Data Wrangling



Some definitions

- A data table is a collection of measurements
- A variable is a column in a data table
- An observation is a row in a data table
- A measurement, or scalar, is a value for each (observation, variable) pair

1918

	A	8	с	D	E	F	G
7	a		Monday	Tuesday	Wednesday	Thursday	Friday
8	Studer	nt Name	15 Nov-15	16 Nov-15	17 Nov-15	18 Nov-15	19 Nov-15
9	01	Lee, John	PR	PR	PR	PR	PR
10	02	Williams, Adam	PR	PR	PR	PR	PR
11	03	Williams, Sarah	PR	PR	PR	PR	PR
12	04	Doe, Jane	PR	AB	AB	PR	AB
13	05	Liu, Kat	PR	AB	PR	PR	PR
14	06	Smith, Elizabeth	PR	PR	PR	PR	PR
15	07	Sanders, Shane	AB	PR	PR	PR	PR
16	08	White, Andres	PR	PR	PR	PR	PR
17	09	Aaron son, Allis on	PR	PR	PR	PR	PR
18	10	Mapple, Noah	PR	PR	PR	PR	PR
19	11	Grande, John	PR	PR	PR	PR	PR
20	12	McDonell, Josh	PR	PR	PR	PR	PR
21	13	Spear, Terry	PR	PR	PR	PR	PR
22	14	Greene, Tom	PR	PR	PR	PR	PR
23	15	Snow, Daniel	PR	PR	PR	PR	PR
24	16	Daniels, Jack	PR	PR	AB	PR	PR
25	17	Daniels, Bob	PR	PR	PR	PR	PR
26	18	West, Williams	PR	₹ PR	PR	PR	PR
27	19						
28	20			ATTE	NDANCE:		
29	21			Sele	ct.		
30	22			AB I	Absent		
31	23				1		
32	24						
33	25						
34	26					8	
35	27						
36	28					0	
37	29						
38	30						
39		Nº PResent per Day:	17	16	16	18	17
40		II* ABsent per Day:	1	2	2	0	1
41	18	Total:	18	18	18	18	18
42		Daily Attendance %:	94	89	29	100	94

Data wrangling

- Reduction/Aggregation: reduces a variable to a scalar
 - Summarizing
 - How many students are in the class?
 - And how many have perfect attendance?
- Transformation/Mutation: creates a new variable based on one or more existing variables
 - From a student's total absences and total number of school days, compute the proportion of days the student was absent
 - Once absent, how many consecutive days was a student absent? (the average, the maximum, etc.)

Data wrangling (cont'd)

- Data verb: transforms a data table into a new one, usually by applying a reduction or transformation
 - Adding or deleting variables or observations
 - Sorting by a variable (e.g., name) in, say, ascending order
 - Filtering observations (e.g., who was absent on the day of the test?)
- Grouping data is another data verb whereby data are grouped before a reduction or transformation is applied
 - "Group by" students whose last name begins with A to M and N to Z
 - "Group by" ethnicity; group by zip code; etc.

Sort and Filter

Sort and Filter

- Sort is used to sort columns over ordered values in either ascending or descending order
 - \circ $\;$ The variable you sort by is called a key
- Filter is used to remove rows that do not satisfy some condition
 - The condition you test is called a predicate

Our Dataset

Variables

- Jobtitle
- Female Average Hourly Rate
- Male Average Hourly Rate

Source Original Dataset:

https://data.seattle.gov/City-Business/City-of-Seattle-W ages-Comparison-by-Gender-Average/24tp-6m99

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	A	В	с
1	Jobtitle	Female Average Hourly Rate	Male Average Hourly Rate
2	Accountant	30.58	30.28
3	Accountant, Prin	38.75	37.64
4	Accountant,Sr	34.48	33.89
5	Act Exec	43.1	42.02
6	Actg Tech I-BU	22.56	22.56
7	Actg Tech II	23.98	24.35
8	Actg Tech II-BU	24.19	24.21
9	Actg Tech III-BU	26.69	26.18
10	Admin Spec I	22.35	21.76
11	Admin Spec I-BU	22.43	22.43
12	Admin Spec II	24.32	23.9
13	Admin Spec II-BU	24.25	24.11
14	Admin Spec III	26.1	26.26
15	Admin Spec III-BU	25.94	25.93
16	Admin Spec II-MC	24.35	24.35
17	Admin Spec I-MC	22.56	22.56
18	Admin Staff Anlyst	35.59	35
19	Admin Staff Asst	30.86	30.48
20	Admin Support Asst-BU	20.3	20.61
21	Admin Support Supv-BU	27.58	27.78
22	Admin Support Supv-MC	27.78	27.78
23	Adms Employee	17.11	17.11
24	Animal Contrl Ofcr I	24.32	24.08
25	Animal Contrl Ofcr II	26.53	26.53
26	Aquarium Biologist 1	23.88	23.88
27	Aquarium Biologist 2	26.26	26.26
28	Aquatic Cntr Coord	32.52	32.52
29	Aquatic Cntr Coord,Asst	28.75	29.17
30	Arboriculturist	33.09	32.9
31	Arts Conserv Tech	27.78	27.78
32	Arts Prgm Spec,Sr	36.37	36.3

Queries we might answer by sorting

- What is the highest (or lowest) paying job for females (or males)?
- Or perhaps, what are the top 3 paying jobs in each category?

