b_stat_nb

February 28, 2018

In [667]:
```
################################
# P(exactly 8)
# P(x = 8)
# dbinom(a,size=n,prob=p)
dbinom(8, size=30, prob=.25)
# P(less than 17)
# P(x=0,1,2,...,16)
# P(x <= 16
# pbinom(a,size=n,prob=p)
pbinom(16,size=30,prob=.25)
# P(at most 12)
# P(x=0,1,2,...,12)
# P(x <= 12)
# pbinom(a,size=n,prob=p)
pbinom(12,size=30,prob=.25)
```

0.15930918764035
0.999784306173905
0.978406359120145

In [668]:
```
################################
# P(more than 20)
# P(x = 21, 22, 23, 24, 25, 26, 27, 28, 29, 30)
# 1 - P(x=0,...,20)
# P(x >= 21)
# 1-pbinom(a-1,size=n,prob=p)
1-pbinom(21-1,size=30,prob=.25)
# P(at least 25)
# P(x=25,26,27,28,29,30)
# P(x >= 25)
# 1-pbinom(a-1,size=n,prob=p)
1-pbinom(25-1,size=30,prob=.25)
```

2.81832537640803e-07
3.20596882374957e-11

In [669]:
```
################################
# P(between 10 and 20 inclusive)
```

```
# P(x=10,11,..,20)
# P(10 <= x <= 20)
# pbinom(b,size=n,prob=p)-pbinom(a-1,size=n,prob=p)
pbinom(20,size=30,prob=.25)-pbinom(10-1,size=30,prob=.25)
```

0.196593081217951

```
In [670]: ###############################
E = .05
clevel = .99
atl = clevel + (1 - clevel)/2
z = qnorm(atl)
# part a
phat = .23
n = phat * (1 - phat) * (z/E)^2
n
```

470.016075216343

```
In [671]: # part b
n = 0.25 * (z/E)^2
n
E = .2
sigma = 1.3
clevel = .95
atl = clevel + (1 - clevel)/2
z = qnorm(atl)
n = (z * sigma/E)^2
n
```

663.489660102121
162.301635174327

```
In [672]: ###############################
x1 = 200
n1 = 1000
x2 = 100
n2 = 780
clevel = .95
atl = clevel + (1 - clevel)/2
z = qnorm(atl)
phat1 = x1/n1
phat2 = x2/n2
lb = (phat1 - phat2) - z * sqrt(phat1 * (1 - phat1)/n1 + phat2 *
                                  (1 - phat2)/n2)
ub = (phat1 - phat2) + z * sqrt(phat1 * (1 - phat1)/n1 + phat2
                                * (1 - phat2)/n2)
lb
ub
```

0.0376614902726703
0.105928253317073

In [673]:
```
################################
n = 25
xbar = 20.2
sigma = 2.1
clevel = .95
atl = clevel + (1 - clevel)/2
z = qnorm(atl)
lb = xbar - z * sigma/sqrt(n)
ub = xbar + z * sigma/sqrt(n)
lb
ub
```

19.3768151264932
21.0231848735068

In [674]:
```
################################
n = 25
xbar = 20.2
s = 2.1
clevel = .95
atl = clevel + (1 - clevel)/2
t = qt(atl,df=n-1)
lb = xbar - t * s/sqrt(n)
ub = xbar + t * s/sqrt(n)
lb
ub
```

19.3331626041162
21.0668373958838

In [675]:
```
################################
x = 50
n = 200
clevel = .95
atl = clevel + (1 - clevel)/2
z = qnorm(atl)
phat = x/n
lb = phat - z * sqrt(phat * (1-phat)/n)
ub = phat + z * sqrt(phat * (1-phat)/n)
lb
ub
```

0.189988604045559
0.310011395954441

```
In [676]: ################################
          n = 18
          s = 2.5
          clevel = .95
          atl = (1 - clevel)/2
          XL = qchisq(atl,df=n-1)
          atl = clevel + (1 - clevel)/2
          XR = qchisq(atl,df=n-1)
          lb = sqrt( (n-1) * s^2/XR)
          ub = sqrt( (n-1) * s^2/XL)
          lb
          ub
```

1.87596898789809
3.74785997538552

```
In [677]: ################################
          n = 25
          s = 10.1
          clevel = .98
          atl = (1 - clevel)/2
          XL = qchisq(atl,df=n-1)
          atl = clevel + (1 - clevel)/2
          XR = qchisq(atl,df=n-1)
          lb = (n-1) * s^2/XR
          ub = (n-1) * s^2/XL
          lb
          ub
```

56.9625464243958
225.51201942914

```
In [678]: ################################
          var1 = 20
          n1 = 21
          var2 = 31
          n2 = 16
          clevel = .95
          atl = (1 - clevel)/2
          FL = qf(atl,n1,n2)
          atl = clevel + (1 - clevel)/2
          FR = qf(atl,n1,n2)
          lb = (var1/var2) * (1/FR)
          ub = (var1/var2) * (1/FL)
          lb
          ub
```

0.242080862029108
1.61749612381827

```
In [679]: ################################
          x <- c(0,1,2,3,4)
          prob <-
            c(0.20,0.30,0.25,0.15,0.10)
          expected_value = sum(x *
                                 prob)
          expected_value
```

1.65

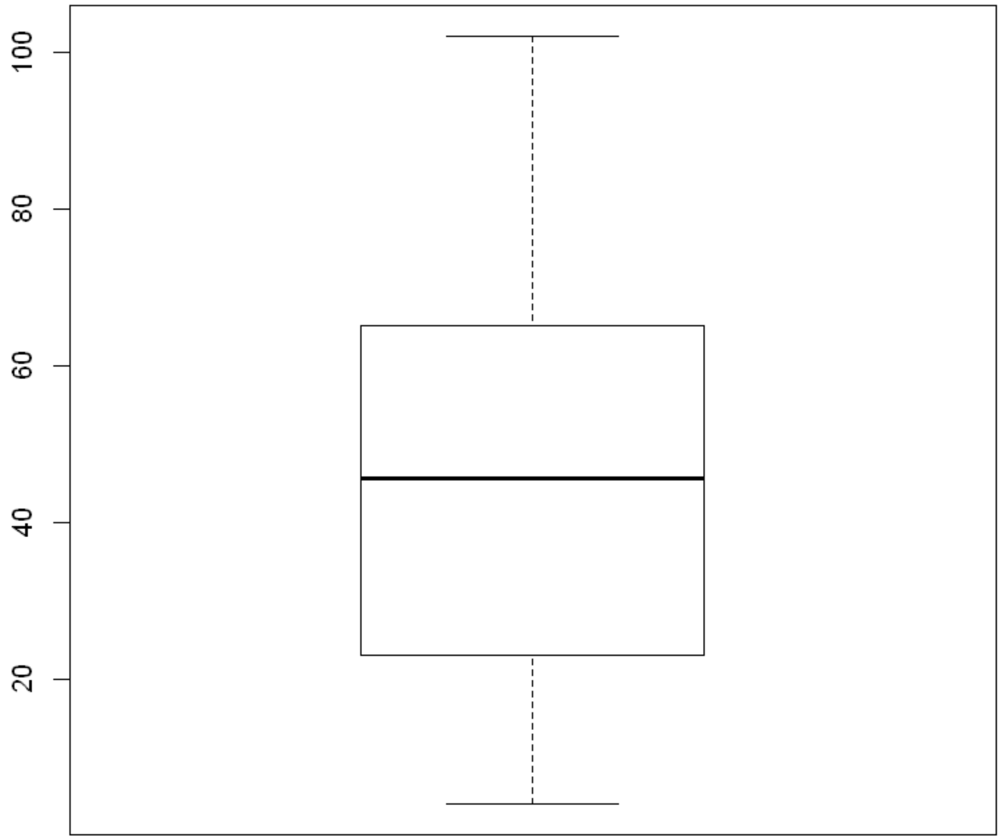
```
In [680]: ################################
          x <- c(0,1,2,3,4)
          prob <- c(0.20,0.30,0.25,0.15,0.10)
          mu = sum(x * prob)
          variance = sum((x-mu)^2*prob)
          sigma = sqrt(variance)
          sigma
          variance
```

1.23592070943083
1.5275

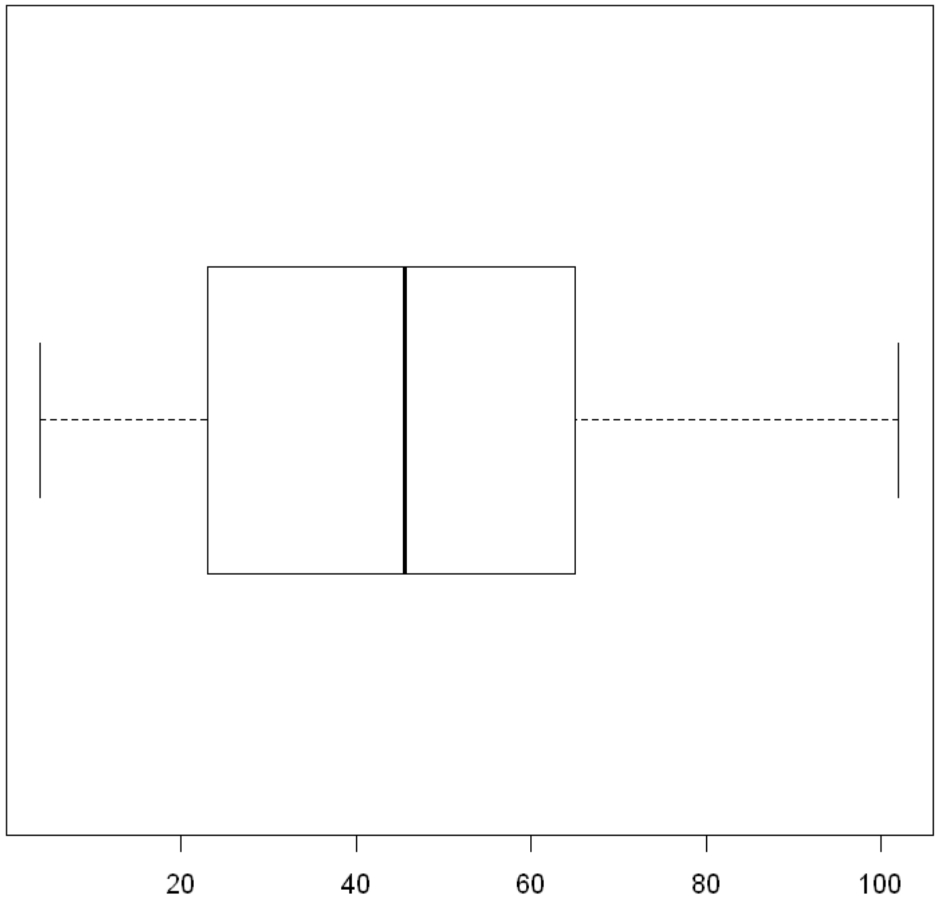
```
In [681]: ################################
          x <- c(4,13,21,23,27,35,41,50,59,61,65,73,81,102)
          min(x)
          quantile(x,0.25)
          quantile(x,0.50)
          quantile(x,0.75)
          max(x)
```

