\n",
      "      for imc in pred_unsatisfied['segmento_imc'].unique():\n",
      "        #definir predictores de entrenamiento del historico de satisfechos\n",
      "        X = hist_satisfied[(hist_satisfied['Item'] == item)&(hist_satisfied['Category'] ==
category)&(hist_satisfied['segmento_imc'] == imc)].filter(variables)\n",
      "        #definir variable a predecir del historico de satisfechos\n",
      "        y = hist_satisfied[(hist_satisfied['Item'] == item)&(hist_satisfied['Category'] ==
category)&(hist_satisfied['segmento_imc'] == imc)]['Size']\n",
      "        y = pd.Series(y, dtype='str')\n",
      "\n",
      "        #definir set de insatisfechos a calibrar\n",
      "        data = pred_unsatisfied[(pred_unsatisfied['Item'] == item)&(pred_unsatisfied['Category'] ==
category)&(pred_unsatisfied['segmento_imc'] == imc)].filter(variables)\n",
      "        #indices de insatisfechos a calibrar\n",
      "        y_indices = list(data.index.values)\n",
      "\n",
      "        if len(data)>0 and len(X)>0 and len(y)>0:\n",
      "          X[variables] = scaler.fit_transform(X[variables])\n",
      "          data[variables] = scaler.fit_transform(data[variables])\n",
      "          #Entrenar KNN con histórico\n",
      "          k = 0\n",
      "          if len(X) < 3: k = len(X) \n",
      "          else:  k=3\n",
      "          knn = KNeighborsClassifier(n_neighbors = k)\n",
      "          knn.fit(X, y)\n",
      "          \n",
      "          #Predecir talla para insatisfechos\n",
      "          knn_prediction = knn.predict(data)\n",
      "          predictions = pd.DataFrame(knn_prediction, columns = ['pred'], index = y_indices)\n",
      "\n",
      "          #Agregar al df de unsatisfechos la nueva talla recomendada\n",
      "          for index in y_indices:\n",
      "            pred_unsatisfied.loc[index, 'New_size']= str(predictions.loc[index, 'pred'])\n",
      "\n",
```

```
      "  pred_unsatisfied['Size'] = pred_unsatisfied['Size'].astype(str)\n",
      "  pred_unsatisfied['Coinciden'] = np.where(pred_unsatisfied['New_size'] ==
pred_unsatisfied['Size'], 1, 0)\n",
      "  contigency= pd.crosstab(pred_unsatisfied['Survey'], pred_unsatisfied['Coinciden']) \n",
      "  contigency_pct = pd.crosstab(pred_unsatisfied['Survey'], pred_unsatisfied['Coinciden']
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    "#b = pred_unsatisfied[(pred_unsatisfied['Size'] !=
pred_unsatisfied['New_size'])][['Body_Type','Fit','Weight','Height','Item','Size','Survey','New_size']]\n",
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      "temp=temp.merge(a['New_size'], how='left', left_index=True, right_index=True, suffixes=('_std_sin', '_std_con'))\n",
      "temp=temp.merge(c['New_size'], how='left', left_index=True, right_index=True, suffixes=('_x', '_mm_con'))\n",
      "temp=temp.merge(d['New_size'], how='left', left_index=True, right_index=True, suffixes=('_mm_con', '_mm_sin'))\n",
      "temp.sort_values(by='Survey')\n",
      "equals = temp[(temp['New_size_std_sin']==temp['New_size_std_con'])&(temp['New_size_std_sin']==temp['New_size_mm_con'])&(temp['New_size_std_sin']==temp['New_size_mm_sin'])]\n",
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      "pred_unsatisfied = df_validacion_filter.filter(items =
list(X_test[X_test['Pred_survey']==0].index.values), axis=0)\n",
      "pred_unsatisfied['Pred_survey'] = X_test['Pred_survey']\n",
      "\n",
      "print('Satisfied: ',len(hist_satisfied))\n",
      "print('Unsatisfied: ',len(pred_unsatisfied), '\\n')\n",
      "\n",
      "contigency= pd.crosstab(pred_unsatisfied['Pred_survey'], pred_unsatisfied['Survey']) \n",
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      "print(contigency,'\\n')\n",
      "print(contigency_pct,'\\n')\n",
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