

HW10_Lin

IST 772 Homework 10

Due December 14th, 2021 at 8:00AM EDT

Homework 10 by Nora Lin: I produced the material below with no assistance.

Excercise 2 p.272:

```
library(nlme)
library(car)
```

```
## Loading required package: carData
```

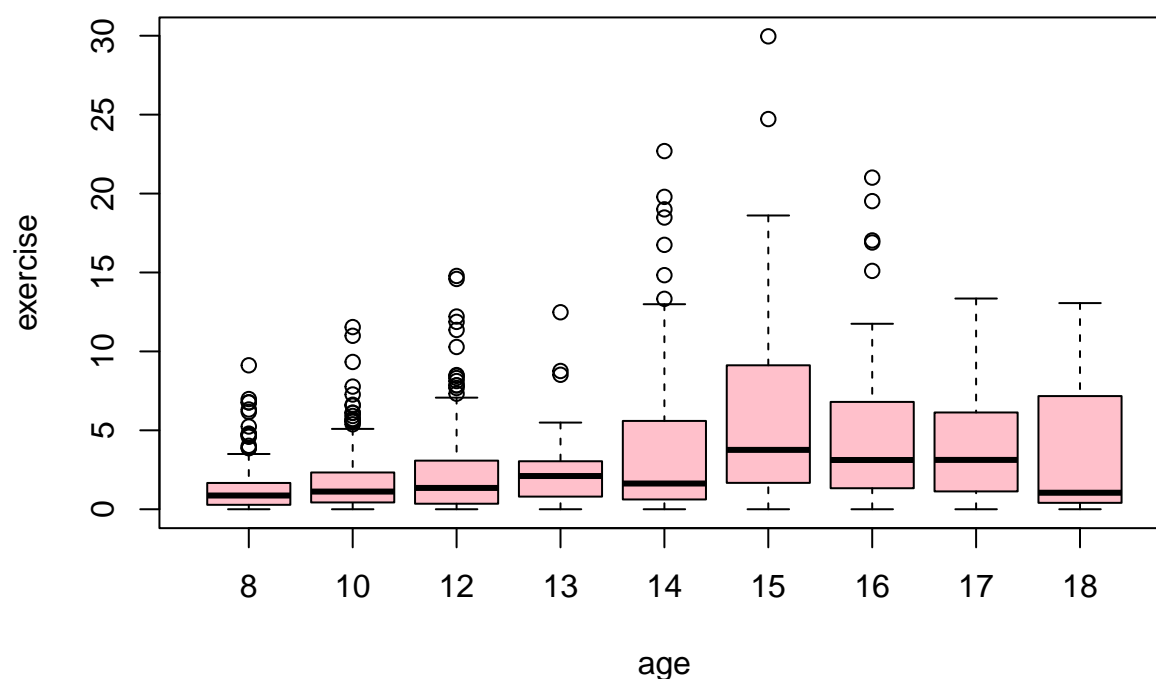
```
data("Blackmore")
```

```
#inspecting the data:
summary(Blackmore)
```

```
##      subject      age      exercise      group
## 100      : 5   Min.    : 8.00   Min.    : 0.000   control:359
## 101      : 5   1st Qu.:10.00   1st Qu.: 0.400   patient:586
## 105      : 5   Median :12.00   Median : 1.330
## 106      : 5   Mean    :11.44   Mean    : 2.531
## 107      : 5   3rd Qu.:14.00   3rd Qu.: 3.040
## 108      : 5   Max.    :17.92   Max.    :29.960
## (Other):915
```

```
Blackmore$age = round(Blackmore$age)
boxplot(exercise~age, data=Blackmore,main="Blackmore Study - Exercise by Age",xlab="age",col="pink")
```