4
25\%: 24
50\%: 45.5
75\%: 64
102

```
In [682]: ################################
          x <- c(4,13,21,23,27,35,41,50,59,61,65,73,81,102)
          boxplot(x)
```



In [683]:
```
################################
x <- c(4,13,21,23,27,35,41,50,59,61,65,73,81,102)
boxplot(x,horizontal=TRUE,outline=FALSE)
```



In [684]:
```
################################
bmw<-c(2.556606964, 2.67855273, 2.896409052, 2.783157674, 2.891704203,
       2.860542363, 3.010177438, 3.006078566, 3.065817881, 3.04599754,
       2.946331923, 2.959845995, 3.026358467, 3.04652044, 2.950368732,
       3.029070333, 3.110533089, 3.085024381, 3.119939077, 2.978535249,
       2.75219467,  2.915389521, 2.988153628, 3.086303972, 3.176594433,
       3.225732266, 3.294465556, 3.243529412, 3.304870018, 3.193147676, 3.129738553,
       3.127374383, 2.92905814, 3.068145954, 3.005435049, 2.843629495, 2.770085592,
       2.777451878, 2.759566804, 2.920092359, 2.92111648, 3.049652116, 3.082093439,
       3.116267075, 3.020815054, 3.067773826, 3.144712467, 3.145272341, 3.101892469,
       3.110666812, 3.072415498, 3.155850824, 3.14246983, 3.183704502, 3.198713933,
       3.113070766, 3.089495803, 3.090996998, 3.048798994, 3.092541329, 3.0610049,
       3.104945359, 3.18507082, 3.115690719, 3.207693535, 3.277106996, 3.30402547,
```

```
            3.241771702, 3.311746668, 3.23569361, 3.26617917, 3.258903904, 3.263772706,
            3.378303983, 3.497567605, 3.44470377, 3.389057322, 3.361797986, 3.395749234,
            3.396519792, 3.440065469, 3.503362798, 3.426215145, 3.469665671, 3.574197854,
            3.510470234, 3.516369605, 3.54208912, 3.649670741, 3.613670877, 3.567191931,
            3.540669427, 3.554004302, 3.575878715, 3.472742549, 3.488230981, 3.347761443,
            3.330774917, 3.297317251, 3.365535661, 3.471003256, 3.25091698, 3.224380646,
            3.163785859, 3.138099515, 2.833036858, 2.810907587, 2.904712875, 2.755251803,
            2.814689898, 2.913002626, 3.099236067, 3.078325572, 3.13366646, 3.322839365,
            3.302444616, 3.338754441, 3.349166974, 3.291345313, 3.303216973, 3.276465257,
            3.237776084, 3.375400827, 3.45817615, 3.488017074, 3.541857471, 3.572457991,
            3.581015808, 3.791774433, 3.79312685, 3.910581968, 3.926340026, 3.878135247,
            3.925156384, 3.924643037, 4.005057871, 3.99085267, 4.103485985, 4.118061089,
            3.903708536, 3.783462097, 3.950685871, 3.897132693, 3.81874476, 4.052497737,
            4.112446398, 4.083216204, 4.146161886, 4.01983651, 3.949145365, 4.014417126,
            3.961879268, 3.948779146, 4.0255481, 4.129615176, 4.196810894, 4.213400861,
            4.165765594, 4.11662777, 4.156520921, 4.241873366, 4.149384994, 4.240520672,
            4.208773832, 4.317394776, 4.367344376, 4.379586159, 4.387250467, 4.334240341,
            4.375203409, 4.459658747, 4.443815285, 4.494730125, 4.500465011, 4.464412748,
            4.456101571, 4.414856779, 4.418370618, 4.493210164, 4.469212996, 4.610565605,
            4.699352457, 4.72942998, 4.636349034, 4.6121458, 4.586802529, 4.514150788, 4.4
            4.372228792, 4.536462988, 4.572233686) #logarithm of BMW stock price
bmw2<-ts(bmw) #indicate that bmw is a time series variable
hw<-HoltWinters(bmw2, gamma=FALSE) #implement Holt Winters method
hw #obtain the estimated coefficients
```

```
Holt-Winters exponential smoothing with trend and without seasonal component.

Call:
HoltWinters(x = bmw2, gamma = FALSE)

Smoothing parameters:
 alpha: 0.9705391
 beta : 0.09581481
 gamma: FALSE

Coefficients:
         [,1]
a 4.571180897
b 0.008494273
```

In [685]:
```
################################
tossingcoin <- sample(c(-1,1), 1000, replace = TRUE)
cumsum(tossingcoin)
plot(cumsum(tossingcoin), type = 's')
```

1. -1 2. -2 3. -1 4. -2 5. -1 6. -2 7. -3 8. -4 9. -3 10. -2 11. -1 12. 0 13. -1 14. 0 15. -1 16. -2 17. -1 18. 0 19. 1 20. 0 21. -1 22. -2 23. -1 24. 0 25. -1 26. 0 27. -1 28. -2 29. -1 30. -2 31. -3 32. -2 33. -3 34. -2 35. -1

