

Homework Problems Stat 479

Chapter 10

91. * A random sample, X_1, X_2, \dots, X_n , is drawn from a distribution with a mean of $2/3$ and a variance of $1/18$.

$\hat{\theta} = (X_1 + X_2 + \dots + X_n)/(n-1)$ is the estimator of the distribution mean θ .

Find $MSE(\hat{\theta})$.

92. * Claim sizes are uniformly distributed over the interval $[0, \theta]$. A sample of 10 claims, denoted by X_1, X_2, \dots, X_{10} was observed and an estimate of θ was obtained using:

$$\hat{\theta} = Y = \max(X_1, X_2, \dots, X_{10})$$

Recall that the probability density function for Y is:

$$f_Y(y) = 10y^9/\theta^{10}$$

Calculate the mean square error for $\hat{\theta}$ for $\theta = 100$.

93. * You are given two independent estimates of an unknown quantity θ :
- Estimator A: $E(\hat{\theta}_A) = 1000$ and $\sigma(\hat{\theta}_A) = 400$
 - Estimator B: $E(\hat{\theta}_B) = 1200$ and $\sigma(\hat{\theta}_B) = 200$

Estimator C is a weighted average of Estimator A and Estimator B such that:

$$\hat{\theta}_C = (w)\hat{\theta}_A + (1-w)\hat{\theta}_B$$

Determine the value of w that minimizes $\sigma(\hat{\theta}_C)$.

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94. * You are given:

x	Pr(X = x)
0	0.5
1	0.3
2	0.1
3	0.1

Using a sample size of n , the population mean is estimated by the sample mean \bar{X} . The variance is estimated by:

$$S_n^2 = \frac{\sum (X_i - \bar{X})^2}{n}$$

Calculate the bias of S_n^2 when $n = 4$.

95. * For the random variable X , you are given:
- $E(X) = \theta, \theta > 0$
 - $\text{Var}(\theta) = \theta^2/25$
 - $\hat{\theta} = kX/(k+1)$
 - $\text{MSE}_{\hat{\theta}}(\theta) = 2[\text{bias}_{\hat{\theta}}(\theta)]^2$

Determine k .

96. You are given the following sample of claims:

X : 12, 13, 16, 16, 22, 24, 26, 26, 28, 30

The sum of X is 213 and the sum of X^2 is 4921.

H_0 is that $\mu_x = 17$ and H_1 is that $\mu_x \geq 17$.

Calculate the z statistic, the critical value(s) assuming a significance level of 1%, and the p value. State your conclusion with regard to the Hypothesis Testing.

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Wang Warranty Corporation is testing iPods. Wang starts with 100 iPods and tests them by dropping them on the ground. Wang records the number of drops before each iPod will no longer play. The following data is collected from this test:

Drops to Failure	Number	Drops to Failure	Number
1	6	9	7
2	2	10	6
4	3	11	7
6	4	12	7
7	4	13	48
8	5	22	1

Ledbetter Life Insurance Company is completing a mortality study on a 3 year term insurance policy. The following data is available:

Life	Date of Entry	Date of Exit	Reason for Exit
1	0	0.2	Lapse
2	0	0.3	Death
3	0	0.4	Lapse
4	0	0.5	Death
5	0	0.5	Death
6	0	0.5	Lapse
7	0	1.0	Death
8	0	3.0	Expiry of Policy
9	0	3.0	Expiry of Policy
10	0	3.0	Expiry of Policy
11	0	3.0	Expiry of Policy
12	0	3.0	Expiry of Policy
13	0	3.0	Expiry of Policy
14	0	3.0	Expiry of Policy
15	0	3.0	Expiry of Policy
16	0.5	2.0	Lapse
17	0.5	1.0	Death
18	1.0	3.0	Expiry of Policy
19	1.0	3.0	Expiry of Policy
20	2.0	2.5	Death

Schneider Trucking Company had the following losses during 2013:

Amount of Claim	Number of Payments	Total Amount of Losses
0 – 10	8	60
10-20	5	70
20-30	4	110
30 +	3	200
Total	20	440

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Chapter 11

97. Using the data from Wang Warranty Corporation, calculate:
- $P_{100}(x)$
 - $F_{100}(x)$
 - The empirical mean
 - The empirical variance
 - $\hat{H}(x)$ where $\hat{H}(x)$ is the cumulative hazard function from the Nelson Åalen estimate
 - $\hat{S}(x)$ where $\hat{S}(x)$ is the survival function from the Nelson Åalen estimate
98. Using the data from Schneider Trucking Company, calculate:
- The ogive, $F_{20}(x)$
 - The histogram, $f_{20}(x)$
 - $E(X \wedge 30)$ minus $E[(X-20)_+]$
99. * You are given:

Claim Size (X)	Number of Claims
(0,25]	30
(25,50]	32
(50,100]	20
(100,200]	8

Assume a uniform distribution of claim sizes within each interval.

