

Titanic Survival Prediction using Logistic Regression

By Meenakshi Sharad Sethi

Disclaimer: This project is conducted solely for academic purposes and as part of individual learning. The analysis and conclusions presented herein are based on personal exploration and may not be suitable for commercial or professional use without further validation and refinement. Any decisions made based on the findings of this project should be taken with caution and additional verification may be necessary before applying the results in real-world scenarios.

Introduction:

In this assignment, we will analyze the Titanic dataset, which contains information about each passenger aboard the HMS Titanic when it sank in 1912. The objective is to build a predictive model to determine whether a person survives or not based on various features such as name, ticket class, sex, age, and more. We will explore the dataset, extract valuable information from the "Name" column, and employ logistic regression for survival prediction. Additionally, we will evaluate the model's performance using precision, recall, F-score, and confusion matrix metrics. Finally, we'll discuss the feasibility of using a linear regression model for this prediction task.

Approach:

1. Data Exploration and Feature Engineering:

- Explore the dataset to understand its structure and characteristics.
- Extract relevant information from the "Name" column that could contribute to survival prediction.
- Consider creating new features or transforming existing ones to enhance the model's predictive capabilities.

1. Logistic Regression Model:

a. Data Preprocessing:

- Handle missing values and categorical data appropriately.

b. Model Training:

- Implement a logistic regression model using the processed data.

c. Model Evaluation:

- Evaluate the model using precision, recall, F-score, and confusion matrix.
- Interpret the results to understand the model's effectiveness in predicting survival.

1. Can we use a Linear Regression Model?

Potential Use Cases:

1. **Maritime Safety:** Predicting survival likelihood for passengers during maritime emergencies can assist in formulating safety protocols and emergency response strategies for the

maritime industry.

2. **Insurance Risk Assessment:** Assessing risk factors associated with survival, such as age, gender, and class, can inform insurance companies' decisions on adjusting premiums based on passengers' likelihood of survival.
3. **Historical Analysis:** Analyzing historical maritime disasters using similar methodologies can help identify patterns and improve safety measures for future voyages.

Importing necessary libraries

In [141...

```
import os
os.environ['OPENBLAS_NUM_THREADS'] = '5'
```

In [142...

```
import warnings
warnings.filterwarnings('ignore')
```

In [143...

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression, LogisticRegression
from sklearn.metrics import r2_score, mean_squared_error, confusion_matrix, precision_score
from sklearn.preprocessing import LabelEncoder
from sklearn.impute import SimpleImputer
from sklearn.pipeline import make_pipeline
from math import sqrt
```

Data Exploration and Feature Engineering

In [144...

```
# Load Titanic dataset

df = pd.read_csv('titanic_data.csv')
df
```

Out[144...

| | PassengerId | Survived | Pclass | Name | Sex | Age | SibSp | Parch | Ticket | Fare | Cabin |
|---|-------------|----------|--------|---|--------|------|-------|-------|------------------|---------|-------|
| 0 | 1 | 0 | 3 | Braund, Mr. Owen Harris | male | 22.0 | 1 | 0 | A/5 21171 | 7.2500 | NaN |
| 1 | 2 | 1 | 1 | Cumings, Mrs. John Bradley (Florence Briggs Th... | female | 38.0 | 1 | 0 | PC 17599 | 71.2833 | C85 |
| 2 | 3 | 1 | 3 | Heikkinen, Miss. Laina | female | 26.0 | 0 | 0 | STON/O2. 3101282 | 7.9250 | NaN |
| 3 | 4 | 1 | 1 | Futrelle, Mrs. Jacques Heath (Lily May Peel) | female | 35.0 | 1 | 0 | 113803 | 53.1000 | C123 |

| | PassengerId | Survived | Pclass | Name | Sex | Age | SibSp | Parch | Ticket | Fare | Cabin |
|------------|-------------|----------|--------|--|--------|------|-------|-------|---------------|---------|-------|
| 4 | 5 | 0 | 3 | Allen, Mr. William Henry | male | 35.0 | 0 | 0 | 373450 | 8.0500 | NaN |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 886 | 887 | 0 | 2 | Montvila, Rev. Juozas | male | 27.0 | 0 | 0 | 211536 | 13.0000 | NaN |
| 887 | 888 | 1 | 1 | Graham, Miss. Margaret Edith | female | 19.0 | 0 | 0 | 112053 | 30.0000 | B42 |
| 888 | 889 | 0 | 3 | Johnston, Miss. Catherine Helen \Carrie\'''' | female | NaN | 1 | 2 | W./C. 6607 | 23.4500 | NaN |
| 889 | 890 | 1 | 1 | Behr, Mr. Karl Howell | male | 26.0 | 0 | 0 | 111369 | 30.0000 | C148 |
| 890 | 891 | 0 | 3 | Dooley, Mr. Patrick | male | 32.0 | 0 | 0 | 370376 | 7.7500 | NaN |

891 rows × 12 columns

In [145...

```
df.head()
```

Out[145...

| | PassengerId | Survived | Pclass | Name | Sex | Age | SibSp | Parch | Ticket | Fare | Cabin | Embarked |
|---|-------------|----------|--------|--|--------|------|-------|-------|------------------|---------|-------|----------|
| 0 | 1 | 0 | 3 | Braund, Mr. Owen Harris | male | 22.0 | 1 | 0 | A/5 21171 | 7.2500 | NaN | S |
| 1 | 2 | 1 | 1 | Cumings, Mrs. John Bradley (Florence Briggs Th...) | female | 38.0 | 1 | 0 | PC 17599 | 71.2833 | C85 | S |
| 2 | 3 | 1 | 3 | Heikkinen, Miss. Laina | female | 26.0 | 0 | 0 | STON/O2. 3101282 | 7.9250 | NaN | S |
| 3 | 4 | 1 | 1 | Futrelle, Mrs. Jacques Heath (Lily May Peel) | female | 35.0 | 1 | 0 | 113803 | 53.1000 | C123 | S |
| 4 | 5 | 0 | 3 | Allen, Mr. William Henry | male | 35.0 | 0 | 0 | 373450 | 8.0500 | NaN | S |

In [146...

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 12 columns):
#   Column          Non-Null Count  Dtype
---  -
0   PassengerId     891 non-null    int64
1   Survived        891 non-null    int64
2   Pclass          891 non-null    int64
3   Name            891 non-null    object
4   Sex             891 non-null    object
5   Age             714 non-null    float64
6   SibSp           891 non-null    int64
7   Parch           891 non-null    int64
8   Ticket          891 non-null    object
9   Fare            891 non-null    float64
10  Cabin           204 non-null    object
11  Embarked        889 non-null    object
dtypes: float64(2), int64(5), object(5)
memory usage: 83.7+ KB
```

Key points from the info summary:

- There are 891 rows in the dataset.
- The "Age" column has 714 non-null entries, indicating missing values.
- The "Cabin" column has only 204 non-null entries, indicating a significant number of missing values.
- The "Embarked" column has 889 non-null entries, suggesting a couple of missing values.

In [147...

```
# Display the count of missing values for each column
print(df.isnull().sum())
```

```
PassengerId      0
Survived          0
Pclass           0
Name             0
Sex              0
Age             177
SibSp            0
Parch            0
Ticket           0
Fare             0
Cabin           687
Embarked         2
dtype: int64
```

In [148...

```
# Display unique values for all columns
cols = df.columns

# for each column
for col in cols:
    print(col)

    # get a list of unique values
    unique = df[col].unique()
    print(unique, '\n===== \n\n')
```

```
PassengerId
[ 1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18
 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36
 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54
 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72
 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90
 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108
109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126
127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144
145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162
163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180
181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198
199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216
217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234
235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252
253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270
271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288
289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306
307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324
325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342
343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360
361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378
379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396
397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414
415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432
433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450
451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468
469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486
487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504
505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522
523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540
541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558
559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576
577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594
595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612
613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630
631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648
649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666]
```

667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684
685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702
703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720
721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738
739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756
757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774
775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792
793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810
811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828
829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846
847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864
865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882
883 884 885 886 887 888 889 890 891]
=====

Survived

[0 1]

=====

Pclass

[3 1 2]

=====

Name

['Braund, Mr. Owen Harris'
'Cumings, Mrs. John Bradley (Florence Briggs Thayer)'
'Heikkinen, Miss. Laina' 'Futrelle, Mrs. Jacques Heath (Lily May Peel)'
'Allen, Mr. William Henry' 'Moran, Mr. James' 'McCarthy, Mr. Timothy J'
'Palsson, Master. Gosta Leonard'
'Johnson, Mrs. Oscar W (Elisabeth Vilhelmina Berg)'
'Nasser, Mrs. Nicholas (Adele Achem)' 'Sandstrom, Miss. Marguerite Rut'
'Bonnell, Miss. Elizabeth' 'Saunders, Mr. William Henry'
'Andersson, Mr. Anders Johan' 'Vestrom, Miss. Hulda Amanda Adolfina'
'Hewlett, Mrs. (Mary D Kingcome)' 'Rice, Master. Eugene'
'Williams, Mr. Charles Eugene'
'Vander Planke, Mrs. Julius (Emelia Maria Vandemoortele)'
'Masselmann, Mrs. Fatima' 'Fynney, Mr. Joseph J' 'Beesley, Mr. Lawrence'
'McGowan, Miss. Anna \"Annie\"' 'Sloper, Mr. William Thompson'
'Palsson, Miss. Torborg Danira'
'Asplund, Mrs. Carl Oscar (Selma Augusta Emilia Johansson)'
'Emir, Mr. Farred Chehab' 'Fortune, Mr. Charles Alexander'
'O'Dwyer, Miss. Ellen \"Nellie\"' 'Todoroff, Mr. Lalio'
'Uruchurtu, Don. Manuel E'
'Spencer, Mrs. William Augustus (Marie Eugenie)'
'Glynn, Miss. Mary Agatha' 'Wheadon, Mr. Edward H'
'Meyer, Mr. Edgar Joseph' 'Holverson, Mr. Alexander Oskar'
'Mamee, Mr. Hanna' 'Cann, Mr. Ernest Charles'
'Vander Planke, Miss. Augusta Maria' 'Nicola-Yarred, Miss. Jamila'
'Ahlin, Mrs. Johan (Johanna Persdotter Larsson)'
'Turpin, Mrs. William John Robert (Dorothy Ann Wonnacott)'
'Kraeff, Mr. Theodor' 'Laroche, Miss. Simonne Marie Anne Andree'
'Devaney, Miss. Margaret Delia' 'Rogers, Mr. William John'
'Lennon, Mr. Denis' 'O'Driscoll, Miss. Bridget' 'Samaan, Mr. Youssef'
'Arnold-Franchi, Mrs. Josef (Josefine Franchi)'
'Panula, Master. Juha Niilo' 'Nosworthy, Mr. Richard Cater'
'Harper, Mrs. Henry Sleeper (Myna Haxtun)'
'Fauntleroy, Mrs. Lizzie (Elizabeth Anne Wilkinson)'
'Ostby, Mr. Engelhart Cornelius' 'Woolner, Mr. Hugh' 'Rugg, Miss. Emily'
'Novel, Mr. Mansouer' 'West, Miss. Constance Mirium'
'Goodwin, Master. William Frederick' 'Sirayanian, Mr. Orsen'
'Icard, Miss. Amelie' 'Harris, Mr. Henry Birkhardt']

