

# ENE434\_Lab\_1

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```
if (!require('pacman')) install.packages('pacman')

## Loading required package: pacman

p_load(tidyverse, ggmap, ggplot2, stats)

oil_fields = data.frame(read_csv("http://jmaurit.github.io/analytics/labs/data/oil_fields_cross.csv"))

## New names:
## * ' ' -> ...1

## Rows: 101 Columns: 8
## -- Column specification -----
## Delimiter: ","
## chr  (1): name
## dbl  (6): ...1, lon, lat, recoverable_oil, remaining_oil, total.invest
## date (1): producing_from
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.

oil_fields

##      ...1      name      lon      lat recoverable_oil remaining_oil
## 1      1  33/9-6 DELTA      NA      NA              NA              NA
## 2      6  ALBUSKJELL  2.993019  56.63079              7.4              0.0
## 3     46      ALVE    7.827906  65.96924              1.9              0.8
## 4     54  ALVHEIM    2.010224  59.57465              37.2             17.5
## 5     64  ÅSGARD    6.728537  65.11635             100.4             18.6
## 6     82      ATLA    2.577873  59.67057              0.3              0.3
## 7     85  BALDER    2.446895  59.30631              72.1             16.2
## 8    109  BLANE     2.473427  56.88505              0.8              0.3
## 9    118  BØYLA     1.848627  59.32033              3.4              3.4
## 10   121  BRAGE     3.014216  60.58058              59.3              4.0
## 11   146  BRYNHILD  2.297317  57.49330              3.6              3.6
## 12   149      COD    2.422911  57.06647              2.9              0.0
## 13   190  DRAUGEN    7.756043  64.33243             146.7             14.9
## 14   216  EDDA      3.103594  56.47110              4.8              0.0
## 15   257  EKOFISK    3.218287  56.54663             569.2            129.8
```

## 16	301	ELDFISK	3.242870	56.39870	137.9	37.3
## 17	341	EMBLA	3.249919	56.32710	11.9	1.5
## 18	365	ENOCK	1.523260	58.64759	0.4	0.1
## 19	374	FRAM	3.528545	61.01547	30.7	5.9
## 20	391	FRIGG	2.094430	59.91108	0.0	0.0
## 21	428	FRØY	2.556764	59.73203	5.6	0.0
## 22	450	GAUPE	1.931471	57.96129	0.2	0.1
## 23	454	GIMLE	2.317010	61.24770	3.0	0.4
## 24	464	GINA KROG	NA	NA	NA	NA
## 25	468	GJØA	3.945822	61.33418	11.6	6.4
## 26	485	GLITNE	1.647140	58.71153	8.9	0.0
## 27	499	GOLIAT	22.296546	71.27406	30.2	30.2
## 28	504	GRANE	2.506074	59.18574	124.6	36.1
## 29	520	GUÐRUN	1.751611	58.84938	11.7	11.7
## 30	524	GULLFAKS	2.130364	61.20896	365.5	11.6
## 31	557	GULLFAKS SØR	2.215286	61.10673	58.8	16.6
## 32	575	GUNGNE	1.917072	58.30961	0.0	0.0
## 33	594	GYDA	3.089733	56.85435	36.5	0.9
## 34	620	HEIDRUN	7.306980	65.32944	182.1	40.1
## 35	648	HEIMDAL	2.226203	59.58547	8.2	1.6
## 36	681	HOD	3.472108	56.19843	10.4	0.9
## 37	707	HULDRA	2.641797	60.85444	5.1	0.0
## 38	723	HYME	7.536641	64.34594	3.2	3.2
## 39	726	ISLAY	NA	NA	0.0	0.0
## 40	730	JETTE	2.359870	59.39335	1.5	1.5
## 41	733	JOTUN	2.325348	59.42954	23.4	0.7
## 42	752	KNARR	2.781421	61.80114	11.9	11.9
## 43	755	KRISTIN	6.433011	64.97139	22.9	6.0
## 44	768	KVITEBJØRN	2.509959	61.09226	27.3	9.8
## 45	782	LILLE-FRIGG	2.382012	59.95617	1.3	0.0
## 46	802	MARTIN LINGE	2.054545	60.50824	6.0	6.0
## 47	808	MARULK	7.586522	65.95250	0.7	0.6
## 48	813	MIKKEL	7.669056	64.68017	6.6	3.3
## 49	826	MIME	2.494998	57.12693	0.4	0.0
## 50	832	MORVIN	6.460434	65.15322	9.3	5.6
## 51	839	MURCHISON	1.744179	61.40133	13.9	0.0
## 52	879	NJORD	7.085968	64.28369	28.5	3.0
## 53	898	NORDØST FRIGG	2.273026	60.00514	0.0	0.0
## 54	917	NORNE	8.147307	66.03421	90.8	3.8
## 55	937	ODIN	2.172505	60.06075	0.0	0.0
## 56	960	ORMEN LANGE	5.349480	63.49258	0.0	0.0
## 57	971	OSEBERG	2.722425	60.54786	384.6	22.7
## 58	1002	OSEBERG ØST	2.978614	60.61807	26.7	7.9
## 59	1020	OSEBERG SØR	2.760004	60.25226	61.0	17.2
## 60	1039	OSELVAR	2.717955	56.93144	4.6	4.5
## 61	1044	ØST FRIGG	2.354428	59.91862	0.0	0.0
## 62	1068	REV	1.932832	58.02975	0.7	0.0
## 63	1081	RINGHORNE ØST	2.494802	59.29083	15.5	6.3
## 64	1090	SIGYN	2.018044	58.28605	0.0	0.0
## 65	1104	SKARV	7.627655	65.72231	15.5	15.5
## 66	1116	SKIRNE	2.491161	59.61747	2.2	0.5
## 67	1129	SKULD	8.314253	66.23375	13.4	13.4
## 68	1132	SLEIPNER ØST	1.967779	58.43631	0.0	0.0
## 69	1159	SLEIPNER VEST	1.730038	58.44112	0.0	0.0

## 70	1182	SNØHVIT	20.974280	71.49443	0.0	0.0
## 71	1194	SNORRE	2.193464	61.49258	249.9	64.1
## 72	1220	STATFJORD	1.866338	61.26222	570.4	4.3
## 73	1260	STATFJORD NORD	1.940215	61.44457	39.5	3.0
## 74	1284	STATFJORD ØST	2.003245	61.33880	36.8	0.7
## 75	1308	SYGNA	2.003040	61.47588	11.0	1.1
## 76	1323	TAMBAR	2.963593	56.97054	9.5	0.6
## 77	1337	TAMBAR ØST	3.002542	56.97172	0.3	0.0
## 78	1344	TOMMELITEN GAMMA	2.927906	56.48807	3.9	0.0
## 79	1369	TOR	3.329413	56.64148	24.3	0.4
## 80	1409	TORDIS	2.117935	61.28220	61.2	6.0
## 81	1432	TROLL	3.552057	60.82293	263.8	36.0
## 82	1460	TRYM	4.236097	56.40414	1.5	0.8
## 83	1465	TUNE	2.653474	60.43847	3.3	0.0
## 84	1481	TYRIHANS	7.000546	64.79362	32.4	16.5
## 85	1491	ULA	2.860582	57.10273	87.9	15.7
## 86	1522	URD	8.181120	66.05629	7.0	2.0
## 87	1533	VALE	2.302589	59.70584	2.4	1.1
## 88	1549	VALEMON	2.355820	61.04258	4.9	4.9
## 89	1553	VALHALL	3.393803	56.27577	147.4	41.5
## 90	1590	VARG	1.908065	58.07247	16.4	1.4
## 91	1608	VEGA	3.353838	61.35584	6.6	5.1
## 92	1616	VESLEFRIKK	2.891658	60.78827	54.1	1.8
## 93	1643	VEST EKOFISK	3.085798	56.56262	12.2	0.0
## 94	1684	VIGDIS	2.147171	61.40055	66.6	15.0
## 95	1704	VILJE	2.275522	59.66342	13.6	6.2
## 96	1713	VISUND	2.558184	61.41580	33.9	11.5
## 97	1732	VISUND SØR	2.345196	61.29676	2.7	2.7
## 98	1735	VOLUND	1.946607	59.48411	8.6	4.0
## 99	1745	VOLVE	1.890830	58.43905	8.7	1.0
## 100	1754	YME	4.362773	57.74885	22.0	14.1
## 101	1796	YTTERGRYTA	7.515016	65.11059	0.3	0.0
##	producing_from total.invest					
## 1	<NA>		0			
## 2	1979-05-26		2752			
## 3	2009-03-19		3864			
## 4	2008-06-08		17708			
## 5	1999-05-19		65301			
## 6	2012-10-07		324			
## 7	1999-10-02		23198			
## 8	2007-09-12		544			
## 9	<NA>		85			
## 10	1993-09-23		17062			
## 11	<NA>		210			
## 12	1977-12-26		1003			
## 13	1993-10-19		23291			
## 14	1979-12-02		2157			
## 15	1971-06-15		94172			
## 16	1979-08-08		34963			
## 17	1993-05-12		3129			
## 18	2007-05-31		208			
## 19	2003-10-02		9875			
## 20	1977-09-13		8614			
## 21	1995-05-15		5551			

## 22	2012-03-31	2085
## 23	2006-05-19	780
## 24	<NA>	0
## 25	2010-11-07	28043
## 26	2001-08-29	2536
## 27	<NA>	10182
## 28	2003-09-23	19746
## 29	<NA>	5857
## 30	1986-12-22	74940
## 31	1998-10-10	28340
## 32	1996-04-21	1930
## 33	1990-06-21	12435
## 34	1995-10-18	52935
## 35	1985-12-13	10064
## 36	1990-09-30	2254
## 37	2001-11-21	7460
## 38	2013-03-02	897
## 39	2012-04-10	578
## 40	2013-05-20	263
## 41	1999-10-25	9484
## 42	<NA>	534
## 43	2005-11-03	24467
## 44	2004-09-26	13707
## 45	1994-05-13	3923
## 46	<NA>	402
## 47	2012-04-02	2173
## 48	2003-08-01	2182
## 49	1993-01-01	324
## 50	2010-08-01	7994
## 51	1980-09-28	2597
## 52	1997-09-30	14888
## 53	1983-12-01	1816
## 54	1997-11-06	23806
## 55	1984-04-01	2614
## 56	2007-09-13	35967
## 57	1988-12-01	66622
## 58	1999-05-03	8827
## 59	2000-02-05	20108
## 60	2012-04-14	3535
## 61	1988-10-01	2186
## 62	2009-01-24	3831
## 63	2006-03-19	738
## 64	2002-12-22	2066
## 65	2013-01-01	37119
## 66	2004-03-03	2685
## 67	2013-03-19	1434
## 68	1993-08-24	26756
## 69	1996-08-29	23176
## 70	2007-08-21	8235
## 71	1992-08-03	65475
## 72	1979-11-24	65264
## 73	1995-01-23	5719
## 74	1994-09-24	6015
## 75	2000-08-01	1984

```
## 76      2001-07-15      2212
## 77      2007-10-02      1034
## 78      1988-10-03      2406
## 79      1978-06-28      3934
## 80      1994-06-03      12201
## 81      1995-09-19     130620
## 82      2011-02-12      2956
## 83      2002-11-28      4746
## 84      2009-07-08      15203
## 85      1986-10-06      14700
## 86      2005-11-08      5073
## 87      2002-05-31      2495
## 88      <NA>           1484
## 89      1982-10-02     61511
## 90      1998-12-22      7880
## 91      2010-12-02      8503
## 92      1989-12-26     16660
## 93      1977-05-31       943
## 94      1997-01-28     14829
## 95      2008-08-01      1947
## 96      1999-04-21     22136
## 97      2012-11-22       826
## 98      2009-09-10      3185
## 99      2008-02-12      3044
## 100     1996-02-27     23438
## 101     2009-01-05      1460
```

