Final Report

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15/03/2020

Contents

Adult Income

Introduction

The Dataset

Who: The data set was extracted by Barry Becker from the 1994 Census database and is donated by Silicon Graphics
What: This is a multivariate dataset with categorical and integer variables. It contains the predicted income of individuals from the census with attributes including age, marital status, work class, education, sex, and race.
When: The data is from a 1994 census.
Why: The data set is found in the University of California Irvine Machine Learning Repository, and was used for ML prediction of whether a person makes over or under 50K a year based on their attributes.
How: The census data was collected by survey.

The Variables

Variable	Type	Description
age	int	Age of individual
workclass	chr	e.g. private, self-emplowed, federal government, never worked, etc.
fnlwgt	int	Final weights: weighted sums of the socio-economic characteristics of the individual. People with similar demographics have similar weights.
education	chr	Highest education recieved
educationnum	factor	Numerical code for highest education recieved
marital_status	int	e.g. married, never married, divorced, etc.
occupation	chr	Occupation of individual
relationship	chr	Relation of individual in family. e.g. wife, child, husband, unmarried
race	chr	Asian-Pacific Islander, Native American, White, Black, other
sex	chr	Male or Female
capital_gain	int	Profit from capital assets such as investments, real estate, etc.
capital_loss	int	Loss from capital assets
hours_per_week		The number of hours that the individual works per week
country	chr	Country of origin
income	chr	Whether individual is predicted to make over or under 50K

The single group used in the following analysis includes divorced, widowed, and never married individuals while the married group includes individials currently married (whether separated, together, or etc.)

The Research Question and Method

Are the number of hours someone works per week correlated with their age, relationship, education level, race or sex?

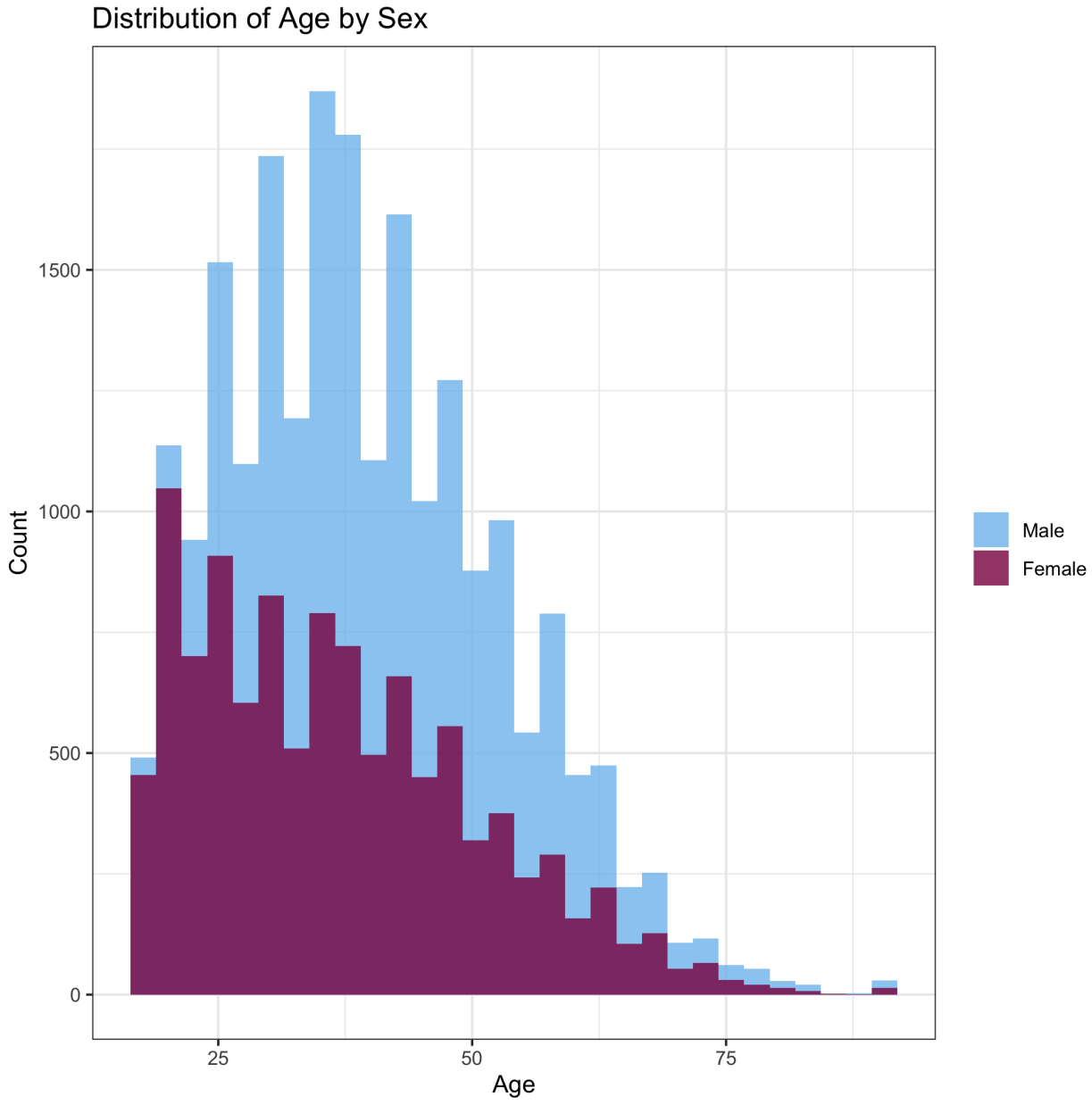
Plots showing the relationship between hours worked and each variable separately. For example, we will use the linear regression model to explore how hours at work is related to variables such as age, relationship, education level, and sex.

