In [641]:

```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
import warnings
warnings.filterwarnings('ignore')
from scipy.optimize import curve_fit
from scipy import asarray as ar,exp
```

Preprocessing

In [642]:

```
data_netto = pd.read_csv('netto.txt', sep=" ", dtype={'weekday': np.int32, 'h': n
data_penny = pd.read_csv('penny.txt', sep=" ", dtype={'weekday': np.int32, 'h': n
data = pd.read_csv('features_normalized.csv')
data_tankstelle = pd.read_csv('tankstelle.txt', sep=" ", dtype={'weekday': np.int
```

In [643]:

```
data_netto.head()
```

Out[643]:

	weekday	h	visit
0	1	7.0	0.4
1	1	8.0	0.6
2	1	9.0	0.8
3	1	10.0	1.0
4	1	11.0	1.2

In [644]:

```
data = data.drop(['Unnamed: 0', 'Unnamed: 0.1', 'Tourism', 'Cloud', 'Rain', 'datu
```

In [645]:

```
data.head()
```

Out[645]:

	h	1	2	3	4	count	prozent1	prozent2	prozent3
0	0	-0.801653	-1.260945	-1.048941	-1.025500	-1.267660	-0.940267	2.029124	-1.473891
1	1	-0.675183	-1.260945	-1.048941	-1.025500	-1.255341	2.394390	-0.400399	-1.473891
2	2	-0.738418	-1.238170	-1.048941	-1.025500	-1.243022	0.423911	1.035228	-1.473891
3	3	-0.422243	-1.162255	-0.903151	-1.025500	-1.132149	2.164414	-1.363831	0.071007
4	4	0.336576	-0.600481	-0.708764	0.105254	-0.540827	1.220591	-0.682224	-0.637586

Correlation Shopping at 'Netto' Supermarket

In [646]:

```
result_netto = pd.merge(data, data_netto, on=['weekday', 'h'])
```

In [647]:

```
result_netto.head()
```

Out[647]:

	h	1	2	3	4	count	prozent1	prozent2	prozent3	
0	7	1.158631	0.788770	0.700539	0.670631	0.863563	0.377537	-0.324692	0.049125	(
1	7	-0.232538	0.955784	0.797732	1.424466	0.900521	-0.564073	0.201906	0.106868	(
2	7	2.549801	0.690080	0.311766	0.105254	0.851244	1.325590	-0.680729	-0.282574	-(
3	7	1.854216	0.272546	0.457555	1.047548	0.493987	1.210758	-1.105210	0.106158	(
4	7	0.652751	-0.327186	-0.514377	0.105254	-0.263645	1.089951	-0.543312	-0.507572	(

In [648]:

```
data_weekday_stats_netto = result_netto.groupby(['weekday', 'h']).describe()
data_weekday_stats_netto.head()
```

Out[648]:

		1							
		count	mean	std	min	25%	50%	75%	max
weekday	h								
1	7	35.0	0.450399	1.174918	-0.801653	-0.517096	-0.169303	1.190249	2.929211
	8	35.0	1.418798	1.834441	-0.738418	-0.074451	0.589516	3.087298	5.015965
	9	35.0	1.931905	2.373435	-0.675183	-0.106068	0.652751	4.541703	6.027725
	10	35.0	1.716906	2.235667	-0.611948	-0.232538	0.842456	3.340238	6.470369
	11	35.0	1.725939	2.214791	-0.738418	-0.169303	0.589516	3.403473	6.660074

5 rows × 80 columns

In [649]:

```
# correlation map, no processing needed
#f,ax = plt.subplots(figsize=(18, 18))
#sns.heatmap(data_weekday_stats_netto.corr(), annot=True)
#plt.savefig("figures/correlation_map", format='pdf')
#plt.show()
```

In [650]:

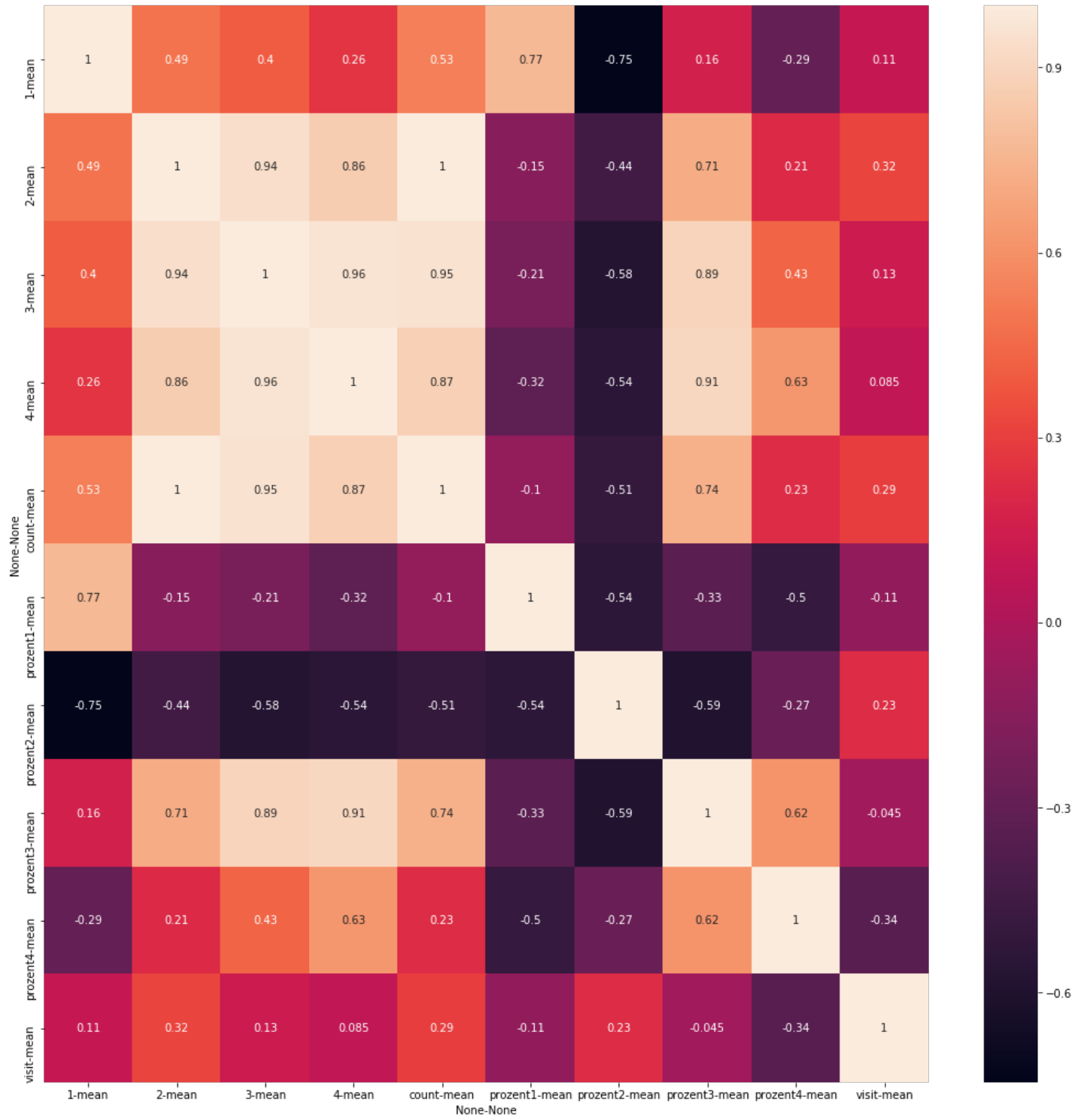
```
#list(data_weekday_stats_netto)
```

In [651]:

```
data_means_netto = data_weekday_stats_netto[[('1', 'mean'),('2', 'mean'), ('3', '
```

In [652]:

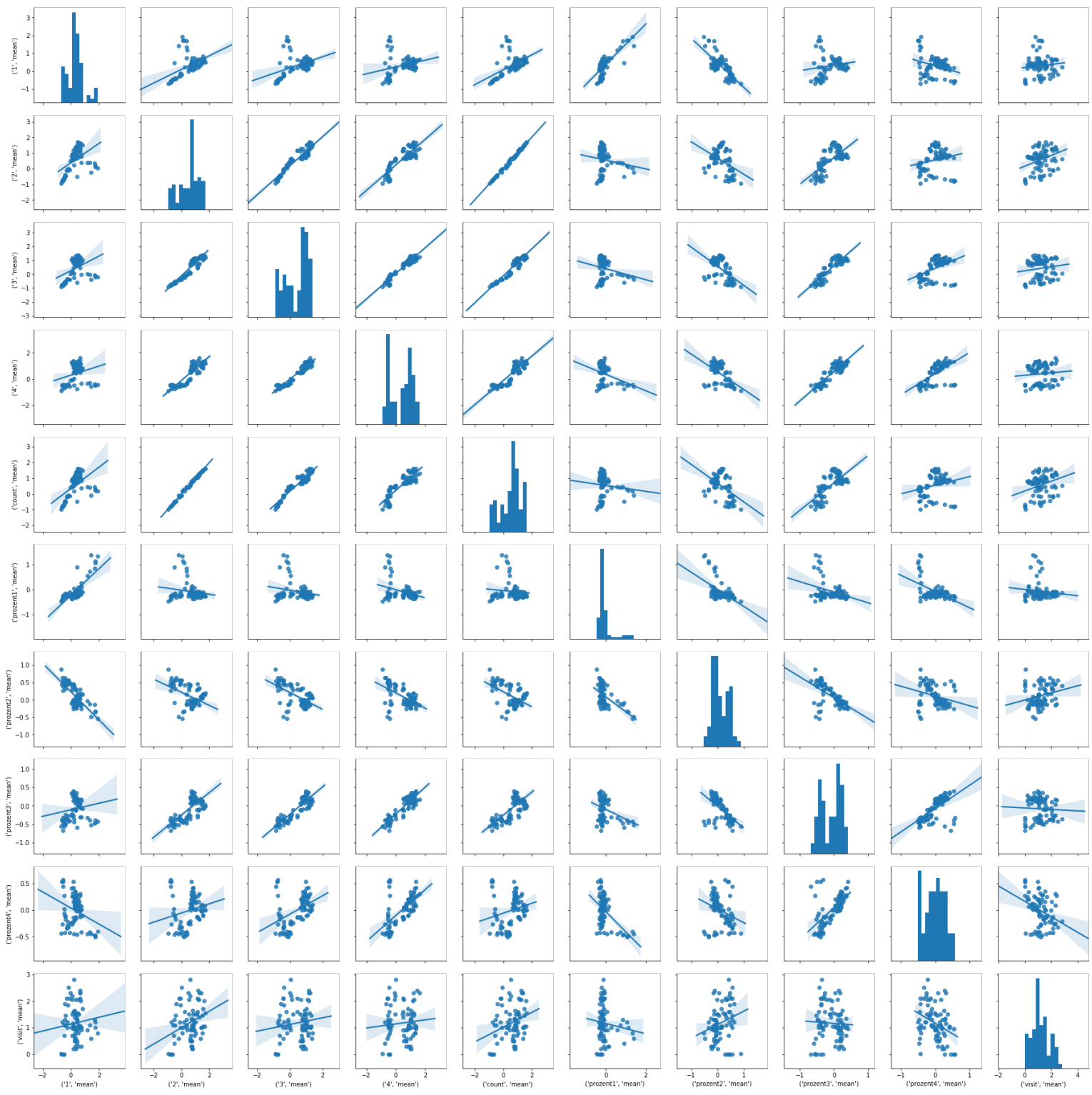
```
# correlation map, no processing needed
f,ax = plt.subplots(figsize=(18, 18))
sns.heatmap(data_means_netto.corr(), annot=True)
#plt.savefig("figures/correlation_map", format='pdf')
plt.show()
```



Already reached a correlation with pearson coefficient 0.32.

In [653]:

```
sns.pairplot(data_means_netto, kind="reg")
plt.show()
```



Correlation Shopping at 'Penny' Supermarket

In [654]:

```
result_penny = pd.merge(data, data_penny, on=['weekday', 'h'])
```

In [655]:

```
data_weekday_stats_penny = result_penny.groupby(['weekday', 'h']).describe()
data_weekday_stats_penny.head()
```

Out[655]:

		1							
		count	mean	std	min	25%	50%	75%	max
weekday	h								
1	7	35.0	0.450399	1.174918	-0.801653	-0.517096	-0.169303	1.190249	2.929211
	8	35.0	1.418798	1.834441	-0.738418	-0.074451	0.589516	3.087298	5.015965
	9	35.0	1.931905	2.373435	-0.675183	-0.106068	0.652751	4.541703	6.027725
	10	35.0	1.716906	2.235667	-0.611948	-0.232538	0.842456	3.340238	6.470369
	11	35.0	1.725939	2.214791	-0.738418	-0.169303	0.589516	3.403473	6.660074

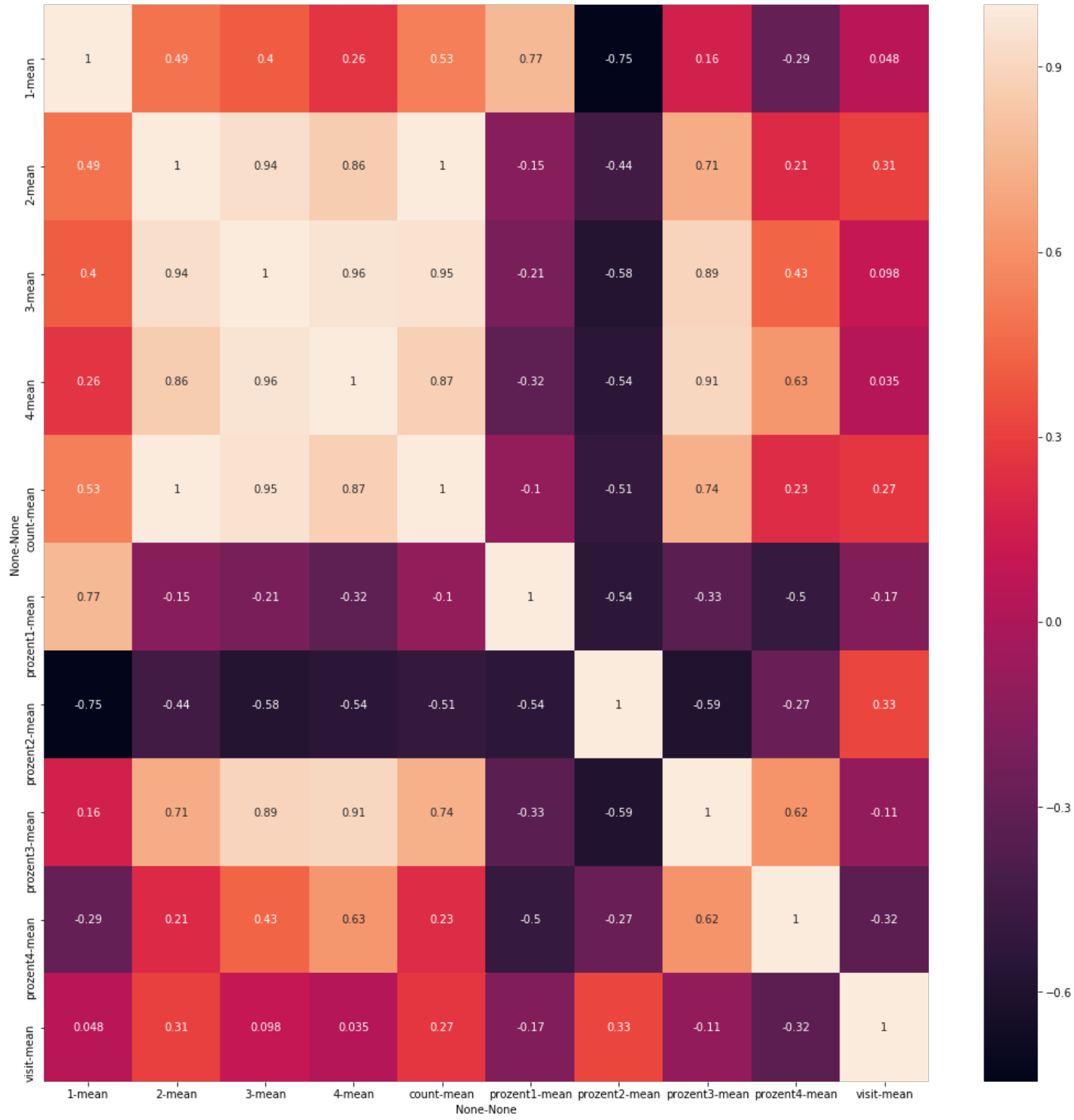
5 rows × 80 columns

In [656]:

```
data_means_penny = data_weekday_stats_penny[[('1', 'mean'),('2', 'mean'), ('3', '
```