Queries we might answer by filtering

- Who are usually higher paid, females or males?
 - Conjecture: Males
- Which jobs, if any, pay females more than males?
- Which jobs pay more than \$50 for both males and females?

Sort

What are the highest paying jobs for women?

- Highlight column B
- Choose from the Drop-down menus Data->Sort->Extend Selection
- Change the radio button from Ascending to Descending
- Then click **OK**

Female Average Hourly	Rate	•	 Ascending Descending
Fort key 2 - undefined -		•	• Ascending
ort key 3 - undefined -		Ŧ	© Ascending © Descendin

What are the lowest paying jobs for women?

- Highlight column B
- Choose from the Drop-down menus Data->Sort->Extend Selection
- Keep the radio button on Ascending
- Then click **OK**

Female Average Hourly	Rate	 	•	 Ascending Descending
ort key 2				
- undefined -			•	Ascending Descending
ort key 3				
- undefined -			*	C Ascending
				• Descendin

The highest and lowest paying jobs for women

	A	В	C	
1	Jobtitle	Female Average Hourly Rate	Male Average Hourly Rate	
2	Electric Util Exec 3,Dir	86.34	86.81	
3	Pol Capt-Precinct	81.65	80.61	
4	Executive3	73.05	70.83	
5	Executive4	72.13	87.78	
6	Muni Judge	64.48	64.48	
7	Exec Manager-Legislative	63.87	64.7	
8	Executive2	63.18	63.94	
9	Pol Lieut	62.84	65.36	
10	Manager3,Engrng&Plans Rev-B▶	60.56	59.78	
11	Elecl PwrSystsEngr,Prin-Mrt	60.11	58.25	
12	Fire Battalion Chief-91.4 Hrs	59.25	57.8	
13	Manager3,Utils-BU	58.24	57.91	
14	StratAdvsr3,Utils	58.23	50.63	
15	Executive1	57.91	56.59	
16	Manager3,Info Technol	57.86	59.36	
17	Pwr Marketer	57.53	51.83	
18	Fire Capt-Admin-80 Hrs	57.39	57.39	
19	Councilmember	57.07	56.88	
20	Manager3,General Govt	56.25	53.63	
21	Info Technol Prof A,Exempt	56.11	55.27	
22	StratAdvsr3,Exempt	55.65	55.11	
23	Manager3,Engrng&Plans Rev	55.58	56.67	
24	StratAdvsr3,Utils-BU	55.58	55.81	
25	Eleci PwrSystsEngr-Mrt	55.08	55.08	
26	Elecl Constr&Maint Supv-BU	55.04	54.85	
27	Civil Engr Supv	54.51	54.16	
28	Elecl Pwr Systs Engr, Prin	54.42	55.22	
29	Struct Plans Engr Supv	53.39	53.39	
30	Manager3,Fin,Bud,&Actg	52.7	52.7	