```
str(oil_fields)
```

```
## 'data.frame':   101 obs. of  8 variables:
## $ ...1          : num  1 6 46 54 64 82 85 109 118 121 ...
## $ name          : chr  "33/9-6 DELTA" "ALBUSKJELL" "ALVE" "ALVHEIM" ...
## $ lon           : num  NA 2.99 7.83 2.01 6.73 ...
## $ lat           : num  NA 56.6 66 59.6 65.1 ...
## $ recoverable_oil: num  NA 7.4 1.9 37.2 100.4 ...
## $ remaining_oil  : num  NA 0 0.8 17.5 18.6 0.3 16.2 0.3 3.4 4 ...
## $ producing_from: Date, format: NA "1979-05-26" ...
## $ total.invest   : num  0 2752 3864 17708 65301 ...
```

```
head(oil_fields$recoverable_oil)
```

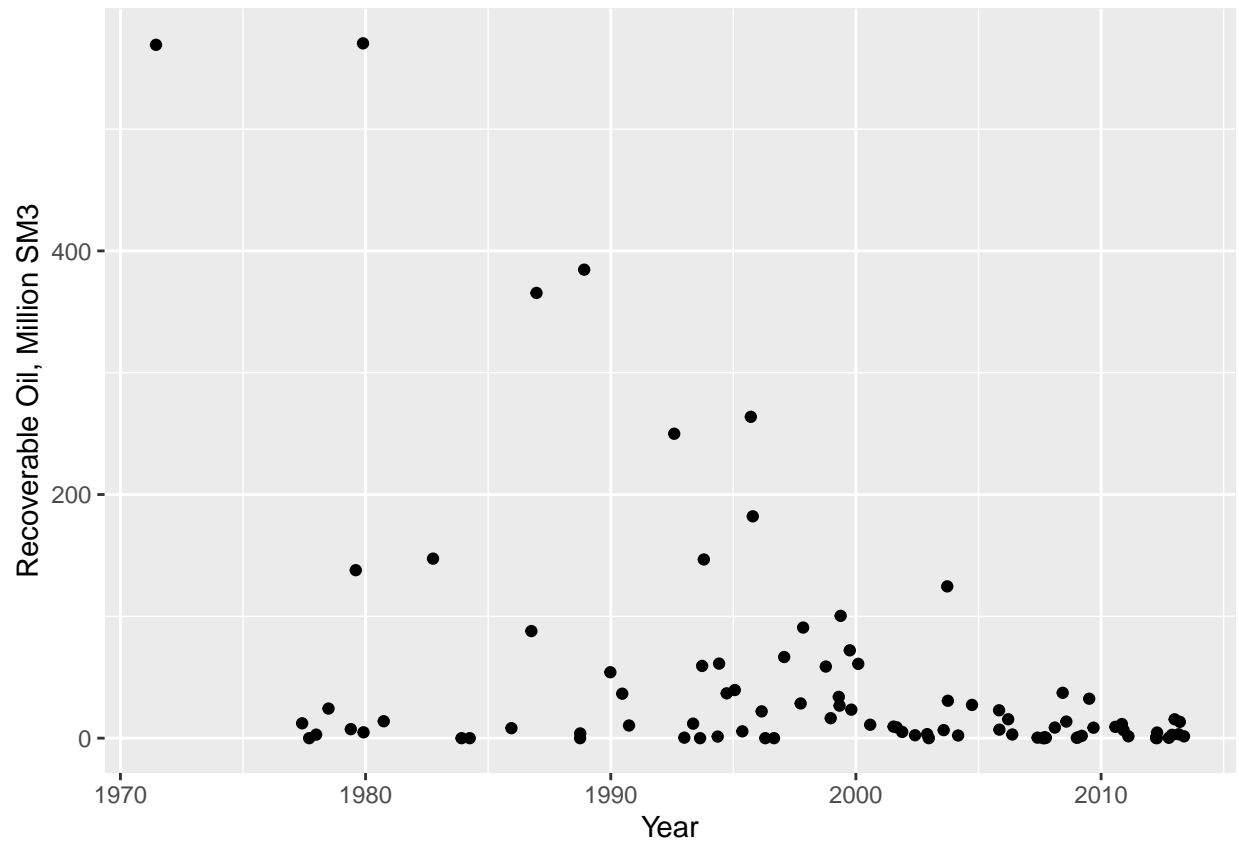
```
## [1]    NA    7.4    1.9   37.2  100.4    0.3
```

```
class(oil_fields$name)
```

```
## [1] "character"
```

```
oil_fields %>% ggplot(aes(x = producing_from, y = recoverable_oil)) +
  geom_point() +
  labs(x = "Year", y = "Recoverable Oil, Million SM3")
```

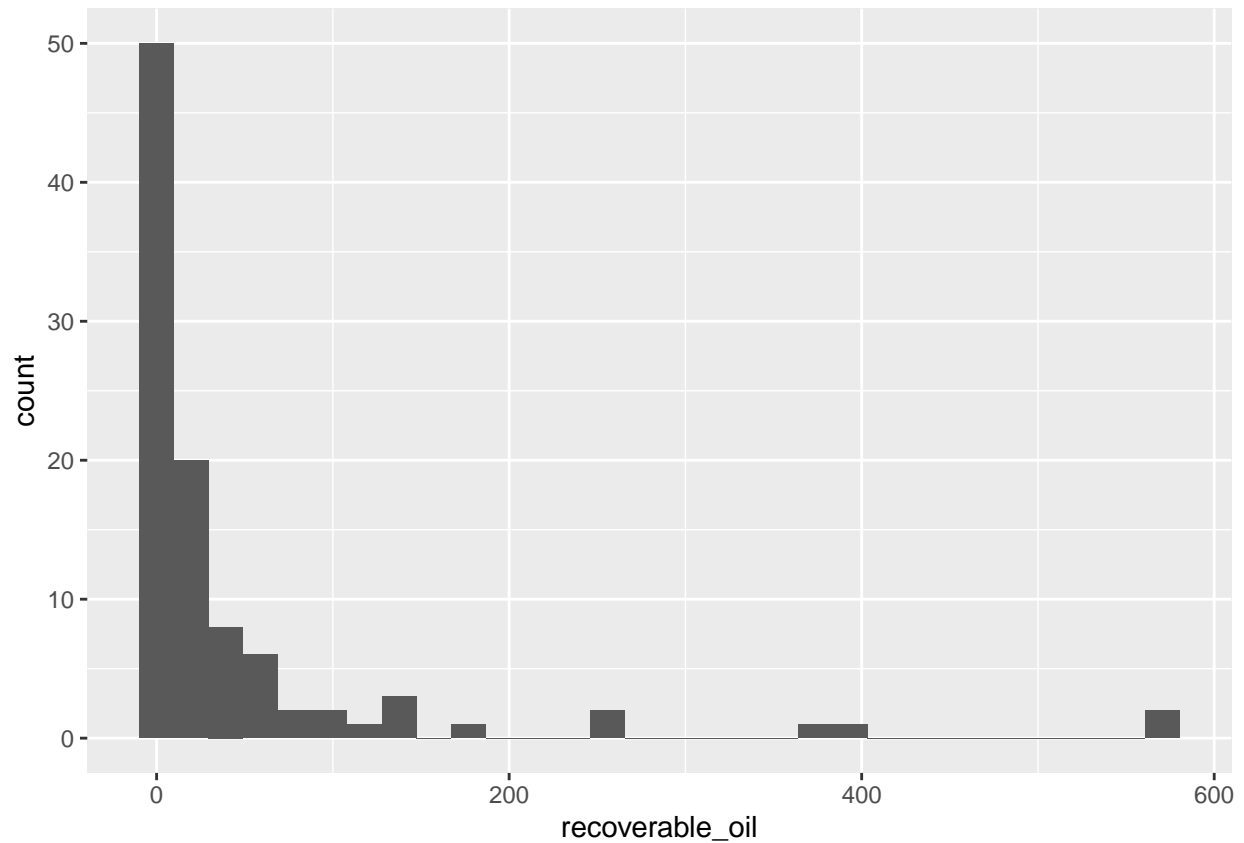
```
## Warning: Removed 9 rows containing missing values (geom_point).
```



```
ggplot(oil_fields, aes(x=recoverable_oil)) +  
geom_histogram()
```

```
## 'stat_bin()' using 'bins = 30'. Pick better value with 'binwidth'.
```

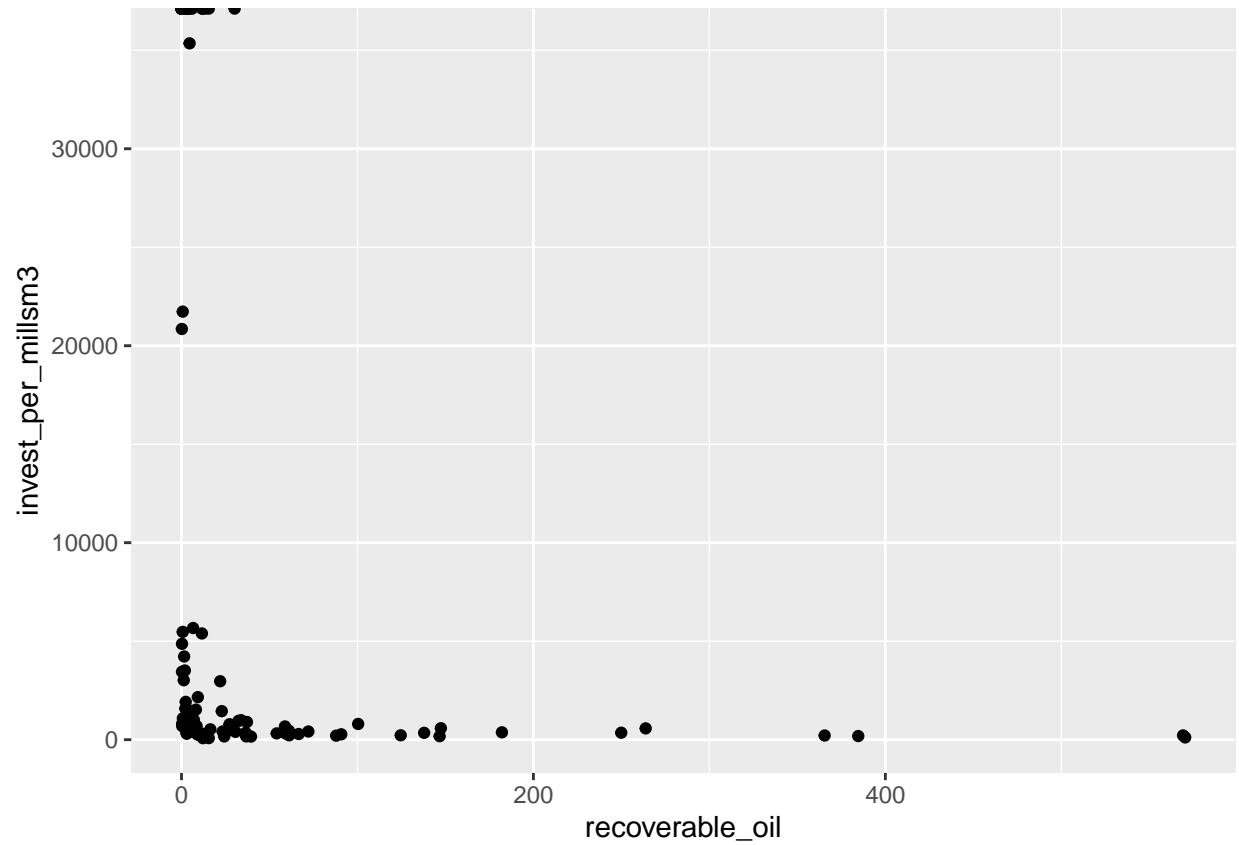
```
## Warning: Removed 2 rows containing non-finite values (stat_bin).
```



```
oil_fields$extracted = oil_fields$recoverable_oil - oil_fields$remaining_oil  
oil_fields$invest_per_millsm3 = oil_fields$total.invest / oil_fields$extracted
```