36. -2 37. -1 38. -2 39. -3 40. -4 41. -5 42. -6 43. -7 44. -6 45. -7 46. -8 47. -7 48. -8 49. -7 50. -6 51. -7 52. -6 53. -5 54. -6 55. -5 56. -6 57. -7 58. -6 59. -7 60. -6 61. -7 62. -6 63. -5 64. -6 65. -5 66. -4 67. -3 68. -4 69. -3 70. -4 71. -5 72. -4 73. -3 74. -2 75. -1 76. -2 77. -3 78. -4 79. -3 80. -2 81. -1 82. -2 83. -3 84. -2 85. -3 86. -4 87. -3 88. -4 89. -5 90. -4 91. -3 92. -4 93. -5 94. -6 95. -7 96. -6 97. -5 98. -6 99. -7 100. -8 101. -7 102. -6 103. -5 104. -4 105. -3 106. -4 107. -5 108. -4 109. -5 110. -4 111. -3 112. -2 113. -3 114. -4 115. -5 116. -4 117. -3 118. -4 119. -3 120. -2 121. -1 122. -2 123. -3 124. -4 125. -5 126. -6 127. -5 128. -4 129. -5 130. -6 131. -5 132. -4 133. -5 134. -4 135. -5 136. -4 137. -5 138. -4 139. -5 140. -4 141. -3 142. -2 143. -1 144. 0 145. -1 146. 0 147. -1 148. -2 149. -3 150. -2 151. -3 152. -4 153. -5 154. -6 155. -5 156. -6 157. -7 158. -8 159. -9 160. -8 161. -9 162. -10 163. -11 164. -10 165. -9 166. -8 167. -9 168. -10 169. -11 170. -10 171. -11 172. -10 173. -11 174. -12 175. -13 176. -12 177. -13 178. -12 179. -13 180. -12 181. -13 182. -12 183. -11 184. -12 185. -13 186. -12 187. -13 188. -12 189. -13 190. -14 191. -13 192. -12 193. -13 194. -12 195. -13 196. -14 197. -15 198. -16 199. -17 200. -18 201. -19 202. -20 203. -21 204. -22 205. -21 206. -22 207. -21 208. -20 209. -21 210. -20 211. -21 212. -20 213. -19 214. -20 215. -19 216. -20 217. -21 218. -22 219. -23 220. -22 221. -21 222. -22 223. -23 224. -24 225. -23 226. -24 227. -23 228. -22 229. -21 230. -22 231. -21 232. -22 233. -23 234. -22 235. -23 236. -24 237. -23 238. -22 239. -21 240. -22 241. -23 242. -22 243. -21 244. -20 245. -19 246. -18 247. -19 248. -20 249. -21 250. -22 251. -21 252. -22 253. -23 254. -24 255. -23 256. -24 257. -25 258. -26 259. -27 260. -28 261. -29 262. -28 263. -27 264. -26 265. -27 266. -28 267. -29 268. -30 269. -31 270. -30 271. -31 272. -30 273. -29 274. -30 275. -31 276. -32 277. -31 278. -32 279. 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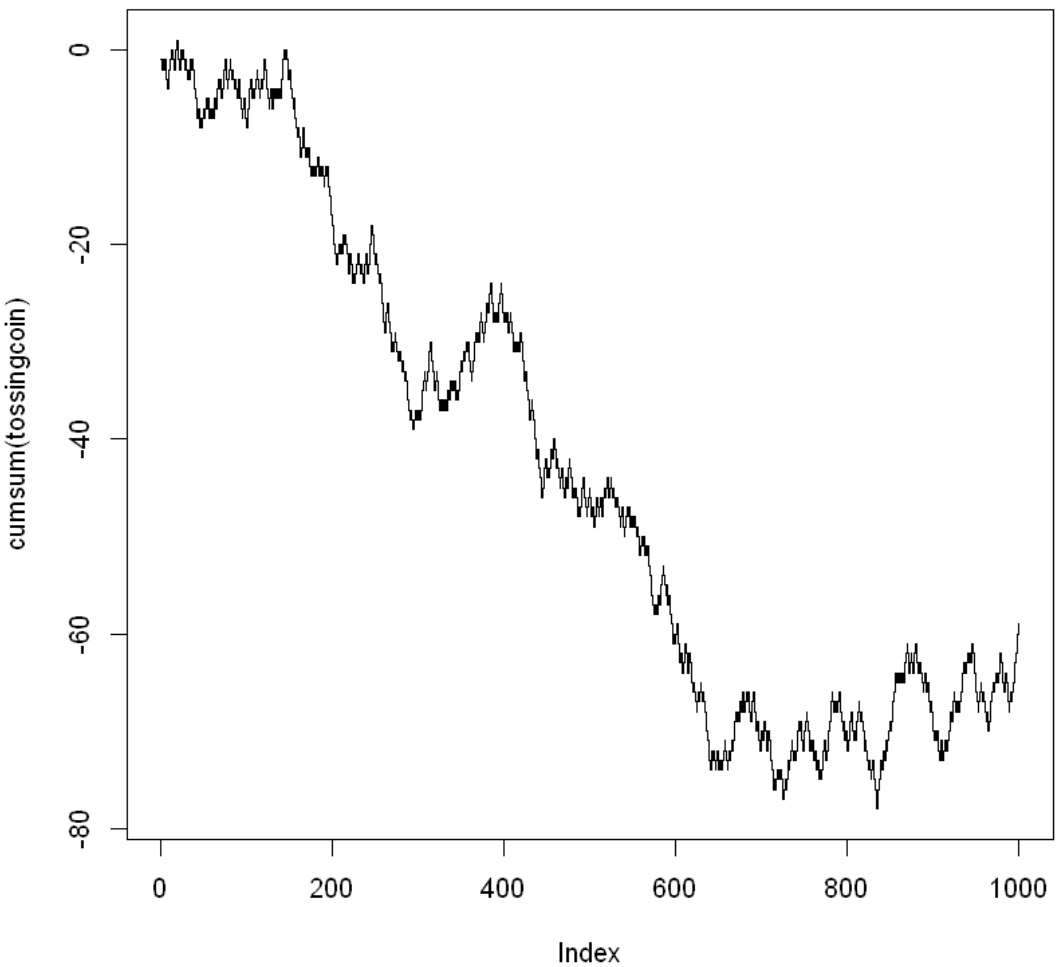
-47 502. -48 503. -47 504. -48 505. -49 506. -48 507. -47 508. -46 509. -47 510. -48 511. -47 512. -46 513. -47 514. -48 515. -47 516. -46 517. -45 518. -46 519. -45 520. -44 521. -45 522. -46 523. -45 524. -44 525. -45 526. -46 527. -45 528. -46 529. -47 530. -46 531. -47 532. -46 533. -47 534. -48 535. -49 536. -48 537. -47 538. -48 539. -49 540. -50 541. -49 542. -48 543. -47 544. -48 545. -47 546. -48 547. -49 548. -48 549. -49 550. -48 551. -49 552. -48 553. -49 554. -50 555. -49 556. -50 557. -51 558. -52 559. -51 560. -50 561. -51 562. -50 563. -51 564. -52 565. -51 566. -52 567. -51 568. -52 569. -53 570. -54 571. -55 572. -56 573. -57 574. -58 575. -57 576. -58 577. -57 578. -58 579. -57 580. -56 581. -57 582. -56 583. -55 584. -54 585. -53 586. -54 587. -55 588. -56 589. -55 590. -56 591. -57 592. -56 593. -57 594. -58 595. -59 596. -60 597. -61 598. -60 599. -61 600. -60 601. -59 602. -60 603. -61 604. -62 605. -63 606. -62 607. -63 608. -64 609. -63 610. -62 611. -61 612. -62 613. -63 614. -64 615. -63 616. -62 617. -63 618. -64 619. -65 620. -66 621. -65 622. -66 623. -67 624. -68 625. -67 626. -66 627. -67 628. -66 629. -65 630. -66 631. -67 632. -66 633. -67 634. -68 635. -69 636. -70 637. -71 638. -72

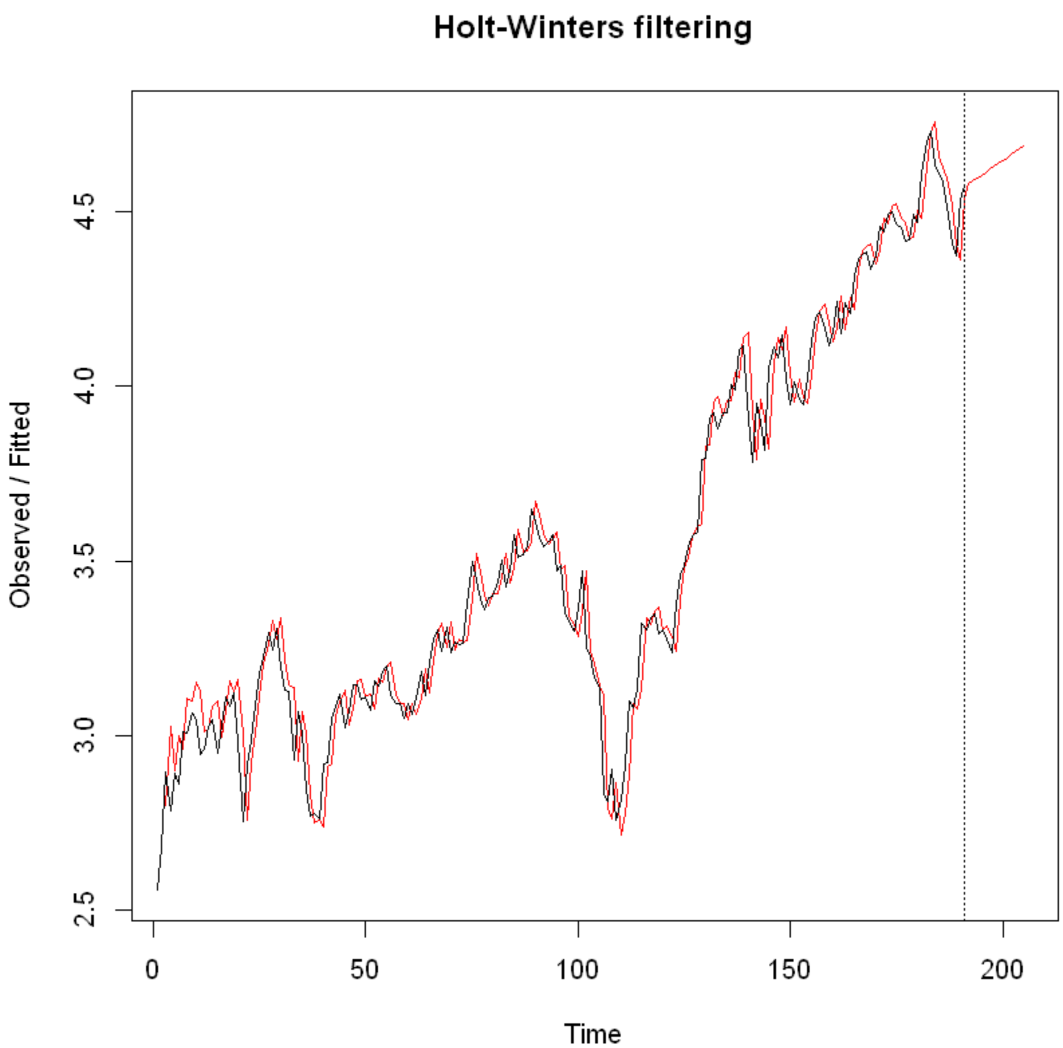
639. -73 640. -74 641. -73 642. -72 643. -73 644. -72 645. -73 646. -74 647. -73 648. -72 649. -73 650. -74 651. -73 652. -74 653. -73 654. -74 655. -73 656. -72 657. -71 658. -72 659. -73 660. -74 661. -73 662. -72 663. -73 664. -72 665. -71 666. -72 667. -71 668. -70 669. -69 670. -68 671. -69 672. -68 673. -69 674. -68 675. -67 676. -68 677. -67 678. -66 679. -67 680. -68 681. -67 682. -66 683. -67 684. -66 685. -67 686. -68 687. -69 688. -68 689. -67 690. -66 691. -67 692. -68 693. -69 694. -70 695. -69 696. -70 697. -71 698. -72 699. -71 700. -70 701. -71 702. -70 703. -69 704. -70 705. -71 706. -72 707. -71 708. -70 709. -71 710. -72 711. -73 712. -74 713. -75 714. -76 715. -75 716. -76 717. -75 718. -74 719. -75 720. -74 721. -75 722. -74 723. -75 724. -76 725. -77 726. -76 727. -75 728. -76 729. -75 730. -74 731. -73 732. -74 733. -73 734. -72 735. -71 736. -72 737. -73 738. -72 739. -73 740. -72 741. -71 742. -70 743. -69 744. -70 745. -69 746. -70 747. -71 748. -72 749. -71 750. -70 751. -69 752. -68 753. -69 754. -70 755. -71 756. -72 757. -71 758. -72 759. -71 760. -72 761. -73 762. -72 763. -73 764. -74 765. -73 766. -74 767. -75 768. -74 769. -75 770. -74 771. -73 772. -72 773. -71 774. -72 775. -73 776. -72 777. -71 778. -70 779. -69 780. -68 781. -67 782. -66 783. -67 784. -68 785. -67 786. -68 787. -67 788. -68 789. -67 790. -66 791. -67 792. -68 793. -69 794. -70 795. -69 796. -70 797. -71 798. -70 799. -71 800. -72 801. -71 802. -70 803. -69 804. -68 805. -69 806. -70 807. -71 808. -70 809. -71 810. -70 811. -69 812. -68 813. -67 814. -68 815. -69 816. -68 817. -69 818. -70 819. -71 820. -72 821. -71 822. -72 823. -73 824. -74 825. -73 826. -74 827. -75 828. -74 829. -73 830. -74 831. -75 832. -76 833. -77 834. -78 835. -77 836. -76 837. -75 838. -74 839. -73 840. -74 841. -73 842. -72 843. -73 844. -72 845. -71 846. -72 847. -71 848. -70 849. -69 850. -70 851. -69 852. -68 853. -67 854. -66 855. -65 856. -64 857. -65 858. -64 859. -65 860. -64 861. -65 862. -64 863. -65 864. -64 865. -65 866. -64 867. -63 868. -62 869. -61 870. -62 871. -63 872. -64 873. -63 874. -62 875. -63 876. -64 877. -63 878. -62 879. -61 880. -62 881. -63 882. -64 883. -63 884. -64 885. -63 886. -64 887. -65 888. -66 889. -65 890. -64 891. -65 892. -66 893. -65 894. -66 895. -67 896. -68 897. -67 898. -68 899. -69 900. -70 901. -71 902. -70 903. -71 904. -70 905. -71 906. -72 907. -73 908. -72 909. -71 910. -72 911. -73 912. -72 913. -71 914. -72 915. -71 916. -72 917. -71 918. -70 919. -69 920. -68 921. -69 922. -68 923. -67 924. -66 925. -67 926. -68 927. -67 928. -68 929. -67 930. -68 931. -67 932. -66 933. -65 934. -64 935. -63 936. -64 937. -63 938. -64 939. -63 940. -62 941. -63 942. -62 943. -63 944. -62 945. -61 946. -62 947. -63 948. -64 949. -65 950. -66 951. -67 952. -68 953. -67 954. -66 955. -65 956. -66 957. -67 958. -66 959. -67 960. -68 961. -69 962. -68 963. -69 964. -70 965. -69 966. -68 967. -67 968. -66 969. -65 970. -66 971. -65 972. -64 973. -65 974. -64 975. -65 976. -64 977. -63 978. -62 979. -63 980. -64 981. -65 982. -66 983. -65 984. -64 985. -65 986. -66 987. -67 988. -68 989. -67 990. -66 991. -67 992. -66 993. -65 994. -64 995. -63 996. -62 997. -61 998. -60 999. -59 1000. -60




```
In [686]: ################################
          pred <- predict(hw, n.ahead = 14, prediction.interval = FALSE)
          #estimate the 14 predictions ahead
          pred #obtain the predictions
          plot(hw, pred) #obtain the graph
          #the red line shows the predicted values while the black line
          #indicates the stock price evolution
```

```
Time Series:
Start = 192
End = 205
Frequency = 1
           fit
```

```
 [1,] 4.579675
 [2,] 4.588169
 [3,] 4.596664
 [4,] 4.605158
 [5,] 4.613652
 [6,] 4.622147
 [7,] 4.630641
 [8,] 4.639135
 [9,] 4.647629
[10,] 4.656124
[11,] 4.664618
[12,] 4.673112
[13,] 4.681606
[14,] 4.690101
```