Blackmore Study – Exercise by Age



```
#subsetting the data:
b_filtered <- Blackmore[Blackmore$age <=12,]
b_filtered$ag <-factor(b_filtered$age)

#examining the samples
l <-table(b_filtered$subject, b_filtered$age)
head(l)
```

```
##
##      8 10 12
## 100 1  1  1
## 101 1  1  1
## 102 1  1  1
## 103 1  1  1
## 104 1  1  1
## 105 1  1  1
```

```
list <-rowSums(l)==3
list <-list[list==TRUE]
list <-factor(names(list))
b_filtered <-b_filtered[b_filtered$subject %in% list,]
table(b_filtered$age)
```

```
##
##      8 10 12
## 187 187 187
```

```
summary(aov(exercise~age + Error(subject),data=b_filtered))
```

```
##
## Error: subject
##           Df Sum Sq Mean Sq F value Pr(>F)
## Residuals 186   1979    10.64
##
## Error: Within
##           Df Sum Sq Mean Sq F value    Pr(>F)
## age         1  101.9    101.9   56.51 4.19e-13 ***
## Residuals 373  672.8      1.8
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

#Analysis:

#Our model tests if exercise does not vary over age. The effect of age is expressed as $F(2,372)=28.23$

Excercise 5 p.273:

```
library(changepoint)
```

```
## Loading required package: zoo
```

```
##
```

```
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:base':
```

```
##
```

```
##      as.Date, as.Date.numeric
```

```
## Successfully loaded changepoint package version 2.2.2
```

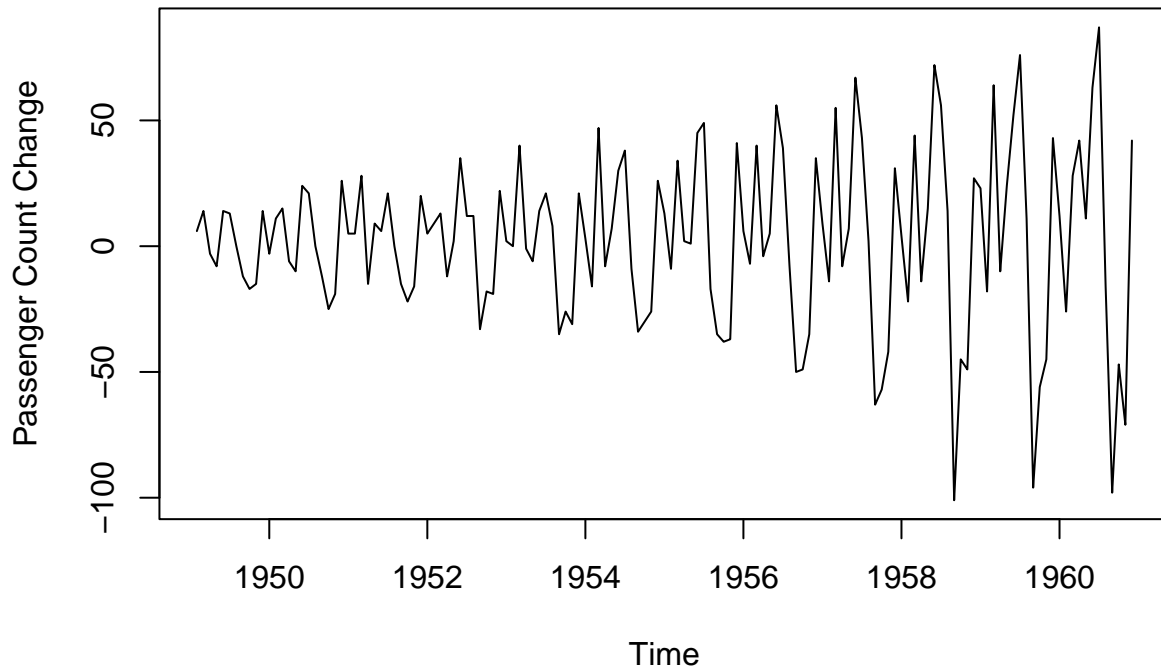
```
## NOTE: Predefined penalty values changed in version 2.2. Previous penalty values with a postfix 1 i
```

```
data("AirPassengers")
```

```
difference_air <-diff(AirPassengers)
```

```
plot(difference_air, main="Difference in Air Passenger Counts Over Time", ylab="Passenger Count Change")
```

Difference in Air Passenger Counts Over Time