Estimate the mean of the claim size distribution.

Estimate the second raw moment of the claim size distribution.

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Chapter 12

100. Using the data for Ledbetter Life Insurance Company, calculate the following where death is the decrement of interest:
- $S_{20}(t)$ using the Kaplan Meier Product Limit Estimator
 - $\hat{H}(t)$ where $\hat{H}(t)$ is the cumulative hazard function from the Nelson Åalen estimate
 - $\hat{S}(t)$ where $\hat{S}(t)$ is the survival function from the Nelson Åalen estimate
101. Using the data for Ledbetter Life Insurance Company, and treating all expiries as lapses, calculate the following where lapse is the decrement of interest:
- $S_{20}(t)$ using the Kaplan Meier Product Limit Estimator
 - $\hat{H}(t)$ where $\hat{H}(t)$ is the cumulative hazard function from the Nelson Åalen estimate
 - $\hat{S}(t)$ where $\hat{S}(t)$ is the survival function from the Nelson Åalen estimate
102. * Three hundred mice were observed at birth. An additional 20 mice were first observed at age 2 (days) and 30 more were first observed at age 4.

There were 6 deaths at age 1, 10 at age 3, 10 at age 4, a at age 5, b at age 9, and 6 at age 12.

In addition, 45 mice escaped and were lost to observation at age 7, 35 at age 10, and 15 at age 13.

The following product-limit estimates were obtained:

$$S_{350}(7) = 0.892 \text{ and } S_{350}(13) = 0.856.$$

Determine a and b .

103. * There are n lives observed from birth. None are censored and no two lives die at the same age. At the time of the ninth death, the Nelson Åalen estimate of the cumulative hazard rate is 0.511 and at the time of the tenth death it is 0.588. Estimate the value of the survival function at the time of the third death.

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104. Astleford Ant Farm is studying the life expectancy of ants. The farm is owned by two brothers who are both actuaries. They isolate 100 ants and record the following data:

Number of Days till Death	Number of Ants Dying
1	4
2	8
3	12
4	20
5	40
6	8
7	4
8	2
9	1
10	1

- a. One of the brothers, Robert, uses the Nelson-Åalen estimator to determine $\hat{H}(5)$. Determine the 90% linear confidence interval for $\hat{H}(5)$.
- b. The other brother, Daniel, decides that since he has complete data for these 100 ants, he will just use the unbiased estimator of $\hat{S}(5)$. Using this approach, determine the 90% confidence interval for $\hat{S}(5)$.

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105. The following information on students in the actuarial program at Purdue is used to complete an analysis of students leaving the program because they are switching majors.

Student	Time of Entry	Time of Exit	Reason for Exit
1	0	.5	Switching Major
2-5	0	1	Switching Major
6	0	2	Switching Major
7	0	3	Graduation
8	0	3	Switching Major
9-12	0	3.5	Graduation
13-23	0	4	Graduation
24	0.5	2	Switching Major
25	0.5	3	Switching Major
26	1	3.5	Graduation
27	1	4	Switching Major
28	1.5	4	Graduation
29	2	5	Graduation
30	3	5	Graduation

$\hat{S}(x)$ is estimated using the product limit estimator.

Estimate $Var[S_{30}(2)]$ using the Greenwood approximation.

106. A mortality study is conducted on 50 lives, all from age 0. At age 15, there were two deaths; at age 17, there were three censored observations; at age 25 there were four deaths; at age 30, there were c censored observations; at age 32 there were eight deaths; and at age 40 there were two deaths.

Let S be the product limit estimate of $S(35)$ and let V be the Greenwood estimate of this estimator's variance. You are given $V / S^2 = 0.011467$.

Determine c .

