Ma3 - HW7

Problem 1 - Calculations

In[1]:=
```
data = {{4, 21}, {5, 25}, {6, 24}, {7, 39}};
expected = {{4, 16.45}, {5, 29.03}, {6, 32.85}, {7, 30.67}};
```

In[21]:=
$$d = \text{Sum}\left[\frac{(\text{data}[[i]][[2]] - \text{expected}[[i]][[2]])^2}{\text{expected}[[i]][[2]]}, \{i, 1, \text{Length}[\text{data}]\}\right]$$

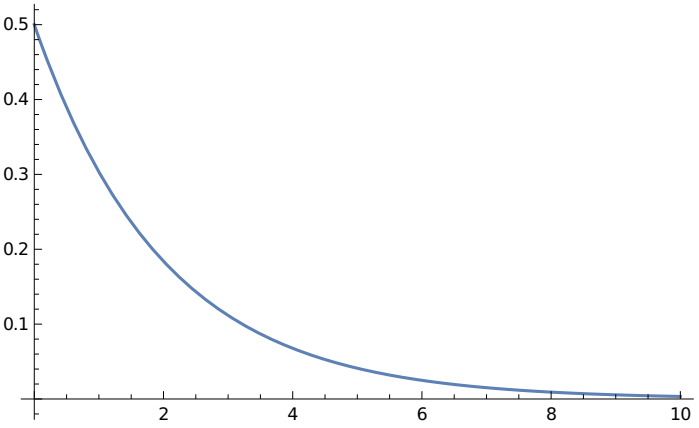
Out[21]= 6.46465

In[22]:=
```
crit = InverseCDF[ChiSquareDistribution[2], 0.95]
```

Out[22]= 5.99146

In[23]:=
```
Plot[PDF[ChiSquareDistribution[2], x], {x, 0, 10}]
```

Out[23]=



In[25]:=
```
p = 1 - CDF[ChiSquareDistribution[2], d]
```

Out[25]= 0.0394657

Problem 2

Part (2)

In[31]:=
```
ClearAll["Global`*"]
```

In[33]:=
```
SetDirectory[NotebookDirectory[]];
```

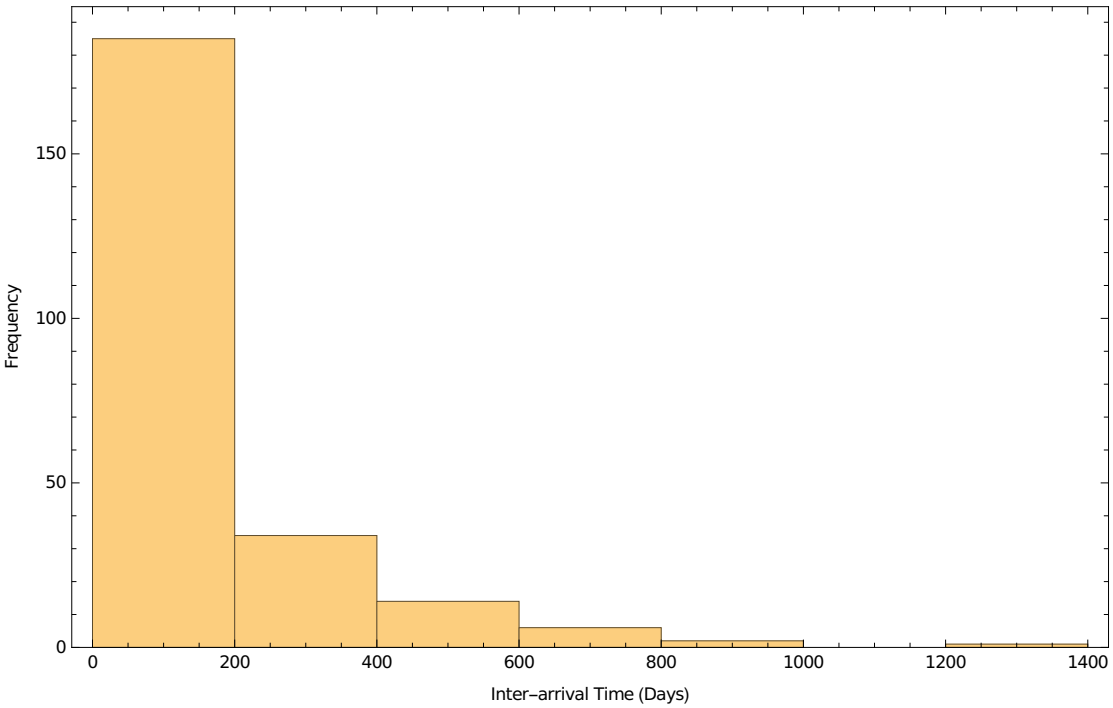
In[39]:=
```
data = Import["SimplifiedEarthquakeCatalog2018.txt", "Table"];
```