'Skoog, Master. Harald' 'Stewart, Mr. Albert A'
 'Moubarek, Master. Gerios' 'Nye, Mrs. (Elizabeth Ramell)'
 'Crease, Mr. Ernest James' 'Andersson, Miss. Erna Alexandra'
 'Kink, Mr. Vincenz' 'Jenkin, Mr. Stephen Curnow'
 'Goodwin, Miss. Lillian Amy' 'Hood, Mr. Ambrose Jr'
 'Chronopoulos, Mr. Apostolos' 'Bing, Mr. Lee' 'Moen, Mr. Sigurd Hansen'
 'Staneff, Mr. Ivan' 'Moutal, Mr. Rahamin Haim'
 'Caldwell, Master. Alden Gates' 'Dowdell, Miss. Elizabeth'
 'Waelens, Mr. Achille' 'Sheerlinck, Mr. Jan Baptist'
 'McDermott, Miss. Brigdet Delia' 'Carrau, Mr. Francisco M'
 'Ilett, Miss. Bertha'
 'Backstrom, Mrs. Karl Alfred (Maria Mathilda Gustafsson)'
 'Ford, Mr. William Neal' 'Slocovski, Mr. Selman Francis'
 'Fortune, Miss. Mabel Helen' 'Celotti, Mr. Francesco'
 'Christmann, Mr. Emil' 'Andreasson, Mr. Paul Edwin'
 'Chaffee, Mr. Herbert Fuller' 'Dean, Mr. Bertram Frank'
 'Coxon, Mr. Daniel' 'Shorney, Mr. Charles Joseph'
 'Goldschmidt, Mr. George B' 'Greenfield, Mr. William Bertram'
 'Doling, Mrs. John T (Ada Julia Bone)' 'Kantor, Mr. Sinai'
 'Petranec, Miss. Matilda' 'Petroff, Mr. Pastcho (\\Pentcho\\)"'
 'White, Mr. Richard Frasar' 'Johansson, Mr. Gustaf Joel'
 'Gustafsson, Mr. Anders Vilhelm' 'Mionoff, Mr. Stoytcho'
 'Salkjelsvik, Miss. Anna Kristine' 'Moss, Mr. Albert Johan'
 'Rekic, Mr. Tido' 'Moran, Miss. Bertha' 'Porter, Mr. Walter Chamberlain'
 'Zabour, Miss. Hileni' 'Barton, Mr. David John' 'Jussila, Miss. Katriina'
 'Attalah, Miss. Malake' 'Pekoniemi, Mr. Edvard' 'Connors, Mr. Patrick'
 'Turpin, Mr. William John Robert' 'Baxter, Mr. Quigg Edmond'
 'Andersson, Miss. Ellis Anna Maria' 'Hickman, Mr. Stanley George'
 'Moore, Mr. Leonard Charles' 'Nasser, Mr. Nicholas' 'Webber, Miss. Susan'
 'White, Mr. Percival Wayland' 'Nicola-Yarred, Master. Elias'
 'McMahon, Mr. Martin' 'Madsen, Mr. Fridtjof Arne' 'Peter, Miss. Anna'
 'Ekstrom, Mr. Johan' 'Drazenoic, Mr. Jozef'
 'Coelho, Mr. Domingos Fernando'
 'Robins, Mrs. Alexander A (Grace Charity Laury)'
 'Weisz, Mrs. Leopold (Mathilde Francoise Pede)'
 'Sobey, Mr. Samuel James Hayden' 'Richard, Mr. Emile'
 'Newsom, Miss. Helen Monypeny' 'Futrelle, Mr. Jacques Heath'
 'Osen, Mr. Olaf Elon' 'Giglio, Mr. Victor'
 'Boulos, Mrs. Joseph (Sultana)' 'Nysten, Miss. Anna Sofia'
 'Hakkarainen, Mrs. Pekka Pietari (Elin Matilda Dolck)'
 'Burke, Mr. Jeremiah' 'Andrew, Mr. Edgardo Samuel'
 'Nicholls, Mr. Joseph Charles'
 'Andersson, Mr. August Edvard (\\Wennerstrom\\)"'
 'Ford, Miss. Robina Maggie \\Ruby\\)"'
 'Navratil, Mr. Michel (\\Louis M Hoffman\\)"'
 'Byles, Rev. Thomas Roussel Davids' 'Bateman, Rev. Robert James'
 'Pears, Mrs. Thomas (Edith Wearne)' 'Meo, Mr. Alfonzo'
 'van Billiard, Mr. Austin Blyler' 'Olsen, Mr. Ole Martin'
 'Williams, Mr. Charles Duane' 'Gilnagh, Miss. Katherine \\Katie\\)"'
 'Corn, Mr. Harry' 'Smiljanic, Mr. Mile' 'Sage, Master. Thomas Henry'
 'Cribb, Mr. John Hatfield'
 'Watt, Mrs. James (Elizabeth \\Bessie\\" Inglis Milne)"'
 'Bengtsson, Mr. John Viktor' 'Calic, Mr. Jovo'
 'Panula, Master. Eino Viljami'
 'Goldsmith, Master. Frank John William \\Frankie\\)"'
 'Chibnall, Mrs. (Edith Martha Bowerman)'
 'Skoog, Mrs. William (Anna Bernhardina Karlsson)' 'Baumann, Mr. John D'
 'Ling, Mr. Lee' 'Van der hoef, Mr. Wyckoff' 'Rice, Master. Arthur'
 'Johnson, Miss. Eleanor Ileen' 'Sivola, Mr. Antti Wilhelm'
 'Smith, Mr. James Clinch' 'Klasen, Mr. Klas Albin'
 'Lefebvre, Master. Henry Forbes' 'Isham, Miss. Ann Elizabeth'
 'Hale, Mr. Reginald' 'Leonard, Mr. Lionel' 'Sage, Miss. Constance Gladys'
 'Pernot, Mr. Rene' 'Asplund, Master. Clarence Gustaf Hugo'
 'Becker, Master. Richard F' 'Kink-Heilmann, Miss. Luise Gretchen'

'Rood, Mr. Hugh Roscoe'
 'O'Brien, Mrs. Thomas (Johanna \\Hannah\\" Godfrey)''
 'Romaine, Mr. Charles Hallace (\\Mr C Rolmane\\")'' 'Bourke, Mr. John'
 'Turcin, Mr. Stjepan' 'Pinsky, Mrs. (Rosa)' 'Carbines, Mr. William'
 'Andersen-Jensen, Miss. Carla Christine Nielsine'
 'Navratil, Master. Michel M' 'Brown, Mrs. James Joseph (Margaret Tobin)'
 'Lurette, Miss. Elise' 'Mernagh, Mr. Robert'
 'Olsen, Mr. Karl Siegwart Andreas' 'Madigan, Miss. Margaret \\Maggie\\'""
 'Yrois, Miss. Henriette (\\Mrs Harbeck\\")''
 'Vande Walle, Mr. Nestor Cyriel' 'Sage, Mr. Frederick'
 'Johanson, Mr. Jakob Alfred' 'Youseff, Mr. Gerious'
 'Cohen, Mr. Gurshon \\Gus\\'"" 'Strom, Miss. Telma Matilda'
 'Backstrom, Mr. Karl Alfred' 'Albimona, Mr. Nassef Cassem'
 'Carr, Miss. Helen \\Ellen\\'"" 'Blank, Mr. Henry' 'Ali, Mr. Ahmed'
 'Cameron, Miss. Clear Annie' 'Perkin, Mr. John Henry'
 'Givard, Mr. Hans Kristensen' 'Kiernan, Mr. Philip'
 'Newell, Miss. Madeleine' 'Honkanen, Miss. Eliina'
 'Jacobsohn, Mr. Sidney Samuel' 'Bazzani, Miss. Albina'
 'Harris, Mr. Walter' 'Sunderland, Mr. Victor Francis'
 'Bracken, Mr. James H' 'Green, Mr. George Henry' 'Nenkoff, Mr. Christo'
 'Hoyt, Mr. Frederick Maxfield' 'Berglund, Mr. Karl Ivar Sven'
 'Mellors, Mr. William John' 'Lovell, Mr. John Hall (\\Henry\\")''
 'Fahlstrom, Mr. Arne Jonas' 'Lefebvre, Miss. Mathilde'
 'Harris, Mrs. Henry Birkhardt (Irene Wallach)' 'Larsson, Mr. Bengt Edvin'
 'Sjostedt, Mr. Ernst Adolf' 'Asplund, Miss. Lillian Gertrud'
 'Leyson, Mr. Robert William Norman' 'Harknett, Miss. Alice Phoebe'
 'Hold, Mr. Stephen' 'Collyer, Miss. Marjorie \\Lottie\\'""
 'Pengelly, Mr. Frederick William' 'Hunt, Mr. George Henry'
 'Zabour, Miss. Thamine' 'Murphy, Miss. Katherine \\Kate\\'""
 'Coleridge, Mr. Reginald Charles' 'Maenpaa, Mr. Matti Alexanteri'
 'Attalah, Mr. Sleiman' 'Minahan, Dr. William Edward'
 'Lindahl, Miss. Agda Thorilda Viktoria' 'Hamalainen, Mrs. William (Anna)'
 'Beckwith, Mr. Richard Leonard' 'Carter, Rev. Ernest Courtenay'
 'Reed, Mr. James George' 'Strom, Mrs. Wilhelm (Elna Matilda Persson)'
 'Stead, Mr. William Thomas' 'Lobb, Mr. William Arthur'
 'Rosblom, Mrs. Viktor (Helena Wilhelmina)'
 'Touma, Mrs. Darwis (Hanne Youssef Razi)'
 'Thorne, Mrs. Gertrude Maybelle' 'Cherry, Miss. Gladys'
 'Ward, Miss. Anna' 'Parrish, Mrs. (Lutie Davis)' 'Smith, Mr. Thomas'
 'Asplund, Master. Edvin Rojj Felix' 'Taussig, Mr. Emil'
 'Harrison, Mr. William' 'Henry, Miss. Delia' 'Reeves, Mr. David'
 'Panula, Mr. Ernesti Arvid' 'Persson, Mr. Ernst Ulrik'
 'Graham, Mrs. William Thompson (Edith Junkins)' 'Bissette, Miss. Amelia'
 'Cairns, Mr. Alexander' 'Tornquist, Mr. William Henry'
 'Mellinger, Mrs. (Elizabeth Anne Maidment)' 'Natsch, Mr. Charles H'
 'Healy, Miss. Hanora \\Nora\\'"" 'Andrews, Miss. Kornelia Theodosia'
 'Lindblom, Miss. Augusta Charlotta' 'Parkes, Mr. Francis \\Frank\\'""
 'Rice, Master. Eric' 'Abbott, Mrs. Stanton (Rosa Hunt)'
 'Duane, Mr. Frank' 'Olsson, Mr. Nils Johan Goransson'
 'de Pelsmaeker, Mr. Alfons' 'Dorking, Mr. Edward Arthur'
 'Smith, Mr. Richard William' 'Stankovic, Mr. Ivan'
 'de Mulder, Mr. Theodore' 'Naidenoff, Mr. Penko' 'Hosono, Mr. Masabumi'
 'Connolly, Miss. Kate' 'Barber, Miss. Ellen \\Nellie\\'""
 'Bishop, Mrs. Dickinson H (Helen Walton)' 'Levy, Mr. Rene Jacques'
 'Haas, Miss. Aloisia' 'Mineff, Mr. Ivan' 'Lewy, Mr. Ervin G'
 'Hanna, Mr. Mansour' 'Allison, Miss. Helen Loraine'
 'Saalfeld, Mr. Adolphe' 'Baxter, Mrs. James (Helene DeLaudeniére Chaput)'
 'Kelly, Miss. Anna Katherine \\Annie Kate\\'"" 'McCoy, Mr. Bernard'
 'Johnson, Mr. William Cahoon Jr' 'Keane, Miss. Nora A'
 'Williams, Mr. Howard Hugh \\Harry\\'"" 'Allison, Master. Hudson Trevor'
 'Fleming, Miss. Margaret'
 'Penasco y Castellana, Mrs. Victor de Satode (Maria Josefa Perez de Soto y Vallejo)'
 'Abelson, Mr. Samuel' 'Francatelli, Miss. Laura Mabel'
 'Hays, Miss. Margaret Bechstein' 'Ryerson, Miss. Emily Borie'