```
ggplot(oil_fields, aes(x = recoverable_oil, y = invest_per_millsm3)) +  
  geom_point()
```

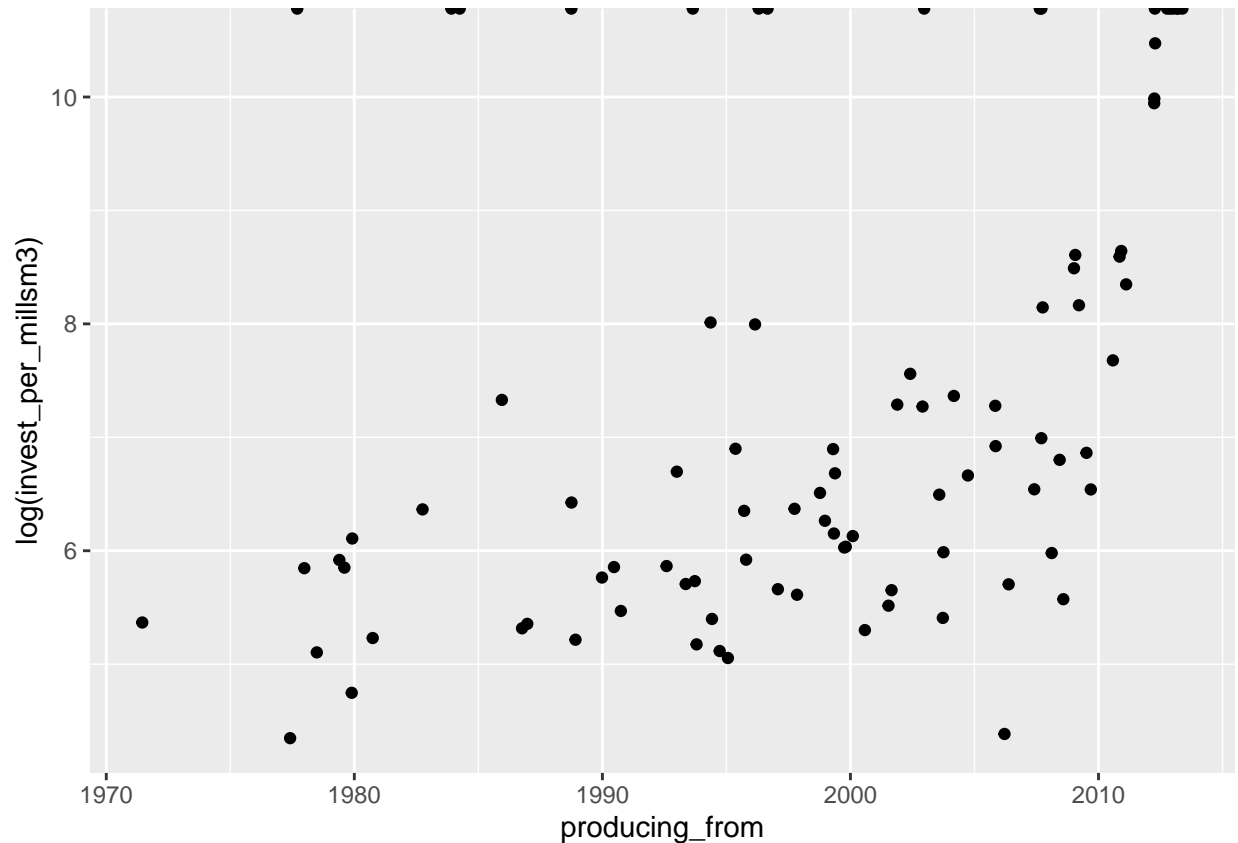
```
## Warning: Removed 2 rows containing missing values (geom_point).
```



```
ggplot(oil_fields, aes(x = producing_from, y = log(invest_per_millsm3))) +  
  geom_point()
```

```
## Warning: Removed 9 rows containing missing values (geom_point).
```





Exercises:

- 1) What does the special tax treatment imply about the initial investment costs of Norwegian offshore oil and gas investments?
- 2) Who is in effect paying for most of the upfront investment costs? Is this warranted/problematic?
- 3) If we know that there was a high risk that oil and gas production would not be profitable (or allowed) in the near future (10-30 years), would the tax system be neutral?

```
big_oil_fields = oil_fields %>% filter(recoverable_oil > 50)
big_oil_fields$name
```

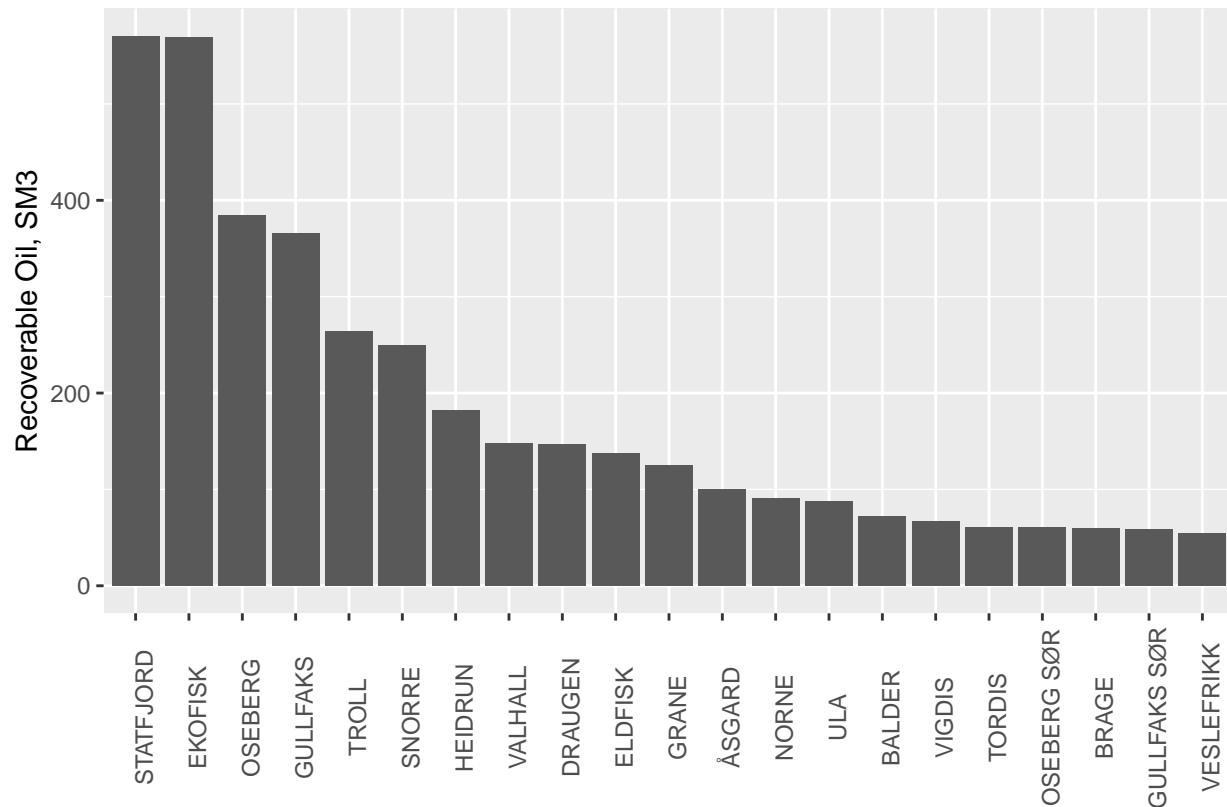
```
## [1] "ÅSGARD"      "BALDER"      "BRAGE"      "DRAUGEN"    "EKOFISK"
## [6] "ELDFISK"     "GRANE"       "GULLFAKS"   "GULLFAKS SØR" "HEIDRUN"
## [11] "NORNE"       "OSEBERG"     "OSEBERG SØR" "SNORRE"     "STATFJORD"
## [16] "TORDIS"      "TROLL"       "ULA"        "VALHALL"    "VESLEFRIKK"
## [21] "VIGDIS"
```

```
big_oil_fields = arrange(big_oil_fields, desc(recoverable_oil))
big_oil_fields
```

```
## ...1      name      lon      lat recoverable_oil remaining_oil
## 1  1220  STATFJORD 1.866338 61.26222      570.4         4.3
## 2   257   EKOFISK 3.218287 56.54663      569.2        129.8
## 3   971   OSEBERG 2.722425 60.54786      384.6         22.7
```

## 4	524	GULLFAKS	2.130364	61.20896	365.5	11.6
## 5	1432	TROLL	3.552057	60.82293	263.8	36.0
## 6	1194	SNORRE	2.193464	61.49258	249.9	64.1
## 7	620	HEIDRUN	7.306980	65.32944	182.1	40.1
## 8	1553	VALHALL	3.393803	56.27577	147.4	41.5
## 9	190	DRAUGEN	7.756043	64.33243	146.7	14.9
## 10	301	ELDFISK	3.242870	56.39870	137.9	37.3
## 11	504	GRANE	2.506074	59.18574	124.6	36.1
## 12	64	ÅSGARD	6.728537	65.11635	100.4	18.6
## 13	917	NORNE	8.147307	66.03421	90.8	3.8
## 14	1491	ULA	2.860582	57.10273	87.9	15.7
## 15	85	BALDER	2.446895	59.30631	72.1	16.2
## 16	1684	VIGDIS	2.147171	61.40055	66.6	15.0
## 17	1409	TORDIS	2.117935	61.28220	61.2	6.0
## 18	1020	OSEBERG SØR	2.760004	60.25226	61.0	17.2
## 19	121	BRAGE	3.014216	60.58058	59.3	4.0
## 20	557	GULLFAKS SØR	2.215286	61.10673	58.8	16.6
## 21	1616	VESLEFRIKK	2.891658	60.78827	54.1	1.8
##	producing_from total.invest extracted invest_per_millsm3					
## 1	1979-11-24	65264	566.1	115.2871		
## 2	1971-06-15	94172	439.4	214.3195		
## 3	1988-12-01	66622	361.9	184.0895		
## 4	1986-12-22	74940	353.9	211.7547		
## 5	1995-09-19	130620	227.8	573.3977		
## 6	1992-08-03	65475	185.8	352.3950		
## 7	1995-10-18	52935	142.0	372.7817		
## 8	1982-10-02	61511	105.9	580.8404		
## 9	1993-10-19	23291	131.8	176.7147		
## 10	1979-08-08	34963	100.6	347.5447		
## 11	2003-09-23	19746	88.5	223.1186		
## 12	1999-05-19	65301	81.8	798.3007		
## 13	1997-11-06	23806	87.0	273.6322		
## 14	1986-10-06	14700	72.2	203.6011		
## 15	1999-10-02	23198	55.9	414.9911		
## 16	1997-01-28	14829	51.6	287.3837		
## 17	1994-06-03	12201	55.2	221.0326		
## 18	2000-02-05	20108	43.8	459.0868		
## 19	1993-09-23	17062	55.3	308.5353		
## 20	1998-10-10	28340	42.2	671.5640		
## 21	1989-12-26	16660	52.3	318.5468		

```
ggplot(big_oil_fields, aes(x=reorder(name, -recoverable_oil), y=recoverable_oil)) +
  geom_col() +
  theme(axis.text.x = element_text(angle = 90)) +
  labs(x="", y="Recoverable Oil, SM3")
```