In[61]:=
```
dates = data[[All, 1]];
```

In[62]:=
```
interArrivalTimes = Differences[dates];
```

In[63]:=
```
Histogram[interArrivalTimes, 10, ImageSize → Large,
 Frame → True, FrameLabel → {"Inter-arrival Time (Days)", "Frequency"}]
```

Out[63]=



Part (3)

In[64]:=
```
Mean[interArrivalTimes]
StandardDeviation[interArrivalTimes]
```

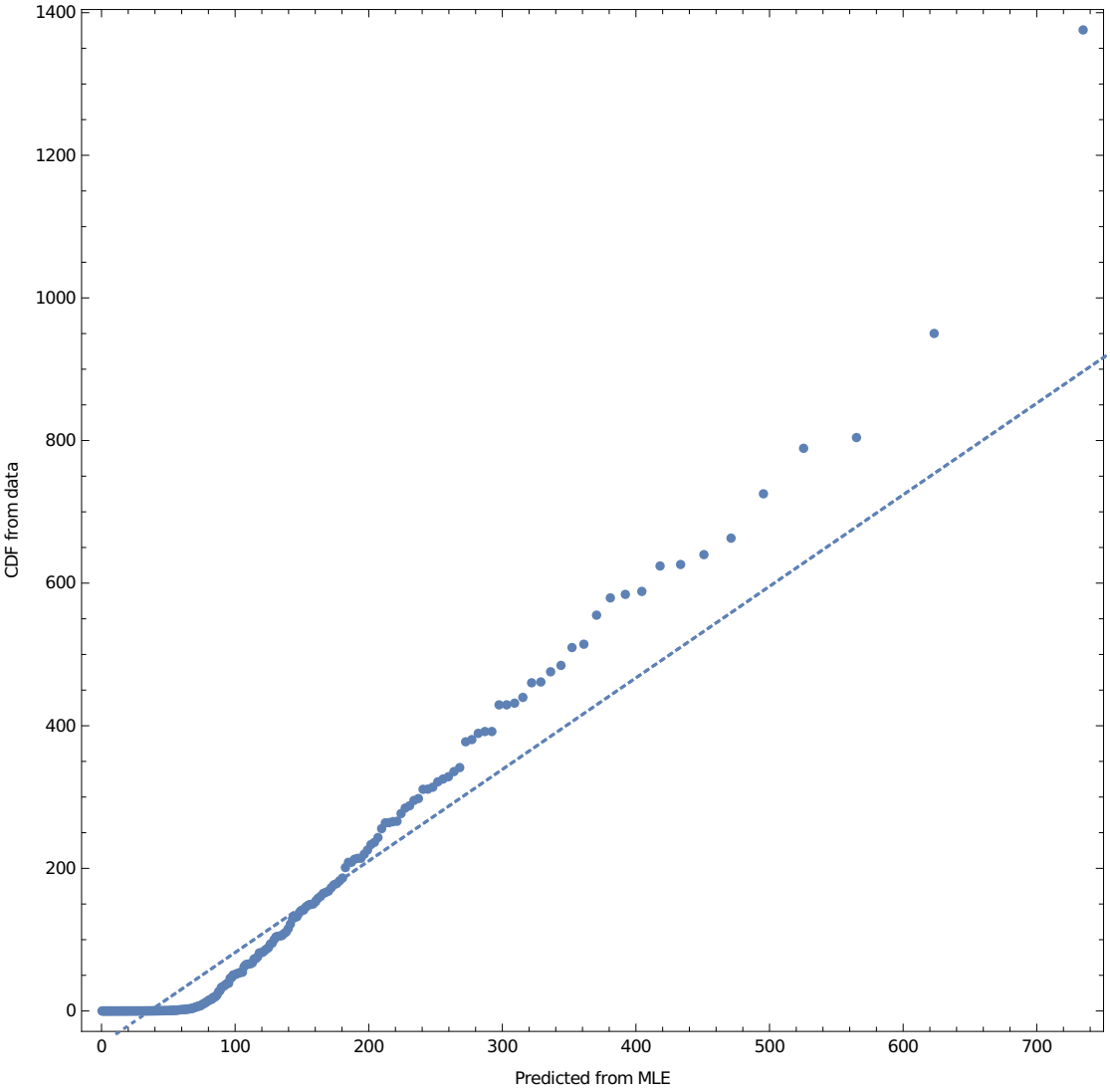
Out[64]= 125.65

Out[65]= 198.887

Part (6)