'Lahtinen, Mrs. William (Anna Sylfven)' 'Hendekovic, Mr. Ignjac'
 'Hart, Mr. Benjamin' 'Nilsson, Miss. Helmina Josefina'
 'Kantor, Mrs. Sinai (Miriam Sternin)' 'Moraweck, Dr. Ernest'
 'Wick, Miss. Mary Natalie'
 'Spedden, Mrs. Frederic Oakley (Margaretta Corning Stone)'
 'Dennis, Mr. Samuel' 'Danoff, Mr. Yoto' 'Slayter, Miss. Hilda Mary'
 'Caldwell, Mrs. Albert Francis (Sylvia Mae Harbaugh)'
 'Sage, Mr. George John Jr' 'Young, Miss. Marie Grice'
 'Nysveen, Mr. Johan Hansen' 'Ball, Mrs. (Ada E Hall)'
 'Goldsmith, Mrs. Frank John (Emily Alice Brown)'
 'Hippach, Miss. Jean Gertrude' 'McCoy, Miss. Agnes' 'Partner, Mr. Austen'
 'Graham, Mr. George Edward' 'Vander Planke, Mr. Leo Edmondus'
 'Frauenthal, Mrs. Henry William (Clara Heinsheimer)' 'Denkoff, Mr. Mitto'
 'Pears, Mr. Thomas Clinton' 'Burns, Miss. Elizabeth Margaret'
 'Dahl, Mr. Karl Edwart' 'Blackwell, Mr. Stephen Weart'
 'Navratil, Master. Edmond Roger' 'Fortune, Miss. Alice Elizabeth'
 'Collander, Mr. Erik Gustaf' 'Sedgwick, Mr. Charles Frederick Waddington'
 'Fox, Mr. Stanley Hubert' 'Brown, Miss. Amelia \\Mildred\\''
 'Smith, Miss. Marion Elsie' 'Davison, Mrs. Thomas Henry (Mary E Finck)'
 'Coutts, Master. William Loch \\William\\'' 'Dimic, Mr. Jovan'
 'Odahl, Mr. Nils Martin' 'Williams-Lambert, Mr. Fletcher Fellows'
 'Elias, Mr. Tannous' 'Arnold-Franchi, Mr. Josef' 'Yousif, Mr. Wazli'
 'Vanden Steen, Mr. Leo Peter' 'Bowerman, Miss. Elsie Edith'
 'Funk, Miss. Annie Clemmer' 'McGovern, Miss. Mary'
 'Mockler, Miss. Helen Mary \\Ellie\\'' 'Skoog, Mr. Wilhelm'
 'del Carlo, Mr. Sebastiano' 'Barbara, Mrs. (Catherine David)'
 'Asim, Mr. Adola' 'O'Brien, Mr. Thomas' 'Adahl, Mr. Mauritz Nils Martin'
 'Warren, Mrs. Frank Manley (Anna Sophia Atkinson)'
 'Moussa, Mrs. (Mantoura Boulos)' 'Jermyn, Miss. Annie'
 'Aubart, Mme. Leontine Pauline' 'Harder, Mr. George Achilles'
 'Wiklund, Mr. Jakob Alfred' 'Beavan, Mr. William Thomas'
 'Ringhini, Mr. Sante' 'Palsson, Miss. Stina Viola'
 'Meyer, Mrs. Edgar Joseph (Leila Saks)' 'Landergren, Miss. Aurora Adelia'
 'Widener, Mr. Harry Elkins' 'Betros, Mr. Tannous'
 'Gustafsson, Mr. Karl Gideon' 'Bidois, Miss. Rosalie'
 'Nakid, Miss. Maria (\\Mary\\')'' 'Tikkanen, Mr. Juho'
 'Holverson, Mrs. Alexander Oskar (Mary Aline Towner)'
 'Plotcharsky, Mr. Vasil' 'Davies, Mr. Charles Henry'
 'Goodwin, Master. Sidney Leonard' 'Buss, Miss. Kate'
 'Sadlier, Mr. Matthew' 'Lehmann, Miss. Bertha'
 'Carter, Mr. William Ernest' 'Jansson, Mr. Carl Olof'
 'Gustafsson, Mr. Johan Birger' 'Newell, Miss. Marjorie'
 'Sandstrom, Mrs. Hjalmar (Agnes Charlotta Bengtsson)'
 'Johansson, Mr. Erik' 'Olsson, Miss. Elina' 'McKane, Mr. Peter David'
 'Pain, Dr. Alfred' 'Trout, Mrs. William H (Jessie L)'
 'Niskanen, Mr. Juha' 'Adams, Mr. John' 'Jussila, Miss. Mari Aina'
 'Hakkarainen, Mr. Pekka Pietari' 'Oreskovic, Miss. Marija'
 'Gale, Mr. Shadrach' 'Widegren, Mr. Carl/Charles Peter'
 'Richards, Master. William Rowe' 'Birkeland, Mr. Hans Martin Monsen'
 'Lefebvre, Miss. Ida' 'Sdycoff, Mr. Todor' 'Hart, Mr. Henry'
 'Minahan, Miss. Daisy E' 'Cunningham, Mr. Alfred Fleming'
 'Sundman, Mr. Johan Julian' 'Meek, Mrs. Thomas (Annie Louise Rowley)'
 'Drew, Mrs. James Vivian (Lulu Thorne Christian)'
 'Silven, Miss. Lyyli Karoliina' 'Matthews, Mr. William John'
 'Van Impe, Miss. Catharina' 'Gheorgheff, Mr. Stanio'
 'Charters, Mr. David' 'Zimmerman, Mr. Leo'
 'Danbom, Mrs. Ernst Gilbert (Anna Sigrid Maria Brogren)'
 'Rosblom, Mr. Viktor Richard' 'Wiseman, Mr. Phillippe'
 'Clarke, Mrs. Charles V (Ada Maria Winfield)'
 'Phillips, Miss. Kate Florence (\\Mrs Kate Louise Phillips Marshall\\')''
 'Flynn, Mr. James' 'Pickard, Mr. Berk (Berk Trembisky)'
 'Bjornstrom-Steffansson, Mr. Mauritz Hakan'
 'Thorneycroft, Mrs. Percival (Florence Kate White)'
 'Louch, Mrs. Charles Alexander (Alice Adelaide Slow)'