In [687]:
```
##################################
alpha = 8
beta = 1
gamma = factorial(alpha - 1)
a = 3
b = 4
f = function(x){(x^(alpha-1)*exp(-x/beta))/(beta ^ alpha *
                                              gamma)}
integrate(f,a,b)
```

```
0.03922911 with absolute error < 4.4e-16
```

In [688]:
```
##################################
observed <- c(200,150,350,20)
prob <- c(0.25,0.20,0.50,0.05)
chisq.test(observed,p=prob)
```

```
Chi-squared test for given probabilities

data:  observed
X-squared = 9.8611, df = 3, p-value = 0.01978
```

In [689]:
```
##################################
x <- c(23, 27, 29, 35, 37, 37, 39, 40, 42, 45, 51)
breaks = seq(20,60,by=10)
xcut = cut(x,breaks,right=FALSE)
freq = table(xcut)
freq
```

```
xcut
[20,30) [30,40) [40,50) [50,60)
      3       4       3       1
```

In [690]:
```
##################################
x <- c(1,2,8,13)
y <- c(10,15,35,44)
t_line = lm(y ~ x)
t_line
x <- c(3,5,7,9)
y <- c(17,23,41,50)
t_line = lm(y ~ x)
```

```
t_line
#form yhat = mx + b
#form yhat = b1*x + b0
coeffs = coefficients(t_line)
b0 = coeffs[1]
b1 = coeffs[2]
b1 * 21 + b0
```

```
Call:
lm(formula = y ~ x)

Coefficients:
(Intercept)            x
      8.894        2.851
```

```
Call:
lm(formula = y ~ x)

Coefficients:
(Intercept)            x
      -2.35         5.85
```

x: 120.5

```
In [691]: ################################
          one <- c(1,1)
          xval <- c(1,2)
          yval <- c(2,5)
          X <- matrix(c(one,xval),nrow=2,ncol=2)
          Y <- matrix(c(yval),nrow=2,ncol=1)
          solve(t(X) %*% X) %*% t(X) %*% Y
```

-1
3

```
In [692]: ################################
          one <- c(1,1,1)
          x1val <- c(1,4,3)
          x2val <- c(2,-1,1)
          yval <- c(9,3,9)
          X <- matrix(c(one,x1val,x2val),nrow=3,ncol=3)
          Y <- matrix(c(yval),nrow=3,ncol=1)
          solve(t(X) %*% X) %*% t(X) %*% Y
```

-1
2
4

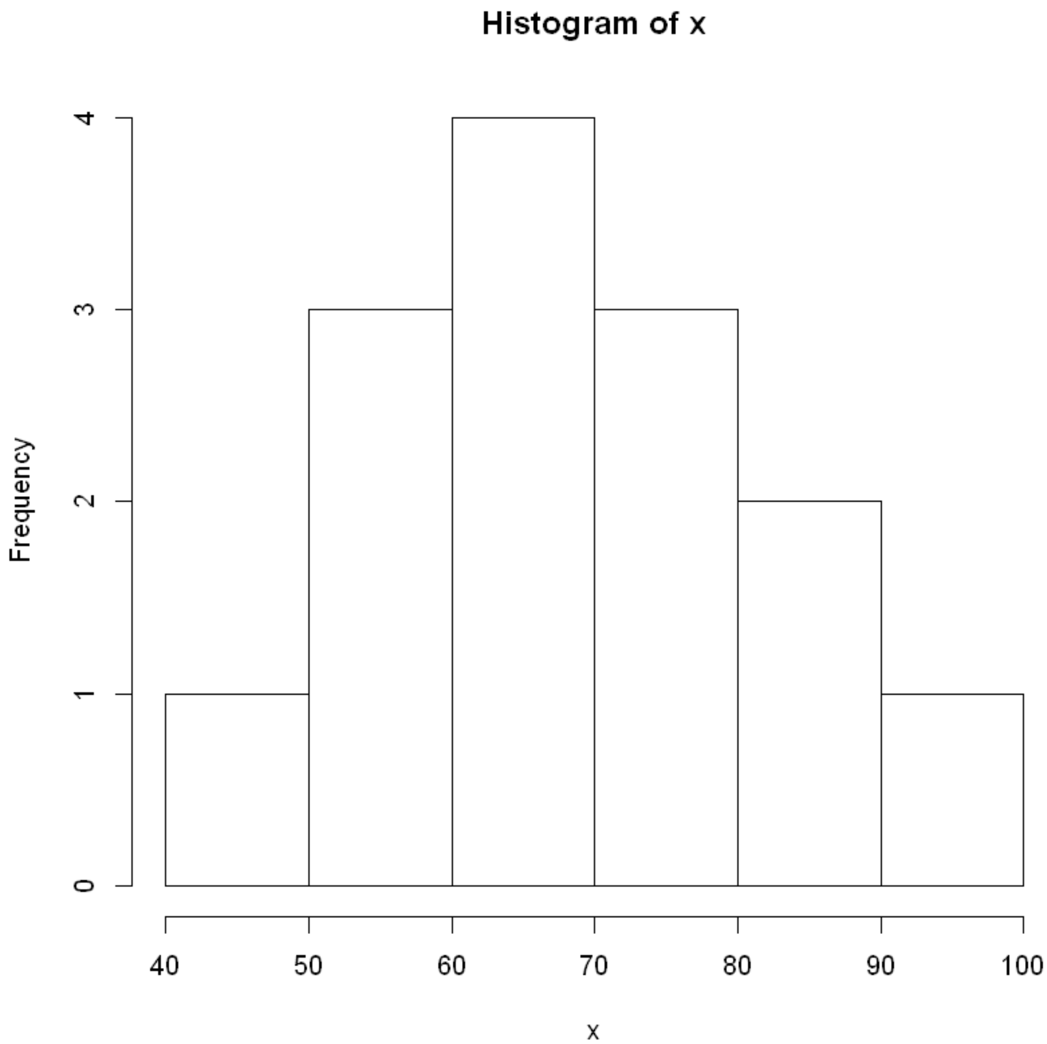
In [693]:
```
################################
one <- c(1,1,1)
xval <- c(1,2,3)
yval <- c(2,5,4)
X <- matrix(c(one,xval),nrow=3,ncol=2)
Y <- matrix(c(yval),nrow=3,ncol=1)
betahat = solve(t(X) %*% X) %*% t(X) %*% Y
betahat
SSE = t(Y) %*% Y - t(betahat) %*% t(X) %*% Y
SSE
```