In[76]:=
```
QuantilePlot[interArrivalTimes, ExponentialDistribution[1/Mean[interArrivalTimes]],
 AspectRatio → 1, ImageSize → Large,
 FrameLabel → {"Predicted from MLE", "CDF from data"}, PlotRange → All]
```

Out[76]=



Part (7)

In[70]:=
```
KolmogorovSmirnovTest[interArrivalTimes,
 ExponentialDistribution[1/Mean[interArrivalTimes]]] // Quiet
```

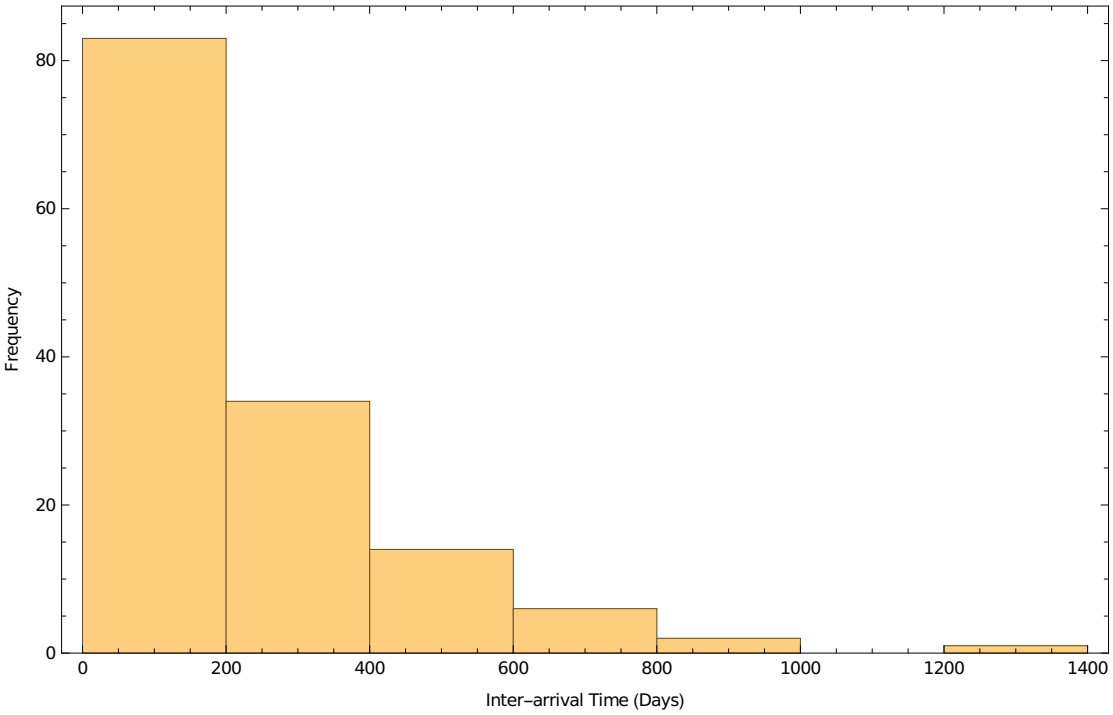
Out[70]= 2.90916×10^{-33}

Part (8)