'Kallio, Mr. Nikolai Erland' 'Silvey, Mr. William Baird'
 'Carter, Miss. Lucile Polk' 'Ford, Miss. Doolina Margaret \\Daisy\\''
 'Richards, Mrs. Sidney (Emily Hocking)' 'Fortune, Mr. Mark'
 'Kvillner, Mr. Johan Henrik Johannesson'
 'Hart, Mrs. Benjamin (Esther Ada Bloomfield)' 'Hampe, Mr. Leon'
 'Pettersen, Mr. Johan Emil' 'Reynaldo, Ms. Encarnacion'
 'Johannesen-Bratthammer, Mr. Bernt' 'Dodge, Master. Washington'
 'Mellinger, Miss. Madeleine Violet' 'Seward, Mr. Frederic Kimber'
 'Baclini, Miss. Marie Catherine' 'Peuchen, Major. Arthur Godfrey'
 'West, Mr. Edwy Arthur' 'Hagland, Mr. Ingvald Olai Olsen'
 'Foreman, Mr. Benjamin Laventall' 'Goldenberg, Mr. Samuel L'
 'Pедуzzi, Mr. Joseph' 'Jalsevac, Mr. Ivan' 'Millet, Mr. Francis Davis'
 'Kenyon, Mrs. Frederick R (Marion)' 'Toomey, Miss. Ellen'
 "O'Connor, Mr. Maurice" 'Anderson, Mr. Harry' 'Morley, Mr. William'
 'Gee, Mr. Arthur H' 'Milling, Mr. Jacob Christian' 'Maisner, Mr. Simon'
 'Goncalves, Mr. Manuel Estanslas' 'Campbell, Mr. William'
 'Smart, Mr. John Montgomery' 'Scanlan, Mr. James'
 'Baclini, Miss. Helene Barbara' 'Keefe, Mr. Arthur' 'Cacic, Mr. Luka'
 'West, Mrs. Edwy Arthur (Ada Mary Worth)'
 'Jerwan, Mrs. Amin S (Marie Marthe Thuillard)'
 'Strandberg, Miss. Ida Sofia' 'Clifford, Mr. George Quincy'
 'Renouf, Mr. Peter Henry' 'Braund, Mr. Lewis Richard'
 'Karlsson, Mr. Nils August' 'Hirvonen, Miss. Hildur E'
 'Goodwin, Master. Harold Victor' 'Frost, Mr. Anthony Wood \\Archie\\''
 'Rouse, Mr. Richard Henry' 'Turkula, Mrs. (Hedwig)'
 'Bishop, Mr. Dickinson H' 'Lefebvre, Miss. Jeannie'
 'Hoyt, Mrs. Frederick Maxfield (Jane Anne Forby)'
 'Kent, Mr. Edward Austin' 'Somerton, Mr. Francis William'
 'Coutts, Master. Eden Leslie \\Neville\\''
 'Hagland, Mr. Konrad Mathias Reiersen' 'Windelov, Mr. Einar'
 'Molson, Mr. Harry Markland' 'Artagaveytia, Mr. Ramon'
 'Stanley, Mr. Edward Roland' 'Yousseff, Mr. Gerious'
 'Eustis, Miss. Elizabeth Mussey' 'Shellard, Mr. Frederick William'
 'Allison, Mrs. Hudson J C (Bessie Waldo Daniels)' 'Svensson, Mr. Olof'
 'Calic, Mr. Petar' 'Canavan, Miss. Mary' "O'Sullivan, Miss. Bridget Mary"
 'Laitinen, Miss. Kristina Sofia' 'Maioni, Miss. Roberta'
 'Penasco y Castellana, Mr. Victor de Satode'
 'Quick, Mrs. Frederick Charles (Jane Richards)'
 'Bradley, Mr. George (\\George Arthur Brayton\\)''
 'Olsen, Mr. Henry Margido' 'Lang, Mr. Fang' 'Daly, Mr. Eugene Patrick'
 'Webber, Mr. James' 'McGough, Mr. James Robert'
 'Rothschild, Mrs. Martin (Elizabeth L. Barrett)' 'Coleff, Mr. Satio'
 'Walker, Mr. William Anderson' 'Lemore, Mrs. (Amelia Milley)'
 'Ryan, Mr. Patrick'
 'Angle, Mrs. William A (Florence \\Mary\\ "Agnes Hughes)''
 'Pavlovic, Mr. Stefo' 'Perreault, Miss. Anne' 'Vovk, Mr. Janko'
 'Lahoud, Mr. Sarkis' 'Hippach, Mrs. Louis Albert (Ida Sophia Fischer)'
 'Kassem, Mr. Fared' 'Farrell, Mr. James' 'Ridsdale, Miss. Lucy'
 'Farthing, Mr. John' 'Salonen, Mr. Johan Werner'
 'Hocking, Mr. Richard George' 'Quick, Miss. Phyllis May'
 'Toufik, Mr. Nakli' 'Elias, Mr. Joseph Jr'
 'Peter, Mrs. Catherine (Catherine Rizk)' 'Cacic, Miss. Marija'
 'Hart, Miss. Eva Miriam' 'Butt, Major. Archibald Willingham'
 'LeRoy, Miss. Bertha' 'Risien, Mr. Samuel Beard'
 'Frolicher, Miss. Hedwig Margaritha' 'Crosby, Miss. Harriet R'
 'Andersson, Miss. Ingeborg Constanzia'
 'Andersson, Miss. Sigrid Elisabeth' 'Beane, Mr. Edward'
 'Douglas, Mr. Walter Donald' 'Nicholson, Mr. Arthur Ernest'
 'Beane, Mrs. Edward (Ethel Clarke)' 'Padro y Manent, Mr. Julian'
 'Goldsmith, Mr. Frank John' 'Davies, Master. John Morgan Jr'
 'Thayer, Mr. John Borland Jr' 'Sharp, Mr. Percival James R'
 "O'Brien, Mr. Timothy" 'Leeni, Mr. Fahim (\\Philip Zenni\\)''
 'Ohman, Miss. Velin' 'Wright, Mr. George'
 'Duff Gordon, Lady. (Lucille Christiana Sutherland) (\\Mrs Morgan\\)''

'Robbins, Mr. Victor' 'Taussig, Mrs. Emil (Tillie Mandelbaum)'
 'de Messemaeker, Mrs. Guillaume Joseph (Emma)' 'Morrow, Mr. Thomas Rowan'
 'Sivic, Mr. Husein' 'Norman, Mr. Robert Douglas' 'Simmons, Mr. John'
 'Meanwell, Miss. (Marion Ogden)' 'Davies, Mr. Alfred J'
 'Stoytcheff, Mr. Ilia' 'Palsson, Mrs. Nils (Alma Cornelia Berglund)'
 'Doharr, Mr. Tannous' 'Jonsson, Mr. Carl' 'Harris, Mr. George'
 'Appleton, Mrs. Edward Dale (Charlotte Lamson)'
 'Flynn, Mr. John Irwin (\\Irving\\)"'" 'Kelly, Miss. Mary'
 'Rush, Mr. Alfred George John' 'Patchett, Mr. George'
 'Garside, Miss. Ethel' 'Silvey, Mrs. William Baird (Alice Munger)'
 'Caram, Mrs. Joseph (Maria Elias)' 'Jussila, Mr. Eiriik'
 'Christy, Miss. Julie Rachel'
 'Thayer, Mrs. John Borland (Marian Longstreth Morris)'
 'Downton, Mr. William James' 'Ross, Mr. John Hugo' 'Paulner, Mr. Uscher'
 'Taussig, Miss. Ruth' 'Jarvis, Mr. John Denzil'
 'Frolicher-Stehli, Mr. Maxmillian' 'Gilinski, Mr. Eliezer'
 'Murdlin, Mr. Joseph' 'Rintamaki, Mr. Matti'
 'Stephenson, Mrs. Walter Bertram (Martha Eustis)'
 'Elsbury, Mr. William James' 'Bourke, Miss. Mary'
 'Chapman, Mr. John Henry' 'Van Impe, Mr. Jean Baptiste'
 'Leitch, Miss. Jessie Wills' 'Johnson, Mr. Alfred' 'Boulos, Mr. Hanna'
 'Duff Gordon, Sir. Cosmo Edmund (\\Mr Morgan\\)"'"
 'Jacobsohn, Mrs. Sidney Samuel (Amy Frances Christy)'
 'Slabenoff, Mr. Petco' 'Harrington, Mr. Charles H'
 'Torber, Mr. Ernst William' 'Homer, Mr. Harry (\\Mr E Haven\\)"'"
 'Lindell, Mr. Edvard Bengtsson' 'Karaic, Mr. Milan'
 'Daniel, Mr. Robert Williams'
 'Laroche, Mrs. Joseph (Juliette Marie Louise Lafargue)'
 'Shutes, Miss. Elizabeth W'
 'Andersson, Mrs. Anders Johan (Alfrida Konstantia Brogren)'
 'Jardin, Mr. Jose Neto' 'Murphy, Miss. Margaret Jane' 'Horgan, Mr. John'
 'Brocklebank, Mr. William Alfred' 'Herman, Miss. Alice'
 'Danbom, Mr. Ernst Gilbert'
 'Lobb, Mrs. William Arthur (Cordelia K Stanlick)'
 'Becker, Miss. Marion Louise' 'Gavey, Mr. Lawrence' 'Yasbeck, Mr. Antoni'
 'Kimball, Mr. Edwin Nelson Jr' 'Nakid, Mr. Sahid'
 'Hansen, Mr. Henry Damsgaard' 'Bowen, Mr. David John \\Dai\\)"'"
 'Sutton, Mr. Frederick' 'Kirkland, Rev. Charles Leonard'
 'Longley, Miss. Gretchen Fiske' 'Bostandyeff, Mr. Guentcho'
 'O'Connell, Mr. Patrick D" 'Barkworth, Mr. Algernon Henry Wilson'
 'Lundahl, Mr. Johan Svensson' 'Stahelin-Maeglin, Dr. Max'
 'Parr, Mr. William Henry Marsh' 'Skoog, Miss. Mabel' 'Davis, Miss. Mary'
 'Leinonen, Mr. Antti Gustaf' 'Collyer, Mr. Harvey'
 'Panula, Mrs. Juha (Maria Emilia Ojala)' 'Thorneycroft, Mr. Percival'
 'Jensen, Mr. Hans Peder' 'Sagesser, Mlle. Emma'
 'Skoog, Miss. Margit Elizabeth' 'Foo, Mr. Choong'
 'Bacini, Miss. Eugenie' 'Harper, Mr. Henry Sleeper' 'Cor, Mr. Liudevit'
 'Simonius-Blumer, Col. Oberst Alfons' 'Willey, Mr. Edward'
 'Stanley, Miss. Amy Zillah Elsie' 'Mitkoff, Mr. Mito'
 'Doling, Miss. Elsie' 'Kalvik, Mr. Johannes Halvorsen'
 'O'Leary, Miss. Hanora \\Norah\\)"'" 'Hegarty, Miss. Hanora \\Nora\\)"'"
 'Hickman, Mr. Leonard Mark' 'Radeff, Mr. Alexander'
 'Bourke, Mrs. John (Catherine)' 'Eitemiller, Mr. George Floyd'
 'Newell, Mr. Arthur Webster' 'Frauenthal, Dr. Henry William'
 'Badt, Mr. Mohamed' 'Colley, Mr. Edward Pomeroy' 'Coleff, Mr. Peju'
 'Lindqvist, Mr. Eino William' 'Hickman, Mr. Lewis'
 'Butler, Mr. Reginald Fenton' 'Rommetvedt, Mr. Knud Paust'
 'Cook, Mr. Jacob' 'Taylor, Mrs. Elmer Zebley (Juliet Cummins Wright)'
 'Brown, Mrs. Thomas William Solomon (Elizabeth Catherine Ford)'
 'Davidson, Mr. Thornton' 'Mitchell, Mr. Henry Michael'
 'Wilhelms, Mr. Charles' 'Watson, Mr. Ennis Hastings'
 'Edvardsson, Mr. Gustaf Hjalmar' 'Sawyer, Mr. Frederick Charles'
 'Turja, Miss. Anna Sofia' 'Goodwin, Mrs. Frederick (Augusta Tyler)'
 'Cardeza, Mr. Thomas Drake Martinez' 'Peters, Miss. Katie'