1 Jobtitle Fernale Average Hourly Rate Male Average Hourly 404 Maint Laborer 23.38 405 Legislative Info Spec I 22.96 406 Meter Reader 22.86 407 Security Ofcr 22.81 408 Scale Attendant 22.78 409 Res&Eval Aide 22.77 410 Mayoral Staff Asst 1 22.73 411 Actg Tech I-BU 22.56 412 Admin Spec I-MC 22.56 413 Util Laborer 22.56 414 Admin Spec I-BU 22.43 415 Admin Spec I-BU 22.43 416 Delivery Wkr 21.36 417 Util Act Rep True 21.2 418 Janitor, Lead-SC/Parks/SPU 20.96 420 Laborer 20.96 421 Admin Support Asst-BU 20.3 422 Social Sycs Aide 19.53 423 Lifeguard, Sr 19.38 424 Cashier, Sr <t< th=""><th></th><th>A</th><th>В</th><th>C</th></t<>		A	В	C
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416 Delivery Wkr 21.36 417 Util Act Rep Tine 21.2 418 Janitor,Lead-FAS/CL 20.96 419 Janitor,Lead-SC/Parks/SPU 20.96 420 Laborer 20.96 421 Admin Support Asst-BU 20.3 422 Social Sycs Aide 19.53 423 Lifeguard,Sr 19.5 424 Cashier,Sr 19.38 425 Janitor-EAS/CL 19.38 426 Janitor-SC/Parks/SPU 19.38 427 Golf Course Groundskeeper II 18.12 428 Adms Employee 17.11 429 Rec Attendant 16.62 430 Cashier 16.61 431 Lifeguard 16.61 432 Dining Room Attendant 15.66 433 Otc/Maint Aide 14.45 434 Civil Syc Commissioner 5.53	415	Admin Spec I	22.35	21.76
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419 Janitor,Lead-SC/Parks/SPU 20.96 420 Laborer 20.96 421 Admin Support Asst-BU 20.3 422 Social Sycs Aide 19.53 423 Lifeguard,Sr 19.5 424 Cashier,Sr 19.38 425 Janitor-FAS/CL 19.38 426 Janitor-SC/Parks/SPU 19.38 427 Golf Course Groundskeeper II 18.12 428 Adms Employee 17.11 429 Rec Attendant 16.62 430 Cashier 16.61 431 Lifeguard 16.61 432 Drining Room Attendant 15.66 433 Otc/Maint Aide 14.45 434 Civil Syc Commissioner 5.53	418	Janitor,Lead-FAS/CL	20.96	20.96
420Laborer20.96421Admin Support Asst-BU20.3422Social Sycs Aide19.53423Lifeguard,Sr19.5424Cashier,Sr19.38425Janitor-FAS/CL19.38426Janitor-SC/Parks/SPU19.38427Golf Course Groundskeeper II18.12428Adms Employee17.11429Rec Attendant16.62430Cashier16.62431Lifeguard16.61432Dining Room Attendant15.66433Ofc/Maint Aide14.45434Civil Syc Commissioner5.53	419	Janitor,Lead-SC/Parks/SPU	20.96	19.38
421Admin Support Asst-BU20.3422Social Sycs Aide19.53423Lifeguard,Sr19.5424Cashier,Sr19.38425Janitor-FAS/CL19.38426Janitor-SC/Parks/SPU19.38427Golf Course Groundskeeper II18.12428Adms Employee17.11429Rec Attendant16.62430Cashier16.62431Lifeguard16.61432Dining Room Attendant15.66433Ofc/Maint Aide14.45434Civil Syc Commissioner5.53	420	Laborer	20.96	21.08
422 Social Sycs Aide 19.53 423 Lifeguard,Sr 19.5 424 Cashier,Sr 19.38 425 Janitor-FAS/CL 19.38 426 Janitor-SC/Parks/SPU 19.38 427 Golf Course Groundskeeper II 18.12 428 Adms Employee 17.11 429 Rec Attendant 16.76 430 Cashier 16.62 431 Lifeguard 16.61 432 Dining Room Attendant 15.66 433 Ofc/Maint Aide 14.45 434 Civil Syc Commissioner 5.53	421	Admin Support Asst-BU	20.3	20.61
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426 Janitor-SC/Parks/SPU 19.38 427 Golf Course Groundskeeper II 18.12 428 Adms Employee 17.11 429 Rec Attendant 16.76 430 Cashier 16.62 431 Lifeguard 16.61 432 Dining Room Attendant 15.66 433 Ofc/Maint Aide 14.45 434 Civil Syc Commissioner 5.53	425	Janitor-FAS/CL	19.38	19.38
427 Golf Course Groundskeeper II 18.12 428 Adms Employee 17.11 429 Rec Attendant 16.76 430 Cashier 16.62 431 Lifeguard 16.61 432 Dining Room Attendant 15.66 433 Ofc/Maint Aide 14.45 434 Civil Syc Commissioner 5.53	426	Janitor-SC/Parks/SPU	19.38	19.38
428 Adms Employee 17.11 429 Rec Attendant 16.76 430 Cashier 16.62 431 Lifeguard 16.61 432 Dining Room Attendant 15.66 433 Ofc/Maint Aide 14.45 434 Civil Syc Commissioner 5.53	427	Golf Course Groundskeeper II	18.12	18.12
429 Rec Attendant 16.76 430 Cashier 16.62 431 Lifeguard 16.61 432 Dining Room Attendant 15.66 433 Ofc/Maint Aide 14.45 434 Civil Syc Commissioner 5.53	428	Adms Employee	17.11	17.11
430 Cashier 16.62 431 Lifeguard 16.61 432 Dining Room Attendant 15.66 433 Ofc/Maint Aide 14.45 434 Civil Syc Commissioner 5.53	429	Rec Attendant	16.76	16.45
431 Lifeguard 16.61 432 Dining Room Attendant 15.66 433 Ofc/Maint Aide 14.45 434 Civil Syc Commissioner 5.53	430	Cashier	16.62	16.6
432 Dining Room Attendant 15.66 433 Ofc/Maint Aide 14.45 434 Civil Syc Commissioner 5.53	431	Lifeguard	16.61	16.39
433 Ofc/Maint Aide 14.45 434 Civil Syc Commissioner 5.53	432	Dining Room Attendant	15.66	14.8
434 Civil Svc Commissioner 5.53	433	Ofc/Maint Aide	14.45	14.75
	434	Civil Svc Commissioner	5.53	5.53
435 OPA Review Board Member 5.11	435	OPA Review Board Member	5.11	5.11