Exploratory Data Analysis

In this section, we will get to know our dataset better by exploring the relationship between certain factors.

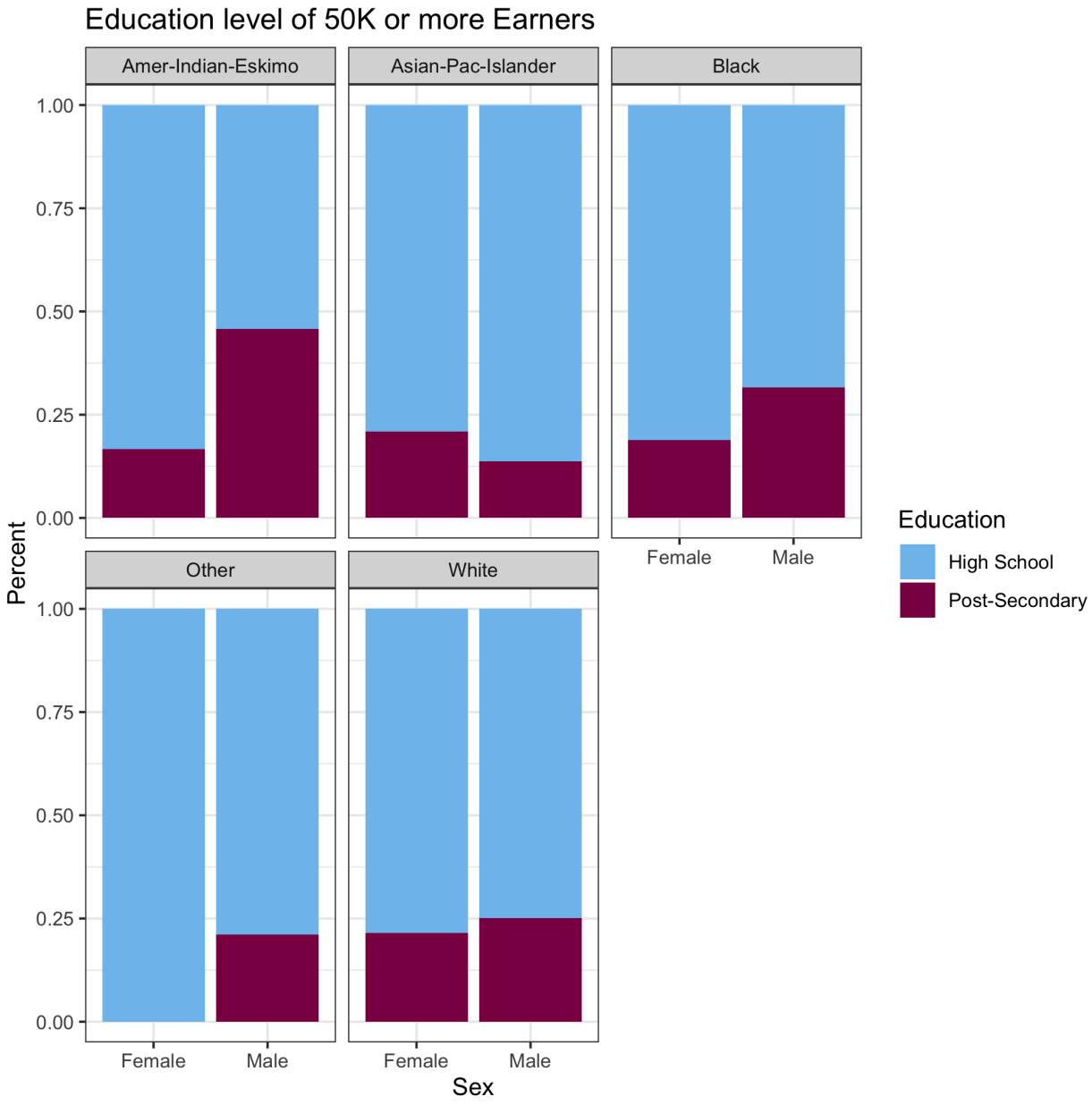
Age and Sex

The plot below shows that there are more male employees than female employees and that the majority of working males are older than working females since the male (blue curve) have a peak shifted to the right with respect to female (red peak).