```
library(ggmap)
```

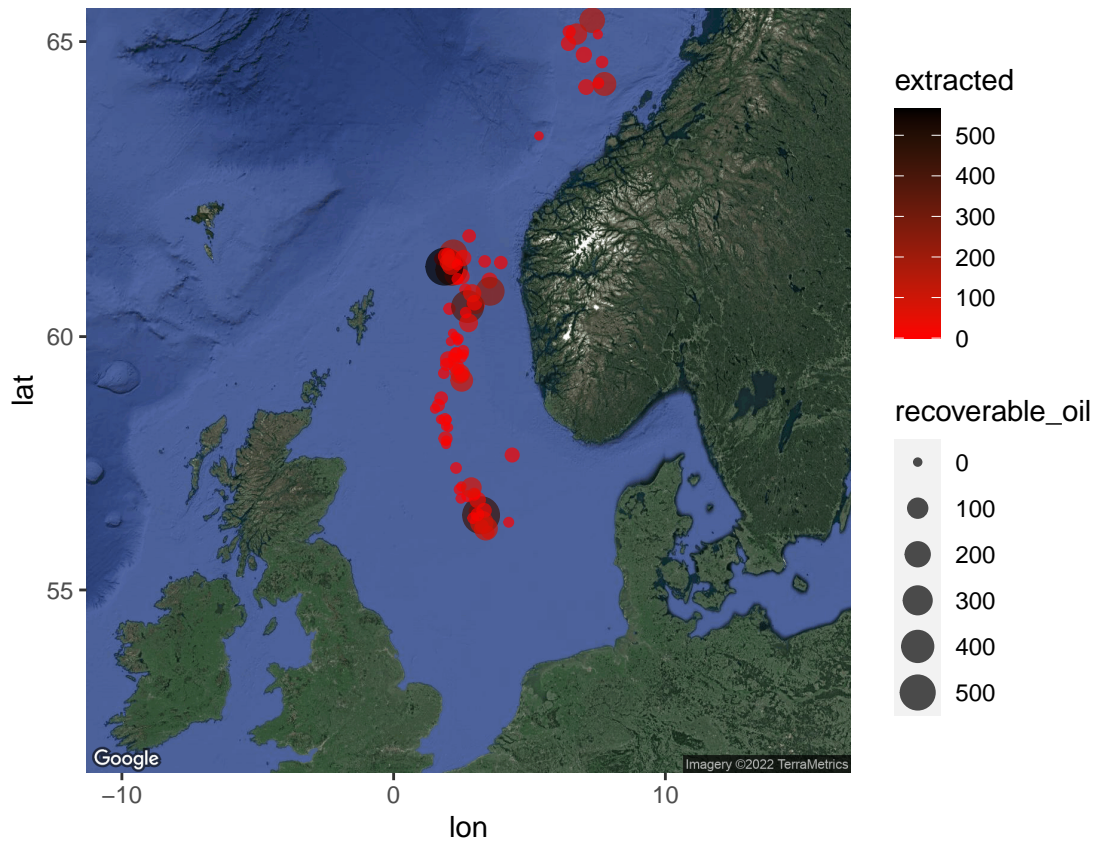
```
maps_api_key <- Sys.getenv('GOOGLE_API_KEY')
maps_api_key = Sys.getenv('GOOGLE_API_KEY')
register_google(key = maps_api_key)
```

```
northsea=get_googlemap(center = c(lon = 2.74, lat = 59.00), zoom=5, maptype="satellite")
```

```
## Source : https://maps.googleapis.com/maps/api/staticmap?center=59,2.74&zoom=5&size=640x640&scale=2&m
```

```
ggmap(northsea) +
  geom_point(aes(x = lon, y = lat, size=recoverable_oil, color=extracted),alpha=.7, data = oil_fields)+
  scale_color_continuous(low="red", high="black")
```

```
## Warning: Removed 11 rows containing missing values (geom_point).
```



#Exercises

oil\_fields

##	...	1	name	lon	lat	recoverable_oil	remaining_oil
## 1	1	33/9-6	DELTA	NA	NA	NA	NA
## 2	6		ALBUSKJELL	2.993019	56.63079	7.4	0.0
## 3	46		ALVE	7.827906	65.96924	1.9	0.8
## 4	54		ALVHEIM	2.010224	59.57465	37.2	17.5
## 5	64		ÅSGARD	6.728537	65.11635	100.4	18.6
## 6	82		ATLA	2.577873	59.67057	0.3	0.3
## 7	85		BALDER	2.446895	59.30631	72.1	16.2
## 8	109		BLANE	2.473427	56.88505	0.8	0.3
## 9	118		BØYLA	1.848627	59.32033	3.4	3.4
## 10	121		BRAGE	3.014216	60.58058	59.3	4.0
## 11	146		BRYNHILD	2.297317	57.49330	3.6	3.6
## 12	149		COD	2.422911	57.06647	2.9	0.0
## 13	190		DRAUGEN	7.756043	64.33243	146.7	14.9
## 14	216		EDDA	3.103594	56.47110	4.8	0.0
## 15	257		EKOFISK	3.218287	56.54663	569.2	129.8
## 16	301		ELDFISK	3.242870	56.39870	137.9	37.3
## 17	341		EMBLA	3.249919	56.32710	11.9	1.5
## 18	365		ENOCH	1.523260	58.64759	0.4	0.1
## 19	374		FRAM	3.528545	61.01547	30.7	5.9
## 20	391		FRIGG	2.094430	59.91108	0.0	0.0
## 21	428		FRØY	2.556764	59.73203	5.6	0.0

## 22	450	GAUPE	1.931471	57.96129	0.2	0.1
## 23	454	GIMLE	2.317010	61.24770	3.0	0.4
## 24	464	GINA KROG	NA	NA	NA	NA
## 25	468	GJØA	3.945822	61.33418	11.6	6.4
## 26	485	GLITNE	1.647140	58.71153	8.9	0.0
## 27	499	GOLIAT	22.296546	71.27406	30.2	30.2
## 28	504	GRANE	2.506074	59.18574	124.6	36.1
## 29	520	GUDRUN	1.751611	58.84938	11.7	11.7
## 30	524	GULLFAKS	2.130364	61.20896	365.5	11.6
## 31	557	GULLFAKS SØR	2.215286	61.10673	58.8	16.6
## 32	575	GUNGNE	1.917072	58.30961	0.0	0.0
## 33	594	GYDA	3.089733	56.85435	36.5	0.9
## 34	620	HEIDRUN	7.306980	65.32944	182.1	40.1
## 35	648	HEIMDAL	2.226203	59.58547	8.2	1.6
## 36	681	HOD	3.472108	56.19843	10.4	0.9
## 37	707	HULDRA	2.641797	60.85444	5.1	0.0
## 38	723	HYME	7.536641	64.34594	3.2	3.2
## 39	726	ISLAY	NA	NA	0.0	0.0
## 40	730	JETTE	2.359870	59.39335	1.5	1.5
## 41	733	JOTUN	2.325348	59.42954	23.4	0.7
## 42	752	KNARR	2.781421	61.80114	11.9	11.9
## 43	755	KRISTIN	6.433011	64.97139	22.9	6.0
## 44	768	KVITEBJØRN	2.509959	61.09226	27.3	9.8
## 45	782	LILLE-FRIGG	2.382012	59.95617	1.3	0.0
## 46	802	MARTIN LINGE	2.054545	60.50824	6.0	6.0
## 47	808	MARULK	7.586522	65.95250	0.7	0.6
## 48	813	MIKKEL	7.669056	64.68017	6.6	3.3
## 49	826	MIME	2.494998	57.12693	0.4	0.0
## 50	832	MORVIN	6.460434	65.15322	9.3	5.6
## 51	839	MURCHISON	1.744179	61.40133	13.9	0.0
## 52	879	NJORD	7.085968	64.28369	28.5	3.0
## 53	898	NORDØST FRIGG	2.273026	60.00514	0.0	0.0
## 54	917	NORNE	8.147307	66.03421	90.8	3.8
## 55	937	ODIN	2.172505	60.06075	0.0	0.0
## 56	960	ORMEN LANGE	5.349480	63.49258	0.0	0.0
## 57	971	OSEBERG	2.722425	60.54786	384.6	22.7
## 58	1002	OSEBERG ØST	2.978614	60.61807	26.7	7.9
## 59	1020	OSEBERG SØR	2.760004	60.25226	61.0	17.2
## 60	1039	OSELVAR	2.717955	56.93144	4.6	4.5
## 61	1044	ØST FRIGG	2.354428	59.91862	0.0	0.0
## 62	1068	REV	1.932832	58.02975	0.7	0.0
## 63	1081	RINGHORNE ØST	2.494802	59.29083	15.5	6.3
## 64	1090	SIGYN	2.018044	58.28605	0.0	0.0
## 65	1104	SKARV	7.627655	65.72231	15.5	15.5
## 66	1116	SKIRNE	2.491161	59.61747	2.2	0.5
## 67	1129	SKULD	8.314253	66.23375	13.4	13.4
## 68	1132	SLEIPNER ØST	1.967779	58.43631	0.0	0.0
## 69	1159	SLEIPNER VEST	1.730038	58.44112	0.0	0.0
## 70	1182	SNØHVIT	20.974280	71.49443	0.0	0.0
## 71	1194	SNORRE	2.193464	61.49258	249.9	64.1
## 72	1220	STATFJORD	1.866338	61.26222	570.4	4.3
## 73	1260	STATFJORD NORD	1.940215	61.44457	39.5	3.0
## 74	1284	STATFJORD ØST	2.003245	61.33880	36.8	0.7
## 75	1308	SYGNA	2.003040	61.47588	11.0	1.1

## 76	1323	TAMBAR	2.963593	56.97054	9.5	0.6
## 77	1337	TAMBAR ØST	3.002542	56.97172	0.3	0.0
## 78	1344	TOMMELITEN GAMMA	2.927906	56.48807	3.9	0.0
## 79	1369	TOR	3.329413	56.64148	24.3	0.4
## 80	1409	TORDIS	2.117935	61.28220	61.2	6.0
## 81	1432	TROLL	3.552057	60.82293	263.8	36.0
## 82	1460	TRYM	4.236097	56.40414	1.5	0.8
## 83	1465	TUNE	2.653474	60.43847	3.3	0.0
## 84	1481	TYRIHANS	7.000546	64.79362	32.4	16.5
## 85	1491	ULA	2.860582	57.10273	87.9	15.7
## 86	1522	URD	8.181120	66.05629	7.0	2.0
## 87	1533	VALE	2.302589	59.70584	2.4	1.1
## 88	1549	VALEMON	2.355820	61.04258	4.9	4.9
## 89	1553	VALHALL	3.393803	56.27577	147.4	41.5
## 90	1590	VARG	1.908065	58.07247	16.4	1.4
## 91	1608	VEGA	3.353838	61.35584	6.6	5.1
## 92	1616	VESLEFRIKK	2.891658	60.78827	54.1	1.8
## 93	1643	VEST EKOFISK	3.085798	56.56262	12.2	0.0
## 94	1684	VIGDIS	2.147171	61.40055	66.6	15.0
## 95	1704	VILJE	2.275522	59.66342	13.6	6.2
## 96	1713	VISUND	2.558184	61.41580	33.9	11.5
## 97	1732	VISUND SØR	2.345196	61.29676	2.7	2.7
## 98	1735	VOLUND	1.946607	59.48411	8.6	4.0
## 99	1745	VOLVE	1.890830	58.43905	8.7	1.0
## 100	1754	YME	4.362773	57.74885	22.0	14.1
## 101	1796	YTTERGRYTA	7.515016	65.11059	0.3	0.0
##	producing_from total.invest extracted invest_per_millsm3					
## 1	<NA>	0	NA	NA		
## 2	1979-05-26	2752	7.4	371.89189		
## 3	2009-03-19	3864	1.1	3512.72727		
## 4	2008-06-08	17708	19.7	898.88325		
## 5	1999-05-19	65301	81.8	798.30073		
## 6	2012-10-07	324	0.0	Inf		
## 7	1999-10-02	23198	55.9	414.99106		
## 8	2007-09-12	544	0.5	1088.00000		
## 9	<NA>	85	0.0	Inf		
## 10	1993-09-23	17062	55.3	308.53526		
## 11	<NA>	210	0.0	Inf		
## 12	1977-12-26	1003	2.9	345.86207		
## 13	1993-10-19	23291	131.8	176.71472		
## 14	1979-12-02	2157	4.8	449.37500		
## 15	1971-06-15	94172	439.4	214.31953		
## 16	1979-08-08	34963	100.6	347.54473		
## 17	1993-05-12	3129	10.4	300.86538		
## 18	2007-05-31	208	0.3	693.33333		
## 19	2003-10-02	9875	24.8	398.18548		
## 20	1977-09-13	8614	0.0	Inf		
## 21	1995-05-15	5551	5.6	991.25000		
## 22	2012-03-31	2085	0.1	20850.00000		
## 23	2006-05-19	780	2.6	300.00000		
## 24	<NA>	0	NA	NA		
## 25	2010-11-07	28043	5.2	5392.88462		
## 26	2001-08-29	2536	8.9	284.94382		
## 27	<NA>	10182	0.0	Inf		

## 28	2003-09-23	19746	88.5	223.11864
## 29	<NA>	5857	0.0	Inf
## 30	1986-12-22	74940	353.9	211.75473
## 31	1998-10-10	28340	42.2	671.56398
## 32	1996-04-21	1930	0.0	Inf
## 33	1990-06-21	12435	35.6	349.29775
## 34	1995-10-18	52935	142.0	372.78169
## 35	1985-12-13	10064	6.6	1524.84848
## 36	1990-09-30	2254	9.5	237.26316
## 37	2001-11-21	7460	5.1	1462.74510
## 38	2013-03-02	897	0.0	Inf
## 39	2012-04-10	578	0.0	Inf
## 40	2013-05-20	263	0.0	Inf
## 41	1999-10-25	9484	22.7	417.79736
## 42	<NA>	534	0.0	Inf
## 43	2005-11-03	24467	16.9	1447.75148
## 44	2004-09-26	13707	17.5	783.25714
## 45	1994-05-13	3923	1.3	3017.69231
## 46	<NA>	402	0.0	Inf
## 47	2012-04-02	2173	0.1	21730.00000
## 48	2003-08-01	2182	3.3	661.21212
## 49	1993-01-01	324	0.4	810.00000
## 50	2010-08-01	7994	3.7	2160.54054
## 51	1980-09-28	2597	13.9	186.83453
## 52	1997-09-30	14888	25.5	583.84314
## 53	1983-12-01	1816	0.0	Inf
## 54	1997-11-06	23806	87.0	273.63218
## 55	1984-04-01	2614	0.0	Inf
## 56	2007-09-13	35967	0.0	Inf
## 57	1988-12-01	66622	361.9	184.08953
## 58	1999-05-03	8827	18.8	469.52128
## 59	2000-02-05	20108	43.8	459.08676
## 60	2012-04-14	3535	0.1	35350.00000
## 61	1988-10-01	2186	0.0	Inf
## 62	2009-01-24	3831	0.7	5472.85714
## 63	2006-03-19	738	9.2	80.21739
## 64	2002-12-22	2066	0.0	Inf
## 65	2013-01-01	37119	0.0	Inf
## 66	2004-03-03	2685	1.7	1579.41176
## 67	2013-03-19	1434	0.0	Inf
## 68	1993-08-24	26756	0.0	Inf
## 69	1996-08-29	23176	0.0	Inf
## 70	2007-08-21	8235	0.0	Inf
## 71	1992-08-03	65475	185.8	352.39505
## 72	1979-11-24	65264	566.1	115.28705
## 73	1995-01-23	5719	36.5	156.68493
## 74	1994-09-24	6015	36.1	166.62050
## 75	2000-08-01	1984	9.9	200.40404
## 76	2001-07-15	2212	8.9	248.53933
## 77	2007-10-02	1034	0.3	3446.66667
## 78	1988-10-03	2406	3.9	616.92308
## 79	1978-06-28	3934	23.9	164.60251
## 80	1994-06-03	12201	55.2	221.03261
## 81	1995-09-19	130620	227.8	573.39772

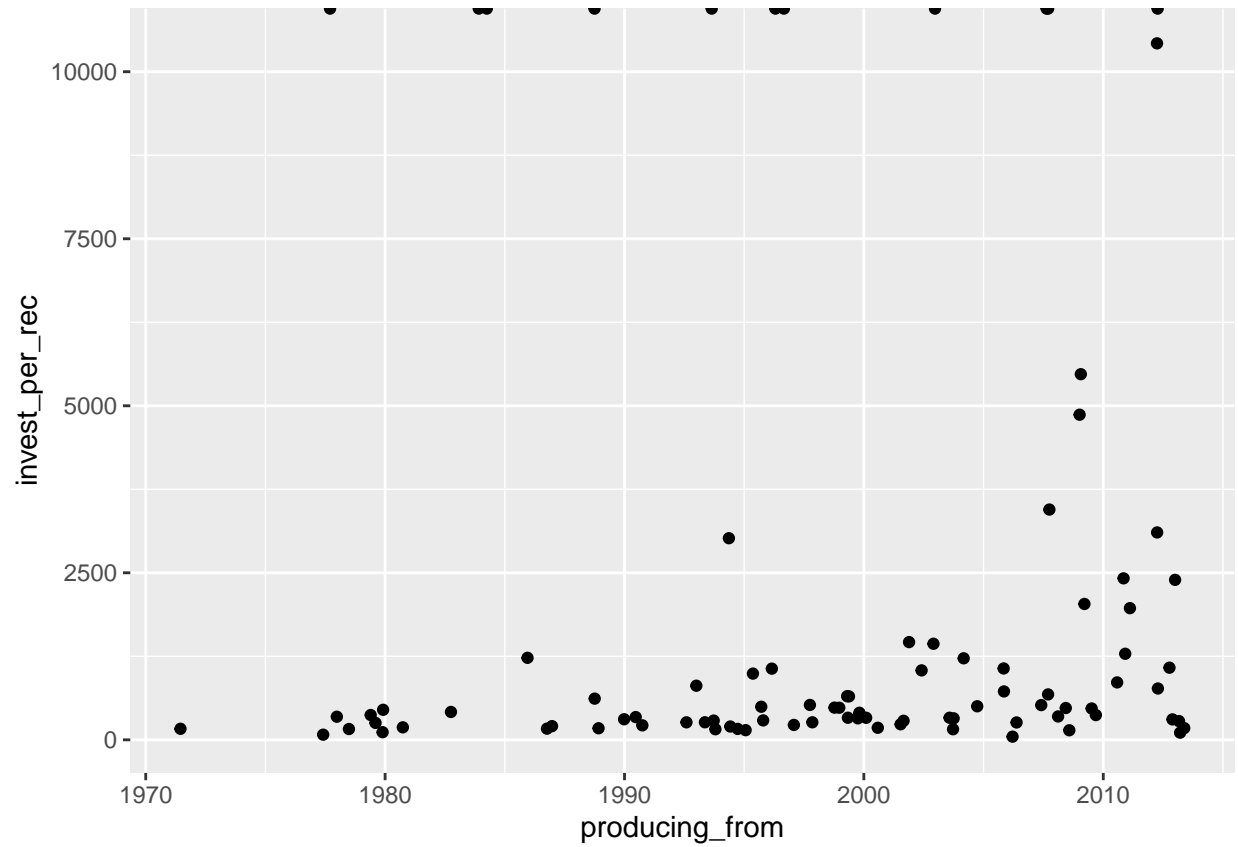
## 82	2011-02-12	2956	0.7	4222.85714
## 83	2002-11-28	4746	3.3	1438.18182
## 84	2009-07-08	15203	15.9	956.16352
## 85	1986-10-06	14700	72.2	203.60111
## 86	2005-11-08	5073	5.0	1014.60000
## 87	2002-05-31	2495	1.3	1919.23077
## 88	<NA>	1484	0.0	Inf
## 89	1982-10-02	61511	105.9	580.84042
## 90	1998-12-22	7880	15.0	525.33333
## 91	2010-12-02	8503	1.5	5668.66667
## 92	1989-12-26	16660	52.3	318.54685
## 93	1977-05-31	943	12.2	77.29508
## 94	1997-01-28	14829	51.6	287.38372
## 95	2008-08-01	1947	7.4	263.10811
## 96	1999-04-21	22136	22.4	988.21429
## 97	2012-11-22	826	0.0	Inf
## 98	2009-09-10	3185	4.6	692.39130
## 99	2008-02-12	3044	7.7	395.32468
## 100	1996-02-27	23438	7.9	2966.83544
## 101	2009-01-05	1460	0.3	4866.66667

#1)

