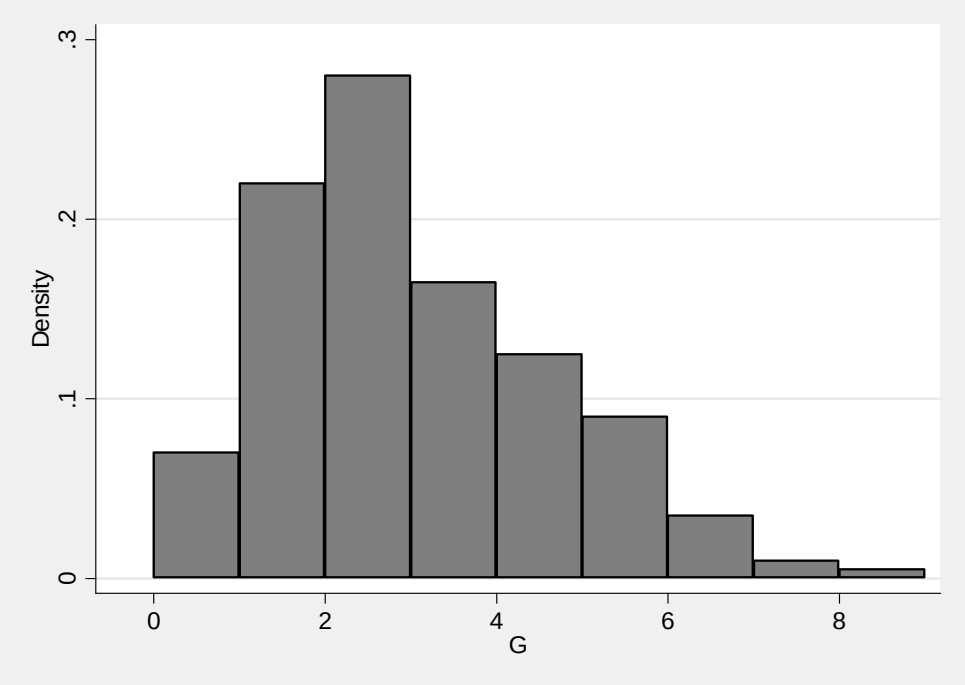
Statistics 104 – Autumn 2004

Practice Midterm Examination 1

1. (10 points) Indicate which of the following statements are true and briefly, for each of the others, show why they are false. You may simply correct the given statement as a way of showing why.

   a) (2 points) If you recode a set of observations on the variable X by $Z = 2 - 3X$, then the mean of Z will be $\overline{Z} = 2 - 3\overline{X}$ and the standard deviation will be $s_Z = 2 - 3s_X$.

   b) (2 points) In the following histogram, the median is approximately equal to the mean.



   c) (2 points) For a data set which is approximately normally distributed, we would expect to find about 3 out of 1000 observations more than two standard deviations from the mean.

   d) (2 points) A correlation of zero between two variables implies that there is no relationship between them.

   e) (2 points) A correlation of –1 means the points falls on a straight line and one variable can perfectly predict the other.

2. (12 points) The data below are annual average CO_2 readings from the Mauna Loa Observatory in Hawaii over the years 1980 – 1988.

Year	CO_2
1980	338.4
1981	339.5
1982	340.8
1983	342.8
1984	344.3
1985	345.7
1986	346.9
1987	348.6
1988	351.2