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107. * Fifteen cancer patients were observed from the time of diagnosis until the earlier of death or 36 months from diagnosis. Deaths occurred as follows: at 15 months, there were two deaths; at 20 months there were three deaths; at 24 months there were 2 deaths; at 30 months there were d deaths; at 34 months there were two deaths; and at 36 months there were one death.

The Nelson \hat{A} alen estimate of $H(35)$ is 1.5641.

Determine the variance of this estimator.

108. A mortality study is completed on 30 people. The following deaths occur during the five years:

3 deaths at time 1.0
4 deaths at time 2.0
5 deaths at time 3.0
8 deaths at time 3.8
10 deaths at time 4.5

There were no other terminations and no lives entered the study after the start of the study.

The data was smoothed using a uniform kernel with a bandwidth of 1. Calculate $\hat{f}(x)$ and $\hat{F}(x)$ for all $x \geq 0$.

109. * From a population having a distribution function F , you are given the following sample:

2.0, 3.3, 3.3, 4.0, 4.0, 4.7, 4.7, 4.7

Calculate the kernel density estimate of $F(4)$, using a uniform kernel with bandwidth of 1.4.

110. * You study five lives to estimate the time from the onset of a disease until death. The times to death are:

2 3 3 3 7

Using a triangular kernel with a bandwidth of 2, estimate the density function at 2.5.

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111. You are given the following random sample:

12 15 27 42

The data is smoothed using a uniform kernel with a bandwidth of 6.

Calculate the mean and variance of the smoothed distribution.

112. You are given the following random sample:

12 15 27 42

The data is smoothed using a triangular kernel with a bandwidth of 12.

Calculate the mean and variance of the smoothed distribution.

113. You are given the following random sample:

12 15 27 42

The data is smoothed using a gamma kernel with a bandwidth of 3.

Calculate the mean and variance of the smoothed distribution.

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Chapter 13

114. You are given the following sample of claims obtained from an **inverse** gamma distribution:

X: 12, 13, 16, 16, 22, 24, 26, 26, 28, 30

The sum of X is 213 and the sum of X^2 is 4921.

Calculate α and θ using the method of moments.

115. * You are given the following sample of five claims:

4 5 21 99 421

Find the parameters of a Pareto distribution using the method of moments.

116. * A random sample of death records yields the follow exact ages at death:

30 50 60 60 70 90

The age at death from which the sample is drawn follows a gamma distribution.
The parameters are estimated using the method of moments.

Determine the estimate of α .

117. * You are given the following:

- i. The random variable X has the density function

$$f(x) = \alpha x^{-\alpha-1}, 1 < x < \infty, \alpha > 1$$

- ii. A random sample is taken of the random variable X.

Calculate the estimate of α in terms of the sample mean using the method of moments.

118. * You are given the following:

- i. The random variable X has the density function $f(x) = \{2(\theta - x)\}/\theta^2, 0 < x < \theta$

- ii. A random sample of two observations of X yields values of 0.50 and 0.70.

Determine θ using the method of moments.

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119. You are given the following sample of claims:

X : 12, 13, 16, 16, 22, 24, 26, 26, 28, 30

Calculate the smoothed empirical estimate of the 40th percentile of this distribution.

120. * For a complete study of five lives, you are given:

- a. Deaths occur at times $t = 2, 3, 3, 5, 7$.
- b. The underlying survival distribution $S(t) = 4^{-\lambda t}$, $t \geq 0$

Using percentile matching at the median, calculate the estimate of λ .

121. You are given the following 9 claims:

X : 10, 60, 80, 120, 150, 170, 190, 230, 250

The sum of $X = 1260$ and the sum of $X^2 = 227,400$.

The data is modeled using an exponential distribution with parameters estimated using the percentile matching method.

Calculate θ based on the empirical value of 120.

122. * For a sample of 10 claims, $x_1 < x_2 < \dots < x_{10}$ you are given:

- a. The smoothed empirical estimate of the 55th percentile is 380.
- b. The smoothed empirical estimate of the 60th percentile is 402.

Determine x_6 .

123. You are given the following:

- a. Losses follow a Pareto distribution with parameters α and θ .
- b. The 10th percentile of the distribution is $\theta - k$, where k is a constant.
- c. The 90th percentile of the distribution is $5\theta - 3k$.

Determine α .

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124. You are given the following random sample of 3 data points from a population with a Pareto distribution with $\theta = 70$:

X: 15 27 43

Calculate the maximum likelihood estimate for α .