```
oil_fields <- oil_fields %>%
  mutate(invest_per_rec = total.invest/recoverable_oil)
ggplot(oil_fields, mapping = aes(
  x = producing_from,
  y = invest_per_rec)
) +
  geom_point()
```

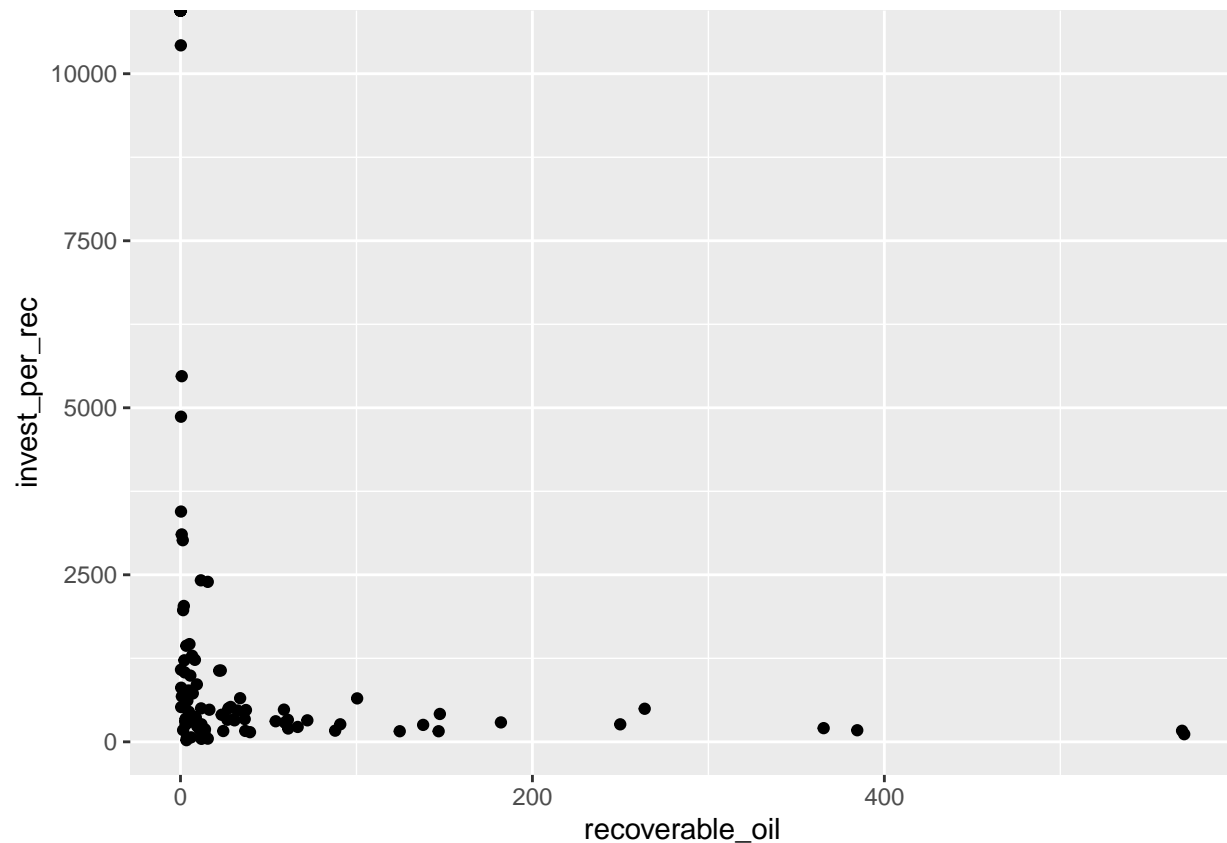
## Warning: Removed 9 rows containing missing values (geom\_point).