1.666667
1.000000
2.666667

In [694]:
```
################################
x <- c(3,5,7,9)
y <- c(17,23,41,50)
t_line = lm(y ~ x)
coeffs = coefficients(t_line)
b0 = coeffs[1]
b1 = coeffs[2]
# form: yhat = b1(x) + b0
yhat = b1 * x + b0
# (y - yhat)^2 and then sum them
sum((y-yhat)^2)
```

24.3

In [695]:
```
################################
x <- c(40,51,53,55,65,67,69,70,72,75,76,81,83,99)
hist(x)
```




```
In [696]: ##################################
          lcl <- c(10,20,30,40)
          ucl <- c(19,29,39,49)
          midpoints = (lcl + ucl)/2
          midpoints
```

1. 14.5 2. 24.5 3. 34.5 4. 44.5

```
In [697]: ##################################
          lcl <- c(10,20,30,40)
          ucl <- c(19,29,39,49)
          new_midpoints <- c()
          for (i in 1:length(lcl))
```

```
{
  new_midpoints[i] = (lcl[i] + ucl[i])/2
}
new_midpoints
```

1. 14.5 2. 24.5 3. 34.5 4. 44.5

In [698]:
```
################################
lcl <- c(10,20,30,40)
ucl <- c(19,29,39,49)
f <- c(5,31,12,2)
x = (lcl+ucl)/2
xbar = sum(f * x)/sum(f)
xbar
```

26.7

In [699]:
```
################################
lcl <- c(10,20,30,40)
ucl <- c(19,29,39,49)
f <- c(5,31,12,2)
x <- c()
```

In [700]:
```
################################
# create the midpoints
for (i in 1:length(lcl))
{
  x[i] = (lcl[i] + ucl[i])/2
}
sum_freq = 0
sum_ftimesx = 0
for (i in 1:length(lcl))
{
  sum_freq = sum_freq + f[i]
  sum_ftimesx = sum_ftimesx + f[i] * x[i]
}
xbar = sum_ftimesx/sum_freq
print(xbar)
```

```
[1] 26.7
```

In [701]:
```
################################
lcl <- c(10,20,30,40)
ucl <- c(19,29,39,49)
f <- c(5,31,12,2)
x <- (lcl + ucl)/2
mean = sum(f * x)/sum(f)
mean
```

```
top_sum = sum((x - mean)^2 * f)
sample_stdev = sqrt(top_sum/(sum(f) - 1))
sample_stdev
```

26.7
6.78834535458098

```
In [702]: #################################
          lcl <- c(10,20,30,40)
          ucl <- c(19,29,39,49)
          f <- c(5,31,12,2)
          x <- (lcl + ucl)/2
          mean = sum(f * x)/sum(f)
          mean
          top_sum = sum((x - mean)^2 * f)
          pop_stdev = sqrt(top_sum/sum(f))
          pop_stdev
```

26.7
6.72011904656458

```
In [703]: #################################
          lcl <- c(10,20,30,40)
          ucl <- c(19,29,39,49)
          f <- c(5,31,12,2)
          x <- (lcl + ucl)/2
          mean = sum(f * x)/sum(f)
          mean
          top_sum = sum((x - mean)^2 * f)
          pop_stdev = sqrt(top_sum/sum(f))
          pop_stdev
          pop_variance = pop_stdev^2
          pop_variance
```

26.7
6.72011904656458
45.16

```
In [704]: #################################
          weights <- c(0.10,0.20,0.50,0.20)
          grades <- c(100,80,70,30)
          course_average = sum(weights * grades)/sum(weights)
          course_average
          #################################
          weights <- c(10,20,50,20)
          grades <- c(100,80,70,30)
          course_average = sum(weights * grades)/sum(weights)
          course_average
```

67
67

In [705]:
```
##################################
x <- c(2, 5, 7, 11, 12, 21, 25, 31, 45, 72, 81, 102)
quantile(x,0.25)
quantile(x,0.50)
quantile(x,0.75)
```

25\%: 10
50\%: 23
75\%: 51.75

In [706]:
```
##################################
x <- c(25,2,31,12)
newx = sort(x)
newx
```

1. 2 2. 12 3. 25 4. 31

In [707]:
```
##################################
x <- c(3.5, 3.2, 4.1, 4.7, 3.8, 5.1, 7.2, 3.9, 5.3, 6.1, 6.2, 3.1, 9.3,
       9.4, 10.5, 10.9, 11.1, 11.2, 12.7, 12.8, 13.1, 13.5, 17, 38.6)
q1 = quantile(x,0.25)
q3 = quantile(x,0.75)
iqr = q3 - q1
lf = q1 - 1.5 * iqr
uf = q3 + 1.5 * iqr
lf
uf
```

25\%: -5.9875
75\%: 22.1125

In [708]:
```
##################################
x <- c(20, 31, 42, 51, 55, 57, 60, 65, 70, 80)
range = max(x) - min(x)
range
```

60

In [709]:
```
##################################
x <- c(2,8,20,50)
tsum = sum((x-mean(x))^2)
pop_stdev = sqrt(tsum/length(x))
pop_stdev
```

18.4932420089069

```
In [710]: ################################
          x <- c(2,8,20,50)
          # find the mean
          tsum = 0
          for (i in 1:length(x))
          {
            tsum = tsum + x[i]
          }
          mean = tsum/length(x)
          # calculate sum of (x-mean)^2
          newsum = 0
          for (i in 1:length(x))
          {
            newsum = newsum + (x[i] - mean)^2
          }
          # find population standard deviation
          pop_stdev = sqrt(newsum/length(x))
          pop_stdev
```

18.4932420089069

```
In [711]: ################################
          x <- c(2,8,20,50)
          sd(x)
```

21.3541565040626

```
In [712]: ################################
          x <- c(2,8,20,50)
          sample_variance = sd(x)^2
          sample_variance
```

456

```
In [713]: ################################
          x <- c(2,8,20,50)
          tsum = sum((x-mean(x))^2)
          pop_stdev = sqrt(tsum/length(x))
          pop_variance = pop_stdev^2
          pop_variance
```

342

```
In [714]: ################################
          x <- c(2, 8, 12, 13, 21, 32, 45, 51, 72, 81)
          tsum = sum((x-mean(x))^2)
          pop_stdev = sqrt(tsum/length(x))
          pop_mean = mean(x)
          CV = pop_stdev/pop_mean * 100
          CV
```

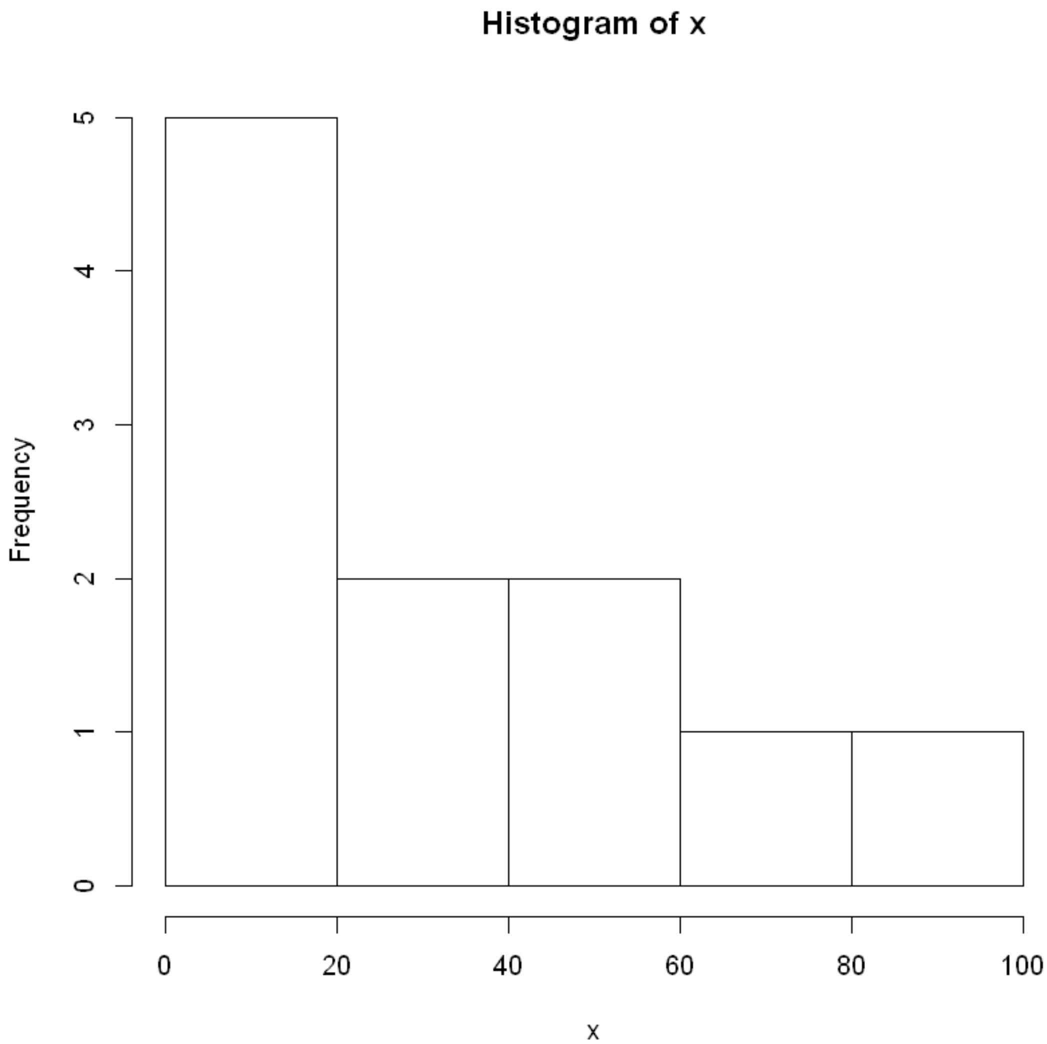
77.7204528415696

In [715]:
```
################################
x <- c(2, 8, 12, 13, 21, 32, 45, 51, 72, 81)
tsum = sum((x-mean(x))^2)
pop_stdev = sqrt(tsum/length(x))
pop_mean = mean(x)
pop_median = median(x)
sk = (3 * (pop_mean - pop_median))/pop_stdev
sk
```