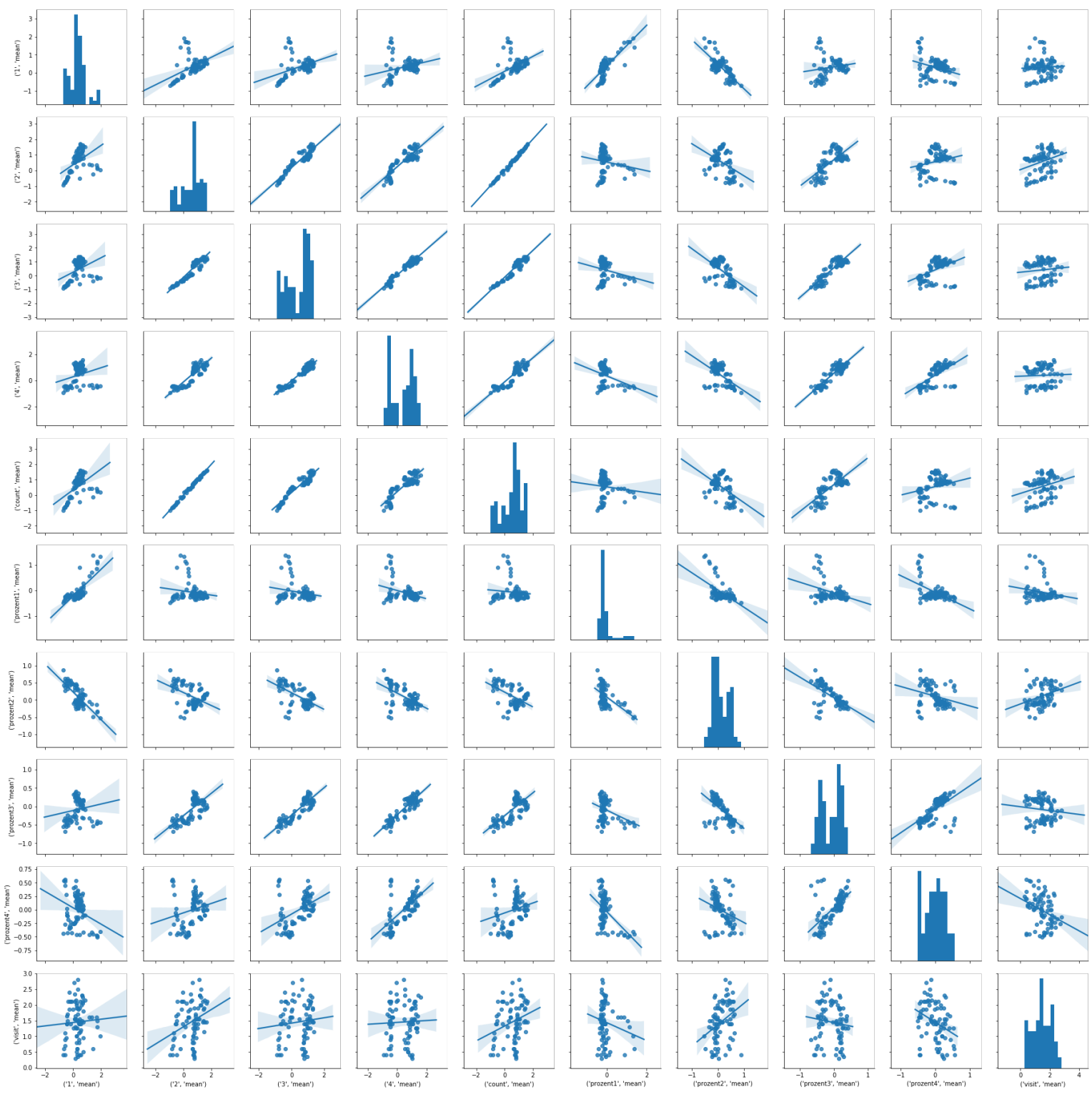
In [657]:

```
# correlation map, no processing needed
f,ax = plt.subplots(figsize=(18, 18))
sns.heatmap(data_means_penny.corr(), annot=True)
#plt.savefig("figures/correlation_map", format='pdf')
plt.show()
```



In [658]:

```
sns.pairplot(data_means_penny, kind="reg")
plt.show()
```



Correlation Shopping at Supermarkets in Town

In [659]:

```
sum_supermarkets = data_penny.add(data_netto, axis='columns', level=None, fill_va
```

In [660]:

```
sum_supermarkets.head()
```

Out[660]:

	weekday	h	visit
0	2	14.0	0.8
1	2	16.0	1.2
2	2	18.0	1.8
3	2	20.0	2.3
4	2	22.0	2.7

In [661]:

```
result_sum = pd.merge(data, sum_supermarkets, on=['weekday', 'h'])
```

In [662]:

```
result_sum.head()
```

Out[662]:

	h	1	2	3	4	count	prozent1	prozent2	prozent3	pı
0	14	1.285101	2.064149	0.894925	0.293713	1.923015	0.002965	0.363165	-0.336061	-0.
1	14	0.020402	1.798445	0.797732	0.482172	1.578077	-0.524323	0.653776	-0.263885	-0.
2	14	0.399811	1.540333	0.700539	0.482172	1.393289	-0.290806	0.460172	-0.249234	-0.
3	14	1.411571	1.806036	0.360362	0.293713	1.658152	0.149378	0.418683	-0.575371	-0.
4	14	-0.232538	1.244263	-0.271394	0.105254	0.955957	-0.573273	1.108150	-0.824586	-0.

In [663]:

```
data_weekday_stats_sum = result_sum.groupby(['weekday', 'h']).describe()
data_weekday_stats_sum.head()
```

Out[663]:

		1							
		count	mean	std	min	25%	50%	75%	max
weekday	h								
2	14	35.0	0.627457	1.004316	-0.611948	-0.011216	0.526281	1.000544	4.51008
	16	35.0	0.193846	0.556861	-0.801653	-0.200921	0.336576	0.621134	1.22186
	18	35.0	-0.281320	0.398485	-0.801653	-0.548713	-0.485478	0.083636	0.71598
	20	35.0	-0.655309	0.112463	-0.801653	-0.738418	-0.675183	-0.611948	-0.35900
	22	35.0	-0.761906	0.063394	-0.801653	-0.801653	-0.801653	-0.738418	-0.48547

5 rows × 80 columns

In [664]:

```
data_means_sum = data_weekday_stats_sum[[('2', 'mean'),('count', 'mean'),('visit'
```

In [665]:

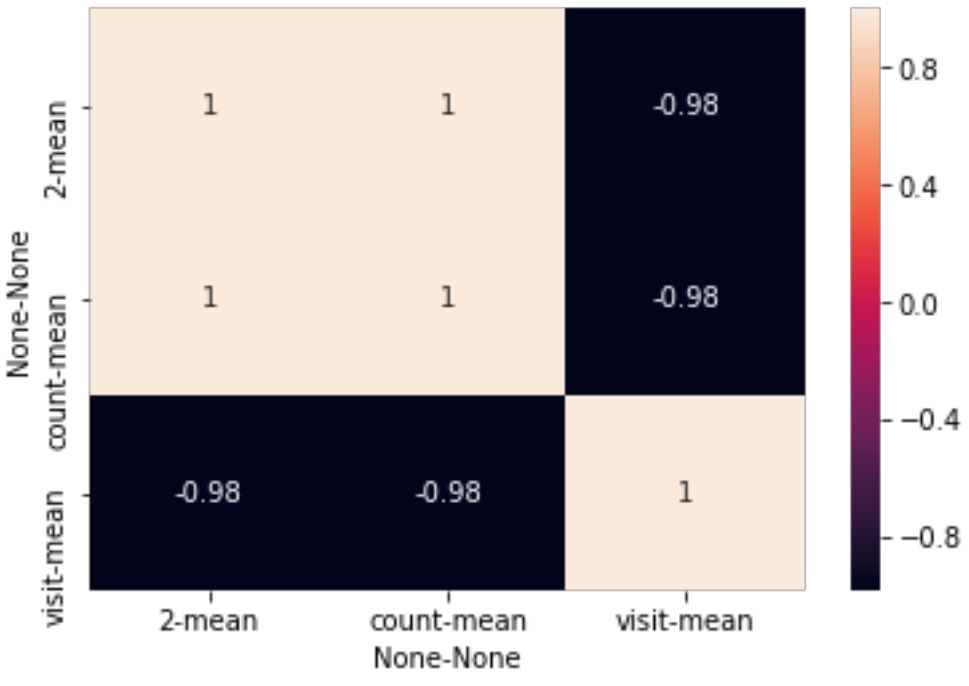
```
data_means_sum[('visit', 'mean')].unique()
```

Out[665]:

```
array([0.79999995, 1.20000017, 1.79999983, 2.30000019, 2.69999981,
       0.70000011, 1.0999999 , 2.30000043, 2.69999957, 0.5       ,
       1.        , 1.5       , 1.94999981, 2.25      ])
```