Sorting by two keys

- Highlight column B, choose from the Drop-down menus Data->Sort->Extend selection, change the radio button from Ascending to Descending, under Sort Key 2 choose Male Average Hourly Rate, keep the radio button on Ascending, and then click OK
- Whenever there are multiple jobs with the same average hourly rate for females, they are sorted in ascending order by the male rates:

	A	B	C
1	Jobtitle	Female Average Hourly Rate	Male Average Hourly Rate
89	Enrgy Mgmt Anlyst,Sr	45.96	45.96
90	Contract Employee *	45.96	61.42

A more intuitive example of sorting by 2 keys

- Data set containing a the first and last names of several characters from Game of Thrones
- First, we shall sort by last name, then we shall sort by first name alphabetically

	A	В
1	First Name	Last Name
2	Tyrion	Lannister
3	Jaime	Lannister
4 Cersei		Lannister
5	Daenerys	Targaryen
6	Jon	Snow
7	Petyr	Baelish
8	Jorah	Mormont
9	Arya	Stark
10	Sansa	Stark
11	Theon	Greyjoy
12	Bran	Stark
13	Sandor	Clegane
14	Joffrey	Baratheon
15	Catelyn	Stark
16	Ned	Stark
17	Robert	Baratheon
18	Viserys	Targaryen
19	Khal	Drogo
20	Samwell	Tarly
21	Tywin	Lannister
22	Jeor	Mormont
23	Tommen	Baratheon
24	Jaqen	H'ghar
25	Davos	Seaworth
26	Margaery	Tyrell
27	Stannis	Baratheon
28	Talisa	Stark
29	Roose	Bolton
30	Ramsay	Bolton
31	Daario	Naharis

A more intuitive example of sorting by 2 keys

- Highlight the whole document
- Choose from the Drop-down menus Data->Sort
- Under Sort Key 1, choose First Name, and keep the radio button on Ascending
- Under Sort Key 2, choose Last Name, and keep the radio button on Ascending
- Then click **OK**

	Sort (on luna.	cs.brown.edu)		
Sort Criteria Options				
Sort key 1			T	 Ascending Descending
Sort key 2 First Name				
Sort key 3 - undefined -				Ascending Descending
	<u></u> K	<u>C</u> ancel	<u>H</u> elp	Reset

A more intuitive example of sorting by 2 keys

	A	В	
1	First Name	Last Name	
2	Tyrion	Lannister	
3	Jaime	Lannister	
4	Cersei Lannister		
5	5 Daenerys Targaryen		
6	Jon	Snow	
7	Petyr	Baelish	
8	Jorah	Mormont	
9	Arya	Stark	
10	Sansa	Stark	
11	Theon	Greyjoy	
12	Bran	Stark	
13	Sandor	Clegane	
14	Joffrey	Baratheon	
15	Catelyn	Stark	
16	Ned	Stark	
17	Robert	Baratheon	
18	Viserys	Targaryen	
19	19 Khal Drogo		
20	Samwell	ll Tarly	
21	Tywin	Lannister	
22	Jeor	Mormont	
23	Tommen	Baratheon	
24	Jaqen	H'ghar	
25	Davos	Seaworth	
26	Margaery	Tyrell	
27	Stannis	Baratheon	
28	Talisa	Stark	
29	Roose	Bolton	
30	Ramsay	Bolton	
31	Daario	Naharis	

	A	В
1	First Name	Last Name
2	Petyr	Baelish
3	Joffrey	Baratheon
4	Robert	Baratheon
5	Stannis	Baratheon
6	Tommen	Baratheon
7	Ramsay	Bolton
8	Roose	Bolton
9	Sandor	Clegane
10	Khal	Drogo
11	Theon	Greyjoy
12	Jaqen	H'ghar
13	Cersei	Lannister
14	Jaime	Lannister
15	Tyrion	Lannister
16	Tywin	Lannister
17	Jeor	Mormont
18	Jorah	Mormont
19	Daario	Naharis
20	Davos	Seaworth
21	Jon	Snow
22	Arya	Stark
23	Bran	Stark
24	Catelyn	Stark
25	Ned	Stark
26	Sansa	Stark
27	Talisa	Stark
28	Daenerys	Targaryen
29	Viserys	Targaryen
30	Samwell	Tarly
31	Margaery	Tyrell

Filter

Predicates

- A predicate is a function whose value is either true or false.
- In this regard, a predicate is like a yes/no question:
 - Is the value of the Hourly Rate variable at least 100?
 - Is the value of the Weather variable sunny on 9/16/2022?

iClicker Q: Which of the following statements is a predicate?

- A) Did I get 8 hours of sleep last night?
- B) Who wants to go to the movies with me?
- C) How fast did I bike to class today?

Conditionals

- A conditional is an expression that includes a predicate, and then branches on the value of that predicate
 - Is it hot today?
 - If yes, then I will go swimming.
 - Otherwise, I will go running.
 - Do I like this course?
 - If yes, then I might take another computer science course sometime.
 - Otherwise, I will stick with visual arts, as I originally planned.

iClicker Q: Which of the following two statements is a conditional?