```
ggplot(oil_fields, mapping = aes(  
  x = recoverable_oil,  
  y = invest_per_rec)  
) +  
  geom_point()
```

```
## Warning: Removed 2 rows containing missing values (geom_point).
```



#2)

```
oil_fields_arranged <- oil_fields %>%
  arrange(by_group = invest_per_rec)
threshold <- oil_fields_arranged[5,]$invest_per_rec
threshold
```

```
## [1] 67
```

```
oil_fields %>%
  filter(invest_per_rec<= threshold)
```

```
##   ...1      name      lon      lat recoverable_oil remaining_oil
## 1  118      BØYLA 1.848627 59.32033           3.4           3.4
## 2  146      BRYNHILD 2.297317 57.49330           3.6           3.6
## 3  752       KNARR 2.781421 61.80114           11.9          11.9
## 4  802  MARTIN LINGE 2.054545 60.50824            6.0            6.0
## 5 1081 RINGHORNE ØST 2.494802 59.29083           15.5            6.3
##   producing_from total.invest extracted invest_per_millsm3 invest_per_rec
## 1             <NA>         85         0.0                Inf      25.00000
## 2             <NA>        210         0.0                Inf      58.33333
## 3             <NA>        534         0.0                Inf      44.87395
## 4             <NA>        402         0.0                Inf      67.00000
## 5      2006-03-19        738         9.2        80.21739      47.61290
```

## oil\_fields

##	...	name	lon	lat	recoverable_oil	remaining_oil
## 1	1	33/9-6 DELTA	NA	NA	NA	NA
## 2	6	ALBUSKJELL	2.993019	56.63079	7.4	0.0
## 3	46	ALVE	7.827906	65.96924	1.9	0.8
## 4	54	ALVHEIM	2.010224	59.57465	37.2	17.5
## 5	64	ÅSGARD	6.728537	65.11635	100.4	18.6
## 6	82	ATLA	2.577873	59.67057	0.3	0.3
## 7	85	BALDER	2.446895	59.30631	72.1	16.2
## 8	109	BLANE	2.473427	56.88505	0.8	0.3
## 9	118	BØYLA	1.848627	59.32033	3.4	3.4
## 10	121	BRAGE	3.014216	60.58058	59.3	4.0
## 11	146	BRYNHILD	2.297317	57.49330	3.6	3.6
## 12	149	COD	2.422911	57.06647	2.9	0.0
## 13	190	DRAUGEN	7.756043	64.33243	146.7	14.9
## 14	216	EDDA	3.103594	56.47110	4.8	0.0
## 15	257	EKOFISK	3.218287	56.54663	569.2	129.8
## 16	301	ELDFISK	3.242870	56.39870	137.9	37.3
## 17	341	EMBLA	3.249919	56.32710	11.9	1.5
## 18	365	ENOCK	1.523260	58.64759	0.4	0.1
## 19	374	FRAM	3.528545	61.01547	30.7	5.9
## 20	391	FRIGG	2.094430	59.91108	0.0	0.0
## 21	428	FRØY	2.556764	59.73203	5.6	0.0
## 22	450	GAUPE	1.931471	57.96129	0.2	0.1
## 23	454	GIMLE	2.317010	61.24770	3.0	0.4
## 24	464	GINA KROG	NA	NA	NA	NA
## 25	468	GJØA	3.945822	61.33418	11.6	6.4
## 26	485	GLITNE	1.647140	58.71153	8.9	0.0
## 27	499	GOLIAT	22.296546	71.27406	30.2	30.2
## 28	504	GRANE	2.506074	59.18574	124.6	36.1
## 29	520	GUDRUN	1.751611	58.84938	11.7	11.7
## 30	524	GULLFAKS	2.130364	61.20896	365.5	11.6
## 31	557	GULLFAKS SØR	2.215286	61.10673	58.8	16.6
## 32	575	GUNGNE	1.917072	58.30961	0.0	0.0
## 33	594	GYDA	3.089733	56.85435	36.5	0.9
## 34	620	HEIDRUN	7.306980	65.32944	182.1	40.1
## 35	648	HEIMDAL	2.226203	59.58547	8.2	1.6
## 36	681	HOD	3.472108	56.19843	10.4	0.9
## 37	707	HULDRA	2.641797	60.85444	5.1	0.0
## 38	723	HYME	7.536641	64.34594	3.2	3.2
## 39	726	ISLAY	NA	NA	0.0	0.0
## 40	730	JETTE	2.359870	59.39335	1.5	1.5
## 41	733	JOTUN	2.325348	59.42954	23.4	0.7
## 42	752	KNARR	2.781421	61.80114	11.9	11.9
## 43	755	KRISTIN	6.433011	64.97139	22.9	6.0
## 44	768	KVITEBJØRN	2.509959	61.09226	27.3	9.8
## 45	782	LILLE-FRIGG	2.382012	59.95617	1.3	0.0
## 46	802	MARTIN LINGE	2.054545	60.50824	6.0	6.0
## 47	808	MARULK	7.586522	65.95250	0.7	0.6
## 48	813	MIKKEL	7.669056	64.68017	6.6	3.3
## 49	826	MIME	2.494998	57.12693	0.4	0.0
## 50	832	MORVIN	6.460434	65.15322	9.3	5.6

## 51	839	MURCHISON	1.744179	61.40133	13.9	0.0
## 52	879	NJORD	7.085968	64.28369	28.5	3.0
## 53	898	NORDØST FRIGG	2.273026	60.00514	0.0	0.0
## 54	917	NORNE	8.147307	66.03421	90.8	3.8
## 55	937	ODIN	2.172505	60.06075	0.0	0.0
## 56	960	ORMEN LANGE	5.349480	63.49258	0.0	0.0
## 57	971	OSEBERG	2.722425	60.54786	384.6	22.7
## 58	1002	OSEBERG ØST	2.978614	60.61807	26.7	7.9
## 59	1020	OSEBERG SØR	2.760004	60.25226	61.0	17.2
## 60	1039	OSELVAR	2.717955	56.93144	4.6	4.5
## 61	1044	ØST FRIGG	2.354428	59.91862	0.0	0.0
## 62	1068	REV	1.932832	58.02975	0.7	0.0
## 63	1081	RINGHORNE ØST	2.494802	59.29083	15.5	6.3
## 64	1090	SIGYN	2.018044	58.28605	0.0	0.0
## 65	1104	SKARV	7.627655	65.72231	15.5	15.5
## 66	1116	SKIRNE	2.491161	59.61747	2.2	0.5
## 67	1129	SKULD	8.314253	66.23375	13.4	13.4
## 68	1132	SLEIPNER ØST	1.967779	58.43631	0.0	0.0
## 69	1159	SLEIPNER VEST	1.730038	58.44112	0.0	0.0
## 70	1182	SNØHVIT	20.974280	71.49443	0.0	0.0
## 71	1194	SNORRE	2.193464	61.49258	249.9	64.1
## 72	1220	STATFJORD	1.866338	61.26222	570.4	4.3
## 73	1260	STATFJORD NORD	1.940215	61.44457	39.5	3.0
## 74	1284	STATFJORD ØST	2.003245	61.33880	36.8	0.7
## 75	1308	SYGNA	2.003040	61.47588	11.0	1.1
## 76	1323	TAMBAR	2.963593	56.97054	9.5	0.6
## 77	1337	TAMBAR ØST	3.002542	56.97172	0.3	0.0
## 78	1344	TOMMELITEN GAMMA	2.927906	56.48807	3.9	0.0
## 79	1369	TOR	3.329413	56.64148	24.3	0.4
## 80	1409	TORDIS	2.117935	61.28220	61.2	6.0
## 81	1432	TROLL	3.552057	60.82293	263.8	36.0
## 82	1460	TRYM	4.236097	56.40414	1.5	0.8
## 83	1465	TUNE	2.653474	60.43847	3.3	0.0
## 84	1481	TYRIHANS	7.000546	64.79362	32.4	16.5
## 85	1491	ULA	2.860582	57.10273	87.9	15.7
## 86	1522	URD	8.181120	66.05629	7.0	2.0
## 87	1533	VALE	2.302589	59.70584	2.4	1.1
## 88	1549	VALEMON	2.355820	61.04258	4.9	4.9
## 89	1553	VALHALL	3.393803	56.27577	147.4	41.5
## 90	1590	VARG	1.908065	58.07247	16.4	1.4
## 91	1608	VEGA	3.353838	61.35584	6.6	5.1
## 92	1616	VESLEFRIKK	2.891658	60.78827	54.1	1.8
## 93	1643	VEST EKOFISK	3.085798	56.56262	12.2	0.0
## 94	1684	VIGDIS	2.147171	61.40055	66.6	15.0
## 95	1704	VILJE	2.275522	59.66342	13.6	6.2
## 96	1713	VISUND	2.558184	61.41580	33.9	11.5
## 97	1732	VISUND SØR	2.345196	61.29676	2.7	2.7
## 98	1735	VOLUND	1.946607	59.48411	8.6	4.0
## 99	1745	VOLVE	1.890830	58.43905	8.7	1.0
## 100	1754	YME	4.362773	57.74885	22.0	14.1
## 101	1796	YTTERGRYTA	7.515016	65.11059	0.3	0.0
##		producing_from total.invest extracted invest_per_millsm3 invest_per_rec				
## 1		<NA>	0	NA	NA	NA
## 2	1979-05-26		2752	7.4	371.89189	371.89189

## 3	2009-03-19	3864	1.1	3512.72727	2033.68421
## 4	2008-06-08	17708	19.7	898.88325	476.02151
## 5	1999-05-19	65301	81.8	798.30073	650.40837
## 6	2012-10-07	324	0.0	Inf	1080.00000
## 7	1999-10-02	23198	55.9	414.99106	321.74757
## 8	2007-09-12	544	0.5	1088.00000	680.00000
## 9	<NA>	85	0.0	Inf	25.00000
## 10	1993-09-23	17062	55.3	308.53526	287.72344
## 11	<NA>	210	0.0	Inf	58.33333
## 12	1977-12-26	1003	2.9	345.86207	345.86207
## 13	1993-10-19	23291	131.8	176.71472	158.76619
## 14	1979-12-02	2157	4.8	449.37500	449.37500
## 15	1971-06-15	94172	439.4	214.31953	165.44624
## 16	1979-08-08	34963	100.6	347.54473	253.53880
## 17	1993-05-12	3129	10.4	300.86538	262.94118
## 18	2007-05-31	208	0.3	693.33333	520.00000
## 19	2003-10-02	9875	24.8	398.18548	321.66124
## 20	1977-09-13	8614	0.0	Inf	Inf
## 21	1995-05-15	5551	5.6	991.25000	991.25000
## 22	2012-03-31	2085	0.1	20850.00000	10425.00000
## 23	2006-05-19	780	2.6	300.00000	260.00000
## 24	<NA>	0	NA	NA	NA
## 25	2010-11-07	28043	5.2	5392.88462	2417.50000
## 26	2001-08-29	2536	8.9	284.94382	284.94382
## 27	<NA>	10182	0.0	Inf	337.15232
## 28	2003-09-23	19746	88.5	223.11864	158.47512
## 29	<NA>	5857	0.0	Inf	500.59829
## 30	1986-12-22	74940	353.9	211.75473	205.03420
## 31	1998-10-10	28340	42.2	671.56398	481.97279
## 32	1996-04-21	1930	0.0	Inf	Inf
## 33	1990-06-21	12435	35.6	349.29775	340.68493
## 34	1995-10-18	52935	142.0	372.78169	290.69193
## 35	1985-12-13	10064	6.6	1524.84848	1227.31707
## 36	1990-09-30	2254	9.5	237.26316	216.73077
## 37	2001-11-21	7460	5.1	1462.74510	1462.74510
## 38	2013-03-02	897	0.0	Inf	280.31250
## 39	2012-04-10	578	0.0	Inf	Inf
## 40	2013-05-20	263	0.0	Inf	175.33333
## 41	1999-10-25	9484	22.7	417.79736	405.29915
## 42	<NA>	534	0.0	Inf	44.87395
## 43	2005-11-03	24467	16.9	1447.75148	1068.42795
## 44	2004-09-26	13707	17.5	783.25714	502.08791
## 45	1994-05-13	3923	1.3	3017.69231	3017.69231
## 46	<NA>	402	0.0	Inf	67.00000
## 47	2012-04-02	2173	0.1	21730.00000	3104.28571
## 48	2003-08-01	2182	3.3	661.21212	330.60606
## 49	1993-01-01	324	0.4	810.00000	810.00000
## 50	2010-08-01	7994	3.7	2160.54054	859.56989
## 51	1980-09-28	2597	13.9	186.83453	186.83453
## 52	1997-09-30	14888	25.5	583.84314	522.38596
## 53	1983-12-01	1816	0.0	Inf	Inf
## 54	1997-11-06	23806	87.0	273.63218	262.18062
## 55	1984-04-01	2614	0.0	Inf	Inf
## 56	2007-09-13	35967	0.0	Inf	Inf

## 57	1988-12-01	66622	361.9	184.08953	173.22413
## 58	1999-05-03	8827	18.8	469.52128	330.59925
## 59	2000-02-05	20108	43.8	459.08676	329.63934
## 60	2012-04-14	3535	0.1	35350.00000	768.47826
## 61	1988-10-01	2186	0.0	Inf	Inf
## 62	2009-01-24	3831	0.7	5472.85714	5472.85714
## 63	2006-03-19	738	9.2	80.21739	47.61290
## 64	2002-12-22	2066	0.0	Inf	Inf
## 65	2013-01-01	37119	0.0	Inf	2394.77419
## 66	2004-03-03	2685	1.7	1579.41176	1220.45455
## 67	2013-03-19	1434	0.0	Inf	107.01493
## 68	1993-08-24	26756	0.0	Inf	Inf
## 69	1996-08-29	23176	0.0	Inf	Inf
## 70	2007-08-21	8235	0.0	Inf	Inf
## 71	1992-08-03	65475	185.8	352.39505	262.00480
## 72	1979-11-24	65264	566.1	115.28705	114.41795
## 73	1995-01-23	5719	36.5	156.68493	144.78481
## 74	1994-09-24	6015	36.1	166.62050	163.45109
## 75	2000-08-01	1984	9.9	200.40404	180.36364
## 76	2001-07-15	2212	8.9	248.53933	232.84211
## 77	2007-10-02	1034	0.3	3446.66667	3446.66667
## 78	1988-10-03	2406	3.9	616.92308	616.92308
## 79	1978-06-28	3934	23.9	164.60251	161.89300
## 80	1994-06-03	12201	55.2	221.03261	199.36275
## 81	1995-09-19	130620	227.8	573.39772	495.14784
## 82	2011-02-12	2956	0.7	4222.85714	1970.66667
## 83	2002-11-28	4746	3.3	1438.18182	1438.18182
## 84	2009-07-08	15203	15.9	956.16352	469.22840
## 85	1986-10-06	14700	72.2	203.60111	167.23549
## 86	2005-11-08	5073	5.0	1014.60000	724.71429
## 87	2002-05-31	2495	1.3	1919.23077	1039.58333
## 88	<NA>	1484	0.0	Inf	302.85714
## 89	1982-10-02	61511	105.9	580.84042	417.30665
## 90	1998-12-22	7880	15.0	525.33333	480.48780
## 91	2010-12-02	8503	1.5	5668.66667	1288.33333
## 92	1989-12-26	16660	52.3	318.54685	307.94824
## 93	1977-05-31	943	12.2	77.29508	77.29508
## 94	1997-01-28	14829	51.6	287.38372	222.65766
## 95	2008-08-01	1947	7.4	263.10811	143.16176
## 96	1999-04-21	22136	22.4	988.21429	652.97935
## 97	2012-11-22	826	0.0	Inf	305.92593
## 98	2009-09-10	3185	4.6	692.39130	370.34884
## 99	2008-02-12	3044	7.7	395.32468	349.88506
## 100	1996-02-27	23438	7.9	2966.83544	1065.36364
## 101	2009-01-05	1460	0.3	4866.66667	4866.66667

