Psychology 315, Winter 2021, Exam 2 (v2 key)

Name ______________________________ ID ____________________

Section [AA] (Natalie), [AB] (Natalie), [AC] (Ryan), [AD] (Ryan), [AE] (Kelly), [AE] (Kelly)

The following problems are worth a total of 100 points. The exam is open book and open note, but not open Google. To look up probabilities, you can also either use the pdf of the statistics table:

`http://courses.washington.edu/psy315/pdf/StatsTables.pdf`

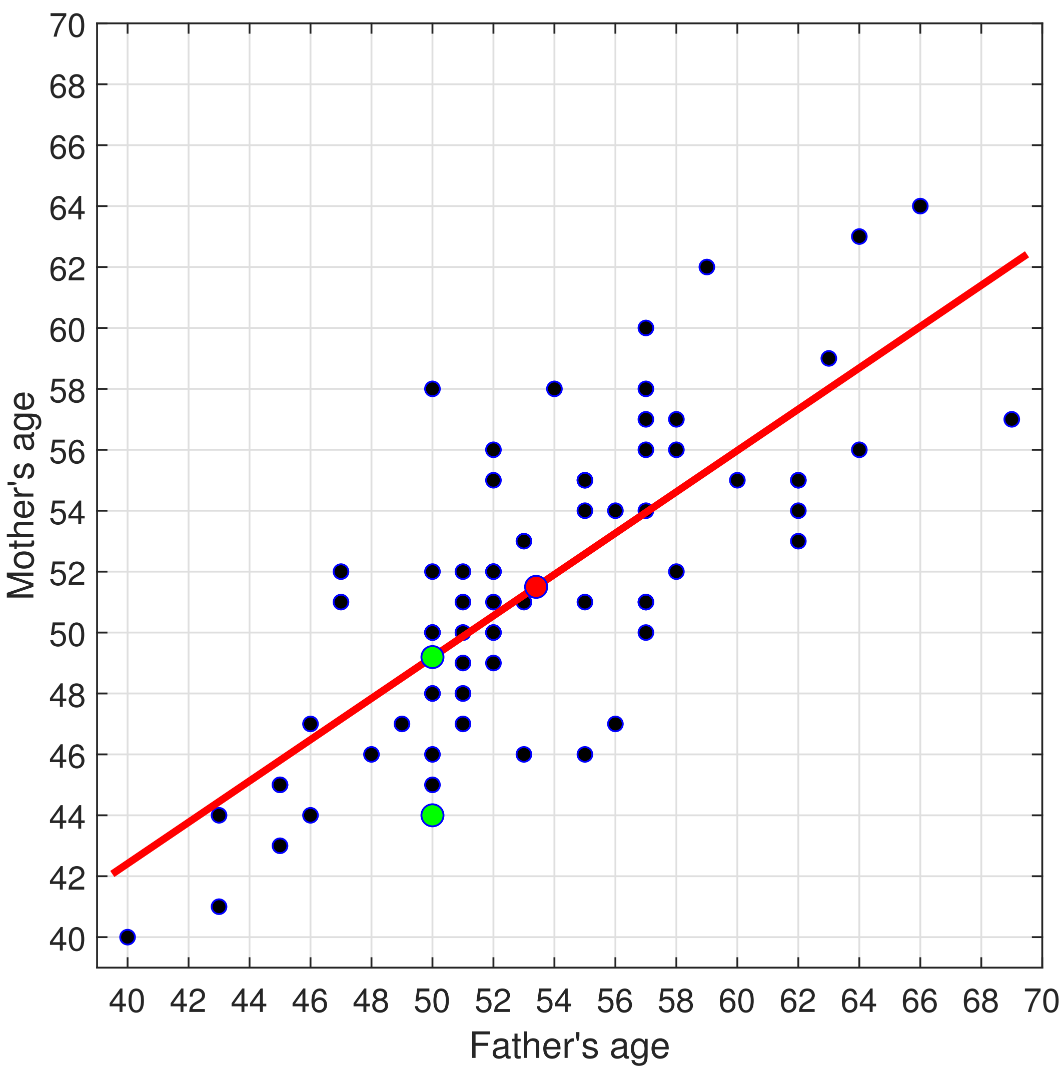
or the Excel file:

`http://courses.washington.edu/psy315/excel_files/StatTables.xlsx`

For answers that require calculations, please show your work. You may use R, but be sure to show your work for partial credit. Give all answers **rounded to 4 decimal places**.

Problem 1 (54 pts) From our survey, the distribution of your Father's ages has a mean of 53.4 and a standard deviation of 5.7, and that the distribution of your Mother's ages has a mean of 51.5 and a standard deviation of 5.02. The ages of your mothers and fathers are strongly correlated with a value of r = 0.77.

Here's a scatterplot of the data:



a) (10 pts) Calculate the slope of the regression line that predicts your Mother's age from your Father's age.

slope = m = r$\frac{sy}{sx}$ $= 0.77\frac{5.02}{5.7} = 0.6781$

b) (10 pts) Calculate the equation of the regression line that predicts your Mother's age from your Father's age. Write the answer in slope-intercept form.