- A) If I wake up early, then I will have time for breakfast before class.
- B) After I eat, I'm not hungry, so I'm able to pay more attention in class!

Conditionals in LibreOffice

- Let's create a column that tells us, for each profession, if female employees make more per hour than males
- Title column D: Female Rate > Male Rate?
- Now we will use a handy dandy conditional formula
- In cell D2, type =IF(B2>C2, "yes", "no")
 - If the contents of cell B2 are greater than those of cell C2, then this formula evaluates to yes; otherwise, it evaluates to no

D2	D2 🔽 🏂 🚬 = [=IF(B2>C2, "yes", "no")						
	A	В	С	D			
1	Jobtitle	Female Average Hourly Rate	Male Average Hourly Rate	Female Rate> Male Rate?			
2	Electric Util Exec 3,Dir	86.34	86.81	no			

Now, grab the lower left corner of cell D2, and drag it all the way down the spreadsheet. (Or, just double click.)

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D19	D19 🍸 🏂 = =IF(B19>C19, "yes", "no")								
	A	В	С	D					
1	Jobtitle	Female Average Hourly Rate	Male Average Hourly Rate	Female Rate> Male Rate?					
2	Electric Util Exec 3,Dir	86.34	86.81	no					
3	Pol Capt-Precinct	81.65	80.61	yes					
4	Executive3	73.05	70.83	yes					
5	Executive4	72.13	87.78	no					
6	Muni Judge	64.48	64.48	no					
7	Exec Manager-Legislative	63.87	64.7	no					
8	Executive2	63.18	63.94	no					
9	Pol Lieut	62.84	65.36	no					
10	Manager3,Engrng&Plans Rev-B▶	60.56	59.78	yes					
11	ElecI PwrSystsEngr,Prin-Mrt	60.11	58.25	yes					
12	Fire Battalion Chief-91.4 Hrs	59.25	57.8	yes					
13	Manager3,Utils-BU	58.24	57.91	yes					
14	StratAdvsr3,Utils	58.23	50.63	yes					
15	Executive1	57.91	56.59	yes					
16	Manager3,Info Technol	57.86	59.36	no					
17	Pwr Marketer	57.53	51.83	yes					
18	Fire Capt-Admin-80 Hrs	57.39	57.39	no					
19	Councilmember	57.07	56.88	yes					
20	Manager3,General Govt	56.25	53.63	yes					
21	Info Technol Prof A, Exempt	56.11	55.27	yes					
22	StratAdvsr3,Exempt	55.65	55.11	yes					
23	StratAdvsr3,Utils-BU	55.58	55.81	no					
24	Manager3, <u>Engrng</u> &Plans Rev	55.58	56.67	no					
25	Elect PwrSystsEngr-Mrt	55.08	55.08	no					
26	Elecl Constr&Maint Supv-BU	55.04	54.85	yes					
27	Civil Engr Supv	54.51	54.16	yes					
28	Elect Pwr Systs Engr, Prin	54.42	55.22	no					
29	Strucl Plans Engr Supv	53.39	53.39	no					
30	Manager3,Fin,Bud,&Actg	52.7	52.7	no					

Who are usually paid more? Males or females?

- In Sheet1, cell C436, type Number Yes
- In Sheet1, cell C437, type Number No
- In cell D436, type the formula =COUNTIF (D2:D435, "yes")
- In cell D437, type the formula =COUNTIF (D2:D435, "no")

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D437	D437 💽 🏂 🚬 = COUNTIF(D2:D435, "NO")								
	A	В	C	D					
1	Jobtitle	Female Average Hourly Rate	Male Average Hourly Rate	Female Rate> Male Rate?					
431	Lifeguard	16.61	16.39	yes					
432	Dining Room Attendant	15.66	14.8	yes					
433	Ofc/Maint Aide	14.45	14.75	no					
434	Civil Svc Commissioner	5.53	5.53	no					
435	OPA Review Board Member	5.11	5.11	no					
436	-		Number Yes	154					
437			Number No	280					

Data -> Filter -> AutoFilter

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H108	\bullet $f_{\rm X} \Sigma = $			
		В	С	D
1	Jobtitle 🔽	Female Average Hourly Ra	Male Average Hourly Rate	Female Rate> Male Rate
2	Accountant	30.58	30.28	ves
3	Accountant,Prin	38.75	37.64	yes
4	Accountant,Sr	34.48	33.89	yes
5	Act Exec	43.1	42.02	yes
9	Actg Tech III-BU	26.69	26.18	yes
10	Admin Spec I	22.35	21.76	yes
12	Admin Spec II	24.32	23.9	yes
13	Admin Spec II-BU	24.25	24.11	yes
15	Admin Spec III-BU	25.94	25.93	yes
18	Admin Staff Anlyst	35.59	35	yes
19	Admin Staff Asst	30.86	30.48	yes
24	Animal Contrl Ofcr I	24.32	24.08	yes
30	Arboriculturist	33.09	32.9	yes
32	Arts Prgm Spec,Sr	36.37	36.3	yes
36	Bailiff	25.77	24.77	yes
37	Bldg Plans Examiner	36.45	35.38	yes
38	Bridge Op	27.34	27.26	yes
40	Buyer,Sr	39.96	38.86	yes
41	Capital Prjts Coord	41.56	41.04	yes
43	Capital Prjts Coord Supv-BU	49.33	47.62	yes
47	Cashier	16.62	16.6	yes
48	Cashier,Sr	19.38	18.74	yes
54	City Records Mgmt Anlyst	36.3	32.39	yes
55	Civil Engr Supv	54.51	54.16	yes
60	Civil Engrng Spec,Asst I	29.41	28.33	yes
62	Civil Engrng Spec,Asst III	34.91	34.73	yes
63	Civil Engrng Spec,Sr	43.08	42.85	yes
75	Councilmember	57.07	56.88	yes
77	Court Cashier	24.66	24.55	ves