125. * You are given:

- a. Losses follow an exponential distribution with mean θ .
- b. A random sample of 20 losses is distributed as follows:

Range	Frequency
[0,1000]	7
(1000, 2000)	6
(2000, ∞)	7

Calculate the maximum likelihood estimate of θ .

126. * You are given the following:

- i. The random variable X has the density function $f(x) = \{2(\theta - x)\}/\theta^2, 0 < x < \theta$
- ii. A random sample of two observations of X yields values of 0.50 and 0.90.

Determine the maximum likelihood estimate for θ .

127. * You are given:

- a. Ten lives are subject to the survival function $S(t) = (1-t/k)^{0.5}, 0 \leq t \leq k$
- b. The first two deaths in the sample occurred at time $t = 10$.
- c. The study ends at time $t = 10$.

Calculate the maximum likelihood estimate of k.

128. * You are given the following:

- a. The random variable X follows the exponential distribution with parameter θ .
- b. A random sample of three observations of X yields values of 0.30, 0.55, and 0.80

Determine the maximum likelihood estimate of θ .

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129. * Ten laboratory mice are observed for a period of five days. Seven mice die during the observation period, with the following distribution of deaths:

Time of Death in Days	Number of Deaths
2	1
3	2
4	1
5	3

The lives in the study are subject to an exponential survival function with mean of θ .

Calculate the maximum likelihood estimate of θ .

130. * A policy has an ordinary deductible of 100 and a policy limit of 1000. You observe the following 10 payments:

15 50 170 216 400 620 750 900 900 900

An exponential distribution is fitted to the ground up distribution function, using the maximum likelihood estimate.

Determine the estimated parameter θ .

131. * Four lives are observed from time $t = 0$ until death. Deaths occur at $t = 1, 2, 3,$ and 4 . The lives are assumed to follow a Weibull distribution with $\tau = 2$.

Determine the maximum likelihood estimator for θ .

132. * The random variable X has a uniform distribution on the interval $[0, \theta]$. A random sample of three observations of X are recorded and grouped as follows:

Interval	Number of Observations
[0,k)	1
[k,5)	1
[5,θ]	1

Calculate the maximum likelihood estimate of θ

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133. * A random sample of three claims from a dental insurance plan is given below:

225 525 950

Claims are assumed to follow a Pareto distribution with parameters $\theta = 150$ and α .

Determine the maximum likelihood estimate of α .

134. * The following claim sizes are experienced on an insurance coverages:

100 500 1,000 5,000 10,000

You fit a lognormal distribution to this experience using maximum likelihood.

Determine the resulting estimate of σ .

Chapter 14

You are given the following data from a sample:

k	n_k
0	20
1	25
2	30
3	15
4	8
5	2

Use this data for the next four problems.

135. Assuming a Binomial Distribution, estimate m and q using the Method of Moments.
136. Assuming a Binomial Distribution, find the MLE of q given that $m = 6$.
137. (Spreadsheet) Assuming a Binomial Distribution, find the MLE of m and q .
138. Assuming a Poisson Distribution, approximate the 90% confidence interval for the true value of λ .

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Chapter 16

139. You are given the following 20 claims:

X: 10, 40, 60, 65, 75, 80, 120, 150, 170, 190, 230, 340, 430, 440, 980, 600, 675, 950, 1250, 1700

The data is being modeled using an exponential distribution with $\theta = 427.5$.

Calculate $D(200)$.

140. You are given the following 20 claims:

X: 10, 40, 60, 65, 75, 80, 120, 150, 170, 190, 230, 340, 430, 440, 980, 600, 675, 950, 1250, 1700

The data is being modeled using an exponential distribution with $\theta = 427.5$.

You are developing a p - p plot for this data. What are the coordinates for $x_7 = 120$.

141. Mark the following statements True or False with regard to the Kolmogorov-Smirnov test:

The Kolmogorov-Smirnov test may be used on grouped data as well as individual data.

If the parameters of the distribution being tested are estimated, the critical values do not need to be adjusted.

If the upper limit is less than ∞ , the critical values need to be larger.

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142. Balog's Bakery has workers' compensation claims during a month of:

100, 350, 550, 1000

Balog's owner, a retired actuary, believes that the claims are distributed exponentially with $\theta = 500$.

He decides to test his hypothesis at a 10% significance level.

Calculate the Kolmogorov-Smirnov test statistic.