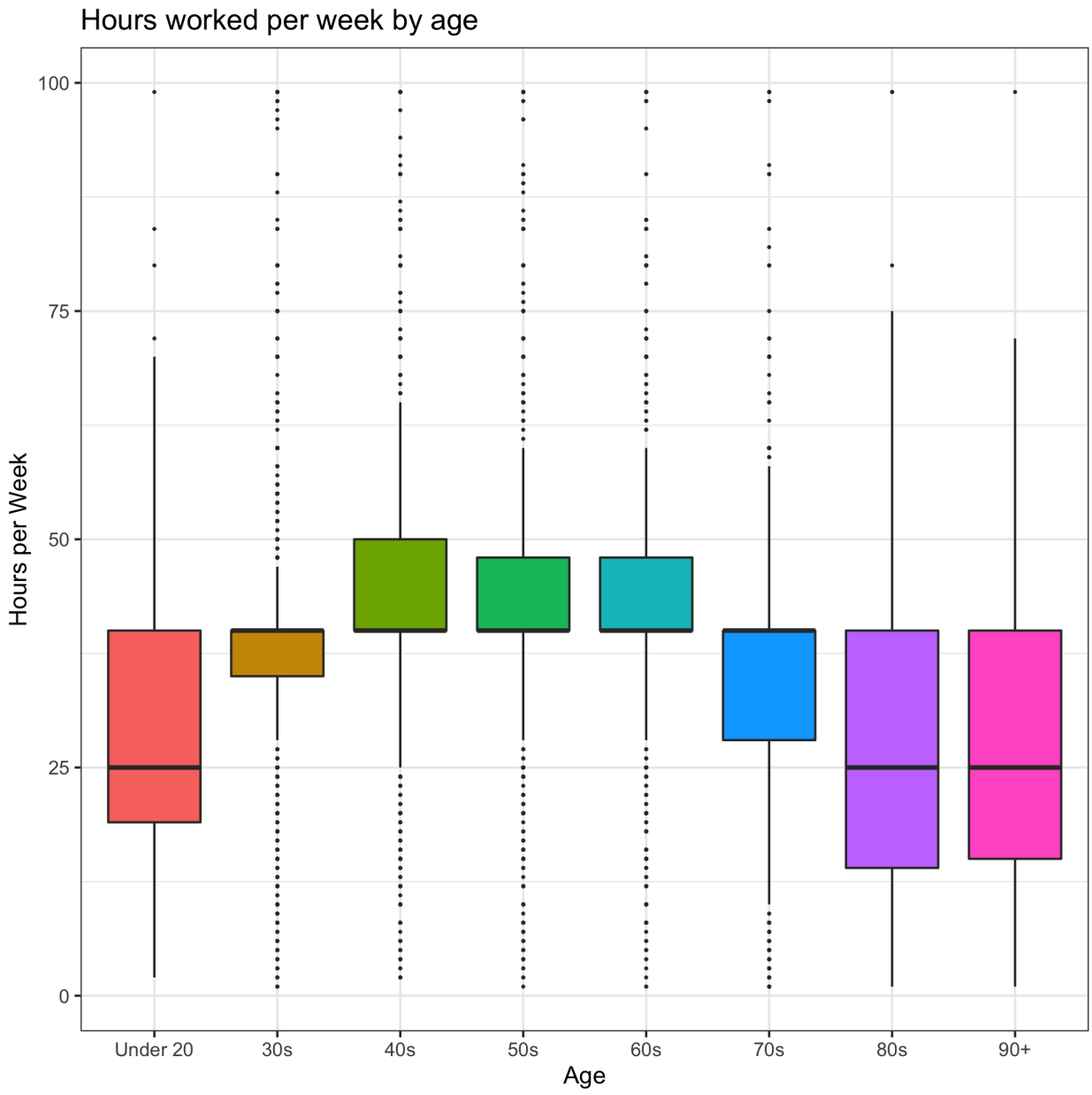
Educational Level and Income

We observe from the following graphs that a majority of individuals earning greater than $50,000 a year only accomplished high school irrespective of sex or ethnical background.