0.824685821379213

In [716]:
```
################################
x <- c(1, 2, 8, 12, 13, 21, 32, 45, 51, 72, 81)
tsum = sum((x-mean(x))^2)
pop_stdev = sqrt(tsum/length(x))
pop_mean = mean(x)
pop_median = median(x)
sk = (3 * (pop_mean - pop_median))/pop_stdev
sk
hist(x)
```

1.0936221794622



In [717]:
```
################################
startval = 10
endval = 20
x <- c(2,12,15,31,32,45,58)
count = 0
for (i in 1:length(x))
{
  if (x[i] >= startval && x[i] <= endval)
    count = count + 1
}
actualp = count/length(x) * 100
actualp
```

28.5714285714286

In [718]:
```
################################
n = 500
p = .20
# P(x is less than 90)
# P(x <= 89.5)
# case 1
pnorm(89.5,mean=n*p,sd=sqrt(n*p*(1-p)),lower.tail=TRUE)
# P(x is at most 92)
# P(x <= 92.5)
# case 1
pnorm(92.5,mean=n*p,sd=sqrt(n*p*(1-p)),lower.tail=TRUE)
# P(x is more than 105)
# P(x >= 105.5)
pnorm(105.5,mean=n*p,sd=sqrt(n*p*(1-p)),lower.tail=FALSE)
# P(x is at least 100)
# P(x >= 99.5)
pnorm(99.5,mean=n*p,sd=sqrt(n*p*(1-p)),lower.tail=FALSE)
# P(between 90 and 98, inclusive)
# P(89.5 <= x <= 98.5)
pnorm(98.5,mean=n*p,sd=sqrt(n*p*(1-p)),lower.tail=TRUE)-
  pnorm(89.5,mean=n*p,sd=sqrt(n*p*(1-p)),lower.tail=TRUE)
```

0.120210393184218
0.200867818527699
0.269304208340612
0.522289941503218
0.313197249379494

In [719]:
```
################################
# P(exactly 8)
# P(x = 8)
# dpois(a,lambda=lam)
a = 3
t = 5
lam = a * t
dpois(8,lambda=lam)
# P(less than 17)
# P(x=0,1,2,...16)
# P(x <= 16)
# ppois(a,lambda=lam,lower=TRUE)
ppois(16,lambda=lam,lower=TRUE)
# P(at most 12)
# P(x=0,1,2,...,12)
# P(x <= 12)
# ppois(a,lamba=lam,lower=TRUE)
ppois(12,lambda=lam,lower=TRUE)
# P(more than 20)
# P(x=21,22,23,...)
```

```
# P(x >= 21)
# ppois(a,lambda=lam,lower=FALSE)
ppois(21,lambda=lam,lower=FALSE)
# P(at least 25)
# P(x=25,26,27,...)
# P(x >= 25)
# ppois(a,lambda=lam,lower=FALSE)
ppois(25,lambda=lam,lower=FALSE)
```

0.0194443003318422
0.664123200606545
0.267611033392577
0.0531064064592713
0.00618490381126678

```
In [720]: ################################
          f = function(x){1/x}
          integrate(f,1,5)
```

```
1.609438 with absolute error < 3.7e-09
```

```
In [721]: ################################
          f = function(x){1/x^2}
          integrate(f,1,Inf)
          ################################
          f = function(x){1/x^3}
          integrate(f,-Inf,Inf)
```

```
1 with absolute error < 1.1e-14
```

```
0 with absolute error < 0
```

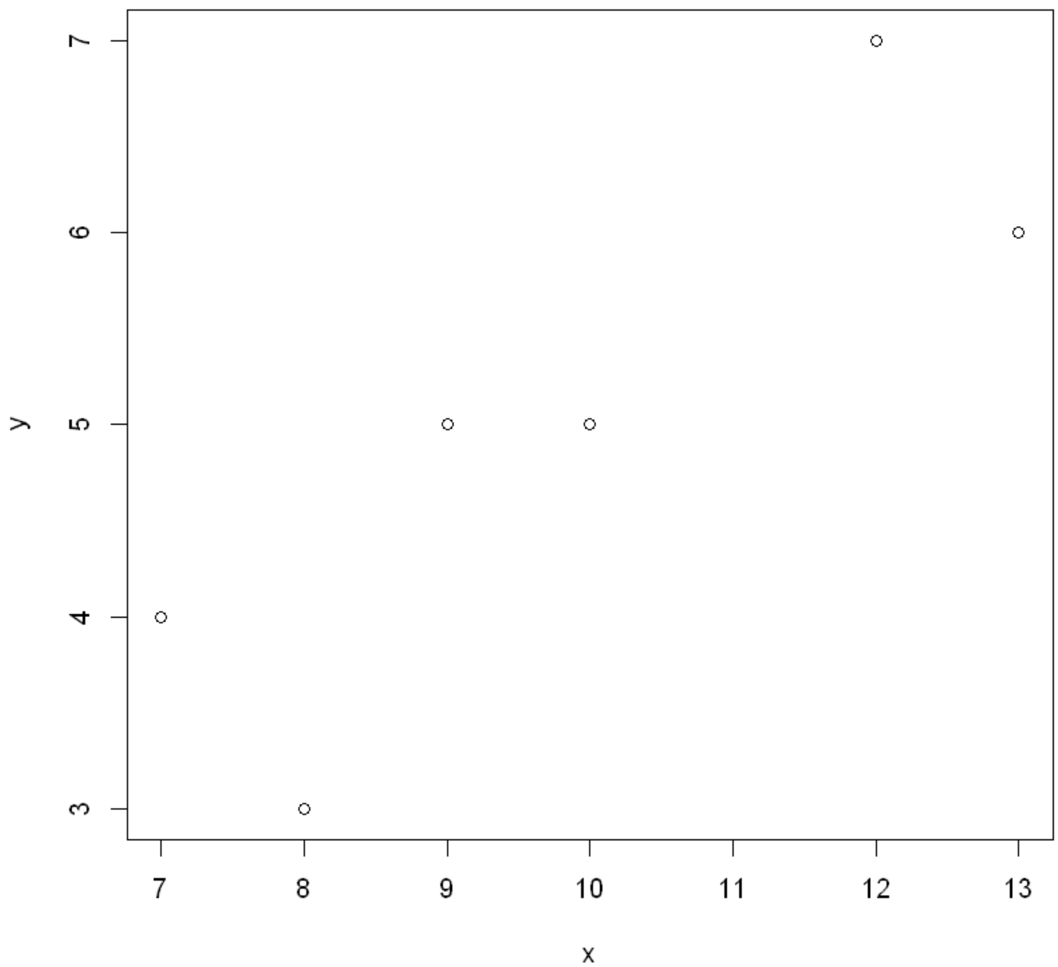
```
In [722]: ################################
          datavalues <- matrix(c(42,20,14,50,24,18,10,16,6),ncol=3,byrow=TRUE)
          colnames(datavalues) <- c("Approve","Disapprove","No_Opinion")
          rownames(datavalues) <- c("Republican","Democrat","Independent")
          tbl <- as.table(datavalues)
          chisq.test(tbl)
```

```
Pearson's Chi-squared test

data:  tbl
X-squared = 8.0305, df = 4, p-value = 0.09047
```

In [723]:
```
################################
datavalues <- matrix(c(25,35,75,45,30,45,45,15),ncol=4,byrow=TRUE)
colnames(datavalues) <- c("0-30","30-60","60-90","90-over")
rownames(datavalues) <- c("male","female")
tbl <- as.table(datavalues)
chisq.test(tbl)
```

```
Pearson's Chi-squared test

data:  tbl
X-squared = 18.146, df = 3, p-value = 0.0004103
```

In [724]:
```
################################
x <- c(7,12,10,9,13,8)
y <- c(4,7,5,5,6,3)
plot(x,y)
```



In [725]:
```
##################################
x <- c(2,3,5,5,6)
y <- c(1.3,1.6,2.1,2.2,2.7)
cor(x,y)
##################################
x <- c(10,11,16,9,7,15,16,10)
y <- c(96,51,62,58,89,81,46,51)
cor(x,y)
```

0.982703641586785
-0.335057535329579

In [726]:
```
##################################
pnorm(9.1,mean=10,sd=1.5/sqrt(20),lower.tail=TRUE)-
```

```
  pnorm(4.5,mean=10,sd=1.5/sqrt(20),lower.tail=TRUE)
#################################
pnorm(7500,mean=7200,sd=1200/sqrt(30))-pnorm(7000,mean=7200,sd=1200/sqrt(30))
```

0.00364517904576781
0.733893025621512

```
In [727]: #################################
          alpha = 0.05
          pknot = 0.25
          n = 300
          truep = 0.22
          ZAL = qnorm(alpha)
          phatL = pknot + ZAL * sqrt(pknot * (1-pknot) / n)
          ZL = (phatL - truep) / sqrt(truep * (1-truep) / n)
          1-pnorm(ZL)
          pnorm(ZL)
```

0.679036639899256
0.320963360100744

```
In [728]: #################################
          f = expression(x^2/(x-1),'x')
          D(f,'x')
          #################################
          f = function(x){2*(1-2*x^3)}
          integrate(f,1/4,3/8)
```

```
2 * x/(x - 1) - x^2/(x - 1)^2


0.2341309 with absolute error < 2.6e-15
```

```
In [729]: #################################
          a = 3
          t = 5
          lam = a * t
          dpois(12,lambda=lam)
          #################################
          a = 8
          t = 3
          lam = a * t
          ppois(21,lambda=lam,lower=FALSE)
```

