Ma3 Final - Jacob Snyder

Problem 2

Problem 2.2

In[173]:=
```
data = {515, 65, 60, 66, 53, 55, 27, 25, 23, 22};
n[s_] := data[[s + 1]];
```

In[175]:=
```
loglikelihood[pi_, mu_] :=
  Sum[Sum[Log[(1 - pi) * mu^s / Factorial[s]] - mu, {i, 1, N@n[s]}], {s, 1, 9}] +
   Sum[Log[pi + (1 - pi) * Exp[-mu]], {i, n[0]}];
```

Calculation of μ and π

In[176]:=
```
NMaximize[{loglikelihood[pi, mu], pi ≥ 0 && pi ≤ 1 && mu ≥ 0}, {pi, mu}]
```

Out[176]=
```
{-1505.23, {pi → 0.556639, mu → 3.93413}}
```

Problem 2.4

In[177]:=
```
pi0 = 0.556639;
mu0 = 3.93413;
pdf[k_] := Piecewise[{{pi0 + (1 - pi0) * Exp[-mu0], k == 0},
     {(1 - pi0) * Exp[-mu0] * mu0^(k) / Factorial[k], k ≥ 1}}];
```

In[180]:=
```
probs = Map[pdf, Range[0, 9]]
```

Out[180]=
```
{0.565312, 0.0341221, 0.0671203, 0.08802, 0.0865705,
 0.068116, 0.0446628, 0.0251013, 0.012344, 0.00539587}
```

In[188]:=
```
exp = probs * 911
```

Out[188]=
```
{515., 31.0852, 61.1466, 80.1862,
 78.8658, 62.0536, 40.6878, 22.8673, 11.2454, 4.91564}
```

Calculation of test statistic

In[182]:=
```
Sum[(n[k] - exp[[k + 1]])^2 / exp[[k + 1]], {k, 0, 9}]
```

Out[182]=
```
125.286
```

Problem 2.6

In[287]:=
```
InverseCDF[ChiSquareDistribution[7], 0.95]
```

Out[287]=
```
14.0671
```

Problem 3

Problem 3.1

In[214]:=
```
X = {{1, -2}, {1, 2}, {1, 0}};
y = {{-1}, {0}, {1}};
```

In[204]:=
```
X^T.X
```

Out[204]=
$$\{\{3, 0\}, \{0, 8\}\}$$

In[221]:=
```
Inverse[X^T.X]
```

Out[221]=
$$\left\{\left\{\frac{1}{3}, 0\right\}, \left\{0, \frac{1}{8}\right\}\right\}$$

In[206]:=
```
Inverse[X^T.X].X^T
```

Out[206]=
$$\left\{\left\{\frac{1}{3}, \frac{1}{3}, \frac{1}{3}\right\}, \left\{-\frac{1}{4}, \frac{1}{4}, 0\right\}\right\}$$

In[218]:=
```
Inverse[X^T.X].X^T.y
```

Out[218]=
$$\left\{\{0\}, \left\{\frac{1}{4}\right\}\right\}$$

Problem 3.7

In[262]:=
```
htd = KolmogorovSmirnovTest[y[[All, 1]],
  NormalDistribution[0, 1.5^0.5], "HypothesisTestData"]
htd["TestConclusion"]
htd["TestDataTable"]
```

Out[262]=
HypothesisTestData[Type: KolmogorovSmirnovTest
p-Value: 0.998]

Out[263]=
```
The null hypothesis that
 the data is distributed according to the NormalDistribution[0, 1.22474]
 is not rejected at the 5 percent level based on the Kolmogorov-Smirnov test.
```

Out[264]=

	Statistic	P-Value
Kolmogorov-Smirnov	0.207108	0.998095

Problem 4

Problem 4.2

Calculation of μ

In[274]:=
```
occ = {162, 267, 271, 185, 111, 61, 27, 8, 3, 1};
ndeath = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9};
N@occ.ndeath / Total[occ]
```

Out[276]= 2.15693

Problem 4.3

Calculation of expected values

In[284]:=
```
ppois[k_] := Exp[-2.1569] * (2.1569) ^k / Factorial[k];
exp = Map[ppois[#] &, ndeath] * Total[occ]
```

Out[285]= {126.789, 273.471, 294.924, 212.041,
114.338, 49.323, 17.7308, 5.46337, 1.47299, 0.353011}

Calculation of test statistic

In[286]:=
```
Sum[(occ[[k + 1]] - exp[[k + 1]]) ^2 / exp[[k + 1]], {k, 0, 9}]
```

Out[286]= 26.9752

Calculation of critical value

In[288]:=
```
InverseCDF[ChiSquareDistribution[8], 0.95]
```

Out[288]= 15.5073