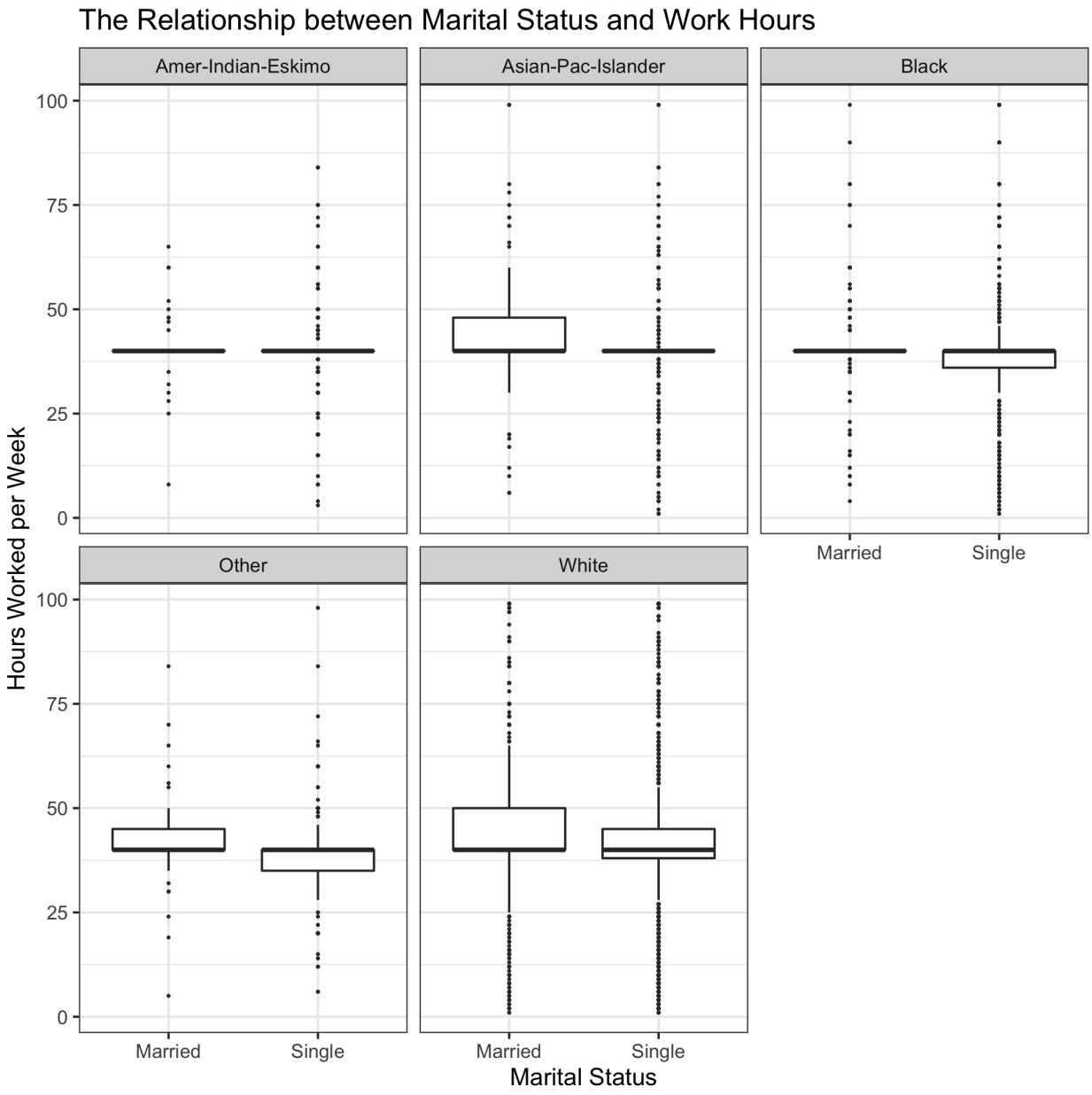
Number of Work Hours and Age

We can deduce from the graph below that individuals work the most hours between their 40's and 60's (probably full time at 40 hours or more a week) and that employees under 20 and over 80 years of age work the same number of hours (probably part time at 25 hours)



Marital Status and Number of Hours Worked

The plot below shows that the working hours between married individuals and single employees are similar.



Linear Regression

We have performed linear regression of hours per week vs. each variable separately, as well as linear regression using all these variables together.

This was done using the lm function of the purrr package. For example: lm(hours_per_week~education,data)

For categorical variables sex, education and relationship, the intercept is the defaul reference group, where the "estimate" is the mean of that group, and the "estimates" of all other variables are the differences in means between that group and the reference. The statistic is the t-statistic comparing these means, with a given p-value reporting the significance of this difference.

Hypothesis and Results

Hours vs. Relationship

Hypotheses: Husbands work more than wives since wives are the primary care takers of the household. Unmarried and individuals not in a family work more than husbands or wives since they have more flexible schedules and more time.

Results:

term	estimate	std.error	statistic	p.value
(Intercept)	32.8759172	0.7907375	41.5762726	0.0000000
sexMale	5.6914173	0.1409826	40.3696318	0.0000000
education11th	-2.7257409	0.5182506	-5.2595035	0.0000001
education12th	-1.0448088	0.6870782	-1.5206548	0.1283562