```
variance_air <-cpt.var(difference_air)
variance_air
```

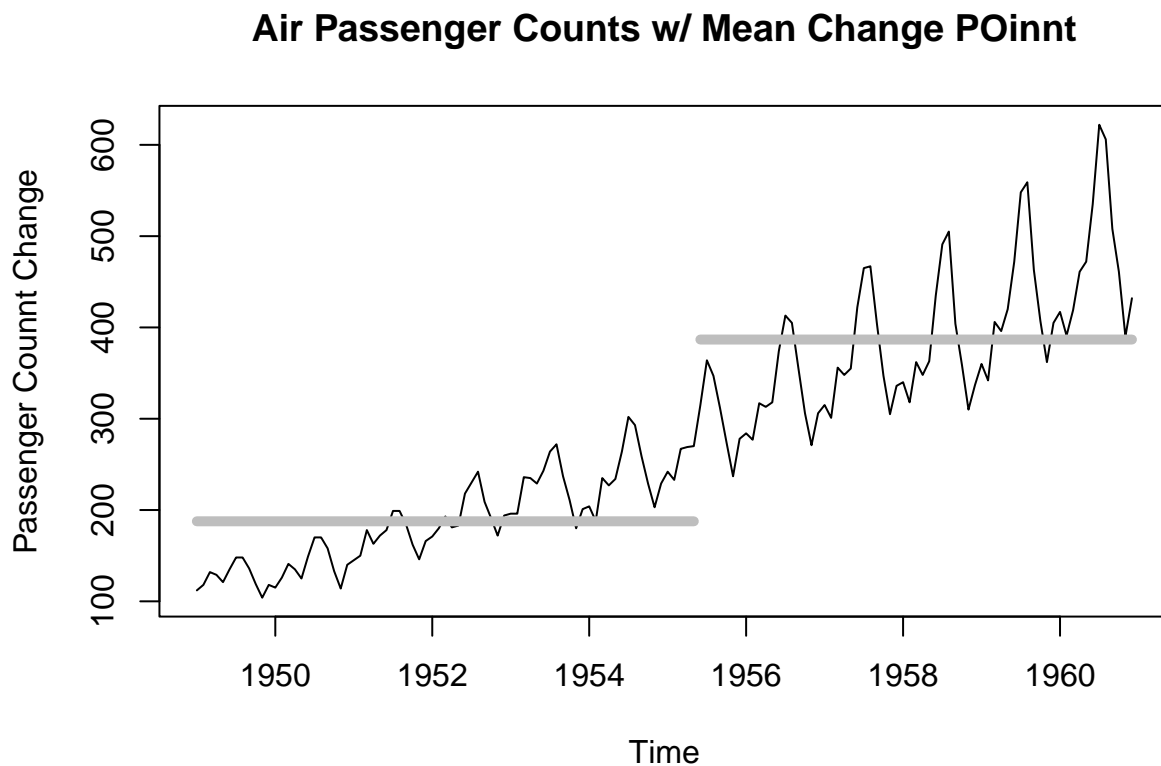
```
## Class 'cpt' : Changepoint Object
##      ~~      : S4 class containing 12 slots with names
##      cpttype date version data.set method test.stat pen.type pen.value minseglen cpts ncpts
##
## Created on   : Tue May 25 17:44:21 2021
##
## summary(.) :
## -----
## Created Using changepoint version 2.2.2
## Changepoint type      : Change in variance
## Method of analysis    : AMOC
## Test Statistic       : Normal
## Type of penalty       : MBIC with value, 14.88853
## Minimum Segment Length : 2
## Maximum no. of cpts   : 1
## Changepoint Locations : 76
```

```
variance_mean <-cpt.mean(AirPassengers)
variance_mean
```

```
## Class 'cpt' : Changepoint Object
##      ~~      : S4 class containing 12 slots with names
```

```
##               cpttype date version data.set method test.stat pen.type pen.value minseglen cpts ncpts
##
## Created on   : Tue May 25 17:44:21 2021
##
## summary(.)   :
## -----
## Created Using changepoint version 2.2.2
## Changepoint type      : Change in mean
## Method of analysis    : AMOC
## Test Statistic       : Normal
## Type of penalty       : MBIC with value, 14.90944
## Minimum Segment Length : 1
## Maximum no. of cpts   : 1
## Changepoint Locations : 77
```

```
plot(variance_mean,cpt.col='grey',cpt.width=5,
     main="Air Passenger Counts w/ Mean Change POinnt",
     ylab="Passenger Counnt Change")
```



```
#Analysis:
#The horizontal lines represents the changepoints. The changepoint occurred around 1955.
```

Excercise 6 p.273:

```
air_mean=cpt.mean(AirPassengers)
air_mean
```

```
## Class 'cpt' : Changepoint Object
##      ~~      : S4 class containing 12 slots with names
##      cpttype date version data.set method test.stat pen.type pen.value minseglen cpts ncpts
##
## Created on   : Tue May 25 17:44:21 2021
##
## summary(.)  :
## -----
## Created Using changepoint version 2.2.2
## Changepoint type      : Change in mean
## Method of analysis    : AMOC
## Test Statistic       : Normal
## Type of penalty       : MBIC with value, 14.90944
## Minimum Segment Length : 1
## Maximum no. of cpts   : 1
## Changepoint Locations : 77
```

```
plot(air_mean, mainn="Changepoint in Mean for Air Passengers")
```

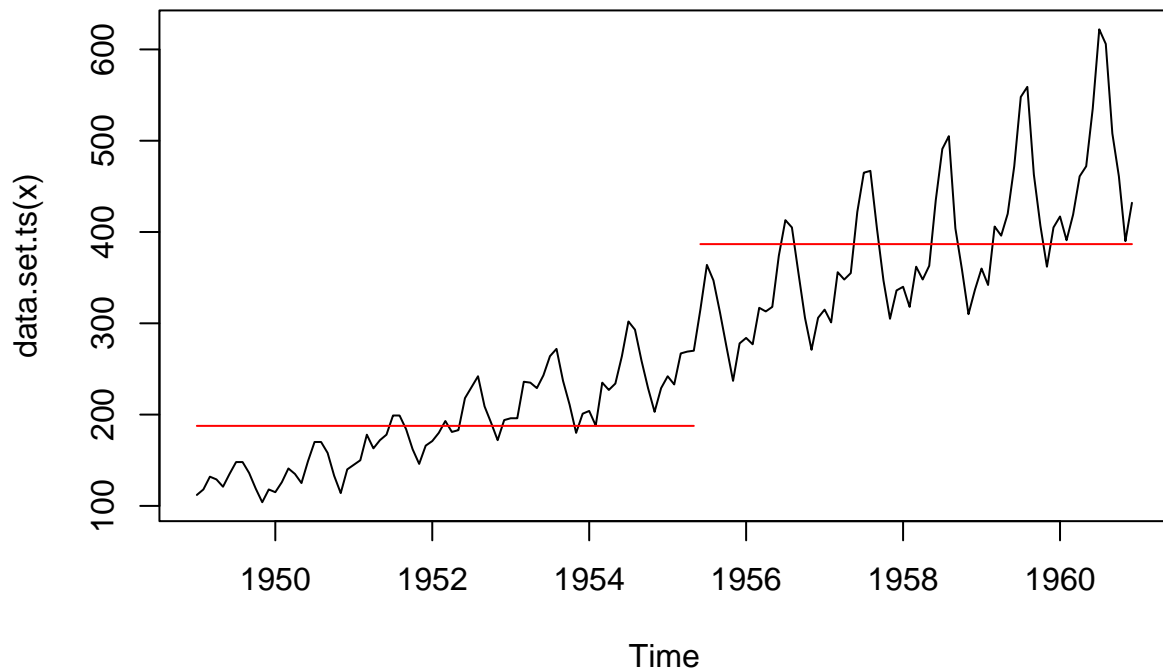
```
## Warning in plot.window(xlim, ylim, log, ...): "mainn" is not a graphical
## parameter
```

```
## Warning in title(main = main, xlab = xlab, ylab = ylab, ...): "mainn" is not a
## graphical parameter
```

```
## Warning in axis(1, ...): "mainn" is not a graphical parameter
```

```
## Warning in axis(2, ...): "mainn" is not a graphical parameter
```

```
## Warning in box(...): "mainn" is not a graphical parameter
```



```
airmean2 <-cpt.mean(AirPassengers, class=FALSE)
airmean2["conf.value"]
```

```
## conf.value
##          1
```

#Analysis:

#We can see there is a shift in the same period as the change point in variance. This is around 1955. T

Excercise 7 p.273:

Excercise 8 p.273:

```
library(bcp)
```

```
## Loading required package: grid
```

```
bcp_Air <-bcp(as.vector(difference_air))
summary(bcp_Air)
```

```
##
```

```

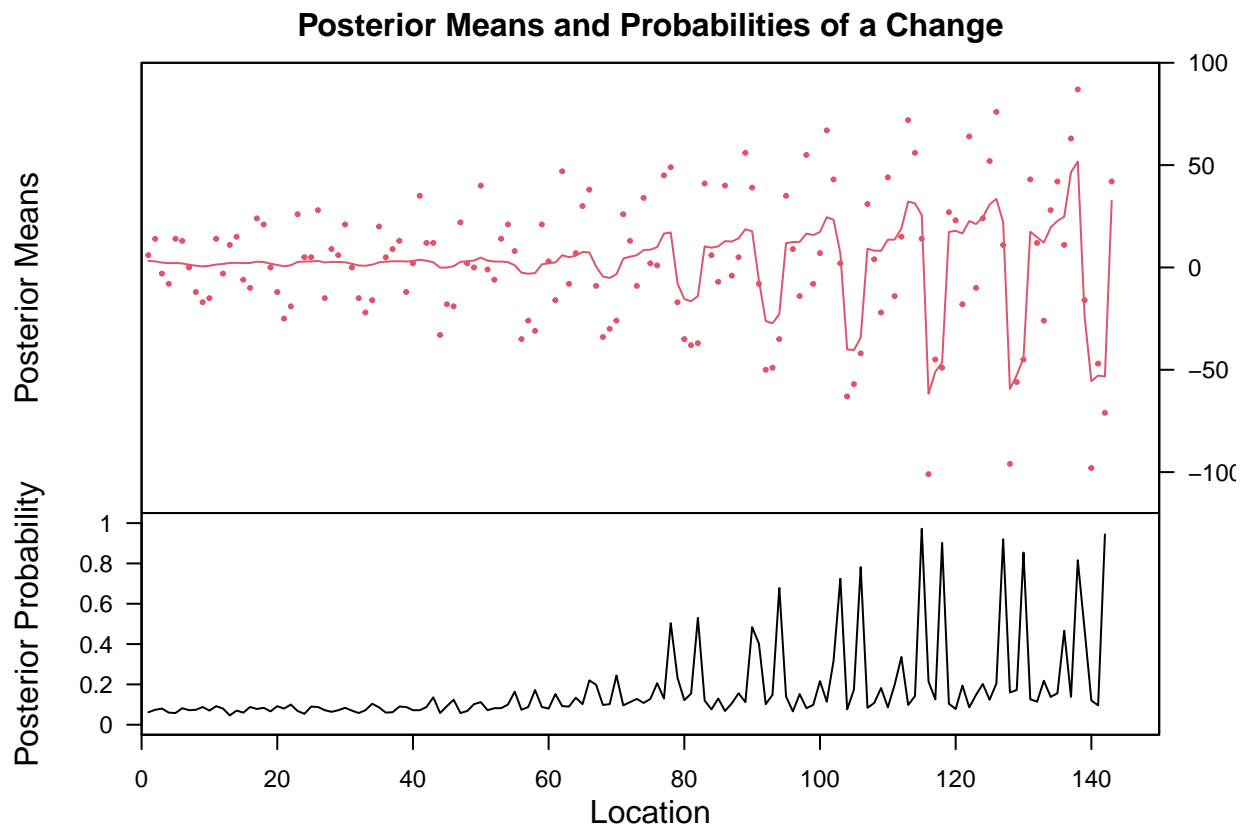
## Bayesian Change Point (bcp) summary:
##
##
## Probability of a change in mean and posterior means:
##
##      Probability      X1
## 1      0.062      3.1721
## 2      0.074      3.0088
## 3      0.080      2.3629
## 4      0.060      2.0962
## 5      0.058      2.1898
## 6      0.082      1.9512
## 7      0.072      1.3383
## 8      0.074      0.8517
## 9      0.088      0.5072
## 10     0.070      0.8125
## 11     0.092      1.4466
## 12     0.080      1.7205
## 13     0.046      2.1819
## 14     0.070      2.2595
## 15     0.060      2.1132
## 16     0.088      2.2022
## 17     0.078      2.8159
## 18     0.084      2.6481
## 19     0.066      1.8425
## 20     0.092      1.2311
## 21     0.080      0.5877
## 22     0.100      1.0767
## 23     0.068      2.6906
## 24     0.054      2.8760
## 25     0.090      2.9513
## 26     0.088      3.2036
## 27     0.072      2.4587
## 28     0.064      2.6845
## 29     0.072      2.6764
## 30     0.084      2.5078
## 31     0.070      1.7844
## 32     0.058      0.9531
## 33     0.072      0.8292
## 34     0.104      1.3729
## 35     0.086      2.4976
## 36     0.060      2.8274
## 37     0.062      3.0112
## 38     0.090      3.0446
## 39     0.088      2.8878
## 40     0.072      3.2041
## 41     0.072      3.7358
## 42     0.088      3.2852
## 43     0.136      2.4824
## 44     0.058     -0.1032
## 45     0.092     -0.0595
## 46     0.124      0.6165
## 47     0.058      2.7243
## 48     0.068      2.9807

```