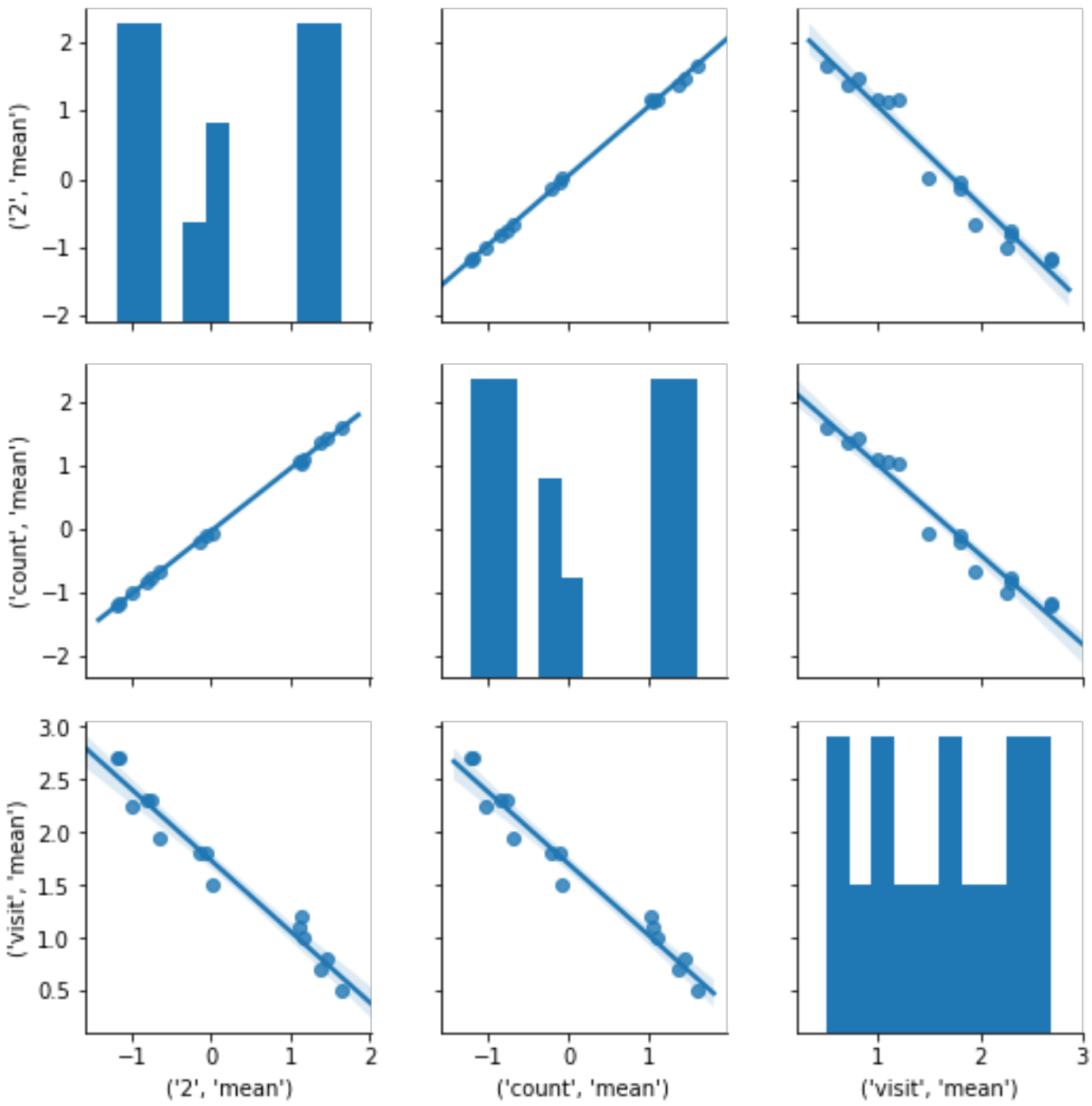
In [666]:

```
# correlation map, no processing needed
f,ax = plt.subplots()
sns.heatmap(data_means_sum.corr(), annot=True)
#plt.savefig("figures/correlation_map", format='pdf')
plt.show()
```



In [667]:

```
sns.pairplot(data_means_sum, kind="reg")
plt.show()
```



In [668]:

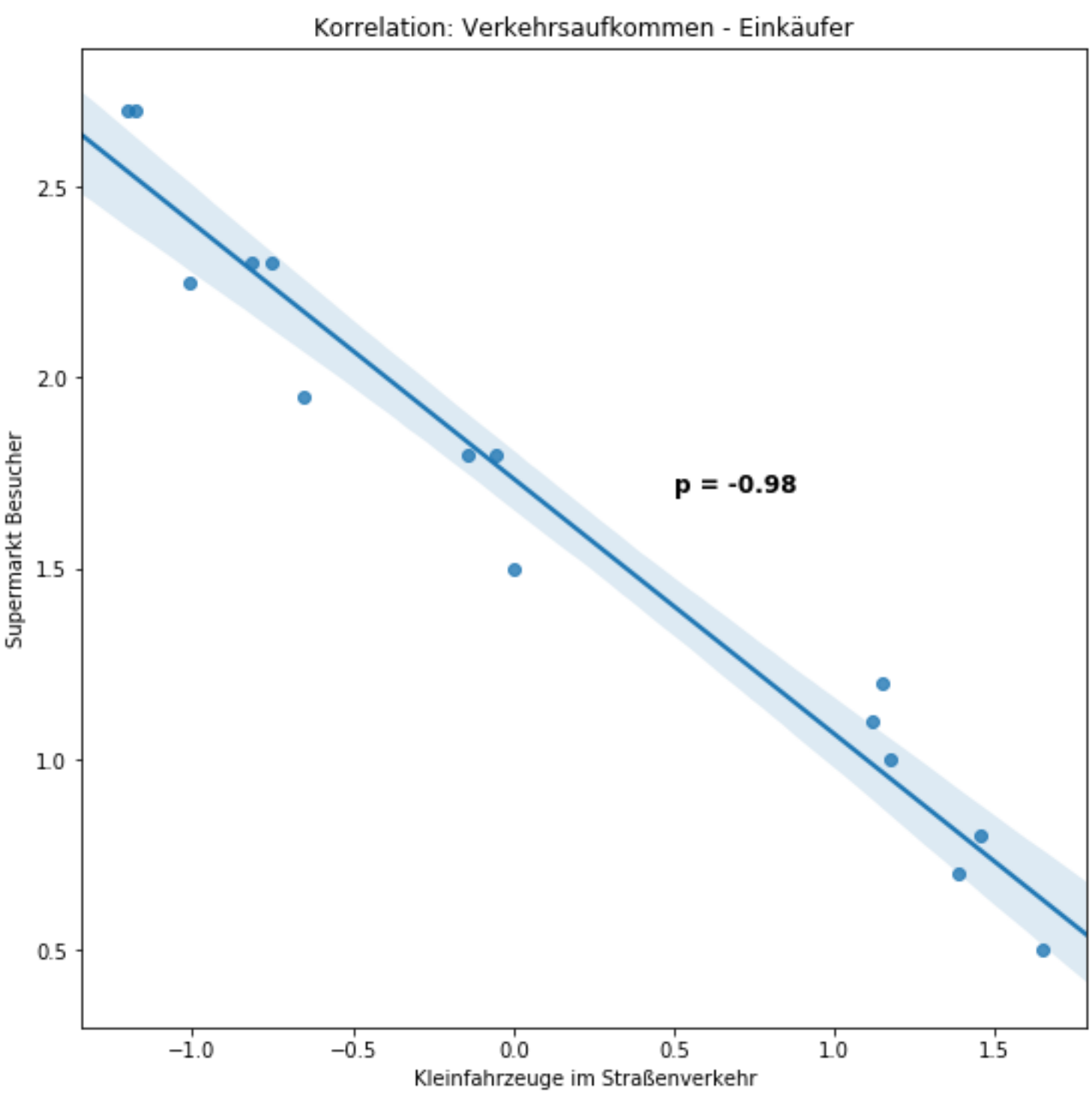
```
data_means_sum.columns
```

Out[668]:

```
MultiIndex(levels=[['1', '2', '3', '4', 'count', 'prozent1', 'prozen
t2', 'prozent3', 'prozent4', 'visit'], ['count', 'mean', 'std', 'min
', '25%', '50%', '75%', 'max']],
           labels=[[1, 4, 9], [1, 1, 1]])
```