education1st-4th	0.7558463	0.9908270	0.7628439	0.4455620
education5th-6th	1.3619671	0.7546659	1.8047286	0.0711264
education7th-8th	1.6580749	0.6068782	2.7321377	0.0062959
education9th	0.7338944	0.6487072	1.1313184	0.2579294
educationAssoc-acdm	3.8926669	0.5293446	7.3537487	0.0000000
educationAssoc-voc	4.7743509	0.5004699	9.5397370	0.0000000
educationBachelors	5.4530816	0.4195405	12.9977493	0.0000000
educationDoctorate	9.0819689	0.7002813	12.9690303	0.0000000
educationHS-grad	3.5205013	0.4033969	8.7271411	0.0000000
educationMasters	6.6058589	0.4816350	13.7154871	0.0000000
educationPreschool	-0.4435165	1.6982491	-0.2611610	0.7939700
educationProf-school	9.3256894	0.6276622	14.8578147	0.0000000
educationSome-college	2.2215778	0.4107771	5.4082322	0.0000001
age	0.0213773	0.0049447	4.3232474	0.0000154
raceAsian-Pac-Islander	-1.5191519	0.7649342	-1.9859904	0.0470428
raceBlack	-1.0175832	0.7022498	-1.4490330	0.1473380
raceOther	-0.2743632	0.9823649	-0.2792885	0.7800252
raceWhite	-0.4243259	0.6736736	-0.6298686	0.5287850

In this case, we are comparing the mean hours worked per week of husbands (intercept) to each other relationship category. It appears that husbands work more than any other age group, (as seen by the negative estimates), with significant p-values in each case.

```
tidy(test_relationship)$p.value
```

```
## [1] NA  0
```

Comparing the full model to the model with no relationship info, we can see that relationship does have a significant effect on hours worked per week, with a p value of near 0

Hours vs. Sex

Hypothesis: Males work more hours than women given that women tend to be the care takers of the household.