'Hassab, Mr. Hammad' 'Olsvigen, Mr. Thor Anderson'
 'Goodwin, Mr. Charles Edward' 'Brown, Mr. Thomas William Solomon'
 'Laroche, Mr. Joseph Philippe Lemercier' 'Panula, Mr. Jaako Arnold'
 'Dakic, Mr. Branko' 'Fischer, Mr. Eberhard Thelander'
 'Madill, Miss. Georgette Alexandra' 'Dick, Mr. Albert Adrian'
 'Karun, Miss. Manca' 'Lam, Mr. Ali' 'Saad, Mr. Khalil' 'Weir, Col. John'
 'Chapman, Mr. Charles Henry' 'Kelly, Mr. James'
 'Mullens, Miss. Katherine \\Katie\\' 'Thayer, Mr. John Borland'
 'Humbler, Mr. Adolf Mathias Nicolai Olsen'
 'Astor, Mrs. John Jacob (Madeleine Talmadge Force)'
 'Silverthorne, Mr. Spencer Victor' 'Barbara, Miss. Saiide'
 'Gallagher, Mr. Martin' 'Hansen, Mr. Henrik Juul'
 'Morley, Mr. Henry Samuel (\\Mr Henry Marshall\\)''
 'Kelly, Mrs. Florence \\Fannie\\' 'Calderhead, Mr. Edward Pennington'
 'Cleaver, Miss. Alice'
 'Moubarek, Master. Halim Gonios (\\William George\\)''
 'Mayne, Mlle. Berthe Antonine (\\Mrs de Villiers\\)''
 'Klaber, Mr. Herman' 'Taylor, Mr. Elmer Zebley'
 'Larsson, Mr. August Viktor' 'Greenberg, Mr. Samuel'
 'Soholt, Mr. Peter Andreas Lauritz Andersen'
 'Endres, Miss. Caroline Louise' 'Troutt, Miss. Edwina Celia \\Winnie\\'''
 'McEvoy, Mr. Michael' 'Johnson, Mr. Malkolm Joackim'
 'Harper, Miss. Annie Jessie \\Nina\\' 'Jensen, Mr. Svend Lauritz'
 'Gillespie, Mr. William Henry' 'Hodges, Mr. Henry Price'
 'Chambers, Mr. Norman Campbell' 'Oreskovic, Mr. Luka'
 'Renouf, Mrs. Peter Henry (Lillian Jefferys)' 'Mannion, Miss. Margareth'
 'Bryhl, Mr. Kurt Arnold Gottfrid' 'Ilmakangas, Miss. Pieta Sofia'
 'Allen, Miss. Elisabeth Walton' 'Hassan, Mr. Houssein G N'
 'Knight, Mr. Robert J' 'Berriman, Mr. William John'
 'Troupiansky, Mr. Moses Aaron' 'Williams, Mr. Leslie'
 'Ford, Mrs. Edward (Margaret Ann Watson)' 'Lesurer, Mr. Gustave J'
 'Ivanoff, Mr. Kanio' 'Nankoff, Mr. Minko' 'Hawksford, Mr. Walter James'
 'Cavendish, Mr. Tyrell William'
 'Ryerson, Miss. Susan Parker \\Suzette\\' 'McNamee, Mr. Neal'
 'Stranden, Mr. Juho' 'Crosby, Capt. Edward Gifford'
 'Abbott, Mr. Rossmore Edward' 'Sinkkonen, Miss. Anna'
 'Marvin, Mr. Daniel Warner' 'Connaghton, Mr. Michael' 'Wells, Miss. Joan'
 'Moor, Master. Meier' 'Vande Velde, Mr. Johannes Joseph'
 'Jonkoff, Mr. Lallio' 'Herman, Mrs. Samuel (Jane Laver)'
 'Hamalainen, Master. Viljo' 'Carlsson, Mr. August Sigfrid'
 'Bailey, Mr. Percy Andrew' 'Theobald, Mr. Thomas Leonard'
 'Roths, the Countess. of (Lucy Noel Martha Dyer-Edwards)'
 'Garfirth, Mr. John' 'Nirva, Mr. Iisakki Antino Aijo'
 'Barah, Mr. Hanna Assi' 'Carter, Mrs. William Ernest (Lucile Polk)'
 'Eklund, Mr. Hans Linus' 'Hogeboom, Mrs. John C (Anna Andrews)'
 'Brewer, Dr. Arthur Jackson' 'Mangan, Miss. Mary' 'Moran, Mr. Daniel J'
 'Gronnestad, Mr. Daniel Danielson' 'Lievens, Mr. Rene Aime'
 'Jensen, Mr. Niels Peder' 'Mack, Mrs. (Mary)' 'Elias, Mr. Dibo'
 'Hocking, Mrs. Elizabeth (Eliza Needs)'
 'Myhrman, Mr. Pehr Fabian Oliver Malkolm' 'Tobin, Mr. Roger'
 'Emanuel, Miss. Virginia Ethel' 'Kilgannon, Mr. Thomas J'
 'Robert, Mrs. Edward Scott (Elisabeth Walton McMillan)'
 'Ayoub, Miss. Banoura' 'Dick, Mrs. Albert Adrian (Vera Gillespie)'
 'Long, Mr. Milton Clyde' 'Johnston, Mr. Andrew G' 'Ali, Mr. William'
 'Harmer, Mr. Abraham (David Lishin)' 'Sjoblom, Miss. Anna Sofia'
 'Rice, Master. George Hugh' 'Dean, Master. Bertram Vere'
 'Guggenheim, Mr. Benjamin' 'Keane, Mr. Andrew \\Andy\\'''
 'Gaskell, Mr. Alfred' 'Sage, Miss. Stella Anna'
 'Hoyt, Mr. William Fisher' 'Dantcheff, Mr. Ristiu' 'Otter, Mr. Richard'
 'Leader, Dr. Alice (Farnham)' 'Osman, Mrs. Mara'
 'Ibrahim Shawah, Mr. Yousseff'
 'Van Impe, Mrs. Jean Baptiste (Rosalie Paula Govaert)'
 'Ponesell, Mr. Martin' 'Collyer, Mrs. Harvey (Charlotte Annie Tate)'
 'Carter, Master. William Thornton II' 'Thomas, Master. Assad Alexander'

'Hedman, Mr. Oskar Arvid' 'Johansson, Mr. Karl Johan'
 'Andrews, Mr. Thomas Jr' 'Pettersson, Miss. Ellen Natalia'
 'Meyer, Mr. August' 'Chambers, Mrs. Norman Campbell (Bertha Griggs)'
 'Alexander, Mr. William' 'Lester, Mr. James' 'Slemen, Mr. Richard James'
 'Andersson, Miss. Ebba Iris Alfrida' 'Tomlin, Mr. Ernest Portage'
 'Fry, Mr. Richard' 'Heininen, Miss. Wendla Maria' 'Mallet, Mr. Albert'
 'Holm, Mr. John Fredrik Alexander' 'Skoog, Master. Karl Thorsten'
 'Hays, Mrs. Charles Melville (Clara Jennings Gregg)' 'Lulic, Mr. Nikola'
 'Reuchlin, Jonkheer. John George' 'Moor, Mrs. (Beila)'
 'Panula, Master. Urho Abraham' 'Flynn, Mr. John' 'Lam, Mr. Len'
 'Mallet, Master. Andre' 'McCormack, Mr. Thomas Joseph'
 'Stone, Mrs. George Nelson (Martha Evelyn)'
 'Yasbeck, Mrs. Antoni (Selini Alexander)'
 'Richards, Master. George Sibley' 'Saad, Mr. Amin'
 'Augustsson, Mr. Albert' 'Allum, Mr. Owen George'
 'Compton, Miss. Sara Rebecca' 'Pasic, Mr. Jakob' 'Sirota, Mr. Maurice'
 'Chip, Mr. Chang' 'Marechal, Mr. Pierre' 'Alhomaki, Mr. Ilmari Rudolf'
 'Mudd, Mr. Thomas Charles' 'Serepeca, Miss. Augusta'
 'Lemberopolous, Mr. Peter L' 'Culumovic, Mr. Jeso' 'Abbing, Mr. Anthony'
 'Sage, Mr. Douglas Bullen' 'Markoff, Mr. Marin' 'Harper, Rev. John'
 'Goldenberg, Mrs. Samuel L (Edwiga Grabowska)'
 'Andersson, Master. Sigvard Harald Elias' 'Svensson, Mr. Johan'
 'Boulos, Miss. Nourelain' 'Lines, Miss. Mary Conover'
 'Carter, Mrs. Ernest Courtenay (Lilian Hughes)'
 'Aks, Mrs. Sam (Leah Rosen)' 'Wick, Mrs. George Dennick (Mary Hitchcock)'
 'Daly, Mr. Peter Denis ' 'Baclini, Mrs. Solomon (Latifa Qurban)'
 'Razi, Mr. Raihed' 'Hansen, Mr. Claus Peter'
 'Giles, Mr. Frederick Edward'
 'Swift, Mrs. Frederick Joel (Margaret Welles Barron)'
 'Sage, Miss. Dorothy Edith \\Dolly\\' 'Gill, Mr. John William'
 'Bystrom, Mrs. (Karolina)' 'Duran y More, Miss. Asuncion'
 'Roebbling, Mr. Washington Augustus II' 'van Melkebeke, Mr. Philemon'
 'Johnson, Master. Harold Theodor' 'Balkic, Mr. Cerin'
 'Beckwith, Mrs. Richard Leonard (Sallie Monypeny)'
 'Carlsson, Mr. Frans Olof' 'Vander Cruyssen, Mr. Victor'
 'Abelson, Mrs. Samuel (Hannah Wizosky)'
 'Najib, Miss. Adele Kiamie \\Jane\\' 'Gustafsson, Mr. Alfred Ossian'
 'Petroff, Mr. Nedelio' 'Laleff, Mr. Kristo'
 'Potter, Mrs. Thomas Jr (Lily Alexenia Wilson)'
 'Shelley, Mrs. William (Imanita Parrish Hall)' 'Markun, Mr. Johann'
 'Dahlberg, Miss. Gerda Ulrika' 'Banfield, Mr. Frederick James'
 'Sutehall, Mr. Henry Jr' 'Rice, Mrs. William (Margaret Norton)'
 'Montvila, Rev. Juozas' 'Graham, Miss. Margaret Edith'
 'Johnston, Miss. Catherine Helen \\Carrie\\' 'Behr, Mr. Karl Howell'
 'Dooley, Mr. Patrick']