In [669]:

```
f,ax = plt.subplots(figsize=(9, 9))
p1 = sns.regplot(data_means_sum[('2', 'mean')], data_means_sum[('visit', 'mean')]
p1.text(0.5, 1.7, "p = -0.98", horizontalalignment='left', size='large', color='b
plt.xlabel('Kleinfahrzeuge im Straßenverkehr')
plt.ylabel('Supermarkt Besucher')
plt.title('Korrelation: Verkehrsaufkommen - Einkäufer')
plt.savefig("korrelation_verkehr_einkaufen", format='pdf')
plt.show()
```



Correlation Gas Station 'Aral'

In [670]:

```
result_tankstelle = pd.merge(data, data_tankstelle, on=['weekday', 'h'])
```

In [671]:

```
data_weekday_stats_tankstelle = result_tankstelle.groupby(['weekday', 'h']).descr
data_weekday_stats_tankstelle.head()
```

Out[671]:

		1							
		count	mean	std	min	25%	50%	75%	max
weekday	h								
1	7	35.0	0.450399	1.174918	-0.801653	-0.517096	-0.169303	1.190249	2.929211
	8	35.0	1.418798	1.834441	-0.738418	-0.074451	0.589516	3.087298	5.015965
	9	35.0	1.931905	2.373435	-0.675183	-0.106068	0.652751	4.541703	6.027725
	10	35.0	1.716906	2.235667	-0.611948	-0.232538	0.842456	3.340238	6.470369
	11	35.0	1.725939	2.214791	-0.738418	-0.169303	0.589516	3.403473	6.660074

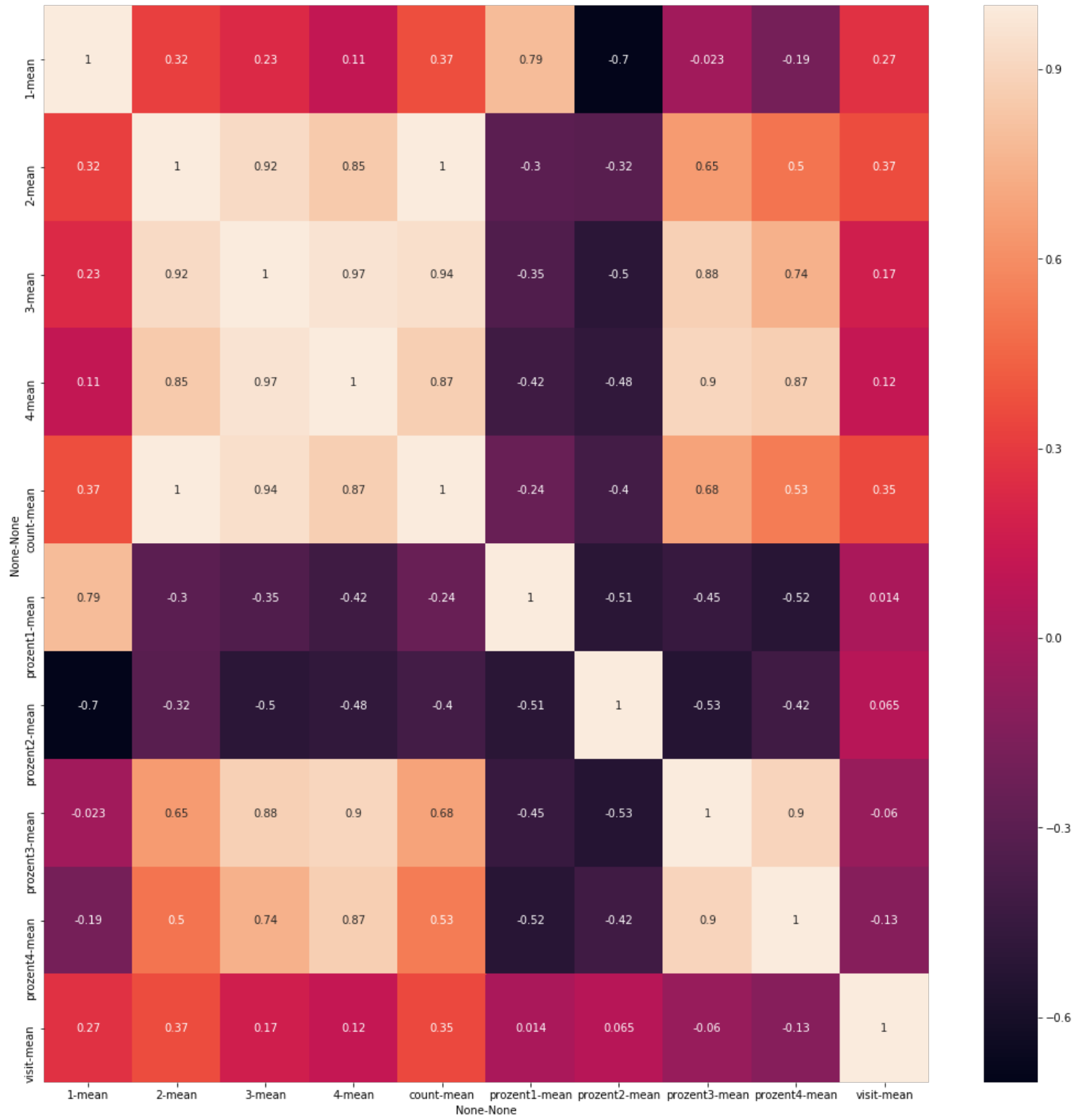
5 rows × 80 columns

In [672]:

```
data_means_tankstelle = data_weekday_stats_tankstelle[[('1', 'mean'),('2', 'mean'
```

In [673]:

```
# correlation map, no processing needed
f,ax = plt.subplots(figsize=(18, 18))
sns.heatmap(data_means_tankstelle.corr(), annot=True)
#plt.savefig("figures/correlation_map", format='pdf')
plt.show()
```



In [674]:

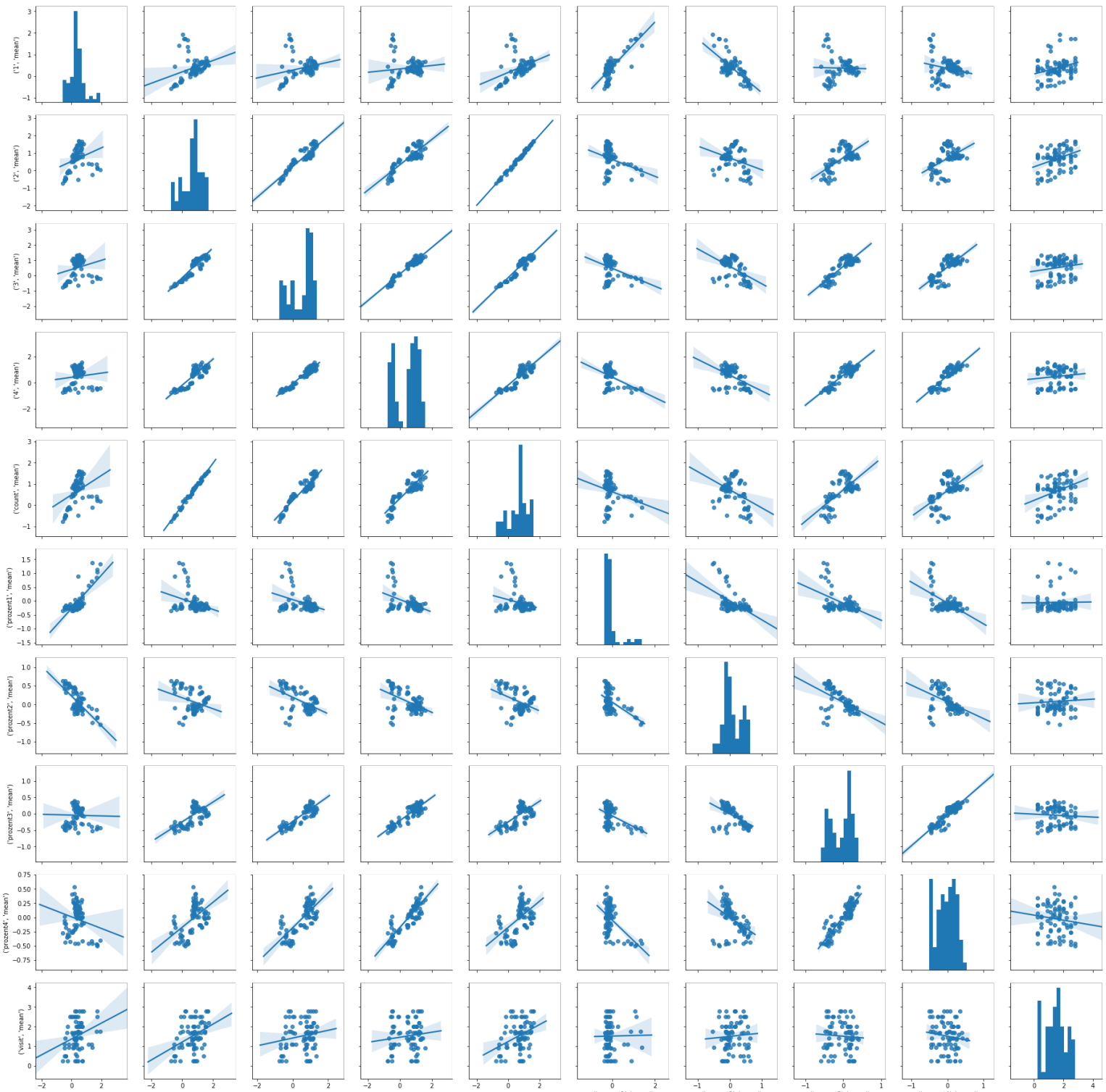
```
data_means_tankstelle.dtypes
```

Out[674]:

```
1          mean    float64
2          mean    float64
3          mean    float64
4          mean    float64
count      mean    float64
prozent1   mean    float64
prozent2   mean    float64
prozent3   mean    float64
prozent4   mean    float64
visit      mean    float64
dtype: object
```