State the critical value for his test and state his conclusion.

He also tests his hypothesis using the Anderson-Darling test statistic. State the values of this test statistic under which Mr. Balog would reject his hypothesis.

143. * The observations of 1.7, 1.6, 1.6, and 1.9 are taken from a random sample. You wish to test the goodness of fit of a distribution with probability density function given by $f(x) = 0.5x$ for $0 \leq x \leq 2$.

Using the Kolmogorov-Smirnov statistic, which of the following should you do?

- a. Accept at both levels
- b. Accept at the 0.01 level but reject at the 0.10 level
- c. Accept at the 0.10 level but reject at the 0.01 level
- d. Reject at both levels
- e. Cannot be determined.

144. * Two lives are observed beginning at time $t=0$. One dies at time 5 and the other dies at time 9. The survival function $S(t) = 1 - (t/10)$ is hypothesized.

Calculate the Kolmogorov-Smirnov statistic.

145. * From a laboratory study of nine lives, you are given:

- a. The times of death are 1, 2, 4, 5, 5, 7, 8, 9, 9
- b. It has been hypothesized that the underlying distribution is uniform with $\omega = 11$.

Calculate the Kolmogorov-Smirnov statistic for the hypothesis.

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146. You are given the following data:

Claim Range	Count
0-100	30
100-200	25
200-500	20
500-1000	15
1000+	10

H_0 : The data is from a Pareto distribution.

H_1 : The data is not from a Pareto distribution.

Your boss has used the data to estimate the parameters as $\alpha = 4$ and $\theta = 1200$.

Calculate the chi-square test statistic.

Calculate the critical value at a 10% significance level.

State whether you would reject the Pareto at a 10% significance level.

147. During a one-year period, the number of accidents per day in the parking lot of the Steenman Steel Factory is distributed:

Number of Accidents	Days
0	220
1	100
2	30
3	10
4+	5

H_0 : The distribution of the number of accidents is distributed as Poisson with a mean of 0.625.

H_1 : The distribution of the number of accidents is not distributed as Poisson with a mean of 0.625.

Calculate the chi-square statistic.

Calculate the critical value at a 10% significance level.

State whether you would reject the H_0 at a 10% significance level.

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148. * You are given the following random sample of automobile claims:
- | | | | | | | | | | |
|-------|-------|--------|--------|--------|--------|--------|--------|--------|--------|
| 54 | 140 | 230 | 560 | 600 | 1,100 | 1,500 | 1,800 | 1,920 | 2,000 |
| 2,450 | 2,500 | 2,580 | 2,910 | 3,800 | 3,800 | 3,810 | 3,870 | 4,000 | 4,800 |
| 7,200 | 7,390 | 11,750 | 12,000 | 15,000 | 25,000 | 30,000 | 32,200 | 35,000 | 55,000 |

You test the hypothesis that automobile claims follow a continuous distribution $F(x)$ with the following percentiles:

x	310	500	2,498	4,876	7,498	12,930
F(x)	0.16	0.27	0.55	0.81	0.90	0.95

You group the data using the largest number of groups such that the expected number of claims in each group is at least 5.

Calculate the Chi-Square goodness-of-fit statistic.

149. Based on a random sample, you are testing the following hypothesis:

H_0 : The data is from a population distributed binomial with $m = 6$ and $q = 0.3$.

H_1 : The data is from a population distributed binomial.

You are also given:

$$L(\theta_0) = .1 \text{ and } L(\theta_1) = .3$$

Calculate the test statistic for the Likelihood Ratio Test

State the critical value at the 10% significance level

150. State whether the following are true or false
- i. The principle of parsimony states that a more complex model is better because it will always match the data better.
 - ii. In judgment-based approaches to determining a model, a modeler's experience is critical.
 - iii. In most cases, judgment is required in using a score-based approach to selecting a model.

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Chapter 21

151. A random number generated from a uniform distribution on (0, 1) is 0.6. Using the inverse transformation method, calculate the simulated value of X assuming:

i. X is distributed Pareto with $\alpha = 3$ and $\theta = 2000$

$$\text{ii. } F(x) = \begin{cases} 0.5x & 0 \leq x < 1.2 \\ 0.6 & 1.2 \leq x < 2.4 \\ 0.5x - 0.6 & 2.4 \leq x < 3.2 \end{cases}$$

$$\text{iii. } F(x) = \begin{cases} 0.1x - 1 & 10 \leq x < 15 \\ 0.05x & 15 \leq x < 20 \end{cases}$$

152. * You are given that $f(x) = (1/9)x^2$ for $0 \leq x \leq 3$.