Which jobs are better paying for females?

• Click the arrow next to Female Rate>Male Rate? and deselect no

	A	В	С	D
1	Jobtitle	Female Average Hourly Rate	Male Average Hourly Rate	Female Rate> Male Rate?
2	Accountant	30.58	30.28	yes
3	Accountant,Prin	38.75	37.64	yes
4	Accountant.Sr	34.48	33.89	ves
	A	В	C C	D
1	Jobtitle	Female Average Hourly Ra	Male Average Hourly Rat 💌	Female Rate> Male Rate 💌
2	Accountant	30.58	30.28	yes
3	Accountant,Prin	38.75	37.64	yes
4	Accountant.Sr	34.48	33.89	ves

What are the top 10 paying jobs for Females?

- Click the arrow next to Female Average Hourly Rate
- Then select > Top Ten

File	<u>E</u> dit <u>V</u> iew <u>I</u> nsert F <u>o</u> rmat <u>T</u> ools	<u>D</u> ata <u>W</u> indow <u>H</u> elp						
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	A	В	С	D				
1	Jobtitle 💌	Female Average Hourly Ra🔽	Male Average Hourly Rat	Female Rate> Male Rate				
114	Elecl PwrSystsEngr,Prin-Mrt	60.11	58.25	yes				
120	Electric Util Exec 3,Dir	86.34	86.81	no				
138	Exec Manager-Legislative	63.87	64.7	no				
140	Executive2	63.18	63.94	no				
141	Executive3	73.05	70.83	yes				
142	Executive4	72.13	87.78	no				
235	Manager3,Engrng&Plans Rev-B♥	60.56	59.78	yes				
257	Muni Judge	64.48	64.48	no				
289	Pol Capt-Precinct	81.65	80.61	yes				
297	Pol Lieut	62.84	65.36	no				
436				0				
437				2				
438								

Which jobs pay both males and females more than \$50 per hour?

- We will find out using Advanced Filter
- First, copy over the column headers and set our specifications:

<u>F</u> ile	Edit View Insert Format Tools	s <u>D</u> ata <u>W</u> indow <u>H</u> elp								
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M41										
1000	A	В	С	D	E	F	G	Н	I	
1	Jobtitle	Female Average Hourly Rate	Male Average Hourly Rate	Female Rate> Male Rate?		Jobtitle	Female Avera	Male Average	Female Rate> Male Rat	e?
2	Accountant	30.58	30.28	yes			>50	>50		
3	Accountant,Prin	38.75	37.64	yes		1				
4	Accountant,Sr	34.48	33.89	yes						
5	Act Exec	43.1	42.02	yes						
6	Actg Tech I-BU	22.56	22.56	no		-		27		2
7	Actg Tech II	23.98	24.35	no						
8	Actg Tech II-BU	24.19	24.21	no						
9	Actg Tech III-BU	26.69	26.18	yes						
10	Admin Spec I	22.35	21.76	yes						
11	Admin Spec I-BU	22.43	22.43	no		1				
12	Admin Spec II	24.32	23.9	yes						
13	Admin Spec II-BU	24.25	24.11	yes				14		_
14	Admin Spec III	26.1	26.26	no						
15	Admin Spec III-BU	25.94	25.93	yes						

- Highlight columns A, B, C, and D
- Select Data -> Filter -> Advanced Filter
- To fill in Read filter criteria from, highlight F1:I2

	F	G	H	
	Jobtitle	Female Avera	Male Average	▶Female Rate> Male Rat
Advanced Filter (on crater.cs.brown.edu)		>50	>50	
Read <u>fi</u> lter criteria from		Advanced Filte	r (on crater.o	cs.brown.edu)
+ Options	Read <u>fi</u> lt	t er criteria fron fined - ▼ \$\$Se	n attleWagesByC	Gender.\$F\$1:\$I 👰
<u>O</u> K <u>Cancel</u> <u>H</u> elp	⊞ Op <u>t</u> ior	ns ,		
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• Then click on **Options**, check **Copy results to**:, click in cell F3, and finally click **OK**.