Results:

term	estimate	std.error	statistic	p.value
(Intercept)	45.6847692	0.7930243	57.6082831	0.0000000
education11th	-2.3984193	0.5081966	-4.7194713	0.0000024
education12th	-0.4493082	0.6736749	-0.6669511	0.5048081
education1st-4th	0.3616861	0.9716930	0.3722226	0.7097295
education5th-6th	0.6912154	0.7407410	0.9331405	0.3507544
education7th-8th	1.3344826	0.5950201	2.2427521	0.0249195
education9th	0.5613643	0.6360024	0.8826449	0.3774347
educationAssoc-acdm	2.5004900	0.5196590	4.8117899	0.0000015
educationAssoc-voc	3.2416635	0.4914013	6.5967743	0.0000000
educationBachelors	4.0753888	0.4125985	9.8773712	0.0000000
educationDoctorate	7.8066512	0.6872874	11.3586416	0.0000000
educationHS-grad	2.6605696	0.3958275	6.7215385	0.0000000
educationMasters	5.0364866	0.4733910	10.6391693	0.0000000
educationPreschool	-0.3712434	1.6652630	-0.2229338	0.8235884
educationProf-school	7.9281041	0.6165185	12.8594741	0.0000000
educationSome-college	1.5559376	0.4026910	3.8638500	0.0001118
relationshipNot-in-family	-3.8350001	0.1653245	-23.1968057	0.0000000
relationshipOther-relative	-7.0112068	0.3910806	-17.9277783	0.0000000
relationshipOwn-child	-11.4675017	0.2197320	-52.1885755	0.0000000
relationshipUnmarried	-4.6884233	0.2265413	-20.6956670	0.0000000
relationshipWife	-7.5408837	0.3102768	-24.3037324	0.0000000
age	-0.0898299	0.0054207	-16.5715434	0.0000000
raceAsian-Pac-Islander	-1.1430075	0.7503539	-1.5232913	0.1276956
raceBlack	-1.0699053	0.6884585	-1.5540594	0.1201800
raceOther	-0.8383543	0.9632921	-0.8703013	0.3841422
raceWhite	-0.4155536	0.6607437	-0.6289180	0.5294071

From this output, we can see that the average hours worked per week for women is 45.7, and men work -2 hours per week on average compared to women.

```
tidy(test_sex)$p.value
```

```
## [1]           NA 9.079086e-112
```

Comparing the full model to the model with no sex info, we can see that sex does have a significant effect on hours worked per week, with a p value of $9.0790857 \times 10^{-112}$

Hours vs. Age

Hypothesis: Individuals start to increase work hours in their 20s as they begin a career and keep increasing or plateauing depending on their marital status until it declines at retirement (around 60 years old).

Results:

term	estimate	std.error	statistic	p.value
(Intercept)	37.3192009	0.7785095	47.9367341	0.0000000
sexMale	4.2170727	0.1788891	23.5736657	0.0000000
education11th	-2.0089308	0.5057768	-3.9719714	0.0000714
education12th	-0.2536480	0.6705897	-0.3782461	0.7052502
education1st-4th	-0.2175083	0.9669353	-0.2249461	0.8220226
education5th-6th	0.3365756	0.7374331	0.4564152	0.6480945
education7th-8th	0.6722287	0.5908766	1.1376803	0.2552624
education9th	0.2632590	0.6331903	0.4157660	0.6775840
educationAssoc-acdm	2.9399743	0.5174695	5.6814448	0.0000000
educationAssoc-voc	3.6576562	0.4894155	7.4735197	0.0000000
educationBachelors	4.3550053	0.4108797	10.5992232	0.0000000
educationDoctorate	7.4759528	0.6837033	10.9344992	0.0000000
educationHS-grad	2.7976545	0.3941757	7.0974815	0.0000000
educationMasters	5.0747684	0.4712905	10.7678134	0.0000000
educationPreschool	-0.8808143	1.6579873	-0.5312551	0.5952456
educationProf-school	7.7337464	0.6137148	12.6015316	0.0000000
educationSome-college	2.0141630	0.4010475	5.0222553	0.0000005
relationshipNot-in-family	-1.4155647	0.1821146	-7.7729350	0.0000000
relationshipOther-relative	-4.2085729	0.3933235	-10.7000291	0.0000000
relationshipOwn-child	-7.9905463	0.2110469	-37.8614647	0.0000000
relationshipUnmarried	-1.1775836	0.2630903	-4.4759670	0.0000076
relationshipWife	-3.0150898	0.3559552	-8.4704199	0.0000000
raceAsian-Pac-Islander	-1.0890407	0.7471663	-1.4575614	0.1449711
raceBlack	-0.9109186	0.6855929	-1.3286582	0.1839701
raceOther	-0.2734727	0.9589600	-0.2851764	0.7755108
raceWhite	-0.4001590	0.6579254	-0.6082134	0.5430502

```
tidy(test_age)$p.value
```

```
## [1]           NA 2.507908e-51
```

Comparing the full model to the model with no age info, we can see that age does have a significant effect on hours worked per week, with a p value of 2.507908×10^{-51}

Hours vs. Education

Hypothesis: Higher educational attainment provides job security and stability leading to more work hours for higher educated individuals.