You are to simulate three observations from the distribution using the inversion method. The follow three random numbers were generated from the uniform distribution on [0,1]:

0.008 0.729 0.125

Using the three simulated observations, estimate the mean of the distribution.

153. * You are to simulate four observations from a binomial distribution with two trials and probability of success of 0.30. The following random numbers are generated from the uniform distribution on [0,1]:

0.91 0.21 0.72 0.48

Determine the number of simulated observations for which the number of successes equals zero.

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154. Kyle has an automobile insurance policy. The policy has a deductible of 500 for each claim. Kyle is responsible for payment of the deductible.

The number of claims follows a Poisson distribution with a mean of 2. Automobile claims are distributed exponentially with a mean of 1000.

Kyle uses simulation to estimate the claims. A random number is first used to calculate the number of claims. Then each claim is estimated using random numbers using the inverse transformation method.

The random numbers generated from a uniform distribution on $(0, 1)$ are 0.7, 0.1, 0.5, 0.8, 0.3, 0.7, 0.2.

Calculate the simulated amount that Kyle would have to pay in the first year.

155. * Insurance for a city's snow removal costs covers four winter months.

You are given:

- i. There is a deductible of 10,000 per month.
- ii. The insurer assumes that the city's monthly costs are independent and normally distributed with mean of 15,000 and standard deviation of 2000.
- iii. To simulate four months of claim costs, the insurer uses the inversion method (where small random numbers correspond to low costs).
- iv. The four numbers drawn from the uniform distribution on $[0,1]$ are:

0.5398 0.1151 0.0013 0.7881

Calculate the insurer's simulated claim cost.

156. * Annual dental claims are modeled as a compound Poisson process where the number of claims has mean of 2 and the loss amounts have a two-parameter Pareto distribution with $\theta = 500$ and $\alpha = 2$.

An insurance pays 80% of the first 750 and 100% of annual losses in excess of 750.

You simulate the number of claims and loss amounts using the inversion method.

The random number to simulate the number of claims is 0.80. The random numbers to simulate the amount of claims are 0.60, 0.25, 0.70, 0.10, and 0.80.

Calculate the simulated insurance claims for one year.

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157. A sample of two selected from a uniform distribution over $(1,U)$ produces the following values:

3 7

You estimate U as the $\text{Max}(X_1, X_2)$.

Estimate the Mean Square Error of your estimate of U using the bootstrap method.

158. * Three observed values from the random variable X are:

1 1 4

You estimate the third central moment of X using the estimator:

$$g(X_1, X_2, X_3) = 1/3 \sum (X_j - \bar{X})^3$$

Determine the bootstrap estimate of the mean-squared error of g .

Chapter 3

159. * Using the criterion of existence of moments, determine which of the following distributions have heavy tails.
- a. Normal distribution with mean μ and variance of σ^2 .
 - b. Lognormal distribution with parameters μ and σ^2 .
 - c. Single Parameter Pareto.

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Answers

91. $(n+8)/[18(n-1)^2]$
 92. 151.52
 93. 1/5
 94. -0.24
 95. 5
 96. $z = 2.0814$; critical value = 2.33; Since 2.0814 is less than 2.33, we cannot reject the null hypothesis; $p = 0.0188$
 97.

x	$p_{100}(x)$	x	$F_{100}(x)$	$\hat{H}(x)$	$\hat{S}(x)$
		$x < 1$	0	0	1
1	0.06	$1 \leq x < 2$	0.06	0.060000	0.941765
2	0.02	$2 \leq x < 4$	0.08	0.081277	0.921939
4	0.03	$4 \leq x < 6$	0.11	0.113885	0.892360
6	0.04	$6 \leq x < 7$	0.15	0.158829	0.853142
7	0.04	$7 \leq x < 8$	0.19	0.205888	0.813924
8	0.05	$8 \leq x < 9$	0.24	0.267616	0.765201
9	0.07	$9 \leq x < 10$	0.31	0.359722	0.697871
10	0.06	$10 \leq x < 11$	0.37	0.446678	0.639750
11	0.07	$11 \leq x < 12$	0.44	0.557789	0.572473
12	0.07	$12 \leq x < 13$	0.51	0.682789	0.505206
13	0.48	$13 \leq x < 22$	0.99	1.662381	0.189687
22	0.01	$x \geq 22$	1.00	2.662381	0.069782