0.0828592343686454
0.686071971901457

In [730]:
```
##################################
a = 8
t = 3
lam = a * t
ppois(21,lambda=lam,lower=TRUE)-ppois(18-1,lambda=lam,lower=TRUE)
```

0.226801591920095

In [731]:
```
##################################
a = 0.01
t = 100
lam = a * t
ppois(2-1,lambda=lam,lower=FALSE)
```

0.264241117657115

In [732]:
```
##################################
a = 4
t = 1
lam = a * t
dpois(7,lambda=lam)^3
```

0.000211073847054545

In [733]:
```
##################################
pnorm(22,mean=25,sd=3.1,lower.tail=FALSE)
mu=25
sigma=3.1
f = function(x){exp(-1 * (x - mu)^2 / (2*sigma^2)) / (sigma * sqrt(2 * pi))}
integrate(f,22,Inf)
```

0.833413365520525

```
0.8334134 with absolute error < 2.2e-06
```

In [734]:
```
##################################
pnorm(24.3,mean=25,sd=3.1,lower.tail=TRUE)- pnorm(18,mean=25,sd=3.1,lower.tail=TRUE)
mu=25
sigma=3.1
f = function(x){exp(-1 * (x - mu)^2 / (2*sigma^2)) / (sigma * sqrt(2 * pi))}
integrate(f,18,24.3)
```

0.398705160765656

```
0.3987052 with absolute error < 4.4e-15
```

```
In [735]: ################################
          pnorm(7.5,mean=6.5,sd=1,lower.tail=TRUE)-pnorm(5,mean=6.5,sd=1,lower.tail=TRUE)
          ################################
          pnorm(1.75,mean=0,sd=1,lower.tail=TRUE)- pnorm(0.23,mean=0,sd=1,lower.tail=TRUE)
          ################################
          qnorm(0.05,mean=25,sd=3.1,lower.tail=TRUE)
          qnorm(0.95,mean=25,sd=3.1,lower.tail=TRUE)
```

0.774537544799685
0.368986727994177
19.9009537564504
30.0990462435496

```
In [736]: ################################
          n = 100
          p = .20
          pnorm(18.5,mean=n*p,sd=sqrt(n*p*(1-p)),lower.tail=TRUE)
          ################################
          n = 100
          p = .20
          pnorm(20.5,mean=n*p,sd=sqrt(n*p*(1-p)),lower.tail=TRUE)
```

0.353830233327276
0.549738224830113

```
In [737]: ################################
          n = 100
          p = .20
          pnorm(17.5,mean=n*p,sd=sqrt(n*p*(1-p)),lower.tail=FALSE)
```

0.734014470951299

```
In [738]: ################################
          n = 100
          p = .20
          pnorm(20.5,mean=n*p,sd=sqrt(n*p*(1-p)),lower.tail=TRUE)-
            pnorm(19.5,mean=n*p,sd=sqrt(n*p*(1-p)),lower.tail=TRUE)
```

0.0994764496602258

```
In [739]: ################################
          n = 100
          p = .60
          pnorm(69.5,mean=n*p,sd=sqrt(n*p*(1-p)),lower.tail=TRUE)
```

0.973760250220377

```
In [740]: ################################
          n = 100
          p = .50
          pnorm(54.5,mean=n*p,sd=sqrt(n*p*(1-p)),lower.tail=FALSE)
```

0.18406012534676

In [741]:
```
#################################
n = 1000
p = .01
pnorm(4.5,mean=n*p,sd=sqrt(n*p*(1-p)),lower.tail=FALSE)
```

0.959769263059912

In [742]:
```
#################################
n = 50
p = 0.30
pnorm(5.5,mean=n*p,sd=sqrt(n*p*(1-p)),lower.tail=TRUE)-pnorm(4.5,mean=n*p,sd=sqrt(n*p
```

0.00108834300126286

In [743]:
```
#################################
x <- c(84.98,87.72,86.82,87.53,88.63,88.51,88.3,86.64,86.69,86.77,87.38,86.61,89.31,
mx = mean(x)
msum = sum((x-mean(x))^2)
pop_std = sqrt(msum/length(x))
pop_std ^2
```

2.13864474999999

In [744]:
```
#################################
x<-c(2,8,13,25,32,40,42,43,45,57,63)
mx = mean(x)
mstd = sd(x)
cv = mstd / mx * 100
cv
```

58.6855034283337

In [745]:
```
#################################
x <- c(8, 19, 25, 31, 33, 47, 512, 803, 20000)
mx = mean(x)
medx = median(x)
mstd = sd(x)
skewness = (3 * (mx - medx)) / mstd
skewness
```

1.06794669775228

In [746]:
```
#################################
x = 28.2
mean = 30
stdev = 2
zscore = (x - mean) / stdev
zscore
```

-0.9

```
In [747]: ################################
          print("Statistics")
          print("----------")
          x = 66
          mean = 79
          stdev = 4.5
          zscore = (x - mean) / stdev
          zscore
          print("Calculus")
          print("--------")
          x = 81
          mean = 69
          stdev = 3.7
          zscore = (x - mean) / stdev
          zscore
```

```
[1] "Statistics"
[1] "----------"
```

-2.88888888888889

```
[1] "Calculus"
[1] "--------"
```

3.24324324324324

```
In [748]: ################################
          print("Geography")
          print("----------")
          x = 56
          mean = 80
          stdev = 20
          zscore = (x - mean) / stdev
          zscore
          print("Mathematics")
          print("-----------")
          x = 285
          mean = 300
          stdev = 10
          zscore = (x - mean) / stdev
          zscore
```

```
[1] "Geography"
[1] "----------"
```

-1.2

```
[1] "Mathematics"
[1] "-----------"
```

-1.5

In [749]:
```
#################################
x <- c(3, 12, 17, 23, 27, 31, 45, 72, 81, 113, 152, 171, 189)
quantile(x,0.25)
quantile(x,0.50)
quantile(x,0.75)
```

25\%: 23
50\%: 45
75\%: 113

In [750]:
```
#################################
x <- c(68,73,66,76,86,74,61,89,65,90,69,92,76,62,81,63,68,81,70,73,60,87,75,64,82)
quantile(x,0.25)
```

25\%: 66

In [751]:
```
#################################
x <- c(1, 25, 33, 41, 42, 45, 51, 67, 88, 91, 105, 231, 405)
q1 = quantile(x,0.25)
q3 = quantile(x,0.75)
iqr = q3 - q1
iqr
```

75\%: 50

In [752]:
```
#################################
x <- c(0.05, 0.00, -0.03, -0.01, 0.18, 0.00, 0.02, 0.29, 0.00, -0.07, 0.10, 0.07, 0.0
q1 = quantile(x,0.25)
q3 = quantile(x,0.75)
iqr = q3 - q1
lf = q1 - 1.5 * iqr
uf = q3 + 1.5 * iqr
lf
uf
#################################
q1 = quantile(x,0.25)
q3 = quantile(x,0.75)
iqr = q3 - q1
lf = q1 - 1.5 * iqr
uf = q3 + 1.5 * iqr
lf
uf
```

25\%: -0.105
75\%: 0.175
25\%: -0.105
75\%: 0.175

```
In [753]: #################################
          one <- c(1,1,1,1)
          xval <- c(1,2,3,4)
          yval <- c(-8,-1,5,12)
          X <- matrix(c(one,xval),nrow=4,ncol=2)
          Y <- matrix(c(yval),nrow=4,ncol=1)
          solve(t(X) %*% X) %*% t(X) %*% Y
```

-14.5
6.6

```
In [754]: #################################
          one <- c(1,1,1,1)
          x1val <- c(1,2,3,4)
          x2val <- c(5,7,11,21)
          yval <- c(12,17,21,30)
          X <- matrix(c(one,x1val,x2val),nrow=4,ncol=3)
          Y <- matrix(c(yval),nrow=4,ncol=1)
          solve(t(X) %*% X) %*% t(X) %*% Y
```

6.595238
2.952381
0.547619

```
In [755]: #################################
          one <- c(1,1,1,1,1,1,1)
          xval <- c(-3,-2,-1,0,1,2,3)
          yval <- c(-5,-1,0,2,-3,-8,-7)
          xsquared = xval^2
          X <- matrix(c(one,xval,xsquared),nrow=7,ncol=3)
          Y <- matrix(c(yval),nrow=7,ncol=1)
          solve(t(X) %*% X) %*% t(X) %*% Y
```

-0.3333333
-0.8214286
-0.7023810

```
In [756]: #################################
          # "right tail"
          n1 = 61
          s1 = 34.4
          n2 = 31
          s2 = 27.6
          df1 = n1 - 1
          df2 = n2 - 1
```

```
ts = s1^2 / s2^2
# 'right tail'
pf(ts,df1,df2,lower.tail=FALSE)
```

0.0947487120743712

```
In [757]: ################################
          n1 = 31
          s1 = 5.46
          n2 = 25
          s2 = 5.4
          df1 = n1 - 1
          df2 = n2 - 1
          ts = s1^2 / s2^2
          # 'two tails'
          2*(pf(abs(ts),df1,df2,lower.tail=FALSE))
```

0.966428568658038

```
In [758]: ################################
          n1 = 16
          s1 = 20.4
          n2 = 13
          s2 = 21.9
          df1 = n1 - 1
          df2 = n2 - 1
          ts = s1^2 / s2^2
          # 'left tail'
          pf(ts,df1,df2)
```

0.391521222988294

```
In [759]: ################################
          n1 = 13
          s1 = 0.99
          n2 = 16
          s2 = 1.17
          df1 = n1 - 1
          df2 = n2 - 1
          ts = s1^2 / s2^2
          # 'left tail'
          pf(ts,df1,df2)
```