	A	В	C	D	E	F	G	Н	j – L	
1	Jobtitle	Female Average Hourly Rate	Male Average Hourly Rate	Female Rate>	Male Rate	Jobtitle	Female Avera	▶Male Average	Female Rate>	> Male
2	Accountant	30.58	30.28	yes			>50	>50		
3	Accountant,Prin					-				
4	Accountant,Sr	Advanced Filt	ter (on cslab9b.cs.brown	.edu)						
5	Act Exec									
6	Actg Tech I-BU	Read <u>fi</u> lter criteria f	rom							
7	Actg Tech II	- undefined - 💌	tSeattleWagesByGender ¢E¢	1.4						
8	Actg Tech II-BU		poculie wages by ochach pro-							
9	Actg Tech III-BU	- Options								
10	Admin Spec I		Pequiar ex	nraccione		-				1
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13	Admin Spec II-BU	Copy results to:	I ∨ <u>K</u> eep filter	criteria						
14	Admin Spec III	- undefined - 🔫	\$SeattleWagesByGender.\$F\$	3 🗖						
15	Admin Spec III-BU									
16	Admin Spec II-MC									
17	Admin Spec I-MC	<u></u>	<u>o</u> K <u>C</u> ancel	<u>H</u> elp						
18	Admin Staff Anlyst			25		-				-
19	Admin Staff Asst	30.86	30.48	yes				-		
20	Admin Support Asst-BU	20.3	20.61	no						
21	Admin Support Supv-BU	27.58	27.78	no						
22	Admin Support Supv-MC	27.78	27.78	no						
23	Adms Employee	17.11	17.11	no	-					
24	Animal Contrl Ofcr I	24.32	24.08	yes						
25	Animal Contrl Ofcr II	26.53	26.53	no						-
26	Aquarium Biologist 1	23.88	23.88	no					14	
27	Aquarium Biologist 2	26.26	26.26	no						-

F	G	н	1	J	l
Jobtitle	Female Averð	Male Average	Female Rate>	Male Rate?	Î
	>50	>50			Ĩ
Jobtitle	Female Averð	Male Average	Female Rate>	Male Rate?	ĺ
Civil Engr Su▶	54.51	54.16	yes		ĺ
Councilmem	57.07	56.88	yes		
Elecl Constr&	55.04	54.85	yes		ĺ
Elecl Engr,Sr	50.69	50.69	no		ĺ
Elecl Pwr Sy	51.93	51.4	yes		ĺ
Elecl Pwr Sy	54.42	55.22	no		ĺ
Elecl PwrSys	60.11	58.25	yes		ĺ
Elecl PwrSys	55.08	55.08	no		ĺ
Electric Util P	86.34	86.81	no		ĺ
Exec Manag	63.87	64.7	no		ĺ
Executive1	57.91	56.59	yes		ĺ
Executive2	63.18	63.94	no		
Executive3	73.05	70.83	yes		l
Executive4	72.13	87.78	no		ĺ
Fire Battalior	59.25	57.8	yes		ĺ
Fire Capt-Ad	57.39	57.39	no		
Fire Lieut-Pre	52.09	51.4	yes		
Info Technol P	56.11	55.27	yes		l
Magistrate	52.25	51.27	yes		
Manager2,Er	51.07	50.27	yes		ĺ
Manager2,Ge	50.15	50.3	no		
Manager2,Ut	52.14	51.35	yes		Ĺ
Manager3,C9	51.56	50.07	yes		
Manager3,Er	55.58	56.67	no		Ĺ
Manager3,Er	60.56	59.78	yes		
Manager3,E*	52.21	53.8	no		
Manager3,Fir▶	52.7	52.7	no		
Manager3,G¢	56.25	53.63	yes		ĺ
Manager3,Inf	57.86	59.36	no		ĺ
Manager3 Ut	58 24	57 91	ves		ĺ.

Which jobs are better paying for females?

- Let's first create a yes sheet and a no sheet
 - o Edit->Sheet->Move/Copy
 - Select the radio button for Copy
 - Under New name type yes
- Repeat this process, this time naming the new sheet no

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Sheet1_2 Sheet1 New <u>n</u> ame yes	OK Cancel

Filter

- In the sheet titled yes:
 - Highlight column D
 - Data->Filter->Standard
 Filter
 - Change condition to
 Begins with
 - \circ Change Value to ${\tt yes}$
 - Then click **OK**
- We now have a spreadsheet of professions where females are paid more than males