Empirical Mean = 10.44 and Empirical Variance = 14.4064

- 98.
- a. $0.04x$ for $0 \leq x \leq 10$
 $0.15 + 0.025x$ for $10 \leq x \leq 20$
 $0.25 + 0.02x$ for $20 \leq x \leq 30$
 Undefined for $x > 30$
- b. 0.04 for $0 \leq x \leq 10$
 0.025 for $10 \leq x \leq 20$
 0.02 for $20 \leq x \leq 30$
 Undefined for $x > 30$
- c. 8

99. 47.50 and 3958.3333333333

100.

	$S_{20}(t)$	$\hat{H}(t)$	$\hat{S}(t)$
$0 \leq t < 0.3$	1	0	1
$0.3 \leq t < 0.5$	0.928571	0.071429	0.931063
$0.5 \leq t < 1.0$	0.773810	0.238095	0.788128
$1.0 \leq t < 2.5$	0.633117	0.419913	0.657104
$t \geq 2.5$	0.575561	0.510823	0.600002

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101.

	$S_{20}(t)$	$\hat{H}(t)$	$\hat{S}(t)$
$0 \leq t < 0.2$	1	0	1
$0.2 \leq t < 0.4$	0.933333	0.066667	0.935507
$0.4 \leq t < 0.5$	0.861538	0.143590	0.866243
$0.5 \leq t < 2.0$	0.789744	0.226923	0.796982
$2.0 \leq t < 3.0$	0.717949	0.317832	0.727725
$t \geq 3.0$	0	1.317832	0.267715

102. $a = 9$ and $b = 4$

103. 0.8667

104.

a. (1.0102, 1.4641)

b. (0.09969, 0.22031)

105. 0.007654

106. 6

107. 0.23414

108.

x	f(x)	F(x)
$x < 0$	0	0
$0 \leq x < 1$	3/60	3x/60
$1 \leq x < 2$	7/60	(7x-4)/60
$2 \leq x < 2.8$	9/60	(9x-8)/60
$2.8 \leq x < 3.0$	17/60	(17x-30.4)/60
$3.0 \leq x < 3.5$	13/60	(13x-18.4)/60
$3.5 \leq x \leq 4$	23/60	(23x-53.4)/60
$4 < x \leq 4.8$	18/60	(18x-33.4)/60
$4.8 < x \leq 5.5$	10/60	(10x+5)/60
$5.5 < x$	0	1

109. 0.53125

110. 0.3

111. Mean = 24 and Variance = 151.50

112. Mean = 24 and Variance = 163.50

113. Mean = 24 and Variance = 378.00

114. $\alpha = 13.812$ and $\theta = 272.89$

115. $\alpha = 3.81889$ and $\theta = 310.0782$

116. 10.8

117. $\bar{X}/(\bar{X} - 1)$

118. 1.8

119. 18.4

120. 1/6

121. 234.91

122. 378

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123. 2
124. 3.002
125. 1996.90
126. 1.5
127. 25
128. 0.55
129. 6
130. 703
131. 2.7386
132. 7.5
133. 0.6798
134. 1.6436
135. $m = 30$ and $q = 0.0573333333$
136. 0.28667
137. $m = 26$ and $q = 0.066154$
138. (1.50426, 1.93574)
139. 0.1264
140. (1/3, 0.2447)
141. All Statements are false.
142. 0.2534, 0.61, Cannot reject,
10% \Rightarrow Reject at $A^2 > 1.933$
5% \Rightarrow Reject at $A^2 > 2.492$
1% \Rightarrow Reject at $A^2 > 3.857$
143. B
144. 0.5
145. 0.1818
146. $\chi^2 = 5.5100$; critical value = 4.605; Reject H_0
147. $\chi^2 = 18.5$; critical value = 7.779; Reject H_0
148. 6.6586
149. $T = 2.197$; critical value = 4.605
150. False; True; True

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- 151. 714.42, 2.4, 15
- 152. 1.6
- 153. 2
- 154. 1105.36
- 155. 14,400
- 156. 630.79
- 157. 4
- 158. $4 \frac{8}{9}$
- 159. C only