In [675]:

```
sns.pairplot(data_means_tankstelle,kind="reg")
plt.show()
```



In [676]:

```
result_tankstelle2 = pd.merge(data.where((data['h'] != 8) & (data['h'] != 19) & (
```

In [677]:

```
data_weekday_stats_tankstelle2 = result_tankstelle2.groupby(['weekday', 'h']).des
data_weekday_stats_tankstelle2.head()
```

Out[677]:

		1							
		count	mean	std	min	25%	50%	75%	max
weekday	h								
1.0	7.0	35.0	0.450399	1.174918	-0.801653	-0.517096	-0.169303	1.190249	2.92921
	10.0	35.0	1.716906	2.235667	-0.611948	-0.232538	0.842456	3.340238	6.47036
	11.0	35.0	1.725939	2.214791	-0.738418	-0.169303	0.589516	3.403473	6.66007
	12.0	35.0	1.673545	2.269689	-0.801653	-0.074451	0.652751	2.929211	7.98800
	13.0	35.0	1.348336	1.709341	-0.675183	-0.137686	0.905691	2.581418	5.83802

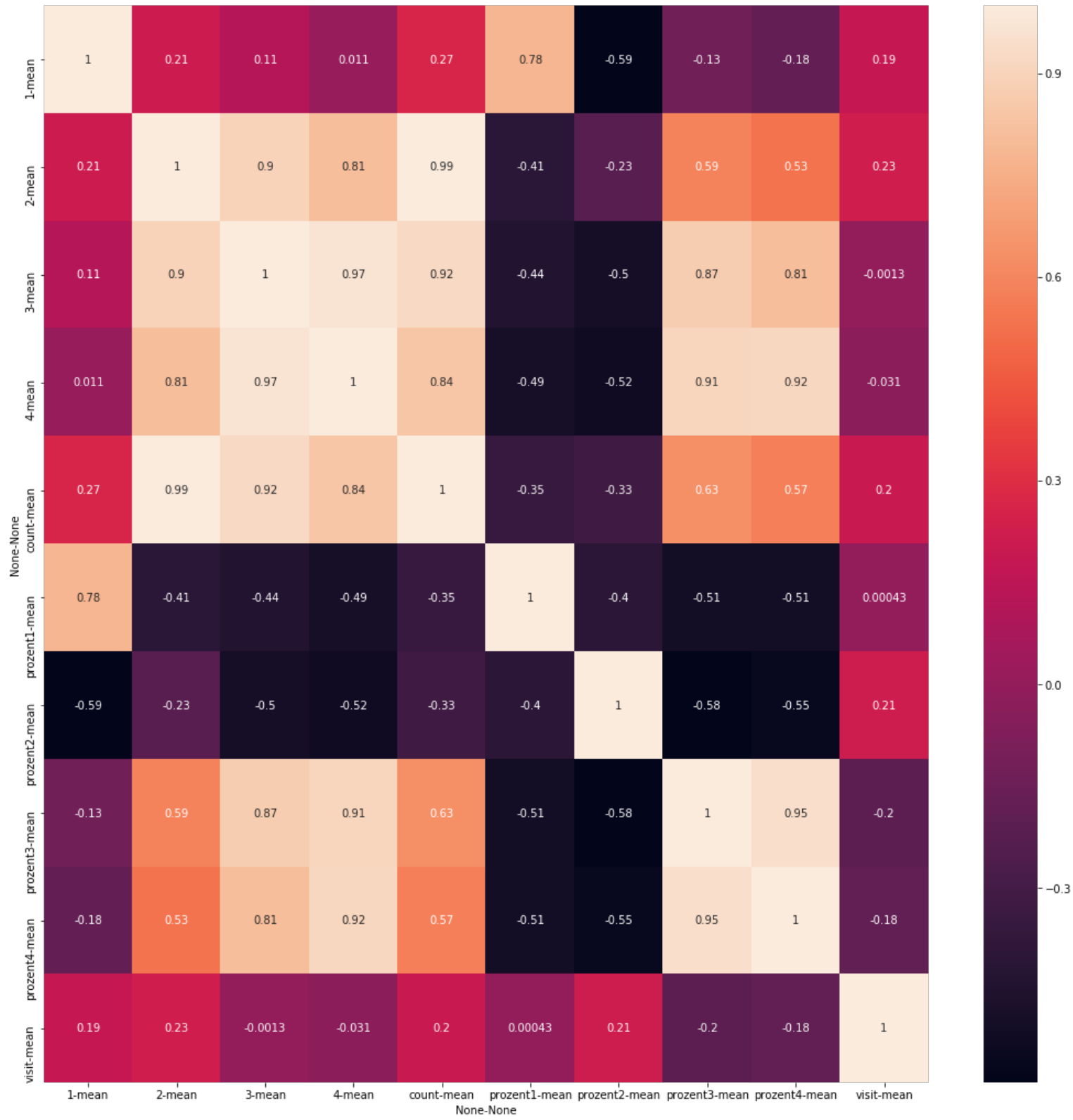
5 rows × 80 columns

In [678]:

```
data_means_tankstelle2 = data_weekday_stats_tankstelle2[[('1', 'mean'),('2', 'mea
```

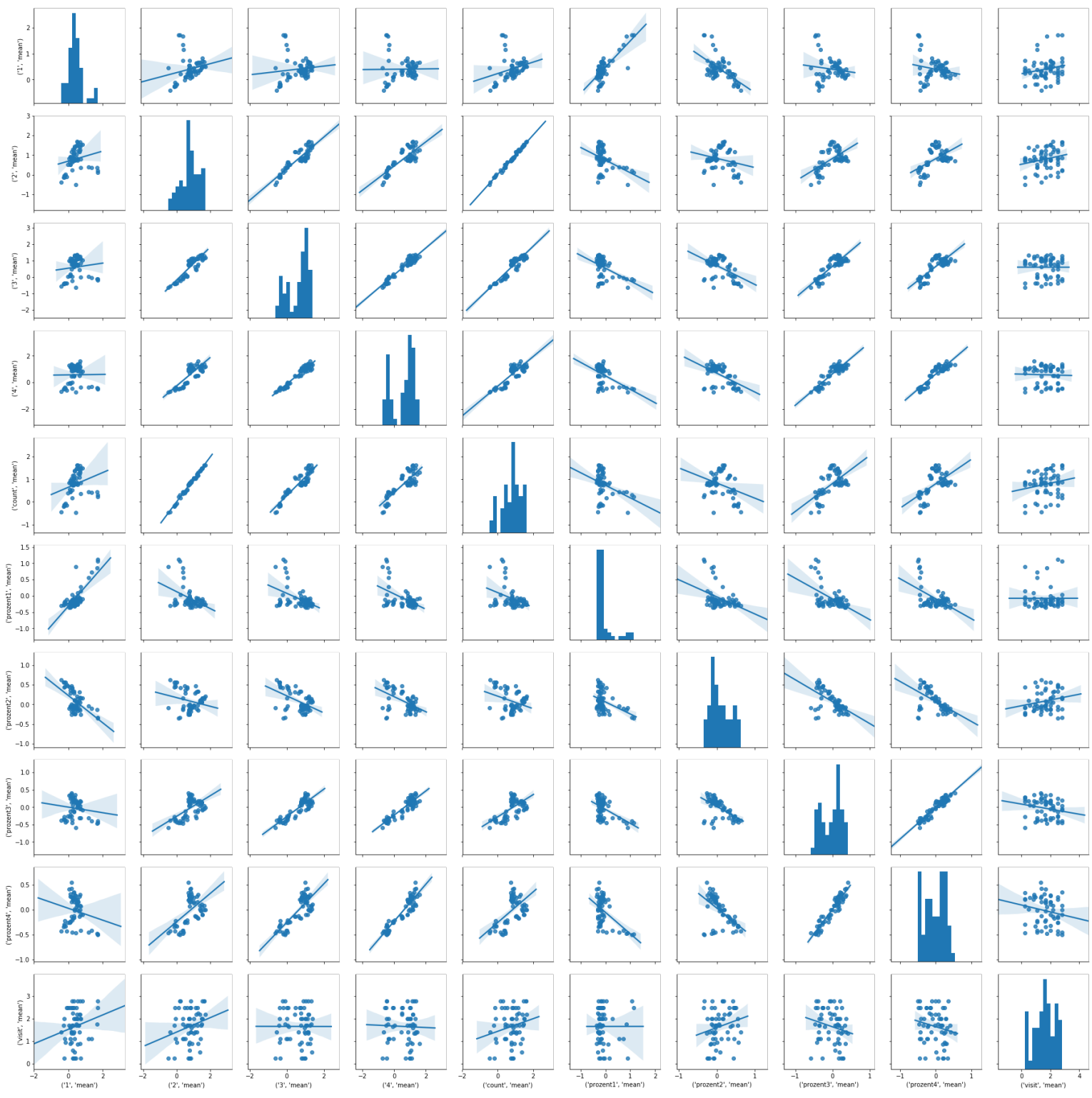
In [679]:

```
# correlation map, no processing needed
f,ax = plt.subplots(figsize=(18, 18))
sns.heatmap(data_means_tankstelle2.corr(), annot=True)
#plt.savefig("figures/correlation_map", format='pdf')
plt.show()
```