```
oil_fields_reg <- oil_fields %>%
  filter(!is.na(invest_per_millsm3)) %>%
  filter(!is.na(lat)) %>%
  filter(invest_per_millsm3 != Inf)
oil_fields_reg
```

##	...	1	name	lon	lat	recoverable_oil	remaining_oil
## 1	6		ALBUSKJELL	2.993019	56.63079	7.4	0.0

## 2	46	ALVE	7.827906	65.96924	1.9	0.8
## 3	54	ALVHEIM	2.010224	59.57465	37.2	17.5
## 4	64	ÅSGARD	6.728537	65.11635	100.4	18.6
## 5	85	BALDER	2.446895	59.30631	72.1	16.2
## 6	109	BLANE	2.473427	56.88505	0.8	0.3
## 7	121	BRAGE	3.014216	60.58058	59.3	4.0
## 8	149	COD	2.422911	57.06647	2.9	0.0
## 9	190	DRAUGEN	7.756043	64.33243	146.7	14.9
## 10	216	EDDA	3.103594	56.47110	4.8	0.0
## 11	257	EKOFISK	3.218287	56.54663	569.2	129.8
## 12	301	ELDFISK	3.242870	56.39870	137.9	37.3
## 13	341	EMBLA	3.249919	56.32710	11.9	1.5
## 14	365	ENOCK	1.523260	58.64759	0.4	0.1
## 15	374	FRAM	3.528545	61.01547	30.7	5.9
## 16	428	FRØY	2.556764	59.73203	5.6	0.0
## 17	450	GAUPE	1.931471	57.96129	0.2	0.1
## 18	454	GIMLE	2.317010	61.24770	3.0	0.4
## 19	468	GJØA	3.945822	61.33418	11.6	6.4
## 20	485	GLITNE	1.647140	58.71153	8.9	0.0
## 21	504	GRANE	2.506074	59.18574	124.6	36.1
## 22	524	GULLFAKS	2.130364	61.20896	365.5	11.6
## 23	557	GULLFAKS SØR	2.215286	61.10673	58.8	16.6
## 24	594	GYDA	3.089733	56.85435	36.5	0.9
## 25	620	HEIDRUN	7.306980	65.32944	182.1	40.1
## 26	648	HEIMDAL	2.226203	59.58547	8.2	1.6
## 27	681	HOD	3.472108	56.19843	10.4	0.9
## 28	707	HULDRA	2.641797	60.85444	5.1	0.0
## 29	733	JOTUN	2.325348	59.42954	23.4	0.7
## 30	755	KRISTIN	6.433011	64.97139	22.9	6.0
## 31	768	KVITEBJØRN	2.509959	61.09226	27.3	9.8
## 32	782	LILLE-FRIGG	2.382012	59.95617	1.3	0.0
## 33	808	MARULK	7.586522	65.95250	0.7	0.6
## 34	813	MIKKEL	7.669056	64.68017	6.6	3.3
## 35	826	MIME	2.494998	57.12693	0.4	0.0
## 36	832	MORVIN	6.460434	65.15322	9.3	5.6
## 37	839	MURCHISON	1.744179	61.40133	13.9	0.0
## 38	879	NJORD	7.085968	64.28369	28.5	3.0
## 39	917	NORNE	8.147307	66.03421	90.8	3.8
## 40	971	OSEBERG	2.722425	60.54786	384.6	22.7
## 41	1002	OSEBERG ØST	2.978614	60.61807	26.7	7.9
## 42	1020	OSEBERG SØR	2.760004	60.25226	61.0	17.2
## 43	1039	OSELVAR	2.717955	56.93144	4.6	4.5
## 44	1068	REV	1.932832	58.02975	0.7	0.0
## 45	1081	RINGHORNE ØST	2.494802	59.29083	15.5	6.3
## 46	1116	SKIRNE	2.491161	59.61747	2.2	0.5
## 47	1194	SNORRE	2.193464	61.49258	249.9	64.1
## 48	1220	STATFJORD	1.866338	61.26222	570.4	4.3
## 49	1260	STATFJORD NORD	1.940215	61.44457	39.5	3.0
## 50	1284	STATFJORD ØST	2.003245	61.33880	36.8	0.7
## 51	1308	SYGNA	2.003040	61.47588	11.0	1.1
## 52	1323	TAMBAR	2.963593	56.97054	9.5	0.6
## 53	1337	TAMBAR ØST	3.002542	56.97172	0.3	0.0
## 54	1344	TOMMELITEN GAMMA	2.927906	56.48807	3.9	0.0
## 55	1369	TOR	3.329413	56.64148	24.3	0.4

## 56 1409	TORDIS	2.117935	61.28220	61.2	6.0
## 57 1432	TROLL	3.552057	60.82293	263.8	36.0
## 58 1460	TRYM	4.236097	56.40414	1.5	0.8
## 59 1465	TUNE	2.653474	60.43847	3.3	0.0
## 60 1481	TYRIHANS	7.000546	64.79362	32.4	16.5
## 61 1491	ULA	2.860582	57.10273	87.9	15.7
## 62 1522	URD	8.181120	66.05629	7.0	2.0
## 63 1533	VALE	2.302589	59.70584	2.4	1.1
## 64 1553	VALHALL	3.393803	56.27577	147.4	41.5
## 65 1590	VARG	1.908065	58.07247	16.4	1.4
## 66 1608	VEGA	3.353838	61.35584	6.6	5.1
## 67 1616	VESLEFRIKK	2.891658	60.78827	54.1	1.8
## 68 1643	VEST EKOFISK	3.085798	56.56262	12.2	0.0
## 69 1684	VIGDIS	2.147171	61.40055	66.6	15.0
## 70 1704	VILJE	2.275522	59.66342	13.6	6.2
## 71 1713	VISUND	2.558184	61.41580	33.9	11.5
## 72 1735	VOLUND	1.946607	59.48411	8.6	4.0
## 73 1745	VOLVE	1.890830	58.43905	8.7	1.0
## 74 1754	YME	4.362773	57.74885	22.0	14.1
## 75 1796	YTTERGRYTA	7.515016	65.11059	0.3	0.0
##	producing_from	total.invest	extracted	invest_per_millsm3	invest_per_rec
## 1	1979-05-26	2752	7.4	371.89189	371.89189
## 2	2009-03-19	3864	1.1	3512.72727	2033.68421
## 3	2008-06-08	17708	19.7	898.88325	476.02151
## 4	1999-05-19	65301	81.8	798.30073	650.40837
## 5	1999-10-02	23198	55.9	414.99106	321.74757
## 6	2007-09-12	544	0.5	1088.00000	680.00000
## 7	1993-09-23	17062	55.3	308.53526	287.72344
## 8	1977-12-26	1003	2.9	345.86207	345.86207
## 9	1993-10-19	23291	131.8	176.71472	158.76619
## 10	1979-12-02	2157	4.8	449.37500	449.37500
## 11	1971-06-15	94172	439.4	214.31953	165.44624
## 12	1979-08-08	34963	100.6	347.54473	253.53880
## 13	1993-05-12	3129	10.4	300.86538	262.94118
## 14	2007-05-31	208	0.3	693.33333	520.00000
## 15	2003-10-02	9875	24.8	398.18548	321.66124
## 16	1995-05-15	5551	5.6	991.25000	991.25000
## 17	2012-03-31	2085	0.1	20850.00000	10425.00000
## 18	2006-05-19	780	2.6	300.00000	260.00000
## 19	2010-11-07	28043	5.2	5392.88462	2417.50000
## 20	2001-08-29	2536	8.9	284.94382	284.94382
## 21	2003-09-23	19746	88.5	223.11864	158.47512
## 22	1986-12-22	74940	353.9	211.75473	205.03420
## 23	1998-10-10	28340	42.2	671.56398	481.97279
## 24	1990-06-21	12435	35.6	349.29775	340.68493
## 25	1995-10-18	52935	142.0	372.78169	290.69193
## 26	1985-12-13	10064	6.6	1524.84848	1227.31707
## 27	1990-09-30	2254	9.5	237.26316	216.73077
## 28	2001-11-21	7460	5.1	1462.74510	1462.74510
## 29	1999-10-25	9484	22.7	417.79736	405.29915
## 30	2005-11-03	24467	16.9	1447.75148	1068.42795
## 31	2004-09-26	13707	17.5	783.25714	502.08791
## 32	1994-05-13	3923	1.3	3017.69231	3017.69231
## 33	2012-04-02	2173	0.1	21730.00000	3104.28571



## 34	2003-08-01	2182	3.3	661.21212	330.60606
## 35	1993-01-01	324	0.4	810.00000	810.00000
## 36	2010-08-01	7994	3.7	2160.54054	859.56989
## 37	1980-09-28	2597	13.9	186.83453	186.83453
## 38	1997-09-30	14888	25.5	583.84314	522.38596
## 39	1997-11-06	23806	87.0	273.63218	262.18062
## 40	1988-12-01	66622	361.9	184.08953	173.22413
## 41	1999-05-03	8827	18.8	469.52128	330.59925
## 42	2000-02-05	20108	43.8	459.08676	329.63934
## 43	2012-04-14	3535	0.1	35350.00000	768.47826
## 44	2009-01-24	3831	0.7	5472.85714	5472.85714
## 45	2006-03-19	738	9.2	80.21739	47.61290
## 46	2004-03-03	2685	1.7	1579.41176	1220.45455
## 47	1992-08-03	65475	185.8	352.39505	262.00480
## 48	1979-11-24	65264	566.1	115.28705	114.41795
## 49	1995-01-23	5719	36.5	156.68493	144.78481
## 50	1994-09-24	6015	36.1	166.62050	163.45109
## 51	2000-08-01	1984	9.9	200.40404	180.36364
## 52	2001-07-15	2212	8.9	248.53933	232.84211
## 53	2007-10-02	1034	0.3	3446.66667	3446.66667
## 54	1988-10-03	2406	3.9	616.92308	616.92308
## 55	1978-06-28	3934	23.9	164.60251	161.89300
## 56	1994-06-03	12201	55.2	221.03261	199.36275
## 57	1995-09-19	130620	227.8	573.39772	495.14784
## 58	2011-02-12	2956	0.7	4222.85714	1970.66667
## 59	2002-11-28	4746	3.3	1438.18182	1438.18182
## 60	2009-07-08	15203	15.9	956.16352	469.22840
## 61	1986-10-06	14700	72.2	203.60111	167.23549
## 62	2005-11-08	5073	5.0	1014.60000	724.71429
## 63	2002-05-31	2495	1.3	1919.23077	1039.58333
## 64	1982-10-02	61511	105.9	580.84042	417.30665
## 65	1998-12-22	7880	15.0	525.33333	480.48780
## 66	2010-12-02	8503	1.5	5668.66667	1288.33333
## 67	1989-12-26	16660	52.3	318.54685	307.94824
## 68	1977-05-31	943	12.2	77.29508	77.29508
## 69	1997-01-28	14829	51.6	287.38372	222.65766
## 70	2008-08-01	1947	7.4	263.10811	143.16176
## 71	1999-04-21	22136	22.4	988.21429	652.97935
## 72	2009-09-10	3185	4.6	692.39130	370.34884
## 73	2008-02-12	3044	7.7	395.32468	349.88506
## 74	1996-02-27	23438	7.9	2966.83544	1065.36364
## 75	2009-01-05	1460	0.3	4866.66667	4866.66667

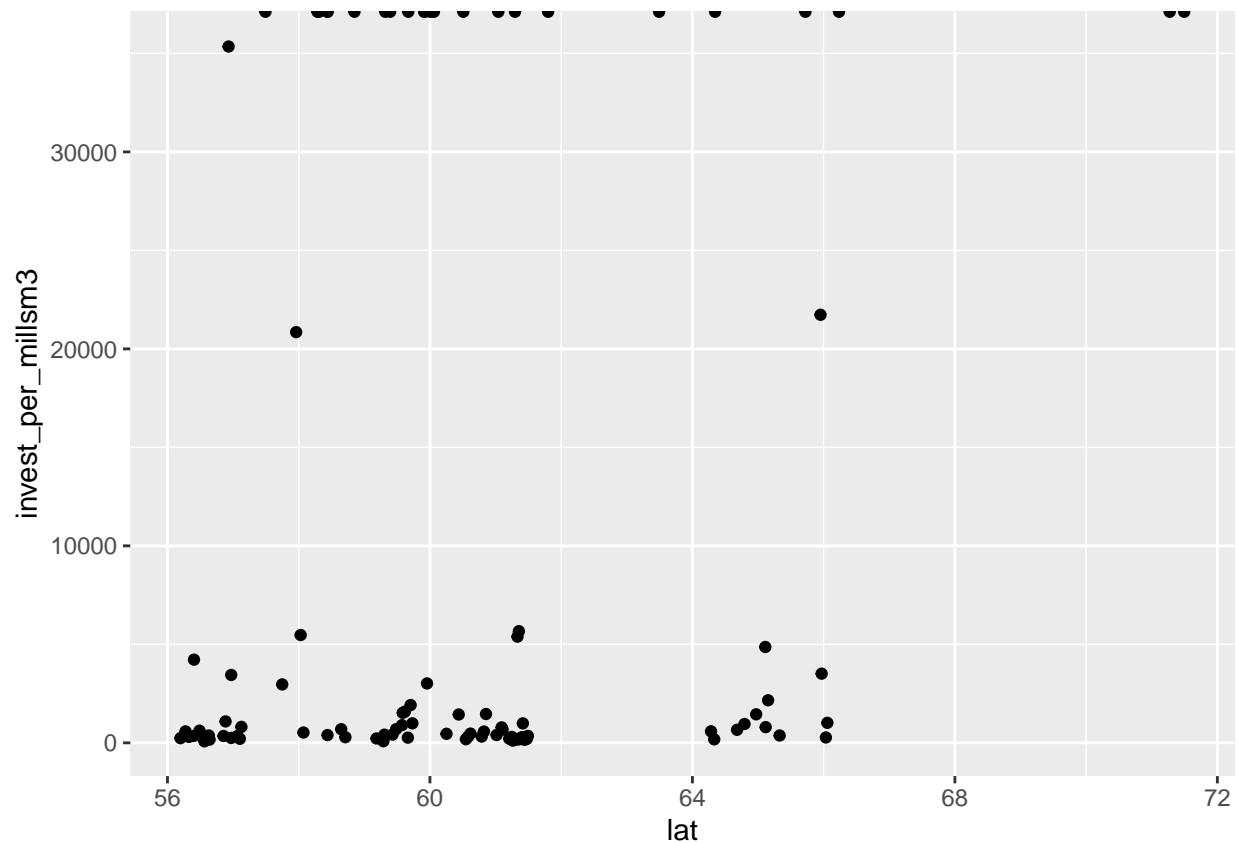
```
Northmodel <- lm(invest_per_millsm3 ~ lat, data = oil_fields_reg)
summary(Northmodel)
```