In[72]:=
```
restrictedInterArrivalTimes = Select[interArrivalTimes, # > 4 &];
```

In[80]:=
```
Histogram[restrictedInterArrivalTimes, 10, ImageSize → Large,
 Frame → True, FrameLabel → {"Inter-arrival Time (Days)", "Frequency"}]
```

Out[80]=



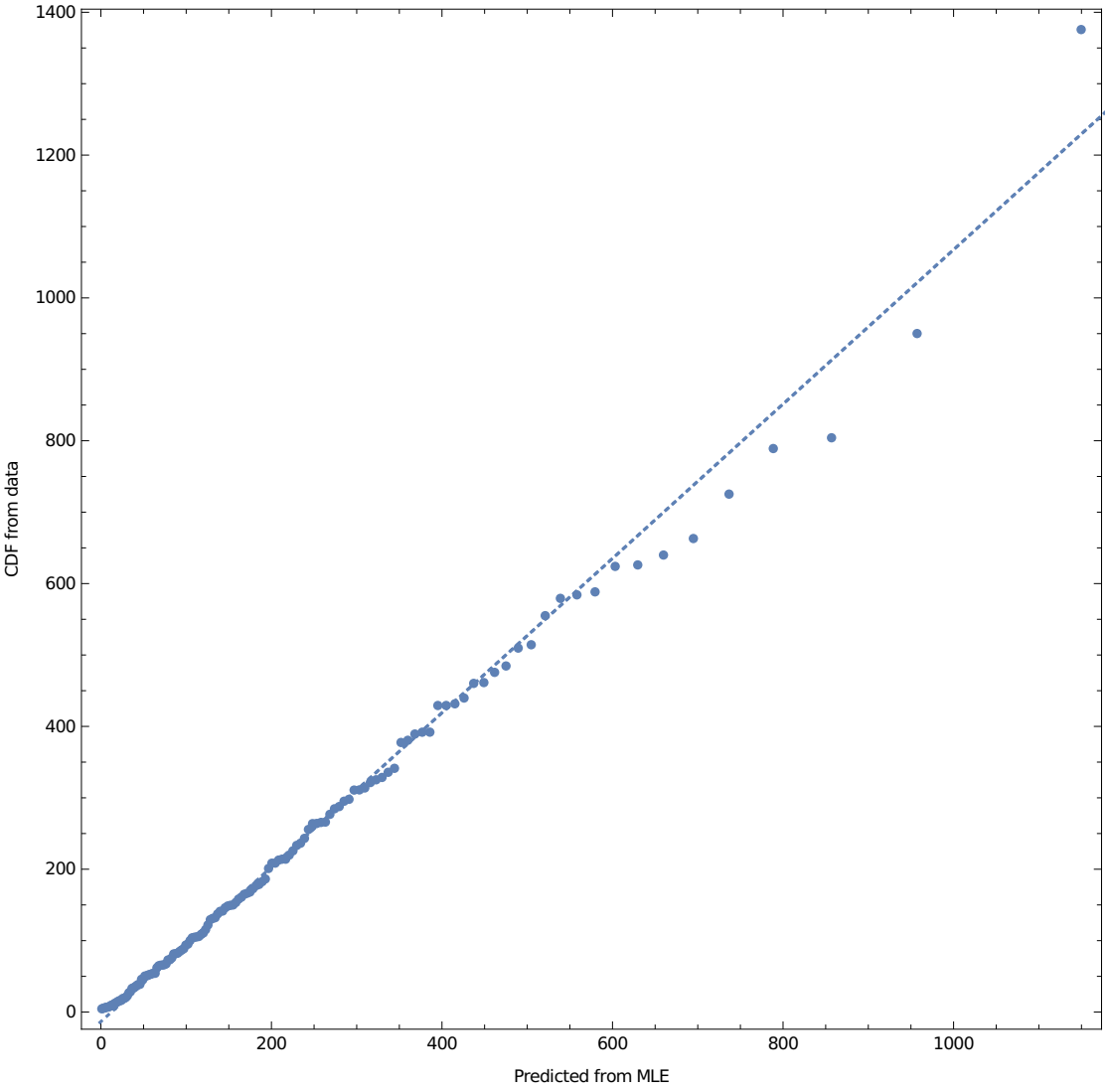
In[73]:=
```
Mean[restrictedInterArrivalTimes]
StandardDeviation[restrictedInterArrivalTimes]
```