0.283219484329873

```
In [760]: ################################
          # "right tail"
          n1 = 21
          s1 = sqrt(1107.2)
```

```
n2 = 18
s2 = sqrt(737.28)
df1 = n1 - 1
df2 = n2 - 1
ts = s1^2 / s2^2
# 'right tail'
pf(ts,df1,df2,lower.tail=FALSE)
```

0.200544817052809

```
In [761]: ################################
          # "right tail"
          n1 = 100
          x1 = 38
          n2 = 140
          x2 = 50
          phat1 = x1/n1
          phat2 = x2/n2
          phat = (x1 + x2) / (n1 + n2)
          z = (phat1 - phat2) / (sqrt(phat*(1-phat)) * sqrt(1/n1 + 1/n2))
          pnorm(z,lower.tail=FALSE)
```

0.358576358733527

```
In [762]: ################################
          # "two tails"
          n1 = 1000
          x1 = 250
          n2 = 1200
          x2 = 195
          phat1 = x1/n1
          phat2 = x2/n2
          phat = (x1 + x2) / (n1 + n2)
          z = (phat1 - phat2) / (sqrt(phat*(1-phat)) * sqrt(1/n1 + 1/n2))
          2 * (pnorm(abs(z),lower.tail=FALSE))
```

3.63105103002167e-07

```
In [763]: ################################
          n1 = 200000
          x1 = 33
          n2 = 200000
          x2 = 115
          phat1 = x1/n1
          phat2 = x2/n2
          phat = (x1 + x2) / (n1 + n2)
          z = (phat1 - phat2) / (sqrt(phat*(1-phat)) * sqrt(1/n1 + 1/n2))
          pnorm(z)
```

7.83228070692809e-12

In [764]:
```
################################
n1 = 11000
x1 = 104
n2 = 11000
x2 = 189
phat1 = x1/n1
phat2 = x2/n2
phat = (x1 + x2) / (n1 + n2)
z = (phat1 - phat2) / (sqrt(phat*(1-phat)) * sqrt(1/n1 + 1/n2))
pnorm(z)
```

2.87911358804214e-07

In [765]:
```
################################
# "two tails"
day <- c(22,24,24,23,19,19,23,22,18,21,21,18,18,25,29,24,23,22,22,21,20,20,20,27,17,
eve <- c(18,23,25,23,21,21,23,24,27,31,24,20,20,23,19,25,24,27,23,20,20,21,25,24,23,
n1 = length(day)
xbar1 = mean(day)
s1 = sd(day)
n2 = length(eve)
xbar2 = mean(eve)
s2 = sd(eve)
ts = ((xbar1-xbar2)-(0)) / sqrt(s1^2/n1 + s2^2/n2)
ts
```

-1.6797979972233

In [766]:
```
################################
# "left tail"
n1 = 15
xbar1 = 5.3
s1 = 1.1
n2 = 16
xbar2 = 5.6
s2 = 1.0
ts = ((xbar1-xbar2)-(0)) / sqrt(s1^2/n1 + s2^2/n2)
pt(ts,df=n-1)
```

0.215838863448689

In [767]:
```
################################
# "right tail"
n1 = 18
xbar1 = 530
s1 = 40
n2 = 13
```

```
xbar2 = 515
s2 = 25
ts = ((xbar1-xbar2)-(0)) / sqrt(s1^2/n1 + s2^2/n2)
pt(ts,df=n-1,lower.tail=FALSE)
```

0.102990469307774

```
In [768]: #################################
          # "left tail"
          n = 28
          s = sqrt(31.5)
          sigmaknot = sqrt(50.4)
          ts = (n - 1) * s^2 / sigmaknot^2
          pchisq(ts,df=n-1)
```

0.0658397354427676

```
In [769]: #################################
          # "right tail"
          n = 101
          s = 1200
          sigmaknot = sqrt(1000000)
          ts = (n - 1) * s^2 / sigmaknot^2
          pchisq(ts,df=n-1,lower.tail=FALSE)
```

0.00262925091745129

```
In [770]: #################################
          # "two tail"
          x <- c(70,48,41,68,69,55,70,57,60,83,32,60,72,58)
          n = length(x)
          s = sd(x)
          sigmaknot = 15
          ts = (n - 1) * s^2 / sigmaknot^2
          2 * (pchisq(abs(ts),df=n-1))
```

0.681331505888145

```
In [771]: #################################
          # "left tail"
          x <- c(70,48,41,68,69,55,70,57,60,83,32,60,72,58)
          n = length(x)
          xbar = mean(x)
          s = sd(x)
          muknot = 60
          t = (xbar - muknot) / (s / sqrt(n))
          pt(t,df=n-1)
```

0.523351010099266

In [772]:
```
#################################
# "right tail"
n = 20
muknot = 3.5
xbar = 3.7
s = 0.8
t = (xbar - muknot) / (s / sqrt(n))
pt(t,df=n-1,lower.tail=FALSE)
```

0.13874506978788

In [773]:
```
#################################
# "two tails"
n = 25
xbar = 1380
sigma = 80
muknot = 1400
z = (xbar - muknot) / (sigma / sqrt(n))
2 * (pnorm(abs(z),lower.tail=FALSE))
```

0.21129954733371

In [774]:
```
#################################
p <- c(0.25,0.05,0.35,0.35)
n = 600
expected = n * p
expected
```

1. 150 2. 30 3. 210 4. 210

In [775]:
```
#################################
observed <- c(65,69,80,86)
prob <- c(0.20,0.20,0.30,0.30)
chisq.test(observed,p=prob)
```

```
Chi-squared test for given probabilities

data:  observed
X-squared = 3.0556, df = 3, p-value = 0.3831
```

In [776]:
```
#################################
observed <- c(66,39,25,30)
prob <- c(0.18,0.39,0.31,0.12)
chisq.test(observed,p=prob)
```

```
Chi-squared test for given probabilities

data:  observed
X-squared = 75.101, df = 3, p-value = 3.447e-16
```

```
In [777]: ################################
          alpha = 3
          beta = 2
          gamma = factorial(alpha - 1)
          a = 0
          b = 4
          f = function(x){(x^(alpha-1)*exp(-x / beta)) / (beta ^ alpha * gamma)}
          integrate(f,a,b)
```

```
0.3233236 with absolute error < 3.6e-15
```

```
In [778]: ################################
          alpha = 10
          beta = 5
          gamma = factorial(alpha - 1)
          a = 0
          b = 10
          f = function(x){(x^(alpha-1)*exp(-x / beta)) / (beta ^ alpha * gamma)}
          integrate(f,a,b)
```

```
4.649808e-05 with absolute error < 5.2e-19
```

```
In [779]: ################################
          alpha = 5
          beta = 3
          gamma = factorial(alpha - 1)
          a = 0
          b = Inf
          f = function(x){((x^(alpha-1)*exp(-x / beta)) / (beta ^ alpha * gamma))*(50*x+3*x^2)
          integrate(f,a,b)
```

```
1560 with absolute error < 6.8e-05
```

```
In [780]: ################################
          var1 = 40
          n1 = 11
          var2 = 35
          n2 = 6
```

```
clevel = .95
atl = (1 - clevel) / 2
FL = qf(atl,n1-1,n2-1)
atl = clevel + (1 - clevel) / 2
FR = qf(atl,n1-1,n2-1)
lb = (var1 / var2) * (1 / FR)
ub = (var1 / var2) * (1 / FL)
lb
ub
```

0.172659086891408
4.84124076364415

```
In [781]: ################################
          x <- c(2.0,3.2,1.8,2.9,0.9,4.0,3.3,2.9,3.6,0.8)
          n = length(x)
          s = sd(x)
          clevel = .90
          atl = (1 - clevel) / 2
          XL = qchisq(atl,df=n-1)
          atl = clevel + (1 - clevel) / 2
          XR = qchisq(atl,df=n-1)
          lb = sqrt( (n-1) * s^2 / XR)
          ub = sqrt( (n-1) * s^2 / XL)
          lb
          ub
```

0.809396273930786
1.8257657861127

```
In [782]: ################################
          n = 15
          x = 200
          n = 440
          clevel = .95
          atl = clevel + (1 - clevel) / 2
          z = qnorm(atl)
          phat = x / n
          lb = phat - z * sqrt(phat * (1-phat) / n)
          ub = phat + z * sqrt(phat * (1-phat) / n)
          lb
          ub
```

0.408020099610956
0.501070809479953

```
In [783]: ################################
          n = 16
          xbar = 645
```

```
sigma = 31
clevel = .95
atl = clevel + (1 - clevel) / 2
z = qnorm(atl)
lb = xbar - z * sigma / sqrt(n)
ub = xbar + z * sigma / sqrt(n)
lb
ub
```

629.810279119815
660.189720880185

```
In [784]: ################################
          x1 = 72
          n1 = 240
          x2 = 82
          n2 = 200
          clevel = .95
          atl = clevel + (1 - clevel) / 2
          z = qnorm(atl)
          phat1 = x1 / n1
          phat2 = x2 / n2
          lb = (phat1 - phat2) - z * sqrt(phat1 * (1 - phat1) / n1 + phat2 * (1 - phat2) / n2)
          ub = (phat1 - phat2) + z * sqrt(phat1 * (1 - phat1) / n1 + phat2 * (1 - phat2) / n2)
          lb
          ub
```

-0.199484752398031
-0.0205152476019691

```
In [785]: ################################
          pbinom(15,size=30,prob=.35)-pbinom(11-1,size=30,prob=.35)
```

0.462158084407176

```
In [786]: ################################
          1-pbinom(12-1,size=30,prob=.35)
          ################################
          dbinom(4, size=20, prob=0.15)
```

0.345175880532805
0.182121672111951