```
##
## Call:
## lm(formula = invest_per_millsm3 ~ lat, data = oil_fields_reg)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1983  -1760  -1561   -781  33293
##
```

```
## Coefficients:
##           Estimate Std. Error t value Pr(>|t|)
## (Intercept)  2475.541  12794.064   0.193   0.847
## lat          -7.348    212.397  -0.035   0.972
##
## Residual standard error: 5306 on 73 degrees of freedom
## Multiple R-squared:  1.639e-05, Adjusted R-squared:  -0.01368
## F-statistic: 0.001197 on 1 and 73 DF,  p-value: 0.9725
```

```
ggplot(data = oil_fields,
       mapping = aes(
         x = lat,
         y = invest_per_millsm3
       )) +
  geom_point()
```

```
## Warning: Removed 3 rows containing missing values (geom_point).
```



I don't think this hypothesis has much merit, latitude is not significantly correlated with invest\_per\_millsm3 and there isn't a clear relationship in the graph.

```
welbore <- read_csv(file = '/Users/EthanMcChristian/Downloads/welbore_exploration_all.csv')
```

```
## Rows: 2009 Columns: 87
```

```
## -- Column specification -----
```

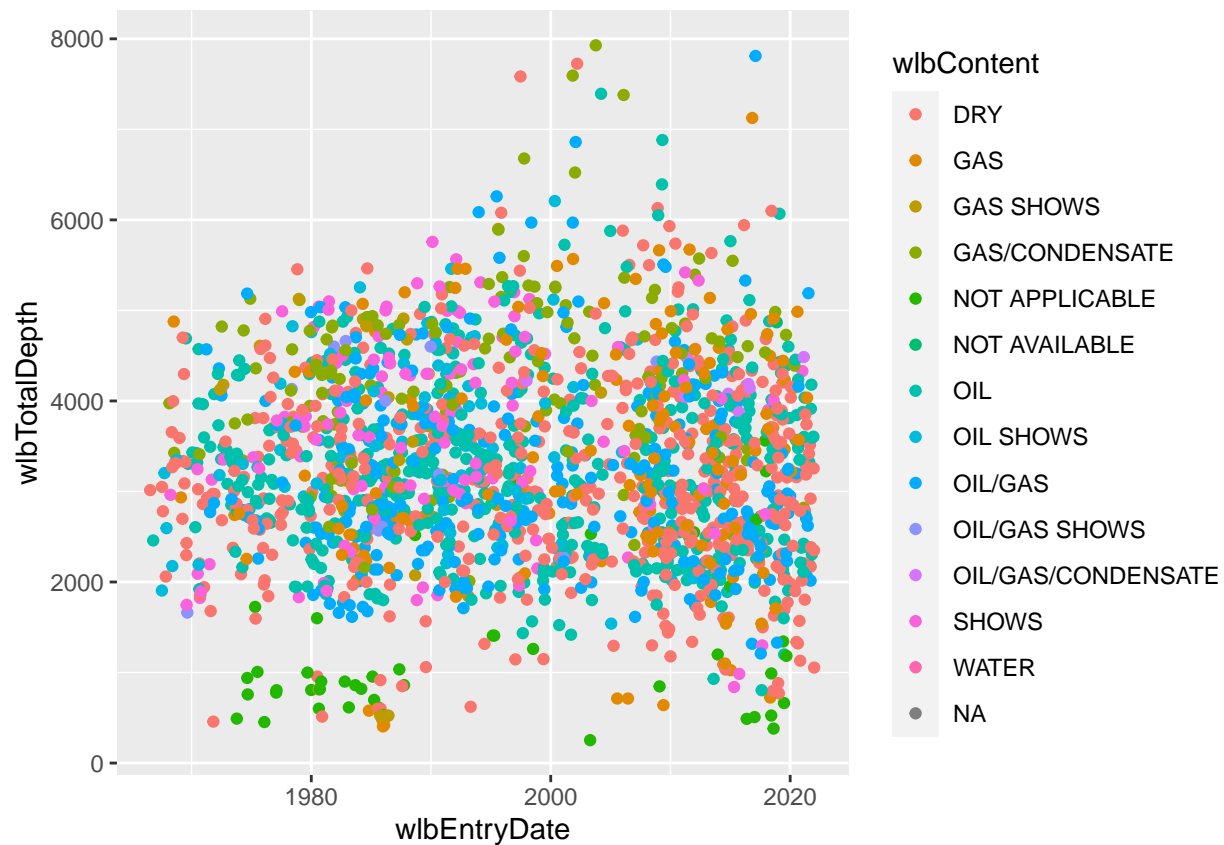
```
## Delimiter: ","
## chr (53): wlbWellboreName, wlbWell, wlbDrillingOperator, wlbProductionLicenc...
## dbl (33): wlbBottomHoleTemperature, wlbMaxInclination, wlbKellyBushElevation, ...
## lgl (1): wlbNamePart6
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
p_load(lubridate)
wellbores <- wellbore
view(wellbores)
```

```
# Changing date variables to be in Date format
wellbores$wlbCompletionDate = dmy(wellbores$wlbCompletionDate)
wellbores$wlbEntryDate = dmy(wellbores$wlbEntryDate)
wellbores$wlbReleasedDate = dmy(wellbores$wlbReleasedDate)
wellbores$wlbPluggedDate = dmy(wellbores$wlbPluggedDate)
wellbores$wlbPluggedAbandonDate = dmy(wellbores$wlbPluggedAbandonDate)
wellbores$datesyncNPD = dmy(wellbores$datesyncNPD)
wellbores$wlbDateReclass = dmy(wellbores$wlbDateReclass)
wellbores$wlbDateUpdated = dmy(wellbores$wlbDateUpdated)
wellbores$wlbDateUpdatedMax = dmy(wellbores$wlbDateUpdatedMax)
```

```
ggplot(data = wellbores,
       mapping = aes(
         x = wlbEntryDate, y = wlbTotalDepth, color = wlbContent
       )) +
  geom_point()
```

```
## Warning: Removed 42 rows containing missing values (geom_point).
```



So it looks like there isn't a huge relationship between well content and well depth, but there is something worth investigating for well depth and time. There seems to be a higher concentration of gas wells after 2010, which is exactly what I expected (shale revolution). Interesting to see the little bunch of orange right after 1980, I wonder what was going on in the world then!