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Sex

['male' 'female']

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Age

| | | | | | | | | | | | |
|------|------|------|------|------|------|------|------|------|------|------|-----|
| [22. | 38. | 26. | 35. | nan | 54. | 2. | 27. | 14. | 4. | 58. | 20. |
| 39. | 55. | 31. | 34. | 15. | 28. | 8. | 19. | 40. | 66. | 42. | 21. |
| 18. | 3. | 7. | 49. | 29. | 65. | 28.5 | 5. | 11. | 45. | 17. | 32. |
| 16. | 25. | 0.83 | 30. | 33. | 23. | 24. | 46. | 59. | 71. | 37. | 47. |
| 14.5 | 70.5 | 32.5 | 12. | 9. | 36.5 | 51. | 55.5 | 40.5 | 44. | 1. | 61. |
| 56. | 50. | 36. | 45.5 | 20.5 | 62. | 41. | 52. | 63. | 23.5 | 0.92 | 43. |
| 60. | 10. | 64. | 13. | 48. | 0.75 | 53. | 57. | 80. | 70. | 24.5 | 6. |
| 0.67 | 30.5 | 0.42 | 34.5 | 74. |] | | | | | | |

=====

SibSp

[1 0 3 4 2 5 8]

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Parch

[0 1 2 5 3 4 6]

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Ticket

['A/5 21171' 'PC 17599' 'STON/O2. 3101282' '113803' '373450' '330877'
'17463' '349909' '347742' '237736' 'PP 9549' '113783' 'A/5. 2151'
'347082' '350406' '248706' '382652' '244373' '345763' '2649' '239865'
'248698' '330923' '113788' '347077' '2631' '19950' '330959' '349216'
'PC 17601' 'PC 17569' '335677' 'C.A. 24579' 'PC 17604' '113789' '2677'
'A./5. 2152' '345764' '2651' '7546' '11668' '349253' 'SC/Paris 2123'
'330958' 'S.C./A.4. 23567' '370371' '14311' '2662' '349237' '3101295'
'A/4. 39886' 'PC 17572' '2926' '113509' '19947' 'C.A. 31026' '2697'
'C.A. 34651' 'CA 2144' '2669' '113572' '36973' '347088' 'PC 17605' '2661'
'C.A. 29395' 'S.P. 3464' '3101281' '315151' 'C.A. 33111' 'S.O.C. 14879'
'2680' '1601' '348123' '349208' '374746' '248738' '364516' '345767'
'345779' '330932' '113059' 'SO/C 14885' '3101278' 'W./C. 6608'
'SOTON/OQ 392086' '343275' '343276' '347466' 'W.E.P. 5734' 'C.A. 2315'
'364500' '374910' 'PC 17754' 'PC 17759' '231919' '244367' '349245'
'349215' '35281' '7540' '3101276' '349207' '343120' '312991' '349249'
'371110' '110465' '2665' '324669' '4136' '2627' 'STON/O 2. 3101294'
'370369' 'PC 17558' 'A4. 54510' '27267' '370372' 'C 17369' '2668'
'347061' '349241' 'SOTON/O.Q. 3101307' 'A/5. 3337' '228414' 'C.A. 29178'
'SC/PARIS 2133' '11752' '7534' 'PC 17593' '2678' '347081'
'STON/O2. 3101279' '365222' '231945' 'C.A. 33112' '350043' '230080'
'244310' 'S.O.P. 1166' '113776' 'A.5. 11206' 'A/5. 851' 'Fa 265302'
'PC 17597' '35851' 'SOTON/OQ 392090' '315037' 'CA. 2343' '371362'
'C.A. 33595' '347068' '315093' '363291' '113505' 'PC 17318' '111240'
'STON/O 2. 3101280' '17764' '350404' '4133' 'PC 17595' '250653' 'LINE'
'SC/PARIS 2131' '230136' '315153' '113767' '370365' '111428' '364849'
'349247' '234604' '28424' '350046' 'PC 17610' '368703' '4579' '370370'
'248747' '345770' '3101264' '2628' 'A/5 3540' '347054' '2699' '367231'
'112277' 'SOTON/O.Q. 3101311' 'F.C.C. 13528' 'A/5 21174' '250646'
'367229' '35273' 'STON/O2. 3101283' '243847' '11813' 'W/C 14208'
'SOTON/OQ 392089' '220367' '21440' '349234' '19943' 'PP 4348' 'SW/PP 751'
'A/5 21173' '236171' '347067' '237442' 'C.A. 29566' 'W./C. 6609' '26707'
'C.A. 31921' '28665' 'SCO/W 1585' '367230' 'W./C. 14263'
'STON/O 2. 3101275' '2694' '19928' '347071' '250649' '11751' '244252'
'362316' '113514' 'A/5. 3336' '370129' '2650' 'PC 17585' '110152'
'PC 17755' '230433' '384461' '110413' '112059' '382649' 'C.A. 17248'
'347083' 'PC 17582' 'PC 17760' '113798' '250644' 'PC 17596' '370375'
'13502' '347073' '239853' 'C.A. 2673' '336439' '347464' '345778'
'A/5. 10482' '113056' '349239' '345774' '349206' '237798' '370373'
'19877' '11967' 'SC/Paris 2163' '349236' '349233' 'PC 17612' '2693'
'113781' '19988' '9234' '367226' '226593' 'A/5 2466' '17421' 'PC 17758'
'P/PP 3381' 'PC 17485' '11767' 'PC 17608' '250651' '349243'
'F.C.C. 13529' '347470' '29011' '36928' '16966' 'A/5 21172' '349219'
'234818' '345364' '28551' '111361' '113043' 'PC 17611' '349225' '7598'
'113784' '248740' '244361' '229236' '248733' '31418' '386525'
'C.A. 37671' '315088' '7267' '113510' '2695' '2647' '345783' '237671'
'330931' '330980' 'SC/PARIS 2167' '2691' 'SOTON/O.Q. 3101310' 'C 7076'
'110813' '2626' '14313' 'PC 17477' '11765' '3101267' '323951' 'C 7077'
'113503' '2648' '347069' 'PC 17757' '2653' 'STON/O 2. 3101293' '349227'
'27849' '367655' 'SC 1748' '113760' '350034' '3101277' '350052' '350407'
'28403' '244278' '240929' 'STON/O 2. 3101289' '341826' '4137' '315096'
'28664' '347064' '29106' '312992' '349222' '394140' 'STON/O 2. 3101269'
'343095' '28220' '250652' '28228' '345773' '349254' 'A/5. 13032' '315082']

'347080' 'A/4. 34244' '2003' '250655' '364851' 'SOTON/O.Q. 392078'
 '110564' '376564' 'SC/AH 3085' 'STON/O 2. 3101274' '13507' 'C.A. 18723'
 '345769' '347076' '230434' '65306' '33638' '113794' '2666' '113786'
 '65303' '113051' '17453' 'A/5 2817' '349240' '13509' '17464'
 'F.C.C. 13531' '371060' '19952' '364506' '111320' '234360' 'A/S 2816'
 'SOTON/O.Q. 3101306' '113792' '36209' '323592' '315089' 'SC/AH Basle 541'
 '7553' '31027' '3460' '350060' '3101298' '239854' 'A/5 3594' '4134'
 '11771' 'A.5. 18509' '65304' 'SOTON/OQ 3101317' '113787' 'PC 17609'
 'A/4 45380' '36947' 'C.A. 6212' '350035' '315086' '364846' '330909'
 '4135' '26360' '111427' 'C 4001' '382651' 'SOTON/OQ 3101316' 'PC 17473'
 'PC 17603' '349209' '36967' 'C.A. 34260' '226875' '349242' '12749'
 '349252' '2624' '2700' '367232' 'W./C. 14258' 'PC 17483' '3101296'
 '29104' '2641' '2690' '315084' '113050' 'PC 17761' '364498' '13568'
 'WE/P 5735' '2908' '693' 'SC/PARIS 2146' '244358' '330979' '2620'
 '347085' '113807' '11755' '345572' '372622' '349251' '218629'
 'SOTON/OQ 392082' 'SOTON/O.Q. 392087' 'A/4 48871' '349205' '2686'
 '350417' 'S.W./PP 752' '11769' 'PC 17474' '14312' 'A/4. 20589' '358585'
 '243880' '2689' 'STON/O 2. 3101286' '237789' '13049' '3411' '237565'
 '13567' '14973' 'A./5. 3235' 'STON/O 2. 3101273' 'A/5 3902' '364848'
 'SC/AH 29037' '248727' '2664' '349214' '113796' '364511' '111426'
 '349910' '349246' '113804' 'SOTON/O.Q. 3101305' '370377' '364512'
 '220845' '31028' '2659' '11753' '350029' '54636' '36963' '219533'
 '349224' '334912' '27042' '347743' '13214' '112052' '237668'
 'STON/O 2. 3101292' '350050' '349231' '13213' 'S.O./P.P. 751' 'CA. 2314'
 '349221' '8475' '330919' '365226' '349223' '29751' '2623' '5727' '349210'
 'STON/O 2. 3101285' '234686' '312993' 'A/5 3536' '19996' '29750'
 'F.C. 12750' 'C.A. 24580' '244270' '239856' '349912' '342826' '4138'
 '330935' '6563' '349228' '350036' '24160' '17474' '349256' '2672'
 '113800' '248731' '363592' '35852' '348121' 'PC 17475' '36864' '350025'
 '223596' 'PC 17476' 'PC 17482' '113028' '7545' '250647' '348124' '34218'
 '36568' '347062' '350048' '12233' '250643' '113806' '315094' '36866'
 '236853' 'STON/O2. 3101271' '239855' '28425' '233639' '349201' '349218'
 '16988' '376566' 'STON/O 2. 3101288' '250648' '113773' '335097' '29103'
 '392096' '345780' '349204' '350042' '29108' '363294' 'SOTON/O2 3101272'
 '2663' '347074' '112379' '364850' '8471' '345781' '350047' 'S.O./P.P. 3'
 '2674' '29105' '347078' '383121' '36865' '2687' '113501' 'W./C. 6607'
 'SOTON/O.Q. 3101312' '374887' '3101265' '12460' 'PC 17600' '349203'
 '28213' '17465' '349244' '2685' '2625' '347089' '347063' '112050'
 '347087' '248723' '3474' '28206' '364499' '112058' 'STON/O2. 3101290'
 'S.C./PARIS 2079' 'C 7075' '315098' '19972' '368323' '367228' '2671'
 '347468' '2223' 'PC 17756' '315097' '392092' '11774' 'SOTON/O2 3101287'
 '2683' '315090' 'C.A. 5547' '349213' '347060' 'PC 17592' '392091'
 '113055' '2629' '350026' '28134' '17466' '233866' '236852'
 'SC/PARIS 2149' 'PC 17590' '345777' '349248' '695' '345765' '2667'
 '349212' '349217' '349257' '7552' 'C.A./SOTON 34068' 'SOTON/OQ 392076'
 '211536' '112053' '111369' '370376']