$y' = m(x - \bar{x}) + \bar{y} = 0.6781(x - 53.4) + 51.5 =$ 0.6781x + 51.5 - 36.2105

or $y' = 0.6781x + 15.2895$

c) (5 pts) Draw the regression line on the scatterplot on the first page.

d) (5 pts) What is the standard error of the estimate (syx)?

$syx = sy\sqrt{1 - r^2} = 5.02\sqrt{1 - (0.77)^2} = 3.203$

e) (5 pts) What is the proportion of the variance in the Mother's age that can be explained by the Father's age?

This is the coeficient of determination: $r^2 = (0.77)^2 = 0.5929$

f) (5 pts) Suppose a new student enters the class, and her father is 50 years old. Based on the regression line, what is the predicted age of this student's mother?

for x = 50, y' = (0.6781)(50) - 15.2895 = 49.1945

g) (2 pts) Plot this student's father's age and the predicted mother's age as a point on the regression line on the first page.

h) (2 pts) Suppose that this student, whose father is 50 years old, has a mother is actually 44 years old. Plot this as a point on the scatterplot on the first page.

j) (10 pts) Assuming homoscedasticity, use the regression line and the standard error of the estimate to determine the probability that a student with father that is 50 years old will have a mother that is 44 years old or younger.

For a father that is 50 years old, the distribution of mother's ages
will be normally distributed with a mean of 49.1945 and a standard deviation of $S_{yx} = 3.203$.

$z = \frac{y-y'}{syx} = \frac{44-49.1945}{3.203} = -1.62$

$Pr(y < 44) = Pr(z < -1.62) = Pr(z > 1.62) = 0.0526$

Problem 2a (10 pts) Suppose the probability that the proportion of left handed people in the population is 0.1. What is the probability a random sample of 8 people will have 2 or more left handers?

This is a binomial problem with P = 0.1, n = 8, and $k \geq 2$
Using Table B:

Pr(k=2) = 0.1488
Pr(k=3) = 0.0331
Pr(k=4) = 0.0046
Pr(k=5) = 0.0004
Pr(k=6) = 0.0000
Pr(k=7) = 0.0000
Pr(k=8) = 0.0000

0.1488 + 0.0331 + 0.0046 + 0.0004 + 0 + 0 + 0 = 0.1869

The probability of drawing 2 or more left handers is 0.1869

Problem 2b (10 pts) Again, assuming that the proportion of left-handers in the population is 0.1. Use the normal approximation to the binomial to estimate the probability that a sample of 64 people will have 9 or more left handers.

Since $n > 20$, we will use the normal approximation to the binomial.

The number of left handers will be distributed approximately normally with

mean: $\mu = (64)(0.1) = 6.4$
and standard deviation: $\sigma = \sqrt{(64)(0.1)(1-0.1)} = 2.4$

Since we want $\Pr(k \geq 9)$, our z-score will be

z = $\frac{8.5-\mu}{\sigma} = \frac{8.5-6.4}{2.4} = 0.87$

From the z-table: $\Pr(z > 0.87) = 0.1922$

Problem 3 (6 pts) Choose the best answer for each of the following multiple choice questions.

a) (2 pts) Suppose heights of sisters are correlated with r=0.35. If you pick out a sister because she is taller than the average of the population then the other sister will be, on average,

A) taller than the average of the population
B) as tall as the first sister
C) less tall than the first sister
D) taller than the first sister
E) less tall than the average of the population
F) A and C

b) (2 pts) When is the standard error of the estimate equal to the standard deviation of y?

A) When the correlation is zero.
B) When the coeficient of non-determiniation is one.
C) D and E
D) When the correlation is 1 or -1.
E) When the coeficient of non-determination is zero.
F) A and B

c) (2 pts) If you increase your sample size from 9 to 81, the standard error of the mean is

A) multiplied by 3
B) multiplied by 9
C) divided by 3
D) divided by 9

Problem 4 (20 pts) Suppose that you know that the age of the population of UW psychology students is normally distributed with a mean of 22.3 and a standard deviation of 2.95 years. Consider the mean age from a sample of 100 students.

a) (10 pts) What is the mean and standard deviation of the population that this mean is drawn from?

According to the Central Limit Theorem, the sampling distribution of the mean of 100 ages will be normal with a mean of:

$\mu_{\bar{x}} = 22.3$ years

and a standard deviation of $\sigma_{\bar{x}} = \frac{\sigma_x}{\sqrt{n}} = \frac{2.95}{\sqrt{100}} = 0.295$ years.

b) (10 pts) What is the probability that a **mean** drawn from a sample of 100 students will exceed 22.45 years?

The z-score for a mean of $x = 22.45$ years is $\frac{x-\mu_{\bar{x}}}{\sigma_{\bar{x}}} = \frac{22.45-22.3}{0.295} = 0.5085$

From the z-table, $Pr(z > 0.51) = 0.305$