In [680]:

```
sns.pairplot(data_means_tankstelle2, kind="reg")
plt.show()
```



Correlation Tourism

In [681]:

```
data = pd.read_csv('features_normalized.csv')
data2 = data.drop(['Unnamed: 0', 'Unnamed: 0.1','datum', 'y', 'd', 'prozent1', 'p
```

In [682]:

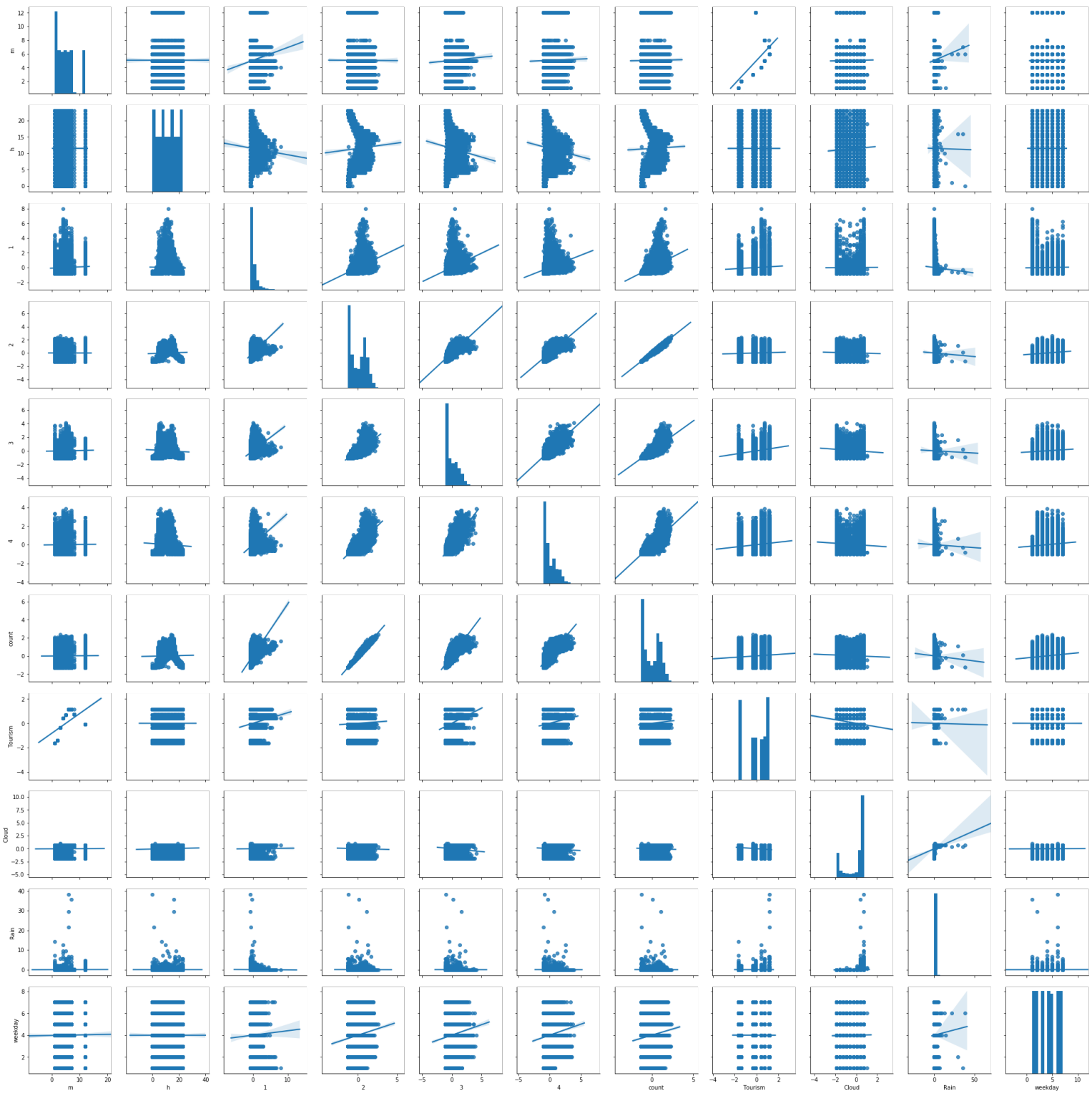
```
data2.head()
```

Out[682]:

	m	h	1	2	3	4	count	Tourism	Cloud	Rai
0	12	0	-0.801653	-1.260945	-1.048941	-1.025500	-1.267660	-0.098199	0.385617	-0.11639
1	12	1	-0.675183	-1.260945	-1.048941	-1.025500	-1.255341	-0.098199	0.711228	-0.11639
2	12	2	-0.738418	-1.238170	-1.048941	-1.025500	-1.243022	-0.098199	0.711228	-0.11639
3	12	3	-0.422243	-1.162255	-0.903151	-1.025500	-1.132149	-0.098199	0.711228	-0.11639
4	12	4	0.336576	-0.600481	-0.708764	0.105254	-0.540827	-0.098199	0.711228	-0.11639