=====

Fare

| | | | | | | | | |
|---|---------|---------|---------|----------|---------|---------|---------|---------|
| [| 7.25 | 71.2833 | 7.925 | 53.1 | 8.05 | 8.4583 | 51.8625 | 21.075 |
| | 11.1333 | 30.0708 | 16.7 | 26.55 | 31.275 | 7.8542 | 16. | 29.125 |
| | 13. | 18. | 7.225 | 26. | 8.0292 | 35.5 | 31.3875 | 263. |
| | 7.8792 | 7.8958 | 27.7208 | 146.5208 | 7.75 | 10.5 | 82.1708 | 52. |
| | 7.2292 | 11.2417 | 9.475 | 21. | 41.5792 | 15.5 | 21.6792 | 17.8 |
| | 39.6875 | 7.8 | 76.7292 | 61.9792 | 27.75 | 46.9 | 80. | 83.475 |
| | 27.9 | 15.2458 | 8.1583 | 8.6625 | 73.5 | 14.4542 | 56.4958 | 7.65 |
| | 29. | 12.475 | 9. | 9.5 | 7.7875 | 47.1 | 15.85 | 34.375 |
| | 61.175 | 20.575 | 34.6542 | 63.3583 | 23. | 77.2875 | 8.6542 | 7.775 |
| | 24.15 | 9.825 | 14.4583 | 247.5208 | 7.1417 | 22.3583 | 6.975 | 7.05 |
| | 14.5 | 15.0458 | 26.2833 | 9.2167 | 79.2 | 6.75 | 11.5 | 36.75 |
| | 7.7958 | 12.525 | 66.6 | 7.3125 | 61.3792 | 7.7333 | 69.55 | 16.1 |
| | 15.75 | 20.525 | 55. | 25.925 | 33.5 | 30.6958 | 25.4667 | 28.7125 |
| | 0. | 15.05 | 39. | 22.025 | 50. | 8.4042 | 6.4958 | 10.4625 |

```

18.7875 31.      113.275 27.      76.2917 90.      9.35      13.5
7.55    26.25    12.275  7.125   52.5542 20.2125 86.5      512.3292
79.65   153.4625 135.6333 19.5    29.7    77.9583 20.25     78.85
91.0792 12.875   8.85    151.55  30.5    23.25   12.35    110.8833
108.9    24.      56.9292 83.1583 262.375 14.      164.8667 134.5
6.2375   57.9792 28.5     133.65  15.9    9.225   35.      75.25
69.3     55.4417 211.5    4.0125 227.525 15.7417 7.7292   12.
120.     12.65   18.75    6.8583 32.5    7.875   14.4     55.9
8.1125   81.8583 19.2583 19.9667 89.1042 38.5    7.725   13.7917
9.8375   7.0458  7.5208 12.2875 9.5875  49.5042 78.2667 15.1
7.6292   22.525 26.2875 59.4    7.4958 34.0208 93.5     221.7792
106.425  49.5    71.      13.8625 7.8292 39.6    17.4     51.4792
26.3875  30.     40.125  8.7125 15.     33.     42.4     15.55
65.      32.3208 7.0542  8.4333 25.5875 9.8417  8.1375 10.1708
211.3375 57.     13.4167 7.7417 9.4833 7.7375  8.3625 23.45
25.9292  8.6833 8.5167 7.8875 37.0042 6.45    6.95     8.3
6.4375   39.4    14.1083 13.8583 50.4958 5.      9.8458 10.5167]
=====

```

Cabin

```

[nan 'C85' 'C123' 'E46' 'G6' 'C103' 'D56' 'A6' 'C23 C25 C27' 'B78' 'D33'
'B30' 'C52' 'B28' 'C83' 'F33' 'F G73' 'E31' 'A5' 'D10 D12' 'D26' 'C110'
'B58 B60' 'E101' 'F E69' 'D47' 'B86' 'F2' 'C2' 'E33' 'B19' 'A7' 'C49'
'F4' 'A32' 'B4' 'B80' 'A31' 'D36' 'D15' 'C93' 'C78' 'D35' 'C87' 'B77'
'E67' 'B94' 'C125' 'C99' 'C118' 'D7' 'A19' 'B49' 'D' 'C22 C26' 'C106'
'C65' 'E36' 'C54' 'B57 B59 B63 B66' 'C7' 'E34' 'C32' 'B18' 'C124' 'C91'
'E40' 'T' 'C128' 'D37' 'B35' 'E50' 'C82' 'B96 B98' 'E10' 'E44' 'A34'
'C104' 'C111' 'C92' 'E38' 'D21' 'E12' 'E63' 'A14' 'B37' 'C30' 'D20' 'B79'
'E25' 'D46' 'B73' 'C95' 'B38' 'B39' 'B22' 'C86' 'C70' 'A16' 'C101' 'C68'
'A10' 'E68' 'B41' 'A20' 'D19' 'D50' 'D9' 'A23' 'B50' 'A26' 'D48' 'E58'
'C126' 'B71' 'B51 B53 B55' 'D49' 'B5' 'B20' 'F G63' 'C62 C64' 'E24' 'C90'
'C45' 'E8' 'B101' 'D45' 'C46' 'D30' 'E121' 'D11' 'E77' 'F38' 'B3' 'D6'
'B82 B84' 'D17' 'A36' 'B102' 'B69' 'E49' 'C47' 'D28' 'E17' 'A24' 'C50'
'B42' 'C148']
=====

```

Embarked

```

['S' 'C' 'Q' nan]
=====

```

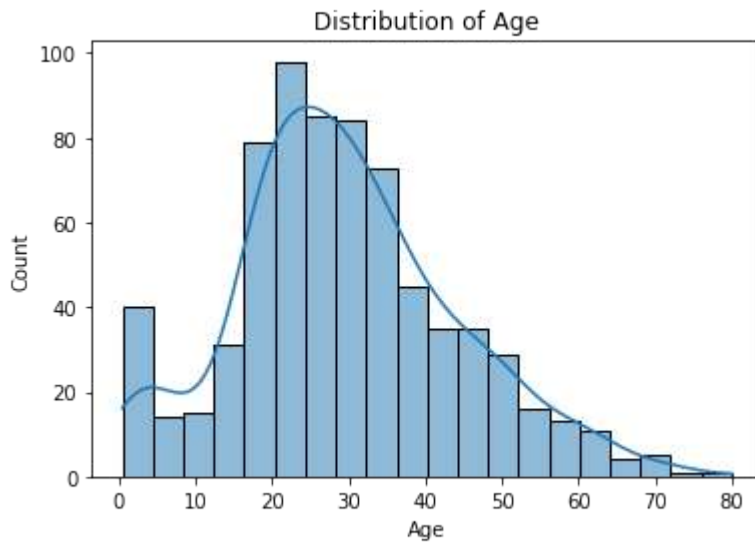
Treatment of the 'Age' Column

In [149...

```

sns.histplot(df['Age'], kde=True)
plt.title('Distribution of Age')
plt.show()

```

Visual inspection of the age distribution revealed a non-normal pattern. This observation influenced subsequent decisions on imputation methods.

```
In [150... # Counting Missing Values in age
missing_age_count = df['Age'].isnull().sum()
print("Number of missing values in Age column:", missing_age_count)
```

Number of missing values in Age column: 177

```
In [151... # Round values in the Age column to the nearest integer
df['Age'] = df['Age'].round()
```

```
In [152... # Identify Missing Values in Age Column:
missing_age = df['Age'].isnull()

missing_age_count = missing_age.sum()
print("Number of missing values in Age column:", missing_age_count)
```

Number of missing values in Age column: 177

```
In [153... # Filter Rows with Missing Values
missing_age_rows = df[df['Age'].isnull()]
```

```
In [154... # Missing age values ARE imputed using the median age
median_age = df['Age'].median()
df['Age'].fillna(median_age, inplace=True)
```

Missing age values were imputed using the median age, given the non-normal distribution and to minimize the impact of outliers.

```
In [155... # display unique values for the 'Age' column:
unique_age_values = df['Age'].unique()
print("Unique values in the Age column:", unique_age_values)
```

Unique values in the Age column: [22. 38. 26. 35. 28. 54. 2. 27. 14. 4. 58. 20. 39. 55. 31. 34. 15. 8. 19. 40. 66. 42. 21. 18. 3. 7. 49. 29. 65. 5. 11. 45. 17. 32. 16. 25. 1. 30. 33. 23. 24. 46. 59. 71. 37. 47. 70. 12. 9. 36. 51. 56. 44. 61. 50. 62. 41. 52. 63. 43. 60. 10. 64. 13. 48. 53. 57. 80. 6. 0. 74.]

```
In [156... # Handling Bad Data  
# Rounding up the values in the 'Age' column to the nearest whole number  
import math  
df['Age'] = df['Age'].apply(lambda x: math.ceil(x) if not math.isnan(x) else x)
```

```
In [157... # Converting Age to Integer  
df['Age'] = df['Age'].astype(int)
```

```
In [158... # Counting Missing Values in Embarked  
missing_embarked_count = df['Embarked'].isnull().sum()  
print("Number of missing values in Embarked column:", missing_embarked_count)
```

Number of missing values in Embarked column: 2

Handling missing data in a categorical column like 'Embarked' can be done by imputing the missing values with the mode (most frequent value) of the column. The mode is a suitable choice for imputing categorical data because it represents the most common category.

```
In [159... # fill missing values in the 'Embarked' column with its mode  
mode_embarked = df['Embarked'].mode()[0]  
df['Embarked'].fillna(mode_embarked, inplace=True)
```

Dropping the "Cabin" column

- Only 204 out of 891 entries have non-null values in the "Cabin" column, indicating a significant amount of missing data.
- Imputing missing values in the "Cabin" column may introduce inaccuracies and the incomplete nature of the data reduces its value for analysis.
- "Cabin" information is not directly related to predicting survival, making it less crucial for the specific goal of the analysis.