	A	В	C	D
1	Jobtitle	Female Average Hourly Rate	Male Average Hourly Rate	Female Rate> Male Rate?
3	Pol Capt-Precinct	81.65	80.61	yes
4	Executive3	73.05	70.83	yes
10	Manager3,Engrng&Plans Rev-B	60.56	59.78	yes
11	Elect PwrSystsEngr,Prin-Mrt	60.11	58.25	yes
12	Fire Battalion Chief-91.4 Hrs	59.25	57.8	yes
13	Manager3,Utils-BU	58.24	57.91	yes
14	StratAdvsr3,Utils	58.23	50.63	yes
15	Executive1	57.91	56.59	yes
17	Pwr Marketer	57.53	51.83	yes
19	Councilmember	57.07	56.88	yes
20	Manager3,General Govt	56.25	53.63	yes
21	Info Technol Prof A, Exempt	56.11	55.27	yes
22	StratAdvsr3,Exempt	55.65	55.11	yes
26	Elect Constr&Maint Supv-BU	55.04	54.85	yes
27	Civil Engr Supy	54.51	54.16	yes
32	StratAdvsr-Audit	52.4	47.52	yes
33	Magistrate	52.25	51.27	yes
35	Manager2,Utils	52.14	51.35	yes
36	Fire Lieut-Prev Inspector I	52.09	51.4	yes
38	Eleci Pwr Systs Engr	51.93	51.4	yes
39	Manager3,CSPI&P	51.56	50.07	yes
40	Pol Sgt-Detective	51.53	51.52	yes
41	Manager2,Utils-BU	51.33	49.16	yes
42	Manager2, Engrng&Plans Rev	51.07	50.27	yes
44	StratAdvsr2,General Govt-BU	50.21	48.74	yes
47	Mech Plans Engr,Sr	50.07	44.8	yes
49	Pwr Dispatcher	49.84	49.63	yes
53	Capital Prits Coord Supv-BU	49.33	47.62	yes
54	Manager2,Exempt	49.22	47.45	yes
57	StratAdvsr-Legislative	49.03	47.99	yes
58	StratAdvsr2,Fin,Bud,&Actg	48.77	46.12	yes
60	Info Technol Prof B-BU	48.55	48.12	yes
63	Fire Capt-91.40 Hrs	48.11	47.77	yes
65	Manager2,Parks&Rec	47.68	47.5	yes
72	Manager1,Exempt	47.33	34.55	yes
73	Mgmt Systs Anlyst Supv	47.26	45.58	yes
76	Info Technol Prof B	47.11	47.09	yes
78	StratAdvsr1,Fin,Bud,&Actg	46.47	42.61	yes

Filter

- In the sheet titled no:
 - Highlight column D
 - Data->Filter->Standard
 Filter
 - Change condition to
 Begins with
 - Change Value to no
 - Then click **OK**
- We now have a spreadsheet of professions where males are paid more than females

2	A	В	С	D
1	Jobtitle	Female Average Hourly Rate	Male Average Hourly Rate	Female Rate> Male Rate?
2	Electric Util Exec 3,Dir	86.34	86.81	no
5	Executive4	72.13	87.78	no
6	Muni Judge	64.48	64.48	no
7	Exec Manager-Legislative	63.87	64.7	no
8	Executive2	63.18	63.94	no
9	Pol Lieut	62.84	65.36	no
16	Manager3,Info Technol	57.86	59.36	no
18	Fire Capt-Admin-80 Hrs	57.39	57.39	no
23	StratAdvsr3,Utils-BU	55.58	55.81	no
24	Manager3, Engrng&Plans Rev	55.58	56.67	no
25	Eleci PwrSystsEngr-Mrt	55.08	55.08	no
28	Elecl Pwr Systs Engr, Prin	54.42	55.22	no
29	Strucl Plans Engr Supv	53.39	53.39	no
30	Manager3,Fin,Bud,&Actg	52.7	52.7	no
31	StratAdvsr3,General Govt	52.58	55.38	no
34	Manager3,Exempt	52.21	53.8	no
37	Pol Sgt-Patrl	51.98	52.14	no
43	Eleci Engr,Sr	50.69	50.69	no
45	Manager2,General Govt	50.15	50.3	no
46	StratAdvsr2,Utils	50.09	50.46	no
48	StratAdvsr2,Utils-BU	50.02	50.57	no
50	Civil Engr,Sr	49.61	50.2	no
51	Enrgy Mgmt Anlyst Supv	49.56	49.56	no
52	StratAdvsr2, <u>Engrng</u> &Plans Rev	49.43	50.84	no
55	City Attorney,Asst	49.2	55.11	no
56	Manager2,P&FM	49.12	50.19	no
59	Manager2,Fin,Bud,& <u>Actg</u>	48.59	49.86	no
61	Prot&Cntrl Elctn II	48.54	48.54	no
62	Labor Relations Coord	48.45	49.05	no
64	StratAdvsr2,General Govt	48.09	49.61	no
66	Line C CC	47.67	47.67	no
67	Line CC-Asg C Coord	47.67	47.67	no
68	Trans Line CC	47.67	47.67	no
69	Manager2,Info Technol	47.66	51.48	no
70	StratAdvsr2,Info Technol	47.52	49.89	no

Summary

- Mutate/Transform is a common data wrangling operation
 - Sort is used to sort by ordinal variables (i.e., columns) in either ascending or descending order
 - Filter is used to remove observations (i.e., rows) that do not satisfy some condition of interest
- Spreadsheets transform data easily (i.e., semi-automatically)