Results:

term	estimate	std.error	statistic	p.value
(Intercept)	43.3263038	0.7316320	59.2187075	0.0000000
sexMale	3.9614292	0.1802404	21.9785823	0.0000000
relationshipNot-in-family	-2.0367467	0.1864589	-10.9233023	0.0000000
relationshipOther-relative	-6.0376017	0.3987168	-15.1425807	0.0000000
relationshipOwn-child	-10.4381682	0.2340288	-44.6020621	0.0000000
relationshipUnmarried	-2.0769597	0.2655478	-7.8214151	0.0000000
relationshipWife	-3.5494329	0.3599806	-9.8600676	0.0000000
age	-0.0733219	0.0053728	-13.6467450	0.0000000
raceAsian-Pac-Islander	-0.0221594	0.7510028	-0.0295064	0.9764609
raceBlack	-0.7379608	0.6907118	-1.0684062	0.2853452
raceOther	-0.6818600	0.9654061	-0.7062935	0.4800107
raceWhite	0.0971549	0.6625748	0.1466323	0.8834231

In this analysis, the default reference group (intercept) is a 10th grade education. It appears that those with an 11th grade education work 3.96 hours less (significant p-value), whereas all other with no more than a high school education work the same amount (no significant p-values).

Every other education level higher than high school worked significantly more hours, as seen by positive estimates of each group and low p-values.

```
tidy(test_education)$p.value
```

```
## [1]             NA 1.039446e-148
```

Comparing the full model to the model with no education info, we can see that education does have a significant effect on hours worked per week, with a p value of $1.0394462 \times 10^{-148}$

Hours vs. Race

Hypothesis: Race does not have a correlation with hours worked since legal work hours required are not based on race but more on the other factors previously explored.

Results:

term	estimate	std.error	statistic	p.value
(Intercept)	40.6273698	0.4958668	81.9320153	0.0000000
sexMale	4.0438025	0.1785923	22.6426434	0.0000000
education11th	-2.2620467	0.5043212	-4.4853295	0.0000073
education12th	-0.5355350	0.6683341	-0.8012982	0.4229649
education1st-4th	0.3053957	0.9636848	0.3169041	0.7513184
education5th-6th	0.5750503	0.7344659	0.7829503	0.4336620
education7th-8th	1.3423145	0.5902245	2.2742439	0.0229578
education9th	0.4297094	0.6310903	0.6809000	0.4959396
educationAssoc-acdm	2.7780743	0.5156767	5.3872400	0.0000001
educationAssoc-voc	3.5512186	0.4876001	7.2830553	0.0000000
educationBachelors	4.2592346	0.4088867	10.4166632	0.0000000
educationDoctorate	7.9350595	0.6814153	11.6449681	0.0000000
educationHS-grad	2.7842538	0.3927560	7.0890158	0.0000000
educationMasters	5.2975034	0.4692626	11.2889963	0.0000000
educationPreschool	-0.5669836	1.6519409	-0.3432227	0.7314331
educationProf-school	7.9516931	0.6110522	13.0131153	0.0000000
educationSome-college	1.8576814	0.3996749	4.6479814	0.0000034
relationshipNot-in-family	-1.9376733	0.1844416	-10.5056209	0.0000000
relationshipOther-relative	-5.2350263	0.3954076	-13.2395685	0.0000000
relationshipOwn-child	-9.5673730	0.2339261	-40.8991236	0.0000000
relationshipUnmarried	-1.6529304	0.2615099	-6.3207191	0.0000000
relationshipWife	-3.5196793	0.3561062	-9.8837909	0.0000000
age	-0.0813743	0.0053874	-15.1044823	0.0000000

```
tidy(test_race)$p.value
```

```
## [1]         NA 0.06580715
```

Comparing the full model to the model with no race info, race does *not* have a significant effect on hours worked per week, with a p value of 0.0658072

Discussion

Our data is quite biased in that there are much more men (21790) than women (10771) in data set. This is especially apparent at older ages, for instance there are 742 women over 60 and 1590 men over 60.

Conclusion

Education, age, sex and relationship all have a very significant effect on the number of hours worked per week, while race does not.