A linear regression model was fit to the data with the output below.

```
regress CO2 Year

      Source |       SS       df       MS              Number of obs =       9
-------------+------------------------------           F(  1,     7) =  907.55
       Model |    146.0164     1    146.0164           Prob > F      =  0.0000
    Residual |  1.12623777     7  .160891109           R-squared     =  0.9923
-------------+------------------------------           Adj R-squared =  0.9913
       Total |  147.142638     8  18.3928297           Root MSE      =  .40111

------------------------------------------------------------------------------
         CO2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        Year |   1.560002   .0517834    30.13   0.000     1.437554     1.68245
       _cons |    -2750.8   102.7383   -26.77   0.000    -2993.737   -2507.862
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a) (3 points) Use the regression equation to predict the average CO_2 for 1980.

b) (3 points) What is the residual for 1980?

c) (2 points) What is the numerical value of the correlation coefficient *r*? Please give your answer rounded to three decimal places, i.e. 0.755 or –0.623.

d) (4 points) Suppose you were asked to predict CO_2 for the year 2025 based on the above regression output. Is this likely to be a good prediction? Why or why not?

3. (13 points) The data in the table and the output below are taken from a study entitled, "Smoking During Pregnancy and Lactation and Its Effects on Breast Milk Volume" (*American Journal of Clinical Nutrition*, 1991, 1011-1016). The data give milk volume, expressed in grams per day (g/day). The purpose of the study was to determine whether the amount of breast milk that a mother can produce is affected by smoking cigarettes.

Smokers	621	793	593	545	753	655	895	767	714	598	693
Nonsmokers	947	945	1086	1202	973	981	930	745	903	899	961

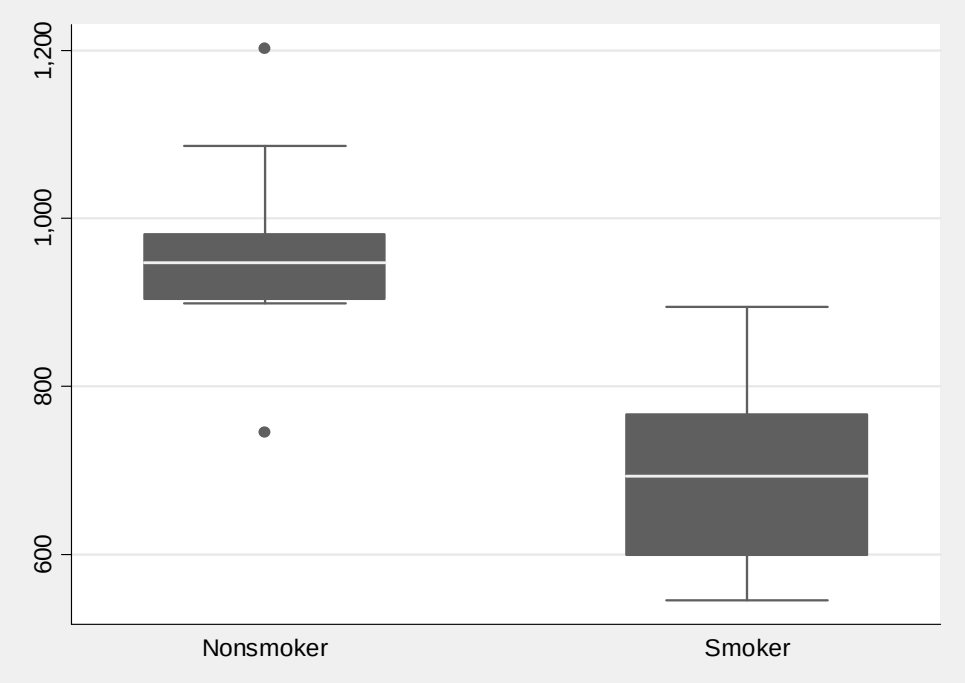
```
Variable      N   Mean    Median  StDev    Min      Max       Q1       Q3
Smokers      11  693.4     693.0  103.9  545.0    895.0    598.0    767.0
Nonsmokers   11  961.1     XXXXX  113.8  745.0   1202.0    903.0    981.0
```

a) (3 points) Give the median and interquartile range for the **Non-smoking** mothers.

b) (4 points) Assuming that the data for smokers follows a normal distribution with mean μ = 700 and standard deviation σ = 100, how much milk was supplied by the mothers with the top 20% in volume.

c) (3 points) Suppose that the observation in the smoking group of 545 g/day (the smallest observed) was recorded incorrectly as 45 g/day. How would this error effect the summary statistics? (You do not need to do any calculations, just describe generally what will change and how.)

d) (3 points) Describe in two or three sentences the conclusions that he investigators might draw from this study. Below is a side by side box plot of the data.



4. (15 points) In an experiment on the behaviour of young children, each child is placed in an area with four toys. The response of interest is the number of toys that the child plays with. Past experiments with many children have shown that the probability distribution of the number X of toys played with is as follows:

X	0	1	2	3	4
$P[X = x] = p_x$	0.05	0.15	???	0.30	0.10

a) (2 points) What is the probability that a child plays with exactly 2 toys?

b) (2 points)What is the probability that a child plays with less than 2 toys?

c) (3 points) What is the probability that a child plays with no toys, given that you are told that the child played with less than 2 toys?

d) (3 points) Assuming children are independent, what is the probability that 2 children both play with 3 toys?

e) (5 points) Find the mean μX.