Out[73]= 216.863

Out[74]= 220.684

In[77]:=
```
QuantilePlot[restrictedInterArrivalTimes,
 ExponentialDistribution[1/Mean[restrictedInterArrivalTimes]],
 AspectRatio → 1, ImageSize → Large,
 FrameLabel → {"Predicted from MLE", "CDF from data"}, PlotRange → All]
```

Out[77]=



In[78]:=
```
KolmogorovSmirnovTest[restrictedInterArrivalTimes,
 ExponentialDistribution[1/Mean[restrictedInterArrivalTimes]]]
```

Out[78]= 0.981649

Part (11)

In[92]:=
```
includeIndices = Position[interArrivalTimes, _?(# > 4 &)];
```

In[94]:=
```
includeList = Table[includeIndices[[i]][[1]], {i, 1, Length[includeIndices]}];
```

In[139]:=
```
restrictedData = Table[dates[[i]], includeList][[1]];
```

In[165]:=
```
yearData = Table[Floor[restrictedData[[i]] / 365], {i, 1, Length[restrictedData]}];
```

In[160]:=
```
yearTally = Map[{#, Count[yearData, #]} &, Table[i, {i, 1, Max[yearData]}]];
```

In[163]:=
```
tallyList = Table[yearTally[[i]][[2]], {i, 1, Length[yearTally]}];
```

In[169]:=
```
distribution = Table[{i, Count[tallyList, i]}, {i, 0, 8}];
```

In[173]:=
```
distributionTable =
  Join[{{"# of Earthquakes", "# of Years"}}, distribution] // Transpose;
```

In[179]:=
```
Grid[distributionTable, Alignment → Left, Spacings → {2, 1},
 Frame → All, ItemStyle → "Text", Background → {{LightGray, None}, None}]
```

Out[179]=

# of Earthquakes	0	1	2	3	4	5	6	7	8
# of Years	15	25	23	11	4	1	1	0	1

In[181]:=
```
n = Sum[distribution[[i]][[1]] * distribution[[i]][[2]], {i, 1, Length[distribution]}]
```

Out[181]= 139

In[191]:=
```
μ = Mean[tallyList] // N
```

Out[191]= 1.71605

In[192]:=
```
var = Variance[tallyList] // N
```

Out[192]= 2.08086

In[202]:=
```
expectedEarthquakes = Table[{i, n * PDF[PoissonDistribution[μ], i]}, {i, 0, 8}];
```

In[201]:=
```
modExpected = Append[Table[expectedEarthquakes[[i]], {i, 1, 4}],
   {"≥ 4", Sum[expectedEarthquakes[[i]][[2]], {i, 5, 9}]}];
```

In[203]:=
```
modData = Append[Table[distribution[[i]], {i, 1, 4}],
   {"≥ 4", Sum[distribution[[i]][[2]], {i, 5, 9}]}];
```

In[204]:=
```
completeSet = Table[{modExpected[[i]][[1]],
    modExpected[[i]][[2]], modData[[i]][[2]]}, {i, 1, Length[modData]}];
```

In[205]:=
```
completeTable =
  Join[{{"# of Earthquakes", "Expected # of Years", "Observed # of Years"}},
   completeSet] // Transpose;
```

In[206]:=
```
Grid[completeTable, Alignment → Left, Spacings → {2, 1},
 Frame → All, ItemStyle → "Text", Background → {{LightGray, None}, None}]
```

Out[206]=

# of Earthquakes	0	1	2	3	≥ 4
Expected # of Years	24.9887	42.8819	36.7937	21.0466	13.2784
Observed # of Years	15	25	23	11	7

In[209]:=
```
d = Sum[(completeSet[[i]][[2]] - completeSet[[i]][[3]])^2 / completeSet[[i]][[2]], {i, 1, 5}]
```

Out[209]= 24.3851

In[210]:=
```
InverseCDF[ChiSquareDistribution[3], 0.95]
```

Out[210]= 7.81473