## 49	0.102	3.3904
## 50	0.112	4.7977
## 51	0.072	3.3600
## 52	0.082	2.8597
## 53	0.082	2.8833
## 54	0.100	2.5798
## 55	0.164	1.0747
## 56	0.074	-2.5346
## 57	0.088	-3.0865
## 58	0.172	-2.7530
## 59	0.088	1.4766
## 60	0.080	2.0940
## 61	0.152	2.4481
## 62	0.092	5.9912
## 63	0.090	4.9970
## 64	0.134	5.7628
## 65	0.102	7.5648
## 66	0.220	7.3456
## 67	0.198	0.4629
## 68	0.098	-4.4788
## 69	0.102	-5.1094
## 70	0.244	-3.3205
## 71	0.096	4.3101
## 72	0.112	5.2978
## 73	0.128	5.9351
## 74	0.108	8.5333
## 75	0.128	8.6851
## 76	0.206	9.9666
## 77	0.130	16.5594
## 78	0.504	17.0888
## 79	0.232	-7.8678
## 80	0.122	-15.4243
## 81	0.154	-16.5583
## 82	0.530	-13.9875
## 83	0.120	10.3066
## 84	0.076	9.6569
## 85	0.130	10.3199
## 86	0.068	12.8300
## 87	0.106	12.6750
## 88	0.156	14.2055
## 89	0.112	18.6736
## 90	0.484	17.6609
## 91	0.402	-6.4004
## 92	0.102	-26.1629
## 93	0.148	-27.2916
## 94	0.678	-22.8123
## 95	0.140	11.8801
## 96	0.066	12.3812
## 97	0.152	12.4981
## 98	0.082	16.5477
## 99	0.098	15.8368
## 100	0.216	17.3404
## 101	0.114	24.5665
## 102	0.318	23.2842

## 103	0.724	6.8603
## 104	0.076	-40.0485
## 105	0.174	-40.3643
## 106	0.782	-34.3191
## 107	0.084	9.1398
## 108	0.108	8.2090
## 109	0.182	8.1270
## 110	0.086	13.5942
## 111	0.198	13.5728
## 112	0.336	19.0926
## 113	0.098	32.1610
## 114	0.142	31.2980
## 115	0.972	25.6051
## 116	0.214	-61.7271
## 117	0.126	-50.9702
## 118	0.902	-46.4663
## 119	0.104	17.3802
## 120	0.078	17.8950
## 121	0.194	16.6229
## 122	0.086	22.6978
## 123	0.148	21.1884
## 124	0.202	24.6191
## 125	0.124	30.7305
## 126	0.204	33.5036
## 127	0.920	22.1195
## 128	0.160	-59.3729
## 129	0.172	-52.6491
## 130	0.854	-44.2116
## 131	0.126	17.4420
## 132	0.114	14.7827
## 133	0.218	12.1016
## 134	0.138	19.5240
## 135	0.156	22.7290
## 136	0.466	24.8050
## 137	0.138	46.5778
## 138	0.816	51.7082
## 139	0.472	-23.7845
## 140	0.120	-55.5493
## 141	0.096	-52.8120
## 142	0.944	-53.2769
## 143	NA	32.5843

```
plot(bcp_Air)
```



```
plot(bcp_Air$posterior.prob >.95,
     main="Plot of Air Passenger Posterior Probability",
     ylab="Posterior Probability", col="pink")
```

Plot of Air Passenger Posterior Probability