In [683]:

```
sns.pairplot(data2, kind="reg")
plt.show()
```

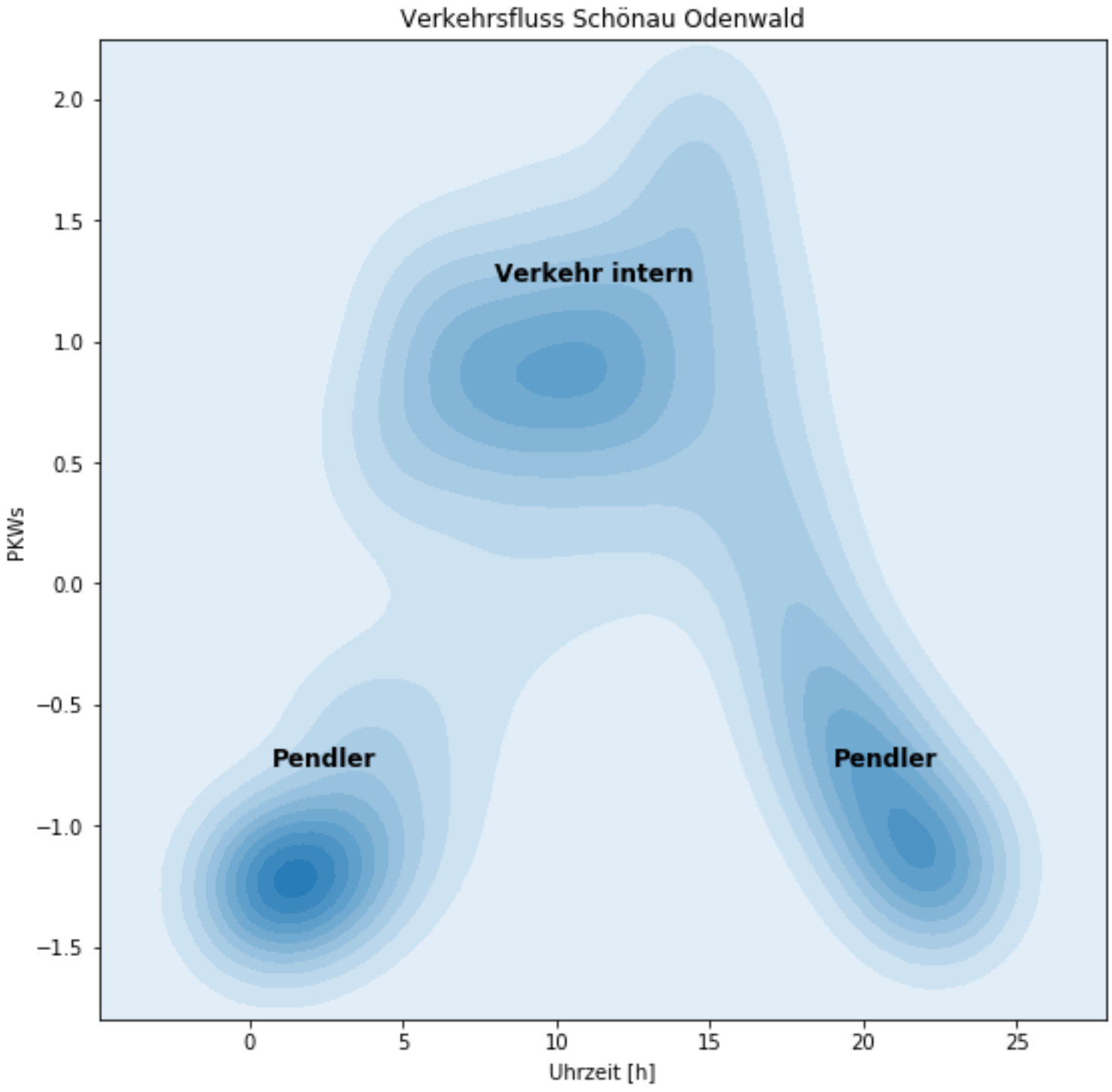


In [684]:

```
g = sns.PairGrid(data2)
g.map_diag(sns.kdeplot)
g.map_offdiag(sns.kdeplot, n_levels=6)
plt.show()
```

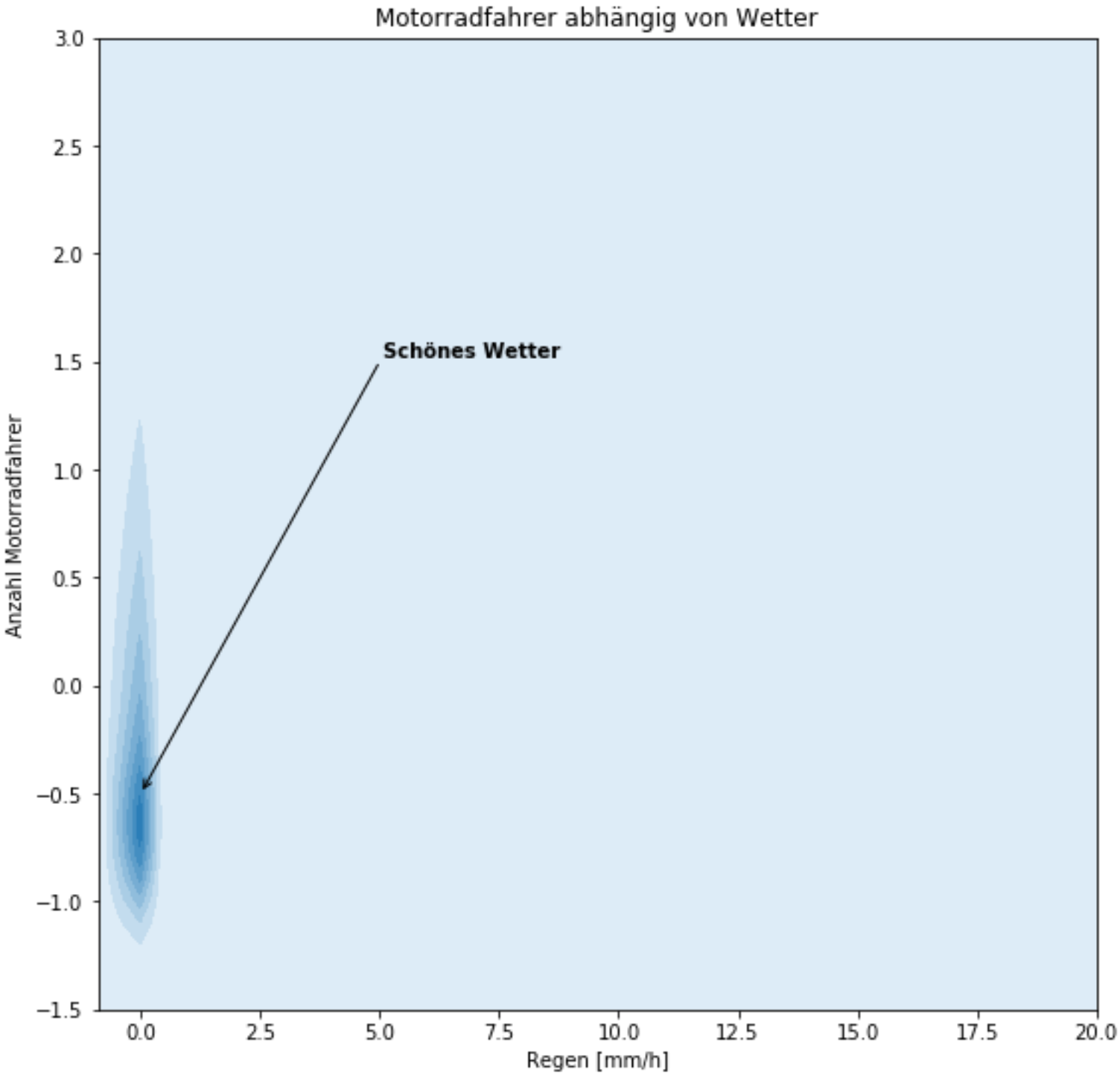
In [685]:

```
f,ax = plt.subplots(figsize=(9, 9))
p1 = sns.kdeplot(data2['h'], data2['2'], shade=True)
p1.text(0.75, -0.75, "Pendler", horizontalalignment='left', size='large', color='
p1.text(8.0, 1.25, "Verkehr intern", horizontalalignment='left', size='large', co
p1.text(19.0, -0.75, "Pendler", horizontalalignment='left', size='large', color='
plt.xlabel('Uhrzeit [h]')
plt.ylabel('PKWs')
plt.ylim((-1.8, 2.25))
plt.title('Verkehrsfluss Schönau Odenwald')
plt.savefig("verkehrsfluss", format='pdf')
plt.show()
```



In [686]:

```
f,ax = plt.subplots(figsize=(9, 9))
p1 = sns.kdeplot(data2['Rain'], data2['1'], shade=True)
#p1.text(-2.0, -0.75, "Pendler raus", horizontalalignment='left', size='large', c
#p1.text(8.0, 1.5, "Interner Verkehr", horizontalalignment='left', size='large',
p1.text(5.05, 1.525, "Schönes Wetter", horizontalalignment='left', size='medium',
plt.xlabel('Regen [mm/h]')
plt.ylabel('Anzahl Motorradfahrer')
plt.ylim((-1.5, 3))
plt.xlim((-0.9, 20))
ax.annotate("", xy=(5, 1.5), xytext=(0, -0.5), arrowprops=dict(arrowstyle="<-"))
plt.title('Motorradfahrer abhängig von Wetter')
plt.savefig("motorradfahrer_wetter", format='pdf')
plt.show()
```



In [688]:

```
x = data2['m'].values
y = data2['Tourism'].values

n = len(x)                              #the number of data
mean = 3                      #note this correction
sigma = 2          #note this correction
```

```
c = -1.5

def gaus(x,a,x0,sigma,c):
    return a*exp(-(x-x0)**2/(2*sigma**2))-c

popt,pcov = curve_fit(gaus,x,y,p0=[1,mean,sigma,c])

f,ax = plt.subplots(figsize=(9, 9))
plt.plot(x,y,'+',label='data')
plt.plot(x,gaus(x,*popt),'.',label='fit')
plt.legend()
plt.xlabel('Monate')
plt.ylabel('Tourismus')
plt.title('Tourismusaufkommen über Jahr')
plt.savefig("tourismusaufkommen", format='pdf')
plt.show()
```