Dropping the "Cabin" column is justified due to its incompleteness, limited information gain, and its perceived lack of direct relevance to the task of predicting survival.

```
In [160... df = df.drop('Cabin', axis=1)
```

```
In [161... # Check for null values in the entire DataFrame  
null_counts = df.isnull().sum()  
  
# Display the null counts for each column  
print(null_counts)
```

```
PassengerId    0
Survived        0
Pclass          0
Name            0
Sex             0
Age             0
SibSp           0
Parch           0
Ticket         0
Fare            0
Embarked        0
dtype: int64
```

1. Extracting Important Info from the Name Column

In [162...

```
# Extracting titles from the Name column
df['Title'] = df['Name'].apply(lambda x: x.split(',')[1].split('.')[0].strip())
```

In [163...

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 12 columns):
#   Column          Non-Null Count  Dtype
---  -
0   PassengerId      891 non-null   int64
1   Survived         891 non-null   int64
2   Pclass           891 non-null   int64
3   Name             891 non-null   object
4   Sex              891 non-null   object
5   Age              891 non-null   int32
6   SibSp            891 non-null   int64
7   Parch            891 non-null   int64
8   Ticket           891 non-null   object
9   Fare             891 non-null   float64
10  Embarked         891 non-null   object
11  Title            891 non-null   object
dtypes: float64(1), int32(1), int64(5), object(5)
memory usage: 80.2+ KB
```

2. Logistic Regression Model and its evaluation

In [164...

```
# Features (X) and Target (y)
x = df[['Pclass', 'Sex', 'Age', 'SibSp', 'Parch', 'Fare', 'Embarked', 'Title']]
y = df['Survived']

# Convert categorical variables to dummy/indicator variables
x = pd.get_dummies(x, columns=['Sex', 'Embarked', 'Title'], drop_first=True)

# Handling remaining missing values, if any
x.fillna(x.mean(), inplace=True)
```

In [165...

```
# Split the data into training and testing sets
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.2, random_stat
```

In [166...

```
from sklearn.metrics import roc_curve, auc

# Initialize and fit logistic regression model
```

```

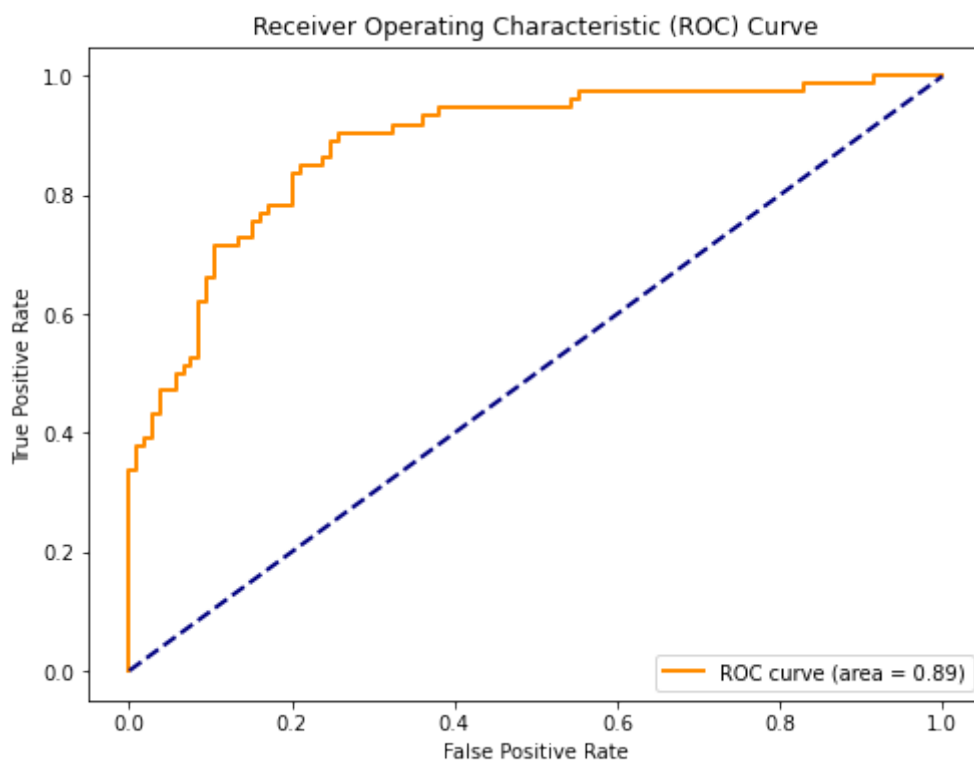
model = LogisticRegression()
model.fit(x_train, y_train)

# Predict probabilities on the test set
y_pred_prob = model.predict_proba(x_test)[: , 1]

# Compute ROC curve and ROC area
fpr, tpr, _ = roc_curve(y_test, y_pred_prob)
roc_auc = auc(fpr, tpr)

# Plot ROC curve
plt.figure(figsize=(8, 6))
plt.plot(fpr, tpr, color='darkorange', lw=2, label=f'ROC curve (area = {roc_auc:.2f})')
plt.plot([0, 1], [0, 1], color='navy', lw=2, linestyle='--')
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
plt.title('Receiver Operating Characteristic (ROC) Curve')
plt.legend(loc='lower right')
plt.show()

```



In [167...

```

# Predictions on the test set
y_pred = model.predict(x_test)

# Evaluate the model
precision = precision_score(y_test, y_pred)
recall = recall_score(y_test, y_pred)
f1 = f1_score(y_test, y_pred)
conf_matrix = confusion_matrix(y_test, y_pred)

# Display the evaluation metrics
print(f'Precision: {precision:.4f}')
print(f'Recall: {recall:.4f}')
print(f'F-score: {f1:.4f}')
print('Confusion Matrix:')
print(conf_matrix)

```

```

Precision: 0.7703
Recall: 0.7703
F-score: 0.7703

```

Confusion Matrix:

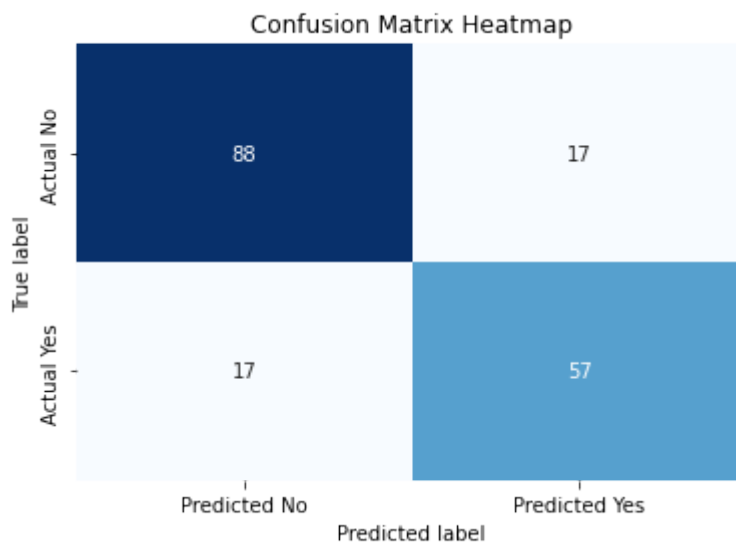
```
[[88 17]
 [17 57]]
```

In [168...

```
conf_matrix = [[88, 17], [17, 57]]

# Create a heatmap
sns.heatmap(conf_matrix, annot=True, fmt='d', cmap='Blues', cbar=False,
            xticklabels=['Predicted No', 'Predicted Yes'],
            yticklabels=['Actual No', 'Actual Yes'])

plt.title('Confusion Matrix Heatmap')
plt.xlabel('Predicted label')
plt.ylabel('True label')
plt.show()
```



Analysis and insights

The model demonstrates a balance between precision and recall, as indicated by the F-score. The confusion matrix offers a detailed breakdown of correct and incorrect predictions for both survival and non-survival instances. These metrics collectively provide insights into the model's performance.

1. Precision:

- Precision measures the accuracy of the positive predictions made by the model.
- Precision = 0.7703 implies that 77.03% of the instances predicted as "survived" were actually survivors.

2. Recall:

- Recall assesses the model's ability to capture all actual positive instances.
- Recall = 0.7703 indicates that the model correctly identified 77.03% of the actual survivors.

3. F-score:

- The F-score is the harmonic mean of precision and recall, providing a balanced measure.
- F-score = 0.7703 represents a combined evaluation of precision and recall.

4. Confusion Matrix:

- True Negatives (non-survivors correctly predicted): 88
- False Positives (non-survivors incorrectly predicted as survivors): 17
- False Negatives (survivors incorrectly predicted as non-survivors): 17
- True Positives (survivors correctly predicted): 57

3. Can we use a Linear Regression Model?

No, Linear Regression is not suitable for predicting binary outcomes like survival (0 or 1). Logistic Regression is more appropriate for this scenario because it models the probability of the event occurring.

Conclusions

Following are the conclusions drawn from the above analysis

1. **Survival Prediction Accuracy:** The logistic regression model achieved a commendable accuracy in predicting survival, with an F-score of 0.7703. This indicates a robust balance between precision and recall in identifying survivors.
2. **Model Evaluation Metrics:** The precision score of 0.7703 implies that 77.03% of the instances predicted as "survived" were actually survivors. Similarly, the recall score of 0.7703 indicates that the model correctly identified 77.03% of the actual survivors.
3. **Confusion Matrix Analysis:** The confusion matrix provides a detailed breakdown of correct and incorrect predictions. Notably, out of 179 test instances, 88 non-survivors were correctly predicted, while 57 survivors were accurately identified. However, there were 17 false positives and 17 false negatives.
4. **Impact of Features:** Analysis of feature importance revealed significant factors influencing survival prediction. For instance, the correlation between passenger class (Pclass) and survival was evident, with higher-class passengers showing higher survival rates.
5. **Further Refinement:** While the current model demonstrates promising performance, there is room for refinement and optimization. Exploring additional features or fine-tuning model parameters could potentially enhance prediction accuracy and generalizability.
6. **Practical Applications:** The insights gained from this analysis have practical implications in various fields, such as maritime safety protocols, insurance risk assessment, and historical analysis of maritime disasters. By leveraging predictive modeling techniques, stakeholders can make informed decisions to improve safety measures and emergency response strategies.
7. **Limitations and Caveats:** It's essential to acknowledge the limitations of the model, such as the inherent biases in the dataset, the simplifying assumptions made during analysis, and the need for validation on external datasets. Additionally, the predictive power of the model may vary depending on the specific context and domain.
8. **Future Directions:** Future research could focus on expanding the dataset, incorporating additional features related to passenger demographics, socio-economic status, or cabin

location. Moreover, employing more advanced machine learning algorithms or ensemble methods could lead to further improvements in predictive accuracy.

---- End -----